Resident Instruction Bulletin

Sardar Vallabhbhai Patel University of Agriculture & Technology

Meerut - 250 110 (Uttar Pradesh)

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SECTION 1

GENERAL INFORMATION

1. History

Sardar Vallabh Bhai Patel University of Agriculture and Technology established as a full-fledged University has unique honour of being called "First Agriculture University of the third millennium and the 21st century". It is committed to a unique mandate of integrating education research and extension so as to serve the rural people. The University was established on 2_{nd} October 2000 under Uttar Pradesh Agriculture University Act (revised) 1958 gazette and notified vide 3204A/X12-8-2000. It was inaugurated on 28th March 2002 by the Honorable Chief Minister of Uttar Pradesh. It is recognized and funded by U.P. Govt. & ICAR, Govt. of India. It is included in the list of recognized Universities maintained by the University Grants Commission (UGC), Govt. of India. The U.P. Government has given the responsibility of all around development of the agriculture and rural community in its four divisions i.e. Saharanpur, Meerut, Moradabad and Bareilly which consists of 15 districts i.e. Saharanpur, Muzaffarangar, Meerut, Gautam Buddha Nagar, Ghaziabad, Bulandshahr, Baghpat, Bijnor, Jyotiba Phule Nagar, Moradabad, Rampur, Bareilly, Pilibhit, Baduan and Shahjahanpur. The state of U.P. has 09 agro-climatic zones in which 03 fall under the Jurisdiction of this University.

- Tarai Zone

Tarai zone comprises the central part of Saharanpur district northern portion of Bijnor. Moradabad, Rampur, Bareilly, Pilibhit and Shahjahanpur. Tarai has a dry season from early October to mid June and a wet season from mid June to early October. Temperature is highest in May - June i.e. 38.4_0C and the lowest in December-January i.e. 4.3_0C. Relative humidity is the highest in July-August i.e. 81.7% and the lowest in May i.e. 39%. The average rainfall is 1400 mm. Soils of Tarai zone are alluvial in nature, low to medium to high in potassium and high in organic matter. The main crops of the area are wheat, rice, and sugarcane. Lentil is the major pulse while rapeseed and mustard are the principal oil seed crops. Potato, tomato, Cole crops, vegetable pea and cucurbits are major vegetables and mango, litchi, papaya, guava are the major fruits in this zone.

- Western Plain Zone

The zone includes districts viz Muzaffarnagar, Meerut, Baghpat, Ghaziabad, Gautam Budh Nagar, Bulandshahr and part of Saharanpur located between the Ganga and the Yamuna ranges from 32 to 85% and the temperature ranges from 1.5_0C to 43.3_0C. Rice-wheat-sugarcane based cropping system is prevalent in the zone. The principal crops of this region is rice, wheat, sugarcane, maize, bajara, black gram, red gram, green gram, ground nut, mustard, rapeseed and mustard. Potato, onion, tomato, pea, Cole crops and chilies are the major vegetables and mango, litchi, grape, guava and papaya are the major fruits crops cultivated in this zone. In addition, commercial flowers cultivation is also practised in this zone.

- Mid Western Plain Zone

This region consists of the districts of Baduan, Shahjahanpur, Jyotiba Phule Nagar and parts of Moradabad, Rampur, Bareilly and Pilibhit. Rainfall in this region is received during mid June to mid October. Annual rainfall is 1032mm and temprature range from 4.5_0C to 45.4_0C. The soil of this region is mostly alluvial and have developed on alluvial deposited by Ganga and its tributaries. Soils are natural to immoderately alkaline and are medium in organic content. Wheat, rice, sugarcane, bajara, sorghum, maize, singhara, groundnut, rapeseed, mustard, gram, peas, lentil, black gram and pigeon pea are the major field crops. Potato, tomato, candy, flower, brinjal, vegetates pea, turmeric, encurbits are the major vegetables. Mango, guava, bea, jack fruit and lemon are the major fruits. Cultivation of mentha is becoming popular. The total area of the university is 262 hectare in which crop research center is in 42.5 hectare, HRC in 21.25 hectare and LRC in 6.5 hectare and in rest area under buildings and roads. The University has 03 zonal research stations viz. Nagina (Bijnore), Bulandshahr and Ujhani (Baduan) under different agro-climatic conditions.

2. Location & Setting

About the City

Meerut is a metropolitan city of Uttar Pradesh. It is an ancient city located at 56 km (35& mi) north-east of New Delhi. It is a part of the National Capital Region of India. It is the 16_{th} largest metropolitan area in India and the 17_{th} largest city in India. It ranked 292 in 2006 and 242 in 2010 in the list of largest cities and urban areas in the world. It is the fastest developing city of Uttar Pradesh after Noida and Ghaziabad. It is spread about 172 square km. The total

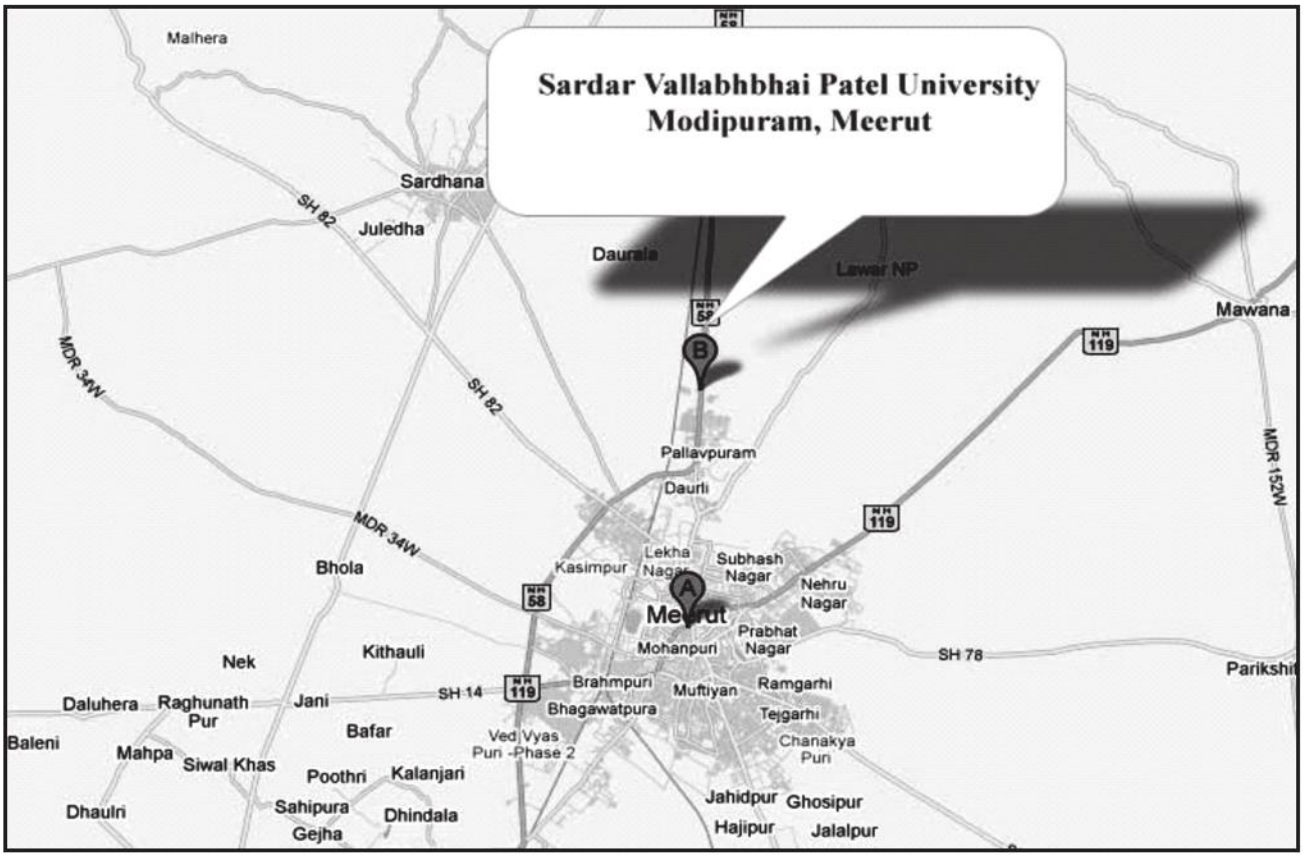
metropolitan area is 198 km which is third in Uttar Pradesh after Lucknow and Kanpur. It has the 2_{nd} largest Army Cantonment of the country. The city is famous for its scissors, Handloom Cloths, gold jewellery, sports goods, Gazak and Rewri; and is sometimes called the city of scissors or the sports capital of India. Most of all, the city is famous for the Revolt of 1857, also called India's First War of Independence, which began here. The city is fast developing as an industrial and education hub in Western Uttar Pradesh.

Geography

Meerut lies between 28.2 latitudes and 77.7 longitudes in the northern plains of India. The ground is not rocky and there are no mountains. Land is highly fertile and suitable for growing crops. Meerut lies between plains of rivers Ganga and Yamuna, there is no water scarcity as ground water is present. The University situated at Modipuram.

Modipuram

Situated on NH-58, Modipuram is said to be the fastest developing area of Meerut. It is only 6 km from Daurala and 8 km from city. It comes in Meerut Metropolitan area. It has many world class restaurants like Bikanerwala, Nirula's and McDonald's. Melange mall is also there. Modipuram is well connected through city buses.



Education

Meerut is an education hub of Western Uttar Pradesh having a total of 4 universities, more than 50 engineering colleges, 27 other colleges and institutions and countless schools. The city is home to the '***Sardar Vallabhbhai Patel University of Agriculture & Technology***' and CCS University. Another two universities are 'Swami Vivekananda Subharti University' and 'Shobhit University'.

The city currently has two medical colleges, namely 'Subharti Medical College' and the 'Lala Lajpat Rai Memorial Medical College'. The city's prominent academic colleges are Meerut College, D.N. College, Faiz-E-Aam Degree College, Ismail National Girls P.G. College, R.G. Degree College and N.A.S College. Some Reputed schools of the city are Dewan Public School, St. Mary's Academy,Government Inter College (GIC), Dayawati Modi Academy, Delhi Public School, Godwin Public School, St. John's Sr. Sec. School, Guru Tegh Bahadur Public School, Meerut Public School, Sophia Girls' School, Translam international academy, J.P. Academy, Gargi girls school, D.A.V. Public School and St Thomas Public School. 'Indian film and television institute' is also opened at western byepass of the

city. Several management colleges have been established at different parts of the city. The city also has a lot of B.Ed. colleges.

Connectivity

Air

The nearest airport is the Indra Gandhi international airport which is about 80 km away. An international airport is proposed by the state government in city to reduce pressure in Delhi airport.

Road

By road Meerut is well-connected to major cities like Delhi, Noida Haridwar etc.. Two national highway (NH-58 & NH-119) pass through Meerut. An expressway from Delhi to Meerut and Upper Ganga Expressway which passes through outskirts of the city are under development.

There are 2 main bus terminals, namely Bhainsali bus terminal and Sohrab Gate bus terminal from where Uttar Pradesh State Road Transport Corporation (UPSRTC) buses ply to cities all over the state.

As Meerut has announced a metropolitan city in 2007, JNNURM scheme has been taken place and many low floor city buses are running over the city roads. Low Floor City Buses, Normal City Buses, auto rickshaws and rickshaws are convenient public transport options to commute within the city. Many new transport infrastructure projects like inner ring road, outer ring road and construction of new flyovers are proposed.

Railways

Meerut has six railway stations- Meerut City, Meerut Cantt, Partapur, Sakoti tanda, Mohdinnpur and Pabli Khas. Meerut City station is busiest station in the city. Meerut cantt station was founded in 1865 and serves as a secondary railway station. Meerut lies on Delhi - Saharanpur railway line.

3. ADMINISTRATION

3.1 Board of Management

The university highest administrative body is the Board of Management. Board of Management body controls the finances and assets of the institution, is the appointing authority for all teachers and gives overall guidance on the running of the university.

1. As nearly as may be one third of the members of the Board shall retire every year.
2. The following members of the Board, first constituted, shall serve for the period specified below :

i. Vice Chancellor	Chairman
ii. The Secretary to the state govt. in agriculture department.	Member
iii. The Secretary to the state govt. in finance department.	Member
iv. The Secretary to the state govt in the education department	Member
v. The Director of agriculture, U.P.	Member
vi. The Director of animalhusbandry U.P.	Member
vii. Two members of the Legislative Assembly	Member
viii. one member the Legislative Council	Member
ix. Five members nominated by the State Govt. being respectively :	
a. An eminent agricultural Scientist	Member
b. AProgressive farmer.	Member
c. A distinguished industrialist of Manufacturer having special knowledge of or practical experience in agricultural development	Member
d. A livestock breeder	Member
e. An outstanding women social worker	Member
x. Comptroller shall be ex-officio Secretary of the Board	

3.2 Vice-Chancellor

The Vice-Chancellor is the Chief Executive Officer of the university appointed for a term of three years. The Vice-Chancellor has the powers to administer the university as an autonomous body. This position is held by a man of great administrative experience, scientific bent of mind and one who could draw confidence of large number of scientists and has a high standing in the society so that his very association with university earns it exalted recognition.

3.3 Academic Council

1. The Academic council shall consist of the Deans of the Colleges, Director of Extension, the Head of the Departments and two members from each of the categories of Professors / Associate Professors / Assistant Professors from each faculty in rotation in order of seniority for a period of two years and one person elected by the board of each faculty of the university out of the members of the faculty. The term of member elected by the Board of each faculty shall be one year. Membership on any standing committee of the Academic council shall be open to a member of a Faculty and carries with it the privileges of the floor of the Academic Council including that of voting, so long as such membership continues.
2. The following officers of the university shall be ex-officio members of the Academic Council.
    - Comptroller
    - Dean Student Welfare
    - Director Communication
    - Director Training & Placement, Librarian and such other officers* as may be recommended by Academic Council and Approved by the Board of Management.
    - Librarian and such other officer may be recommended Academic council & Approved by the BOM.

3.4 Registrar

(i) The Registrar is a whole time officer of the university and shall be appointed by the Vice-Chancellor.

(ii) He shall be responsible for the due custody of the records and the common seal of the university. He will be ex-officio secretary of the Academic Council, and shall be bound to place before it all such information as may be necessary for the transaction of business. He shall receive applications for entrance to the University and shall keep a permanent record of all courses, curricula and other information as deemed necessary.

(iii) Registrar shall be responsible for the conduct of the examinations as prescribed and make all other arrangements necessary therefore and be responsible for the due execution of all processes connected therewith.

(iv) The Registrar shall perform such other duties as may be prescribed and required from time to time by the board.

SECTION-II

ADMISSION PROCEDURES AND ADMISSION RULES

1. Combined Agriculture and Technology Entrance Test (CATET)

Combined agriculture and technology entrance test (CATET) will be conducted by one out of four universities e.g. SVPUAT, Meerut/CSAUAT, Kanpur/NDUAT, Faizabad/MSKRJUAT, Banda on rotational year in the $1_{st}/2_{nd}$ week of May as per Uttar Pradesh Krishi Evam Prodyogik Vishwavidyalaya (Dwitiya Sanshodhan) Adhiniyam, 2006 (Uttar Pradesh Adhiniyam Sankhya 16 of 2006) as passed by the Uttar Pradesh Legislature and assented to by the Governor on May 23, 2006.

Note: Only Uttar Pradesh State Domicile candidates are eligible for appearing in all courses.

2. Age limit

a) Minimum age for BVSc-17 years and maximum eligible age will be 23 years. For SC/ST/OBC relaxation of 5 years in maximum eligible age.

b) Minimum age for other graduate courses 16 years and maximum eligible age will be 22 years. For SC/ST/OBC relaxation of 5 years in maximum eligible age.

c) There is no age limit for PG courses.

3. Programmes and Minimum Educational Eligibility

a. UNDER GRADUATE PROGRAMMES

1. B.Sc. (Hons.) Agriculture	Intermediate in Agri. Sci. /PCB/PCM/PCMB
2. B.V.Sc. & A.H.	Intermediate in PCB/ PCMB with English as a subject alongwith 50% aggregate marks in Physics, Chemistry, Biology and English for General Category and 40% for OBC/ SC/ST
3.. B.Tech. (Biotechnology)	Intermediate in Agriculture Science / PCB/PCMB/PCM

b. MASTER'S and Ph. D. PROGRAMMES

1. M.Sc. (Ag.)	
(i) Agril. Biotechnology	B.Sc.(Ag.)/B.Sc. Ag. (Hons.)/B.Sc.(Hort.)/ (10+2+4 years degree) /B.Sc. Bio/ B.Sc. (Biotech.). / B.Tech.(Biotech.)
(ii) Agricultural Economics & Management	B.Sc.(Ag.)/B.Sc. Ag. (Hons.) (10+2+4 years degree)
(iii) Agricultural Extension	B.Sc.(Ag.)/B.Sc. Ag. (Hons.) (10+2+4 years degree)
(iv) Agronomy	B.Sc.(Ag.)/B.Sc. Ag. (Hons.) (10+2+4 years degree)
(v) Animal Husbandry	B.Sc.(Ag.)/B.Sc. Ag. (Hons.) (10+2+4 years degree)
(vi) Entomology	B.Sc.(Ag.)/B.Sc. Ag. (Hons.)/(10+2+4 years degree)/ B.Sc.(Hort.) (10+2+4 years degree)
(vii) Genetics & Plant Breeding	B.Sc.(Ag.)/B.Sc. Ag. (Hons.) (10+2+4 years degree)
(viii) Horticulture	B.Sc.(Ag.)/B.Sc. Ag. (Hons.)/ B.Sc. Hort. (10+2+4 years degree)
(ix) Plant Pathology	B.Sc.(Ag.)/B.Sc. Ag. (Hons.)/B.Sc.(Hort.) (10+2+4 years degree)
(x) Soil Science	B.Sc.(Ag.)/B.Sc. Ag. (Hons.) (10+2+4 years degree)
2. M.Tech. (Agril. Engg.)	
(i) Agri. Process and Food Engineering	Bachloers degree in Agril. Engg. / Mechanical Engg. / B.Tech.(Biotech.)/ B.Tech.(Food Tech.) /B.Tech.(Dairy Tech.)
3. M.Tech. / M.Sc. (Biotechnology)	B.Tech. (Biotechnology)/B.Sc. (Biotechnology), B.Sc. (Biology) candidate are not eligible.
4. Ph. D. PROGRAMMES	
(i) Agril Biotechnology	M.Sc. Ag. Biotechnology/ M.Sc.Biotechnology/M.Tech. (Biotechnology)

(ii) Agricultural Economics & Management	M.Sc. (Ag.) in Agril. Economics / M.Sc. (Ag.) in Agril. Economics & Management
(iii) Agricultural Extension	M.Sc. (Ag.) in Agril. Extension / Extension Education/Agril. Communication
(iv) Agronomy	M.Sc. (Ag.) Agronomy
(v) Animal Husbandry	M.Sc. (Ag.) in Animal Husbandry
(vi) Entomology	M.Sc. (Ag.) in Entomology, (M.Sc.(Ag.) in Plant Protection degree holders are not eligible)
(vii) Genetics & Plant Breeding	M. Sc.(Ag.) in Gen. & Pl.Breeding / [(Agril. Botany, Agril. Biotechnology & M.Tech./M.Sc. Biotechnology
(viii) Horticulture	M. Sc.(Ag.) in Horticulture/ M.Sc.(Hort.)
(ix) Plant Pathology	M.Sc. (Ag.) in Plant Pathology, (M.Sc.(Ag.) in Plant Protection degree holders are not eligible)
(x) Soil Science	M. Sc.(Ag.) in Soil Science & Agril. Chemistry / M.Sc. (Ag.) in Soil Science
(xi) Agri. Process and Food Engineering	Master's degree in Agril. Engg. / Agril. Process & Food Engg./ Process & Food Engg /Mechanical Engg./Biotech. Engg. / Food Biotech. Engg. /Post Harvest Engg. & Tech.
C . Diploma Programmes	
1. Diploma in Fruit and Vegetable Processing	Intermediate in Agriculture Science/PCB/PCMB/PCM/ Home Science
2. Diploma in Backery Technology	Intermediate in Agriculture Science/PCB/PCMB/PCM/ Home Science

4. Reservations

As per state govt.

Note: A candidate shall not be allowed admission to B.V.Sc. & A.H. degree course if he/she suffers disabilities in physical fitness as listed below:

a) disability of total body including disability of chest/spine more than 50%.
b) disability of lower limb of more than 50%,
c) disability of upper limb,
d) visually handicapped candidates and those with hearing disability,
e) candidates with progressive diseases like myopathies, etc.
f) disabilities which otherwise would interfere in the performance of the duties of a veterinarian.

The disability should be certified by a duly constituted and authorized Medical Board comprising of atleast three-specialists out of which two should be of the specialty concerned and the candidate has to present him/her - self before the Medical Board. The last valid disability certificate of the candidate from a Medical Board should not be more than three months old from the date of submitting his/her certificate for disabled candidates.

5. NRI and payment seats

Number of seats and the fees structure will be decided by the university.

6. Procedure of application form procurement

Application forms can be obtained from office of the registrar/concerned bank of the university after depositing the required amount. The candidate may also obtain the application form by post by sending the required amount by the name of comptroller of the university.

7. Sports weightage

Except BVSc&AH programe a sports weightage of 2% will be given to the candidates who had participated in interuniversity/state level (Junior/Senior) sports competitions. Candidates have to produce the original sports certificate at the time of counseling of admission.

SECTION-III

ACADEMIC REGULATIONS

I. Regulation on meeting of the Board of Management

The quorum for any meeting of the Board shall consist of four member. Provided that if a meeting is adjourned for want of quorum, no quorum shall be required for that adjourned meeting.

II. A. Regulation on the conduct of meeting of the Academic Council

1. The Secretary, Academic Council (Registrar), shall issue notice for holding of the meeting of the Council on such date/ time/place as the Council had decided in the preceding meeting or on a date which may be fixed by the chairman of the Academic Council inviting list of items for the meeting
2. Copies of agenda notes shall be supplied by the faculty /department concerned duly signed, at least 21 days in advance of the date of the meeting to the secretary, Academic Council. Every item must be received with a detailed agenda note regarding different aspects of the item, the earlier decisions and the existing regulations on the subject, the impact, if any, of the proposed changes on existing programmes/courses, and a concrete suggestion or draft of the resolution for approval at the end of the agenda note. No item should be taken up for discussion in the Academic Council without a proper agenda note. The items received without proper agenda note would be returned to the person concerned by the secretary, Academic Council. The agenda notes shall be carefully screened by the Dean, Director/HOD concerned before these are sent to the secretary
3. No agenda item (s) received beyond the date as prescribed in (2) above shall be included in the agenda unless specifically permitted by the Vice-Chancellor for doing so under special circumstances
4. It shall be obligatory for each member of the Academic Council to attend the meeting, if he is on duty on the campus on the date of meeting. Members who are unable to attend the meeting because of a class at the time or for some other unavoidable reasons, shall inform the secretary about the same, preferably before the meeting. Normally only a bonafide member of the Academic Council shall be allowed to attend a meeting of the Council. However, any other person who may not be a member of the Academic Council may by general or specific order be allowed/invited by the secretary of the Council to attend the meeting(s) with the prior permission of the Chairman (Vice- Chancellor).
5. A mention about the presence/absence, of the members with or without intimation, shall be made in the minutes of the meeting concerned
6. Items for discussions in the meeting may originate from or with the permission of the Chairman of the Board of faculties, the standing committees of the Council or on a reference/direction of the Board of Management or by an individual member with the prior permission of the Chairman. An item not included in the agenda may be placed before the Council for consideration under the item with the permission of the Chair.
7. The agenda and notice for any regular meeting shall be circulated by the Secretary, Academic Council so as to reach the members at least 5 days before the day of meeting. The agenda and notice for a emergency meeting must normally be issued three days before the meeting. However, decisions taken in an emergency meeting with less notice will not be invalidated because of inadequacy of notice.
8. A copy of the minutes of each meeting shall be supplied to the members. Copies of the minutes shall also be sent to the Library for the information of students and staff, provided that the Council, through a special resolution decides that minutes of a particular meeting may not be sent to the Library
9. Follow-up action on the decisions of a meeting shall be taken by Dean/Directors/Faculty Secretary/sub-committees and a report about the action taken shall be forwarded to the Secretary, Academic Council atleast 10 days in advance, for reporting the same to the Council at the next meeting
10. Agenda notes once circulated shall not be circulated again and the members are expected to retain those agenda notes till they are considered by the Academic Council.
11. On all matters not specifically provided for in these Regulations from clause 1 to 10 about the conduct of meeting of the Academic Council, the decision of the Vice - Chancellor shall be final.

B. Formation of Academic Council

1. The Academic council shall consist of the Deans of the Colleges, Director of Extension, the Head of the Departments and two members from each of the categories of Professors / Associate Professors / Assistant Professors from each family in rotation in order of seniority for a period of two years and one person elected by the board of each faculty of the university out of the members of the faculty. The term of member elected by the Board of each faculty shall be one year. Membership on any standing committee of the Academic council shall be open to a member of a Faculty and carries with it the privileges of the floor of the Academic Council including that of voting, so long as such membership continues.
2. The following officers of the university shall be ex-officio members of the Academic Council.
   a. Comptroller
   b. Dean Student Welfare
   c. Director Communication
   d. Director Training & Placement, Librarian and such other officers* as may be recommended by Academic Council and Approved by the Board of Management.
   e. Librarian and such other officer may be recommended Academic council & Approved by the BOM.

III. Regulations on Enrolment & Continuance of Students

ENROLMENT (REGISTRATION)

Advisement

1. (a) Students freshly admitted as well as continuing students shall present themselves in the beginning of each semester on dates notes notified by the Registrar for advisement and shall be assigned in groups to staff advisors (i) by the Dean concerned at the under- graduate level and (ii) by the Head of the Department, in which the student is majoring, at the Postgraduate level.

   (b) The Advisor shall help the under-graduate students in planning the programme of his studies and the choice of courses. He shall also guide the student in determining the credit load, which he can safely and conveniently carry in each semester and shall advise him regarding adding of or withdrawal from the courses during a semester. Each Advisor shall maintain a close contact with his adviser and keep himself informed of their progress. Problem cases needing special measures shall be brought to the notice of the Dean concerned by the Advisor.

Registration

2. (a) Following advisement as prescribed above, registration of candidates selected for admission as well as that of continuing students shall be completed on scheduled date (s) notified earlier by the Registrar for each semester.

   (b) Normally a student shall not be permitted to offer a course unless he has cleared its pre-requisite course. In case any student has failed in a pre-requisite course after attending the course at least for 15 weeks, the Dean concerned may permit him to register for advance course.

   In case of genuine difficulties the Dean of the College concerned may also permit offering of pre-requisite course and the advance course to which it was pre-requisite concurrently.

Mode of Registration

3. Registration shall consist of the following steps:

   (i) Enrolment of the students in various courses with individual Instructors at a particular place, date and time.

   (ii) Payment of the University fees and other dues to the Comptroller and the Dean student Welfare.

   (iii) Depositing with the Registrar the prescribed registration cards/ forms, duly filled in and signed by the Advisor, Instructors and other officers concerned.

Registration of Fresh Students

4. Registration for the first semester of the first year of a degree pragramme is a part of admission procedure and shall be governed by the admission rules. Admission of new students failing to register in the prescribed manner on the appointed date is liable to be cancelled and the seats so fallen vacant shall be offered to the next candidates

in the waiting list. In the event of a newly admitted student being permitted by the Vice- chancellor to register late, he shall pay late registration fee as prescribed under Regulation 25 (a) for continuing students, unless exempted by the Vice-chancellor.

Registration of Continuing Students

5. Registration of continuing students in the subsequent semester shall be held in a similar way on the date & time notified by the Registrar.

Late Registration Fee

6. (a) A continuing student who does not register on the day of registration, shall be required to pay a late registration fee at the rate of Rs. 200.00 for the first day and rate of Rs. 50.00 for each subsequent day, till the registration is completed as prescribed.

(b) Any student may be exempted from the payment of late registration fee by the Vice-Chancellor where he is convinced that the student is late for circumstances beyond his control.

Last Day of Registration

7. The registration of continuing students shall not be permitted later than ten working days from the scheduled date of registration in each semester unless allowed by the Vice- chancellor with late registration fee mentioned in 6(a). No student shall be permitted after expiry of 15 working days from date of registration under any circumstances.

Summary Cancellation of Registration

8. The Vice- Chancellor may summarily cancel the registration of any student or group/batch / classes of students who indulge (s) in acts of indiscipline, misconduct, violation of rules and regulation of the University, strikes, absents from class (es) without permission or without any valid reason or in whose cases the Vice- Chancellor has reasons to believe that their continuance in the University would not be in the best interest of the University.

Suspension of Registration

9. The registration of a student may also be suspended by the Vice- Chancellor or the Dean of the College concerned or the Dean of students Welfare either at his discretion or on the recommendations of the Discipline Committee pending enquiry or the receipt of a report from the Warden or a faculty member alleging that the student concerned has committed an act of indiscipline as defined under the regulation. A student whose registration has been suspended as above may also be ordered to vacate the hostel and leave the campus if such a measure is deemed necessary by the authority passing the order of suspension in the interest of academic discipline and peace on the campus.

The period of suspension under this regulation shall not exceed 15 days except in cases in which the Vice-Chancellor or the Dean has reasons to believe that the proceedings in the Discipline Committee can not be concluded during this period or where it is felt that the enquiry by the Discipline Committee needs to be held in abeyance so as not to prejudice the proceedings in court cases involving the alleged commission of a serious crime or an offence under the laws of the country or the state involving moral turpitude.

Registration necessary for award of degree

10. In case a student studies a course without registering in the prescribed manner, he will not be awarded any grade in that course.

Minimum Credit Load

11. (a) The following shall be minimum credit requirements for registration in each semester.

Undergraduate Student : 12 Credits (B.Tech. Biotechnology)

Postgraduate Students : 12 Credits

(including Teaching/Research Assistantship)

Note : If a student is left with less than 12 credits in his approved programme, above limit will not operate.

(b) *Exceptions*: The Dean concerned may permit a lower credit load, among others, on the following grounds to be specifically recorded in each case.

i) Marginal adjustments;

ii) Unavoidable clashes in time table;

iii) Non- availability of sufficient number of course to be covered;

iv) Non- availability of suitable course or failure to clear pre- requisites or for other reasons;

v) Need for taking up preparatory course;

vi) In case of post- graduate students completion of course requirement and being left with only credits for research;

Maximum Credit Load

12. (a) The following shall be the maximum credit load to be allowed by an Advisor :

i) Under-graduate: For B.Sc. (Hons.) Agriculture 26 credits, for B.Tech Biotech 22 credits for B.V.Sc as per VCI and for diploma 15 credits in a semester (excluding credits for N.S.S., Work Programme, N.C.C. Games & Sports & New Education/ Liberal Education courses). For B.Sc. (Hons.) Agriculture in addition 26 credit, 2 course per semester (repeated) can be offered without attending classes.

ii) Full time Post - graduate (with teaching/ Research Assistantship:) 16 credits in a semester.

iii) An Advisor may permit an under- graduate student of take up to a maximum of 24 credits in a particular semester on either of the following grounds:

1) The CGPA of the student at the end of the preceeding semester was not less than 7.500 and he has also not been placed on Academic Probation for the instant semester.

2) The GPA of the student in each of the preceeding two semesters was not less than 7.500 and his CGPA at the end of preceeding semester was less than 6.000.

iv) In genuine cases an Advisor may also permit a marginal adjustment upto 1 credit over the credit load prescribed in clause (i) to (ii) above.

(b) *Exceptions:* The Dean concerned may permit an increase in the maximum credit load (as specified above) upto the limits detailed below on any of the grounds listed in (c) below.

i) Under- Graduate students (B.Tech Biotech) : 25 credits

ii) Full- time Post - Graduate students : 20 credits

(c) The grounds for increase in maximum credit load up to the limits laid down in 12 (b) above shall be as follows, but they shall not operate in case of students on Academic Probation.

i) Where extra departmental of extra- non - credit course are deemed necessary;

ii) Where a course is not offered in the subsequent semester within the time laid down for the maximum duration of the course;

iii) Where only thesis requirements are left to be completed; and

iv) Where four or less credits remain to be covered in the subsequent semester.

v) Last semester of the degree programme

(d) Any increase beyond the limits prescribed in (b) above, or on grounds other than those listed in (c) above may be permitted by the Vice- Chancellor on the recommendation of the Dean concerned for reasons to be recorded.

Maximum class strength

13. (a) No unscheduled course shall be offered except with the specific permission of the Dean which should be communicated to all concerned including the Registrar unless the number of students offering that course is 5 in the case of under- graduate course (s).

(b) In Genuine cases where the number of students below the number prescribed in (a) above, the requirement of minimum class strength may be waived by the Dean concerned.

Record of Class Attendance

14. Each Instructor shall maintain a record of the students attendance in each course taught by him in each semester in a register prescribed by the Registrar.

All postgraduate students (both Master's and Ph.D. programmes) during the course of their registration for thesis research only shall regularly sign on the register maintained in the Advisor/HOD office, as decided by the department. Further, any student leaving for his/her personal work outside the University shall have to take permission from the Advisor, HOD and Dean of the college concerned.

Minimum Class Attendance

15. (a) Each student shall be regular in attending classes and shall be required to have a minimum of 85% attendance in each course in each semester, failing which he shall be awarded failure grade in that course unless withdrawal from the course is permitted.

(b) The percentage of attendance of a student in a course in a semester shall be computed on the basis of the total number of lectures, practical and tutorials attended by him and those actually held between the date of commencement of instructions and the date of closing of instruction, irrespective of the date of registration/ or the duration of leave granted to him provided that attendance in respect of the students representing the University in games and sports, debates etc. outside the campus shall be calculated after ignoring the period which they spend outside the campus on due authorization by the Dean of the College concerned and Dean Students Welfare subject to the condition that such authorized absence should normally not exceed 7 days in a semester *and further that no condonation even under this clause shall be allowed below 75%.* Students having less than 75% attendance shall not be allowed for final examination.

(c) (i) The Dean concerned may, on the recommendation of the Instructor/ Advisor, condone shortage in attendance up to 5% in a course (s) in exceptional circumstances and allow students with an attendance of 80% or more to appear at the final examinations.

(ii) The Vice-Chancellor may, on the Recommendation of Instructor/ Advisor / Dean concerned condone shortage in attendance upto 10% in a course (s) in exception circumstances and allow students with an attendance of 75% or more to appear at the final examination.

(d) All the Instructors shall display on the College notice board(s) the shortage of attendance of the students (below 85%) in particular course before the start of the final semester examinations with a copy to the Dean concerned. The student will submit the application for condonation of shortage of attendance to the office of the Dean concerned through Instructor, Advisor within a week of the start of semester final examinations. The shortage in attendance of student may be condoned on the grounds and limits as given in (a), (b) and (c). In case the condonation of the attendance is granted by the Dean, the student will apply to the Registrar through Instructor/Advisor/Dean concerned on plain paper for the revision of his grade. No application for the condonation of shortage in attendance will be entertained under any circumstances after prescribed date mentioned above.

(e) Further in view to have the regularly in the academic programme following shall be observed.

(i) No teacher shall leave the campus without making arrangement for the class.

(ii) The attendance must be taken whenever class is scheduled whether any student attends or not, not-withstanding.

(iii) The monitoring about holding of the scheduled classes be done by the Head of the Department and Dean concerned.

(iv) Reports about defaulters must be promptly submitted and action taken.

(v) The provision of the regulations regarding attendance shall be strictly a heard to.

(vi) Alterative question papers be prepared and kept sealed from the start of the semester, for use at the final examinations.

(vii)All formalities towards condonation of shortage in attendance must be completed within 7 days of commencement of semester final examination.

Leave for Illness

16. In case of unavoidable absence from the class e.g., serious illness, the student shall apply for leave to the Dean of the College concerned through his Hostel Warden, in the prescribed form. The Dean of the College concerned, if satisfied, may permit him such leave and shall inform all the Instructors and Heads of Department concerned. In such cases efforts should be made to make up the work missed by the students.

Addition / Withdrawal of course(s)

17. (a) A student who desires to add/withdraw course(s) from the original registration has to complete the following steps failing which the addition/withdrawal will not be allowed under my circumstances:

(i) The application is made on the prescribed form, obtainable from the office of the Dean concerned.

(ii) The recommendations of all concerned are obtained in person.

(iii) The approval/ recommendation of Dean concerned is obtained.

(iv) The form is submitted in the office of the Registrar in person after payment of necessary fee of Rs. 50/- per course within the prescribed time limit, and

(v) The orders are obtained from the office of the Registrar supplied to the Advisor and Instructor(s) concerned within the prescribed time limit.

(b) The course withdrawn within the prescribed period and manner stated above shall not be shown on the transcript.

(c) (i) A student may be allowed to add a course(s) in original registration upto 6 working days from the scheduled date of registration by the Dean concerned on the recommendation of Advisor and Instructor (s) on payment of fee of Rs. 50/- per course with the condition that the credit load of the student does not exceed the prescribed maximum credit limit, However, in genuine cases, the Vice - Chancellor may permit addition of course(s) upto 15 working days from the scheduled date of registration on payment fee as prescribed above.

(ii) A student may be permitted to withdraw from a course within 4 weeks from scheduled date of registration in the semester by the Dean concerned on the recommendation of Advisor and Instructor(s) concerned on payment of fee of Rs. 50/- per course. In case of prolonged illness, duly certified by the Medical Officer of the University, a student may be permitted to withdraw from a course worth upto 4 credits, upto six weeks by the Vice-Chancellor on the recommendation of Advisor, Instructor(s) and Dean concerned subject to the following conditions:

(i) The credit load after withdrawal does not fall below 12 credit for UG and Master's students and 10 credits for Ph.D. Students.

(ii) If the credit load of a student as at (i) falls below 12 credits, the student will not be entitled for graduate Assistantship.

(iii) If the credit load does not fall below 9 credit in UG and 4 credits in PG Programme for staff students under full time study programme.

(d) The first year Under-graduate students shall not be permitted to withdraw from the non-credit (Remedial)/ non gradial courses of English, Mathematics, Physics, Chemistry, Agriculture and comprehension and communication skills.

Auditing the course(s)

18. A student may be permitted to audit course(s) offered in a semester by the Dean concerned on the recommendation of the Advisor. The student shall have to attend at least 75% classes and have to secure at least 50% marks in various examinations conducted in the course(s) to get the course recorded in the transcript as an audit course.

Note: In a situation where the course first announced and offered but could not be run, the registration of the course be either cancelled by the Dean and the Advisor should ensure that withdrawal of the course is permitted within the prescribed period.

CONTINUANCE OF STUDENTS

Withdrawal from the University

19. (a) Every enrolled student shall be required to register at the beginning of each semester till the completion of his degree requirements, unless otherwise permitted / ordered by the Dean/ Vice -Chancellor, as the case may be, failing which his/her enrolment shall be cancelled. Readmission in such case shall be by petition, and not as a matter of right.

(b) Permission to withdraw from the University, for a semester shall not be granted unless the application is made through the advisor to the Dean at least 15days before the commencement of the semester final examinations after obtaining upto date no dues from the Comptroller.

(c) (i) No student will be permitted to drop the Ist semester of his Ist year both at under-graduate and Post-graduate level. However, the Vice- Chancellor may permit the dropping of the Ist semester of the Ist year on the recommendations of the Dean of the college concerned in exceptional circumstances i.e.

1. Hospitalization for one month or more in the Ist semester.

2. Confinement to bed for one month or more in the Ist semester as a result of serious illness/ ailment.

(d) A student may be permitted to drop the IInd semester only on the condition that he was not placed on Academic Probation after the first semester final examinations. Under no circumstances a student who was permitted to drop the Ist semester shall be allowed to drop the IInd semester.

(e) Permission to withdraw from the University for a semester shall be accorded on the following grounds:

(i) The student is hospitalized in the University Hospital or in a Hospital, advised by the University Medical Officer Incharge or advised complete rest by the University Medical Officer Incharge or the I/ C of such

Hospital to which his case was referred by the Medical Officer Incharge, University Hospital for a period on account of which his attendance are likely to fall below 75% and/or he is likely to miss or has missed examination as well as make ups thereof. The application, on this ground duly countersigned by the University Medical Officer Incharge and supported by the relevant certificate(s), is to be made within a week from the last day of hospitalization. No application submitted beyond this period will be considered.

(ii) In case of an accident whereby a student has been disabled temporarily to attend his classes, the application for level duly supported by the Medical certificate(s) countersigned by the University Medical Officer Incharge, is to be made with in a week from the day the student is declared fit to attend classes.

(iii) In case where a student has left the University Campus on authorized leave on any ground including the unfortunate death of parent/guardian and falls sick there and has to undergo treatment for such a period that his/her attendance falls short of the minimum prescribed limit he/she may also be permitted by the Dean to drop/ withdraw from a semester if he/she makes formal application to the Dean through his guardian/ parent duly supported by Medical Certificate(s)from an M.B.B.S. registered medical practitioner within a fortnight from the date of expiry of the authorized leave.

(iv) Any other unforeseen circumstance which, in the opinion of Vice-Chancellor, are fit reasons for allowing a student to drop a semester.

(f) If a student has not obtained permission from the competent authority as defined above, he/she shall be awarded grades as per the actual performance in various courses by awarding zero in missed examinations. In case his/ her attendance falls short of prescribed limit, failure grades shall be awarded.

(g) Normally, permission shall not be granted to a student to withdraw from the University for more than two semester under the Regulation 19 (b), (c), (d) and (e).

(h) The Vice-Chancellor may, on the recommendation of the Advisor and Dean, college concerned, permit temporary discontinuance of studies for maximum period as detailed below on grounds prescribed under 19 (i).

(i) Under Graduate programme 2 semesters

(ii) Master's programme 3 semesters

(iii) Ph.D. programme 4 semesters

In exceptional circumstance where the Vice- Chancellor is convinced that the duration of withdrawal beyond the limits prescribed above, has become necessary for reasons beyond student's control, he may, on the recommendation of the Advisor and Dean concerned permit a student to withdraw from the University for a longer period, within the provisions of Regulations 42 of these regulations and clause 10 of Regulation on Award of Degrees & Diplomas (Chapter VII).

(i) Permission to discontinue studies may be accorded on the following grounds:-

(i) The student has to join service and extension in joining date is not possible.

(ii) In case of in-service sponsored student the sponsoring institution wants to withdraw the student for a temporary period.

(iii) In case of University staff student, the concerned department/ section wants to withdraw the student for temporary period in the interest of work of the department, section and / or University.

(iv) Any other circumstances which in the opinion of the Vice-Chancellor, is fit reasons for allowing the student to discontinue his/ her studies. Discontinuance of studies on the above grounds shall be permitted only if the application is made in advance,after obtaining upto date no dues from the Comptroller.

(j) (i) No student shall be permitted to withdraw from the University for a period laid down in clause 19(h) above on any ground whatsoever.

(ii) In case any student wants to withdraw from the University for more than two semesters, on medical grounds, he shall be advised to seek admission elsewhere or else withdraw from the University permanently and seek readmission when he/she feels completely fit to resume studies.

(iii) The case of dropping/withdrawal of a semester in respect of such students as may have a CGPA of less than 5.500 in case of U.G. and OGPA of 6.500 in case of Master's & 7.250 for Ph.D. upto the end preceding semester, shall be referred to the Petitions committee for disposal.

(iv) The student permitted to withdraw for one or two semester on medical grounds shall be required to submit a certificate of fitness from the University Medical Officer Incharge on rejoining.

Clearance Certificate

20. Any student who wants to leave the University during or after a semester must officially withdraw by obtaining 'Clearance Certificate' on the prescribed form from all sections and Heads of Deptt. concerned and deposit in the office of the Registrar. A student not following this procedure shall be liable to pay the University fees and other charges until a 'Clearance Certificate' has been filled by him/her or by somebody else on his/her behalf.

Procedure for Withdrawal

21. (a) A student may be entitled to withdraw from the University on completion of his studies in this University.

(b) No student shall be deemed to have withdraw from the University unless he has obtained a 'Clearance Certificate' i.e. No Dues certificate from the Comptroller.

(c) Unless a student has obtained a 'Clearance Certificate' from the University, no refund of the amount due to him/her shall be allowed, nor shall the transcript and any other documents be issued to him/her.

(d) The 'No Dues certificate, may be obtained by the student himself/herself immediately after completion of his/her degree or at the time of his/her being permitted to withdraw from the University. The 'No Dues Certificate' may also be obtained by making an application to the Comptroller in this behalf.

(e) It shall be the responsibility of the Sectional Heads concerned, e.g. the Warden, the Librarian, the Dean Student Welfare and the Heads of Department etc. to report to the Comptroller immediately, at the end of each semester final examinations, the dues if any outstanding against any student.

(f) It shall be the duty of the Comptroller to prepare and maintain, an upto date statement of dues outstanding against student and also to furnish a copy of the statement to the Registrar within three weeks from the date of the commencement of the semester break each semester.

(g) The Registrar shall consult the report furnished by the Comptroller and if no dues are show against a student in the list, shall cause to issue the transcript or any other documents which can be issued to a student after withdrawl from the University.

Provided that no application for issue of document shall be held up beyond three weeks for want of a report.

Refund of Caution Money

22. The refund of caution money of a student shall be made only after he/she has obtained a 'Clearance Certificate' from all concerned and deposited it in the office of the Registrar. The refund of caution money shall be permissible upto a period of five years from the date the student leaves the University, where after it shall be credited to the University revenue.

Readmission of Students

23. Students who withdraw from the University or who have been dropped by the University may petition to the Vice- Chancellor for readmission. However, on readmission such students shall be treated as continuing students as far as time of admission is concerned they shall not be treated as continuing students for the purpose of fees payable.

Concession to Students Joining Armed Forces in An Emergency

24. (a) A student who has withdraw from the University to join the Armed Forces during a period of emergency of in normal times may petition to the Vice- Chancellor for readmission. Re-admission in such case may be granted by the Vice- Chancellor on the recommendations of the Dean concerned.

(b) If the students has withdraw from the University during the currency of a semester after completing instruction for not less than 14 weeks the grade in the courses for which he had registered in a semester; shall be deferred. On readmission he/she may be given a proficiency examination.

(c) The maximum duration for the degree in case of student as in (a) above may at the discretion of the Vice-Chancellor, be extended by the period for which he had been in the Armed Forces on temporary commission. This concession shall not be allowed to students having regular commission in the Armed Forces except in case of candidates who might have suffered injury in the battle field rendering him of 'low medical category' or otherwise disabled in any way.

(d) In such cases where concession has been allowed for joining Armed Forces, the graduation requirements may be adjusted in terms of the regulations on courses of studies for degree and diploma.

Academic Probation

25. If at the end of any semester of an academic year the CGPA (GPA in case of Ist year students at the end of Ist semester of their study) of an under-graduate student falls below 5.50 in case of undergraduate, 6.5 in case of Master and 7.250 in case of Ph.D. he/she shall be placed on academic probation for the duration of the following semester.

Removal of Academic Probation

26. If at the end of the semester during which a student has been on academic probation, the CGPA of the student for that semester is 5.500 or above in case of undergraduate, 6.500 or above in case of Master and 7.250 or above in case of Ph.D. he/she shall cease to be on academic probation.

Dropping from the University

27. (a) If any student fails to remove the academic probation in accordance to the regulation 26, he/she shall be dropped from the University for poor academic performance, with the right to petition for the admission. The student shall, however, be finally dropped with no right to petition if he/she fails to attain less than a CGPA of 4.0 in case of undergraduate, 5.00 in case of Master and 6.00 in case of Ph.D. at the end of an academic year. In case a student has been permitted to drop Ist or IInd semester of his Ist academic year or he/she has been admitted in second Semester, his/her CGPA at the end of first two semesters of his stay in the university will be counted for this purpose.

(b) Any student failing in the same course thrice shall finally be dropped from the University. In exceptional circumstances, however, the Vice-Chancellor may permit a fourth chance on the recommendation of the Advisor and Dean concerned.

Repetitions of Courses

28. (a) If a student secures a 'F' grade, he shall have to repeat the course whenever it is offered by the University.

(b) In case a student obtains 'F' grade in a course and repeat it, the grade secured by the student on repeating the course shall be reflected in the grade report on the final transcript.

(c) No student shall register again a course which he/ she has already cleared with a passing grade. If he / she register again a course already passed, subsequent grade shall be ignored.

Cancellation of studentship of Staff Members of the University

29. (1) The studentship of an employed of the University shall cease *ipso facto* if he/she ceases to be in the employment of the University.

(2) Such an employee shall have the privilege of petitioning to the Vice-Chancellor for re- admission as full- time regular student.

(3) No such employee shall be given re- admission if:

(i) He had been dismissed from the University services;

(ii) He had been convicted by a court of law for any criminal offence involving moral turpitude;

(iii) whose re- admission, in the opinion of the Vice- Chancellor, will not be in the interests of discipline in the University.

(4) In case of his readmission, he/she shall be liable to pay the University fees like other full-time regular student.

(5) He/she shall be treated as any other student of the University and shall have to abide by the rules and regulations etc. which may be in force from time to time.

Disposal of Petitions for Readmission

30. The petitions of dropped students for re-admission shall be examined by a petitions committee appointed by the Vice- Chancellor. The committee shall advise the Vice- Chancellor in respect of each petition whether it may be rejected or accepted, subject to such conditions as the committee may deem fit. In case student has to take make-up examination (s) his performance for the purpose of dropping shall be judged on the basis of the results already available without waiting for the make-up examination. The decision of the Vice- Chancellor in such cases shall be final. The petitions committee constituted above shall also decide the complicated cases of make-up examinations not strictly covered in the regulations, referred to it by the Deans of the Colleges and make necessary recommendations. On the basis of the recommendations of the petitions committee necessary decision may be taken by the Dean of the College concerned.

Breach of Discipline and Punishment(s) there for

31. Acts of Indiscipline

(1) The following shall constitute acts of indiscipline.

(a) Keeping, carrying, using or supplying of any firearms, lethal weapons, knife with a blade or more than four inches length in the room or outside.

(b) Keeping, using or supplying intoxicants in any form.

(c) Gambling in any form.

(d) Ragging, bullying or harassing of students.

(e) Demonstration in any form including procession and meeting

(f) Strike or hunger strike.

(g) Bycotting of an University function, programme or activity preventing any student from attending to classes, functions, programme or any other activity of the University.

(h) Abusing.

(i) Recourse of violence, assault, intimidation, rioting.

(j) Showing or causing to show any disrespect to a teacher or officer or any misbehavior or intimidation or an employee of the University.

(k) Incitement to commit any act of indiscipline.

(l) Any breach of law of the country or the state or the Statute, Regulation, Rules of the University or orders of a competent authority.

(m) Disturbing other students in their studies.

(n) Damaging any University property.

(o) Disorderly behavior in any form.

(p) Attending or organizing unauthorized meetings and participation in such meetings.

(q) Displaying notices, leaflets or posters not signed or countersigned by the Warden or other University officers authorized by the Vice- Chancellor at the hostel and University notice boards or other places or distributing such notices or leaflets or disfiguring or defacing or writing slogans and undesirable things on the building, property etc.

(r) Any act specifically forbidden by the Warden, Chief Warden, Dean Student Welfare or any officer of the University.

(s) Any other act intended or calculated to cause inconvenience, annoyance, injury or damage to any other intimate of the hostile, employee of the University or resident of the campus, or guests visitors to the University.

(2) Punishment for Indiscipline

i) Any inmate who violates any regulation or otherwise indulges in any act of indiscipline in clause 31 (1) may be fined upto Rs.250/- by the Warden/ Incharge of the hostel/ Instructor, if the Warden/ Instructor is satisfied that the fine is adequate punishment for the act of indiscipline.

ii) Cases of indiscipline, which in the opinion of the Warden/ Instructor are so serious that a fine of Rs. 250/- or less would not be sufficient punishment shall be referred by the Warden to the Chief Warden/ Dean of the College concerned for taking disciplinary action against the inmates.

iii) The Chief Warden/ Dean on the recommendation of the Discipline Board of his college may award any of the following punishments:-

(a) Fine upto Rs. 1000/- This shall be noted on the inmate's permanent record card but shall not go out on the transcript.

(b) Placing the inmate on 'Conduct Probation' on the recommendations of College Discipline Board. This will consist of an official warning to the students that one more incident of indiscipline might lead to the dismissal of the student from the University. It shall be noted on the inmate's permanent record card and shall go out on the transcript of the student so long as the student is on such probation.

(c) *Reprimand of Record:* This shall consist of an official warning to the student not to repeat any act of indiscipline. This will be noted on student's permanent record card but not on any outgoing transcript.

(iv) Cases of more serious indiscipline in respect of which the Chief Warden/ Dean is satisfied that the forgoing punishment in clause 31 (2) above, would not be adequate to meet the ends of justice and call for more severe punishment or cases involving students of more than one college/ hostel, shall be referred to the Discipline committee by the Chief Warden or any other officer of the University coming across any acts of indiscipline to the Secretary of the Discipline Committee.

(v) The recommendations of the Discipline Committee shall be forwarded to the Vice- Chancellor as expeditiously as possible.

(vi) The Vice- Chancellor after considering the recommendations of the discipline Committee may award any one or more of the following punishments:

(a) *Monetary Fine*

(b) *Collective or Group Fine :* May be imposed on a group of students, as a whole, when the Vice- Chancellor, on the recommendation of the Discipline Committee, is of the opinion that it is not possible to fix the responsibility on individual member of the group, for any act of indiscipline.

(c) *Reprimand on Record:* This shall be consist of an official working to the student not to repeat any act of indiscipline. This will be noted on student's permanent record card but not on any out going transcript.

(d) *Conduct Probation:* This shall consist of an official warning that one more incident of indiscipline might lead to the dismissal of the student from the University. It shall be noted on the permanent record card and shall go out on the transcript so long as the student is on conduct probation.

(e) *Temporary Dismissal:* The student shall be dismissed from the University for a specific semester(s) and required to leave the University immediately. This will be entered on the permanent record card and shall go out in transcript of the student if the same is issued during the period of temporary dismissal. It shall, however, not be mentioned in the outgoing transcript, in case the transcript is issued after re-admission. However, he/she shall be debarred from admission to the University for any further programme.

(f) *Permanent Dismissal / Rustication from University.*

The student shall be dismissed permanently from the University and shall be required to leave the University immediately. The punishment shall be entered in the permanent record card and transcript of the student and he shall be debarred from admission to the University for any further programme.

(3) Suspended Dismissal

(i) If a student has been awarded the punishment of temporary dismissal for one or more semester and he has only two semesters or less to complete his degree then the punishment of temporary dismissal may be suspended on compassionate ground and he may be placed on 'Conduct Probation' by the Vice- Chancellor to enable him to complete his degree on his moving an application duly countersigned by his parent/ guardian and filling in a bond of good behavior with such conditions as may be imposed for the remaining period of his stay in the University.

(ii) In the case of permanent dismissal, if a student has completed at least two semesters satisfactorily in this University prior to being awarded the punishment of permanent dismissal may be suspended on compassionate grounds and the student may be re- admitted on bond with such conditions as may be imposed of good behavior under this regulations.

(iii) Readmission through suspension of punishment shall invariably be subject to the following conditions:

i) The student concerned may be readmitted not as a matter of right but only on compassionate ground on the submission of an unconditional apology.

ii) The student concerned will remain on conduct probation during the remaining period of his stay in the University.

iii) The student concerned will fill a bond of good behavior as prescribed duly countersigned by his parent/ guardian which would remain operative for the entire period of his stay in the University.

iv) He will not apply for nor will be entitled to admission to any new degree programme in the University.

v) If the student concerned has been permanently dismissed he may be considered to apply for relief under this regulation only after expiry of three semesters from the date of issue of orders of punishment but in no case will be entitled to re-admission before the expiry of less than four semesters from the effective date of punishment.

vi) No student shall be eligible for seeking relief under this regulation unless he has completed at least 2 semesters satisfactorily in this University prior to his being awarded the punishment of permanent dismissal.

vii) No student shall be eligible to seek or be granted relief under this regulation if he commits any act of indiscipline in the University campus or misbehaves with any officer or teacher of the University within the campus or outside during the period laid down in clause (v) above.

(iv) Before granting the *extraordinary concession of Suspension* of the permanent or temporary dismissal the Vice- Chancellor may follow any procedure that he considers appropriate in order to ascertain as to whether the student applying for the same is likely to abide by the rules and regulations of the University and is not likely to himself indulge or instigate others to indulge in violation of the Rules and Regulations. During the period of suspension of permanent / temporary dismissal, the daily attendance of the student concerned shall be taken by the Warden / Asstt. Warden of the hostel and it shall be obligatory for him to present himself before either of them when called upon to do so.

(v) The Vice- Chancellor may revoke the order of suspension of punishment on his/her own initiative or on the receipt of a report from the Chief- Warden/ Dean of the College concerned / Dean Student Welfare / Registrar to the effect that the student concerned has violated conditions of the bond which will in addition to any other specific conditions which may be enforced at Vice- Chancellor's discretion, invariably require him not to:

a. Absent himself from the hostel for two or more days consecutively without prior permission of the Warden / Chief Warden.

b. Boycott or absent himself from any examination without prior permission. c. Fall

below 75% in attendance in any of the course offered by him/her.

d. Fail to present himself/herself before his/her Advisor, Warden, Chief Warden despite having been asked to do so.

e. Commit any of indiscipline as defined.

f. Fail to maintain a GPA of 5.500 in the case of under- graduate, 6.500 in the case of Master's and 7.250 in case of Ph.D. degree programme.

(vi) However, while the benefit of this regulation may be available to cases of indiscipline where the punishment of temporary or permanent dismissal has been awarded for the first time, it is hereby laid down that (i) the suspension of temporary dismissal may be given to student only once during his stay in the University, (ii) if the orders of suspension of punishment of permanent dismissal have been revoked by the Vice-Chancellor on his own or on receipt of a report from the Chief Warden/ Dean of the College concerned/ Dean Student /Welfare / Registrar to the effect that the student concerned has violated the conditions of the bond or other conditions imposed upon him at the time of readmission, then such a student may apply for the review of revocation order only after the expiry of four semesters from the date of issue of revocation orders of suspended dismissal and may be readmitted on bond with such conditions as may be imposed of good behavior under the regulations and this re-admission, through review of revocation order of permanent dismissal shall invariably be subject to the same conditions as imposed earlier. In case such a student violates any conditions of the bond or other conditions imposed by the Vice- Chancellor or involve in any act of indiscipline then the student shall be permanent with no right to appeal for readmission.

(vii)The regulations shall also not apply in case a student is awarded the punishment of temporary dismissal for copying or to any student who is awarded the punishment of temporary or permanent dismissal and who after having been debarred from entering the campus is reported to be seen entering the campus without specific permission of the Vice- Chancellor. If a student indulges in any act of indiscipline after completing the graduation requirement and or after obtaining the Provisional Degree Certificate, in such cases a F.I.R. will invariably be lodged with the police and his character certificate will be issued only after the final decision.

(4) The advisor of the student concerned, hostel warden concerned may also be invited by the College Discipline Board / Discipline Committee while enquiring into a disciplinary case.

(5) A punished student may file a request for review of the decision within one month from the date of issue of the orders after which no review application shall lie and only one review application can be field.

(6) Procedure for the Removal of Conduct Probation

A. The Dean of the College concerned may remove a student from the conduct probation on the recommendation of the Advisor, Warden and if necessary of college discipline board in case he was not involved in acts of indiscipline more than once under the following conditions:-

(i) If the student was placed on conduct probation by the Dean/Chief Warden on the recommendation of the College Discipline Board.

(ii) If the student was placed on conduct probation by the Vice- Chancellor and has completed the graduation requirements.

B. The Vice- Chancellor may remove a student from the conduct probation on the recommendation of the Discipline Committee under the following situations:

(i) If the student was placed on conduct probation by the Vice- Chancellor on the recommendation of the Discipline Committee;

(ii) If the student was placed on conduct probation either by the Dean / Chief Warden or by the Vice- Chancellor and was involved in acts of indiscipline more than once.

C. The procedure for removal of Conduct Probation for the students temporarily dismissed or permanently dismissed but readmitted under regulation 31 (3) shall be as under:-

(i) The Conduct Probation of students, temporarily dismissed once and for one semester may be removed by the Vice- Chancellor on the recommendations of the Discipline Committee.

(ii) The conduct probation of students permanently dismissed but readmitted under regulation 31 (3) may be removed by the Academic Council on the recommendation of the Committee constituted by the Council.

(iii) The Conduct Probation of students, temporarily dismissed more than once for two semesters or more may be removed by the Academic Council on the recommendation of the Discipline Committee.

NOTE: The constitution of Academic Council's Sub- Committee for removal of Conduct Probation and issuance of documents with good conduct or otherwise in case of permanently dismissed students will be as per the following procedure:

"If a student who was awarded the punishment of permanent dismissal but was subsequently allowed relief under regulation 31 (3), wishes that he shall be given a clean record of conduct, he may apply for the same after the completion of his degree. On receipt of such an application a committee would be constituted by the Academic Council on whose recommendation it would be decided as to whether or not the fact of permanent dismissal would be recorded on the outgoing transcript and if a satisfactory character certificate should be issued to him. This committee would be constituted in a meeting of the Academic Council and shall consist of 7 members of the Academic Council to be selected randomly either with the help of a computer or through table of random members. This committee may follow such procedure as it may deem necessary and may also consider the reports of the Advisor, Warden, Head of the Department and Dean of the College concerned or of any other person whose views the committee may deem relevant."

32. Students awarded the punishment of 'dismissal' may at the discretion of the Vice- Chancellor, be readmitted after the expiry of the period of punishment on the recommendation of the Dean concerned and the Discipline Committee on such conditions as may be prescribed in this behalf. No student will, however, be entitled to readmission as a matter of right.

33. 1) Temporary Dismissal

The fact of punishment of temporary dismissal or suspended dismissal during the period of temporary dismissal shall be recorded on the permanent record card and shall be mentioned in the outgoing transcript until the punishment has been revoked and the student is re-admitted. It shall, however, not be mentioned in the outgoing transcript after readmission of the student. However, if any prospective employer or institution etc. request for details about the student concerned, the punishment awarded to the student shall normally be intimated to them only after obtaining the orders of the Vice- Chancellor on the desirability or otherwise of giving such information to the party concerned.

2) Permanent Dismissal

The fact of punishment of permanent dismissal or suspended dismissal shall be recorded in the permanent record card and shall be mentioned in the outgoing transcript, unless the sub- committee to be constituted as per the procedure laid down under regulations 28(6) (c), recommended otherwise.

34. Issue of Character Certificate to various categories of students

(1) Character Certificate with good conduct as well as the prescribed two- points Character Certificate shall be issued to all students who are not punished at any time during the period of their studentship as well as to those who are awarded the punishment of (1) Reprimand of record/ warning, (2) Monetary fine and (3) Conduct Probation, provided the Conduct probation has been removed at the time of issuing the certificate.

(2) The two- point Character Certificate shall not be issued to the following categories of students:

(i) All students awarded the punishment of permanent dismissal, rustication or temporary dismissal for any length of time, even after their re-admission.

(ii) All students who were found guilty of using unfair means in any examination at any time during their stay in the University.

(iii) Character Certificate with satisfactory conduct may be issued to the students who are awarded the punishment of temporary dismissal only once during period of their stay in the University if the same is recommended by the Discipline Committee and approved by the Academic council.

(3) Character Certificate with satisfactory conduct to the students who have been awarded (1) punishment of temporary dismissal more than once or (2) punishment of permanent dismissal / rustication may be issued if they are allowed readmission under regulation 31 (3) only after the recommendation of the Committee constituted by the Academic Council as defined in the note for regulation under 31 (6) (c) of the regulations on Admission, Enrolment and continuance of Students.

The Sub-Committee of the Academic Council may collect information from various sources like Advisors, Deans concerned, Wardens, Security Officer and the Discipline Committee before making their recommendations about the issue of Character Certificate to such students.

35. Refusal of Admission to students against whom cases in the Courts were pending

No student who is involved as an accused in a case involving a cognizable offence or who has been convicted of such an offence or of an offence involving moral turpitude shall be admitted to any degree programme in the University.

IV. Regulation on Conduct of Examinations

1. Date of Enforcement

These regulations shall come into force with effect from the date of this resolution i.e. 29.8.2005.

2. Extent of Application

These regulations shall apply to all the students already on the rolls of the University as well as those seeking admission to the University or admitted to the University hereafter.

3. Interpretation

Subject to such advice as may be given by the Chancellor, the decision of the Vice- Chancellor about the interpretation of any Regulation (s) shall be final and no suit, application, petition, revision or appeal shall lie in a court of law or any other authority outside the University in respect of interpretation of these Regulations.

4. Types of Examinations

The examinations shall be of the following types

(a) Master & Ph.D. Programme

i Pre- final examinations.

a Short quizzes (unannounced)

b Hourly examinations

c Practical / lab /viva

ii Semester final examinations

iii Other examinations:

a Preliminary examinations b

Proficiency examinations

c Make- up examinations

d Any other types of examinations as may be prescribed by the Academic Council from time to time.

(b) Under Graduate Programme B.Sc. (Hons.) Agriculture and B.Tech. (Biotechnology)

Examinations	Course with practical	Course without practical
Midterm	20%	20%
Practical	30%	—
Final examination	50%	80%

5. There shall be at least two pre- final examinations in each course. The first pre- final examination shall be held in the 6th -7th week and the second in the 12th - 13th week of the Semester.

"As pre- final make - up examination shall be conducted in the 15th week of the Semester, which shall be called make-up for any one of the missed pre-final examinations. No make-up of this examination shall be granted under any circumstances. This pre-final make-up examination shall include the course covered upto the 14th week of the semester".

The distribution of marks for course of normal nature having lectures, laboratory and assignment, would be 40% for final, 40- 50% for pre- final and 10-20% for final lab. examination, viva-voce, assignment etc.

For courses consisting of only lectures, the distribution of marks would be 40% for final and 50% for pre-finals. However, if the instructor decides to conduct more than two pre- final examinations, the distribution of marks would be 40% for final and 60% pre- finals.

No pre- final examination shall carry weightage of more than 25%.

There shall be no written semester final examination in purely laboratory type course and courses of special type like P.C.P., Project, Seminar, Special Problem, Clinical Practice, NSS and the like. For such courses distribution of marks will be decided by the Instructor with the approval of HOD. No change in the distribution of marks would be permissible without prior approval of the HOD.

6. Final Lab/ Practical/ Viva-voce Examinations

All final practical & Viva-voce examinations shall be finished one week before the commencement of Semester final examinations. Practical and viva-voce shall carry 10-20%of marks except for courses of purely practical nature. The make-up of Final Lab./Practical/ Viva-Voce shall be completed before the start of semester final examinations subject to regulations on make-up for final examinations.

7. Semester Final Examinations (PG and Ph.D.)

The semester final examination shall be held on the dates notified by the Registrar and shall carry 40% marks except in case of courses of purely theoretical nature where the weightage of marks of final examination may go up to 50%

a. The educational tours may be organized in such a way that it should not disturb the academic programme, i.e. advisement, registration and examination. To utilities the full tour money, students can be paid halting allowance if the funds permit

The Deans / Directors should fix such tours in Semester break or during the summer vacation.

b. The Academic programme must always get preference over any programme including extra-curricular activities, tours etc

Make -Up of Mid-term examination (B.Sc. (Hons.) Agriculture and B.Tech. (Biotechnology))

If a candidate absents in mid -term examination of final theory Absent ('A') is to be accorded.

- Mid- term Examination will be conducted, if:

(i) Any student claiming to be sick and indisposed or the loss of his close relative (father, mother, grand parents, siblings) may be permitted after the production a medical certificate from Modi Rubber Limited or referred by Modi Hospital & University authorized Doctor or Govt. Hospital. The application should come through Advisor, Warden & HOD to Dean. If Dean is satisfied with the genuine reason, he will permit them.

(ii) Conducting Re-examination for such students is on payment of fee of Rs. 500/- per course subject to a maximum or Rs. 1000/- in a semester for two courses.

(iii) Under special circumstances V.C. shall be empowered to take decision and approval for make-up examination of midterm.

(iv) The mid-term examination shall be conducted before the last date of instruction of that semester only.

(B) Final Practical Examination

They have to pay examination fees Rs. 1000/- per course, maximum two courses will be allowed at a time.

(C) Make- Up for Final Examination

No make-up is permissible. A student has to offer the course in scheduled course of semester if he/she has CGPA less 5.00. if he/she has CGPA more than 5.00, he may be permitted for examination in scheduled course without attending regular class. In this case mid -term result will remain same.

(D) Maximum Credit Load

The following shall be the maximum credit load to follow by an advisor:

- Under -Graduate: 23 credits is maximum under 4_{th} Deans Committee in a maximum under semester (excluding credits for N.S.S. Work Programme, N.C.C., Games & Sports, New Educational/ Liberal, Educational Courses). However 26 credits hrs will be allowed to those students who is failed and re-registered for regular classes and for those students who are re-registered without classed. Maximum of two courses per semester will be allowed in which he was failed or absent on genuine and acceptable grounds. These courses will be offered in next academic session.

(E) Scrutiny

The fees will be charged Rs. 1000/- per paper. The scrutiny will be done in the office of the Registrar internally with a committee i.e. concern HOD, Instructor and Dean concerned.

In case there is complaint of more than 50% of the concerned students, only then the rechecking of answer book will be done by other external examiner.

(F) Proficiency

There is no provision of proficiency examination in external examination system.

Guidelines for preparation of Question paper for semester Final Examinations/Semester Final Make-up Examinations

In order to strengthening the existing system of examination, the Instructor(s) concerned and one more faculty member of the department will set the paper containing questions two times more than the number of questions to be attempted and should cover the entire syllabus of the course(s). The paper so prepared will be handed over to the HOD concerned in a sealed cover 2-3 days prior to date of examination. The HOD and one more senior faculty member of the department will moderate the question paper and ensure that the entire course contents are covered and get the question paper finalized and hand over to the Instructor concerned for conduct of examination. After the examination is over, the evaluation of the answer-books will be done by the other faculty member of the department. The marks given shall be handed over to the Instructor concerned who shall thereafter submit the grades. However, in the department(s) where there are only 2-3 faculty members available and the course(s) is of highly specialized in nature, the Instructor concerned will set the question paper containing questions three times more than the questions to be attempted and covering the entire course contents and hand over to the HOD 2-3 days prior to date of examination. The HOD after doing moderation will get the question paper finalized and hand over it to the Instructor concerned for conducting the examination. In such cases the Instructor teaching the course(s) will also evaluate the answer-books and submit the grades. In case where HOD is teaching the course(s), the other senior faculty member of the department will moderate the question papers. At the time of showing the answer books to the students, both the Instructor teaching the course and the person evaluated the answer books shall be present.

8. Adjustment of Examinations dates

In the event of any break- down or dislocation of the normally academic functioning of the University for whatever reasons, the dates specified as above for pre-final and other examination shall be suitably adjusted by the Dean of the College concerned.

9. Preparation of Examination Schedule

The final examination schedule shall be prepared by the Registrar and notified to the students and staff ten days before the commencement of the examinations.

The final examinations once fixed shall not be postponed and nobody should issue orders for such postponement and that no major activity would be scheduled during the examination period.

10. Seating Arrangement

The examination shall be conducted in all the colleges for which arrangement shall be made by the Registrar. As far as possible the students of a college shall be allotted examination halls in the same college.

The student shall be seated strictly according to seating plan. Invigilators and the Exam. Superintendents shall enforce this and the Invigilators Incharge shall be supplied with a copy of the seating arrangement chart in each room.

Refusal of a student to occupy the seat allotted to him in the seating plan shall be construed as an attempt to use of unfair means.

11. Supply of Examination Material

Examination material, such as answer- books, twine, drawing papers, log tables, graph paper etc. will be supplied by the Registrar.

12. Duration of Examinations

Courses having less than 3 credits shall have the final examination of at least, one hour and those having 3 credits or more, 2 hours or more.

13. Appearing the Final Examination

Candidates coming late by more than 30 minutes in any examination shall not be allowed to appear in that examination and no examinee shall be allowed to go out of the examination hall for the first 30 minutes.

14. Examination & Evaluation for B.V.Sc. and A.H. Progamme

i. It shall be the responsibility of the teacher(s)/instructor(s) to ensure that the topics to be covered in the theory and practical in each course is recorded through a lecture/practical schedule and distributed to the students at the beginning of each course. The Head of the Department/Dean shall ensure that the schedule is adhered to and alternate arrangements are made to cover up the loss in case of any eventualities of unavoidable reasons that lead to non-adherence of the above schedule.

ii. Work distribution chart of each teacher should be available with Dean's office for inspection of the Council. In each subject Professors and senior teachers must be actively involved in teaching, especially in conducting practical for degree course. The principle behind each practical, the objective of each practical level of competence expected from the students etc. should be clearly explained to them by senior teachers.

iii. The examination shall be to assess whether the student has been able to achieve a level of competence. For academic assessment, evaluation of practical aspects of the curriculum should receive much greater emphasis leading to separate examinations and requiring the student to secure a minimum of 50% marks, in theory as well as in practical, in each such examination.

iv. The weightage of Theory and Practical shall be in the ratio of 60:40 respectively in both internal and annual examinations.

v. The distribution of marks for objective and subjective questions in each course/paper shall be in the ratio of 60:40 respectively both in internal and annual examinations.

vi. The schedule of examination during B.V.Sc. & A.H. course shall consist of internal (semester) and external (annual) examinations: internal examination (theory and practical separately) for each course at the end of each semester; and external examinations (theory and practical separately) at the end of each academic year comprising of all the courses of a particular subject taught during that year.

vii. The internal assessment (Semester) shall be conducted in 50% of total marks in theory and practical separately and shall invariably be conducted on completion of the course as per lecture/practical schedule explained under sub-regulation (1) and shall be held without any preparatory leave. It shall be the responsibility of the University/College authorities to conduct these examinations without loss of instructional days of a Semester Internal Practical examination shall be conducted by a board of examiners consisting of Instructor(s) of the course and a representative of the head of the department. Evaluation of answer books shall be done by the concerned instructor(s). Marks obtained in theory and practical in the internal examinations would be recorded separately and submitted to the Dean/ Principal at the end of the particular semester.

viii. A composite Annual examination for a group of courses/ a course (if only a single course is involved in the paper) shall be conducted for the rest 50% marks in theory and practical separately as per schedule of examination. The annual theory examination(s) shall be conducted by inviting the question paper from appointed paper setter(s). A paper setter shall be provided the courses and syllabus prescribed by the VCI including detailed course outline. A paper setter shall be requested to prepare two sets of question papers, each for main examination and compartment examination (if any). Where necessary, more than one paper setter/examiner can be appointed. The practical examinations shall be conducted by the Board of Examiners appointed by the university and shall consist of two or more internal (representing the subjects being examined) and one external examiner. Evaluation of answer books of annual examinations shall be done by the external examiner (3).

ix. Annual examinations shall be held on such dates, time and places as the university may determine and must be completed so that the results are announced before the onset of the ensuing semester.

x. The schedule of examinations (internal/external) shall be adhered to strictly. No re-examination shall be allowed in events of students' strike, boycott, walkouts, medical grounds or what-so-ever may be the reason.

xi. There shall be no supplementary (make up) examinations during the academic session. However, a candidate may be allowed to provisionally sit in the next class provided he/she has failed only in two papers. He/She cannot be promoted to next B.V.Sc. & A.H. class unless he/she has cleared the failed paper(s).

xii. The records of examination shall be made available to the Council, as and when required and the records of assessment may be retained till six months after the conduct of the Annual examination.

Explanation 1: For the first B.V.Sc. & A.H. examination, the subject of Veterinary Anatomy has one course in the first semester (VAN-111, 1+2=3) and one course in the second semester (VAN-121, 2+2=4). Internal evaluations for VAN-111 shall be conducted at the end of the 1_{st} semester and for VAN-121 the internal evaluation shall be conducted at the end of the 2_{nd} semester. The marks obtained in the examinations shall be recorded separately for theory and practical and sent to the concerned Registrar/Controller of Examinations/ Dean. After the completion of courses in the second semester, a composite annual examination (for Veterinary Anatomy Paper-I) shall be conducted for the theory and practical of VAN-111 and VAN-121 giving due weightage to each course. The marks obtained in the theory and practical of internal and annual examination shall be added and the grade point calculated and recorded against Anatomy Paper-I. Similar pattern shall be followed for all other subjects of B.V.Sc. & A.H. Degree course.

Explanation 2: The teachers while evaluating practical, shall take into account the followings:-

a. A record or log book maintained by each student as practical records.

b. Observation and recording of the skill with which each student executes the practical.

c. Assessment of the comprehensive skill and knowledge of each student through an oral examination (viva-voce).

d. Atleast ten percent marks may be awarded to day to day records including record of case sheets etc.

NB: Practical manuals be prepard by the respective departments of each of the courses.

15. Teachers, Examiners, Paper Setters for B.V.Sc. & A.H. Programme

i. The persons with basic veterinary qualification (B.V. Sc./B.V. Sc. & A.H.) shall be recruited as teaching faculty in the Veterinary Colleges.

ii. Teachers in the disciplines of biochemistry, Biotechnology, Biostatistics and Computer Application, Entrepreneurship, Extension and Economics may be recruited from the persons having qualifications other than the basic veterinary qualification only in case of non-availability of candidates with basic veterinary qualifications. Where candidates with basic veterinary qualification are available, they should be given priority in selection/appointment over the candidates without basic veterinary qualification. Appointment of persons without basic veterinary qualification as teachers in the aforesaid disciplines shall require prior approval of the Veterinary Council of India.

iii. The post of Head of Department of in a Veterinary College shall be filled up only with a teacher with basic veterinary qualification.

iv. A person possessing qualification included in the first or Second Schedule to the Act shall be generally appointed as examiner or paper setter for the conduct of a professional examination for the B.V. Sc. & A.H. course. However, a person without the qualifications mentioned above may also be appointed examiner in his/her concerned subject provided he/she possesses the doctorate degree in that subject and a minimum three years teaching experience.

Provided that-

(a) no such person shall be appointed as an external examiner unless he/she has at least three year's teaching experience.

(b) no person below the rank of Lecturer/Assistant Professor or equivalent shall be appointed as internal examiner.

(c) no person shall be appointed as an external examiner in any para clinical subject unless he/she possesses a recognized veterinary qualification and holds a postgraduate degree and teaching experience in the subject concerned.

(d) Persons working in government/Semi Government or similar organization may also be considered for appointment as external examiners provided they possess qualification and experience as laid down above.

(e) Paper setter(s) cannot be appointed as practical examiner(s) in the same paper.

(f) Local person(s) shall normally not be appointed as paper setter(s)/external examiner(s). However, under exceptional circumstances or unavoidable exigencies arising at the time of examination (like not arrival

of appointed examiner/non-receipt of question paper from paper setter etc.) the university may appointed any qualified person for the purpose to avoid postponement/cancellation of annual board examination.

v. Oral and practical examination shall be conducted by the respective internal and external examiners with mutual co-operation. They shall allot marks to the candidate approach at the examination according to their performance and the marks sheet so prepared shall be signed by both the examiners.

vi. Every veterinary college shall provide all facilities to the internal and external examiners which are necessary for the conduct of examinations and the internal examiner shall make all preparation for holding the examinations.

vii. The external examiner shall have the right to communicate to the examining body his/her views and observations about any shortcomings or deficiencies in the facilities provided by the Veterinary College with a copy to VCI, if he/she so desires.

viii. Verification of percentage of passing/falling and deviation from the normal curve of distribution will be subject to scrutiny/enquiry by the examining body.

16. Attendance for B.V.Sc. & A.H. Programme

i. The required condition of attendance shall not be deemed to have been satisfied in respect of the course, unless the student has ordinarily attended all the scheduled theory and practical classes; however, the minimum requirement of attendance shall not be less than 75% (including attendance benefit, if any) of scheduled theory and practical classes separately on the basis of cumulative attendance of all the courses grouped for a paper for annual examination.

ii. A candidate having attendance below 75% in a paper will not be eligible to appear in the annual examination of that paper.

iii. The percentage of attendance of a student in a course/paper shall be computed on the basis of the total number of theory and practical classes scheduled between the date of commencement of instructions and date of closing of instructions irrespective of the date of registration. However, for the students who are reverted back owing to failure in the compartment examination the attendance shall be counted from the date of declaration of result of compartment examination and the date of closing of instructions.

17. Promotions and Failure in B.V.Sc. & A.H. Programme

i. Promotion or failure of a student in a professional year shall be decided only on the basis of aggregate marks of internal and annual board examinations.

ii. A student shall be promoted to next higher professional class only if he/she has passed in all the papers of his/her class by obtaining atleast 50% marks in theory and practical separately (internal and external combined).

iii. A student should secure overall grade point average (OGPA) of 5.00 out of 10.00 at the end of degree programme to be eligible to get B.V.Sc. & A.H. degree.

iv. A student may also be allowed provisional promotion to next higher class till the declaration of the result of the compartment examination(s). However, this promotion shall be subject to clearance in the compartment examination(s) of that/those paper(s) and shall be provisional. If the student fails in the compartment examination(s), he/she shall stand automatically reverted to the class from where he/she was allowed provisional promotion.

v. Failed students shall register again for the entire professional class, they failed. Such students shall have to fulfill all requirements of the class afresh.

vi. A student failing in the annual examination for three consecutive years in a professional year of B.V.Sc. & A.H. degree programme, shall be finally dropped automatically from the University on account of poor academic performance.

vii. In no case, a student shall be allowed to continue his/her B.V.Sc. & A.H. studies beyond 8 academic years (16 semesters) in a Veterinary College.

18. Compartment Examination in B.V.Sc. & A.H. Programme

i. A student failing in a maximum of two papers only may be allowed once to appear in compartment examinations for those paper(s). Compartment examination shall comprise of the external component of both the theory and practical of the failed paper(s), which shall constitute the 100% weightage for that paper(s) and the marks of internal examination shall not be considered for the evaluation of Compartment Examination.

ii. The compartment examinations shall be conducted within 20 calendar days after the date the results of the concerned professional year examination declared. The results of such compartment examination shall be declared within 5 days after the examination is conducted.

iii. In case of failure in any of the compartment paper(s), the student will be reverted back to the previous professional year and will be required to repeat all the requirements of that failed professional year.

19. Scrutiny of Answer Books and Rectification of Errors in B.V.Sc. & A.H. Programme

i. There shall be no provisions of re-evaluation of answer book(s)

ii. A student, however, may be allowed to get his/her answer book(s) scrutinized, for which, the student shall have to apply to Controller of Examination/Coordinator of Examination within three days after the declaration of result and after paying prescribed fee.

iii. The Controller/Coordinator (Examination) shall arrange the scrutiny of answer book(s) by the Moderation Committee.

iv. Scrutiny means re-totaling of the marks, and examination of unmarked question(s), if any.

v. The answer book(s) of annual examination shall not be shown to the student under any circumstances.

vi. In case, the total marks are found to be incorrect on scrutiny, the same will be corrected and the result shall be revised accordingly (even if it is towards lower side). If, however, any question is found to be unchecked by the Examiner, the answer book(s) shall be sent to the Examiner for doing the needful and the result(s) shall be revised accordingly if there occurs any change in the marks.

vii. No representation by the student(s) shall be entertained regarding the outcome of the result after scrutiny.

viii. In case a student on the basis of the result of scrutiny become eligible for the compartment examination, he/ she may apply to the concerned authority to appear in the compartment examination on the announced scheduled date. The scheduled date of the compartment examination shall under no circumstances be changed on this account.

20. Moderation (B.V.Sc. & A.H. Programme)

i. Question Paper

The examining body may appoint a single moderator or a board of moderators not exceeding three in number. The moderator(s) shall review the question papers on the day of examination after they have been distributed. Any corrections needed will be conveyed to the examinees and any discrepancy in the question paper in respect of syllabus noticed will be conveyed to the Controller/Coordinator of Examination in a written report.

ii. The Results

The Controller/Coordinator of Examination in consultation with the Dean of the College shall from Committee of three members consisting of Dean of the College as Chairman and two other teaching faculty members to moderate the results obtained at the annual board examination. This Committee shall review the results for the normal distribution of marks, the percentage of pass or failure. Any moderation suggested shall be uniformly applied to all students for that paper(s) without altering the merit of the passed candidates. Any moderation effected should not involve of enhancing of more than total of 5 marks in a professional year for a particular candidate, and in no case more than 3 marks in one paper. The provisions for Moderation of results shall not apply to Compartment Examinations. There shall be no provision for grace marks in any case.

21. Grading and Grade Point Average in B.V.Sc. & A.H. Programme

i. Grade Point (GP) in a course will be the total marks obtained by a student out of 100 divided by 10.

ii. Credit Point (CP) in a course will be GP multiplied by the credit hours. iii. Total

Credit Points = Sum of the credit points secured.

iv. The Credit Points earned will be zero if the GP in a paper is less than 5.00

v. Grade Point Average (GPA) = Sum of the Total credit Points earned divided by the sum of Credit Hours. vi.

The corresponding ranking of OGPA with respect to traditional scoring system of Division Ranking shall be as follws:

8.000 and above	-	First Division with Distinction
7.000-7.999	-	First Division
6.000-6.999	-	Second Division
5.000-5.999	-	Pass

22. Exemptions

Exemption in the particular course shall be granted to the student if he has already passed an equivalent examination of the graduate or postgraduate standard. Such cases shall be examined by the Instructor(s) concerned who would recommend the case through the HOD to the Dean of the College in which the course is being taught. The student shall be exempted from such course (s) by the Dean concerned. He shall be given credit (s) without awarding the grade.

23. Make up Examinations (PG and Ph.D. Programmes)

a. Pre- final Examinations Out of Pre- Exams. student will be allowed make -up for any one of the Exams. missed by him by the Instructor himself. Under no circumstance a make-up for more than one examinations would be permissible irrespective of the reasons. The make -up examination in lieu of the missed pre- final examination shall be administered in the 15_{th} week of the Semester. No make-up of these examinations shall under any circumstances be permissible

b. Final Lab Practical / Viva-voce Examinations Make-up of the final lab practical / viva voce examinations missed by a student shall be completed before the announcement of the Semester final examinations. This make- up will be allowed by the Dean of the college as per regulation for Semester final make- up No make-up of the final lab/ Viva-voce examinations will be admissible after the commencement of the Semester final Examinations

c. Final Examinations Normally no make-up shall be permissible in lieu of the missed final examination(s). However, under special circumstances, make-up examination may be permitted at the discretion of the Dean of the College concerned subject to such directions as may be issued by the Vice- Chancellor from to time on any one or more grounds such as:

i. Hospitalization of the student for a period of 72 hours in Govt. Hospital or as per reference of the Medical officer Incharge of the University.

No exemption may be allowed for the diseases for which no clinical examination is possible. In other words, headache, abdomen pain, giddiness etc. shall not be regarded as sufficient justification for make-up examination

ii. Death of parent(s)

iii. Attending interview (for final year students, i.e. if his degree is to be completed within next semester only)

iv. Attendance in court case(s)

v. Participation in national level competitions, Debates, Sports & Games etc. organized by various central agencies.

Note Question Paper for Semester Final Make-up Examination shall be prepared in accordance with the provisions made under 7(c) above.

Procedure for obtaining the make-up examination (PG and Ph.D. Programmes)

1. If a student failed to appear at any semester final examination for reasons beyond his control, he must file an application on the very day on which the examination is missed.
2. The application for make-up examination must be supported with medical certificate and medical examination report and should be routed through the hostel Warden/Advisor /Dean concerned.
3. No application for make-up examination shall be considered if received after 72 hours from the expiry of the last date of the semester final examination.
4. The application for exemption should be submitted on the date of commencement of sickness itself. The student should be examined by the Advisor/Warden and Chief Warden, besides the Medical Officer.
5. Exemption should be granted only if the Chief Warden certifies that he has himself seen the student and found him in a state of sickness to justify the exemption and that the student has been admitted to the hospital.
6. The make-up examinations would be held immediately after regular examination as per schedule, notified by the Dean of the college concerned.

24. Restrictions for Student on Academic Probation

Students on Academic Probation shall not be allowed to represent the University in functions held outside the campus.

25. Instructions for Paper Setter Instructors / Invigilators

i. Normally no staff member shall be assigned to teach a course, conduct of examination, evaluation, invigilation (in the particular exam.) etc. where his/her immediate blood relation may be a student.

ii. All the paper setters shall reach the college in which their examination has been fixed along with the question papers, to distribute the question paper among the students atleast half-an-hour before the commencement of the exam. concerned. There shall be sufficient extra papers for each room to meet any emergency.

iii. In case any instructor goes on leave during the final examinations or pre- final examinations or make-up examinations or lab final examinations, he should hand over the question papers to the Dean/Director/ HOD concerned, who will be responsible to make necessary arrangements to hold these examinations on scheduled dates and time.

iv. In each college, one room shall be earmarked as Examination Office where the examination material shall be available.

v. All paper setters shall prepare in advance separate packets of question papers for each room of exam. The number of papers shall be clearly marked on each packet. The student appearing for a particular exam. shall be mentioned in the exam. schedule.

vi. All invigilators shall come to the examination office at least half an hour before the commencement of the examination. The examination halls shall be opened 15 minutes before the start of examination in the presence of the Instructor I/C.

vii. All the invigilators will check in each room the identity cards of all the students in their exams. rooms to verify their identity.

viii. A blank answer book marked 'A' shall be provided to each student in the first instance. Students demanding additional answer book shall be provided with blank answer book marked 'B'.

ix. Invigilator Incharge shall take attendance of the students 20 minutes after the commencement of each exam. on the attendance sheet to be provided and in the manner required by the Registrar.

x. After taking attendance, the invigilators shall check and see that the balance of question papers left over tallies with the attendance.

xi. At the end of the examination, answer books shall be collected from all the students by the invigilators. The Invigilator Incharge shall deposit blank answer books etc. in the examination office/ immediately after the examination is over and deliver filled up answer books to the Instructor concerned directly.

xii. The invigilator shall allow only those students in the examination hall as are mentioned in the room chart of the examination hall. In case of omission of the name of any student form the chart, the Invigilator Incharge may exercise his own discretion and notify the fact to the Registrar immediately.

xiii. Invigilator finding any student resorting to unfair means in the examination or creating disturbance or acting in any manner so as to cause any inconvenience to other students in the examination hall, shall report the matter at once to the Registrar and the Dean concerned for suitable action.

26. Examination Superintendent

The Deans of College or their nominees shall act as Superintendent of Examination for the respective Colleges and shall be responsible for the proper conduct of supervision of the examinations.

27. Flying Squad

To make surprise inspections at various examination centers during the semester final examination a flying squad consisting of 2 to 4 Professors belonging to other faculties may be constituted by the Registrar. The name of Professor will be obtained from the Dean of the College. The flying Squad will be expected to make inspection of observance of regulations of Conduct examinations and will submit report to the Vice-Chancellor with copies to Dean of the College concerned and Registrar immediately after the final exams are over.

28. Cyclostyling and Duplicating of Question Papers

i. All the clerks assigned the work of cyclostyling / duplicating shall remain with the Instructors till the commencement of the examination. The teachers may, however type out their own papers, if they know typing.

ii. One room in each college shall be earmarked as Confidential Room for examination purposes and typing and duplicating work will be done in that room.

iii. Typing and duplicating work shall be taken a day before the start of each examination in the presence of the Instructor concerned in the confidential room earmarked for the purpose.

29. Preparation of Final Examinations Result

i. Each Instructor shall prepare four copies of Instructor's Result slips (Grade Reports) in the proforma prescribed by the Registrar giving the academic performance of the student in his course

ii. Each copy of the Instructor's Result slip shall be signed by the Instructor and his HOD

iii. Each Instructor shall fill the marks obtained in the various examinations in the Semester and final grade obtained by the Student in the prescribed form. In case of over writing or alteration or cutting, the Instructor shall delete the whole line and re-write the whole matter and put his signatures.

iv. The result slips shall be prepared in four copies. The Instructor, at the end of the course in a Semester, shall send two copies of the result containing the marks of various examinations during the Semester and grades of the students in his course to the Dean through HOD. The Dean shall forward one copy to the Registrar. The third copy shall be sent to the HOD and the fourth copy shall be displayed on the Notice Board for the information of students.

v. Each Instructor shall prepare the Result Slip College- wise and I.D. No. wise.

vi. The Instructor shall submit the grade slips with in 6 days from the date of examination positively.

30. Tabulation of Results

i. Tabulation of the result shall be done from the Instructor's result slip in the office of the Dean and the Registrar separately, simultaneously and independently of each other.

ii. The tabulation work shall be completed within three days from the last date of the receipt of the grade slips from the Instructors.

iii. Tabulation sheets shall be supplied by the Registrar and tabulation at both officers shall be done in accordance with the procedure and rules prescribed by the Registrar.

iv. To assist the Registrar's office in the tabulation & preparation of results, each college shall depute clerk/ typist(s) to the office of the Registrar.

v. Each tabulation sheet shall be signed by the Clerk Incharge and the officer concerned.

31. Checking of Tabulation Sheets

i. After the tabulation sheets in the officer of the Dean are ready, he shall send the same to the office of the Registrar, which shall be returned to him after the results are compared.

ii. The Deans of the College will nominate two pairs of staff members from respective college for comparing the tabulation sheets prepared in two different offices.

iii. In case any entry does not tally, the teacher deputed for this purpose shall check it from the original result slip registration card adding/withdraw form too, if necessary and recalculate the grade point average whenever found wrong. Each such correction shall be signed and separate entry shall be recorded for such mistakes by the checking officer.

32. Preparation of Grade Reports

i. After comparison of the rolls by the checking office(s) is completed, the assistants shall transcribe the grades on the individual report cards.

ii. The teachers deputed for this purpose shall further check the transcribed grade on the student report cards and put up their signatures on the individual report cards.

iii. The grade reports shall mention specifically both the name of the course and course number.

33. Accuracy of Tabulation Charts/ Sheets and Grade Reports

The tabulation clerks shall do their best to bring accuracy on preparation of tabulation charts/ sheets & grade reports. In case of more than three mistakes he shall have to explain therefore.

34. Mid Term Report

The Instructor(s) concerned of the different course shall send the mid term reports of the students whose performance is unsatisfactory through the Adviser(s) to the guardian/parent on the prescribed proforma within

ten days from the first pre-final exam. The results of the first pre-final exam shall form the basis for the purpose of this clause.

35. Student Records

All the student records maintained in the office of the Registrar shall be treated as official and final.

36. Evaluation and Grading and Significance of Grades

i. Each course offered in the University shall be given a certain number of credit hours in accordance with the amount of work which the student does in the class room, the laboratory and outside study.

ii. Each student shall be examined in every course from time to time throughout the semester. While examining the students, the Instructor shall mark individual questions in numerical (no rounding off) and then convert the total number of marks obtained into points.

The 'Points' earned in a course will be total marks obtained by a student out of 100, divided by 10. The Points secured in course(s) will be 'Points in course(s) X Credit(s) of the course(s)'. The significance of points for undergraduate students shall be as follows

Percentage of Marks	Points
100	10
90-below 100	9-below 10
80- below 90	8-below 9 7-
70-below 80 60-	below 8 6-
below 70	below 7 5-
50-below 60 (Barely Pass)	below 6
Below 50 (Fail)	Below 5
e.g., 80.76	8.076
57.25	5.725
43.80	4.380
72.50 (But Shortage of Attendance)	Fail (WH)

iii. After the marks obtained by a student at various examination held in a course during a semester including semester final examinations are added up and result awarded.

iv. Divisions shall also be mentioned on the complete transcripts, and the provisional degree certificates of the graduates of the University along with the overall grade point average on the basis of the following equivalence:

37. Calculation of GPA/CGPA/OGPA

i. For calculation of Grade Point Average (GPA), Cumulative Grade Point Average (CGPA) and Overall Grade Point Average (OGPA), the following shall be the formula/procedure

GPA = Total Points Secured/Total Credits (For I Semester only)

CGPA = Σ Total Points Secured / Σ Course Credits

OGPA = Σ Total Points earned (after excluding failure points) / Σ Course Credits*

ii. The following shall be the formula for conversion of the overall grade point average into aggregate percentage of marks

Formula Percentage of Marks = OGPA x 100/10

e.g. if the OGPA is 6.000 then the percentage of marks would be 6.000x100/10 = 60%

iii. While converting the credits of the course from Semester to Trimester system anyone of the following alternatives may be followed without any disadvantage to the students

a. OGPA shall be calculated without any conversion i.e. Trimester credits and points and Semester credits & Point shall be taken as such for calculating the OGPA

OR

b. The Semester credits may be converted into Trimester credits and OGPA may be worked out

OR

c. Trimester credits may be converted into Semester credits

iv. For purposes of Academic Probation, Dropping, readmission only CGPA will be taken into account.

Minimum Credit to be completed in a year

Each undergraduate student must complete a minimum of 24 credits during a year consisting of two semesters.

38. Uniformity of Standards for Examinations

i. When a course is being taught by more than one Instructor the common course work, evaluation, grading & final marking shall be on a common standard for all the examinations. They shall mutually consult each other and the HOD and the Dean in this regard.

ii. When more than one Instructor(s) are teaching same subject to the same class in various groups, they shall maintain the uniformity of standards for the same class and for the same course examined at the same time through a common examination conducted by all the Instructors together and grades given on the basis of consensus. If the Instructors are unable to reach the consensus, they shall give marks separately according to their own judgment. The grades shall be based on the average of the marking by all the Instructors.

iii. a If a HOD is satisfied or has reasons to believe that marking / grading in a particular course has been abnormal, he shall submit a detailed report to the Dean of the College concerned recommending re-evaluation or re- assessment of the answer books giving full details of the reasons for his belief that the marking/ grading has been abnormal.

b On receiving such a report, the Dean, after such an enquiry or checking as he may deem proper, pass necessary orders on the report.

c In case the Dean is satisfied that there is not a prima facie case and there has been no abnormality in marking / grading of the answer books, he may communicate the same to the HOD and submit a report accordingly to the Vice-Chancellor.

d In case where the Dean is satisfied that there is a Prime facie case he shall appoint a committee for re-assessment and re-examination of the answer- books with the approval of the Vice-Chancellor. The committee shall consist of 3 to 5 member, the majority of whom shall be of the same specialization in which the answer books are to be re- examined. The committee shall submit its report within a week from the date of receiving such a reference. Among other things, the committee shall specifically report whether the grading / marking has been uniform or whether there has been any abnormality in marking / grading from student to student and also whether in the opinion of the committee the abnormal variation has been because of negligence or of any malafide intentions.

e If as a result or re-evaluation/ re-exam. of the answer books it is found that the marks awarded by the Instructor are not significantly different, there should be no change in the marks / grades.

f In case, however, it is revealed that the variation in marking / grading as reported by the committee and as done by the Instructor is significant, the marks awarded by the committee shall be treated as final. Consequent change(s) in grades as a result of re-marking of the answer books shall be affected after the approval of the Vice- Chancellor.

g All re-assessment or re-evaluation that may be necessary shall be completed within two weeks of the date of registration in the following semester, except in case of final semester students who are to complete their degree in a particular semester when it should be completed within a week from the date of registration in the following semester after which all such case shall be treated as closed and no re-evaluation shall be done under any circumstances.

39. Scrutiny

i. a If any student desires scrutiny in any course, he shall be permitted to do so with scrutiny fee of Rs. 100.00 per paper for external and internal examination.

b He shall have to file an application on the prescribed form which can be obtained from the office of the Registrar.

c After having the approval of the Registrar, he will present the form to the Instructor concerned.

ii. Scrutiny means checking of marks, examination of question(s) left unmarked and reassessment of the question(s) already marked.

iii. Answer-books of the semester final examinations shall be shown by the Instructor concerned to the students on the day following registration in the following semester.

iv. Application for scrutiny of results shall be entertained upto seven days after showing the semester final examination answer book to students, after which no such application shall be entertained that is normally after eight days of the start of the semester.

v. The result of scrutiny shall be intimated to the Registrar as soon as possible, but in no case later than two weeks from the date of registration.

40. Change of Grades as a Result of Scrutiny

After the grade has revised as a result of scrutiny the Instructor will send the grade, with reasons under which grade has been revised, through his HOD to the Dean, who will examine and forward the same to the office of the Registrar. All such grade revised as a result of scrutiny will be forwarded to the Vice-Chancellor after the last date of scrutiny. Necessary correction in the students' report card would be made after the approval of the Vice-Chancellor is received.

41. Retention of the Examination Answer Books

i. Instructors must retain the answer books with them till at least the last date for revision of the grades was over and show the answer book to the students to understand their mistakes after the commencement of the next semester.

ii. The Instructors shall announce the date, time and place for showing the semester final examination answer-books to the students, after reopening of the University in the following semester in the last lecture of the class. Any change in the date so fixed shall be notified to the students immediately after reopening of the University in the following semester.

iii. After the last date for revision of the grades was over and the answer books had been shown to the students, the Instructor may pass on the answer-books to the HOD concerned for disposal.

iv. Marks obtained by students in pre- final and semester final examinations should be shown to students, explaining the mistakes committed by them and the reasons for deducting marks. In the case of Semester final exams, the Instructors shall retain the answer- books with them till the commencement of the next semester.

42. Concession to Student on Joining Armed Forces

In a given semester, if a student has pursued the studies for not less than 14 weeks, he shall, on his readmission be given a proficiency examination for which the grade shall be either 'pass' or 'fail'. No letter grade shall be awarded.

If a student leaves the University for joining the Armed Forces, before complete at least 14 weeks of study, he shall have to repeat a course on his readmission to the University. However, he shall be allowed to drop the course without prejudices.

43. Use of unfair Means

i. The terms 'use of unfair means in the examination' or 'attempt to use unfair means in the examination' shall denote the items prescribed by the Academic Council, through its resolutions, from time to time. The following items are included in the category:

a. Possession of any books, notes, chits or such other material and also any note(s) or signs written on any part of the body, furniture or any other material pertaining to the subject- matter or the examination in the examination hall during the exam. hours

b. Talking, whispering or signaling in any form in the examination hall or outside the examination hall during the examination hours

c. Copying or allowing to copy

d. Any other activity, which may give undue advantage in the examination to any student

e Any attempt to use any other means which in the opinion of the Vice- Chancellor may be construed to be unfair

ii. Every student shall be required to bring his own examination material, such as set squares, scales and the like, himself, as he shall not be permitted to borrow any of these material from fellow student in the examination hall.

iii. If any student is found to have used or attempted to use 'Unfair means' in any examination, his answer-book shall be seized by the Invigilator Incharge forthwith. The student may, however, be permitted to answer the remaining part of the question paper but on a separate answer book.

iv. The Invigilator Incharge shall submit a detailed report along with the answer books of the student and other related material if any, to the examination superintendent (Dean of the College) concerned immediately after exam. is over, with a copy to the Registrar & the Dean of the college concerned.

v. A written statement of the student, found to use or attempting to use unfair means in the examination hall will be obtained by the Invigilator Incharge and be forwarded with his report along with any other materials found with the student which should be signed by the student concerned in token of the same having been recovered from his possession.

vi. In case the student refuses to give a statement, he shall not be forced to do so but the fact of his refusal recorded by the Invigilator Incharge in his report.

vii. The Examination Superintendent shall forward the report of the Invigilator Incharge to the Student Discipline Committee for detailed investigation, which shall send its report to the Vice-Chancellor with specific recommendations within a week from the date of report.

viii. Student found using or attempting to use unfair means or copying during a pre- final examination shall be debarred from that Semester.

ix. Student found using or attempting to use unfair-means or copying during a Semester Final Examination shall be debarred from the current and the next Semester.

x. Debarring a student would be treated as having been dropped from the University.

44. Medium of Examination

The medium of examination shall be the same as prescribed by the Academic Council as the medium of instruction.

45. Medium of Instruction

i. Hindi/English shall be the medium of Instruction for B.Sc. Ag. Programme.

ii. Instruction shall also be imparted in English in the above mentioned degree programmes for the facility of foreign students and the students whose mother tongue is other than Hindi and who do not know Hindi provided sufficient number of students are available to comprise one section.

iii. The medium of instruction for B. Tech. (Biotech.) and B.V.Sc. & AH/ Master's / Ph.D. programme should continue to be English until such time as suitable text books become available.

Allotment of Medium of Instruction

iv. The medium of instruction shall be allotted on the basis of performance of students in entrance examination in order of merit and their choice by the Dean of the college. Foreign students and students whose mother tongue is other than Hindi may be allowed English medium provisionally.

v. The student who fail to get English medium in the beginning of the first Semester may be permitted to change the medium of instruction from Hindi to English if they secure a grade point average of 7.500 or above at the end of first semester. Such change shall, however, be permitted in order of merit according to the G.P.A. and also subject to the availability of seats in English medium section(s).

46. Proficiency Examination in Hindi (For undergraduate students)

i. All foreign students shall be exempted from the Hindi course. However, foreign students desirous of learning Hindi, with a view to be better conversant with Indian culture shall be allowed to offer the Hindi course(s), and in case they pass course(s), a mention of the same shall be made in their transcripts.

ii. All undergraduate students who have not passed their High School or equivalent examination with Hindi and who are required to offer Hindi course(s) shall be divided by the instructor concerned in the following two categories on the basis of proficiency examination (oral or written) to be conducted by the Department of Social Sciences & Humanities

a. Those who are totally unacquainted with Hindi as judged on the basis of proficiency exam.

b. Those who have some acquaintance with the rudiments of Hindi learning, as judged on the basis of proficiency examination.

The student in the first category shall be required to study Hindi remedials and the students in the second category shall be required to study only one Hindi course.

47. UNDER GRADUATE PROGRAMME (B.Sc. (Hons.) Agriculture/B.Tech. (Biotechnology))

i. Program Duration

Minimum: 8 semesters (4 academic years)

Maximum: 14 semesters (7 academic years)

ii. Reservation of seats

Reservation of seats shall be governed by the rules of State government. The Committee recommends 25% ICAR seats to be filled through ICAR entrance examination.

iii. Semester Duration

The minimum duration of 110 working days, consisting of 95 instructional days and 15 examination days.

iv. Credit Definition

One credit is defined as one-hour lecture/2 hours lab/3 hours field work per week.

v. Course Curriculum and minimum credits requirement

The ICAR Model Course Curriculum and Syllabus should be followed with 30 percent variation to meet regional requirements if felt necessary by the Academic Council of the AU.

The minimum credit requirement for the graduate degree should be 160 credits excluding non-credit courses for language/NSS.

V. Regulations on the Award of Post- Graduate Degrees

1. Advisor

Every student on admission to the college of Post-Graduate Studies shall be assigned to an advisor. An Advisor must be specialist in the field of studies of the student and shall be:

a. A statutory member of the Board of Post Graduate Faculty.

b. Staff of the University accredited for appropriate Post-Graduate level of research.

c. Staff at the other institution in case of joint training programme who are given honorary membership of Post-Graduate Faculty.

d. The HOD concerned shall propose an advisor for each and every student in the department according to guidelines, if any, within one month of the date of registration of the student and submit the proposal to the Dean of the College concerned. The Dean of the College concerned may, at his discretion; either endorses the proposal submitted by the HOD or proposes change in the proposal submitted by the HOD and forward the final proposal to the Dean Post- Graduate Studies normally within fifteen days of the receipt of the proposal from the HOD. The reasons for not accepting the proposals of HOD shall be recorded in writing by the Dean concerned with a copy to the HOD concerned. In case there is difference of opinion between Dean of the college and Dean, Post Graduate Studies, the matter shall be referred to the Vice-Chancellor whose decision shall be final. The Dean Post-Graduate Studies shall intimate the final approval on the proposal normally within fifteen days of the receipt of the proposal from the Dean of the College concerned.

The allotment of PG students shall preferably be made to those accredited faculty members who have research project (funded by outside agencies like ICAR/CSIR/ AICTE etc.) in their name as Project Leader/Co- Project Leader. While allotting the PG students to the faculty members, a Committee of 3-5 members (consisting of HOD, senior faculty members) be constituted in each department. The said Committee shall examine the allotment of students considering the infrastructure/facilities available in the department/project and also the interest of the candidates for area of their specialization. Further, the maximum number of students with a faculty member at a given time will be 5, M. Sc. & Ph.D. both.

e. An Advisor once assigned to a student will normally not be changed. Where the need for the change of Advisor becomes necessary, either because the Advisor has resigned and left or is on long leave or is unable to function as an Advisor or in any other circumstance where the Dean of the college of Post Graduate Studies is convinced or has reasons to believe that the change of Advisor has become imminent, the Dean, PGS may after consultation with the HOD The Dean of the college concerned, and such member of the Advisory Committee as he deems proper, allow assignment of another Advisor.

In all such cases, the circumstance under which such a change became unavoidable shall be recorded and intimated to the Registrar. While assigning another Advisor, among other things, the stage of the research work / thesis of the student and the guidance required as well as the availability / possibility of the Advisor providing the guidance with out detriment to the quality of thesis / research or unduly prolonging the duration of the thesis / research work must be taken into consideration.

f. Normally no staff member registered for Ph.D. degree of this University shall be an Advisor and if an Advisor registers himself for a Ph.D. degree of this University, he shall cease to be an Advisor thereafter.

Allotment of Students to the retiring persons

g. Normally, retiring person may not be allotted M.Sc. student if he is left with less than 2 years of service and Ph.D. student if left with less than 3 years of service. However, in special circumstances, permission may be obtained from Dean, P.G.S. by the concerned HOD.

2. Advisory Committee

a. For every student in the college of Post-Graduate Studies, there shall be an Advisory Committee consisting of not fewer than three members in the case of a candidate for Master's degree and four in the case of Ph.D. degree with the Advisor as Chairman. The Advisory Committee should have representative from the major and minor fields

b. The Advisor in consultation with the HOD concerned shall within fifteen days of his appointment as Advisor recommend through the Dean of the college concerned to the Dean of the Post- Graduate Studies names of the members of the Advisory Committee from amongst the members of the P.G. Faculty and the staff of the University accredited for appropriate Post- Graduate level research. However, in those departments where qualified staff exists but due to unavoidable reasons post- graduate degree programmes are not existing, the staff having post- graduate teaching experience of three years or more may be included in the Advisory Committee as member representing the minor

c. The Dean of the college of the Post- Graduate Studies shall appoint the committee by the end of the semester of student's admission in the P.G. programme after making such changes, as he considers necessary

d. The Advisor should convene a meeting of the Advisory Committee atleast once a Semester. The summary record should be communicated to the HOD, Dean of the College concerned, Registrar and Dean, Post-Graduate Studies for information.

3. Staff members on extra ordinary leave or study leave or ex-staff to continue as Advisor

i. Normally staff members of the University on extra ordinary leave or on study leave or who leave the University service will cease to continue to serve as Advisors of the Post-Graduate Studies of the University. However, the Dean, Post-Graduate Studies may permit them to continue to serve as Advisor subject to the following conditions

a. The concerned staff member must be resident in India and if he agrees to guide research must be available for occasional consultations

b. An application is made by the student concerned and that is duly supported by the Advisory Committee

c. In case of a Ph. D. student, he must have completed his preliminary examination and the research work must be well in progress and it is expected that the student will submit the thesis within a year

d. The HOD and the Dean of the college concerned agree to the proposal

e. The staff member, after leaving the University service is granted the status of honorary faculty's membership by the Vice-Chancellor on the recommendation of the Dean, Post-Graduate Studies for guiding the thesis / theses of the student(s) concerned only.

Staff Member for guiding outside students

ii. a. Teachers in the University departments where Ph. D. programme do not exist or where there is no likelihood of Ph. D. programmes being started in the near future be permitted to guide research of outside students registered in other University subject to the following conditions.

i. Such permission should be restricted in number.

ii. When a student utilizes the facilities provided for by the University special permission shall have to be obtained and the student shall have to pay for use of such facilities.

b. In case of staff members of this University only registered at some other University for Ph.D. degree, a staff member may be permitted by the Vice- Chancellor to guide such students. In case the University where the staff member has been registered for Ph.D. degree requires that a person in the department of this University may act as Co-guide/ Co-supervisor that may also be permitted by the Vice- Chancellor.

4. Requirement for the Master's degree

a. A minimum of 45 Semester credit hours shall be required for the Master's degree out of which 15 credits may be earned by research and thesis work.

b. The remaining Semester credit hours may cover course work in one major field, or the candidate may select a major and one minor with the approval of his Advisory Committee, the concerned HOD, the Dean of the college concerned and the Dean Post- Graduate Studies. Such minor shall carry at least 8 Semester credits in that field.

c. As undergraduate pre-requisites required for postgraduate study in his major and minor subjects, a student must have completed such work as the department concerned may require. If a student is deficient in his under graduate pre- requisite, he may remove such deficiency by taking courses for which graduate credit will not be given.

d. Full - time staff members registered for Master's degree programme shall be exempted from the formal registration of thesis / research credits for the degree if the Advisory Committee certified that the research carried out by the candidate in the discharge of duties as a member of the staff had been used for thesis and the amount of work put in was equivalent to a minimum of 15 credits as case may be.

5. Requirements for the Ph.D. degree

a. The minimum requirement for course work for Ph.D. after Master's degree shall be 30 Semester credit hours mad up of one major and at least one minor. Not more than two minors shall be permissible.

b. The Ph.D. major should carry atleast 20 Semester credits.

c. The group of courses to be known as ' Minors' should carry 10 Semester credits and should not be from the same field of study as the major.

d. In case of two 'Minors' the course requirements may go up to 40 credit hours instead of 30 credit hours as prescribed in (a) above. If, however, both the 'Minors' are in closely related fields, the course requirement in each minor shall be minimum of 8 semester credit hours.

e. The minimum requirement for thesis work for Ph.D. shall be 30 credit hours.

f. In the case of full time staff members registered for Ph.D. degree, the maximum credits permissible in a semester would apply only to course work. No formal registration for thesis would be required, if the Advisory Committee certified that the research carried out by the candidate in the discharge of duties as member of the staff, had been used for thesis and the amount of work put in his equivalent to a minimum of 30 credit hours.

6. Programme of Study

a. A detailed programme of studies giving the course requirement of the students admitted to the Master's or Ph. D. degree programme shall be prepared by the respective Advisory Committee and submitted by the Advisors within first fifteen days of the second Semester of the joining of the students through the HOD and Dean of the college concerned to the Dean, P.G.S. for his approval. The Dean, P.G.S. shall issue the approved programme of studies within one month of the receipt of the programme of studies by the Advisors after making such changes, as he may deem necessary

b. The programme of study shall be prepared out of the approved courses and shall be so devised as to ensure the inclusion of the core, major and basic supporting courses prescribed

Making core courses of M.Sc. programme of a particular discipline compulsory at Ph.D. level for the students admitted from the related majors

c. The students admitted to a Ph.D. degree in a discipline from the related area would be required to study the core courses of the Master's degree of that discipline. This will be over and above the requirements of 30 credits

7. Courses

I. There shall be the following types of courses in each Post-graduate major:

a. Core Courses

i. Major: These shall consist of courses from the Department concerned, which are compulsory for a particular major

ii. Supporting Courses: These courses shall consist of such basic supporting course from departments, other than the major department, which shall also be invariable components of each individual programme of study of Post- Graduate students taking up a particular major

b. Open Electives: These shall consist of the courses both from the major Department and other department which may be required to be offered by a post-graduate student

II. The core and basic supporting courses in each major shall be compulsory for all Post-Graduate students and shall carry credits. If a student has studied the equivalent course(s) the matter may be examined by the Committee consisting of (1) Advisor of the student, (2) Head of the majoring Department concerned, (3) The HOD to which the course belongs, on whose recommendations the Vice- Chancellor may exempt the student from studying the course (s).

III. For each Post- Graduate programme the core courses and basic supporting courses shall be defined by the Department concerned and approved by the Academic Council.

IV. Of the total course requirement for the Post-graduate degree the composition of the Core, Basic Supporting courses and open elective shall be as follows:

	Master's degree	Ph.D. degree
a. Core & Basic Supporting courses	2/3	1/2
b. Open Elective	1/3	1/2

8. Change in the programme of studies

No change in the programme of studies shall normally be permitted. However, under special circumstances Dean, Post-Graduate Studies may, on the recommendation of the Advisory Committee/ Head(s) of Department(s) and Dean (s) of College(s) concerned, for reasons to be specified, permit a change in the programme of studies comprising of the Open Elective component of the major.

9. Evaluation

Each student shall be examined in every course from time to time throughout the semester. While examining the students, the Instructor shall mark individual questions in numerical (no rounding off) and then convert the total number of marks obtained into points.

a. The 'Points' earned in a course will be total marks obtained by a student out of 100, divided by 10. The Points secured in course(s) will be 'Points in course(s) X Credit(s) of the course(s). The significance of points for undergraduate students shall be as follows

Percentage of Marks	Points
100	10
90-below 100	9-below 10 8-
80- below 90 70-	below 9 7-
below 80	below 8 6-
60-below 70 (Barely Pass)	below 7
Below 50 (Fail)	Below 6
e.g., 80.76	8.076
57.25	5.725
43.80	4.380
72.50 (But Shortage of Attendance)	Fail (1 Point)

b. A student shall be eligible for the award of Master's degree only if he maintains an OGPA of 6.500 out of 10.000, in 500 series courses included in the course programme. However, a student shall be eligible for the award of Ph.D. degree only if he maintains an OGPA of 7.250 out of 10.000.

10. Research Thesis

a. Requirements of the Master's degree shall include successful completion of scientific investigation and creditable research reported in the form of a thesis.

b. The ability to widen the field of knowledge by distinct original contribution shall be one of the out- standing qualifications for the Ph.D. degree. A candidate must therefore, present satisfactory evidence of such ability by submitting a thesis embodying the results of the research on a creditable problem within the field of his major subject.

Seminar before writing of the thesis

c. Each Ph.D. student should present seminar on his/her thesis in the department, which will be open to all before submitting his/her thesis.

11. Subject of the thesis

a. The subject of thesis research must be approved by

1. Advisory committee of the student
2. The Head of the Department in which the student is majoring
3. The Dean of the College where the research is carried out and
4. The Dean, Post- Graduate Studies

b. The approved problem of research shall be communicated by the Dean, Post-graduate Studies to the Registrar not later than two Semesters from the time of admission of the student. The actual title of the thesis may be communicated later, but it must reach the office of the Registrar at least a month before the date of the submission of the thesis by the candidate.

c. No change in the title of the thesis can be made without the prior written permission of the Dean, Post-Graduate Studies.

12. Submission of thesis

a. A candidate for Master's or Doctorate degree must present to the Dean, Post Graduate Studies, three typed written copies of the thesis approved by his Advisory Committee and forwarded by the HOD latest by the end of the Semester. In case of fellowship holders the number of copies as prescribed by the Dean, PGS shall be submitted.

b. If a candidate fails to submit the thesis before the commencement of the subsequent semester, he shall be required to register himself for the semester and pay the necessary dues.

c. The student shall not be required to pay any fee for the period between the submission of thesis and the conduct of the viva-voce examination. For all purposes the student shall be considered to have been enrolled till the end of the month in which the thesis is submitted.

Submission of research paper alongwith the thesis

d. At least one research paper must be submitted by the Ph.D. students prior to submission of Ph.D. thesis. Further, the Dean PGS will have a certificate from the Advisor to this effect along with the copies of the paper(s) from each Ph.D. students at the time of Ph.D. thesis submission.

Number of thesis abstracts to be submitted by the Ph.D. students

e. 10 copies of thesis abstracts must be submitted by a Ph.D. student at the time of submitting the thesis.

13. Appointment of External Examiner

After the receipt of the thesis, the Registrar, in consultation with Dean of Post-Graduate Studies, shall appoint an examiner who shall not be a person on the staff of the University, in the following manner:

a. The Advisor in consultation with the HOD concerned shall suggest for every thesis a panel of atleast three names for being appointed as examiner which shall after the approval of the Dean of the college concerned be submitted to the Registrar the name of the person to be appointed as examiner.

b. Where the number of students to be examined in any field of specialization is more than four, additional examiner(s) may be appointed to the panel.

c. Normally, no person should be appointed as examiner for more than two years consecutively. After a break of one year or more the same person shall, however, be eligible for re-appointment.

d. The Chairman Advisory Committee or in his unavoidable absence the HOD concerned shall act as the Internal Examiner.

e. While asking the consent of the examiner for evaluating the thesis, it shall also be indicated to him that the thesis for a master's degree has to be evaluated within 30 days and the thesis for a Ph.D. degree has to be evaluated within 60 days and in case the evaluation of the thesis is provided that viva-voce examination shall not be conducted before 15 days have elapsed from the date of the dispatch of the thesis by the office of the Registrar.

14. Evaluation of Thesis

a. After the Advisory Committee of a Post-Graduate student has been satisfied with the quality and the norms prescribed by the Dean, PGS for the assessment of the thesis, the Chairman, Advisory Committee shall forward the thesis to the HOD.

The HOD after being satisfied shall forward the thesis to the Dean, Post-Graduate Studies, who shall forward the same to the Registrar for its evaluation by the examiner appointed for the purpose.

b. In case the HOD dose not approve the thesis he shall assign reasons for the same and return the thesis to the Chairman of the Advisory Committee for necessary modifications.

c. The thesis shall be sent to the external examiner by registered post and the examiner must send the report of the evaluation of the thesis to the Registrar.

d. On receipt of a favorable thesis evaluation report from the external examiner, the Registrar shall communicate the same to the advisor along with the date suggested by the external examiner for the conduct of examination. If the external examiner has suggested no date, the Advisor and External Examiner will decide a date and communicate it to the Registrar for approval. The examination may be conducted within 15 days before or after the date approved for the examination without violating the provision of regulation 14(e) In case the examination is not conducted within this period, a fresh date may be requested for by the Advisor and approval obtained. The examination shall be conducted on that, date. The examination conducted without prior approval of the Registrar will not be accepted and re-examination shall be arranged. If any oral examination has been conducted in violation of this regulation, the University shall not be liable to pay TA & DA to the External Examiner. Under exceptional circumstances, however, the decision of the Vice-Chancellor in this regard shall be final.

NOTE The above procedure shall also apply for oral preliminary examinations (in case of Ph.D. students)

e. In case the thesis is rejected by the External Examiner, a student shall be required to resubmit the thesis after incorporating the changes as required not earlier than three months from the date of rejection of thesis after payment of proper registration fees.

Provided that a student shall be allowed not more than three chances to modify his thesis after its rejection by the external examiner, and as far as possible same external examiner shall be appointed to evaluate his thesis.

15. Preliminary Examination

a. A candidate for the Ph.D. degree of the University shall be required to pass a preliminary examination to be conducted in three phases namely; written examinations in major and minor subjects separately, oral examination by the Advisory Committee and oral examination by the External Examiner along with the Advisory Committee.

b. A candidate for the Ph.D. degree of the University shall be required to pass a preliminary examination only after completing the course work with a minimum OGPA of 7.250 in 500 and higher series courses included in the programme of studies. In special cases, however, a student may petition to Dean PGS for relaxation of this regulation provided he has completed at least prescribed courses for the minor and at least 75% of the courses prescribed for the major with the minimum OGPA requirements specified above.

c. The preliminary examination shall consist of written and oral tests covering the entire field of study of the candidate for the Ph.D. degree.

Written Preliminary Examinations

d. The written examination in major field of study shall be conducted by the Advisory Committee other than the member from the minor area under the coordination of Advisor. The written examination in each minor field of study shall be conducted by the member of Advisory Committee from the respective minor field of study.

e. The student shall be required to secure satisfactory grade (S) by securing not less than 60% marks in the major and minor areas separately. A student securing unsatisfactory (US) grade in major or minor field of studies shall have to appear for written examination after a lapse of not less than one month if he/she fails in one paper and after a lapse of one semester, if he/she fails in both major as well as minor.

f. The student shall apply for written preliminary examination to the Registrar through Advisor, HOD and the Dean PGS. The examination shall be conducted only after written approval for the same by the Registrar.

g. The result of the written preliminary examination shall be sent by the Advisor/ Examiner of minor field to the Dean PGS and the Registrar through HOD of the major department and that of the oral preliminary examination by the Advisor through the same channel.

Oral Preliminary Examinations

h. After successfully completing the written preliminary examination, each Ph.D. student shall be required to appear for oral preliminary examination to be conducted by the Advisory Committee on approval of the Dean PGS. The result of the examination shall be sent to the Dean PGS by the Advisor and if the student has been cleared by the Advisory Committee, he/she will be allowed to take oral preliminary examination to be conducted by the External Examination along with the Advisory Committee. The student shall be graded Pass or Fail at both the stages of oral preliminary examination.

i. If a student fails in oral preliminary exam. conducted by the Advisory Committee, he/she shall not be eligible to re-appear in the exam. before the expiry of one month. If a student fails in an oral preliminary exam. conducted by the Advisory Committee along with the External Examiner, he/she shall not be permitted to re-appear in this preliminary exam. before the expiry of a period of one month.

j. No candidate shall be permitted to appear in the written or oral preliminary exam. more than two times. Normally, the same External Examiner shall be associated with the conduct of second oral preliminary exam. However, in special circumstances, another External Examiner can be appointed by the Dean PGS after obtaining a panel of External Examiners from the Advisor and the HOD.

Note: The oral preliminary examinations in respect of Ph.D. programmes may be held by grouping the candidates in the departments, as far as possible, on quarterly basis. For this purpose, a panel of 3 Examiners with their specialization will be submitted by the Advisors/Projects Guides to the HOD, who will communicate the same to the Dean PGS through Dean of the college concerned. The Dean PGS will finally select the Examiners from the list so provided by the HOD for seeking consent as per existing procedure. If M. Sc. student also requires to undergo through these programme.

16. Final Viva-voce Examination

a. A Post-Graduate student failing to show 'Satisfactory' performance in his final viva voce examination shall be permitted by the Registrar to take the examination again after expiry of atleast three months form the date of his first viva voce examination.

b. In case the student again fails to show 'Satisfactory' performance in the second chance, he shall be given a third chance by the Registrar to take the viva- voce examination after the expiry of atleast one month from the date of his second viva voce examination. No further chance to take the viva voce examination shall be given.

c. Normally the same external examiner shall be associated with the conduct of second and third viva voce examination.

d. The viva-voce examination in case of Ph.D. student shall be held at College/University level. The Chairman of the Advisory Committee will ensure to notify the venue, time and date of the open thesis defense/viva-voce examination of the student to all PG Departments/Dean/Directors and also make all necessary arrangements for the same.

e. For conduct of viva-voce examination at both Master's and Ph.D. level another External Examiner may be invited to conduct the viva-voce examination based on the report of the first External Examiner if he (who evaluated the thesis) has sent his refusal not to conduct the viva-voce examination.

17. Additional Requirement for Ph.D. Degree

A postgraduate student may also be required to undertake and complete successfully the additional requirements necessary for the degree he is registered for.

18. Remuneration to External Examiners

a. A person not on the staff of the University, who is appointed to examine the thesis and conduct the viva voce examination thereof for the M.Sc. and Ph.D. degree or conduct the oral preliminary examinations shall be paid the remuneration as decided by the Academic Council from time to time. The present rates of remuneration are as follows

Particular	Remuneration per student	
	P.G.	Ph.D.
i. To evaluate the thesis and conduct viva voce examination	Rs. 800.00	Rs. 1200.00
ii. To evaluate the thesis only at each time	Rs. 400.00	Rs. 600.00
iii.To conduct viva voce only at each time	Rs. 400.00	Rs. 600.00
iv. To conduct oral preliminary exam at each time	-	Rs. 600.00

b. Normally the same external examiner shall be appointed to evaluate the thesis and conduct the viva voce examination at each subsequent time with regard to the same student.

19. Collaboration for Ph.D. Degree with other Institutions

i. A student may be permitted to complete the course requirement or research work for his degree in full or in part at another institution subject to following conditions

a. The courses to be taken and the credits to be given shall be determined by the Dean, PGS in consultation with the authorities concerned

b. The research problem shall also be approved by the Dean, P.G.S. in consultation with the concerned authorities of this University and the co- advisor of the student at the institution where the research work has to be undertaken

ii. Where a candidate for a post- graduate degree of the University is permitted to complete the course work or research in full or in part at another institution recognized for this purpose, such course or research work may be accepted in fulfillment of the course requirement, or may be permitted to be submitted as thesis for the same degree at this University. Further if the candidate has successfully completed the preliminary examination at the cooperating institution he shall also be exempted from taking the preliminary examination at this University.

20. Minimum Class Attendance

a. Each student shall be regular in attending classes and shall be required to have a minimum of 85 per cent attendance in each course in each semester, failing which he/ she be awarded 'D' grade unless withdrawal from the course has been permitted. This however shall not apply to students leaving the University to join the Armed Forces during a period of emergency provided that they attended classes and tests for at least 14 weeks in that semester

b. The percentage of attendance of a student in a course of lectures, practical, tutorials attended by him and those actually held between the date of commencement of instruction and the date of closing of instruction, irrespective of the date of his registration and / or the duration of leave duly granted to him

c. The Vice-Chancellor may on the recommendations of the Instructor/Advisor/ Dean of the college where the department is situated and the Dean, P.G.S., condone shortage in attendance up to ten percent in a course(s) in exceptional circumstances and allow students with an attendance of seventy five percent to appear at the final examination

d. More than ten percent shortage of attendance shall not be condoned under any circumstances.

21. Continuance

For continuance in the University a post-graduate student shall maintain a minimum OGPA of 6.500 in case of Master's and 7.250 in case of Ph.D. out of 10.000 in programme in each semester in 500 and higher series of courses included in his/her programme of studies.

22. Academic Probation

If at the end of any semester the overall grade point average of any post- graduate student falls bellow 6.500 in case of Master's and 7.250 in case of Ph.D. programme out of 10.000 in 500 and higher series of courses included in his/her programme of studies, he shall be placed on 'Academic Probation' for the duration of the following semester.

23. Removal From Academic Probation

If at the end any semester during which a post- graduate student has been on Academic probation the overall grade point average of that student for that semester in 500 and higher series courses is 6.500 for Master's and 7.250 for Ph.D. or above out 10.000 he shall cease to be on 'Academic Probation'.

24. Dropping for Poor Academic Performance

i. If at the end of any semester during which a postgraduate student has been on Academic probation the Overall Grade Point Average of the student in 500 and higher series courses falls below 6.500 out of 10.000 in case of Master's and 7.250 out of 10.000 in case of Ph.D. programme, he/she shall be dropped from the University for poor academic performance with a right to petition for readmission. However, a student falling in the following categories will be finally dropped from the University with no right to petition for readmission:

a. A student having an OGPA less than 6.000 in case of Master's and 6.500 in case of Ph.D. programme out of 10.000

b. A student having 6.000 points in more than 10 credits

ii. Any postgraduate student failing twice in the same course/examination shall be dropped from the University for poor academic performance. In exceptional circumstances the Vice-Chancellor may permit a third chance to pass the course to the student on the recommendation of the concerned Advisor, HOD and Dean PGS. Any student failing in the same course/examination thrice shall be finally dropped from the University with no right to petition.

iii. No post-graduate student shall register again in a course, which he/she has already cleared with a passing grade. If he/she registers again a course already passed the subsequent grade shall be ignored.

iv. A Post-graduate student unable to complete his courses as well as thesis within maximum permissible degree duration with on OGPA of 6.500 in case of Master's and 7.250 in case of Ph.D. programme out of 10.000 will be finally dropped from the University with no right to petition.

v. A postgraduate student whose petition has been rejected by the Vice- Chancellor will have no further right to petition for readmission.

25. Petition for readmission

Any post-graduate student dropped from the University for poor academic performance shall have the privilege of petitioning to the Vice-Chancellor for readmission.

26. Disposal of petitions

Petition for readmission after dropping on academic grounds must be filed within one week from the date of registration for the semester immediately following the semester in which the student has been finally dropped. No petition may be entertained after this date.

All petitions made by the dropped students for readmission shall be examined by a petitions committee appointed by the Vice-Chancellor. The petitions committee shall advise the Vice-Chancellor in respect of each petition whether it may be rejected or accepted subject to such conditions as the committee may deem fit. In case any student has to take make- up examination his performance for the purposes of dropping be judged on the basis of results already available without waiting for make- up examination results. The decision of the Vice -Chancellor in such cases shall be final. Once a petition has been rejected by the Vice-Chancellor no further petition shall be entertained.

27. Repetition of Courses

i. If a post- graduate student secures a failing in a course included in his programme of studies, he /she shall have to repeat the course and shall be provided one more chance to pass the course. In case, however, he again fails in the course no further chance to repeat the course shall be given and the student shall be dropped from the University.

ii. In case a post-graduate student obtains a failure grade in a course in the first attempt and repeats the same course, the grade/points secured by the student on repeating the course shall be counted for computation of his overall grade point average though the failure grade secured by the student in the first attempt shall be shown in his transcript.

iii. The course(s) that form the degree requirements of students are required to be passed. Many a times students also register for course(s) which are in addition to their degree requirements. Such additional courses are taken in all seriousness after full application of mind by the Student/Advisor/Dean of the college concerned. Therefore, a course once registered whether part of degree requirement or not be must cleared through a passing grade.

Guidelines for Implementation of Regulations Clauses 23 to 27

a. If any course of 300 and higher series is offered in the first semester after admission at the time of registration the Advisor shall clearly indicate whether it is taken for credits or as non- credit course. No change in this shall be permissible.

b. The post- graduate faculty should devise ways and means to review grades in post-graduate course after the end of each semester as is being done by other faculties.

c. Credits courses in certain majors which carry numbers in series below 300 should for purposes of credit load of graduate student in a particular department who offer such courses for credits, be reconsidered and raised to 500 series or above.

d. For purpose of calculating OGPA, the failing grade in a course will be counted for the OGPA till it is repeated after which only repeat grade will be counted.

28. Class division

No Division shall be awarded at Ph.D. level. In case of Master's degree, however, equivalent division that is 'First' or 'First Division with Distinction' or 'Second' shall be written in Brackets both in the transcript as well as in the degree certificate.

29. Addition or Withdrawal of Courses

a. Subsequent to his registration a student may add or withdraw any course, in the manner prescribed below

i. Application for addition or withdrawal shall be made in the prescribed 'Change of Course(s) Form' obtainable from the office of the Dean concerned.

ii. The advisor of the student and the instructor of the course shall give their recommendations with reasons on the form itself.

iii. After completing (ii) above the student shall go to the Dean, College of Post-graduate Studies and obtain his approval for the change.

iv. In the event of the permission for the change being granted by the Dean, Post-graduate Studies the student shall deposit the prescribed fee of Rs. 25.00 in the office of the Comptroller and obtain a receipt there of.

v. After the fees as (iv) above has been deposited, the student shall deposit one copy of the ' Change of Course(s) Form' with his Advisor and the remaining two copies in the office of the Registrar. The Registrar shall inform the Instructors concerned through HOD about the addition or withdrawal of the course(s) by the student and shall also forward a copy of the completed ' Change of Course (s) Form' to the Dean concerned.

vi. Until all the procedures mentioned above are completed, the change shall not become effective.

b. Course(s) may be added by a student not later than seven days from the date of registration. In exceptional cases exemption from this rule may be given by the Vice-Chancellor on the recommendation of the Dean concerned

c. Students may withdraw any course(s) in the manner prescribed without payment of fee up to two weeks from the date of registration. The course(s) withdrawn within the prescribed period shall not be shown on the transcript

d. Normally students shall not be permitted to withdraw from courses beyond a period of two weeks specified in clause(c) above. However, under special circumstances to remove genuine difficulties which may arise on account of any one or more of the following reasons, Vice- Chancellor, may on the recommendation of the Dean of the college concerned permit withdrawal of courses beyond two weeks from the date of registration upto six weeks on payment of a Rs. 25.00/-.

i. Where a student has not been able to adjust clashes in the time- table within a period of two weeks and has to drop either of the two courses.

ii. Change of major and / or minor.

iii. Wrong advisement by an Advisor. The Advisor will submit a note to the Dean as to how the wrong advisement took place and if approved by the Dean, withdrawal from a course shall be permitted.

e. Withdrawal of courses beyond the normal date for withdrawal shall automatically result in failure grade for that course. In case of prolonged absence of a student on account of severe illness certified by the University Medical Officer, the Vice-Chancellor, may on the recommendation of the Advisor and Dean, PGS permit him to withdraw course(s) beyond two weeks from the date of registration on payment of prescribed fee.

30. Formula for conversion of OGPA into percentage of marks

The formula for conversion of the Overall Grade Point Average into aggregate percentage of marks is as under

Formula

Percentage of marks = OGPA x 100/10

e.g. if the OGPA is 6.000 then the percentage of marks would be 6.000 x 100/10 = 60%

31. Recognition of Institutions For Carrying Out of Research/Course work

All the Agricultural Universities, National Institutes deemed to be Universities, all chartered U. S. Universities and such other institutions as may be approved by the Academic Council by name, are recognized for purposes of clause 6 of the Statutes under Chapter-XXVII reproduced below:

The course work or research for the degree and diplomas of the University may be completed at a University or some other institution approved for this purpose by the Academic Council. Where the requirement are completed at some institution other than the University the credits so earned may be transferred to the University and counted towards the requirements for the degree or diploma concerned. Where the research has been conducted at some institution other than the University it may be submitted as a thesis to the University in partial fulfillment of the requirements for the degree or diploma concerned.

32. The Indian Veterinary Research Institute, Izatnagar (Bareilly), Indian Agriculture Research Institute (IARI), New Delhi, National Dairy Research Institute (NDRI), Karnal, Central Avian Research Institute (CARl), Izatnagar, Institute of forestry Genetics & Tree Breeding, Coimabatore, Indian Grassland and Fodder Research Institute, Jhansi, Central Food Technology Research Institute, Mysore, International Crop Institute for the Semi- Arid Tropics (ICRISAT), Himachal Pradesh Krishi Vishwavidyalaya, Palampur, all the 5 IITs, Roorkee University, Tata Institute of Fundamental Research, Bombay, Indian Institute of Science, Bangalore, Snow and Avalanche Study Establishment (SASE)/Defence Research & Development organization (DRDO), Regional Engg. College, Kurukshetra, and International Rice Research Institute (IRRI), Manila, Philippines, are recognized for the purpose.

VI. Regulations on Convocation

Special Convocation Procedure for the Honorary Degrees of the University

1. A special convocation for conferment of the Honorary Degrees of the University shall be held on such date and time as may be fixed by the Vice-Chancellor.
2. The Academic Procession will be formed in the following order from the place and the time notified earlier by the Register for the purpose.

   Register

   Members of the Academic Council

   Members of the Board of Management

   Vice-Chancellor

   Honorary Degree Recipient(s)

   Chancellor

   Secretary/ADC to the Chancellor
3. The Academic dress for the special convocation shall be the same as for the Annual Convocation, i.e., black buttoned up coast, while trousers and a hood as prescribed for the purpose. The Honorary degree Recipients shall put on the academic robes to which they are entitled to or the hood for the Ph.D. degree recipients of the University.
4. The Honorary Degree Recipients shall be seated on the dias as guests.
5. The proceedings of the Special Convocation shall commence with the singing of the University song. 6. The

Chancellor shall declare the Special Convocation open.

7. The Registrar shall read out the proposal of the University for the conferment of the Honorary Degree in the following form:

   'The Board of Management of the Sardar Vallabh Bhai Patel University of Agriculture & Technology Modipuram Meerut, on the recommendation of the Academic Council and confirmation by the Chancellor, have decided to confer the Honorary Degree of DOCTOR OF SCIENCE (Honoris cause) on Mr/Dr..... ....."

8. The Vice-Chancellor will present the Honorary Degree Recipients to the Chancellor in the following form:

"Mr. Chancellor: I have the honour to present to you Mr./Dr.....
for conferment of the degree of DOCTOR OF SCIENCE (Honoris causa) for his outstanding contribution to the objects of the University.....(read out the citation).

9. The Chancellor will confer the degree in the following forms:

"By virtue of the authority vested in me as Chancellor of the Sardar Vallabh Bhai Patel University of Agriculture and Technology Meerut, I confer the honorary degree of DOCTOR OF SCIENCE (Honoris causa) on Mr./Dr....."
(The Chancellor will decorate the recipient with hood and present the degree).

10. In case, the Honorary degree Recipient may not be able to receive the degree in person, formal announcement for the award of the degree shall be mode by the "Vice Chancellor in Annual Convocation or, Special Convocation, in the following form:

"The Board of Management of the Sardar Vallabh Bhai Patel University of Agriculture and Technology Meerut, on the recommendation of the Academic Council and confirmation by the Chancellor, have decided to confer the Honorary degree of DOCTOR OF SCIENCE (Honoris causa) on Mr./Dr..... for his outstanding contribution for the objects of the University.....
(read out the citation).

I pray, Mr. Chancellor, that Mr./Dr..... be honoured by conferring the degree of DOCTOR OF SCIENCE (Honoris causa) of this University in absentia.

11. The Chancellor, will confer the degree in the following term:

"By virtue of the authority vested in me as Chancellor of the Sardar Vallabh Bhai Patel University of Agriculture and Technology Meerut, I confer the honorary degree of DOCTOR OF SCIENCE (Honoris causa) on Mr./Dr..... in absentia."

12. Speech by the Honorary Degree Recipient. 13.

Observation by the Chancellor.

**14. Thanks by the Registrar

**15. The Chancellor will declare the Special Convocation closed. **16.

Singing of the National Anthem.

**17. The Academic Procession will leave the pandal and the Assembly will stand.

Note: In case the Special Convocation is combined with the regular Annual Convocation, items 14-17 will be held at the end of the Convocation.

VI I. Regulation on Annual Convocation

1. Normally, a convocation shall be held annually on the University campus to confer the degrees on such date as may be fixed by the Vice-Chancellor in consultation with the Chancellor and the Chief Guest, unless it is decided that in a particular year formal convocation might not be held for reasons to be specified and the formalities for conferment of degree in absentia be completed by the Members of the Board of Management and the Academic Council in a convocation without organizing a formal function or the convocation may not be held at all in that particular year and the degrees may be awarded at the next convocation.
2. Every candidate for a degree must appear in person at the convocation to receive the degree. Such candidate should inform the Registrar in writing of his intention to be present. No candidate shall be admitted to the Convocation who has not sent his name to the Registrar within the prescribed time. In exceptional cases the Vice-Chancellor may permit candidates who have not sent their names to Registrar within the prescribed time, to be admitted to the Convocation, Provided their applications are received by the Registrar not later than 48 hours before the time of Convocation and are accompanied by a fine of Rs. 750/- in each case. No candidate whose application and requisite fee is received later than 48 hours before the time of the Convocation will be allowed to take his degree at the convocation.
3. Such candidates who are unable to present themselves in person at the convocation will be supplied their degree direct by the Registrar on application and on payment of a fee of Rs 500/-.
4. Candidates must appear in the prescribed academic dress at the time of convocation.
5. A rehearsal shall be arranged on or before the day of Convocation at which candidates for degree must be present.

6. Registrar shall issue a notice to each recipient of a degree intimation the convocation programme and the procedure to be observed.
7. The academic dress for the convocation shall be a black coat with closed collar, white trouser, hood and robes as proscribed below.
   i. For Chancellor: A hood with golden zari work.
   ii. For Chief Guest: A hood with golden and silver zari work.
   iii. For Chairman, Board of Management & Vice-Chancellor: A hood with silver zari work.
   iv. For Deans, Registrar, Members of Board of Management and Academic Council and Others: A scarlet hood.
   v. For Honorary Degree Recipients: A hood in green colour with golden embroidery work having university insignia in the middle.
   vi. For Bachelors degree recipients: A hood of green silk and white lining.
   vii. For Master's and Doctor's degree recipients: A scarlet red hood.
8. An UTTARIYA about 7.5"x7" with University seal, 3 ears and traditional motif design no the bottom shall be used being drapped around the neck in different colours as per details given below.
   i. For Chief Guest : Chancellor and Vice-Chancellor—One cream silken cloth with embroidered emblem in zari as given above.
   ii. For Postgraduate students and members of the Academic Council and Board of Management—Light cream colour silk or some other cloth with the University seal and traditional motif embroidered with 3 wheat ears painted or printed in red and green colours thereon.
   iii. For Graduates—Light cream colour cloth with the University seal and traditional motif with 3 wheat ears painted or printed in blue and green colours thereon.
   iv. In addition, to the above, head wear and gown shall also be used for Chief Guest, Chancellor, Vice-Chancellor, Guest (S) of Honour, Deans, Registrar and Members of the Board of Management and other distinguished visitors attending the Academic Procession.
   v. For girls graduating students, the academic dress shall be white or cream colour Sari with red boarder, hood and uttariya.
   vi. In case the female members of the Academic Council or the Board of Management, the dress shall be white or cream colour sari with red boarder, hood, gown and uttariya.

Convocation Procedure

1. The Chancellor, Vice-Chancellor and Chairman of the Board of Management, Members of the Board of Management, Members of the Academic Council and other distinguished guests shall assemble in the place notified for the purpose at the appointed hour and shall walk in procession in rows in rows of two in the following order to the Convocation Hall. The procession will be led by the Registrar.

REGISTRAR

MEMBERS OF THE ACADEMIC COUNCIL

DEANS OF FACULTIES AND

MEMBERS, OF THE BOARD OF MANAGEMENT

DISTINGUISHED GUESTS

VICE-CHANCELLOR AND CHAIRMAN, BOM

A.D.C. & A.D.C.

CHANCELLOR CHIEF GUEST

SECRETARY TO THE CHANCELLOR

2. The Chancellor, Chairman of the Board of Management and Vice-Chancellor and Chief Guest shall be seated in the front the dais and the members of the Board of Management and Academic Council and distinguished guests, if any, in the rear of The dais, as mentioned below :

Vice-Chancellor Chief Guest Chancellor Guest (S) Honour

Registrar

Members of the Academic Council Members of Board of Management

3. On the procession entering the hall the assembly shall rise and remain standing till the Chief Guest, Chancellor, Chairman Board of Management and Vice-Chancellor, distinguished guests and members of the Academic Council and Board of management have taken their seats.
4. The proceedings of convocation will commence with the singing of the "Vande Matram" or the "University Song". Then the Chancellor, if he is present, will declare the convocation open. When the Chancellor is not present, the Vice-Chancellor will declare the convocation open.
5. The Vice-Chancellor shall read out his report.
6. After the report of the Vice-Chancellor is over, there be the exhortations as mentioned below by him :

dqyifr	eSa nh{kkUnsrk gwa& lR; dksyks] dÙkZO;&ikyu djks] v/;;u'khy jgksA eSa
Lukrdx.k	izfrKk djrk gwa
dqyifr	LoLFk cuks] le`) cuks] mnkj cuksA
Lukrdx.k	eSa izfrKk djrk gwa
dqyifr	ns'k dks cyoku cukvks] ns'k dks lq[kh cukvks] ns'k dks xkSjoiw.kZ cukvksA
Lukrdx.k	eSa izfrKk djrk gwa
dqyifr	Ñf"k ds fodkl ds fy, u,&u, vuqla/kku djks] u;s Kku dk v/;kiu djks] vuqla/kku ds ifj.kkeksa dks izkIr djksA
Lukrdx.k	eSa izfrKk djrk gwa
dqyifr	lR; ls fopfyr u gksuk] dÙkZO; ls fopfyr u gksuk] mRFkku dk;Z ls fopfyr u gksuk] dY;k.k dk;Z ls fopfyr u gksukA
Lukrdx.k	eSa izfrKk djrk gwa
dqyifr	rqEgkjk thou eaxye; gksA

7. The Honorary Degrees, if any, shall then be presented.
8. The Registrar will them request the Deans of Faculties to present their students to the Chancellor/Vice-Chancellor for the award of Degrees, The Deans shall present their students in the following order :

   1. Doctor of Philosophy
   2. Master of Science
   3. Bachelor of Science

   (A) Agriculture

   (B) Bio-Technology (C)

   B.V.Sc. & A.H.

   All the Presentees will stand when the Dean presents them to the Chancellor/Vice-Chancellor for the Degree and will remain standing till admitted to the Degrees.
9. Deans will say :

   "Mr. Chancellor/Vice-Chancellor, I present to you candidates who have been examined and found qualified for..... Degree to which I pray they may be admitted and on behalf of those who have been permitted to secure their Degree in Absentia, I pray that they may also be admitted thereto".

The Chancellor/Vice-Chancellor will say :

"By the authority vested in me as Chancellor/Vice-Chancellor of Sardar Vallabh Bhai Patel University of Agriculture & Technology, Meerut, I admit you one and all to ..... Degree and I charge you that ever in your life and activities out prove yourselves worthy of the same. I admit the other candidates also to the Degree in Absentia".

10. After the distribution of Degrees is over, the Registrar shall call the recipients of University Gold Medalists. They shall stand before the Chancellor/Vice-Chancellor who shall present the medals.
11. The Chancellor/Vice-Chancellor will introduce the Chief Guest and request him to deliver the Convocation Address.
12. The Chief Guest will then deliver the Convocation Address.
13. Thanks by the Registrar.
14. The Chancellor/Vice-Chancellor will then declare the Convocation closed.
15. Singing of National Anthem.
16. The procession will leave the Convocation Hall in the following order and the assembly will stand.

REGISTRAR

SECRETARY TO THE CHANCELLOR ETC.

A.D.C. & A.D.C.

CHANCELLOR & CHIEF GUEST

VICE-CHANCELLOR & CHAIRMAN BOM

DISTINGUISHED GUESTS

MEMBERS OF THE BOARD OF MANAGEMENT

DEANS OF FACULTIES

MEMBERS OF THE ACADEMIC COUNCIL

VIII. Regulations on No Dues or Clearance Certificate

Students should be required to produce a clearance within ten days of their completing the degree re\quirements and the names of those who fail to do so should not be recommended to the Academic council for conferment of degrees.

IX. Regulations on Weight of Various Gold/Silver/Bronze Medals Awarded by the University at the Annual Convocation

The weight of various Gold/Silver/Bronze medals awarded by the University at the Annual Convocation shall be as follows :

Medal :	Weight	Name of Metal
(1) Chancellor's Gold Medal	15 grams	Made by Silver Polish
(2) Vice-Chancellor's Gold Medal	10 grams	Made by Gold Polish
(3) Vice-Chancellor's Silver Medal	15 grams	Made by Silver
(4) Vice-Chancellor's Bronze Medal	15 grams	Made by Bronze

All recipients to Gold, Silver and Bronze medals shall be awarded a certificate in addition to the medals.

Special Convocation Procedure for the Honorary Degrees of the University

(1) A special convocation for conferment of the Honorary Degrees of the University shall be held on date and time as fixed by the Vice- Chancellor

(2) The academic dress for the convocation shall be a Black buttoned up Coat with closed collar, White Trousers and a Hood as prescribed below, or the robes of the University from which the person takes his Degree.

(i) FOR CHANCELLOR

A hood with golden and silver zari work

(ii) FOR GUEST OF HONOUR

A hood with golden and silver zari work

(iii) FOR CHAIRMAN, BOARD OF MANAGEMENT & VICE-CHANCELLOR

A hood with silver zari work

(iv) FOR REGISTRAR, DEANS, MEMBERS OF BOARD OF MANAGEMENT AND ACADEMIC COUNCIL AND OTHERS

A scarlet hood

(v) FOR HONORARY DEGREE RECIPIENTS

A hood in green colour with golden embroidery work having University insignia in the middle or a scarlet - red hood.

(3) An UTTARIYA about 7.1/2" X 7' with the University seal, 3 wheat ears and traditional motif design on the bottom shall be used being draped around the neck in different colours as per details given below:

(i) For Chief Guest, Chancellor and Vice- Chancellor.

One cream silken cloth with embroidered emblem in zari as given above.

(ii) For members of Academic Council and Board of Management.

Light cream colour silk or some other cloth with the University seal and traditional motif embroidered with 3 wheat ears painted or printed in red and green colours thereon.

(iii) In addition to the above, hood, head wear and gown shall also be used for the Chief Guest, Chancellor, Vice-Chancellor, Registrar, Deans and members of the Board of Management and other distinguished visitors attending the Academic Procession.

(iv) In case of female members of the Academic Council or the Board of Management, the dress shall be white or cream colour Sari with red boarder, hood, gown and Uttariya.

(4) The Chancellor, Vice - Chancellor, Chairman and Members of Board of Management and Members of the Academic Council and other distinguished guests shall assemble in the place notified for the purpose at the appointed hour and shall walk in procession in rows of two in the following order to the Convocation hall. The procession will be led by the Registrar.

REGISTRAR

MEMBERS OF THE ACADEMIC COUNCIL

MEMBERS OF THE BOARD OF MANAGEMENT

VICE- CHANCELLOR

HONORARY DEGREE RECIPIENT(S)

CHANCELLOR

SECRETARY / ADC TO THE CHANCELLOR

(5) On the procession entering the hall the assembly shall rise and remain standing till the Chief Guest Chancellor, Chairman Board of Management and Vice- Chancellor, distinguished Guests and Members of Academic Council and Board of Management have taken their seats.

(6) The Chancellor, Chairman of the Board of Management and Vice- Chancellor and Chief Guest shall be seated in the front of the dias and the members of the Board of Management and Academic Council and distinguished guests, if any, in the rear of the dias, as mentioned below.

Vice- Chancellor, Chief Guest,	Chancellor
Members	Members
Academic	Board of Management
Council	
Distinguished Guests	Honorary Degree Recipients

(7) The Honorary Degree Recipients shall be seated on the dias as guests.

(8) The proceedings of the Special Convocation shall commence with the singing of the " Vandematram" song (The "Rastrtra - Geet")

(9) The Chancellor shall declare the Special Convocation open.

(10) The Registrar shall read out the proposal of the University for the conferment of the Honorary Degree in the following form:

" The Board of Management of the Sardar Vallabh Bhai Patel University of Agriculture & Technology, Meerut, on the recommendation of the Academic Council and confirmation by the Chancellor, have decided to confer the Honorary Degree of DOCTOR OF SCIENCE (Honoris causa) on Mr/ Dr…….. and DOCTOR OF LITERATURE (Honoris causa) on Sri. / Dr.————————————

(11) The Vice- Chancellor will present the Honorary Degree Recipients to the Chancellor in the following form.

"Mr. Chancellor: I have the honour to present to you Mr. / Dr……..for conferment of the degree of DOCTOR OF SCIENCE / DOCTOR OF LITERATURE (Honoris causa) for his outstanding contribution to the objects of the University ……...…….. (read out the citation).

Object of the University :

The University shall be deemed to have been established and incorporated for the purposes, among others, of -

(a) making provision for the education of the rural people of Uttar Pradesh in different branches of study particularly agriculture, rural industry and business and other allied subjects;

(b) furthering the prosecution of research, particularly in agriculture and other allied sciences; and (c)

Undertaking field and extension programmes.

I pray, Mr. Chancellor, that Mr. / Dr. ……be honoured by conferring the degree of DOCTOR OF SCIENCE (Honoris causa) / D. Lit (Honoris causa) of this University."

(12) The Chancellor will confer the degree in the following forms:

" By virture of the authority vested in me as Chancellor of the Sardar Vallabh Bhai Patel University of Agriculture & Technology Meerut, I confer the honorary degree of DOCTOR OF SCIENCE / DOCTOR OF LITERATURE (Honoris causa) on Mr. / Dr……." (The Chancellor will decorate the recipient with hood and present the degree).

(13) In case, the Honorary degree Recipient may not be able to receive the degree in person, formal announcement for the award of the degree shall be made by the "Vice Chancellor in the Special Convocation, in the following form:

" The Board of Management of the Sardar Vallabh Bhai Patel University of Agriculture & Technology Meerut, on the recommendation of the Academic Council and confirmation by the Chancellor, have decided to confer the Honorary degree of DOCTOR OF SCIENCE / DOCTOR OF LITERATURE (Honoris causa) on Mr./ Dr……...for his outstanding contribution for the objects of the University……..(read out the citation).

Object of the University :

The University shall be deemed to have been established and incorporated for the purposes, among others, of - (a) making provision for the education of the rural people of Uttar Pradesh in different branches of study particularly agriculture, rural industry and business and other allied subjects;

(b) furthering the prosecution of research, particularly in agriculture and other allied sciences; and

(c) Undertaking field and extension programmes.

I pray, Mr. Chancellor, that Mr./Dr……be honoured by conferring the degree of DOCTOR OF SCIENCE / DOCTOR OF LITERATURE (Honoris causa) of this University in absentia.

(14) The Chancellor, will confer the degree in the following term:

"By virtue of the authority vested in me as Chancellor of the Sardar Vallabh Bhai Patel University of Agriculture & Technology Meerut, I confer the honorary degree of DOCTOR OF SCIENCE / DOCTOR OF LITERATURE (Honoris causa) on Mr./Dr……...……...in absentia."

(15) Speeches by the Honorary Degree Recipients. (16)

Convocation Address by the Chancellor.

(17) Thanks by the Vice - Chancellor

(18) The Chancellor will declare the Special Convocation closed.

(19) Singing of the "Jan- Gan- Man" song (the Rashtra Gaan)

(20) The Academic Procession will leave the pandal and the Assembly will stand.

(Format for Honorary D.Sc. Degree)

ljnkj oYyHkHkkbZ iVsy
Ñf"k,oa izkS|ksfxd fo'ofo|ky;] esjB

dk

izcU/k eaMy

fo}r~ ifj"kn dh laLrqfr ij

Jh@ Jherh

@Mk0&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&dks

foKku okfjf/k dh ekun mikf/k

vkt fnukad &&&&&&&&&&&&&&&20 &&&&&&&&&&&&dks iznku djrk gSA

SARDAR VALLABHBHAI PATEL

UNIVERSITYOFAGRICULTURE&TECHNOLOGY,MEERUT

The Board of Management, on the recommendation of the Academic Council confers the Degree of

DOCTOR OF SCIENCE (HONORIS CAUSA)

On Mr./ Mrs. / Dr...

on this...day of two thousand..................................

dqykf/kifr — **dqyifr**

Chancellor — Vice- chancellor

(Format for Honorary D. Lit. Degree)

ljnkj oYyHkHkkbZ iVsy
Ñf"k,oa izkS|ksfxd fo'ofo|ky;] esjB

dk

izcU/k eaMy

fo}r~ ifj"kn dh laLrqfr ij

Jh@ Jherh

@Mk0&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&dks

lkfgR; okfjf/k dh ekun mikf/k

vkt fnukad &&&&&&&&&&&&&&20 &&&&&&&&&&&&dks iznku djrk gSA

SARDAR VALLABHBHAI PATEL

UNIVERSITYOFAGRICULTURE&TECHNOLOGY,MEERUT

The Board of Management, on the recommendation of the Academic Council confers the Degree of

DOCTOR OF LITERATURE (HONORIS CAUSA)

On Mr./ Mrs. / Dr..

on this...day of two thousand..................................

dqykf/kifr **dqyifr**

Chancellor Vice- chancellor

X. Regulations on Maintenance of Student's Record

The proposal submitted by Secretary Academic Council was approved as below :

The following procedure shall be adopted for maintenance of the student's record:

1. The "Live and closed" filing system should be introduced for student records. The name of the student who is registered with the University should be on the file. After he has completed the course and left the University his file should be closed and kept in the record room. If any student leaves the University in the middle, his file should temporarily be consigned to the record room and requisitioned from there whenever needed in future. An upto-date list of "Live & Closed" files should always be readily available.
2. It may be ensured that every student file should have an index at the beginning to facilitate prompt location of any particular paper kept in the file.
3. All students' files should be checked regularly and required formalities should be completed without waiting for the students to come and remind the office at the nick of time.
4. Applications should be obtained at the end of each semester from those students who think that they have completed their course successfully. This would, however, be only by way of an additional check.
5. A consolidated statement showing the important documents such as registration cards, results, etc. which are not available in individual student record file be prepared and a copy of which may be sent to Dean/Director concerned and the records be completed.
6. Complete information as to how many students have registered and how many students have graduated semester-wise should be readily available. Migration Certificate shall not be asked from the candidates who join the University after completing the qualifying examination from the institution/University which does not issue Migration Certificate or from the candidates who passed the qualifying examination from the foreign universities.

XI. Regulations on Issuing of Documents to the Students

The proposal submitted by Secretary, Academic Council was approved as below :

1. All the students who are admitted to the University shall be required to submit copies of the following documents:
   i. Attested Copies of mark sheets and Certificates for all educational qualifications starting from High school or equivalent to the qualifying examination.
   ii. Character Certificate in original from the last institution attended.
   iii. Transfer Certificate /Migration Certificate (in original) from the last institution attended. iv.
   Certificate for utilizing the intervening period, if any, after leaving the last institution. v. Passport
   size five copies of recent Photograph. vi. Any other certificate as may be prescribed.
2. The office of the Registrar will issue the following documents as per the procedure outlined below: i.
   Semester Report Card.
   ii. Bonafide Certificate.
   iii. Degree/Course Completion Certificate. iv.
   Provisional Degree Certificate. v. Transcript.
   vi. Transfer Certificate or Migration Certificate.
   vii. Character Certificate.
   viii. Degree.

If any student requires any other type of certificate or signature on some forms, the same may also be issued by the office of Registrar if considered necessary.

3. No documents shall be issued to students unless the required documents detailed hereunder are submitted by them:
   i. Semester Repot Card: It may be issued without insisting any earlier document because registration in subsequent semester is involved.
   ii. Bonafide Certificate: On submission of TC/Migration (in original), mark sheet of qualifying examination and 5 copies of photographs unless not done already.

iii. Degree Completion Certificate, Course Completion Certificate, Thesis Submission Certificate, Character Certificate and Incomplete Transcript:

On submission of documents at sl.no. 2 above, mark sheets of earlier examinations, two point character certificate, gap certificate (if any) and upto date no dues from the comptroller.

iv. Complete P.D.C. and Character Certificate: On submission of documents at sl.no. 2 and 3 above plus all copies of certificates/degrees and final no dues. In case any certificate/degree are lacking he will give an undertaking to submit the same later.

v. Transcript/Migration/TC: As 4 above except if some certificate is from where he passed that examination that it has not been issued to him.

vi. Degree: On submission of all documents only.

4. Character Certificate with satisfactory conduct may be issued to the students who are awarded the punishment of temporary dismissal only once during the period of their stay in the university if the same is recommended by the Discipline Committee and approved by the Academic Council.

5. In case of foreign students, in whose cases the institutions last attended i.e. Universities or Colleges, are located abroad, exemptions shall be given from submitting the two point character certificate, transfer certificate, migration certificate and gap certificate. However, if foreign students have completed last degree certificate from the institution located in India, the above exemption will not apply.

6. For staff students, gap certificate and may not be insisted if they produce a certificate from the office of the C.P.O. that their antecedents have been verified satisfactorily with the provision that character certificate to staff students will be issued from the office of the C.P.O.

7. Students who have qualified privately, would be required to submit Transfer Certificate and Two-point Character Certificate, from the institution from where they passed earlier examination as regular student.

8. The name of the students, both in English and Hindi, in the documents to be issued by this University, shall be spelled as given in the Marksheet and Certificate/Degrees of the qualifying examination only. In case, the name of the student either in Hindi or English are not available in the marksheet certificate of earlier examination, the same shall be spelled as given in the application form submitted by the students at the time of admission.

9 The surname of graduating girl students may be changed only after submission of marriage certificate or satisfactory evidence to this effect by the student concerned. In place of Ms./Km. word Mrs./Smt. be added as brief after the name changed as above.

10 Issuing of Duplicate copy (ies) of Certificates: The rates of various certificates issued to the students by the Registrar shall be as under:

Particulars of Documents	Fee (in Rupees)
i. Degree Certificate (Duplicate)	200/-subject to fulfillment of prescribed norms
ii. Degree (in absentia)	150/-
iii. Transcript (Duplicate):	
1st copy	100/-
2nd copy	200/-
3rd and onwards copies	300/-
iv. Migration (Duplicate)	
1st copy	150/-subject to fulfillment of prescribed norms
2nd and onwards copies	300/-subject to fulfillment of prescribed norms
v. P.D.C. (Duplicate)	
1st copy	100/-
2nd and onwards copies	200/-
vi. Duplicate Character Certificate, Thesis Submission Certificate, Bonafide Certificate and Course Completion Certificate etc.	
1st copy	50/-
2nd and onwards copies	100/-

11. The University may issue a duplicate copy of the Degree certificate to a student who might have lost it in the following manner :

a) The candidate who has lost the degree shall swear an affidavit in the court of law to the effect that he has lost the degree and submit the same to the University.

b) He shall also issue a notice in the press that he has lost the degree immediately after the loss of the same and enclose with his application a copy of press notice issued in this regard, while intimating detailed circumstances under which the original degree has been lost.

c) The candidate applying for issue of a duplicate copy of a degree shall also give an undertaking to the effect that in case his original degree is recovered subsequently he will surrender the duplicate copy of the degree to the University.

XII. Regulations for the Award of the Chancellor/Vice-chancellor Medals

The rules and regulations framed by the committee for the award of Chancellor and Vice-Chancellor medals are as below :

1. At the end of each academic year, a Gold Medal to be named as "Chancellor's Gold Medal" shall be awarded to the alround best graduating student of the University on the basis of the composite index for academic as well as co-curricular and extra curricular activities provided that the Vice-Chancellor on the advise of the Academic Council may declare that in any particular year no "Chancellor's Gold Medal" shall be awarded.

   At the end of each academic year, the Dean Student welfare will propose the name of candidates who fulfill the following requirements, shall be eligible for being considered for the award of the medal.

   a. That he should have obtained a Cumulative Grade Point Average of 7.500 or above out 10.000 at the end of the degree programme.

   b. That he should have successfully completed the prescribed course of study for the degree programme within the minimum prescribed period;

   c. (i) That he should not have been on Academic Probation/C Probation at any time during his stay at this University.

   (ii) He should not have been convicted by a court of law for any criminal offence involving moral turpitude.

   d. That he should have actively participated in at least one extra-curricular/co-curricular activity and should have secured at least fifty percent marks, out of a total of 25 in co-curricular/extra-curricular activities.

2 The graduating students who are eligible for the award of the medal on the basis of the criteria laid down in clause 2 above shall be evaluated by awarding marks as follows :

(a) For Academic performance	75 marks
(b) For performance in co-curricular and extra-curricular Activity excluding work programme and N.S.S.	25 marks.

3 The marks for performance in co-curricular and extra-curricular activities, as in clause 3(b) above, shall be awarded on the following basis :

Total Marks : 25

(i) Games/Sports /NCC	(a) 3 marks for each year for being member of any University team	07 maximum marks
(ii) Cultural and Literary activities	(a) 3 marks for each year for being member of any University team	07 maximum marks
(iii) Any intervarsity/state/National participation resulting in Winning any prize (first 3 positions)		07 marks
(iv) Captain/Vice-Captain of University team.		02 marks
(v) Any others (community development etc.)		02 marks

4. After grading the eligible candidate for the award of the Medal on the basis of clause 4 and 5 above, a committee consisting of the following officers shall scrutinize the proposals and finalize the recommendations:

   (i) Registrar

   (ii) Deans of the Colleges (iii) Dean

   Student Welfare

5. The recommendations of the committee appointed under clause (6) shall be submitted to the Vice-Chancellor and the Academic Council for approval.

6. In case of tie, the Medal shall be awarded to each of the candidate securing equal marks.

7. The award of 'Chancellor's Gold Medal' shall not deprive a candidate of another Medal/Prize which he might be entitled to by virtue of his having good first as a graduating student of the faculty during that year.

8. The Medal shall be awarded at the annual convocation of the University and shall commence from.

9. The material contents of the Medal shall be as per rules prescribed by the State/Central Government from time to time.

10. The inscription on one side of the Medal shall be:

    CHANCELLOR'S GOLD MEDAL AWARDED TO THE ALL ROUND BEST GRADUATING STUDENT OF THE YEAR

    and on the reverse side:

    SARDAR VALLABH BHAI PATEL UNIVERSITY OF AGRICULTURE & TECHNOLOGY MODIPURAM MEERUT

    (With the University insignia)

11. Any matter not provided for in these regulations shall be determined by the Vice-Chancellor, on the recommendation of the Academic Council. The decision on the Vice-Chancellor on all such matters shall be final.

b. Regulations for the award of Vice-Chancellor's Gold, Silver and Bronze Medals to under graduate students 1. At the end of an academic year a Gold/Silver/Bronze shall be awarded in each graduate degree programmes to those graduating students who secure First, Second and third positions respectively on the basis of their over-all grade point average (including Failure Points) and completed the degree with in minimum prescribed period. Provided further that in case of tie, the medal shall be awarded to each of the candidate securing equal marks.

2. To be eligible for the award of Vice-Chancellor's Gold/Silver/Bronze medal astudent should have obtained an OGPA of 8.000 or above out of 10.000 at the end of his degree programme.

3. He/She should not have been placed on Conduct Probation at any time during his stay at the University.

4. In order to be eligible for this award, a graduating student shall have completed the graduating requirements within the minimum period prescribed for the degree concerned.

5. The names of medalists shall be displayed on an honors Board fixed in the building of the college concerned.

6. The award of these medals shall not deprive a student for the award of other medal (s) and prizes to which he/she might be entitled to by virtue of his being eligible for the same.

7. The Vice-Chancellor whose decision shall be final shall determine any matter not provided for in these regulations.

   Note : Course (s) of New Education/Liberal Education shall not be taken into consideration while computing the OGPA for award of these medals.

XIII. Regulations for the Award of Degrees in Absentia in the Joint Meeting of the Board of Management and the Academic Council

1. The date of joint meeting of the Board of Management and the Academic Council shall be the date as decided by the Board of Management.

2. All the degree recipients shall be intimated by the Registrar through a letter that the degrees would be awarded without holding the formal convocation and that they should send the formal application for the same, the draft of which is annexed (Appendix-1).

3. A free of Rs. 75.00 for the award of degree in absentia shall be charged from each degree recipient.

4. The detailed procedure for the joint meeting of the Board of Management and the Academic Council for conferment of degrees in absentia without holding formal convocation shall be as under:

(i) The Vice-Chancellor, Members of the Board of Management and the Academic Council shall assemble in a place and at the appointed time notified for the purpose.

(ii) The Vice-Chancellor shall declare the joint meeting open. (iii)

The Vice-Chancellor shall read out his report.

(iv) The Registrar shall then request the Deans of the Faculties to present the list of the degree recipients of their faculties for the award of degrees in absentia to the Vice-Chancellor. The Deans shall present their list in the following order—

1. Doctor of Philosophy
2. Master of Science
3. Bachelor of Science : (a) Agriculture (b) Biotech

(v) The Deans shall say :

"Mr. Vice-Chancellor, I present to you the list of candidates who have been examined and qualified for the award of..... degree to which I pray they may be admitted.

The Vice-Chancellor shall say :

"By the authority vested in me as Vice-Chancellor, Sardar Vallabh Bhai Patel University of Agriculture & Technology, Meerut admit all the candidates who have been examined and found qualified for the..... degree."

(vi) After the award of degree is over, the Registrar shall present the list of recipients of the various Gold, Silver and Bronze medals.

(vii)The Vice-Chancellor shall then declare the joint meeting closed.

SECTION IV

FINANCIAL ASSISTANCE AND SCHOLARSHIP

1. Regulation on award of Ph.D. Scholarship/Fellowship

- These regulations shall apply to the students admitted to various Ph.D. programmes in the academic year Jan. 2006 and thereafter through Entrance Examination. However, the students of previous batches on the roll of the university will be entitled to get the scholarship from January 2006 onward for the left over period of their degree programme.
- The value of scholarship shall be Rs. 1500 per month or as revised as per State Government decision from time to time. The Board of Management shall approve it on the recommendation of the Academic Council. Normally, there shall be two scholarships in each discipline. The total number of scholarships thus provided are not utilized due to any valid reasons whatsoever, the university shall be free to redistribute the allocation of the vacant scholarship position and award the same to other student who could not be granted scholarship in the first instance due to the aforesaid restriction of two scholarships in each discipline. However, this latter award shall be based on the academic rating and shall be made after all admissions in question have been made for the academic year.
- Application for the scholarship shall be made by the concerned student on the prescribed form obtainable from the office of the Dean Student Welfare and shall be submitted through Advisor, Head of the majoring Department, Dean of the college concerned, Director Agricultural Experiment Station and the Dean Post Graduate Studies.
- The scholarship shall commence from the date of the registration of the students in the semester of his/her admission and shall be tenable for a maximum of 36 months during Ph.D. programme of the candidate. However, the payment of scholarship for any semester shall be made only after satisfactory performance of the student in that semester.
- Student on Academic or Conduct Probation shall not be eligible for this scholarship.
- Continuance of the scholarship shall be subject to the satisfactory performance of the student concerned in academic programmes as well as his conduct. The scholarship may, however, be restored with effect from the date the academic performance as well as his conduct is rated satisfactory.
- In case, the student drops a semester or discontinues his studies, he shall loose the scholarship for that semester. In case a student drops a semester after studying some time in the semester, he shall loose the scholarship for the remaining part of the semester. The scholarship may, however, he restored in such case only after the student is allowed to resume his studies and will be tenable for a period not exceeding 36 months.
- A student awarded the scholarship will devote his whole time to the approved study and will not be allowed to accept any financial assistance from other agencies. In the event of award of outside scholarship, the recipient shall have to refund the amount paid to him by the university, for the duration for which outside scholarship has been availed by him. In such cases, the scholarship may be awarded to the student next in the rating for the duration for which the outside scholarship has been availed.
- The scholarship will be terminated on the date:
  a. The recipient ceases to be on the roll of the university
  b. The recipient completes his degree programme, i.e., submission of his thesis etc.
  c. The recipient is awarded any punishment by the competent authority either on the recommendation of the College Discipline Board or on the recommendation of Discipline Committee. In such cases, the scholarship may be awarded to the students next in the rating.
- The award of scholarship will be made by the Dean Student Welfare. However, the records and accounts will be handled by the Comptroller Office
- The Advisor of the concerned recipient would submit a progress report of the work through proper channel to the Dean Student Welfare at the end of every semester, failing which his scholarship will not be renewed
- The scholarship may also be terminated by the Vice-Chancellor at any time without assigning any reason and in all matters not provided in these regulations, the decision of the Vice-Chancellor shall be final.

2. Scholarship and fees available from Samaj Kalian, Meerut: This scholarship is available to those students whose parents income (jointly of mother and father) is less than rupees two lacs in case of general, OBC, minority student, SC and ST students. Full fee is refundable to the ST and SC students falling in the parent's income limit while in case of General, OBC and minority, according G.O. issued time to time. Presently Rs. 12000 per year

scholarship is available to the students in hostels and Rs. 8500/year for day scholars irrespective to the degree programme.

3. Scholarship from Mandi Parishad: This scholarship is available to the students registered in bachelor and post graduate programs in agriculture only. The terms and condition are as below:

   i. Parents income is 50,000/- per year or less.

   ii. To the sons and daughters of agricultural labourers.

   iii. To the sons and daughters of farmers having 1.5 to 2.5 ha land and are doing farming.

   iv. Rupees 36,000 per year is paid to 20 B.Sc. (Hons.) Agriculture and 5 M.Sc. (Ag) students selected on merit basis.

4. National Talent Scholarship: Students admitted in the university through ICAR are awarded Rs. 1000/- month provided they attain minimum GPA of 7.5/10 in case of general and OBC or 6.5/10 in case of SC and ST students.

5. ICAR Junior Research Fellowship: The written test is carried out by ICAR for admission on Indian Agricultural Universities and students selected and admitted through this scheme are awarded Rs. 8640/ month but in veterinary sciences this amount is Rs. 12000/ per month. This is available for two years from the date of registration.

6. ICAR Senior Research Fellowship: Students selected through ICAR for Ph.D. admission, are awarded Rs. 12000/month for the first two years and Rs. 14000/ month in third year.

7. UGC M.Tech Fellowship for ST/SC students only: Students admitted in this scheme (Master degree) are awarded Rs. 5000/ month with contingency of Rs. 15000/ year (for Engg. Research Management, Pharmacy etc.). In other master degree programs the amount paid is Rs. 3000/ month with a contingency of Rs. 10000/ year. The maximum age limit is 45 years.

8. IRRI Fellowship: This fellowship is provided to the Ph.D. students under CSISA project. The amount of fellowship is Rs. 12000/ month for a duration of 25 month.

9. U.G.C. Rajiv Gandhi National Fellowship for SC/ST unemployed students only: The amount paid for first two years (JRF) is Rs. 16000/ month and a contingency of Rs. 12000/ year and during third year (SRF) amount paid is Rs. 18000/ month and contingency Rs. 25000/. This is only for Ph.D. students.

10. Maulana Azad National Fellowship (UGC): This fellowship is available to only minority community unemployed students. During first two years (JRF), the amount paid is Rs. 16000/ month with a contingency of Rs. 12000/ year and during third year (SRF) fellowship is Rs. 18000/ month and contingency is Rs. 25000/ year. This is only for Ph.D. students.

11. Indira Gandhi National Fellowship (Post Graduate Indira Gandhi National Fellowship for single girl child): The ministry of Human Resource Development, Government of India has introduced this scheme through the University Grant Commission (UGC) with the objective of supporting post-graduation through scholarship for such girls who happen to be the only girl child (with-out having a brother) in her family. The scheme also recognized the value of small family norms. It's scholarship amount is Rs. 20,000/ P.A. for 2 years (total amount Rs. 40,000), if she has secured at least 60% of marks in first attempt in PG- Ist year (55% in case of physically challenged).

*For further information, students may contact concerned person in the office of Dean Student Welfare.

SECTION V

HOSTEL REGULATIONS

GENERAL REGULATIONS ON ACCOMMODATION, OTHER FACILITIES, DISCIPLINE AND MANAGEMENT

1. The Right to Admission: Hostel shall be treated as a facility provided by the University for the convenience of the students registered in the University and the right to admission and continuance is reserved by the University. Any person may be refused accommodation or deprived of accommodation already provided, at any time by the Vice-Chancellor without assigning any reason. Vice-Chancellor shall constitute or cancel any Committee for the welfare of students and for maintaining discipline among the students.

2. Admission and Occupation

   (i) Admission to the hostel shall be restricted to registered students of the University and others specifically permitted by the Vice-Chancellor. Accommodation will be provided to the students only on the production of Registration Card and to others on production of permission slip. Priority will be given to outsider than local (8-10 Km) in allotments.

   (ii) Subject to the availability of accommodation, it may also be allotted to staff members and visitors, with the permission of the Vice-Chancellor.

   (iii) Prospective students may be permitted to occupy the hostel temporarily for a period not exceeding 72 hours on the production of the permission slip from the Registrar, indicating that the student's application for registration is under consideration.

3. Eviction from the Hostel: If the registration of a student is suspended or cancelled, he/she shall vacate the hostel within 24 hours of such intimation. The student may also be asked to vacate the hostel during such other periods as the university may need the hostel rooms for use by visiting participants in seminar, conferences or other university functions. The university may also ask the students to vacate hostels in the event of students not attending the classes or for some other reasons when in the opinion of the Vice-Chancellor, the continuance of the students in the hostels may not be desirable. In the event of non-compliance of these instructions, the Warden In-charge of the Hostel or any other person duly authorized by Chief Warden may evict students from the hostels. If a students is warned/ fined for three times in a semester, Chief Warden may order for eviction.

4. Suspension or Expulsion: Any student can be suspended from the hostel or deprived of the hostel facilities for specific period by the Vice-Chancellor without assigning any reason on the recommendation of the Chief Warden or permanently deprived of the hostel facility on the recommendation of the Discipline Committee.

5. No Outsider to be Allowed in the Hostel: No person other than a bonafide student of the university duly admitted to the hostel or temporarily accommodated due to pending registration under rule 2 above or otherwise permitted by the Vice-Chancellor, shall occupy the hostel.

6. Penalty for Keeping Unauthorised Persons: Any inmate of the hostel allowing any person to live in his room, shall himself be liable besides other penalty, to be deprived of the hostel facilities for a specific period or permanently. All guests, relatives and friends of the students shall approach the reception officer for accommodation in Guest House of the University, through the Warden of the hostel concerned.

7. Visitor's Register: The Warden shall get a register of Visitors maintained by the Chaukidar in each hostel in which all the visitors shall enter their names, full address, purpose of visit along with date and time of entry and departure. The register shall be checked and signed by the Warden daily to ensure that only bonafide person visit the hostel.

8. Chief Warden and Officer Incharges of Hostel Management

   (A) The college Dean shall function as chief warden for respective hostel(s). However, in special circumstances the Vice-Chancellor shall appoint a Chief Warden in the cadre of Professor by his own judgment and by framing his own opinion about an university academic staff who has ability to manage all affairs related to the hostels. Wardens of all hostels shall be appointed by the Vice-Chancellor on the recommendation of Chief Warden and Dean, Student Welfare. All the warden in-charges of the hostels shall be responsible to the chief warden and Dean Student Welfare. Chief Wardens shall be ex-officio member of the discipline committee consisting of -

   i. Chairman - appointed by the Vice-Chancellor amongst the Deans of the colleges for the period of one year, rotationally.

ii. All colleges Deans / Chief wardens - Ex-officio members,

iii. Dean, student welfare - Ex-officio member and shall act as secretary of the discipline committee,

iv. Warden concerned.

(B) Duties of the Chief Warden and the Warden Incharge of the Hostel: (i) Chief Warden shall be responsible for controlling the overall activities of the students in regards to maintaining discipline in the hostels, campus and outside the campus with the help of wardens and chief security officer. He may request the Vice-Chancellor to call the police in the hostels and university campus if the issues are related with students. (ii) The Warden In-charge of each hostel shall be responsible for the administration of all affairs of the hostel under the guidance of the Chief Warden in regard to discipline, medical aid, advisory service and food management on the one hand and the Dean, Student Welfare in regard to Physical Education, Recreation and other Cultural and Extra Curricular Activities on the other. The Director Works and Plant/officer concerned shall be responsible for the maintenance of utility services like water supply, electricity, sanitary fittings, furniture and other dead stock etc. In special conditions, wardens can manage the utility services from outside with the permission of Chief Warden or Dean, Student Welfare. (iii) The Warden shall be available in the hostel office for at least one fixed hour every day to be notified in advance. (iv) In addition to above, the duties of the Warden shall be as follows:

(a) To give personal attention to the inmates problems and render all necessary and possible help with a view to maintain discipline and order amongst the inmates.

(b) To organize games and sports/co-curricular/extra curricular and general activities.

(c) To attend all matches/functions along with the inmates and maintain discipline.

(d) Timely procurement of railway concession orders from DSW office as per the rules and its proper distribution to the inmates.

(e) To look after the hostel/mess maintenance, its surroundings and get the needful done from the various university services agencies and hostel/mess staff.

(f) To look after the hostel furniture and accommodation and its allotment and take necessary action in maintaining a complete inventory and update the same.

(g) To supervise record of hostel activities and its inmates.

(h) To maintain the hostel and mess accounts if mess/cafeteria is run in supervision of warden and or by university administration.

(i) Any other work which may be assigned by Chief Warden as per the need/contingency from time to time.

(j) Warden In-charge of the hostel may request to chief warden for Asstt. Warden depending upon the strength of students in the hostel and other managerial problems.

9. Utility Service Committee: There shall be a committee consisting of all counselors and hostel office bearers including warden as Chairman and one of the counselors as Secretary to review all matters from time to time but at least once in a month. Measures to be taken to ensure proper working of the utility services, other facilities provided in the hostel and the physical education and recreational activities. This committee shall meet regularly and a copy of the minutes shall be sent to the chief warden, director works and plants and the Dean Student Welfare or the other concerned persons. Necessary action for implementation of the decisions through Director Works and Plant/Officer in-charge shall be taken-up the Warden concerned.

10. Maintenance of Physical Facilities in Hostels: The Director Works and Plant or concern officer and his staff shall be responsible for the maintenance of physical facilities in the hostels. Four registers shall be maintained in each hostel with the Chaukidar/Warden's Office for recording defects pertaining to civil works, electrical fittings, furniture repair and water supply separately. The inmates shall record the defects noticed by them in these registers. The staff of the Director Works and Plant or concerned officer will attend to these regularly and ensure that repairs/replacement are done within three days and also record the actions taken by them against each complaint recorded in the register. Light and fans should be maintained within few hours.

11. Inspection Register: An Inspection Register shall be maintained in each hostel in which the Dean/Directors and other officers of the University visiting the hostel shall record their comments in regard to working of the hostel and mess. A copy of the inspection notes shall be forwarded to the Chief Warden, Dean Student Welfare and other concerned also along with the detail of the follow up actions taken by the Warden.

12. Committee for Food Management, Recreation and Other Cultural Activities: A committee consisting of the Dean/Chief Warden, Dean Student Welfare and the Wardens of the Hostels shall review from time to time, the measures to be taken to ensure proper working of the Food Management Service, Physical Education and Recreational Activities.

13. Identity Cards: All students admitted to the university shall have their identity cards duly filled in with their passport size photograph attested by the Registrar, affixed thereon. These identity Cards shall be got renewed every semester from the Registrar. Students shall always carry the Identity Cards with them and shall produce them when so demanded by any officer of the university or a member of the academic staff or any faculty member of the university.

14. Manner of Allotment of Rooms: The allotment of rooms shall be made class-wise in an alphabetical order at the commencement of each semester/academic session, by the Warden subject to such changes as may be prescribed by the Chief Warden/ Dean Student Welfare.

15. Shifting of Inmates of the Hostel: No inmates of the hostel shall be allowed to shift from one room to another except with the written permission from the Warden/Chief Warden.

16. Allotment of Room to Counselor: Each Wing counselor shall be provided with rent free preferably single seated room to the extent possible.

17. Inspection of Rooms: The rooms shall be opened for inspection by Warden and other officers of the university at any time, and any student obstructing such inspection and refusing the same shall be liable to disciplinary action and punishment which may involve his permanent eviction from the hostel besides such other punishment as may be awarded to him by the Vice-Chancellor on the recommendation of Chief Warden, Discipline Committee, as the case may be.

18. Warden to Maintain Register of Inmates: The Warden of the hostel shall maintain an up-to-date register of all inmates of his hostel in his office in which he shall enter name, I.D. No., College, Room No. and permanent address with telephone/ mobile number or PP of each inmate of the hostel. He shall furnish a wing-wise list of inmates residing in the hostel by the first day of the following month.

19. Duties of Inmates Regarding their Rooms etc.: The inmates shall keep their rooms in a neat and tidy condition and shall be responsible jointly and individually for the furniture issued to them and fittings present in the room. The room shall not be disfigured by writing, drawing, fixing of nails etc.

20. Proper Use of Facilities: The inmates of the hostel shall use the lavatories, bathrooms, washbasins, urinals etc, properly and cause no damage to the various fixtures.

21. Avoiding of Waste: The inmates of the hostel shall avoid any wastage of electricity, water etc and shall in no circumstances leave their rooms with lights or fans on.

22. Regular Payment of Dues: All charges for hostel such as hostel fees, food charges of mess/cafeteria as the case may be, electricity and water charges and other kind of fee or charge shall be paid by each inmate punctually. All inmates shall be member of hostel mess/cafeteria. Taking meals from out side shall be permitted by Dean/Chief Warden. All students residing in hostels, shall take their meals during specified timings. Mess manager and any servant shall not be responsible for catering students after and before the notified timings.

23. Supply of Electric Bulbs: The University shall not supply any electric bulb or tube light to the inmates of the hostel. The inmates shall bring their own tubes or bulbs for lighting their rooms, as and when necessary. Light arrangements for common places shall be maintained by the warden. Or-as decided by the university administration.

24. Cooking Not Permissible: No cooking of any kind shall be allowed in the rooms. Students are not allowed to bring cooked food from outside of the hostel and eat in their rooms.

25. Annual Repairs during Summer Vacation: Students, other than those required to remain in the University for Academic Work and specifically permitted by the Chief Warden, shall vacate the hostel rooms before they leave for the summer vacation and semester breaks to enable the University Officers to carry out annual repair, white-washing etc.

26. Return of Hostel Property: All hostel properties issued to the inmates of the hostel shall be returned to the Warden, otherwise they shall be liable for charges equal to the cost of the property issued to them.

27. Use of the Hostel Employess: The hostel employees shall not be utilized for any unauthorized work, other than their official duties. Hostel warden / Dean Student Welfare shall have over all control on the hostel staff, servants and students.

28. Use of Heaters etc.: Use of heaters and other electrical equipments shall be prohibited. Use of computers may be allowed in special cases by Chief Warden/Dean Student Welfare.

29. Use of Radios, Transistors etc.: Use of ordinary radios shall not be allowed. The inmates of the hostel may however, use transistors radios with earphones. The Warden may disallow the use of any transistor/sound system if he is satisfied that it is being used in a manner prejudicial to the studies and comforts of any inmates of the hostel including the owner of the transistor radio himself.

30. Restriction of Leaving the Hostel: No inmate of the hostel shall leave the Campus during any hour of the day or night without prior permission in writing of the Warden who may grant leave of absence up to 8 hours during daytime. Normally, a student is expected to study from 8.00 P.m. either in the library, or in his hostel room. No inmate of the hostel shall leave the hostel during the night after the time notified by warden except with the permission in writing of the Chief Warden/Dean Student Welfare in an emergency.

31. Late Comers Register: The inmates coming late in the night i.e., after the attendance time shall be required to enter their names along with the reasons for returning late before allowing his entry to the hostel. This register shall be seen by the warden next morning for taking necessary action as per rules.

32. Penalty for Absence: The Warden shall take the attendance of the inmates of the hostel at any time at night after 10.00 P.M. and any inmate found absent without permission of the Warden, shall be fined up to Rs.200 per absence not exceeding three per semester. Any inmate found absent from the hostel without permission more than thrice shall be liable to be expelled from the hostel by Chief Warden / Dean Student Welfare. A statement of 'Absentees' shall be sent to the Chief Warden by the Warden every week for necessary action.

33. Leave of Absence: All leave of absence for more than 8 hours during the day or any time at night from the hostel shall be sanctioned by the Chief Warden on the recommendation or Warden. The Chief Warden shall inform about the orders passed on such applications of any inmate of the hostel to the Warden.

34. Appointment of Student as Wing Counsellor: There shall be a Student counselor for each wing. The student counselor shall be appointed from amongst the post-graduate students with a grade point average of 7.500 or more, with the year of admission at least one year earlier than the students accommodated in the wing, with regard to qualities of leadership, clean record of conduct in the University and interest in extra curricular activities.

35. Duties of Student Wing Consellors: The duties of the Student Counselors shall be as follows:

(a) To guide the academically weak inmates in their studies.

(b) To report serious cases of illness in his wing to the Warden.

(c) To help the Warden in taking attendance of inmates in the night.

(d) To encourage the participation of the inmates of the hostel in extra-curricular activities.

(e) To generally help the Warden in the administration and in maintenance of a healthy atmosphere of the hostel.

(f) To ensure proper maintenance of furniture and other utility services in the hostel wing. (g) To promptly bring to the notice of the Warden about any breach of rules in the hostel.

36. Arrangements for Games, Sports and Cultural Activities: Adequate arrangements shall be made for games and sports and other cultural activities in each hostel by the Warden in collaboration with the Dean, Student Welfare and the inmates of the hostel. Each hostel shall be treated as a unit for this purpose besides treating the University a bigger unit.

37. Organisation of Co-Curricular and Extra Curricular Activities: Each inmate of the hostel has to participate in at least one game/sport of his liking. Enrollment for game/ sports is compulsory.

(i) Whether feasible, separate clubs shall be organized for various games in each hostel, e.g. volleyball, foot ball, hockey, badminton, basket ball etc. The wardens shall nominate captains for different games/sports with due consideration of the performance/ achievements of the inmates and their qualities of leadership and organizing skill, to be determined on the basis of the bio-data submitted by each inmate at the beginning of the first semester each year. The Captains shall help the Warden in organizing games and sports.

(ii) The games material shall be issued by the Physical Education Section/DSW Office on indents duly signed by the Warden who shall be responsible for the safe custody and return of all serviceable material to Physical Education/ DSW Section at the close of the session.

(iii) The Warden shall nominate Secretaries for cultural and literary activities for each hostel who shall be responsible for organizing such activities in the hostel and forming societies, if necessary.

(iv) No student on 'Academic Probation, or 'Conduct Probation, shall hold any level i.e. Hostel/College or University. None of the students on 'Academic Probation, or 'Conduct Probation, shall be elected/selected for any purpose.

38. Proper Use of Common Room

(A) Inmates shall make proper use of the common room and not remove, misuse or damage any furniture, newspaper(s) or other materials placed there in.

(B) Inmates are required to visit common room, mess and places outside their rooms in proper dress.

39. Medical Care

(A) Normally any student falling ill will report to University Medical Officer or as notified, after informing the Warden and the responsibility for this will rest with the students themselves. Complete address of the students should include police station and the telegraph office in the student directory prepared by the office of the Registrar w.e.f. the batch of students to be admitted in July/August with telephone contact number(s).

(B) 1. Bonafide Registered University Students: The bonafide registered University students shall be extended the medical facilities to the extent available at the Hospital or as notified. In case a student is sent for treatment in the event of an emergency/serious illness, university shall bear the transportation charge only. The parents/ guardian of the students shall be informed by the Dean concerned/Dean Student Welfare. It would be the responsibility of the parents to arrange for further treatment of their ward and bear the expenses of treatment.

2. In case a student has fallen sick and would need prolonged treatment, the Dean concerned/Dean Student Welfare shall be informed accordingly by the Warden and to the intimate's parents/guardian for taking the student home for further treatment and care.

SPECIAL (ADDITIONAL) REGULATIONS FOR THE HOSTEL FOR GIRL STUDENTS

40. (i) Management: The girl's hostel(s) shall be managed by the Chief Warden with the help of Hostel Advisory Committee. The Committee shall consist of-

(a) Dean, College of Bio-Technology, Dean, College of Veterinary & Animal husbandry, Dean, College of Home Science and Dean Student Welfare.

(b) Warden of the girl's hostel(s).

(c) Two lady employees of the University nominated by the Vice-Chancellor, out of which one shall be from the College of Bio-Technology. The Warden of any one girl's hostel shall be member-Secretary of the Committee.

(d) The Warden shall be responsible for the general discipline of the hostel and supervision of all the accounts of the hostel and shall have control over the hostel staff and students residing in the hostel.

(ii) Admission And Withdrawl

(a) Girl students of the university shall be entitled for admission to the hostel and any such student who does not reside with her parents or with approved guardian may become a member of the girl's Hostel. In special conditions a girl student may be permitted to stay out of campus by the permission of Vice-Chancellor only.

(b) All applications for admission to the hostel shall be made to the Warden before the date of registration or within 24 hours after getting registered.

(iii) Guest And Visitors

(a) The parents/guardian shall give a name of relative (not exceeding more than two) with photograph and signature who can visit their ward in the hostel. No person shall be included in the list who is not related by blood on either side. No male person, not included in this list, shall be permitted to visit any student in the girl's hostel. Any such person who wants to meet the inmate in the girl's hostel will have to bring a letter of permission from the parents/guardian and can visit only after obtaining prior permission from the Warden in the presence of warden only.

(b) No male visitor including those mentioned in the above para, shall be allowed beyond visitor's room of the hostel.

(c) Visitors may call on the inmates of the hostel between 4:30 P.M. to 5:00 P.M. during winter and 5:30 P.M. to 6:30 P.M. during summer on Sundays and holydays only.

(d) The names of all such visitors shall be entered by the visitor himself in the register kept for the purpose, every time a visitor visits the students.

(e) The parents/guardian of each inmate, may assign a family on the campus whom the student may visit not more than once in a week on holidays and shall be back to hostel by 5:00 P.M. during winter and 7:00 P.M. during summer. Permission may be granted up to 9:00 P.M. for special occasions such as marriage, festival etc. provided her local guardian escorts the student to the hostel. However, the special permission may be granted by Chief Warden on obtaining a written request from the local guardian.

(f) No student shall be qualified to be a local guardian and will never visit the girl's hostels.

(iv) Restriction on Absence from the Hostel

(a) All inmates shall return to the hostel not later than 7:00 P.M. during summer and 5:00 P.M. during winter and no one shall over stay beyond 5:00 P.M. or 7:00 P.M. as the case may be, outside the hostel except in the company of the parent's/guardian with the prior written permission of the Warden, P.G. girl students should get specific recommendations from Advisor, Dean/Chief Warden for doing research/library work after 7:00 P.M.

(b) In no case a girl student shall be permitted to stay out side the hostel during night.

(c) The roll-call of the girl students shall be taken at 7:30 P.M. during summer and 5:30 P.M. during winter by the hostel warden/ assigned person in the hostel.

(d) All students shall enter their names in the register to be maintained in the hostel available with the staff on duty at the time of going out and returning to the hostel.

(e) No girl student shall be permitted to visit boy's hostels and no boy student is permitted to visit the girl's hostel.

(v) Movement from and to the Hostel

(a) The local girl student shall be allowed to go home once in a month when two consecutive holidays fall within the week and for the semester break with prior permission of their parent's, guardian and Warden.

(b) Games and Sports within the hostel shall be organized for all girl students and students shall be encouraged to participate in University level sports and functions. The students shall be escorted by the Warden and University vehicle shall be arranged for this purpose, if required.

(c) The gates of the girl's hostels shall be closed at 5:00 P.M. during winter and at 7:00 P.M. during summer. The names of inmates returning after these hours shall be entered in a register maintained for the purpose in the hostel giving reasons for coming late. Explanation shall be called and copy of explanation letter shall be sent to the Chief Warden if coming late by 1:00 hr or more than the notified time.

(vi) Visit in Proper Dress: Inmates are expected to visit common room, dinning hall and places outside the hostel in proper dress. Students dressed in night clothes shall not be permitted in the dinning hall, visitor's room and out of the hostel.

All regulations applicable to the other hostels shall also apply to the girl's hostel unless they are barred or modified by the above special regulations framed specifically for the girl's hostel(s).

SECTION VI

COLLEGES OF UNIVERSITY

1. COLLEGE OF AGRICULTURE

The College of Agriculture is offering under graduate degree programme in agriculture, post graduate programme in the disciplines namely Agronomy, Soil Science, Genetics and Plant Breeding, Entomology, Plant Pathology, Horticulture, Animal Husbandry, Agricultural Economics and Management, Agricultural Communication and Rural Development, Agricultural Bio- Technology, and Ph. D programme in all these disciplines except Agricultural Bio-Technology. The college registered its first batch for under graduate degree program in Agriculture in the year 2001. Seventy three students were admitted to B.Sc. Ag. Degree programme during the academic session 2006-07 while 26 students of 2003-04 batch completed their degree successfully. The under graduate curricula is designed to have a shift in priority on resource cum technology management coupled with managerial of field crops, vegetables, fruits and ornamentals etc. with emphasis on diversification, integration (pest and nutrient management) and post harvest technology for qualitative production. The Animal Science department is targeting development of indigenous cattle, augmenting feed resources, low cost management systems and development of production system for different categories of farmers.

College of Agriculture is the largest academic unit engaged primarily in teaching but also integrating with research and extension activities. Practical crop production (PCP) is a unique feature of the B.Sc. Ag. Degree program providing practical training of raising crop to the students. The students are grouped into teams each getting 1.0 ha land with all the facilities. The students do all the operations themselves and earn while learning. Another innovative feature of the agricultural education is the Rural Agricultural Work Experience (RAWE) programme of 16 credits exposing students to real farming situation and application of technology to build up confidence in their knowledge/ learning by way of acquaintance with constraints in management and application of technologies.

The physical facilities of the College comprise of classrooms, laboratories, a conference hall and mini auditorium. The laboratories are equipped with modern instruments required for effective teaching and conduct of basic and strategic research in different areas of specializations/disciplines.

1.1 UNDERGRADUATE PROGRAMME (BSc.Ag.)

Department wise distribution of courses after Fourth Dean's Committee recommendation for B.Sc(Ag.)

S.No.	Course Code		
		1. Agronomy	
1	(APA-111)	Introductory Agriculture (Ancient, Heritage, Agriculture, Scenario and gender equity in Agriculture)	1(1+0)
2	(APA-112)	Principles of Agronomy	2(1+1)
3	(APA-121)	Water Management Including Micro Irrigation	3(2+1)
4	(APA-211)	Field Crops-I (Kharif)	3(2+1)
5	(APA-212)	Organic Farming	3(2+1)
6	(APA-213)	Crop Physiology	3(2+1)
7	(APA-221)	Field crops-II (Rabi)	3(2+1)
8	(APA-311)	Farming Systems and Sustainable Agriculture	2(1+1)
9	(APA-312)	Practical Crop Production I (Kharif Crops)	1(0+1)
10	(APA-321)	Practical crop production II (Rabi Corps)	1(0+1)
11	(APA-322)	Environmental Science	2(1+1)
12	(APA-323)	Weed Management	2(1+1)
		Total	26(15+11)

		2. Genetics and Plant Breeding	
1	(AGP-111)	Fundamentals of Genetics	3(2+1)
2	(AGP-121)	Fundamentals of Seed Technology	3(2+1)
3	(AGP-211)	Fundamentals of Plant Breeding	3(2+1)
4	(AGP-221)	Breeding of Field corps	2(1+1)
		Total	11(7+4)
		3. Soil Science	
1	(APS-111)	Agricultural Meteorology	2(1+1)
2	(APS-112)	Introduction to Soil Science	3(2+1)
3	(APS-121)	Agricultural Microbiology	3(2+1)
4	(APS-122)	Soil Chemistry, Soil Fertility and Nutrient Management	3(2+1)
5	(APS-221)	Manures, Fertilizers and Agrochemicals	3(2+1)
		Total	9 (6+3)
		4. Entomology	
1	(APE-211)	Insect Morphology and Systematics	3(2+1)
2	(APE-221)	Insect Ecology & Integrated Pest Management Including Beneficial Insects	3(2+1)
3	(APE-311)	Crops Pests and Stored Grain Pests and Their Management	3(2+1)
		Total	14(9+5)
		5. Agricultural Economics	
1	(AEM-121)	Principles of Agricultural Economics	2(2+0)
2	(AEM-211)	Agricultural Finance and Co-operation	2(1+1)
3	(AEM-221)	Agricultural Marketing, Trade and Prices	2(1+1)
4	(AEM-311)	Fundamentals of farm Business Management (Including product Development, Appraisal and Monitoring)	2(1+1)
5	(AEM-321)	Production Economics & Farm management	2(1+1)
		Total	10(6+4)
		6. Agricultural Engineering	
1	(AET-111)	Fundamentals of Soil water conservation and engineering	3(2+1)
2	(AET-211)	Farm Power and Machinery	2(1+1)
3	(AET-221)	Protected Cultivation and Post Harvest Technology	2(1+1)
4	(AET-321)	Renewable Energy	2(1+1)
		Total	9(5+4)
		7. Plant Pathology	
1	(APP-111)	Plant Pathogens and Principles of Plant Pathology	4(3+1)
2	(APP-121)	Introductory Nematology	2(1+1)
3	(APP-221)	Diseases of Field Crops and their management	3(2+1)
4	(APP-311)	Disease of Horticultural Crops and Their Management	3(2+1)
		Total	12(8+4)
		8. Horticulture	
1	(APH-111)	Production technology of fruit crops	3(2+1)
2	(APH-211)	Production Technology of Vegetables & Flowers	3(2+1)
3	(APH-221)	Production Technology of Spices, Aromatics Medicinal and Plantation Crops	3(2+1)
4	(APH-222)	Breeding of Horticultural Crops	2(1+1)
5	(APH-311)	Post Harvest Management and Value Addition of Fruits and Vegetables	2(1+1)
		Total	13(8+5)

		9. Agricultural Extension	
1	(AEE-121)	Dimensions of Agricultural Extension	3(2+1)
2	(AEE-311)	Fundamentals of Rural Sociology and Educational Psychology	2(2+0)
3	(AEE-321)	Extension Methodologies for Transfer of Agricultural Technology	3(2+1)
4	(AEE-322)	Entrepreneurship Development and Communications Shills	2(1+1)
5	(AEE-323)	NSS/NCC/PE (NCC-321/PE-321)	1(0+1)
		Total	11(7+4)
		10. Basic Sciences	
1	(BHE-111)	Comprehension and Communication Skills in English	2(1+1)
2	(BPS-121)	Statistics	2(1+1)
3	(BPO-121)	Introduction to Computer Applications	2(1+1)
4	(BHE-321)	Biochemistry	3(2+1)
		Total	9(5+4)
		11. Animal Husbandry	
1	(AAH-211)	Livestock Production and Management	3(2+1)
2	(AAH-311)	Principles of Animal Nutrition	2(1+1
3	(AHH-321)	Breeding and Improvement of Farm Animals	2(1+1)
		Total	7(4+3)
		12. Agricultural Biotechnology	
1	(ABT-311)	Principles of Plant Biotechnology	3(2+1)
		13. College Level	
1	NCC/NSS/Physical Education		

Semester wise distribution of courses after Fourth Dean's Committee recommendation for B.Sc(Ag.)

S.No.	Course Code		
		I Semester	
1	(APA-111)	Introductory Agriculture (Ancient, Heritage, Agriculture, Scenario and gender equity in Agriculture)	1(1+0)
2	(APA-112)	Principles of Agronomy	2(1+1)
3	(APS-111)	Agricultural Meteorology	2(1+1)
4	(APS-112)	Introduction to Soil Science	3(2+1)
5	(AGP-111)	Fundamentals of Genetics	3(2+1)
6	(AET-111)	Fundamentals of Soil water conservation and engineering	3(2+1)
7	(APP-111)	Plant Pathogens and Principles of Plant Pathology	4(3+1)
8	(APH-111)	Production technology of fruit crops	3(2+1)
9	(BHE-111)	Comprehension and Communication Skills in English	2(1+1)
		Total	3(15+8)
		II Semester	
1	(APP-121)	Introductory Nematology	2(1+1)
2	(BPS-121)	Statistics	2(1+1)
3	(APA-121)	Water Management Including Micro Irrigation	3(2+1)
4	(AGP-121)	Fundamentals of Seed Technology	3(2+1)
5	(AEM-121)	Principles of Agricultural Economics	2(2+0)

6	(AEE-121)	Dimensions of Agricultural Extension	3(2+1)
7	(APS-121)	Agricultural Microbiology	3(2+1)
8	(APS-122)	Soil Chemistry, Soil Fertility and Nutrient Management	3(2+1)
9	(BPO-121)	Introduction to Computer Applications	2(1+1)
		Total	22(14+8)
		III Semester	
1	(APA-211)	Field Crops-I (Kharif)	3(2+1)
2	(APA-212)	Organic Farming	3(2+1)
3	(AGP-211)	Fundamentals of Plant Breeding	3(2+1)
4	(APE-211)	Insect Morphology and Systematics	3(2+1)
5	(AEM-211)	Agricultural Finance and Co-operation	2(1+1)
6	(AET-211)	Farm Power and Machinery	2(1+1)
7	(APH-211)	Production Technology of Vegetables & Flowers	3(2+1)
8	(AAH-211)	Livestock Production and Management	3(2+1)
		Total	23(14+8)
		IV Semester	
1	(APA-221)	Field crops-II (Rabi)	3(2+1)
2	(APS-221)	Manures, Fertilizers and Agrochemicals	3(2+1)
3	(APE-221)	Insect Ecology & Integrated Pest Management Including Beneficial Insects	3(2+1)
4	(AEM-221)	Agricultural Marketing, Trade and Prices	2(1+1)
5	(AET-221)	Protected Cultivation and Post Harvest Technology	2(1+1)
6	(APP-221)	Diseases of Field Crops and their management	3(2+1)
7	(APH-221)	Production Technology of Spices, Aromatics Medicinal and Plantation Crops	3(2+1)
8	(APH-222)	Breeding of Horticultural Crops	2(1+1)
9	(AGP-221)	Breeding of Field corps	2(1+1)
		Total	23(14+9)
		V Semester	
1	(APA-311)	Farming Systems and Sustainable Agriculture	2(1+1)
2	(APA-312)	Practical Crop Production I (Kharif Crops)	1(0+1)
3	(APA-213)	Crop Physiology	3(2+1)
4	(AEM-311)	Fundamentals of farm Business Management (Including product Development, Appraisal and Monitoring)	2(1+1)
5	(ABT-311)	Principles of Plant Biotechnology	3(2+1)
6	(AEE-311)	Fundamentals of Rural Sociology and Educational Psychology	2(2+0)
7	(APH-311)	Post Harvest Management and Value Addition of Fruits and Vegetables	2(1+1)
8	(APP-311)	Disease of Horticultural Crops and Their Management	3(2+1)
9	(AAH-311)	Principles of Animal Nutrition	2(1+1
10	(APE-311)	Crops Pests and Stored Grain Pests and Their Management	3(2+1)
		Total	23(14+9)
		VI Semester	
1	(AEM-321)	Production Economics & Farm management	2(1+1)
2	(AEE-321)	Extension Methodologies for Transfer of Agricultural Technology	3(2+1)
3	(BHE-321)	Biochemistry	3(2+1)
4	(AEE-322)	Entrepreneurship Development and Communications Shills	2(1+1)

5	(APA-321)	Practical crop production II (Rabi Corps)	1(0+1)
6	(AHH-321)	Breeding and Improvement of Farm Animals	2(1+1)
7	(APA-322)	Environmental Science	2(1+1)
8	(APA-323)	Weed Management	2(1+1)
9	(AET-321)	Renewable Energy	2(1+1)
10	(AEE-323)	NSS/NCC/PE (NCC-321/PE-321)	1(0+1)
		Total	20(10+10)
		VII Semester	
	(AEE-411)	Rural Agricultural Work Experience (RAWE)	
		Crops Production Crops	5
		Protection Rural	4
		Economics	3
		Extension Programme	4
		Research Station/KVK/DAATT Center activities and Attachment to the Agro-based industries	4
		Total	20(0+20)
		VIII Semester	
		Courses for Experiential Learning	20

Courses for Experiential Learning: A student has to register 20 credits with major load in one area of electives and rest from among one/two areas of electives in the eighth Semester.

Sr.		Title of the module	Credits
I		Crop Production	
1	AGP-421	Seed Production Technology	3(1+2)
2	APS-421	Remote Sensing GIS and Land use Planning	3(1+2)
3	APA-421	Integrated Farming System	3(1+2)
4	APA-422	Water Management (Watershed Micro-irrigation Problematic Water)	4(1+3)
5	APS-422	Soil Management (Conservation Problematic soil quality)	4(1+3)
II		Crop Protection	
1	APP/APE-421	IPM and IDM (Pest Disease Scouting)	4(2+2)
2	APP/APE-422	Management of Post Harvest insect-pests and diseases	3(1+2)
3	APE-423	Non-insect and their Management	3(1+2)
4	APA-423	Agriculture	2(0+2)
5	APP-423	Mushroom (cultivation)	2(0+2)
6	APP/APE-424	Bio-control agencies and bio-pesticide (mass multiplication and uses)	3(1+2)
7	APP/APE-425	Pesticides and Plant Protection equipment	3(1+2)
III		Horticulture	
1	APH-421	Commercial Vegetable Production	3(1+2)
2	APG-422	Commercial Floriculture	3(1+2)
3	APH-423	Commercial Fruit Production	3(1+2)
4	APH-424	Nursery management of horticultural crops	4(1+3)
5	APH-425	Protected cultivation of horticultural crops and Seed production of vegetables and flowers	4(1+3)
6	APH-426	Processing and value addition of horticultural crops	3(1+2)

IV		Post Harvest Technology and Value addition	Will be taught by	
1	AET-421	Post harvest technology of horticultural crops	Deptt. of A.E.F.T.	3(1+2)
2	AET-422	Unit operation for quality value addition processing and development of new products	Deptt. of A.E.F.T.	4(1+3)
3	AET-423	Post harvest technology of spices, plantation crops, medicinal and aromatic crops	Deptt. of A.E.F.T.	3(1+2)
4	AET-424	Integrated storage management of fruits, flowers and vegetables	Deptt. of A.E.F.T.	3(1+2)
5	AET-425	Post harvest handling of cut flowers and dry flowers	Deptt. of A.E.F.T.	3(1+2)
6	AET-426	Processing of cereals, pulses and oilseed crops including biodiesel	Deptt. of A.E.F.T.	3(1+2)
V		Agri-Business Management	Will be taught by	
1	AEM-421	Information & Communication Management	Deptt. of Economics	3(1+2)
2	AEM-422	Management of Agro-based industry	Deptt. of Economics	4(1+3)
3	AEM-422	Marketing Management	Deptt. of Economics	3(1+2)
4	AEM-423	Financial Management of Agri-Business	Deptt. of Economics	4(1+3)
5	AEM-424	Natural Resources Economics and Management	Deptt. of Economics	3(1+2)
6	AEM-425	Project formulation, Evaluation and Monitoring	Deptt. of Economics	3(1+2)
VI		Social Sciences	Will be taught by	
1	AEE-422	Agricultural Journalism	Deptt. of Ag. Extension	3(1+2)
2	AEE-423	Visuals and Graphics Communication	Deptt. of Ag. Extension	3(1+2)
3	AEE-424	Cyber Extension	Deptt. of Ag. Extension	3(1+2)
4	AEE-425	Behavioral Skills	Deptt. of Ag. Extension	3(1+2)
5	AEM-426	Live Stock, Poultry and Fish Marketing	Deptt. of Ag. Economics	3(1+2)
6	AEM-427	Farm Planning and Budgeting	Deptt. of Ag. Economics	3(1+2)
7	AEM-428	Government Policies and Programmes Related to Agriculture	Deptt. of Ag. Economics	3(1+2)
VII		Basic Sciences	Will be taught by	
1	ABT-421	Molecular Breeding		3(1+2)
2	ABT-422	Plant tissue culture	Deptt. of Ag. Biotech	4(1+3)
3	ABT-423	Recombinant DNA Technology	Deptt. of Ag. Biotech	3(1+2)
4	ABT-424	Bio informatics	Deptt. of Ag. Biotech	3(1+2)
5	ABT-425	Microbial & Environmental Technology	Deptt. of Ag. Biotech	4(1+3)
6	ABT-426	Molecular Diagnostics	Deptt. of Ag. Biotech	3(1+2)
VIII		Commercial Agriculture	Will be taught by	
1	APH-427	Commercial floriculture	Deptt. of Horticulture	3(0+3)
2	APH-428	Commercial fruit production	Deptt. of Horticulture	3(0+3)
3	APH-429	Nursery management of horticultural crops	Deptt. of Horticulture	3(1+2)
4	APH-42-10	Cultivation of commercially important medicinal & aromatic plants	Deptt. of Horticulture	2(1+1)
5	APH-42-11	Commercial spices production	Deptt. of Horticulture	3(1+2)
6	APH-42-12	Production technology of economic forest plants	Deptt. of Horticulture & Agronomy	3(1+2)
7	AGP-422	Commercial seed production technologies	Deptt. of Horticulture & Plant Breeding	3(1+2)

Rural Agricultural Work Experience (RAWE): Under this programme two models are suggested and colleges could choose any one depending upon need assessment.

Sr.	RAWE Model I	Duration (Week)
1	Orientation	1
2	Village	16
3	Research Station/KVK/DAATT Center activities and attachment to the Agro-based industries	2
4	Project report preparation and examination	1

Sr.	RAWE Model II	Duration (Week)
1	Orientation	1
2	Village	6
3	Agri-clinics/Plant Health Clinics/Experiential leaning/ Industrial Attachement	12
4	Project report preparation and examination	1

AGRONOMY

1. Introductory Agriculture (Ancient Heritage, Agricultural Scenario and Gender Equity in Agriculture) (APA-111) 1(1+0)

Art, Science and business of crop production, Basic elements of crop production; Factors affecting crop production; History of Agricultural Development; Ancient India Agriculture in Civilization Era, Chronological Agricultural Technology development in India. Indian Agriculture, balance sheet, liabilities; Assets and Contrasting trends (DATA), Agril. growth, contrasting food chains, Diversity in physiography, Soil groups, marine, livestock and water; Liabilities: Soil factors, weather factors, Economic ecology, dry and irrigation agriculture, Farming Systems approach, value addition, requirements in new technology; Women in Agriculture: multifaceted roles and tasks, work stress factors, Nutritional and rural life standards, women friendly agricultural technology.

2. Principles of Agronomy (APA- 112) 2 (1+1)

Meaning and scope of Agronomy: National and International Agricultural Research Institutes in India. Agro-climatic zones of India and Uttar Pradesh. Tillage and tilth: definition, objectives, type, modem concept of tillage, minimal and zero tillage and implements used. Crops stand establishment: Planting geometry and its effect on growth and yield. Crop nutrition: Role of manures and fertilizers, their types, factors affecting fertilizer use, time and method of application. Crop production in dry land areas: conservation and efficient use of rain water, choice of crops and their varieties, crop management practices. Cropping system: Monoculture, crop rotation, mixed cropping, multiple cropping, parallel multiple cropping, alley cropping and relay cropping. Harvesting, threshing processing and storage.

Practical: Study of tillage implements, practice of puddling. Study of seeding equipments, different methods of sowing. Study of manures, fertilizers and green manure crops/seeds (including calculations). Study of inter cultivation implements and practices. Practices of methods of fertilizer application. Participation in on going field operations. Study of layout, design and statistical techniques used in field experimentation. Study of yield contributing characters and yield estimation. Preparation of copping scheme for a given farm. Suitable crops and their varieties for dry land area.

3. Water Management Including Micro Irrigation (APA-121) 3(2+1)

Irrigation: definition and objectives, water resources and irrigation development in India and Rajasthan; Soil plant water relationships; Methods of soil moisture estimation, evapotranspiration and crop water requirement; effective rainfall, scheduling of irrigation; Methods of irrigation: surface, sprinkler and drip irrigation; Irrigation efficiency and water use efficiency, conjunctive use of water, irrigation water quality and its management. Water management of different crops (rice, wheat, maize, groundnut, sugarcane, mango, banana and tomato); Agricultural drainage.

Practical: Determination of bulk density by field method; Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter; Determination of field capacity by field method; Determination of permanent wilting point; Measurement of irrigation water through flumes and weirs; Calculation of irrigation water requirement (Problems); Determination of infiltration rate; Demonstration of furrow method of irrigation; Demonstration of check basin and basin method of irrigation; Visit to farmers field and cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection and flushing of laterals; Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Determination of EC, pH, carbonates, biocarbonates, Ca++ and Mg++ in irrigation water (quality parameters).

4. Practical Crop Production I (Kharif Crops) (APA-211) 1(0+1)

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed treatment, nursery raising, sowing, nutrient management, water management, weed management and management of insect pests and diseases of crops harvesting, threshing, drying, winnowing, storage and marketing of produce. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of a group of students.

5. Organic Farming (APA-212) 3(2+1)

Introduction, concept, relevance in present context; Organic production requirements; Biological intensive nutrient management-organic manures, vermicomposting, green manuring, recycling of organic residues, biofertilizers; Soil improvement and amendments; Integrated diseases and pest management - use of biocontrol agents, biopesticides pheromones, trap crops, bird perches; Weed management; Quality considerations, certification, labeling and accreditation processors, marketing, exports.

Practical: Raising of scented rice, pulses, maize & vegetable crops organically through nutrient, diseases and pest management; vermin composting; rice & vegetable nursery raising; macro quality analysis, grading, packaging, post harvest management.

6. Crop Physiology (APA-213) 3(2 + 1)

Introduction, Importance in Agriculture. Seed Physiology, Seed structures, Morphological, physiological and biochemical changes during seed development, Physiological maturity - Morphological and physiological changes associated with physiological maturity in crop, Harvestable maturity, Seed viability and vigour, Factors affecting seed viability and vigour. Methods of testing seed viability and vigour, Germination, Utilization of seed reserves during seed germination, Morphological, physiological and biochemical changes during seed germination, Factors affecting seed germination. Growth and Development, Definition, Determinate and Indeterminate growth, Monocarpic and Polycarpic species with examples. Measurement of growth, Growth analysis Growth characteristics, Definitions and mathematical formulae. Crop Water Relations, Physiological importance of water to plants, Water potential and its components, measurement of water status in plants. Transpiration, significance, Transpiration in relation to crop productivity, Water Use Efficiency, WUE in C3, C4 and CAM plants, Factors affecting WUE. Photosynthesis, Energy synthesis, Significance of C3, C4 and CAM pathway, Relationship of Photosynthesis and crop productivity, Translocation of assimilates, Phloem loading, apoplastic and symplastic transport of assimilates, Source and sink concept, Photorespiration, Factors affecting Photosynthesis and productivity, Methods of measuring photosynthesis, Photosynthetic efficiency, Dry matter partitioning, Harvest index of crops. Respiration and its significance, Brief account of Growth respiration and maintenance respiration, Alternate respiration - Salt respiration - wound respiration - measurement of respiration. Nutriophysiology - Definition - Mengel's classification of plant nutrients - Physiology of nutrient uptake - Functions of plant nutrients - Deficience and toxicity symptoms of plant nutrients - Foliar nutrition - Hydroponics. Introduction of Photoperiodism and Vernalisation in relation to crop productivity - Photoperiodism Plant Growth Regulators - Occurrence - Biosynthesis - Mode of action of Auxins, Gibberellins, Cytokinins, ABA, Ethylene. Novel plant growth regulators, Commercial application of plant growth regulators in agriculture. Senescence and abscission - Definition - Classification - Theories of mechanism and control of senescence - Physiological and biochemical changes and their significance. Post Harvest Physiology - Seed dormancy - Definition - types of seed dormancy - Advantages and disadvantages of seed dormancy - Causes and remedial measures for breaking seed dormancy, Optimum conditions of seed storage - Factors influencing seed storage (ISTA standards). Fruit ripening - Metamorphic changes - Climateric and non-climateric fruits - Hormonal regulation of fruit ripening (with ethrel, CCC, Polaris, paclobuterozole).

Practical: Preparation of solutions; Growth analysis: Calculation of growth parameters; Methods of measuring water status in roots, stems and leaves; Measurement of water potential by Chardakov's method; Measurement of absorption spectrum of chloroplastic pigments and fluorescence; Measurement of leaf area by various methods; Stomatal frequency and index - Respirometer - Measurement of respirometer; Leaf anatomy of C3 and C4 plants; Transpiration of measurement; Imbibition of seed; Optimum conditions for seed germination; Breaking seed dormancy; (a) Chemical method (b) Mechanical method; Yield analysis; Seed viability and vigour tests; Effect of ethylene on regulation of stomata.

7. Practical Crop Production II (Rabi Crops) (APA-221) 1(0+1)

Crop planning, raising field crops in multiple cropping systems: Field preparation, seed treatment, nursery raising, sowing, nutrient management, water management, weed management and management of insect-pests and diseases of crops harvesting, threshing, drying, winnowing, storage and marketing of produce. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of a group of students.

8. Farming Systems and Sustainable Agriculture (APA-311) 2(1+1)

Sustainable agriculture: Introduction, definition, goal and current concepts, factors affecting ecological balance and ameliorative measures; Land degradation and conservators of natural resources, LEIA & HEIA; Irrigation problems, waste lands and their development; Organic farming: definition, principles and components; Farming systems: definition, principles and components, IFS models for wetland, irrigated dryland and dryland situations. Practical: Preparation of cropping scheme for irrigated situations; Preparation of cropping scheme for dryland situations; Study of existing farming systems in nearby villages; Preparation of integrated farming system model for wetlands; Preparation of integrated farming system model for drylands; Preparation of enriched Farm Yard Manure; Preparation of Vermicompost; Visit to urban waste recycling unit; Study of profitable utilization of agricultural wastes; Visit to poultry and dairy units to study resource allocation, utilization and economics; Visit to an organic farm to study various components and utilization; Study of degraded lands.

9. Field Crops-I (***Kharif***) (APA- 312) 3 (2+1)

Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield of kharif crops, Cereals - rice, maize, sorghum, pearl millet and minor millets; Pulses : pigeonpea, mungbean and urdbean; Oilseeds: groundnut, sesame and soybean; Fibre crops: cotton, jute and sunhemp; and Forage crops: sorghum, maize, cowpea, cluster bean and napier. Practical: Rice nursery preparation and transplanting/seed bed preparation and sowing of Kharif crops; Calculations on seed rate; Sowing of soybean, pigeonpea, mungbean, maize, groundnut, and cotton; Effect of seed size on germination and seedling vigour of soybean/groundnut; Effect of sowing depth on germination of soybean; Identification of weeds in rice, maize and soybean fields and study of weed control experiments in these crops; Top dressing of nitrogen in maize and rice and study of fertilizer experiments on rice, maize, sorghum and millets; Study of yield contributing characters, yield calculations, harvesting and yield estimation of above crops; Study of crop varieties and important agronomic experiments; Study of forage experiments.

10. Field Crops- II (Rabi) (APA-321) 3(2+1)

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of rabi crops; Cereals: wheat, barley; Pulses: chickpea, lentil, peas, ucern bean; Oilseeds: rapeseed and mustard, sunflower, safflower and linseed; Sugar crops: sugarcane and sugarbeet, Commercial crops: potato and tobacco, Forage crops: berseem, ucerne and oat.

Practical: Seed bed preparation and sowing of wheat, sugarcane and sunflower; Calculations on seed rate; Top dressing of nitrogen in wheat and study of fertilizer experiments on wheat and mustard; Identification of weeds in wheat and grain legumes, application of herbicide and study of weed control experiments; Morphological characteristics of wheat, sugarcane, chickpea and mustard; Yield contributing characters of wheat; Yield and quality analysis of sugarcane; Crop distribution in the state and the region; Important agronomic experiments of rabi crops and visit to research stations related to rabi crops.

11. Environmental Science (APA-322) 2 (1+1)

Scope and importance of environmental studies. Natural resources: Renewable and renewable resources. Forest, Water, Food, energy and land resources. Ecosystems: Definition, concept, structure and functions. Producers,

consumers and decomposers of an ecosystem. Energy flow in the ecosystem. Types of ecosystems. Bio-diversity: Definition, classification, threats to biodiversity and its conservation. Environmental pollution: Causes, effects and control of air, water, soil, thermal, noise and marine pollution. Causes, effects and management of soil nuclear hazards and industrial wastes. Disaster management, Floods, earthquakes, cyclones and land slides. Social issues and the environment, unsustainable to sustainable development. The Environment Protection Act, The Air Act, The water Act, The Wildlife Protection. Act and Forest Conservation Act. Woman and child welfare, HIV/AIDS and Role of information technology on environment and human health.

Practical: Collection, processing and storage of effluent samples; Determination of Bio- Chemical oxygen demand (BOD) in effluent sample; Determination of chemical oxygen demand (COD) in effluent sample; Estimation of dissolved oxygen in effluent samples; Determination of sound level by using sound level meter; Estimation of respirable and non respirable dust in the air by using portable dust sampler; Determination of total dissolved solids (TDS) in effluent samples; Estimation of species abundance of plants; Estimation of nitrate contamination in ground water; Analysis of temporary and total hardness of water sample by titration; Estimation of pesticide contamination in Agro-Ecosystem; Visit to Social Service Organisation / Environmental Education Centre; Crop adaptation to environmental variables, soils conditions; Study of transpiration and water balance in plants; Visit to a local polluted site. Observations and remedial measures; Assessment of chlorophyll content of fresh water / sea water ecosystem.

12. Weed Management (APA-323) 2 (1+1)

Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination; Weed biology and ecology, crop weed association, crop weed competition and allelopathy, Concepts of weed prevention, control and eradication; Methods of weed control: physical, cultural, chemical and biological methods. Integrated weed management; Herbicides: advantages and limitation of herbicide usage in India, Herbicide classification, formulations, methods of application; Introduction to Adjuvants and their use in herbicides; Introduction to selectivity of herbicides; Compatibility of herbicides with other agro chemicals; Weed management in major field and horticultural crops, shift of weed flora in cropping systems, aquatic and problematic weeds and their control.

Practical: Identification of weeds; Survey of weeds in crop fields and other habitats; Preparation of herbarium of weeds; Calculations on weed control efficiency and weed index; Herbicide label information; Computation of herbicide doses; Study of herbicide application equipment and calibration; Demonstration of methods of herbicide application; Preparation of list of commonly available herbicides; Study of phytotoxicity symptoms of herbicides in different crops; Biology of nut sedge, bermuda grass, parthenium and celosia; Economics of weed control practices; Tours and visits of problem areas.

GENETICS AND PLANT BREEDING

1. Fundamentals of Genetics (AGP-111) 3 (2+1)

Mendel's laws of inheritance and exceptions to the laws; Types of gene action, Multiple alleles, Pleiotropism, Penetrance and expressivity; Quantitative traits, Qualitative traits and differences between them; Multiple factor hypothesis; Cytoplasmic inheritance, it's characteristic features and difference between chromosomal and cytoplasmic inheritance; Mutation and it's characteristic features; Methods of inducing mutations and C l B technique. Gene expression and differential gene activation; Lac operon and Fine structure of Gene; Ultra structure of cell and cell organelles and their functions; Study of chromosome structure, morphology, number and types, Karyotype and Idiogram; Mitosis and meiosis, their significance and differences between them; DNA and it's structure, function, types, modes of replication and repair. RNA and its structure, function and types; Transcription, Translation, Genetic code and outline of protein synthesis; Crossing over and factors affecting it; Mechanism of crossing over and Cytological proof of crossing over; Linkage, Types of linkage and estimation of linkage; Numerical chromosomal aberrations (Polyploidy) and evolution of different crop species like Cotton, Wheat, Tobacco, Triticale and Brassicas; Structural chromosomal aberrations.

Practical: Microscopy (Light microscopes and electron microscopes; Preparation and use of fixatives and stains for light microscopy; Preparation of micro slides and identification of various stages of mitosis; Preparation of micro slides and identification of various stages of mitosis; Preparation of micro slides and identification of various stages of meiosis; Preparation of micro slides and identification of various stages of meiosis; Monohybrid ratio and its modifications; Dihybrid ratio and its modifications; Trihybrid ratio; Chi-square analysis and Interaction of factors; Epistatic factors, Supplementary factors and Duplicate factors; Complementary factors, Additive factors and Inhibitory

factors; Linkage - Two point test cross; Linkage - Three point test cross; Induction of polyploidy using colchicines; Induction of chromosomal aberrations using chemicals.

2. Fundamentals of Seed Technology (AGP-121) 3(2+1)

Introduction to Seed Production, Importance of Seed Production, Seed policy, Seed demand forecasting and planning for certified, foundation and breeder seed production, Deterioration of crop varieties, Factors affecting deterioration and their control; Maintenance of genetic purity during seed production, Seed quality; Definition, Characters of good quality seed, Different classes of seed, Production of nucleus & breeder's seed, Maintenance and multiplication of pre-release and newly released varieties in self and cross-pollinated crops; Seed Production, Foundation and certified seed production in maize (varieties, hybrids, synthetics and composites); Foundation and certified seed production of rice (varieties & hybrids); Foundation and certified seed production of sorghum and bajra (varieties, hybrids, synthetics and composites); Foundation and certified seed production of cotton and sunflower (varieties and hybrids); Foundation and certified seed production of castor (varieties and hybrids); Foundation and certified seed production of tomato and brinjal (varieties and hybrids); Foundation and certified seed production of chillies and bhendi (varieties and hybrids); Foundation and certified seed production of onion, bottle gourd and ridge gourd (varieties and hybrids); Seed certification, phases of certification, procedure for seed certification, field inspection and field counts etc.; Seed Act and Seed Act enforcement, Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories; Duties and powers of seed inspectors, offences and penalties; Seed control order: Seed Control Order 1983, Seed Act 2000 and other issues related to seed quality regulation. Intellectual Property Rights, Patenting, WTO, Plant Breeders Rights, Varietal Identification through Grow-Out Test and Electrophoresis; Seed Drying: Forced air seed drying, principle, properties of air and their effect on seed drying, moisture equilibrium between seed and air, Heated air drying, building requirements, types of air distribution systems for seed drying, selection of crop dryers and systems of heated air drying, recommended temperature and depth of the seeds, management of seed drying, Planning and layout of seed processing plant; Establishment of seed processing plant. Seed processing: air screen machine and its working principle, different upgrading equipments and their use, establishing a seed testing laboratory. Seed testing procedures for quality assessment, Seed treatment, Importance of seed treatment, types of seed treatment, equipment used for seed treatment (Slurry and Mist-O-matic treater), Seed packing and seed storage, stages of seed storage, factors affecting seed longevity during storage and conditions required for good storage, General principles of seed storage, constructional features for good seed warehouse, measures for pest and disease control, temperature control, Seed marketing, marketing structure, marketing organization, sales generation activities, promotional media, pricing policy; Factors affecting seed marketing.

Practical: Seed sampling principles and procedures; Physical Purity analysis of Field and Horticultural crops; Germination analysis of Field and Horticultural crops; Moisture tests of Field and Horticultural crops; Viability test of Field and Horticultural crops; Seed health test of Field and Horticultural crops; Vigour tests of Field and Horticultural crops; Seed dormancy and breaking methods; Grow out tests and electrophoresis for varietal identification; Visit to Seed production plots of Maize, Sunflower, Bajra, Rice, Sorghum, Cotton, Chillies and Vegetables. (Add or delete crops of the region); Visit to Seed processing plants; Visit to Seed testing laboratories; Visit to Grow out testing farms; Visit to Hybrid Seed Production farms; Varietal identification in seed production plots; Planting ratios, isolation distance, roguing etc

3. Fundamentals of Plant Breeding (AGP-211) 3(2+1)

Classification of plants, Botanical description, Floral biology, Emasculation and Pollination techniques in cereals, millets, pulses, oil seeds, fibers, plantation crops etc. Aims and objectives of Plant Breeding; Modes of reproduction, Sexual, Asexual, Apomixis and their classification; Significance in plant breeding; Modes of pollination, genetic consequences, differences between self and cross pollinated crops; Methods of breeding - introduction and acclimatization. Selection, Mass selection Johannson's pure line theory, genetic basis, pure line selection; Hybridization, Aims and objectives, types of hybridization; Methods of handling of segregating generations, pedigree method, bulk method, back cross method and various modified methods; Incompatibility and male sterility and their utilization in crop improvement; Heterosis, inbreeding depression, various theories of Heterosis, exploitation of hybrid vigour development of inbred lines, single cross and double cross hybrids; Population improvement programmes, recurrent selection, synthetics and composites; Methods of breeding for vegetatively propagated crops; Clonal selection; Mutation breeding; Ploidy breeding; Wide hybridization, significance in crop improvement.

Practical: Botanical description and floral biology; Study of megasporogenesis and microsporogenesis; Fertilization and life cycle of an angiospermic plant; Plant Breeder's kit; Hybridization techniques and precautions to be taken; Floral morphology, selfing, emasculation and crossing techniques; Study of male sterility and incomapribility in field plots; Rice and Sorghum; Maize and Wheat; Bajra and ragi; Sugarcane and coconut; Groundnut, Castor, Safflower and Sesamum; Redgram, Bengalgram and Greengram; Soybean and blackgram; Chillies, Brinjal and Tomato; Bhendi, Onion, Bottle gourd and Ridge gourd; Cotton and Mesta; Jute and Sunhemp

4. Breeding of Field Crops (AGP-221) 2(1+1)

Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Hardy-Weinberg Law; Study in respect of origin, distribution of species, wild relatives and forms, Cereals, (rice, wheat, maize, millets, sorghum, bajra); Pulses (redgram, greengram, blackgram, soybean); Oilseeds (Groundnut, sesame, sunflower, mustard) etc. Fibers and Cash crops (Cotton, Sugar cane) etc. Major breeding procedures for development of hybrids / varieties of various crops; Plant Genetic resources their conservation and utilization in crop improvement; Ideotype concept in crop bimprovement; Breeding for resistance to biotic and abiotic stresses variability in pathogens and pests; Mechanisms of resistance in plant to pathogens and pest; Genetic basis of adaptability to unfavourable environments; Definition of biometrics, assessment of variability i.e., additive, dominance and epistasis and their differentiation; Genotype Environment interaction and influence on yield/performance, IPR and its related issues.

Practical: Emasculation and Hybridization techniques; Handling of segregating generations, pedigree methods; Handling of segregating generations, bulk methods; Handling of segregating generations, back cross methods; Field lay out of experiments; Field trials, maintenance of records and registers; Estimation of Heterosis and inbreeding depression; Estimation of Heritability, GCA and SCA; Estimation of variability parameters; Parentage of released varieties/hybrids; Problems on Hardy, Weinberg Law; Study of quality characters; Sources of donors for different characters; Visit to seed production and certification plots; Visit to AICRP trials and programmes; Visit to grow out test plots; Visit to various research stations; Visit to other institutions.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

1. Agricultural Meteorology (APS-111) 2(1+1)

Agricultural meteorology: Weather and climate, micro-climate, weather elements, Earths' atmosphere, Composition and structure, solar radiation, Nature, properties, depletion, solar constant and energy balance, Atmospheric, temperature, factors affecting, horizontal and vertical distribution, variations and global warming, Air Pressure variations; Wind: factors affecting, cyclones and anticyclones and general circulation, Atmospheric humidity, vapour pressure and saturation, Process of condensation, formation of dew, fog, mist, snow, rain and hail; Formation and classification of clouds, Introduction to monsoon, Basics of weather forecasting.

Practical : Site selection for Agromet observatory; Measurement of temperature; Measurement of rainfall; Measurement of evaporation (atmospheric/soil); Measurement of atmospheric pressure; Measurement of sunshine duration and solar radiation; Measurement of wind direction and speed and relative humidity; Study of weather forecasting and synoptic charts.

2. Introduction to Soil Science (APS-112) 3(2+1)

Soil: Pedological and edaphological concepts, Origin of the earth, Earth's crust; Composition: Rocks and minerals Weathering, Soil formation factors and processes Components of soils; Soil profile, Soil physical properties, Soil texture, Textural classes, Particle size analysis, Soil structure Classification, Soil aggregates, significance, Soil consistency, Soil crusting, Bulk density and particle density of soils & porosity, their significance and manipulation, Soil compaction, Soil Colour, Elementary knowledge of soil classification and soils of India; Soil water, Retention and potentials, Soil moisture constants, Movement of soil water, Infiltration, percolation, permeability, Drainage, Methods of determination of soil moisture Thermal properties of soils, Soil temperature, Soil air, Gaseous exchange, Influence of soil temperature and air on plant growth; Soil colloids, Properties, nature, types and significance; Layer silicate clays, their genesis and sources of charges, Adsorption of ions, Ion exchange, CEC & AEC Factors influencing ion exchange and its Significance. Soil organic matter, Composition, Decomposability, Humus, Fractionation of organic matter, Carbon cycle, C: N ratio. Soil biology, Biomass, Soil organisms and their beneficial and harmful

roles. Practical: Determination of bulk density and particle density, Aggregate analysis, Soil strength, Soil moisture determination, Soil moisture constants - Field capacity Inflitration rate, water holding capacity, soil texture and mechanical analysis - Soil temperature. Analytical chemistry - Basic concepts, techniques and calculations - Collection and processing of soil for analysis - Organic carbon, pH, EC, soluble cations and anions - Study of a soil profile - Identification of rocks and minerals.

3. Agricultural Microbiology (APS-121) 3(2+1)

History of Microbiology: Spontaneous generation theory, Role of microbes in fermentation, Germ theory of disease, Protection against infections, Applied areas of Microbiology Metabolism in bacteria: ATP generation, chemoautotrophy, photo autotrophy, respiration, fermentation. Bacteriophages: structure and properties of Bacterial viruses - Lytic and Lysogenic cycles: viroids, prions. Bacterial genetics; Gene expression; Genetic recombination: transformation, conjugation and transduction, genetic engineering, Plasmids, episomes, genetically modified Organisms. Soil Microbiology: Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur, Biological nitrogen fixation. Microflora of Rhizosphere and Phyllosphere microflora, microbes in composting. Microbiology of Water. Microbiology of food: microbial spoilage and principles of food preservation. Beneficial microorganisms in Agriculture: Biofertilizer (Bacterial Cyanobacterial and Fungal), microbial insecticides, Microbial agents for control of Plant diseases, Biodegradation, Biogas production, Biodegradable plastics, Plant - Microbe interactions. Practical: General instructions, Familiarization with instruments, materials, glassware etc. in a microbiology laboratory: Practice of Aseptic methods: I - Evaluation of aseptic technique with Nutrient broth tubes. II- Evaluation of aseptic technique with a Nutrient agar plate. Methods of Sterilization and Preparation of media I- Preparation of nutrient broth, nutrient agar plates, nutrient agar slant and nutrient agar stabling; II-Sterilization of glassware by Dry heating; III-Sterilization of nutrient broth by Filtration. Plating methods for Isolation and Purification of bacteria I - Isolation of bacteria by Streak plate method. II-Isolation of aerobic spore forming bacteria by Enrichment using Streak plate method. III-Checking of purity of a bacterial culture by Streak plating method. Identification of bacteria by staining methods and Biochemical tests: I-Morphological examination of bacteria by Simple and Differential staining. II-Different biochemical tests for identification of bacterial culture; Enumeration of bacteria: I-Enumeration of bacteria by Stain slide method. II- Enumeration of bacteria by most probable number method. III-Enumeration of bacteria by Pour plate method and Spread plate method.

4. Soil Chemistry, Soil Fertility and Nutrient Management (APS-122) 3(2+1)

Soil as a source of plant nutrients. Essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Measures to overcome deficiencies and toxicities. Problem soils - acid, salt affected and calcareous soils, characteristics, nutrient availabilities. Reclamation - mechanical, chemical and biological methods. Fertilizer and insecticides and their effect on soil water and air. Irrigations water - Quality of irrigation water and its appraisal. Indian standards for water quality. Use of saline water for agriculture. Soil fertility - Different approaches for soil fertility evaluation. Methods, Soil testing - Chemical methods. critical levels of different nutrients in soil. Plant analysis - DRIS methods, critical levels in plants. Rapid tissue tests. Indicator plants. Biological method of soil fertility evaluation. Soil test based fertilizer recommendations to crops. Factors influencing nutrient use efficiency (NUE) in respect of N, P, K, S, Fe and Zn fertilizers. Source, method and scheduling of nutrients for different soils and crops grown under rainfed and irrigated conditions.

Practical: Principles of analytical Instruments and their calibration and applications, Colorimetry and flame photometry. Estimation of available N, P, K, S, and Zn in oils, pH, EC, soluble cations and anions in soil water extracts. Lime requirement and gypsum requirement of problem soils. Estimation of N, P and K in plants.

5. Manures, Fertilizers and Agro-Chemicals (APS-221) 3(2+1)

Introduction - Raw materials - Manures - Bulky and concentrated - FYM, Composts - Different methods, Mechanical compost plants, Vermicomosting, Green manures, Oil cakes, Sewage and sludge - Biogas plant slurry, Plant and animal refuges. Fertilizers - classifications, Manufacturing processes and properties of major nitrogenous (ammonium sulphate, urea, calcium ammonium nitrate, ammonium nitrate, ammonium sulphate nitrate) phosphatic (single super phosphate, enriched super phosphate, diammonium phosphate, ammonium poly phosphate), potassic and complex fertilizers their fate and reactions in the soil, Secondary and micronutrients fertilizers, Amendments. Fertilizer Control Order, Fertilizer storage; Biofertilizers and their advantage, Organic chemistry as prelude to agro

chemicals, Diverse types of agrochemicals, Botanical insecticides (Neem), Pyrethrum, Synthetic pyrethroids. Synthetic organic insecticides, Major classes, Properties and uses of some important insecticides under each class. Herbicides - Major classes - Properties and uses of 2, 4-D, atrazine, glyphosate, butachlor benthiocarb; Fungicides - Major classes - Properties and uses of carbendazim, carboxin, captan, tridemorph and copper oxychloride - Insecticides Act, Plant growth regulators.

Practical: Total nitrogen and phosphorus in manures / composts - Ammoniacal and nitrate nitrogen - Water soluble P2O5, potassium, calcium, sulphur and zinc contents of fertilizers COD in organic wastes - Adulteration in fertilizer. Argentimetric and iodometric titrations - their use in the analysis of lindane metasystox, endosulfan, malathion, copper and sulphur fungicides - Compatibility of fertilizers with pesticides.

ENTOMOLOGY

1. Insect Morphology and Systematic (APE-211) 3(2+1)

History of Entomology in India. Factors for insects abundance. Classification of phylum Arthropoda upto classes. Relationship of class Insecta with other classes of Arthropoda. Morphology: Structure and functions of insect cuticle and moulting. Body segmentation. Structure of Head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts and legs. Wing venation, modifications and wing coupling apparatus. Structure of male and female genetalia. Sensory organs. Metamorphosis and diapause in insects. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretory (Endocrine) and reproductive system in insects. Types of reproduction in insects. Systematics: Taxonomy-importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta upto Orders. Orthoptera- Acrididae. Dictyoptera, Mantidae; Odonata; Isoptera- Termitidae; Thysanoptera- Thripidae; Hemiptera- Pentatomidae, Coreidae, Pyrrhocoridae, Lygaeidae, Cicadellidae, Delphacidae, Aphididae, Coccidae, Aleurodidae, Pseudococcidae; Neuroptera- Chrysopidae; Lepidoptera- Noctuidae, Sphingidae, Pyralidae, Gelechiidae, Arctiidae; Coleoptera-Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae, Scarabaeidae; Hymenoptera- Tenthridinidae, Apidae, Trichogrammatidae, Ichneumonidae, Braconidae; Diptera- Cecidomyiidae, Trypetidae, Tachinidae, Agromyziidae.

Practical: Methods of collection and preservation of insects including immature stages; External features of Grasshopper/Blister beetle; Types of insect antennae, mouthparts and legs; Wing venation, types of wings and wing coupling apparatus Types of insect larvae and pupae; Dissection of digestive system in insects (Grassopher); Dissection of male and female reproductive systems in insects (Grassopher); Study of characters of orders Orthoptera, Dictyoptera, Odonata, Isoptera, Thysanoptera, Hemiptera, Lepidoptera, Neuroptera, Coleoptera, Hymenoptera, Diptera and their families of agricultural importances

2. Insect Ecology and Integrated Pest Management Including Beneficial Insects (APE-221) 3(2+1)

Introduction, Environment and its components. Effect of abiotic factors- temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors - food competition, natural and environmental resistance. Concepts of Balance of life in nature, biotic potential and environmental resistance and causes for outbreak of pests in agro-ecosystem. IPM- Pest surveillance and pest forecasting. Categories of pests. Introduction, importance, Practices, scope and limitations of IPM concepts and tools of IPM-Host plant resistance, Cultural, Mechanical, Physical, Legislative, Biological (parasites, predators & transgenic plant pathogens such as bacteria, fungi and viruses) Chemical control - importance, hazards and limitations. Classification of insecticides, toxicity of insecticides and formulations of insecticides. Study of important insecticides. Botanical insecticides - neem based products, Organophosphates, Carbamates, Synthetic pyrethroids, Novel insecticides- Pheromones, Nicotinyl insecticides, Chitin synthesis inhibitors, Phenyl pyrazoles, Avermectins, Macrocyclic lactones, Oxadiazimes, Thiourea derivaties, pyridine azomethines, pyrroles, etc. Nematicides, Rodenticides, Acaricides and fumigants. Recent methods of pest control-repellents, antifeedants, hormones, attractants, gamma radiation and genetic control. Insecticides Act 1968 - Important provisions. Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes. Beneficial insects: parasites and predators used in pest control and their mass multiplication techniques. Important groups of microorganisms, bacteria, viruses and fungi used in pest control and their mass multiplication techniques. Important species of pollinators, weed killers and scavengers, their importance. Non insect pests - mites, nematodes, rodents and birds. Vermiculture, Aprculture, Sericulture, Laculture.

Practical: Visit to meteorological observatory / automatic weather reporting station; Study of terrestrial and pond ecosystems of insects; Studies on behaviour of insects and orientation (repellency, stimulation, deterancy); Study of distribution patterns of insects, sampling techniques for the estimation of insect population and damage; Pest surveillance through light traps, pheremone traps and field incidence; Practicable IPM practices, Mechanical and physical methods; Practicable IPM practices, Cultural and biological methods; Mass multiplication techniques of bio-agents. Chemicalcontrol, Insecticides and their formulations; Calculation of doses/concentrations of insecticides; Compatibility of pesticides and Phytotoxicity of insecticides; IPM case studies; Identification of common phytophagous mites and their morphological characters; Identification of common plant parasitic nematodes and their morphological characters; Identification of rodents and bird pests and their damage; Identification of earthworms in vermiculture - visit to vermiculture unit; Other beneficial insects - Pollinators, weed killers and scavengers.

3. Crop Pests and Stored Grain Pests and Their Management (APE-311) 3(2+1)

Stored grain pests: Coleopteran and Lepidopteran pests, their biology and damage, preventive and curative methods. Distribution, biology, nature and symptoms of damage, and management strategies of insect and non insect pests of rice, sorghum, maize, ragi (Eleucinen coracana), wheat, sugarcane, cotton, mesta, sunhemp, pulses, groundnut, castor, gingerly, safflower, sunflower, mustard, brinjal, bhendi, tomato, cruciferous and cucurbitaceous vegetables, potato, sweet potato, colacasia, moringa, amaranthus, chillies, mango, citrus, grapevine, cashew, banana, pomegranate, guava, sapota, ber, apple, coconut, tobacco, coffee, tea, turmeric, betelvine, onion, coriander, garlic, curry leaf, pepper, ginger and ornamental plants.

Practical: Identification of pests, their damage symptoms and management of rice, sorghum, maize, wheat, sugarcane, cotton, pulses, Solanaceous and Malvaceous vegetables, cruciferous and cucurbitaceous vegetables, chilli, mango, carbon, citrus and sapota.

AGRICULTURAL ECONOMICS

1. Principles of Agricultural Economics (AEM-121) 2 (2+0)

Economics: Meaning, Definition, Subject matter, Divisions of Economics, Importance of Economics; Agricultural Economics: Meaning, Definition; Basic Concepts: Goods, Service, Utility, Value, Price, Wealth, Welfare. Wants: Meaning, Characteristics, Classifications of Wants, Importance. Theory of consumption: Law of Diminishing Marginal utility, Meaning, Definition, Assumption, Limitations, Importance. Consumer's surplus: Meaning, Definition, Importance. Demand: Meaning, Definition, Kinds of Demand, Demand schedule, Demand Curve, Law of Demand, Extension and Contraction Vs Increase and Decrease in Demand. Elasticity of Demand: Types of Elasticity of Demand, Degrees of price elasticity of Demand, Methods of Measuring Elasticity, Factors influencing elasticity of Demand, Importance of Elasticity of Demand. Welfare Economics: Meaning, Pareto's optimality. National Income: Concepts, Measurement. Public Finance: Meaning, Principles. Public Resource: Meaning, Services Tax, Meaning, Classification of Taxes: Cannons of Taxation, Public expenditure: Meaning, Principles. Inflation: Meaning, Definition, Kinds of inflation.

2. Agricultural Finance and Co-Operation (AEM-211) 2 (1+1)

Agricultural finance: nature and scope. Time value of money, Compounding and Discounting. Agricultural credit: meaning, definition, need, classification. Credit analysis: 4R's 5C's and 7 P's of credit, repayment plans. History of financing agriculture in India. Commercial banks, nationalization of commercial banks. Lead bank scheme, regional rural banks, scale of finance. Higher financing agencies, RBI, NABARD, AFC, Asian Development Bank, World Bank, Insurance and Credit Guarantee Corporation of India. Assessment of crop losses, determination of compensation. Crop insurance, advantages and limitations in application, estimation of crop yields. Agricultural cooperation: philosophy and principles. History of Indian cooperative Movement, pre-independence and post independence periods, cooperation in different plan periods, cooperative credit structure: PACS, FSCS. Reorganisation of cooperative credit structure in Andhra Pradesh and single window system. Successful cooperative systems in Gujarat, Maharastra. Punjab etc.

Practical: Factors governing use of Capital and identification of credit needs; Time value of money, Compounding and discounting; Tools of financial management, Balance sheet, Income statement and cash flow analysis; Estimations of credit needs and determining unit costs; Preparations and analysis of loan proposals; Types of repayment loans; Study of financial institutions: PACS, DCCB, Apex Banks, RRBs, CBs, NABARD.

3. Agricultural Marketing, Trade and Prices (AEM-221) 2 (1+1)

Agricultural Marketing: Concepts and Definition, Scope and subject matter, Market and Marketing: Meaning, Definitions, Components of a market, Classification. Market structure, Conduct, performance. Marketing structure, Market functionaries or agencies, Producer's surplus: Meaning, Types of producers surplus, marketable surplus. Marketed surplus, importance, Factors affecting Marketable surplus. Marketing channels: Meaning, Definition, Channels for different products. Market integration, Meaning, Definition, Types of Market Integration. Marketing efficiency: Meaning, Definition, Marketing costs, Margins and price spread, Factors affecting the cost of marketing, Reasons for higher marketing costs of farm commodities, Ways of reducing marketing costs. Theories of International Trade: Domestic Trade, Free trade, International Trade, GATT, WTO, Implications of AOA. Market access, Domestic support, Export subsidies, EXIM-Policy & Ministerial conferences. Cooperative Marketing. State Trading. Ware Housing Corporation; Central and State, Objectives, Functions, Advantages. Food Corporation of India: Objectives and Functions. Quality Control, Agricultural Products, AGMARK. Price Characteristics of agricultural product process, Meaning, Need for Agricultural Price Policy. Risk in Marketing: Meaning and importance, Types of Risk in Marketing. Speculations and Hedging, Futures trading, Contract farming.

Practical: Identification of marketing channels; Study of Rythu Bazars, Regulated markets; Study of unregulated markets; Study of livestock markets; Price spread analysis; Visit to market institutions, NAFED; Study of SWC, CWC and STC; Analysis of information of daily prices; Marketed and marketable surplus of different commodities.

4. Fundamentals of Farm Business Management (AEM-311) 2 (1+1)
(Including Project Development, Appraisal and Monitoring)

Agribusiness: Meaning, Definition, Structure of Agribusiness, (Input, Farm, Product Sectors). Importance of Agribusiness in the Indian Economy, Agricultural Policy. Agribusiness Management, Distinctive features, Importance of Good Management, Definitions of Management. Management Functions, Planning, Meaning, Definition, Types of Plans (Purpose or Mission, Goals or Objectives, Strategies, Polices, Procedures, rules, programmes, Budget) characteristics of sound plan, Steps in planning, Organisation, Staffing, Directing, Motivation, Ordering, Leading, Supervision, Communication, control. Capital Management. Financial Management of Agribusiness: Importance of Financial Statements, Balance sheet, Profit and Loss Statement, Analysis of Financial statements. Agro-based Industries: Importance and Need, Classification of Industries, Types of Agro-based Industries, Institutional arrangement, Procedure to set up agro-based industries, Constraints in establishing agro-based industries. Marketing Management: Meaning, Definitions, Marketing Mix, 4Ps of Marketing. Mix, Market segmentation, Methods of Market, Product life cycle. Pricing policy, Meaning, pricing method. Prices at various stages of Marketing. Project, definitions, project cycle, Identification, Formulation, Appraisal, Implementation, Monitoring and evaluation, Appraisal and Evaluation techniques, NPW, BCR, IRR, N/K ratio, sensitivity analysis, characteristics of agricultural projects: preparation of project reports for various activities in agriculture and allied sectors: Dairying, poultry, fisheries, agro-industries etc. Practical: Study of input markets: seed, fertilizers, pesticides. Study of output markets, grains, fruits, vegetables, flowers. Study of product markets, retail trade commodity trading, and value added products. Study of financing institutions cooperatives commercial banks, RRBs, Agribusiness Finance Limited, NABARD; Preparations of projects, Feasibility reports; Project appraisal techniques; Case study of agro-based industries.

5. Production Economics and Farm Management (AEM-321) 2 (1+1)

Production Economics: Meaning, Definition, Nature and Scope of Agricultural Production Economics. Basic concepts and terms. Concepts of Production. Production Functions: Meaning, Definition, Types. Laws of returns: Increasing, Constant and decreasing. Factor Product Relationship. Determination of optimum input and output. Factor relationship. Product relationship. Types of enterprise relationships. Returns to scale: Meaning, Definition, Importance. Farm Management. Economic principles applied to the Organizations of farm business. Types and systems of farming. Farm planning and budgeting. Risk and uncertainty. Farm budgeting. Linear programming: Assumptions, Advantages and Limitations of Linear programming.

Practical: Computation of cost concepts; Methods of computation of depreciation; Analysis of Net worth statement; Farm inventory analysis; Preparation of farm plans and budgets; Types of farm records and accounts; Preparation of profit and loss account; Break, Even analysis; Economics analysis of different crop and livestock enterprises; Application of Farm Management Principles.

AGRICULTURAL ENGINEERING

1. Fundamentals of Soil, Water and Conservation Engineering (AET-111) 3(2+1)

Surveying: survey equipment, chain survey, cross staff survey, plotting procedure, calculations of area of regular and irregular fields. Levelling - levelling equipment, terminology, methods of calculation of reduced levels, types of levelling, contouring. Irrigation, classification of projects, flow irrigation and lift irrigation. Water source, Water lifting devices - pumps (shallow and deep well), capacity, power calculations. Irrigation water measurement - weirs, flumes and orifices and methods of water measurement and instruments. Water conveyance systems, open channel and underground pipeline. Irrigation methods - drip and sprinkle irrigation systems. Soil and water conservation - soil erosion, types and engineering control measures.

Practical: Acquaintance with chain survey equipment; Ranging and measurement of offsets; Chain triangulation; Cross staff survey; Plotting of chain triangulation; Plotting of cross staff survey; Levelling equipment - dumpy level, levelling staff, temporary adjustments and staff reading; Differential leveling; Profile leveling; Contour survey - grid method; Plotting of contours; Study of centrifugal pumping system and irrigation water measuring devices; Study of different components of sprinkler irrigation systems; Study of different components of drip and sprinkler irrigation systems; Uniformity of water application in drip and sprinkler systems; Study of soil and water conservation measures.

2. Farm Power and Machinery (AET-211) 2(1+1)

Farm power in India: sources, I.C engines, working principles, two stroke and four stroke engines, I.C. engine terminology, different systems of I.C. engine. Tractors, Types, Selection of tractor and cost of tractor power. Tillage implements: Primary and Secondary tillage implements, Implements for intercultural operations, seed drills, paddy transplanters, plant protection equipment and harvesting equipment; Equipment for land development and soil conservation. Threshers, winnowers, maize shellers, decordicators,- Principles of working, care and maintenance.

Practical: Study of different components of I.C. Engine; Study of working of four stroke engine; Study of working of two stroke engine; Study of M.B. plough, measurement of plough size, different parts, horizontal and vertical suction, determination of line of pull etc.; Study of disc plough; Study of seed-cum-fertilizer drills-furrow opener, metering mechanism, and calibration; Study, maintenance and operation of tractor; Learning of tractor driving; Study, maintenance and operation of power tiller; Study of different parts, registration, alignment and operation of mower. Study of different inter cultivation equipment in terms of efficiency, field capacity; Repairs and adjustments and operation of sprayers; Repairs and adjustments and operation of dusters; Study of paddy transplanters, Study of harvesters and threshers etc.

3. Protected Cultivation and Post Harvest Technology (AET-221) 2(1+1)

Green house technology, Introduction, Types of Green Houses; Plant response to Green house environment, Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes. Green house equipment, materials of construction for traditional and low cost green houses. Irrigation systems used in greenhouses, Typical applications, passive solar green house, hot air green house heating systems, green house drying. Performance evaluation of greenhouse, cooling efficiency, measurement of environmental parameters, soil moisture cost estimation and economic analysis. Choice of crops for cultivation under greenhouses, problems/constraints of greenhouse cultivation and future strategies. Growing media, soil culture, type of soil required, drainage, flooding and leaching, soil pasteurization in peat moss and mixtures, rock wool and other inert media, nutrient film technique (NFT)/ hydroponics. Unit operations of post harvest technology of cereals, pulses, oilseeds, - cleaning, grading, drying, milling storage, packaging etc. Grain Cleaners and Graders, Grain drying, types of drying, types of dryers. Storage, grain storage, types of storage structures, Size reduction, equipment for size reduction care and maintenance. Moisture content, Post harvest technology of fruits and vegetables- cleaning methods, machinery for cleaning, care and maintenance. Methods of grading, equipment for grading of fruits and vegetables, care and maintenance. Value addition, quality evaluation, quality standards - FAQ, ASTA, FPO, FDA.,. Preservation methods, Evaporation-principles, types of evaporators,. By products and waste management.

Practical: Study of different types of green houses based on shape, construction and cladding materials; Calculation of air rate exchange in an active summer winter cooling system; Calculation of rate of air exchange in an active winter cooling system; Soil solarization, Estimation of drying rate of agricultural products inside green house;

Testing of soil and water to study its suitability for growing crops in greenhouses; The study of fertigation requirements for greenhouses crops and estimation of E.C. in the fertigation solution; The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization / sterilization; Visit to commercial green houses. Moisture content determination, Study of cleaners and graders, Study of dryers, Study of improved grain storage structures; study of milling/size reduction equipments, Study of food processing unit, Study on product development, Study on plant visit.

4. Renewable Energy (AET-321) 2 (1+1)

Energy sources, Introduction, Classification, Energy from Biomass, Types of biogas plants, constructional details, Biogas production and its utilization, Agricultural wastes, Principles of combustion, pyrolysis and gasification, Types of gasifiers, Producer gas and its utilization. Briquettes, Types of Briquetting machines, uses of Briquettes, Shredders. Solar energy, Solar flat plate and focussing plate collectors, Solar air heaters, Solar space heating and cooling, Solar energy applications / Solar energy gadgets, Solar cookers, Solar water heating systems, solar grain dryers, Solar Refrigeration system, Solar ponds, Solar photo voltaic systems, solar lantern, Solar street lights, solar fencing, Solar pumping systems. Wind energy, Types of wind mills, Constructional details & application of wind mills. Liquid Bio fuels, Bio diesel and Ethanol from agricultural produce, its production & uses.

Practical: Constructional details of KVIC & Janatha type biogas plants; Constructional details of Deen Bandu type biogas plants; Field visit to biogas plants; Constructional details of different types of gasifiers; Testing of gasifiers; Briquette preparation from biomass; To study and find the efficiency of solar cooker; To study and find the performance of a solar still; To study and find the performance of a solar dryers; Study and working of solar photovoltaic pumping system; Study and performance evaluation of domestic solar water heater; Study and performance evaluation of solar lantern; Study and performance evaluation of solar street light; To study the performance of different types of wind mills; Field visit to wind mills; To study the processing of Bio-diesel production from Jatropha.

PLANT PATHOLOGY

1. Plant Pathogens and Principles of Plant Pathology (APP-111) 4 (3+1)

Introduction, Important plant pathogenic organisms, different groups, fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, viriods, algae, protozoa and phanerogamic parasites with examples of diseases caused by them. Prokaryotes: classification of prokaryotes according to Bergey's Manual of Systematic Bacteriology. General Characters of fungi, Definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction in fungi (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions and sub-divisions. Introduction: Definition and objectives of Plant Pathology. History of Plant Pathology. Terms and concepts in Plant Pathology. Survival and Dispersal of Plant Pathogens. Phenomenon of infection - pre-penetration, penetration and post penetration. Plant disease epidemiology. Plant Disease Forcasting - Remote sensing - General principles of plant diseases management - Importance, general Principles - Avoidance, exclusion, protection -regulatory method, cultural methods, biological method, physical methods, host plant resistance and Chemical methods - Methods of application of fungicides. Integrated plant disease management (IDM) - Concept, advantages and importance.

Practical: Acquaintance to plant pathology laboratory and equipments; Preparation of culture media for fungi and bacteria; Isolation techniques, preservation of disease samples; Study of Pythium, Phytophthora and Albugo; Study of Sclerospora, Peronosclerospora, Pseudoperonospora, Peronospora, Plasmopara and Bremia; Study of genera Mucor and Rhizopus. Study of Oidium, Oidiopsis, Ovulariopsis, Erysiphe, Phyllactinia, Uncinula and Podosphaera; Study of Puccinia (different stages), Uromyces, Hemiliea; Study of Sphacelotheca, Ustilago and Tolyposporium; Study of Agaricus, Pleurotus and Ganoderma; Study of Septoria, Colletotrichum, Pestalotiopsis and Pyricularia; Study of Aspergillus, Penicillium, Trichoderma, and Fusarium; Study of Helminthosporium, Drechslera, Alternaria, Stemphyllium, Cercospora, Phaeoisariopsis, Rhizoctonia and Sclerotium; Demonstration of Koch's postulates; Study of different groups of fungicides and antibiotics; Preparation of fungicides - Bordeaux mixture, Bordeaux paste, Chestnut compound; Methods of application of fungicides - seed, soil and foliar; Bio-assay of fungicides - poisoned food technique, inhibition zone technique and slide germination technique; Bio-control of plant pathogens - dual culture technique, seed treatment. Visit to quarantine station and remote sensing laboratory.

2. Introductory Nematology (APP-121) 2 (1+1)

Introduction: History of phytonematology. Economic importance. General characteristics of plant pathogenic nematodes. Nematode general morphology and biology. Classification of nematodes upto family level with emphasis on groups containing economically important genera. Classification of nematodes by habitat. Identification of economically important plant nematodes upto generic level with the help of keys and description. Symptoms caused by nematodes with examples. Interaction between plant parasitic nematodes and disease causing fungi, bacteria and viruses. Different methods of nematode management. Cultural methods (crop rotation, fallowing, soil amendments, other land management techniques), physical methods (soil solarisation, hot water treatment) Biological methods, Chemical methods (fumigants, non fumigants). Resistant varieties. IDM.

Practical: Methods of survey - sampling methods, collection of soil and plant samples; Extraction of nematodes from soil and plant tissues following combined Cobb's decanting - sieving and Baermann funnel technique, counting and estimation of plant parasitic nematodes; Preparation of temporary and permanent mounts; Method of preparation of perennial patterns for identification of species of Meloidogyne; Study and identification of most important plant parasitic nematodes with special reference to their characteristics and symptomtolgy - Meloidogyne, Pratylenchus; Anguina, Heterodera, Ditylenchus, Globodera, Tylenchulus, Xiphinema, Radopholus, Rotylenchulus, and Helicotylenchus. Experimental techniques used in pathogenicity studies with root knot nematode.

3. Diseases of Field Crops and Their Management (APP-221) 3 (2+1)

Economic importance, symptoms, cause, epidemiology and disease cycle and integrated management of diseases of rice, sorghum, bajra, maize, wheat, sugarcane, tobacco, mustard, linseed, groundnut, sesamum, sunflower, cotton, redgram, lentil, bengalgram, blackgram, greengram, soybean.

Practical: Study of symptoms, etiology, host-parasite relationship and specific control measures of the following crop diseases. Presentation of disease samples survey and collection of Diseases of rice, sorghum; Diseases of wheat, bajra & maize; Diseases of sugarcane, mustard, linseed & tobacco; Diseases of groundnut, castor & sunflower; Diseases of sesamum & cotton; Diseases of redgram, greengram, lentil, blackgram, bengalgram & beans; Field visits at appropriate time during the semester Note: Students should submit 50 pressed, well mounted diseased specimens in threeinstallments during the semester.

4. Diseases of Horticultural Crops and Their Management (APP-311) 3(2+1)

Economic Importance, symptoms, cause, disease cycle and integrated management of diseases of: citrus, mango, banana, grapevine, pomegranate, papaya, guava, sapota, apple, chilli, turmeric, brinjal, bhindi, potato, crucifers, cucurbits, tomato, beans, onion, coconut, oil palm, betelvine, mulberry, coffee, tea, rose, tuberose, gladioli, chrysanthemum and jasmine.

Practical: Diseases of beans, citrus, guava, & sapota; Diseases of papaya, banana, pomegranate & ber; Diseases of mango, grapes & apple; Diseases of chilli, brinjal & bhendi; Diseases of potato, tomato & crucifers; Diseases of cucurbits, onion & betelvine; Diseases of oil palm, coconut, tea, coffee & mulberry; Diseases of rose, tuberose, gladioli, chrysanthemum and jasmine. Field visits at appropriate time during the semester. Note: Students should submit 50 pressed, well mounted diseased specimens in three installments during the semester.

HORTICULTURE

1. Production Technology of Fruit Crops (APH-111) 3(2+1)

Definition and importance of pomology. Classification of fruit crops. Climatic zones of horticulture crops. Area and production of different fruit crops. Selection of site, fencing, and wind break, planting systems, high density planting, planning and establishment. Propagation methods and use of rootstocks. Methods of training and pruning. Use of growth regulators in fruit production. Package of practices for the cultivation of major fruits - mango, banana, citrus, grape, guava, sapota, apple, litchi. Papaya, Minor fruits - pineapple, annonaceous fruits, pomegranate, ber, fig, phalsa, jack, pear, plum, peaches and cherry.

Practical: Study of horticultural tools used in fruit cultivation; Propagation by cuttings (soft wood, hard wood and semi-hardwood) layering (simple layering, Air layering, stooping in guava); grafting and budding. Layout and planting systems (Traditional system and high density planting methods); Methods of pruning and training; Training of ber,

grape and pomegranate; Pruning of ber, grape, phalsa, fig, apple, pear, peach; Description and identification of varieties of mango, guava, grape, papaya, apple and sapota; Description and identification of varieties of banana, citrus, (lime lemon, sweet orange, mandarin, grape fruit) pomegranate, ber, pear and cherries; Irrigation methods in fruit crops including drip - Micro irrigation methods. Establishment of orchard; Methods of Fertiliser application in fruit crops including fertigation technology; Visit to local commercial orchards; Preparation of growth regulators in powder, solution and lanolin paste for propagation; Application of growth regulators for improving fruit set, fruit size, quality, delaying ripening and hastening ripening.

2. Production Technology of Vegetables and Flowers (APH-211) 3(2+1)

Importance of Olericulture, vegetable gardens, vegetable classification. Origin, area, production, varieties, package of practices for fruit vegetables -, tomato, brinjal, chillies, and okera; Cucurbitaceous vegetables cucumber, ridge gourd, ash gourd, snake gourd, bottle gourd, bitter gourd and melons, Cole crops - cabbage, cauliflower and knol- khol. Bulb crops - onion and garlic. Beans and peas - French beans, cluster beans, dolichos beans, peas and cowpea. Tuber crops - potato, sweet potato, tapioca, colocasia, yams; Root crops - carrot, radish, turnip and beet root; Leafy vegetables - amaranthus, palak, gogu; Perennial vegetables - drumstick, coccinia and curry leaf. Importance of ornamental gardens. Planning of ornamental gardens. Types and styles of ornamental gardens. Use of trees, shrubs, climbers, palms, houseplants and seasonal flowers in the gardens. Package of practices for rose, jasmine, chrysanthemum, crossandra, marigold and tuberose.

Practical: 1 Planning and layout of kitchen garden; 2 Identification of important vegetable seeds and plants; Raising of vegetable nurseries; Identification of ornamental plants (trees,shrubs,climbers,house plants,palms etc.,) and development of garden features; Transplanting of vegetable seedlings in main field; Layout of lawns and maintenance; Seed extraction in tomato and brinjal; Depotting, repotting and maintenance of house plants; Visit to commercial vegetable farms; Training and pruning of rose (standards, hybrid 'T' roses cented roses) and chrysanthemum (pinching and disbudding); Planning and layout of gardens and garden designs for public and private areas; Intercultural operations in vegetable plots; Seed production in vegetable crops; Harvesting indices of different vegetable crops; Grading and packing of vegetables; Prolonging the shelf life of cut flowers.

3. Production Technology of Spices, Aromatic, Medicinal and Plantation Corps (APH-221) 3 (2+1)

Plantation Crops Importance and cultivation technology of Spices - ginger, turmeric, pepper, cardamom, coriander, cumin, fenugreek; Aromatic crops - lemon grass, citronella, palmarosa, vetiver, geranium, dawana, mentha; Plantation crops - coconut, arecanut, betelvine, cashew, cocoa, coffee, oilpalm; Medicinal plants - diascoria, rauvolfia, opium, ocimum, perwinkle, aloe, guggul, belladonna, nuxvomica, Solanum khasiamum, aonla,senna, plantago, stevia and coleus.

Practical: Botanical description and identification of aromatic plants; Identification of varieties in spices and plantation crops; Identification of medicinal plants; Propagation techniques in aromatic and spice crops; Selection of mother palm, and seed nuts in coconut and oil palm; Study of identification of aromatic plants; Distillation procedures for aromatic crops; Propagation methods in plantation crops; Propagation and planting methods in turmeric; Propagation and planting techniques in ginger; Harvesting procedures in aromatic plants; Processing and curing of spices (ginger, turmeric and black pepper); Training methods in betelvine; Rejuvenation practices in cashewnut; Products - byproducts of spices and plantation crops; Procedures for oleoresin extraction; Visit to local commercial plantations. Aromatic & medicinal plant nurseries and seed spices field.

4. Breeding of Horticulture Crops (APH-222) 2(1+1)

Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops; Origin, distribution of species, wild relatives and forms, Vegetables (Solenaciaus, cucurbits, Legumes etc.); Flowers crops (Chrysanthemum, rose, galardia, gerbera & marigold); Fruit crops (guava, mango, peach, citrus, banana, papaya); Major breeding procedures for development of hybrids / varieties of various crops; Plant Genetic resources their conservation and utilization in crop improvement; Ideotype concept in crop improvement; Breeding for resistance to biotic and abiotic stresses, variability in pathogens and pests; Genetic basis of adaptability to unfavourable environments; of IPR and its related issues.

Practical: Emasculation and Hybridization techniques; Handling of segregating generations, pedigree methods; Handling of segregating generations, bulk methods; Handling of segregating generations, back cross methods; Field lay out of experiments; Field trials, maintenance of records and registers; Visit to seed production and certification

plots; Visit to AICRP trials and programmes; Visit to grow out test plots; Visit to various research stations; Visit to other institutions.

5. Post Harvest Management and Value Addition of Fruits and Vegetables (APH-311) 2(1+1)

Importance of post harvest technology in fruit and vegetable crops. Maturity indices, harvesting and post harvest handling of fruits and vegetables. Maturity and ripening process. Factors affecting ripening of fruits, and vegetables. Pre harvest factors affecting quality and post harvest shelf life of fruits and vegetables. Factors responsible for deterioration of harvested fruits and vegetables. Chemicals used for hastening and delaying ripening of fruits and vegetables. Methods of storage - precooling, prestorage treatments, low temperature storage, controlled atmospheric storage, hypobaric storage, irradiation and low cost storage structures. Various methods of packing, packaging materials and transport. Packing technology for export. Fabrication & types of containers, cushioning material, vacuum packing, poly shrink packing, specific packing for export of mango, banana, grapes kinnow, sweet orange, and mandarin etc. Importance and scope of fruit and vegetable preservation in India. Principles of preservation by heat, low temperature, chemicals and fermentation. Unit layout - selection of site and precautions for hygienic conditions of the unit. Preservation through canning, bottling, freezing, dehydration, drying, ultraviolet and ionizing radiations. Preparation of jams, jellies, marmalades, candies, crystallized and glazed fruits, preserves, chutneys, pickles, ketchup, sauce, puree, syrups, juices, squashes and cordials Spoilage of canned products, biochemical, enzymatic and microbial spoilage. Preservatives, Colours permitted and prohibited in India.

Practical: Practice in judging the maturity of various fruits and vegetables. zero energy cool chambers for storage. Determination of physiological loss in weight (PLW), total soluble solids (TSS), total sugars, acidity and ascorbic and acid content in fruits acid vegetables. Packing methods and types of packing and importance of ventilation. Pre cooling packing methods for export or international trade. Methods of prolonging storage life. Effect of ethylene on ripening of banana, sapota, mango, sapota. Identification of equipments and machineries used is preservation of fruits and vegetables. Preservation bydrying and dehydration. Preparation of jam, jelly and marmalades. Preparation of squash, cordials and syrups. Preparation of chutneys, pickles sauces and ketchup. Visit to local processing units. Visit to local market yards, cold storage units and packing industries.

AGRICULTURAL EXTENSION

1. Dimensions of Agricultural Extension (AEE-121) 3(2+1)

Education - Meaning, Definition, Types - Formal and Non-formal education and their Characteristics. Extension Education and Agricultural Extension - Meaning, Definition, Concepts, Objectives and Principles. Rural development - Meaning, Definition, Concepts, Objectives, Importance and Problems in rural development. Developmental programmes of pre-independence era - Sriniketan, Marthandam, Gurgaon experiment and Gandhian constructive proprogramme. Development programmes of Post independence era, Firka Development, Etawah - Pilot project and Nilokheri Experiment. Community Development Programme - Meaning, Definition, Concepts, Philosophy, Principles, Objectives, Differences between Community Development and Extension Education, National Extension service. Panchayat Raj System - Meaning of Democratic - Decentralization and Panchayat Raj, Two tiers and Three tiers of Panchayat Raj system, Powers, Functions, Objectives and Organizational setup. Agricultural Development Programmes with reference to year of start, Objectives & Sailent features - nIntensive Agricultural District Programme (IADP), High Yielding Varieties Programme (HYVP), Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP), National Agricultural Technology Project (NATP), ATMA, ATIC. Social Justice and Poverty alleviation programmes - Integrated Tribal Development Agency (ITDA), Integrated Rural Development Programme (IRDP), Swarna Jayanthi Gram Swarojgar Yojana (SGSY), Prime Minsiter Employment Yojana (CMEY). New trends in extension, privatization. Women Development programmes - Development of Women and Children in Rural Areas (DWCRA), Rashtriya Mahila Kosh (RMK), Integrated Child Development Scheme (ICDS) and Mahila Samriddi Yojana (MSY). Reorganized extension system (T&V System) - Introduction, Meaning, Salient features, and Linkages, Merits and Demerits.

Practical: Visit to a village to study the on going rural development programme. To collect information related to agriculture from farm families in a village. To prepare a plan of work for organizing rural development activity. To prepare a calendar of work for organizing rural development activity. To Acquaint with University Extension System. Set up of organization development department central to village level. To preparation and presentation of effective

extension talk. Preparation of Self Help Group/Farmers Interest Group. To study the Panchayati Raj System. To participate in monthly work shop of Training & Visit System. To visit and study the District Rural Development Agency. Visit to a Voluntary Orgnization to study the development activities. To study of field visit/Home visit, Evaluation of development programme.

2. Fundamentals of Rural Sociology and Educational Psychology (AEE-311) 2 (1+1)

Sociology and Rural Sociology, Meaning, Definition, Scope, Importance of Rural Sociology in Agricultural Extension and Interrelationship between Rural Sociology & Agricultural Extension. Indian Rural Society, Important characteristics, Differences and Relationship between Rural and Urban societies. Social Groups - Meaning, Definition, Classification, Factors considered in formation and organization of groups, Motivation in group formation and Role of Social groups in Agricultural Extension. Social Stratification - Meaning, Definition, Functions, Basis for stratification, Forms of Social stratification - Characteristics and - Differences between Class & Caste System.
Cultural concepts - Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions - Meaning, Definition and their Role in Agricultural Extension. Social Values and Attitudes - Meaning, Definition, Types and Role of Social Values and Attitudes in Agricultural Extension. Social Institutions - Meaning, Definition, Major institutions in Rural society, Functions and their Role in Agricultural Extension. Social Organizations - Meaning, Definition, Types of organizations and Role of Social organizations in Agricultural Extension. Social Control - Meaning, Definition, Need of social control. Social change - Meaning, Definition, Nature of Social change, Dimensions of social change and factors of social change. Leadership - Meaning, Definition, Classification, Roles of a leader, Different methods of Selection of Professional and Lay leaders. Psychology and Educational Psychology - Meaning, Definition, Scope and Importance of Educational Psychology in Agricultural Extension. Intelligence - Meaning, Definition, Types, Factors affecting intelligence and Importance of intelligence in Agricultural Extension. Personality - Meaning, Definition, Types, Factors influencing the Personality and Role of personality in Agricultural Extension. Teaching - Learning process - Meaning and Definition of Teaching, Learning, Learning experience and Learning situation, Elements of learning situation and its characteristics. Principles of learning and their implication for teaching.

3. Extension Methodologies for Transfer of Agricultural Technology (AEE-321) 3(2+1)

Communication - Meaning, Definition, Models, Elements and their Characteristics, Types and Barriers in communication. Extension Programme Planning - Meaning, Definitions of Planning, Programme, Importance, Principles and Steps in Programme Development Process, Monitoring and Evaluation of Extension Programmes. Extension Teaching methods Meaning, Definition, Functions and Classification. Individual contact methods - Farm and Home visit, Result Demonstration, Field trials - Meaning, Objectives, Steps, Merits and Demerits. Group contact methods - Group discussion, Method demonstration, Field Trips - Meaning, Objectives, Steps, Merits and Demerits. Small group discussion techniques - Lecture, Symposium, Panel, Debate, Forum, Buzz group, Workshop, Brain Storming, Seminar and Conference. Mass contact Methods - Campaign, Exhibition, Kisan Mela, Radio & Television - Meaning, Importance, Steps, Merits & Demerits. Factors influencing in selection of Extension Teaching Methods and Combination (Media Mix) of Teaching methods. Innovative Information sources - Internet, Cyber Cafes, Video and Tele conferences, Kisan call centers, Consultancy clinics. Agricultural Journalism - Meaning, Scope and Importance, Sources of news, Types, Merits and Limitations. Diffusion and Adoption of Innovations - Meaning, Definition, Models of adoption Process, Innovation - Decision Process - Elements, Adopter categories and their characteristics, Factors influencing adoption process. Capacity building of Extension Personnel and Farmers - Meaning, Definition, Types of training, Training to farmers, farm women and Rural youth - FTC and KVK.

Practical: To enlist various books related to course, Group discussion, Method demonstration & result demonstration, Writing a circular latter, Preparation of Poster, Flash card, Leaflets, Chart, Folder, Pamphlet, News story, Success story and transparency. System of technology transfer at village level. Identifying the farmers of different stages of adoption in villages. Meaning importance and classification of A.V. Aids, Visit to K.V.K. / F.T.C., Handling of O.H.P. & P.A. System.

4. Entrepreneurship Development and Communication Skills (AEE-322) 2 (1+1)

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation

and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Communication Skills: Meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

Practical: Listening and writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precis writing, summarizing, abstracting; individual and group presentations.

NSS (AEE-323)/NCC (NCC-321)/PE (PE-321) 1(0+1)

NSS: Orientation of students in national problems, study of philosophy of NSS, fundamentals rights, directive principles of state policy, socio-economic structure of Indian society, population problems, brief of five year plan. Functional literacy, non-formal education of rural youth, eradication of social evils, awareness programmes, consumer awareness, highlights of consumer act. Environment enrichment and conservation, health, family welfare and nutrition. NCC: Introduction to NCC, defence services, system of NCC training, foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching, arms drill, shoulder arm, order arm, present arm, guard of honour, ceremonial drill, weapon training - rifle bayonet, light machine gun, sten machine carbine. Introduction and characteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visual training, targets, judging distance, fire discipline and fire control orders, battle craft, field signals, description of ground, section formation, section battle drill, scouts and patrols, ambush, field engineering, map reading, conventional signs, grid systems, use of service protractor, prismatic compass and its use, self defence, general principles, precautions and training, attacks and counter attacks, marching and searching, first aid, hygiene and sanitation, civil defence, leadership and NCC song. Physical Education: Introduction to physical education. Posture, exercise for good posture, physical fitness exercises for agility, strength, coordination, endurance and speed. Rules regulations of important games, skill development in any one of the games, football, hockey, cricket, volleyball, badminton, throw ball, tennis. Participation in one of the indoor games, badminton, chess and table tennis. Rules and regulations of athletic events, participation in any one of the athletic events, long jump, high jump, triple jump, javelin throw, discuss

throw, shot put, short and long distance running, Safety education, movement education, effective way of doing day-to-day activities. First-aid training, coaching for major games and indoor games. Asans and indigenous ways for physical fitness and curative exercises. Exercises and games for leisure time, use and experience.

Note: Warming up and conditioning exercises are compulsory before the commencement of each class.

BASIC SCIENCES

1. Comprehension and Communication Skills in English (BHE-111) 2(1+1)

Comprehension: Text for comprehension, Current English for Colleges, By N. Krishnaswamy & T. Sriraman, Macmillan India Limited, Madras, 1995. Reading Comprehension, Vocabulary: Synonyms - Antonyms and two exercises to help the students in the enrichment of vocabulary based on TOEFL and GRE and other competitive examinations. Homonyms and Homophones, Exercise on idioms and phrases (E.g.: dust and ashes, doorstep of doom, boundaries of knowledge, Apple of one's eye, in a fix etc). Language study: Functional Grammar, Agreement of verb with subject. Written Skills: Mechanics of good letter, Effective business correspondence, Personal Correspondence, Preparation of Curriculum vitae and Job applications. The Style, Importance of Professional writing -Choice of words and phrases, precision, conciseness cliches, redundancy, jargon, foreign words, Precis writing. Practical: Listening Comprehension: Listening to short talks, lectures, speeches (scientific, commercial and general in nature)

Practical: Listening to at least two tape-recorded conversations aimed at testing the listening comprehension of students; Communication: Spoken English- Speech mechanism, Phonetic sounds and symbols, importance of stress and intonation. Practical: Spoken English practice by using audiovisual aids, the essentials of good conversations, oral exercises in conversation practice (At the Doctor, at the Restaurant, at the Market Yard); Practical: One presentation by individual/group on the given topic related to agriculture like W.T.O, Developing new technologies

in Agriculture, Bio- fertilizers etc.; Evaluation of a Presentation: evaluation sheet, other strategies to be considered for evaluating a presentation, Practical: Mock evaluation of a presentation; Dyadic communication, face to face conversation, Telephonic conversation, rate of speech, clarity of voice, speaking and listening politeness, telephone etiquette. Practical: Practice of Telephonic conversation. Reading skills, using Dictionary, reading/speaking dialogues, rapid reading, intensive reading, improving reading skills; Conducting. Group Discussions and Debates on current topics; Practical examination.

Note:

1 Language Lab facility required.
2 Gadgets/Audio Visual Aids required for improving the listening, speaking, reading and writing skills of students.

2. Statistics (BPS-121) 2(1+1)

Introduction: Definition of Statistics and its use and limitations; Frequency Distribution and Frequency Curves; Measures of Central Tendency: Characteristics of Ideal Average, Arithmetic Mean; Median, Mode, Merits and Demerits of Arithmetic Mean; Measures of Dispersion: Standard Deviation, Variance and Coefficient of Variation; Probability: Definition and concept of probability; Normal Distribution and its properties; Introduction to Sampling: Random Sampling; the concept of Standard Error; Tests of Significance- Types of Errors, Null Hypothesis, Level of Significance and Degrees of Freedom, Steps involved in testing of hypothesis; Large Sample Test- SND test for Means, Single Sample and Two Samples (all types); Small Sample Test for Means, Student's t-test for Single Sample, Two Samples and Paired t test. F test; Chi-Square Test in 2x2 Contingency Table, Yates' Correction for continuity; Correlation: Types of Correlation and identification through Scatter Diagram, Computation of Correlation Coefficient 'r' and its testing. Linear Regression: of Y on X and X on Y. Inter-relation between 'r' and the regression coefficients, fitting of regression equations. Experimental Designs: Basic Designs, Completely Randomized Design (CRD), Layout and analysis with equal and unequal number of observations, Randomized Block Design (RBD), Layout and analysis, Latin Square Design (LSD), Layout and analysis. Practical: Construction of Frequency Distribution Tables and Frequency Curves; Computation of Arithmetic Mean for Un-Grouped and Grouped data; Computation of Median for Un-Grouped and Grouped data; Computation of Mode for Un-Grouped and Grouped data; Computation of Standard Deviation, Variance and Coefficient of Variation for Un-Grouped and Grouped data; SND test for Means, Single Sample; SND test for Means, Two Samples; Student's t-test for Single Sample; Student's t-test for Two Samples; Paired test and F test; Chi-Square Test in 2x2 Contingency Table, Yates' Correction for continuity; Computation of Correlation Coefficient 'r' and its testing; Fitting of regression equations- Y on X and X on Y;
Analysis of Completely Randomized Design (CRD); Analysis of Randomized Block Design (RBD); Analysis of Latin Square Design (LSD).

3. Introduction to Computer Applications (BPO-121) 2(1+1)

Introduction to Computers, Anatomy of Computers, Input and Output Devices. Units of Memory, ardware, Software and Classification of Computers. Personal Computers, Types of Processors, booting of computer, warm and cold booting. Computer Viruses, Worms and Vaccines. Operating System - DOS and WINDOWS. Disk Operating System (DOS): Some fundamental DOS Commands, FORMAT, DIR, COPY, PATH, LABEL, VOL, MD, CD and DELTREE, Rules for naming files in DOS and Types of files. WINDOWS: GUI, Desktop and its elements, WINDOWS Explorer, working with files and folders; setting time and date, starting and shutting down of WINDOWS. Anatomy of a WINDOW, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus
and Tool Bars. Applications - MSWORD:

Word, processing and units of document, features of word-processing packages. Creating, Editing, Formatting and Saving a document in MSWORD; MSEXCEL: Electronic Spreadsheets, concept, packages. Creating, Editing and Saving a spreadsheet with MSEXCEL. Use of in-built Statistical and other functions and writing expressions. Use of Data Analysis Tools, Correlation and Regression, t-test for two-samples and ANOVA with One-way Classification. Creating Graphs. MS Power Point: Features of Power Point Package. MSACCESS: Concept of Database, Units of database, creating database; Principles of Programming: Flow Charts and Algorithms, illustration through examples. Internet: World Wide Web (WWW), Concepts, Web Browsing and Electronic Mail Practical: Study of Computer Components; Booting of Computer and its Shut Down; Practice of some fundamental DOS Commands, TIME, DATE, DIR, COPY, FORMAT, VOL, LABEL, PATH; Practicing WINDOWS Operating System, Use of Mouse, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars; WINDOWS Explorer, Creating

Folders, COPY and PASTE functions; MSWORD: Creating a Document, Saving and Editing; MSWORD, Use of options from Tool Bars, Format, Insert and Tools (Spelling & Grammar) Alignment of text; MSWORD, Creating a Table, Merging of Cells, Column and Row width; MSEXCEL: Creating a Spreadsheet, Alignment of rows, columns and cells using Format tool bar; MSEXCEL: Entering Expressions through the formula tool bar and use of inbuilt functions, SUM, AVERAGE, STDEV; MSEXCEL: Data Analysis using inbuilt Tool Packs, Correlation & Regression; MS EXCEL: Creating Graphs and Saving with & without data; MSACCESS: Creating Database, Structuring with different types of fields; MS Power Point: Preparation of slides on Power Point; Transforming the data of WORD, EXCEL and ACCESS to other formats; Internet Browsing: Browsing a Web Page and Creating of E-Mail ID

4. Biochemistry (BHE-321) 3(2+1)

Biochemistry - Introduction and importance. Plant cell, cell wall and its role in live stock, food and paper industries. Bio-molecules - Structure, properties & applications: Amino acids, peptides and proteins -Plant proteins and their quality. Enzymes -Factors affecting the activity, classification, Immobilistion and other industrial applications. Lipids -Acyl lipids, Their industrial application in soaps, detergents, paints, Varnishes, lubricants, adhesives, plastics, nylon, Bio-diesel, Biodegradable plastics etc. Carbohydrates; Nucleotides and Nucleic acids. Metabolic energy and its generation - Metabolism - Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation. General reactions of amino acid degradation. Biosynthesis - carbohydrates, Lipids, Proteins and Nucleic acids. Metabolic regulation. Secondary metabolites, Terpenoids, Alkaloids, Phenolics and their applications in food and pharmaceutical industries.

Practical: Amino acid models (atomic); Paper electrophoresis for the separation of plant pigments; Protein denaturation - heat, pH, precipitation of proteins with heavy metals, Protein estimation by Lowry method; Enzyme kinetics, competitive inhibition, enzyme immobilization; Extraction of nucleic acids, column chromatography of RNA hydrolysate; Characterization of lipids by T.L.C.; Extraction of oil from oil seeds; Estimation of fatty acids by G.L.C.; Models of sugars, sucrose & starch; Quantitative determination of sugars; Paper chromatography for the separation of sugars; Determination of phenols.

ANIMAL HUSBANDRY

1. Livestock Production and Management (AAH -211) 3(2+1)

Place of livestock in the national economy, different livestock development programmes of Govt. of India. Important exotic and Indian breeds of cattle, buffalo, sheep, goat and swine. Measures and factors affecting fertility in livestock, reproductive behavior like oestrus, parturition, farrowing etc. Milk secretion, milking of animals and factors affecting milk yield and composition. Selection and breeding of livestock for higher milk and meat production. Feeding and management of calves, growing heifers and milch animals and other classes and type of animals, housing principles, space requirement for different species of livestick. Disease control measures, sanitation and care, breeding, feeding and production records. Breed characteristics of poultry, their methods of rearing, breeding, feeding and management, incubation, hatching and brooding, vaccination and prevention of diseases, preservation and marketing of eggs, its economics and keeping quality. Cost of production of milk, economical units of cattle, buffalo, sheep, goat and swine. Basics of Aquaculture, systems of aquaculture, Major candidate species for fresh water and marine aquaculture, important management factors, integrated aquaculture.

Practical: Identification, handling and restraining of animals: Judging and culling: Feeding and ration formulation; Hatching, housing and management of poultry; visit to livestock farms and Economics of livestock production.

2. Principles of Animal Nutrition (AAH -311) 2(1+1)

Introduction to expanding field of nutrient chemical composition of animal and its food, digestive system and process of farm animals. Digestion absorption and metabolism of carbohydrates lipids and proteins in ruminants and non-ruminants, Carbohydrates, lipid and protein content in various classes of feeds. Concept of essential amino acids for non-ruminants and protein quality of feeds. The absorption and metabolism of essential minerals and vitamins: symptoms of their deficiencies: minerals and vitamin content of various classes of feeds. The nutritive evaluation of feeds for energy and protein, digestibility of feeds and partition of feed energy within animal system of expressing energy values of feeds nutrient requirements of farm animals for maintenance, growth, reproduction and lactation. Growth stimulating substances.

Practical : Understanding the nutritive value of feed stuffs. Study of forages, fodders, cereals, cereal offal's and oilcakes. Study of animals avain and marine offal's minerals and vitamins supplements and other feed additives. Proximate analysis of feed samples for musture, crude protein, crude fat, crude fiber, ash and nitrogen free extractive. Formulation of least cost ration for cattle, buffaloes, sheep, goat, swine and poultry.

3. Breeding and Improvement of Farm Animals (AAH -321) 2(1+1)

Reproduction system of farm animals. Qualitative and quantitative inheritance and effect of environment of them. Various qualitative and quantitative traits of livestock. Gene frequently and forces affecting them. Random mating and Hardy Weinoerg law. Variation and its measures, genetic, phenotypic and environmental variances. Heritability and repeatability, qualitative and quantitative traits, selection, differential, response to selection, generation interval and annual rate of gain. Genetic correlation and correlated response. Basis of selection, individual, family, progency, pedigree and combined selection. Methods of selection for one or more traits- tandom, independent culling level and selection index. Inbreeding-its consequence, inbred lines, line breeding, inbreeding coefficient and relationship coefficient. Outbreeding-various types of out crossing and cross-breeding, species hybridization and development of new breeds.

Practical: Computation of mean, variance, standard deviation in economic traits. Computation of co-relation and regression coefficient. Estimation of gene frequency in animal population. Estimation of repeatability and haritability. Computation of inbreeding coefficient and relationship coefficient.

BIOTECHNOLOGY

Principles of Plant Biotechnology (ABT-311) 3(2+1)

Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant Genetic Engineering; Scope and importance in Crop Improvement: Totipotency and Morphogenesis, Nutritional requirements of in-vitro cultures; Techniques of In-vitro cultures, Micro propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting above in-vitro culture; Applications and Achievements; Somaclonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology; Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in crop improvement. Genetic engineering; Restriction enzymes; Vectors for gene transfer - Gene cloning - Direct and indirect method of gene transfer - Transgenic plants and their applications. Blotting techniques - DNA finger printing - DNA based markers - RFLP, AFLP, RAPD, SSR and DNA Probes - Mapping QTL - Future prospects. MAS, and its application in crop improvement.

Practical: Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants; Aseptic manipulation of various explants; Callus induction and Plant Regeneration; Micro propagation of important crops; Anther, Embryo and Endosperm culture; Hardening/ Acclimatization of regenerated plants; Somatic embryogenesis and synthetic seed production; Isolation of protoplast; Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel-electrophoricsis techniques.

1.2 DIPLOMA COURSES

1. Diploma Course on Fruit and Vegetable Processing (DCFP)

Semester wise courses and syllabus

Course No.	Name of Course	Credit hrs
SEMESTER-I		
DCF-101	Fundamentals of fruit and vegetable processing	3(2-0-1)
DCF-102	Product development	3(2-0-1)
DCF-103	Packaging, handling and storage Technology	3(2-0-1)
DCF-104	Quality evaluation, standards and regulations	3(2-0-1)
DCF-105	By-products and waste management	3(2-0-1)

SEMESTER-II		
DCF - 106	Industrial Training and Project work	15
Total Credits (Semester I+II)		30

DCF - 101 Fundamentals of fruit and vegetable processing

Introduction-composition, importance, status of processing industries, methods and principles of preservation, drying and dehydration, canning, evaporation, freezing.

DCF - 102 Product development

Methodology for production of Jam, Jelly, Marmalade, Preserve, Candy, Toffee, Fruit Bar, Pickles, Chutneys, Squash, Beverages, Fermented products, Frozen products.

DCF- 103 Packaging, handling and storage Technology

Packaging methods, machines, handling methods, pre-cooling, cold chain, storage, changes during storage, factors affecting storage life.

DCF -104 Quality evaluation, standards and regulations

Quality evaluation-physical, chemical, microbiological, sensory. Factors affecting fruit and vegetable quality, quality control criteria, standards, regulations.

DCF - 105 By-products and Waste Management

Introduction, By-products from fruit and vegetable processing industries and their management.

DCF - 106 Industrial Training and Project work

Visit of fruit and vegetable processing industries and one month in- plan training, project writing and presentations, submission of project and viva-voce examination.

2. Diploma Course on Bakery Technology (DCBT)

Semester wise courses and syllabus

Course No.	Name of Course	Credit hrs
SEMESTER-I		
DCB - 101	Baking Science	3(2-0-1)
DCB - 102	Bread and Bun production	3(2-0-1)
DCB - 103	Biscuit and Cookie Production	3(2-0-1)
DCB - 104	Cake and Pastry Production	3(2-0-1)
DCB - 105	Entrepreneurship Development and Management	3(2-0-1)
SEMESTER-II		
DCB - 106	Industrial Training and Project work	15
Total Credits (Semester I+II)		30

DCB - 101 Baking Science

Introduction - Structure, chemical and nutritional composition of cereals, wheat milling and equipment, Baking ingredients-functions and storage, Bakery equipment-working of various equipments like mixers, proofing chambers, dough dividers, moulder and sheeters, baking oven, cooling chambers, sealing and packaging machines.

DCB - 102 Bread and Bun Production

Raw materials, Dough method, Bread manufacturing method, Recipes for breads, specifications for various type of breads, Bun production, Types of Bun, machinery and equipment, packaging etc. Quality evaluation.

DCB - 103 Biscuit and Cookie Production

Biscuit raw materials- cereals, sweeteners, shortening, milk, leavening agents and nutrients, other miscellaneous products, market potential, manufacturing process, Recipes for various types of biscuits, Biscuit coatings, Basic ingredients for cookies, equipments for manufacturing cookies, coatings for cookies.

DCB - 104 Cake and Pastry Production

Basic ingredients of cake - flour, sugar, shortenings, eggs, milk, cake processing, common faults in cakes, Type of cakes, equipment and machinery, preservation methods, ingredients and formulation of pastry, manufacturing process, equipment, microbiological quality.

DCB - 105 Entrepreneurship development and management

Concept, Role of financial institutions in promoting small scale industries, preparation of project report, basics of marketing management, identification of project in baking, management of resources, food laws viz FPO/PFA/ BIS etc., Book keeping and accounts, Factories Act 1948, human and industrial relations, functions of HR.

DCB - 106 Industrial Training and Project work

Visit of baking industries and one month in-plant training. Project writing and presentations. Submission of project report and viva-voce examination

1.3 POSTGRADUATE PROGRAMME

AGRONOMY

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
AGRON 501*	MODERN CONCEPTS IN CROP PRODUCTION	3+0
AGRON 502*	PRINCIPLES AND PRACTICES OF SOIL FERTILITY AND NUTRIENT MANAGEMENT	2+1
AGRON 503*	PRINCIPLES AND PRACTICES OF WEED MANAGEMENT	2+1
AGRON 504*	PRINCIPLES AND PRACTICES OF WATER MANAGEMENT	2+1
AGRON 505	AGROMETEOROLOGY AND CROP WEATHER FORECASTING	2+1
AGRON 506	AGRONOMY OF MAJOR CEREALS AND PULSES	2+1
AGRON 507	AGRONOMY OF OILSEED, FIBRE AND SUGAR CROPS	2+1
AGRON 508	AGRONOMY OF MEDICINAL, AROMATIC AND UNDER UTILIZED CROPS	2+1
AGRON 509	AGRONOMY OF FODDER AND FORAGE CROPS	2+1
AGRON 510	AGROSTOLOGY AND AGROFORESTRY	2+1
AGRON 511	CROPPING SYSTEMS	2+0
AGRON 512	DRYLAND FARMING	2+1
AGRON 513	PRINCIPLES AND PRACTICES OF ORGANIC FARMING	2+1
AGRON 591	MASTER'S SEMINAR	1+0
AGRON 599	MASTER'S RESEARCH	20
AGRON 601	CURRENT TRENDS IN AGRONOMY	3+0
AGRON 602	CROP ECOLOGY	2+0
AGRON 603	CROP PRODUCTION AND SYSTEM MODELING	2+1
AGRON 604	ADVANCES IN CROP GROWTH AND PRODUCTIVITY	2+1
AGRON 605	IRRIGATION MANAGEMENT	2+1
AGRON 606	ADVANCES IN WEED MANAGEMENT	2+0
AGRON 607	INTEGRATED FARMING SYSTEMS	2+0
AGRON 608	SOIL CONSERVATION AND WATERSHED MANAGEMENT	2+1

AGRON 609	STRESS CROP PRODUCTION	2+1
AGRON 691	DOCTORAL SEMINAR I	1+0
AGRON 692	DOCTORAL SEMINAR II	1+0
AGRON 699	DOCTORAL RESEARCH	45

AGRONOMY

Course Contents

AGRON 501 MODERN CONCEPTS IN CROP PRODUCTION 3+0

Objective

To teach the basic concepts of soil management and crop production.

Theory

UNIT I

Crop growth analysis in relation to environment; gro-ecological zones of India.

UNIT II

Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit.

UNIT III

Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield.

UNIT IV

Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress.

UNIT V

Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture.

AGRON 502 SOIL FERTILITY AND NUTRIENT MANAGEMENT 2+1

Objective

To impart knowledge of fertilizers and manures as sources of plant nutrients and apprise about the integrated approach of plant nutrition and sustainability of soil fertility.

Theory

UNIT I

Soil fertility and productivity - factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions.

UNIT II

Criteria of essentiality of nutrients; Essential plant nutrients - their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients.

UNIT III

Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management.

UNIT IV

Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions.

UNIT V

Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; use of vermin-compost and residue wastes in crops.

Practical

- Determination of soil pH, ECe, organic C, total N, available N, P, K and S in soils.
- Determination of total N, P, K and S in plants
- Interpretation of interaction effects and computation of economic and yield optima.

AGRON 503 PRINCIPLES AND PRACTICES OF WEED MANAGEMENT 2+1

Objective

To familiarize the students about the weeds, herbicides and methods of weed control.

Theory

UNIT I

Weed biology and ecology, crop-weed competition including allelopathy; principles and methods of weed control and classification; weed indices.

UNIT II

Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides.

UNIT III

Herbicide structure - activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures; herbicide resistance and management; weed control through bio herbicides, myco-herbicides and allelochemicals; Degradation of herbicides in soil and plants; herbicide resistance in weeds and crops; herbicide rotation.

UNIT IV

Weed management in major crops and cropping systems; parasitic weeds; weed shifts in cropping systems; aquatic and perennial weed control.

UNIT V

Integrated weed management; cost : benefit analysis of weed management.

Practical

- Identification of important weeds of different crops
- Preparation of a weed herbarium
- Weed survey in crops and cropping systems
- Crop-weed competition studies
- Preparation of spray solutions of herbicides for high and low-volume sprayers
- Use of various types of spray pumps and nozzles and calculation of swath width
- Economics of weed control
- Herbicide resistance analysis in plant and soil
- Bioassay of herbicide resistance
- Calculation of herbicidal requirement

AGRON 504 PRINCIPLES AND PRACTICES OF WATER MANAGEMENT 2+1

Objective

To teach the principles of water management and practices to enhance the water productivity.

Theory

UNIT I

Water and its role in plants; water resources of India, major irrigation projects, extent of area and crops irrigated in India and different states.

UNIT II

Soil water movement in soil and plants; transpiration; soil-water-plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition.

UNIT III

Soil, plant and meteorological factors determining water needs of crops; scheduling, depth and methods of irrigation; microirrigation system; fertigation; management of water in controlled environments and poly- houses.

UNIT IV

Water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; water use efficiency.

UNIT V

Excess of soil water and plant growth; water management in problem soils; drainage requirement of crops and methods of field drainage, their layout and spacing.

Practical

- Measurement of soil water potential by using tensiometer, and pressure plate and membrane apparatus
- Soil-moisture characteristics curves
- Water flow measurements using different devices
- Determination of irrigation requirements
- Calculation of irrigation efficiency
- Determination of infiltration rate
- Determination of saturated/unsaturated hydraulic conductivity

AGRON 505 AGROMETEOROLOGY AND CROP WEATHER FORECASTING 2+1

Objective

To impart knowledge about agro-meteorology and crop weather forecasting to meet the challenges of aberrant weather conditions.

Theory

UNIT I

Agro meteorology - aim, scope and development in relation to crop environment; composition of atmosphere, distribution of atmospheric pressure and wind.

UNIT II

Characteristics of solar radiation; energy balance of atmosphere system; radiation distribution in plant canopies, radiation utilization by field crops; photosynthesis and efficiency of radiation utilization by field crops; energy budget of plant canopies; environmental temperature: soil, air and canopy temperature.

UNIT III

Temperature profile in air, soil, crop canopies; soil and air temperature effects on plant processes; environmental moisture and evaporation: measures of atmospheric temperature and relative humidity vapor pressure and their relationships; evapo-transpiration and meteorological factors determining evapotranspiration.

UNIT IV

Modification of plant environment: artificial rain making, heat transfer, controlling heat load, heat trapping and shading; protection from cold, sensible and latent heat flux, controlling soil moisture; monsoon and their origin, characteristics of monsoon; onset, progress and withdrawal of monsoon; weather hazards, drought monitoring and planning for mitigation.

UNIT V

Weather forecasting in India - short, medium and long range; aerospace science and weather forecasting; benefits of weather services to agriculture, remote sensing; application in agriculture and its present status in India; atmospheric pollution and its effect on climate and crop production; climate change and its impact on agriculture.

Practical

- Visit to agro-meteorological observatory and to record sun-shine hours, wind velocity, wind direction, relative humidity, soil and air temperature, evaporation, precipitation and atmospheric pressure
- Measurement of solar radiation outside and within plant canopy
- Measurement/estimation of evapo-transpiration by various methods
- Measurement/estimation of soil water balance
- Rainfall variability analysis
- Determination of heat-unit requirement for different crops
- Measurement of crop canopy temperature
- Measurement of soil temperatures at different depths
- Remote sensing and familiarization with agro-advisory service bulletins
- Study of synoptic charts and weather reports, working principle of automatic weather station
- Visit to solar observatory

AGRON 506 AGRONOMY OF MAJOR CEREALS AND PULSES 2+1

Objective

To teach the crop husbandry of cereals and pulse crops.

Theory

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of

UNIT I

Rabi cereals.

UNIT II

Kharif cereals.

UNIT III

Rabi pulses.

UNIT IV

Kharif pulses.

Practical

- Phenological studies at different growth stages of crop
- Estimation of crop yield on the basis of yield attributes
- Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
- Working out growth indices (CER, CGR, RGR, NAR, LAD), aggressiveness, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems of different crops

- Estimation of protein content in pulses
- Planning and layout of field experiments
- Judging of physiological maturity in different crops
- Intercultural operations in different crops
- Determination of cost of cultivation of different crops
- Working out harvest index of various crops
- Study of seed production techniques in various crops
- Visit of field experiments on cultural, fertilizer, weed control and water management aspects
- Visit to nearby villages for identification of constraints in crop production

AGRON 507 AGRONOMY OF OILSEED, FIBRE AND SUGAR CROPS 2+1

Objective

To teach the crop husbandry of oilseed, fiber and sugar crops.

Theory

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of :

UNIT I

Rabi oilseeds - Rapeseed and mustard, linseed, etc.

UNIT II

Kharif oilseeds - Groundnut, sesame, castor, sunflower, soybean etc.

UNIT III

Fiber crops - Cotton, jute, sunhemp etc.

UNIT IV

Sugar crops - Sugar-beet and sugarcane.

Practical

- Planning and layout of field experiments
- Cutting of sugarcane setts, its treatment and methods of sowing, tying and propping of sugarcane
- Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice phenological studies at different growth stages of crop
- Intercultural operations in different crops
- Cotton seed treatment
- Working out growth indices (LER, CGR, RGR, NAR, LAD) aggressivity, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems
- Judging of physiological maturity in different crops and working out harvest index
- Working out cost of cultivation of different crops
- Estimation of crop yield on the basis of yield attributes
- Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
- Determination of oil content in oilseeds and computation of oil yield
- Estimation of quality of fibre of different fibre crops • Study of seed production techniques in various crops
- Visit of field experiments on cultural, fertilizer, weed control and water management aspects
- Visit to nearby villages for identification of constraints in crop production

AGRON 508 AGRONOMY OF MEDICINAL,AROMATIC AND UNDER-UTILIZED CROPS 2+1

Objective

To acquaint students about different medicinal, aromatic and underutilized field crops, their package of practices and processing.

Theory

UNIT I

Importance of medicinal and aromatic plants in human health, national economy and related industries, classification of medicinal and aromatic plants according to botanical characteristics and uses.

UNIT II

Climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Isabgol, Rauwolfia, Poppy, *Aloe vera*, Satavar, Stevia, Safed Musli, Kalmegh, Asaphoetida, *Nux vomica*, Rosadle etc).

UNIT III

Climate and soil requirements; cultural practices; yield and important constituents of aromatic plants (Citronella, Palmarosa, Mentha, Basil, Lemon grass, Rose, Patchouli, Geranium etc.).

UNIT IV

Climate and soil requirements; cultural practices; yield of under-utilized crops (Rice bean, Lathyrus, Sesbania, Clusterbean, French bean, Fenugreek, Grain Amaranth, Coffee, Tea and Tobacco).

Practical

- Identification of crops based on morphological and seed characteristics
- Raising of herbarium of medicinal, aromatic and under-utilized plants
- Quality characters in medicinal and aromatic plants
- Methods of analysis of essential oil and other chemicals of importance in medicinal and aromatic plants

AGRON 509 AGRONOMY OF FODDER AND FORAGE CROPS 2+1

Objective

To teach the crop husbandry of different forage and fodder crops along with their processing.

Theory

UNIT I

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like maize, *bajra*, *guar*, cowpea, oats, barley, berseem, *senji*, lucerne etc.

UNIT II

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti quality factors of important forage crops/grasses- lime, napier grass, *Panicum, Lasiuras, Cenchrus* etc.

UNIT III

Year-round fodder production and management, preservation and utilization of forage and pasture crops.

UNIT IV

Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition; value addition of poor quality fodder.

UNIT V

Economics of forage cultivation uses and seed production techniques.

Practical

- Practical raining of farm operations in raising fodder crops;
- Canopy measurement, yield and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose etc. of various fodder and forage crops
- Anti-quality components like HCN in sorghum and such factors in other crops
- Hay and silage making and economics of their preparation

AGRON 510 AGROSTOLOGY AND AGRO-FORESTRY 2+1

Objective

To teach crop husbandry of different forage, fodder and agro-forestry crops/trees along with their processing.

Theory

UNIT I

Agrostology: definition and importance; principles of grassland ecology: grassland ecology - community, climax, dominant species, succession, biotype, ecological status of grasslands in India, grass cover of India; problems and management of grasslands.

UNIT II

Importance, classification (various criteria), scope, status and research needs of pastures; pasture establishment, their improvement and renovation-natural pastures, cultivated pastures; common pasture grasses.

UNIT III

Agroforestry: definition and importance; agroforestory systems, agri-silviculture, silvipasture, agrisilvipasture, agrihorticulture, aqua-silviculture, alley cropping and energy plantation.

UNIT IV

Crop production technology in agro-forestory and agrostology system; silvipastoral system: meaning and importance for wasteland development; selection of species, planting methods and problems of seed germination in agro-forestry systems; irrigation and manuring in agro-forestry systems, associative influence in relation to above ground and underground interferences; lopping and coppicing in agro-forestry systems; social acceptability and economic viability, nutritive value of trees; tender operation; desirable tree characteristics.

Practical

- Preparation of charts and maps of India showing different types of pastures and agro-forestry systems
- Identification of seeds and plants of common grasses, legumes and trees of economic importance with reference to agro-forestry
- Seed treatment for better germination of farm vegetation
- Methods of propagation/planting of grasses and trees in silvipastoral system
- Fertilizer application in strip and silvipastroal systems
- After-care of plantation
- Estimation of protein content in loppings of important fodder trees
- Estimation of calorie value of wood of important fuel trees
- Estimation of total biomass and fuel wood
- Economics of agro-forestry
- Visit to important agro-forestry research stations

AGRON 511 CROPPING SYSTEMS AND SUSTAINABLE AGRICULTURE 2+0

Objective

To acquaint the students about prevailing cropping systems in the country and practices to improve their productivity.

Theory

UNIT I

Cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use.

UNIT II

Concept of sustainability in cropping systems and farming systems, scope and objectives; production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping, mechanism of yield advantage in intercropping systems.

UNIT III

Above and below ground interactions and allelopathic effects; competition relations; multi-storied cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture.

UNIT IV

Crop diversification for sustainability; role of organic matter in maintenance of soil fertility; crop residue management; fertilizer use efficiency and concept of fertilizer use in intensive cropping system.

UNIT V

Plant ideotypes for drylands; plant growth regulators and their role in sustainability.

AGRON 512 DRYLAND FARMING AND WATERSHED MANAGEMENT 2+1

Objective

To teach the basic concepts and practices of dry land farming and soil moisture conservation.

Theory

UNIT I

Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture.

UNIT II

Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop

planning for erratic and aberrant weather conditions.

UNIT III

Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions.

UNIT IV

Tillage, tilth, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); anti-transpirants; soil and crop management techniques, seeding and efficient fertilizer use.

UNIT V

Concept of watershed resource management, problems, approach and components.

Practical

- Seed treatment, seed germination and crop establishment in relation to soil moisture contents
- Moisture stress effects and recovery behaviour of important crops
- Estimation of moisture index and aridity index
- Spray of anti-transpirants and their effect on crops
- Collection and interpretation of data for water balance equations
- Water use efficiency
- Preparation of crop plans for different drought conditions
- Study of field experiments relevant to dryland farming
- Visit to dryland research stations and watershed projects

AGRON 513 PRINCIPLES AND PRACTICES OF ORGANIC FARMING 2+1

Objective

To study the principles and practices of organic farming for sustainable crop production.

Theory

UNIT I

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; land and water management - land use, minimum tillage; shelter zones, hedges, pasture management, agro-forestry.

UNIT II

Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers.

UNIT III

Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

UNIT IV

Control of weeds, diseases and insect pest management, biological agents and pheromones, biopesticides.

UNIT V

Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

Practical

- Aerobic and anaerobic methods of making compost
- Making of vermicompost
- Identification and nursery raising of important agro-forestry tress and tress for shelter belts.
- Efficient use of biofertilizers, technique of treating legume seeds with *Rhizobium* cultures, use of *Azotobacter*, *Azospirillum*, and PSB cultures in field
- Visit to an organic farm
- Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms

AGRON 601 CURRENT TRENDS IN AGRONOMY 3+0

Objective

To acquaint the students about recent advances in agricultural production.

Theory

UNIT I

Agro-physiological basis of variation in yield, recent advances in soil-plant-water relationship.

UNIT II

Globalization of agriculture and WTO, precision agriculture, contract farming, organic farming, marketing and export potential of organic products, certification, labeling and accreditation procedures.

UNIT III

Crop residue management in multiple cropping systems; latest developments in plant management, weed management, cropping systems, grassland management, agro-forestry, allelopathy.

UNIT IV

GIS, GPS and remote sensing for crop management, global warming, GM crops, seed production technology; seed certification, seed multiplication, hybrid seed production etc.

UNIT V

Concepts of system agriculture; holistic approach of farming systems, dryland farming, sustainable agriculture and research methodology in Agronomy.

AGRON 602 CROP ECOLOGY 2+0

Objective

To acquaint the students about the agricultural systems, agro-ecological regions, and adaptation of crops to different agro-climatic conditions.

Theory

UNIT I

Concept of crop ecology, agricultural systems, ecology of cropping systems, principles of plant distribution and adaptation, crop and world food supply.

UNIT II

Ecosystem characteristics, types and functions, terrestrial ecology, flow of energy in ecosystem, ecosystem productivity, biomass, succession and climax concept.

UNIT III

Physiological response of crop plants to light, temperature, CO_2, moisture and solar radiation; influence of climate on photosynthesis and productivity of crops; effect of global climate change on crop production.

UNIT IV

Exploitation of solar energy in crops; vertical distribution of temperature; efficiency in crop production.

UNIT V

Competition in crop plants; environmental pollution, ecological basis of environmental management and environment manipulation through agronomic practices; improvement of unproductive lands through crop selection and management.

AGRON 603 CROP PRODUCTION AND SYSTEM MODEL 2+1

Objective

To familiarize the students about systems approach and to simulate yields and growth of several crops under varied soil and weather conditions with different management practices and their optimization.

Theory

UNIT I

Systems classification; flow charts, modeling techniques and methods of integration - state, rates and driving variables, feedbacks and relational diagrams.

UNIT II

Elementary models for crop growth based on basic methods of classical growth analysis.

UNIT III

Crop modeling methods for crop-weather interaction, climate change and variability components.

UNIT IV

Potential production: leaf and canopy CO_2 assimilation, respiration, dry matter accumulation, crop phenology and dry matter distribution and development in different crops.

UNIT V

Production by moisture availability, potential evapotranspiration, water balance of the soil, and production with nutrient and moisture limitations.

Practical

- Simulation of elementary models for crop growth
- Simulation of potential production

- Simulation with limitations of water and nutrient management options
- Sensitivity analysis using different climatic years and crop management practices

AGRON 604 ADVANCES IN CROP GROWTH AND PRODUCTIVITY 2+1

Objective

To study the physiology of vegetative and reproductive growth in relation to productivity of different crops in various environments.

Theory

UNIT I

Plant density and crop productivity; plant and environmental factors, yield, plant distribution, strategies for maximizing solar energy utilization; leaf area; interception of solar radiation and crop growth; photosynthesis: the photosynthetic apparatus, factors essential for photosynthesis; difference in photosynthetic rates among and within species; physiological limitations to crop yield; solar radiation concept and agro-techniques for harvesting solar radiation.

UNIT II

Growth analysis: concept, CGR, RGR, NAR, LAI, LAD, LAR; validity and Limitations in interpreting crop growth and development; growth curves: sigmoid, polynomial and asymptotic; root systems; root-shoot relationship; principles involved in inter and mixed cropping systems under rainfed and irrigated conditions; concept and differentiation of inter and mixed cropping; criteria in assessing the yield advantages.

UNIT III

Competitive relationship and competition functions; biological and agronomic basis of yield advantage under intercropping; physiological principles of dry land crop production, constraints and remedial measures; heat unit concept of crop maturity: concept and types of heat units.

UNIT IV

Concept of plant ideotypes: crop physiological and new ideotypes; characteristics of ideotype for wheat, rice, maize, etc.; concept and types of growth hormones; their role in field crop production; efficient use of resources.

Practical

- Field measurement of root-shoot relationship in crops at different growth stages
- Estimation of growth evaluating parameters like CGR, RGR, NAR, LAI etc., at different stages of crop growth
- Computation of harvest index of various crops
- Assessment of crop yield on the basis of yield attributing characters •

Construction of crop growth curves based on growth analysis data

- Computation of competition functions, viz. LER, IER aggressively competition index etc in intercropping
- Senescence and abscission indices
- Analysis of productivity trend in un-irrigated areas
- Analysis of productivity trend in irrigated areas

AGRON 605 IRRIGATION MANAGEMENT 2+1

Objective

To teach students about optimization of irrigation in different crops under variable agroclimatic conditions.

Theory

UNIT I

Water resources of India, irrigation projects; irrigation needs, atmospheric, soil, agronomic, plant and water factors affecting irrigation need; water deficits and crop growth.

UNIT II

Soil-plant-water relationships, transpiration and evapotranspiration, significance of transpiration, energy utilization in transpiration, physiological processes and crop productivity.

UNIT III

Infiltration; water movement under saturated and unsaturated conditions; management practices for improving water use efficiency of crops.

UNIT IV

Application of irrigation water, conveyance and distribution system, irrigation efficiency; agronomic considerations in the design and operation of irrigation projects; characteristics of irrigation and farming systems affecting irrigation management.

UNIT V

Strategies of using limited water supply; factors affecting ET, control of ET by mulching and use of anti-transpirants; fertilizer use in relation to irrigation; optimizing the use of given irrigation supplies.

UNIT VI

Land suitability for irrigation, land irrigability classification; integrated water management in command areas, institution of water management in commands, farmer's participation in command areas; irrigation legislation.

Practical

- Determination of water infiltration characteristics and water holding capacity of soil profiles
- Moisture extraction pattern of crops
- Consumptive use, water requirement of a given cropping pattern for optimum/variable productivity
- Crop planning at the farm and project level
- Agronomic evaluation of irrigation projects, case studies

AGRON606 ADVANCES IN WEED MANAGEMENT 2+0

Objective

To teach about the changing weed flora, new herbicides, their resistance, toxicity, antidotes and residue management under different cropping systems.

Theory

UNIT I

Crop-weed competition in different cropping situations; changes in weed flora, various causes and affects.

UNIT II

Physiological and biological aspects of herbicides, their absorption, translocation, metabolism and mode of action; selectivity of herbicides and factors affecting them.

UNIT III

Climatic factors and phytotoxicity of herbicides; fate of herbicides in soil and factors affecting them, residue management of herbicides, adjuvants.

UNIT IV

Advances in herbicide application techniques; herbicide resistance; antidotes and crop protection compatibility of herbicides of different groups; compatibility of herbicides with other pesticides.

UNIT V

Development of transgenic herbicide resistant crops; herbicide development, registration procedures.

UNIT VI

Relationship of herbicides with tillage, fertilizer and irrigation; bio-herbicides, allelochemical herbicide bioassays.

AGRON 607 INTEGRATED FARMING SYSTEMS FOR SUSTAINABLE AGRICULTURE 2+0

Objective

To apprise about different enterprises suitable for different agroclimatic conditions for sustainable agriculture.

Theory

UNIT I

Farming systems: definition and importance; classification of farming systems according to type of rotation, intensity of rotation, degree of commercialization, water supply, enterprises.

UNIT II

Concept of sustainability in farming systems; efficient farming systems; natural resources - identification and management.

UNIT III

Production potential of different components of farming systems; interaction and mechanism of different production factors; stability in different systems through research; eco-physiological approaches to intercropping.

UNIT IV

Simulation models for intercropping; soil nutrient in intercropping; preparation of different farming system models; evaluation of different farming systems.

UNIT V

New concepts and approaches of farming systems and cropping systems and organic farming; case studies on different farming systems.

AGRON608 SOIL CONSERVATION AND WATERSHED MANAGEMENT 2+1

Objective

To teach about different soil moisture conservation technologies for enhancing the agricultural productivity through holistic approach watershed management.

Theory

UNIT I

Soil erosion: definition, nature and extent of erosion; types of erosion, factors affecting erosion.

UNIT II

Soil conservation: definition, methods of soil conservation; agronomic measures - contour cultivation, strip cropping, cover crops; vegetative barriers; improved dry farming practices; mechanical measures - bunding, gully control, bench terracing; role of grasses and pastures in soil conservation; wind breaks and shelter belts.

UNIT III

Watershed management: definition, objectives, concepts, approach, components, steps in implementation of watershed; development of cropping systems for watershed areas.

UNIT IV

Land use capability classification, alternate land use systems; agro-forestry; ley farming; *jhum* management - basic concepts, socio-ethnic aspects, its layout.

UNIT V

Drainage considerations and agronomic management; rehabilitation of abandoned *jhum* lands and measures to prevent soil erosion.

Practical

- Study of different types of erosion
- Field studies of different soil conservation measures
- Run-off and soil loss measurements
- Laying out run-off plot and deciding treatments
- Identification of different grasses and trees for soil conservation
- Visit to a soil conservation research centre, demonstration and training centre

AGRON 609 STRESS CROP PRODUCTION 2+1

Objective

To study various types of stresses in crop production and strategies to overcome them.

Theory

UNIT I

Stress and strain terminology; nature and stress injury and resistance; causes of stress.

UNIT II

Low temperature stress: freezing injury and resistance in plants, measurement of freezing tolerance, chilling injury and resistance in plants, practical ways to overcome the effect of low temperature tress through, soil and crop manipulations.

UNIT II

High temperature or heat stress: meaning of heat stress, heat injury and resistance in plants, practical ways to overcome the effect of heat stress through soil and crop manipulations.

UNIT III

Water deficit stress: meaning of plant water deficient stress and its effect on growth and development, water deficit injury and resistance, practical ways to overcome effect of water deficit stress through soil and crop, manipulations.

UNIT IV

Excess water or flooding stress: meaning of excess water stress, its kinds and effects on crop plants, excess water stress injury and resistance, practical ways to overcome excess water stress through soil and crop manipulations.

UNIT V

Salt stress: meaning of salt stress and its effect on crop growth, salt stress injury and resistance in plants, practical ways to overcome the effect of salt stress through soil and crop manipulations.

UNIT VI

Mechanical impedance of soil and its impact on plant growth; measures to overcome soil mechanical impedance.

UNIT VII

Environmental pollution: air, soil and water pollut ion, and their effect on crop growth and quality of produce; ways and means to prevent environmental pollution.

Practical

- Determination of electrical conductivity of plant cell sap
- Determination of osmotic potential and tissue water potential
- Measurement of transpiration rate
- Measurement of stomatal frequency
- Growing of plants in sand culture under salt stress for biochemical and physiological studies
- Studies on effect of osmotic and ionic stress on seed germination and seedling growth
- Measurement of low temperature injury under field conditions

PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
ABT 501**	PRINCIPLES OF BIOTECHNOLOGY	2+1
ABT 502**	FUNDAMENTALS OF MOLECULAR BIOLOGY	3+0
ABT 503**	MOLECULAR CELL BIOLOGY	3+0
ABT 504	TECHNIQUES IN MOLECULAR BIOLOGY I	0+3
ABT 505**	PLANT TISSUE CULTURE AND GENETIC TRANSFORMATION	1+2
ABT 506	MOLECULAR BREEDING	2+0
ABT 507	GENOMICS AND PROTEOMICS	2+0
ABT 508	TECHNIQUES IN MOLECULAR BIOLOGY II	0+3
ABT 509	BIOSAFETY, IPR AND BIOETHICS	2+1
ABT 510*	GENERAL BIOCHEMISTRY	2+1
ABT 511*	PRINCIPLES OF MICROBIOLOGY	2+1
ABT 512*	INTRODUCTION TO BIOINFORMATICS	2+1
GP 501	PRINCIPLES OF GENETICS	2+1
GP 509	BIOTECHNOLOGY FOR CROP IMPROVEMENT	2+1
ABT/GP 514	GENE REGULATION AND EXPRESSION	2+0
ABT 515*,**	IMMUNOLOGY AND MOLECULAR DIAGNOSTICS	2+1
ABT 516*	NANO- BIOTECHNOLOGY	3+0
STAT 511	STATISTICAL METHODS FOR APPLIED SCIENCES	3+1
ABT 591	MASTER'S SEMINAR	1+0
ABT 599	MASTER'S RESEARCH	20
ABT 601	ADVANCES IN PLANT MOLECULAR BIOLOGY	3+0
ABT 602	ADVANCES IN GENETIC ENGINEERING	3+0
ABT 603	ADVANCES IN MICROBIAL BIOTECHNOLOGY	3+0
ABT 604	ADVANCES IN CROP BIOTECHNOLOGY	3+0
ABT 605	ADVANCES IN FUNCTIONAL GENOMICS AND PROTEOMICS	2+0
ABT 606	COMMERCIAL PLANT TISSUE CULTURE	2+0
ABT 607	ENVIRONMENTAL BIOTECHNOLOGY	2+0
ABT 691	DOCTORAL SEMINAR I	1+0
ABT 692	DOCTORAL SEMINAR II	1+0
ABT 699	DOCTORAL RESEARCH	45

*May be taken as minor/supporting courses; **Compulsory for M.Sc. Programme

PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Course Contents

ABT 501 PRINCIPLES OF BIOTECHNOLOGY 2+1

Objective

To familiarize the students with the fundamental principles of Biotechnology, various developments in Biotechnology and its potential applications.

Theory

UNIT I

History, scope and importance; DNA structure, function and metabolism.

UNIT II

DNA modifying enzymes and vectors; Methods of recombinant DNA technology; Nucleic acid hybridization; Gene libraries; PCR amplification; Plant and animal cell and tissue culture techniques and their applications.

UNIT III

Molecular markers and their applications; DNA sequencing; Applications of gene cloning in basic and applied research; Genetic engineering and transgenics; Genomics, transcriptomics and proteomics.

UNIT IV

General application of biotechnology in Agriculture, Medicine, Animal husbandry, Environmental remediation, Energy production and Forensics; Public perception of biotechnology; Bio-safety and bioethics issues; Intellectual property rights in biotechnology.

Practical

i. Isolation of genomic and plasmid DNA
ii. Gel electrophoresis techniques
iii. Restriction enzyme digestion, ligation, transformation and screening of transformants
iv. PCR and molecular marker analysis
v. Plant tissue culture: media preparation, cell and explant culture, regeneration and transformation.

ABT 502 FUNDAMENTALS OF MOLECULAR BIOLOGY 3+0

Objective

To familiarize the students with the basic cellular processes at molecular level.

Theory

UNIT I

Historical developments of molecular biology; Nucleic acids as genetic material; Chemistry, structure and properties of DNA and RNA.

UNIT II

Genome organization in prokaryotes and eukaryotes; Chromatin structure and function; DNA replication; DNA polymerases, topoisomerases, DNA ligase, etc; Molecular basis of mutations; DNA repair mechanisms.

UNIT III

Transcription process; RNA processing; Reverse transcriptase; RNA editing; Ribosomes structure and function; Organization of ribosomal proteins and RNA genes; Genetic code; Aminoacyl tRNA synthases.

UNIT IV

Translation and post-translational modifications; Operon concept; Attenuation of *trp* operon; important features of gene regulation in eukaryotes.

ABT 503 MOLECULAR CELL BIOLOGY 3+0

Objective

To familiarize the students with the cell biology at molecular level.

Theory

UNIT I

General structure and constituents of cell; Similarities and distinction between plant and animal cells; Cell wall, cell membrane, structure and composition of biomembranes, cell surface related functions.

UNIT II

Structure and function of major organelles: Nucleus, Chloroplasts, Mitochondria, Ribosomes, Lysosomes, Peroxisomes, Endoplasmic reticulum, Microbodies, Golgi apparatus, Vacuoles, etc.

UNIT III

Organellar genomes and their manipulation; Ribosomes in relation to cell growth and division; Cyto-skeletal elements.

UNIT IV

Cell division and regulation of cell cycle; Membrane transport; Transport of water, ion and biomolecules; Signal transduction mechanisms; Protein targeting.

ABT 505 PLANT TISSUE CULTURE AND GENETIC TRANSFORMATION 1+2

Objective

To familiarize the students and provide hands on training on various techniques of plant tissue culture, genetic engineering and transformation.

Theory

UNIT I

History of plant cell and tissue culture; Culture media; Various types of culture; callus, suspension, nurse, root, meristem, etc.; *In vitro* differentiation: organogenesis and somatic embryogenesis; Plant growth regulators: mode of action, effects on *in vitro* culture and regeneration; Molecular basis of plant organ differentiation.

UNIT II

Micropropagation; Anther and microspore culture; Somaclonal variation; *In vitro* mutagenesis; *In vitro* fertilization; *In vitro* germplasm conservation; Production of secondary metabolites; Synthetic seeds.

UNIT III

Embryo rescue and wide hybridization; Protoplast culture and regeneration; Somatic hybridization: protoplast fusion, cybrids, asymmetric hybrids, etc.

UNIT IV

Methods of plant transformation; Vectors for plant transformation; Genetic and molecular analyses of transgenics; Target traits and transgenic crops; Biosafety issues, testing of transgenics, regulatory procedures for commercial approval.

Practical

i. Laboratory set-up.

ii. Preparation of nutrient media; handling and sterilization of plant material; inoculation, subculturing and plant regeneration.

iii. Anther and pollen culture. iv.

Embryo rescue.

v. Suspension cultures and production of secondary metabolites. vi.

Protoplast isolation, culture and fusion.

vii. Gene cloning and vector construction

viii. Gene transfer using different methods, reporter gene expression, selection of transformed tissues/plants, molecular analysis.

ABT 504 TECHNIQUES IN MOLECULAR BIOLOGY-I 0+3

Objective

To provide hands on training on basic molecular biology techniques.

Practical

UNIT I

Good lab practices; Biochemical techniques: Preparation of buffers and reagents, Principle of centrifugation, Chromatographic techniques (TLC, Gel Filtration Chromatography, Ion exchange Chromatography, Affinity Chromatography).

UNIT II

Gel electrophoresis- agarose and PAGE (nucleic acids and proteins); Growth of bacterial culture and preparation of growth curve; Isolation of plasmid DNA from bacteria; Growth of lambda phage and isolation of phage DNA; Restriction digestion of plasmid and phage DNA; Isolation of high molecular weight DNA and analysis.

UNIT III

Gene cloning - Recombinant DNA construction, transformation and selection of transformants; PCR and optimization of factors affecting PCR.

UNIT IV

Dot blot analysis; Southern hybridization; Northern hybridization; Western blotting and ELISA; Radiation safety and non-radio isotopic procedure.

ABT 506 MOLECULAR BREEDING 2+0

Objective

To familiarize the students about the use of molecular biology tools in plant breeding.

Theory

UNIT I

Principles of plant breeding; Breeding methods for self and cross pollinated crops; Heterosis breeding; Limitations of conventional breeding; Aspects of molecular breeding.

UNIT II

Development of sequence based molecular markers - SSRs and SNPs; Advanced methods of genotyping; Mapping genes for qualitative and quantitative traits.

UNIT III

QTL mapping using structured populations; AB-QTL analysis; Association mapping of QTL; Fine mapping of genes/QTL; Map based gene/QTL isolation and development of gene based markers; Allele mining by TILLING and Eco-TILLING; Use of markers in plant breeding.

UNIT IV

Marker assisted selection (MAS) in backcross and heterosis breeding; Transgenic breeding; Foreground and background selection; MAS for gene introgression and pyramiding: MAS for specific traits with examples.

ABT 507 GENOMICS AND PROTEOMICS 2+0

Objective

To familiarize the students with recent tools used for genome analysis and their applications.

Theory

UNIT I

Structural genomics: Classical ways of genome analysis, large fragment genomic libraries; Physical mapping of genomes; Genome sequencing, sequence assembly and annotation; Comparative genomics, etc.

UNIT II

Functional genomics: DNA chips and their use in transcriptome analysis; Mutants and RNAi in functional genomics; Metabolomics and ionomics for elucidating metabolic pathways, etc.

UNIT III

Proteomics - Protein structure, function and purification; Introduction to basic proteomics technology; Bio-informatics in proteomics; Proteome analysis, etc.

UNIT IV

Applications of genomics and proteomics in agriculture, human health and industry.

ABT 508 TECHNIQUES IN MOLECULAR BIOLOGY-II 0+3

Objective

To provide hands on training on various molecular techniques used in molecular breeding and genomics.

Practical

UNIT I

Construction of gene libraries; Synthesis and cloning of cDNA and RTPCR analysis; Real time PCR and interpretation of data.

UNIT II

Molecular markers (RAPD, SSR, AFLP etc) and their analysis; Case study of SSR markers (linkage map, QTL analysis etc); SNP identification and analysis; Microarray studies and use of relevant software.

UNIT III

Proteomics (2D gels, mass spectrometry, etc.); RNAi (right from designing of construct to the phenotyping of the plant); Yeast 1 and 2-hybrid interaction.

UNIT IV

Generation and screening of mutants; Transposon mediated mutagenesis.

ABT 509 BIOSAFETY, IPR AND BIOETHICS 2+0

Objective

To discuss about various aspects of biosafety regulations, IPR and bioethics concerns arising from the commercialization of biotech products.

Theory

UNIT I

Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, Cross border movement of germplasm; Risk management issues - containment.

UNIT II

General principles for the laboratory and environmental biosafety; Health aspects; toxicology, allergenicity, antibiotic resistance, etc; Impact on environment: gene flow in natural and artificial ecologies; Sources of gene escape, tolerance of target organisms, creation of superweeds/superviruses, etc.

UNIT III

Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and nonradio isotopic procedure; Benefits of transgenics to human health, society and the environment.

UNIT IV

The WTO and other international agreements; Intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications, etc; Protection of plant variety and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products.

ANIMAL BIOTECHNOLOGY 3+0

Objective

Intended to provide an overview and current developments in different areas of animal biotechnology.

Theory

UNIT I

Structure of animal cell; History of animal cell culture; Cell culture media and reagents, culture of mammalian cells, tissues and organs, primary culture, secondary culture, continuous cell lines, suspension cultures, somatic cell

cloning and hybridization, transfection and transformation of cells, commercial scale production of animal cells, application of animal cell culture for *in vitro* testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

UNIT II

Introduction to immune system, cellular and hormonal immune response, history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, hybridoma technology, phage display technology for production of antibodies, antigen-antibody based diagnostic assays including radioimmunoassays and enzyme immunoassays, immunoblotting, nucleic acid based diagnostic methods, commercial scale production of diagnostic antigens and antisera, animal disease diagnostic kits, probiotics.

UNIT III

Structure of sperms and ovum, cryopreservation of sperms and ova of livestock, artificial insemination, super ovulation, *in vitro* fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-spliting, embryo sexing, transgenic manipulation of animal embryos, different applications of transgenic animal technology, animal viral vectors, animal cloning basic concept, cloning from- embryonic cells and adult cells, cloning of different animals, cloning for conservation for conservation endangered species, ethical, social and moral issues related to cloning, *in situ* and *ex situ* preservation of germplasm, *in utero* testing of foetus for genetic defects, pregnancy diagnostic kits, anti-fertility animal vaccines, gene knock out technology and animal models for human genetic disorders.

UNIT IV

Introduction to different breeds of cattle, buffalo, sheep, goats, pigs, camels, horses, canines and poultry, genetic characterization of livestock breeds, marker assisted breeding of livestock, introduction to animal genomics, different methods for characterization of animal genomes, SNP, STR, QTL, RFLP, RAPD, genetic basis for disease resistance, Transgenic animal production and application in expression of therapeutic proteins. Immunological and nucleic acid based methods for identification of animal species, detection of meat adulteration using DNA based methods, detection food/feed adulteration with animal protein, identification of wild animal species using DNA based methods using different parts including bones, hair, blood, skin and other parts confiscated by anti-poaching agencies.

ABT 515 IMMUNOLOGY AND MOLECULAR DIAGNOSTICS 2+1

Objective

To discuss the application of various immunological and molecular diagnostic tools.

Theory

UNIT I

History and scope of immunology; Components of immune system: organs, tissues and cells, Immunoglobulin chemistry, structure and functions; Molecular organization of immunoglobulins and classes of antibodies.

UNIT II

Antibody diversity; antigens, haptens, antigens- antibody interactions; immuno-regulation and tolerance; Allergies and hypersensitive response; Immunodeficiency; Vaccines; Immunological techniques.

UNIT III

Immunological application in plant science, monoclonal antibodies and their uses, molecular diagnostics. Introduction to the basic principles of molecular technology and techniques used in pathogen detection, Principles of ELISA and its applications in viral detection.

UNIT IV

Basics and procedures of PCR, Real time PCR, PCR based and hybridization based methods of detection, microarrays based detection, multiplexing etc, detection of soil borne and seed born infections, transgene detection in seed,

planting material and processed food, molecular detection of varietal impurities and seed admixtures in commercial consignments.

Practical

i. Preparation of buffers and reagents.
ii. Immunoblotting, immunoelectrophoresis and fluorescent antibody test.
iii. Enzyme immunoassays including ELISA western blotting.
iv. Extraction and identification of DNA/RNA of pathogenic organisms.
v. Restriction hybridoma technique and production of monoclonal antibodies.
vi. Immunogenic proteins, expression and immunogenecity studies, purification of immunogenic protein and immunization of laboratory animals.

ABT 516 NANO-BIOTECHNOLOGY 3+0

Objective

Understanding the molecular techniques involved in structure and functions of nano-biomolecules in cells such as DNA, RNA and proteins.

Theory

UNIT I

Introduction to Biomacromolecules: The modern concepts to describe the conformation and dynamics of biological macromolecules: scattering techniques, micromanipulation techniques, drug delivery applications etc.

UNIT II

Cellular engineering: signal transduction in biological systems, feedback control signaling pathways, cell-cell interactions etc. Effects of physical, chemical and electrical stimuli on cell function and gene regulation.

UNIT III

Chemical, physical and biological properties of biomaterials and bioresponse: biomineralization, biosynthesis, and properties of natural materials (proteins, DNA, and polysaccharides), structure-property relationships in polymeric materials (synthetic polymers and structural proteins); Aerosol properties, application and dynamics; Statistical Mechanics in Biological Systems,

UNIT IV

Preparation and characterization of nanoparticles; Nanoparticular carrier systems; Micro- and Nano-fluidics; Drug and gene delivery system; Microfabrication, Biosensors, Chip technologies, Nano- imaging, Metabolic engineering and Gene therapy.

GP 501 PRINCIPLES OF GENETICS 2+1

Objective

This course is aimed at understanding the basic concepts of genetics, helping students to develop their analytical, quantitative and problemsolving skills from classical to molecular genetics.

Theory

UNIT I

Early concepts of inheritance; Discussion on Mendel's paper; Sex determination, differentiation and sex-linkage, Sex-influenced and sexlimited traits; Linkage, recombination and genetic mapping in eukaryotes, Somatic cell genetics.

UNIT II

Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Organization of DNA in chromosomes; Mutations and mutagenic agents.

UNIT III

Genetic code and protein biosynthesis; Gene regulation, Genes in development; Extra chromosomal inheritance, Male sterility and incompatibility; Recombination in bacteria, fungi and viruses, tetrad analysis.

UNIT IV

Inheritance of quantitative traits; Concepts in population genetics; Genes and behavior; Genetics and evolution; Recombinant DNA technology; Genetic fine structure analysis, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Gene families; An overview of some recent discoveries in the field of genetics.

Practical

i. Laboratory exercises in probability and chi-square.
ii. Demonstration of genetic principles using laboratory organisms. iii.
Chromosome mapping using three point test cross. iv. Tetrad analysis.
v. Induction and detection of mutations through genetic tests. vi.
Pedigree analysis in humans.
vii. Numerical problems on Hardy Weinberg Equilibrium, Quantitative inheritance and Molecular genetics.

BASIC BIOCHEMISTRY 2+1

Objective

To provide elementary knowledge/overview of structure, functions and metabolism of biomolecules.

Theory

UNIT I

Scope and importance of biochemistry in agriculture; Fundamental principles governing life; structure of water; acid base concept and buffers; pH; hydrogen bonding; hydrophobic, electrostatic and Van der Waals forces; General introduction to physical techniques for determination of structure of biopolymers.

UNIT II

Classification, structure and function of carbohydrates, lipids and biomembranes, amino acids, proteins, and nucleic acids.

UNIT III

Structure and biological functions of vitamins, enzymes classification and mechanism of action; regulation, factors affecting enzyme action. Fundamentals of thermodynamic principles applicable to biological processes, Bioenergetics.

UNIT IV

Metabolism of carbohydrates, photosynthesis and respiration, oxidative phosphorylation, lipids, proteins and nucleic acids. DNA replication, transcription and translation; recombinant DNA technology, Nutritional aspects of carbohydrates, lipids, proteins and minerals.

Practical

i. Preparation of standard and buffer solutions.
ii. Extraction and estimation of sugars and amino acids.
iii. Estimation of proteins by Lowry's method.
iv. Estimation of DNA and RNA by Diphenyamine and orcinol methods.
v. Estimation of ascorbic acid.
vi. Separation of biomolecules by TLC and paper chromatography.

BIOSTATISTICS AND COMPUTERS 2+1

Objective

This is the special course for M.Sc. students of Biotechnology. They are exposed to various statistical methods to analyze their experimental data.

Theory

UNIT I

Aims, scope and idea of elementary statistics; Measures of central tendency and dispersion, skewness and kurtosis.

UNIT II

Concept of probability and probability laws, mathematical expectation, moments, moments generating function; Standard probability distributions- Binomial, Poisson and Normal distributions.

UNIT III

Tests of significance based on Z, ÷2, t and F statistics; Correlation and regression, curve fitting by least squares methods.

UNIT IV

Basic principles, organization and operational aspects of computers, operating systems. Introduction to MS-Office, MS-Word, MS-Excel. Statistical Data analysis based on above topics through MS-Excel.

Practical

i. Data analysis using probability, test of significance
ii. Correlation and regression analysis
iii. Usage of MS-Windows
iv. Exercises on test processing, spreadsheet and DBMS
v. SPSS

ABT 511 PRINCIPLES OF MICROBIOLOGY 2+1

Objective

To acquaint the students with history, classification and role of microbiology in agriculture, food and environment.

Theory

UNIT I

Development of Microbiology in the 18th and 19th century. Morphology, structure and function of prokaryotic and eukaryotic cell. Archea. Classification of prokaryotes - Basic principles and techniques used in bacterial classification.

UNIT II

Evolutionary relationship among prokaryotes. Phylogenetic and numerical taxonomy. Use of DNA and r-RNA sequencing in classifications.

UNIT III

Study of major groups of bacteria belonging to Gracilicutes, Firmicutes, Tanericutes and Mendosicutes.

UNIT IV

Viruses - morphology, classification and replication of plant, animal and bacterial viruses. Cultivation methods of viruses. Immune response - specific and non-specific resistance. Normal microflora of human body; some common bacterial and viral diseases of humans and animals.

Practical

i. Methods of isolation, purification and maintenance of microorganisms from different environments (air, water, soil, milk and food).
ii. Enrichment culture technique - isolation of asymbiotic, symbiotic nitrogen fixing bacteria. Isolation of photosynthetic bacteria.
iii. Use of selective media, antibiotic resistance and isolation of antibiotic producing microorganisms. iv. Morphological, physiological and biochemical characterization of bacteria.

ABT 512 INTRODUCTION TO BIOINFORMATICS 2+1

Objective

To impart an introductory knowledge about the subject of bioinformatics to the students studying any discipline of science.

Theory

UNIT I

Introduction, biological databases - primary, secondary and structural, Protein and Gene Information Resources - PIR, SWISSPROT, PDB, genebank, DDBJ. Specialized genomic resources.

UNIT II

DNA sequence analysis, cDNA libraries and EST, EST analysis, pairwise alignment techniques, database searching, multiple sequence alignment.

UNIT III

Secondary database searching, building search protocol, computer aided drug design - basic principles, docking, QSAR.

UNIT IV

Analysis packages - commercial databases and packages, GPL software for Bioinformatics, web-based analysis tools.

Practical

i. Usage of NCBI resources
ii. Retrival of sequence/structure from databases
iii. Visualization of structures
iv. Docking of ligand receptors
v. BLAST exercises.

ABT 607 ENVIRONMENTAL BIOTECHNOLOGY 3+0

Objective

To apprise the students about the role of biotechnology in environment management for sustainable eco-system and human welfare.

Theory

UNIT I

Basic concepts and environmental issues; types of environmental pollution; problems arising from high-input agriculture; methodology of environmental management; air and water pollution and its control; waste water treatment - physical, chemical and biological processes; need for water and natural resource management.

UNIT II

Microbiology and use of micro-organisms in waste treatment; biodegradation; degradation of Xenobiotic, surfactants; bioremediation of soil & water contaminated with oils, pesticides & toxic chemicals, detergents etc; aerobic processes (activated sludge, oxidation ditches, trickling filter, rotating drums, etc); anaerobic processes: digestion, filteration, etc.

UNIT III

Renewable and non-Renewable resources of energy; energy from solid waste; conventional fuels and their environmental impact; biogas; microbial hydrogen production; conversion of sugar to alcohol; gasohol; biodegradation of lignin and cellulose; biopesticides; biofertilizers; composting; vermiculture, etc.

UNIT IV

Treatment schemes of domestic waste and industrial effluents; food, feed and energy from solid waste; bioleaching; enrichment of ores by microorganisms; global environmental problems: ozone depletion, UV-B, greenhouse effects, and acid rain; biodiversity and its conservation;biotechnological approaches for the management environmental problems.

ABT 601 ADVANCES IN PLANT MOLECULAR BIOLOGY 3+0

Objective

To discuss the specialized topics and recent advances in the field of plant molecular biology.

Theory

UNIT I

Arabidopsis in molecular biology, Forward and Reverse Genetic Approaches, Transcriptional and post transcriptional regulation of gene expression, isolation of promoters and other regulatory elements.

UNIT II

RNA interference, Transcriptional gene silencing, Transcript and protein analysis, use of transcript profiling to study biological systems.

UNIT III

Hormone regulatory pathways: Ethylene, Cytokinin, Auxin and ABA, SA and JA; ABC Model of Floral Development, Molecular basis of self incompatibility, Regulation of flowering: photoperiod, vernalization, circadian rhythms.

UNIT IV

Molecular biology of abiotic stress responses: Cold, high temperature, submergence, salinity and drought; Molecular Biology of plant-pathogen interactions, molecular biology of *Agrobacterium* Infection, Molecular biology of *Rhizobium* infection (molecular mechanisms in symbiosis), Programmed cell death in development and defense.

ABT 602 ADVANCES IN GENETIC ENGINEERING 3+0

Objective

To discuss the specialized topics and advances in field of genetic engineering and their application in plant improvement.

Theory

UNIT I

General overview of transgenic plants; Case studies: Genetic engineering of herbicide resistance, Transgenic plants resistant to insects/pests, Genetic engineering of abiotic stress tolerance, Engineering food crops for quality, Genetically engineered pollination control, Induction of male sterility in

plants.

UNIT II

Molecular farming of plants for applications in veterinary and human medicine systems: Boosting heterologous protein production in transgenics, Rapid production of specific vaccines, High-yield production of therapeutic proteins in chloroplasts.

UNIT III

Recent developments in plant transformation strategies; Role of antisense and RNAi-based gene silencing in crop improvement; Regulated and tissue-specific expression of transgenes for crop improvement; Gene stacking; Pathway engineering; Marker-free transgenic development strategies; High throughput phenotyping of transgenic plants.

UNIT IV

Field studies with transgenic crops; Environmental issues associated with transgenic crops; Food and feed safety issues associated with transgenic crops; Risk assessment of transgenic food crops.

ABT 603 ADVANCES IN MICROBIAL BIOTECHNOLOGY 3+0

Objective

To discuss specialized topics about industrially important microorganisms.

Theory

UNIT I

Fermentative metabolism and development of bioprocessing technology, processing and production of recombinant products; isolation, preservation and improvement of industrially important microorganisms.

UNIT II

Immobilization of enzymes and cells; Batch, plug flow and chemostate cultures; Computer simulations; Fed-batch and mixed cultures; Scale-up principles; Down stream processing etc.

UNIT III

Current advances in production of antibiotics, vaccines, and biocides; Steroid transformation; Bioreactors; Bioprocess engineering; Production of non-microbial origin products by genetically engineered microorganisms.

UNIT IV

Concept of probiotics and applications of new tools of biotechnology for quality feed/food production; Microorganisms and proteins used in probiotics; Lactic acid bacteria as live vaccines; Factors affecting delignification; Bioconversion of substrates, anti-nutritional factors present in feeds; Microbial detoxification of aflatoxins; Single cell protein, Bioinsecticides; Biofertilizers; Recent advances in microbial biotechnology.

ABT 604 ADVANCES IN CROP BIOTECHNOLOGY 3+0

Objective

To discuss specialized topics on the application of molecular tools in breeding of specific crops.

Theory

UNIT I

Conventional versus non-conventional methods for crop improvement; Present status and recent developments on available molecular marker, transformation and genomic tools for crop improvement.

UNIT II

Genetic engineering for resistance against abiotic (drought, salinity, flooding, temperature, etc) and biotic (insect pests, fungal, viral and bacterial diseases, weeds, etc) stresses; Genetic Engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation and nutrient uptake efficiency; Genetic engineering for quality improvement (protein, essential amino acids, vitamins, mineral nutrients, etc); edible vaccines, etc.

UNIT III

Molecular breeding: constructing molecular maps; integrating genetic, physical and molecular maps; diversity assessment and phylogenetic analysis; molecular tagging of genes/traits; selected examples on markerassisted selection of qualitative and quantitative traits

UNIT IV

Discussion on application of molecular, transformation and genomic tools for the genetic enhancement in some major field crops such as rice, wheat, cotton, maize, soybean, oilseeds, sugarcane etc.

ABT 605 ADVANCES IN FUNCTIONAL GENOMICS AND PROTEOMICS 2+0

Objective

To discuss recent advances and applications of functional genomics and proteomics in agriculture, medicine and industry.

Theory

UNIT I

Genome sequencing and functional genomics; Human, animal, plant, bacterial and yeast genome projects; genome annotation; *ab initio* gene discovery; functional annotation and gene family clusters; etc.

UNIT II

Functional analysis of genes; RNA-mediated interference; gene knockoffs; Gene traps/ T-DNA insertion lines; homologous recombination; microarray profiling; SAGE; SNPs/variation; yeast-two hybrid screening; gene expression and transcript profiling; EST contigs; EcoTILLING; allele/gene mining; synteny and comparative genomics; Genome evolution, speciation and domestication etc.

UNIT II

Proteomics: protein annotation; protein separation and 2D PAGE; mass spectroscopy; protein microarrays; protein interactive maps; structural proteomics: protein structure determination, prediction and threading, software and data analysis/ management, etc.

UNIT IV

Discussion on selected papers on functional genomics, proteomics, integrative genomics etc.

ABT 606 COMMERCIAL PLANT TISSUE CULTURE 2+0

Objective

To discuss the commercial applications of plant tissue culture in agriculture, medicine and industry.

Theory

UNIT I

Micropropagation of commercially important plant species; plant multiplication, hardening, and transplantation; genetic fidelity; scaling up and cost reduction; bioreactors; synthetic seeds; management and marketing.

UNIT II

Production of useful compounds via biotransformation and secondary metabolite production: suspension cultures, immobilization, examples of chemicals being produced for use in pharmacy, medicine and industry.

UNIT III

Value-addition by transformation; development, production and release of transgenic plants; patent, bio-safety, regulatory, environmental and ethic issues; management and commercialization.

UNIT IV

Some case studies on success stories on commercial applications of plant tissue culture. Visits to some tissue culture based commercial units/industries.

ADVANCES IN ANIMAL BIOTECHNOLOGY 2+0

Objective

Intended to provide cutting edge knowledge on advances in different areas of animal biotechnology.

Theory

UNIT I

Advances in animal cell culture technology, suspension culture technology, advances in commercial scale productions of mammalian cells.

UNIT II

Advances in cell cloning and cell hybridization, advances in monoclonal antibody production technology, Advances in diagnostic technology, Computational vaccinology, reverse genetics based vaccines.

UNIT III

Advances in embryo manipulation, knock out and knock in technology, advances in animal cloning technology, stem cell technology, Advances in development of animal models for human diseases using transgenic animal technology.

UNIT IV

Advances in genetic basis for animal disease resistance, Molecular methods for animal forensics, Advances in animal genomics, proteomics,

AGRICULTURE ECONOMICES

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
AG ECON 501*	MICRO ECONOMIC THEORY AND APPLICATIONS	2+0
AG ECON 502*	MACRO ECONOMICS AND POLICY	2+0
AG ECON 503*	EVOLUTION OF ECONOMIC THOUGHT	1+0
AG ECON 504*	AGRICULTURAL PRODUCTION ECONOMICS	1+1
AG ECON 505*	AGRICULTURAL MARKETING & PRICE ANALYSIS	2+1
AG ECON 506*	RESEARCH METHODOLOGY FOR SOCIAL SCIENCES	1+1
AG ECON 507*	ECONOMETRICS	2+1
AG ECON 508*	LINEAR PROGRAMMING	1+1
AG ECON 509*	AGRICULTURAL FINANCE AND PROJECT MANAGEMENT	2+1
AG ECON 511	INTERNATIONAL ECONOMICS	1+1
AG ECON 512	INSTITUTIONAL ECONOMICS	1+0
AG ECON 513	AGRICULTURAL DEVELOPMENT POLICY ANALYSIS	2+0
AG ECON 514	NATURAL RESOURCE AND ENVIRONMENTAL ECONOMICS	1+1
AG ECON 515	INTELLECTUAL PROPERTY MANAGEMENT	1+0
AG ECON 516#	COMPUTER APPLICATIONS FOR AGRICULTURAL ECONOMICS	2+1
AG ECON 517	RURAL MARKETING	2+0
AG ECON 518	COMMODITY FUTURES TRADING	2+0
AG ECON 591	MASTER'S SEMINAR	1+0
AG ECON 599	MASTER'S RESEARCH	20
AG ECON 601**	ADVANCED MICRO-ECONOMIC ANALYSIS	1+1
AG ECON 602**	ADVANCED MACRO-ECONOMIC ANALYSIS	2+0
AG ECON 603**	ADVANCED ECONOMETRICS	2+1
AG ECON 604**	ADVANCED PRODUCTION ECONOMICS	2+1

AG ECON 605**	QUANTITATIVE DEVELOPMENT POLICY ANALYSIS	1+1
AG ECON 606**	ADVANCED AGRICULTURAL MARKETING AND PRICE ANALYSIS	2+1
AG ECON 608	COMMODITY FUTURES TRADING	2+0
AG ECON 609	NATURAL RESOURCE MANAGEMENT	1+1
AG ECON 610	ENVIRONMENTAL ECONOMICS	2+0
AG ECON 691	DOCTORAL SEMINAR I	1+0
AG ECON 692	DOCTORAL SEMINAR II	1+0
AG ECON 699	DOCTORAL RESEARCH	45

* Compulsory for Master's programme; ** Compulsory for Doctoral programme

Cross-listed with Statistics

The following Basic Supporting courses (5 credits) are recommended for M. Sc. / Ph. D. programmes

M. Sc.

STAT MATHEMATICS FOR AGRICULTURAL ECONOMICS 3

STAT STATISTICAL METHODS FOR SOCIAL SCIENCES 2

Ph. D.

STAT MULTIVARIATE ANALYSIS 2

STAT OPERATIONS RESEARCH 3

AGRICULTURAL ECONOMICS

Course Contents

AG ECON 501 MICRO ECONOMIC THEORY AND APPLICATIONS 2+0

Objective

This course is intended to provide an overview of microeconomic theory and its applications. The course starts with the theory of consumer behaviour consisting of consumer's utility maximization problem and demand theory. It intends to provide fundamental concepts and models in the theory of production and costs and sets out to provide a basic understanding of price and / or output determination under different types of market structures including factor markets. This course will also expose the students to the theory of general equilibrium and welfare economics.

Theory

UNIT I

Theory of Consumer Behaviour - Cardinal Utility Approach - Ordinal Utility Approach - Income effect and substitution effect - Applications of Indifference curve approach - Revealed Preference Hypothesis - Consumer surplus - Derivation of Demand curve - Elasticity of demand.

UNIT II

Theory of Production - Production functions - Returns to scale and economies of scale - Technical progress - Theory of Costs - Cost curves- Profit maximization and cost minimization - Derivation of supply curve - Law of Supply - Producers' surplus.

UNIT III

Market Equilibrium - Behavior of Firms in Competitive Markets - Perfect Competition- Effect of Taxation and Subsidies on market equilibrium - Monopoly- Monopolistic - Oligopoly- Theory of Factor Markets.

UNIT IV

General Equilibrium Theory - Welfare Economics - Pareto Optimality - Social welfare criteria - Social Welfare functions.

AG ECON 502 MACRO ECONOMICS AND POLICY 2+0

Objective

Macro economics and Policy course is intended to expose the students to macroeconomic concepts and theory, the application of the macro economic theory, and implication of the macroeconomic policies.

Theory

UNIT I

Nature and Scope of Macro Economics - Methodology and Keynesian Concepts National Income - Concepts and measurement- Classical theory of Employment and Say's Law-Modern theory of Employment and Effective Demand.

UNIT II

Consumption function- Investment and savings - Concept of Multiplier and Accelerator - Output and Employment - Rate of interest - Classical, Neo classical and Keynesian version- Classical theory Vs Keynesian theory - Unemployment and Full employment.

UNIT III

Money and classical theories of Money and Price - Keynesian theory of money and Friedman Restatement theory of money - Supply of Money - Demand for Money -Inflation: Nature, Effects and control.

UNIT IV

IS & LM frame work - General Equilibrium of product and money markets - Monetary policy - Fiscal policy- Effectiveness of Monetary and Fiscal policy - Central banking.

UNIT V

Business cycles - Balance of Payment - Foreign Exchange Rate determination.

AG ECON 503 EVOLUTION OF ECONOMIC THOUGHT 1+0

Objective

To introduce the students to the evolution of economic thought over a period of time, the background of emanation of thoughts and approaches, as acts of balancing and counter balancing events and criticisms. The course will also in a comprehensive way help the students to know and appreciate the contributions of the Galaxy of Economists.

Theory

UNIT 1

Approaches for the study of history of economic thought - Absolutist vs. Relativist approaches - Evolution of Economic Thought vs. Economic History. Ancient economic thought - medieval economic thought - mercantilism - physiocracy - Forerunners of Classical Political Economy.

UNIT II

Development of Classical Thoughts (Adam Smith, Robert Malthus and David Ricardo) - Critics of Classical Thoughts- Socialist critics - Socialist and Marxian Economic Ideas - Austrian School of Thought - Origins of Formal Microeconomic Analysis - William Stanley Jevons, Cournot and Dupuit.

UNIT III

The birth of neoclassical economic thought - Marshall and Walras - General Equilibrium Theory Welfare Theory - Keynesian economics.

UNIT IV

The Era of globalization - Experiences of developing world - Rigidity of the past vs. emerging realism - The changing path of international Institutions to economic growth and development approaches.

UNIT V

Economic Thought in India - Naoroji and Gokhale - Gandhian Economics - Economic thought of independent India - Nehru's economic philosophy - Experiences of the Structural adjustment programmes of the post liberalization era.

AG ECON 504 AGRICULTURAL PRODUCTION ECONOMICS 1+1

Objective

To expose the students to the concept, significance and uses of agricultural production economics.

Theory

UNIT I

Nature, scope and significance of agricultural production economics- Agricultural Production processes, character and dimensions-spatial, temporal - Centrality of production functions, assumptions of production functions, commonly used forms - Properties, limitations, specification, estimation and interpretation of commonly used production functions.

UNIT II

Factors of production, classification, interdependence, and factor substitution - Determination of optimal levels of production and factor application -Optimal factor combination and least cost combination of production - Theory of product choice; selection of optimal product combination.

UNIT III

Cost functions and cost curves, components, and cost minimization -Duality theory - cost and production functions and its applications -Derivation of firm's input demand and output supply functions -Economies and diseconomies of scale.

UNIT IV

Technology in agricultural production, nature and effects and measurement - Measuring efficiency in agricultural production; technical, allocative and economic efficiencies - Yield gap analysis-concepts-types and measurement - Nature and sources of risk, modeling and coping strategies.

Practical

Different forms of production functions - specification, estimation and interpretation of production functions - returns to scale, factor shares, elasticity of production - physical optima-economic optima-least cost combination-optimal product choice- cost function estimation, interpretation-estimation of yield gap - incorporation of technology in production functions- measuring returns to scalerisk analysis through linear programming.

AG ECON 505 AGRICULTURAL MARKETING AND PRICE ANALYSIS 2+1

Objective

To impart adequate knowledge and analytical skills in the field of agricultural marketing issues, and enhance expertise in improving the performance of the marketing institutions and the players in marketing of agricultural commodities.

Theory

UNIT I

Review of Concepts in Agricultural Marketing - Characteristic of Agricultural product and Production Problems in Agricultural Marketing from Demand and Supply and Institutions sides. Market intermediaries and their role - Need for regulation in the present context - Marketable & Marketed surplus estimation. Marketing Efficiency - Structure Conduct and Performance analysis - Vertical and Horizontal integration - Integration over space, time and form-Vertical coordination.

UNIT II

Marketing Co-operatives - APMC Regulated Markets - Direct marketing, Contract farming and Retailing - Supply Chain Management - State trading, Warehousing and other Government agencies -Performance and Strategies - Market infrastructure needs, performance and Government role - Value Chain Finance.

UNIT III

Role of Information Technology and telecommunication in marketing of agricultural commodities - Market research- Market information service - electronic auctions (e-bay), e-Chaupals, Agmarket and Domestic and Export market Intelligence Cell (DEMIC) - Market extension.

UNIT IV

Spatial and temporal price relationship - price forecasting - time series analysis - time series models - spectral analysis. Price policy and economic development - non-price instruments.

UNIT V

Theory of storage - Introduction to Commodities markets and future trading - Basics of commodity futures - Operation Mechanism of Commodity markets - Price discovery - Hedging and Basis - Fundamental analysis - Technical Analysis - Role of Government in promoting commodity trading and regulatory measures.

Practical

Supply and demand elasticities in relation to problems in agricultural marketing. Price spread and marketing efficiency analysis. Marketing structure analysis through concentration ratios. Performance analysis of Regulated market and marketing societies. Analysis on contract farming and supply chain management of different agricultural commodities, milk and poultry products. Chain Analysis quantitative estimation of supply chain efficiency - Market Intelligence - Characters, Accessibility, and Availability Price forecasting. Online searches for market information sources and interpretation of market intelligence reports - commodity outlook - Technical Analysis for important agricultural commodities - Fundamental Analysis for important agricultural commodities - Presentation of the survey results and wrap-up discussion.

AG ECON 506 RESEARCH METHODOLOGY FOR SOCIAL SCIENCES 1+1

Objective

To expose the students to research methodology used in social sciences. The focus will be on providing knowledge related to research process, data collection and data analysis etc.

Theory

UNIT I

Importance and scope of research in agricultural economics. Types of research - Fundamental vs. Applied. Concept of researchable problem - research prioritization - selection of research problem. Approach to research - research process.

UNIT II

Hypothesis - meaning - characteristics - types of hypothesis - review of literature - setting of Course Objective and hypotheses - testing of hypothesis.

UNIT III

Sampling theory and sampling design - sampling error - methods of sampling - probability and non-probability sampling methods - criteria to choose. Project proposals - contents and scope - different types of projects to meet different needs - trade-off between scope and cost of the study. Research design and techniques - Types of research design.

UNIT IV

Data collection - assessment of data needs - sources of data collection - discussion of different situations. Mailed questionnaire and interview schedule - structured, unstructured, open ended and closed-ended questions. Scaling

Techniques. Preparation of schedule - problems in measurement of variables in agriculture. Interviewing techniques and field problems - methods of conducting survey - Reconnaissance survey and Pre testing.

UNIT V

Coding editing - tabulation - validation of data. Tools of analysis - data processing. Interpretation of results - Preparing research report / thesis - Universal procedures for preparation of bibliography - writing of research articles.

Practical

Exercises in problem identification. Project proposals - contents and scope. Formulation of Objective and hypotheses. Assessment of data needs - sources of data - methods of collection of data. Methods of sampling - criteria to choose - discussion on sampling under different situations. Scaling Techniques - measurement of scales. Preparation of interview schedule - Field testing. Method of conducting survey. Exercise on coding, editing, tabulation and validation of data. Preparing for data entry into computer. Hypothesis testing - Parametric and Non-Parametric Tests. Exercises on format for Thesis / Report writing. Presentation of the results.

AG ECON 507 ECONOMETRICS 2+1

Objective

The Course Objective of the course is to impart knowledge on econometric tools to the students of agricultural economics. Training in econometrics will help the student to analyze the economic problem by applying quantitative techniques.

Theory

UNIT I

Introduction - relationship between economic theory, mathematical economics, models and econometrics, methodology of econometrics-regression analysis.

UNIT II

Basic two variable regression - assumptions estimation and interpretationapproaches to estimation - OLS, MLE and their properties - extensions to multi variable models-multiple regression estimation and interpretation.

UNIT III

Violation of assumptions - identification, consequences and remedies for Multicollinearity, heteroscedasticity, autocorrelation - data problems and remedial approaches - model misspecification.

UNIT IV

Use of dummy variables-limited dependent variables - specification, estimation and interpretation.

UNIT V

Simultaneous equation models - structural equations - reduced form equations - identification and approaches to estimation.

Practical

Single equation two variable model specification and estimation - hypothesis testing- transformations of functional forms and OLS application-estimation of multiple regression model - hypothesis testing - testing and correcting specification errors - testing and managing Multicollinearity - testing and managing heteroscedasticity - testing and managing autocorrelation - estimation of regressions with dummy variables - estimation of regression with limited dependent variable - identification of equations in simultaneous equation systems.

Theory

UNIT I

Decision Making- Concepts of decision making, introduction to quantitative tools, introduction to linear programming, uses of LP in different fields, graphic solution to problems, formulation of problems.

UNIT II

Simplex Method: Concept of simplex Method, solving profit maximization and cost minimizations problems. Formulation of farms and non farm problems as linear programming models and solutions.

UNIT III

Extension of Linear Programming models: Variable resource and price programming, transportation problems, recursive programming, dynamic programming.

UNIT IV

Game Theory- Concepts of game theory, two person constant sum, zero sum game, saddle point, solution to mixed strategies, the rectangular game as Linear Programme.

Practical

Graphical and algebraic formulation of linear programming models. Solving of maximization and minimization problems by simplex method. Formulation of the simplex matrices for typical farm situations.

AG ECON 509 AGRICULTURAL FINANCE AND PROJECT MANAGEMENT 2+1

Objective

The Course Objective of the course is to impart knowledge on issues related to lending to priority sector credit management and financial risk management. The course would bring in the various appraisal techniques in project - investment of agricultural projects.

Theory

UNIT I

Role and Importance of Agricultural Finance. Financial Institutions and credit flow to rural/priority sector. Agricultural lending - Direct and Indirect Financing - Financing through Co-operatives, NABARD and Commercial Banks and RRBs. District Credit Plan and lending to agriculture/priority sector. Micro-Financing and Role of MFI's - NGO's, and SHG's.

UNIT II

Lending to farmers - The concept of 3 C's, 7 P's and 3 R's of credit. Estimation of Technical feasibility, Economic viability and repaying capacity of borrowers and appraisal of credit proposals. Understanding lenders and developing better working relationship and supervisory credit system. Credit inclusions - credit widening and credit deepening.

UNIT III

Financial Decisions - Investment, Financing, Liquidity and Solvency. Preparation of financial statements - Balance Sheet, Cash Flow Statement and Profit and Loss Account. Ratio Analysis and Assessing the performance of farm/ firm.

UNIT IV

Project Approach in financing agriculture. Financial, economic and environmental appraisal of investment projects. Identification, preparation, appraisal, financing and implementation of projects. Project Appraisal techniques - Undiscounted measures. Time value of money - Use of discounted measures - B-C ratio, NPV and IRR. Agreements, supervision, monitoring and evaluation phases in appraising agricultural investment projects. Net work Techniques - PERT and CPM.

UNIT V

Risks in financing agriculture. Risk management strategies and coping mechanism. Crop Insurance programmes - review of different crop insurance schemes - yield loss and weather based insurance and their applications.

Practical

Development of Rural Institutional Lending - Branch expansion, demand and supply of institutional agricultural credit and Over dues and Loan waiving- : An overview, Rural Lending Programmes of Commercial Banks, Lead Bank Scheme- Preparation of District Credit Plan, Rural Lending Programmes of Co-operative Lending Institutions,

Preparation of financial statements using farm/firm level data, Farm credit appraisal techniques and farm financial analysis through financial statements, Performance of Micro Financing Institutions - NGO's and Self-Help Groups, Identification and formulation of investment projects, Project appraisal techniques - Undiscounted Measures and their limitations. Project appraisal techniques - Discounted Measures, Network techniques - PERT and CPM for project management, Case Study Analysis of an Agricultural project, Financial Risk and risk management strategies - crop insurance schemes, Financial instruments and methods - E banking, Kisan Cards and core banking.

AG ECON 510 INTERNATIONAL ECONOMICS 1+1

Objective

The expected outcome of this course will be creating awareness among the students about the role of International Economics on National welfare.

Theory

UNIT I

Scope and Significance of International Economics - The role of trade- General Equilibrium in a Closed Economy (Autarky Equilibrium) - Equilibrium in a Simple Open Economy - Possibility of World Trade - Trade gains and Trade Equilibrium.

UNIT II

Tariff, Producer Subsidy, Export Subsidy, Import Quota and Export Voluntary Restraints- The Case of Small Country and Large Country Case.

UNIT III

Ricardian Model of Trade- Specific Factors Model- Heckscher - Ohlin Model - Trade Creation and Trade Diversion - Offer Curve - Export Supply Elasticity and Import Demand Elasticity - Comparative Advantage and Absolute Advantage.

UNIT IV

Official Exchange Rate and Shadow Exchange Rate - Walra's Law and Terms of Trade - Trade Blocks.

UNIT V

IMF, World Bank, IDA, IFC, ADB - International Trade agreements - Uruguay Round - GATT - WTO.

Practical

Producer's Surplus, Consumer's Surplus, National Welfare under Autarky and Free Trade Equilibrium with small and large country assumption- Estimation of Trade Gains- Estimation of competitive and comparative measures like NPC, EPC, ERP and DRC- Estimation of Offer Curve Elasticity- Estimation of Effect of Tariff, Export Subsidy, Producer Subsidy, Import Quota and Export Voluntary Restraints on National Welfare- Estimation of Ricardian Model - Estimation of Effect of Trade under Specific Factor Model- Estimation of trade Equilibrium under Heckscher -Ohlin model - Trade Creation and Diversion.

AG ECON 511 AGRICULTURAL DEVELOPMENT AND POLICIES 2+0

Objectives

- to provide orientation to the students regarding the concepts and measures of economic development
- to provide orientation on theories of economic growth and relevance of theories in developing countries.
- to make them to understand the agricultural policies and its effect on sustainable agricultural development
- to make them to understand the globalization and its impact on agricultural development.

Theory

UNIT I

Development Economics - Scope and Importance - Economic development and economic growth - divergence in concept and approach - Indicators and Measurement of Economic Development - GNP as a measure of economic

growth - New Measures of Welfare - NEW and MEW - PQLI - HDI - Green GNP - Criteria for under development - Obstacles to economic development - Economic and Non-Economic factors of economic growth.

UNIT II

Economic development - meaning, stages of economic development, determinants of economic growth. Theories of economic growth - Ricardian growth model - The Harrod - Domar Model - The Neo classical Model of Growth - The Kaldor Model - Optimal Economic Growth - Recent Experiences of developing country economies in transition - Role of state in economic development - Government measures to promote economic development. Introduction to development planning.

UNIT III

Role of agriculture in economic / rural development - theories of agricultural development - Population and food supply - need for sound agricultural policies - resource policies - credit policies - input and product marketing policies - price policies.

UNIT IV

Development issues, poverty, inequality, unemployment and environmental degradation - Models of Agricultural Development - Induced Innovation Model -policy options for sustainable agricultural development.

UNIT V

Globalization and the relevance of development policy analysis - The dilemma of free trade? - Free trade versus Protectionism- Arguments for protection. Arguments against protection. Role of protection in Developing Countries. WTO - Agreement on Agriculture - Contradictions of free trade - proponents and opponents policies in vulnerable sectors like agriculture - Lessons for developing countries.

AG ECON 512 INSTITUTIONAL ECONOMICS 1+0

Objective

The course exposes the students to the institutional problems and remedies.

Theory

UNIT I

Old and New Institutional Economics - Institutional Economics Vs Neo- classical Economics. Definition of institutions - Distinction between institutions and organizations - Institutional evolution

UNIT II

Institutional change and economic performance - national and international economic institutions. Transaction cost economics - Transaction costs and the allocation of resources. Transaction costs and efficiency. Asymmetric information - Moral hazard and Principal-Agent problem.

UNIT III

Free rider problem - path dependency - Interlinked transactions. Collective action and the elimination of free-rider problem - The logic of collective action and its role in reducing free rider problem - theory of Groups. Rent seeking - interest groups and policy formulation.

UNIT IV

Economic analysis of property rights- property rights regimes - private property -State Property - Common property Resources (CPRs) - public goods and club goods.

UNIT V

Special features of institutional arrangements in agriculture - Transaction costs in agriculture - Case Studies - Theories of agrarian institutions - tenancy institutions.

AG ECON 513 NATURAL RESOURCE AND ENVIRONMENTAL ECONOMICS 1+1

Objectives

- To introduce economics principles related to natural resource and environmental economics
- To explore the concept of efficiency and the efficient allocation of natural resources
- To understand the economics of why environmental problems occur.
- To explore the concept of efficiency and the efficient allocation of pollution control and pollution prevention decisions.
- To understand the environmental policy issues and alternative instruments of environmental policies

Theory

UNIT I

Concepts, Classification and Problems of Natural Resource Economics - Economy - Environment interaction - The Material Balance principle, Entropy law- Resources Scarcity - Limits to Growth - Measuring and mitigating natural resource scarcity - Malthusian and Recardian scarcity - scarcity indices - Resource Scarcity and Technical Change.

UNIT II

Theory of optimal extraction renewable resources -economic models of oil extraction- efficiency - time path of prices and extraction - Hotelling's rule, Solow-Harwick's Rule. Theory of optimal extraction exhaustible resources - economic models of forestry and fishery.

UNIT III

Efficiency and markets - market failures - externalities - types - property rights -transaction costs - Coase's theorem and its critique - public goods - common property and open access resource management - Collective action.

UNIT IV

Environmental perspectives - biocentrism, sustainability, anthropocentrism - Environmental problems and quality of environment - Sources and types of pollution -air, water, solid waste, land degradation - environmental and economic impacts - Economics of pollution control - efficient reduction in environmental pollution.

UNIT V

Environmental regulation - economic instruments - pollution charges - Pigovian tax - tradable permits - indirect instruments - environmental legislations in India.

UNIT VI

Concept of sustainable development - Economic Perspective - Indicators of sustainability Relation between development and environment stress- Environmental Kuznet's curve Environmental Accounting - resource accounting methods - International Environmental Issues - climate change - likely impacts - mitigation efforts and international treaties.

Practical

Exhaustible resource management -optimum rate of oil extraction. Renewable resource management - optimum harvest of Forestry/fishery. Exercise on pollution abatement -I. Exercise on pollution abatement -II. Concepts in valuing the environment. Taxonomy of valuation techniques. Productivity change method - substitute cost method - Hedonic price method - Travel cost method -Contingent valuation methods. Discount rate in natural resource management. Environment impact assessment Visit to Pollution Control Board.

AG ECON 514 INTELLECTUAL PROPERTY MANAGEMENT 1+0

Objective

The Course Objective of the course is to create awareness about intellectual property rights in agriculture. The course deals with management of patents, trademark, geographical indications, copy rights, designs, plant variety protection and biodiversity protection. The students will be taught on the Marketing and Commercialization of Intellectual Properties.

Theory

UNIT I

World Trade Organization- Agreement on Agriculture (AoA) and Intellectual Property Rights (IPR) - Importance of Intellectual Property Management - IPR and Economic growth- IPR and Bio diversity -Major areas of concern in Intellectual Property Management -Technology Transfer and Commercialization-Forms of different Intellectual Properties generated by agricultural research.

UNIT II

Discovery *versus* Invention - Patentability of Biological Inventions - Method of Agriculture and Horticulture- procedure for patent protection: Preparatory work. Record keeping, writing a patent document, filing the patent document - Types of patent application-patent application under the Patent cooperation treaty (PCT).

UNIT III

Plant genetic resources -Importance and conservation - Sui Generic System -Plant Varieties Protection and Farmers Rights Act- Registration of Extant varieties - Registration and protection of New Varieties / Hybrids / Essentially Derived Varieties - Dispute prevention and settlement -Farmers' Rights.

UNIT IV

Trademark- Geographical Indications of Goods and Commodities - Copy rights-Designs - Biodiversity Protection.

UNIT V

Procedures for commercialization of technology - Valuation, Costs and Pricing of Technology- Licensing and implementation of Intellectual Properties- Procedures for commercialization - Exclusive and non exclusive marketing rights-Research Exemption and benefit sharing.

AG ECON 515 RURAL MARKETING 2+0

Objective

To provide understanding regarding issues in rural markets like marketing environment, consumer behaviour, distribution channels, marketing strategies, etc.

Theory

UNIT I

Concept and scope of rural marketing, nature and characteristics of rural markets, potential of rural markets in India.

UNIT II

Environmental factors - socio-cultural, economic and other environmental factors affecting rural marketing.

UNIT III

Rural consumer's behaviour - behavior of rural consumers and farmers; buyer characteristics and buying behaviour; Rural v/s urban markets.

UNIT IV

Rural marketing strategy - Marketing of consumer durable and non-durable goods and services in the rural markets with special reference to product planning; product mix, pricing Course Objective, pricing policy and pricing strategy.

UNIT V

Product promotion - Media planning, planning of distribution channels, and organizing personal selling in rural market in India.

AG ECON 516 COMMODITY FUTURES TRADING 2+0

Objective

This course is aimed at providing the basic understanding and the mechanics and value of futures markets for speculators and hedgers who in turn will serve as price risk management activities of agribusiness firms.

Theory

UNIT I

History and Evolution of commodity markets - Terms and concepts: spot, forward and futures Markets - factors influencing spot and future markets. Speculatory mechanism in commodity futures.

UNIT II

Transaction and settlement - delivery mechanism - role of different agents -trading strategies - potential impact of interest rate, Foreign Exchange, FDI in Commodity Markets.

UNIT III

Risk in commodity trading, importance and need for risk management measures -managing market price risk: hedging, speculation, arbitrage, swaps - pricing and their features.

UNIT IV

Important global and Indian commodity exchanges - contracts traded - special features -Regulation of Indian commodity exchanges - FMC and its role.

UNIT V

Fundamental Vs Technical analysis - construction and interpretation of charts and chart patterns for analyzing the market trend - Market indicators - back testing. Introduction to technical analysis software - analyzing trading pattern of different commodity groups.

AG ECON 601 ADVANCED MICRO ECONOMIC ANALYSIS 1+1

Objectives

The Course Objective of this course is to introduce the theoretical models and applications of microeconomic theory. In particular, the basic comparative statistical techniques and the more modern duality theory will be developed and applied to the models of maximization, unconstrained and constrained utility maximization, expenditure minimization, constrained profit maximization, and cost and expenditure minimization. These mathematical structures form the basic building blocks of neoclassical economics; this course will stress the development and application of these important models. We follow a calculus rather than a graphical approach to the theory. In the subsequent sections of the course, we provide a fairly rigorous exposure to price determination under different market situations, general equilibrium theory, causes and consequences of market failure and welfare economics including the theory of public choice.

Theory

UNIT I

Theory of consumer behaviour - Duality in consumer theory - expenditure function and indirect utility function - Measurement of Income Effect and Substitution Effect. Measurement of Changes in Consumers' Welfare - Consumer's Surplus, Compensating Variation and Equivalent Variation - Dynamic versions of demand functions - Integrability of demand functions. Demand Models - Linear Expenditure System, Almost Ideal Demand System. Applications of consumer theory - Household model and time allocation - Labour supply decisions by households.

UNIT II

Perfect competition - Monopoly, monopolistic competition and oligopoly. Oligopoly models - collusive and non-collusive models of oligopoly - Cournot model, Chamberlin model, Stackleberg solution.

UNIT III

General equilibrium theory - Conceptual overview - General equilibrium conditions with Production and Consumption. Existence, Uniqueness and Stability of general competitive equilibrium. Walrasian general equilibrium - Mathematical derivation of conditions for general equilibrium.

UNIT IV

Market failure - Incomplete markets - Asymmetric information - Principal-Agent problem, adverse selection and moral hazard. Externalities - Network externalities - Public goods - Optimal provision of public goods.

UNIT V

Welfare Economics - Concepts, problems, approaches and limitations of Welfare Economics, Pareto conditions of maximum welfare - Criteria for social welfare - Social Welfare functions, Social versus Private costs and benefits.

Practical

Problems in consumer utility maximization - Estimation of income and substitution effects; Estimation and comparison of Consumer's surplus, equivalent variation and compensating variation. Estimation of demand models - Derivation and estimation of labour supply equations from household models comparative static analysis in consumption. Advanced problem solving in price determination under perfect competition, monopoly, oligopoly and monopolistic competition. Game theory models. Problems solving in General Equilibrium Theory and Welfare Economics. Problems in public goods provision.

AG ECON 602 ADVANCED MACRO ECONOMICS ANALYSIS 2+0

Objective

Advanced macroeconomics course will be offered to PhD students of Agricultural Economics with the following Course Objective.

- to understand the macroeconomic theory
- to examine the macroeconomic Policy issues
- to analyze the macroeconomic Policy implications

Theory

UNIT I

Review of Macro Economics concepts-Comparative statistics- Keynesian theory-Consumption Function and Theories of Consumption -Saving Function and Theories of Saving.

UNIT II

Theories of Investment-Savings and Investment Equality - IS - LM Framework and its mand for and Supply of Money-Monetary Policy in the static model -Inflation.

UNIT III

Stagflation and Supply side Economics - Theory of Unemployment - Phillips Curve controversy - Inflation, Productivity and distribution - Fiscal policy: Effectiveness and Problems.

UNIT IV

Social Accounting Matrix Framework - General Equilibrium Analysis - Neo classical Macro Economics - Stochastic Macro Economics.

UNIT V

BOP & Adjustment Policies - Foreign Exchange Policy - Foreign sector : Capital and Current Account - Impact of WTO on Indian Economy - Impact of IMF & IBRD on Indian Economy - Review of Macro Economic Policies in India.

AG ECON 603 ADVANCED ECONOMETRICS 2+1

Objective

The Course Objective of the course is to impart knowledge on advanced econometric tools to the Research Scholars of agricultural economics. Training in advanced econometrics will help the Research Scholars to analyze the economic problem by applying quantitative techniques.

Theory

UNIT I

Review of classical regression model - review of hypothesis testing - restrictions on parameters - single equation techniques.

UNIT II

Ordinary least squares - weighted least squares - generalized least squares - method of principal components - instrumental variables method - maximum likelihood method - errors in variables, non-linearity and specification tests - non spherical error terms.

UNIT III

Dummy variables - Qualitative and truncated dependent variables - limited dependent variables -LPM, probit and logit models, their multinomial extensions.

UNIT IV

Autoregressive distributed lag models - panel data fixed and random effects models and their extensions.

UNIT V

Simultaneous equation methods -identification - estimation by indirect least squares 2SLS, PIML, SURE, 3SLS.

Practical

Estimation of multiple regression model - GLS estimation methods - testing misspecification errors - Testing and Managing multicollinearity, heteroscedasticity and autocorrelation - estimation of LPM, Logit and Probit models - comparing two regressions - Chow test - estimation of distributed lag models - panel data random and fixed effects models - Indirect least squares 2SLS, SURE, 3SLS, estimation of simultaneous equation models

AG ECON 604 ADVANCED PRODUCTION ECONOMICS 2+1

Objective

To expose the students to the concept, significance and uses of advance production economics.

Theory

UNIT I

Agricultural Production process - Relationship between farm planning and production economics-scope of agricultural production and planningmethods/ procedures in agro-economic research and planning.

UNIT II

Production functions, components, assumptions, properties and their economic interpretation - Concepts of homogeneity, homotheticity, APP, MPP, elasticities of substitution and their economic relevance - Production relations - optimality- Commonly used functional forms, nature, properties, limitations, estimation and interpretation -linear, Spillman -Cobb Douglas, quadratic, multiplicative (power) functional forms - Translog, and transcendental functional forms -CES, production functional forms-Conceptual and empirical issues in specification, estimation and application of production functions- Analytical approaches to economic optimum - Economic optimum - determination of economic optimum with constant and varying input and output prices- Economic optimum with production function analysis - input use behaviour.

UNIT III

Decision making with multiple inputs and outputs - MRT and product relationship-cost of production and adjustment in output prices-single input and multiple product decisions- Multi input, and multi product production decisions - Decision making with no risk -Cost of wrong decisions - Cost curves - Principles and importance of duality theory - Correspondence of production, cost, and profit functions - Principles and derivation of demand and supply functions.

UNIT IV

Technology, input use and factor shares -effect of technology on input usedecomposition analysis-factor shares-estimation methods- Economic efficiency in agricultural production - technical, allocative and economic efficiency - measurement -Yield gaps analysis - concepts and measurement - Risk and uncertainty in agriculture - incorporation of risk and uncertainty in decision making - risk and uncertainty and input use level-risk programming.

UNIT V

Simulation and programming techniques in agricultural production-Multiple Course Objective Programming - Goal programming and Compromise programming - applications.

Practical

Estimation of different forms of production functions- Optimal input and product choice from estimated functions-Derivation of demand and supply functions and estimation-Estimation of cost function and interpretations-Optimal product and input choice under multi input and output system-Estimation of factor shares from empirical functions estimated-Estimating production functions incorporating technology changes: Decomposition analysis and incorporation of technology- Estimation of efficiency measures - Stochastic, probabilistic and deterministic frontier production functions-Risk programming - MOTAD-Quadratic programming-Simulation models for agricultural production decisions-Goal programming - Weighted, lexicographic and fuzzy goal programming-Compromise programming.

AG ECON 605 QUANTITATIVE DEVELOPMENT POLICY ANALYSIS 1+1

Objective

- The course trains the Scholars in the art of informed decision making and helps them to appreciate the value of the analytical basis in policy decisions.
- They are given hands on training on the estimation and use of various criteria such as elasticities in making QDPA more meaningful
- The scholars make extensive reviews to get acquainted with the analytical relevance and in drawing inferences.

Theory

UNIT I

Policy framework - goals, value, beliefs and welfare maximization. Market - Policy and State - State vs. Market - Failure of Policy - Failure of Markets - Rationale for Government Intervention. Role of Quantitative Policy Analysis.

UNIT II

Demand analysis for policymaking - Alternative approaches to demand analysis -Policy implications. Supply response - Alternative approaches to measurement of supply response - Nerlovian models of supply response - Policy implications.

UNIT III

Household behaviour and policy analysis - Household models.

UNIT IV

Partial equilibrium analysis - Concept of reference prices - Price distortions -indicators and impact. Transaction costs - Implications for efficiency and productivity - Institutional solutions - Multi market approach to policy analysis.

UNIT V

Social Accounting Matrices and multipliers -- Computable General Equilibrium models to assess economy wide impact of policy changes.

Practical

Review of criteria for policy evaluation - Estimation of price elasticities - Review of estimation of complete demand systems - Estimation of Nerlovian supply Response model - Review of Household models - Specification and estimation of household models - Partial equilibrium analysis - Input-output table - Social Accounting Matrix - Construction of a SAM - computation of Multipliers - Multi Market Analysis - Review of Computable General Equilibrium Models.

AG ECON 606 ADVANCED AGRICULTURAL MARKETING AND PRICE ANALYSIS 2+1

Objective

The main Course Objective of this course is to critically analyze the important marketing concepts, models, properties of agricultural commodity prices and forecasting, data collection and analysis using current software etc., in order to make them policy decisions in the field of agricultural marketing.

Theory

UNIT I

Importance of market analysis in the agricultural system - types of marketingadvantages and disadvantages - quantitative estimation - the distinguishing characteristics and role of agricultural prices - data sources for agricultural products and prices - softwares used in market analysis.

UNIT II

Role of various formal institutions in agricultural marketing - and functions -measuring their efficiency - public - private partnership - institutional arrangements. Successful case studies.

UNIT III

Multi market estimation, supply response models. Market integration and price transmission - supply / value chain management. GAP analysis. Current trends in information in the changing agrifood system.

UNIT IV

Agricultural commodity marketing - spot and futures- marketing of derivatives-speculation, hedging, swap, arbitrage etc. commodity exchanges - price discovery and risk management in commodity markets- Regulatory mechanism of futures trading.

UNIT V

Lag operators and difference equations; stationary and stochastic processes; UNIT roots and cointegration; conditional heteroscedasticity: ARCH and GARCH models - forecast evaluation; methods of forecasting. price indices and econometric estimation and simulation.

Practical

Estimation of demand/ supply forecasting, supply chain / value chain analysis for different commodities - Commodity models- multi market estimation- time series analysis - market integration studies- price discovery price volatility estimation - commodity price forecasting using econometric softwares.

AG ECON 607 COMMODITY FUTURES TRADING 2+0

Objective

This course is aimed at providing the basic understanding and the mechanics and value of futures markets for speculators and hedgers which in turn will serve as price risk management activities of agribusiness firms.

Theory

UNIT I

History and Evolution of commodity markets - Terms and concepts: spot, forward and futures Markets - factors influencing spot and future markets. Speculatory mechanism in commodity futures.

UNIT II

Transaction and settlement - delivery mechanism - role of different agents -trading strategies - potential impact of interest rate, Foreign Exchange, FDI in Commodity Markets.

UNIT III

Risk in commodity trading, importance and need for risk management measures -managing market price risk: hedging, speculation, arbitrage, swaps - pricing and their features.

UNIT IV

Important global and Indian commodity exchanges - contracts traded - special features -Regulation of Indian commodity exchanges - FMC and its role.

UNIT V

Fundamental Vs Technical analysis - construction and interpretation of charts and chart patterns for analyzing the market trend - Market indicators - back testing. Introduction to technical analysis software - analyzing trading pattern of different commodity groups.

AG ECON 608 NATURAL RESOURCE MANAGEMENT 1+1

Objectives

This is an applied economics course that focuses on the economic analysis of natural resources, and seeks to identify and solve natural resource management problems via mathematical approach using dynamic optimization techniques. During the course, we will encounter bio-economic models of natural resources including the classic and more recent forestry and fisheries models, models of land and water use and extraction of non-renewable resources (such as from a mineral deposit). We will focus on intuition and understanding of the economic analysis rather than complicated mathematical models in this class. That said, natural resource problems are inherently dynamic, so some mathematical modeling of biophysical and economic processes will be required. Using computers as an aid to understanding the models will be an important part of the class. The primary tool will be Microsoft Excel, which is the easiest introduction to computational optimization and graphical representation of the results.

Theory

UNIT I

Natural resources - definition - characteristics and classification. Stock dynamics of renewable and non-renewable resources. Equation of motion for renewable and non-renewable resources. Fundamental equation of renewable resources.

UNIT II

Growth curves of fishery and forest resources. The role of time preference in natural resource use. Simple two-period model of optimal use of renewable and non-renewable resources. Advanced models of optimal resource use - Static Vs. dynamic efficiency in natural resource use Applications of dynamic programming and optimal control.

UNIT III

Economics of groundwater use - optimal extraction of groundwater. Analytical and numerical solutions for optimal inter-temporal allocation of natural resources. Optimal harvesting of single rotation and multiple rotation forests. Optimal management of fishery.

UNIT IV

Property rights in natural resources and their implication for conservation and management of natural resources. Management of common property natural resources - Institutional arrangements for conservation and management of common pool fishery, groundwater and forestry resource.

UNIT V

Resource scarcity - Natural resource degradation - Poverty and resource degradation - Natural resource accounting - Pricing and valuation of natural resources - Natural resources policy.

Practical

Derivation of the fundamental equation of renewable resources-Estimation of growth curves and stock dynamics for fishery and forestry resources. Simple two period problem of optimal resource use - Numerical solution for simple twoperiod model of dynamic efficiency in natural resource extraction. Multi-period dynamic efficiency - Using Excel Solver in solving dynamic natural resource harvesting problems. Using analytical solution procedures for solving natural resource management problems - Optimal control.

AG ECON 609 ENVIRONMENTAL ECONOMICS 2+1

Objective

The main objective of this course is to provide an advanced treatment of the economic theory of environmental management and policy, externalities and market and non-market approaches to environmental improvement. Topics in economic growth and environmental problems, poverty and environmental degradation, conservation and sustainable economic growth, intergenerational and global environmental problems, policy issues in environmental regulation and management will be covered at a sufficient depth so as to equip the students with the recent developments in the field.

Theory

UNIT I

Environmental pollution as a consequence of market failure - Causes and consequences of market failure - Externalities - Public goods and externalities - Economics of pollution - Private vs. Social cost of environmental pollution - Property rights, environment and development - Theory of environmental policy.

UNIT II

Environmental cost benefit analysis - Environmental impact assessment techniques - Non-market valuation of environmental resources (WTP / WTA) - Environment, market and social welfare.

UNIT III

Economic growth and environmental cost - Growth oriented economic policies and their environmental impacts - Population and environmental quality - poverty and environmental degradation - Sustainable development - Indicators of sustainable development - Issues in sustainable development.

UNIT IV

Environment, ecology and environmental accounting - Environmental pollution with respect to water and air - Land and forest resources related environmental pollution - Coastal externalities - Urbanization and environment - Basic approaches to environmental policy (Tax, subsidy, pollution permits etc.) Green taxes - Political economy of environmental regulation and management.

UNIT V

Transboundary environmental problems - Economics of global warming, climate change and emission trading - Environment, international trade and development.

Practical

Contemporary global environmental global environmental issues, movement, policies, programmes, laws and other regulatory mechanisms - Criteria for evaluating the environment related projects and review of Environmental Impact Assessment (EIA) techniques - Recreation demand models of environmental valuation - Contingent valuation techniques - Environmental Resource Accounting Techniques - Discussion on the techniques dealing with air pollution and review of case studies on air pollution and its impacts - forest environment and wild life conservation - Green GDP and Green house insurance - Practical considerations and comparison of instruments of environmental policy - Non-point source pollution control methodologies - Environment in macroeconomic modeling - Meta-analysis,

economic valuation and environmental economics - Multi-criteria methods for quantitative, qualitative and fuzzy evaluation problems related to environment - Input output analysis, technology and the environment - Computable general equilibrium models for environmental economics and policy analysis.

AGRICULTURE ENGINEEARING AND FOOD TECHNOLOGY
PROCESSING AND FOOD ENGINEERING

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
PFE 501*	TRANSPORT PHENOMENA IN FOOD PROCESSING	2+1
PFE 502*	ENGINEERING PROPERTIES OF FOOD MATERIALS	2+1
PFE 503*	ADVANCED FOOD PROCESS ENGINEERING	2+1
PFE 504*	UNIT OPERATIONS IN FOOD PROCESS ENGINEERING	2+1
PFE 505	ENERGY MANAGEMENT IN FOOD PROCESSING INDUSTRIES	2+1
PFE 506	PROCESSING OF CEREALS, PULSES AND OILSEEDS	2+1
PFE 507	FOOD PROCESSING EQUIPMENT AND PLANT DESIGN	2+1
PFE 508	FRUITS AND VEGETABLES PROCESS ENGINEERING	2+1
PFE 509	MEAT PROCESSING	2+1
PFE 510	FOOD PACKAGING	2+1
PFE 511	FOOD QUALITY AND SAFETY ENGINEERING	2+1
PFE 512	FARM STRUCTURES AND ENVIROMENTAL CONTROL	1+1
PFE 513	STORAGE ENGINEERING AND HANDLING OF AGRICULTURAL PRODUCTS	2+1
PFE 514	SEED DRYING, PROCESSING AND STORAGE	2+1
PFE 515	BIOCHEMCIAL AND PROCESS ENGINEERING	2+1
PFE 591	MASTER'S SEMINAR	1+0
PFE 592	SPECIAL PROBLEM	0+1
PFE 595#	INDUSTRY/ INSTITUE TRAINING NC	
PFE 599	MASTER'S RESEARCH	20
PFE 601**	TEXTURAL & RHEOLOGICAL CHARACTERISTICS OF FOOD MATERIALS	2+1
PFE 602**	ADVANCES IN FOOD PROCESSING	3+0
PFE 603	MATHEMATICAL MODELS IN FOOD PROCESSING	3+0
PFE 604	ADVANCES IN DRYING OF FOOD MATERIALS	2+1
PFE 605	AGRICULTURAL WASTE AND BY -PRODUCTS UTILIZATION	2+1
PFE 691	DOCTORAL SEMINAR I	1+0
PFE 692	DOCTORAL SEMINAR II	1+0
PFE 693	SPECIAL PROBLEM	0+1
PFE 694	CASE STUDY	0+1
PFE 699	DOCTORAL RESEARCH	45

*Compulsory for Master's programme; ** Compulsory for Doctoral programme

PFE 595 - Minimum of Three Weeks Training

Note: Some of the identified Minor/Supporting fields are Mechanical Engineering, Processing & Food Engineering, Energy in Agriculture, Civil Engineering, Computer Science, Electrical Engineering, Mathematics and Statistics; The contents of some of the identified Minor/Supporting courses have been given.

PROCESSING AND FOOD ENGINEERING

Course Contents

PFE 501 TRANSPORT PHENOMENA IN FOOD PROCESSING 2+1

Objective

To acquaint and equip the students with the principles of heat and mass transfer and its applications in food processing.

Theory

UNIT I

Introduction to heat and mass transfer and their analogous behaviour,steady and unsteady state heat conduction, analytical and numerical solution of unsteady state heat conduction equations, use of Gurnie-Lurie and Heisler Charts in solving heat conduction problems. Applications in food processing including freezing and thawing of foods.

UNIT II

Convective heat transfer in food processing systems involving laminar and turbulent flow heat transfer in boiling liquids, heat transfer between fluids and solid foods. Functional design of heat exchangers: Shell and tube, plate and scraped surface heat exchangers, Jacketed vessels.

UNIT III

Radiation heat transfer and its governing laws, its applications in food processing.

UNIT IV

Molecular diffusion in gases, liquids and solids; molecular diffusion in biological solutions and suspensions molecular diffusion in solids, unsteady state mass transfer and mass transfer coefficients, molecular diffusion with convection and chemical reaction, diffusion of gases in porous solids and capillaries, mass transfer applications in food processing.

Practical

Solving problems on steady and unsteady state conduction with or without generation; numerical analysis; problems in natural and forced convection; radiation; design of heat exchangers; performing experiments on heat conduction, convection and radiation heat transfer.

PFE 502 ENGINEERING PROPERTIES OF FOOD MATERIALS 2+1

Objective

To acquaint and equip the students with different techniques of measurement of engineering properties and their importance in the design of processing equipments.

Theory

UNIT I

Physical characteristics of different food grains, fruits and vegetables; Shape and size, description of shape and size, volume and density, porosity, surface area. Rheology; ASTM standard, terms, physical states of materials, classical ideal material, rheological models and equations, viscoelasticity, creep-stress relaxation, Non-Newtonian fluid and viscometry, rheological properties, force, deformation, stress, strain, elastic, plastic behaviour.

UNIT II

Contact stresses between bodies, Hertz problems, firmness and hardness, mechanical damage, dead load and impact damage, vibration damage, friction, effect of load, sliding velocity, temperature, water film and surface roughness.

Friction in agricultural materials, rolling resistance, angle of internal friction, angle of repose, flow of bulk granular materials, aero dynamics of agricultural products, drag coefficients, terminal velocity.

UNIT III

Thermal properties: Specific heat, thermal conductivity, thermal diffusivity, methods of determination, steady state and transient heat flow. Electrical properties; Dielectric loss factor, loss tangent, A.C. conductivity and dielectric constant, method of determination, energy absorption from highfrequency electric field.

UNIT IV

Application of engineering properties in design and operation of agricultural equipment and structures.

Practical

Experiments for the determination of physical properties like, length, breadth, thickness, surface area, bulk density, porosity, true density, coefficient of friction, angle of repose and colour for various food grains, fruits, vegetables, spices and processed foods, aerodynamic properties like terminal velocity, lift and drag force for food grains, thermal properties like thermal conductivity, thermal diffusivity and specific heat, firmness and hardness of grain, fruits and stalk, electrical properties like dielectric constant, dielectric loss factor, loss tangent and A.C. conductivity of various food materials.

PFE 503 ADVANCED FOOD PROCESS ENGINEERING 2+1

Objective

To acquaint and equip the students with different unit operations of food industries and their design features.

Theory

UNIT I

Thermal processing: Death rate kinetics, thermal process calculations, methods of sterilization and equipments involved, latest trends in thermal processing. Evaporation: Properties of liquids, heat and. mass balance in single effect and multiple effect evaporator, aroma recovery, equipments and applications. Drying: Rates, equipments for solid, liquid and semi-solid material and their applications, theories of drying, novel dehydration techniques.

UNIT II

Non-thermal processing: Microwave, irradiation, ohmic heating, pulsed electric field preservation, hydrostatic pressure technique etc.

UNIT III

Freezing: Freezing curves, thermodynamics, freezing time calculations, equipments, freeze drying, principle, equipments. Separation: Mechanical filtration, membrane separation, centrifugation, principles, equipments and applications, latest developments in separation and novel separation techniques.

UNIT IV

Extrusion: Theory, equipments, applications. Distillation and leaching: Phase equilibria, multistage calculations, equipments, solvent extraction.

Practical

Solving problems on single and multiple effect evaporator, distillation, crystallisation, extraction, leaching, membrane separation and mixing, experiments on rotary flash evaporator, humidifiers, reverse osmosis and ultra filtration - design of plate and packed tower, visit to related food industry.

PFE 504 UNIT OPERATIONS IN FOOD PROCESS ENGINEERING 2+1

Objective

To acquaint and equip the students with different unit operations of food industries.

Theory

UNIT I

Review of basic engineering mathematics; Units and dimensions; Mass and energy balance.

UNIT II

Principles of fluid flow, methods of heat transfer, heat exchangers and their designs.

UNIT III

Psychrometry, dehydration, EMC, Thermal processing operations; Evaporation, dehydration/drying, types of dryers, blanching, pasteurization, distillation, steam requirements in food processing.

UNIT IV

Refrigeration principles and Food freezing. Mechanical separation techniques, size separation equipments; Filtration, sieving, centrifugation, sedimentation. Material handling equipment, conveyors and elevators; Size reduction processes; Grinding and milling.

UNIT V

Homogenization; Mixing- mixers, kneaders and blenders. Extrusion. Membrane technology. Non-thermal processing techniques.

UNIT VI

Food plant design; Food plant hygiene- cleaning, sterilizing, waste disposal methods, engineering aspects of radiation processing. Food packaging: Function materials, technique, machinery and equipment.

Practical

Fluid flow properties, study of heat exchangers problems, application of psychrometric chart, determination of EMC, study of driers, elevating and conveying equipments, size reduction equipments, cleaning and sorting equipments, mixing equipments, sieve analysis, kinetics of fruits and vegetables dehydration, calculation of refrigeration load, food plant design, gas and water transmission rate, solving of numerical problems.

PFE 505 ENERGY MANAGEMENT IN FOOD PROCESSING INDUSTRIES 2+1

Objective

To acquaint and equip the students with different energy management techniques including energy auditing of food industries.

Theory

UNIT I

Energy forms and units, energy perspective, norms and scenario; energy auditing, data collection and analysis for energy conservation in food processing industries.

UNIT II

Sources of energy, its audit and management in various operational units of the agro-processing units; passive heating, passive cooling, sun drying and use of solar energy, biomass energy and other non-conventional energy sources in agro-processing industries.

UNIT III

Reuse and calculation of used steam, hot water, chimney gases and cascading of energy sources. Energy accounting methods, measurement of energy, design of computer-based energy management systems, economics of energy use.

Practical

Study of energy use pattern in various processing units i.e., rice mills, sugar mills, dal mills, oil mills, cotton-ginning units, milk plants, food industries etc. Energy audit study and management strategies in food processing plants.

Identification of energy efficient processing machines. Assessment of overall energy consumption, production and its cost in food processing plants, visit to related food processing industry.

PFE 506 PROCESSING OF CEREALS, PULSES AND OILSEEDS 2+1

Objective

To acquaint and equip the students with the post harvest technology of cereals, pulses and oilseeds with special emphasis on their equipments.

Theory

UNIT I

Production and utilization of cereals and pulses, grain structure of major cereals, pulses and oilseeds and their milling fractions; grain quality standards and physico-chemical methods for evaluation of quality of flours.

UNIT II

Pre-milling treatments and their effects on milling quality; parboiling and drying, conventional, modern and integrated rice milling operations; wheat roller flour milling; processes for milling of corn, oats, barley, gram, pulses, paddy and flour milling equipments.

UNIT III

Dal mills, handling and storage of by-products and their utilization. Storage of milled products, Expeller and solvent extraction processing, assessment of processed product quality.

UNIT IV

Packaging of processed products, design characteristics of milling equipments; selection, installation and their performance, BIS standards for various processed products.

Practical

Physical properties of cereals and pulses, raw and milled products quality evaluations; parboiling and drying; terminal velocities of grains and their fractions; study of paddy, wheat, pulses and oilseeds milling equipments; planning and layout of various milling plants, visit to related agroprocessing industry.

PFE 507 FOOD PROCESSING EQUIPMENT AND PLANT DESIGN 2+1

Objective

To acquaint and equip the students with the design features of different food processing equipments being used in the industries and with the layout, planning of different food and processing plants.

Theory

UNIT I

Design considerations of processing agricultural and food products.

UNIT II

Design of machinery for drying, milling, separation, grinding, mixing, evaporation, condensation, membrane separation.

UNIT III

Human factors in design, selection of materials of construction and standard component, design standards and testing standards. Plant design concepts and general design considerations: plant location, location factors and their interaction with plant location, location theory models, computer aided selection of the location.

UNIT IV

Feasibility analysis and preparation of feasibility report: plant size, factors affecting plant size and their interactions, estimation of break-even and economic plant size; Product and process design, process selection, process flow charts, computer aided development of flow charts.

UNIT V

Hygienic design aspects and worker's safety, functional design of plant building and selection of building materials, estimation of capital investment, analysis of plant costs and profitabilities, management techniques in plant design including applications of network analysis, preparation of project report and its appraisal.

Practical

Detailed design and drawing of mechanical dryers, milling equipment, separators, evaporators, mixers and separators. Each individual student will be asked to select a food processing plant system and develop a plant design report which shall include product identification and selection, site selection, estimation of plant size, process and equipment selection, process flow-sheeting, plant layout, and its evaluation and profitability analysis.

PFE 508 FRUITS AND VEGETABLES PROCESS ENGINEERING 2+1

Objective

To acquaint and equip the students with processing of fruits and vegetables and the design features of the equipments used for their processing.

Theory

UNIT I

Importance of post harvest technology of fruits and vegetables, structure, cellular components, composition and nutritive value of fruits and vegetables, fruit ripening, spoilage of fruits and vegetables.

UNIT II

Harvesting and washing, pre-cooling, preservation of fruits and vegetables, blanching, commercial canning of fruits and vegetables, minimal processing of fruits and vegetables.

UNIT III

Cold storage of fruits and vegetables, controlled atmosphere packaging of fruits and vegetables, gas composition, quality of storage.

UNIT IV

Dehydration of fruits and vegetables, methods, osmotic dehydration, foam mat drying, freeze drying, microwave heating, applications, radiation preservation of fruits and vegetables, irradiation sources.

UNIT V

Intermediate moisture foods, ohmic heating principle, high pressure processing of fruits and vegetables, applications, sensory evaluation of fruit and vegetable products, packaging technology for fruits and vegetables, general principles of quality standards and control, FPO, quality attributes.

Practical

Determination of size, shape, density, area-volume-mass relationship of fruits and vegetables, sugar-acid ratio of fruits, evaluation of washer, grader and packaging methods, experiments on drying of fruits and vegetables, controlled atmosphere storage and quality evaluation.

PFE 509 MEAT PROCESSING 2+1

Objective

To acquaint and equip the students with processing of meat and meat products and the design features of the equipments used for their processing.

Theory

UNIT I

Meat and poultry products: Introduction, kinds of meat animals and poultry birds, classification of meat, composition of meat.

UNIT II

Slaughtering: Pre slaughter operations, post slaughter operations, wholesale and retail cuts.

UNIT III

Preservation of poultry: different methods, stuffed products, frozen products, poultry concentrates and flavours, synthetic poultry flavour.

UNIT IV

Different preservation methods of meat: Smoking, curing and freezing, chilling of meat and different methods of chilling, freezing of meat and different methods of freezing of meat, physical and chemical changes during chilling and freezing, packaging of meat and meat products, quality control.

UNIT V

Classification, composition and nutritive value of eggs: Grading of eggs, different quality parameters of eggs, Haugh unit, processing of egg, yolk processing, egg breaking mechanisms, freezing of egg, pasteurization, desugarisation and dehydration of egg, different dehydration methods, quality control and specification of egg products.

UNIT VI

Fish: Nutritional quality of fish and fish products, fillet and steaks, different preservation techniques, chilling, freezing, drying, canning, curing and smoking, quality control in fish processing.

Practical

Experiments in slaughtering, dressing, wholesale and retail cutting: Curing, preservation of meat and meat products, estimation of quality of egg, Haugh unit, desugarisation, preparation of whole egg powder, yolk powder, freezing of fish, drying of fish, canning of fish, visit to meat and fish processing units.

PFE 510 FOOD PACKAGING 2+1

Objective

To acquaint and equip the students with packaging methods, packaging materials, packaging machineries, modern packaging techniques etc.

Theory

UNIT I

Introduction of packaging: Package, functions and design. Principle in the development of protective packaging. Deteriorative changes in foodstuff and packaging methods of prevention.

UNIT II

Food containers: Rigid containers, glass, wooden boxes, crates, plywood and wire bound boxes, corrugated and fibre board boxes, textile and paper sacks, corrosion of containers (tin plate); Flexible packaging materials and their properties; Aluminium as packaging material; Evaluation of packaging material and package performance.

UNIT III

Packaging equipments: Food packages, bags, types of pouches, wrappers, carton and other traditional package; Retortable pouches; Shelf life of packaged foodstuff.

UNIT IV

Methods to extend shelf life; Packaging of perishables and processed foods; Special problems in packaging of food stuff.

UNIT V

Package standards and regulation; Shrink packaging; Aseptic packaging, CA and MAP, Active packaging; Biodegradable packaging.

Practical

Thickness, substance weight, water absorption capability of flexible packaging materials; Strength properties of packaging materials; Water vapour and gas transmission rate of flexible packaging materials; Identification and chemical resistance of plastic films; Packaging of fruits/vegetables; Estimation of shelf-life of packaged food stuff; Familiarization of types of packaging material.

PFE 511 FOOD QUALITY AND SAFETY ENGINEERING 2+1

Objective

To acquaint and equip the students with the latest standards to maintain food quality as well as to study HACCP protocol.

Theory

UNIT I

Food safety, need for quality control and safety, strategy and criteria, microbiological criteria for safety and quality, scope of food toxicology, toxic potential and food toxicants, biological and chemical contaminants.

UNIT II

Food additives and derived substances, factors affecting toxicity, designing safety in products and processes, intrinsic factors, establishing a safe raw material supply, safe and achievable shelf life.

UNIT III

Process equipment and machinery auditing, consideration of risk, environmental consideration, mechanical quality control.

UNIT IV

Personnel hygienic standards, preventative pest control, cleaning and disinfesting system, biological factors underlying food safety.

UNIT V

Preservation and stability, contaminants of processed foods, adulteration, prevention and control, FPO, PFA, Codex, GMP, BIS and HACCP; Practices, principles, standards, specifications, application establishment and implementation; HACCP and quality management system.

Practical

Microbiological examination of food, hazard analysis, premises design, HACCP project plan; CCP, CCP Decision tree, HACCP control chart. HACCP case studies; Survey, BIS, FPO, Codex standards and specifications. Visits to food industries to study the various quality and safety aspects adopted.

PFE 512 FARM STRUCTURES AND ENVIRONMENTAL CONTROL 1+1

Objective

To acquaint and equip the students with the techniques to control temperature, humidity and other composition of air to create favourable environment in the agricultural structures.

Theory

UNIT I

Thermodynamic properties of moist air, psychorometric chart and computer programmes for thermodynamic properties.

UNIT II

Farm structures, their design, constructional details and design of low cost structures. Heating, ventilating and exhaust systems, air distribution and air cleaning, combustion of fuels and equipment.

UNIT III

Drying and dehumidification system, air-water contact operations and evaporation, process and product air conditioning, energy efficient environmental control practices.

UNIT IV

Instruments and measurements; codes and standards.

Practical

Calculation of heating and cooling load; design calculation of moisture condensation in agricultural buildings; study of moisture migration behaviour in storage bins; design aspect of cold storage.

PFE 513 STORAGE ENGINEERING AND HANDLING OF AGRICULTURAL PRODUCTS 2+1

Objective

To acquaint and equip the students with the safe storage of food materials, design of storage structures and the design of different material handling equipments used in the industries.

Theory

UNIT I

Storage of grains, biochemical changes during storage, production, distribution and storage capacity estimate models, storage capacity models, ecology, storage factors affecting losses, storage requirements.

UNIT II

Bag and bulk storage, godowns, bins and silos, rat proof godowns and rodent control, method of stacking, preventive method, bio-engineering properties of stored products, function, structural and thermal design of structures, aeration system.

UNIT III

Grain markets, cold storage, controlled and modified atmosphere storage, effects of nitrogen, oxygen, and carbon dioxide on storage of durable and perishable commodities, irradiation, storage of dehydrated products, food spoilage and preservation, BIS standards.

UNIT IV

Physical factors influencing flow characteristics, mechanics of bulk solids, flow through hoppers, openings and ducts; design of belt, chain, screw, roller, pneumatic conveyors and bucket elevators; principles of fluidization; recent advances in handling of food materials.

Practical

Quality evaluation of stored products, design of storage structures, cold storage, load estimation, construction, maintenance, static pressure drop, experiment on controlled and modified atmosphere storage system, estimation of storage loss, and quality of stored products.

PFE 514 SEED DRYING, PROCESSING AND STORAGE 2+1

Objective

To acquaint and equip the students with processing of seeds and the design features of the equipments used for their processing.

Theory

UNIT I

Processing of different seeds and their engineering properties, principles and importance of seed processing.

UNIT II

Performance characteristics of different unit operations such as precleaning, grading, conveying, elevating, drying, treating, blending, packaging and storage, seed processing machines like scalper, debreader, huller, velvet separator, spiral separator, cleaner-cum-grader, specific gravity separator, indent cylinder, disc separator, and colour sorter, seed treater, weighing and bagging machines, their operation and maintenance, installation and determination of their capacity, seed quality maintenance during processing, plant design and layout, economy and safety consideration in plant design.

UNIT III

Seed drying principles and methods, theory of seed drying, introduction to different types of heated air dryers, significance of moisture equilibrium, method of maintaining safe seed moisture, thumb rule and its relevance, importance of scientific seed storage, types of storage structures to reduce temperature and humidity; management and operation/cleanliness of seed stores, packaging-principles, practices, materials and hermetic packaging, seed treatment methods and machines used, method of stacking and their impact, design features of medium and long term seed storage building.

Practical

Study of various seed processing equipments such as pre-cleaners, scalpers, air screen cleaners, graders, spiral and pneumatic separators, seed treating equipment, bag closures, scale etc. and their performance evaluation, design and layout of seed processing plant and its economics, analysis of cost of operation and unit cost of processed product, effect of drying temperature and duration of seed germination and storability.

PFE 515 BIOCHEMICAL AND PROCESS ENGINEERING 2+1

Objective

To acquaint and equip the students with the basic principles of biochemical and process engineering.

Theory

UNIT I

Applications of engineering principles; mass and energy balance, fluid flow principles, unit operations of process engineering.

UNIT II

Fundamentals of growth kinetics, maintenance energy and yield concepts, principles of media sterilization, media formulations of industrial fermentation.

UNIT III

Aerobic and agitated rheology of fermentative fluids, design and scale-up of bioreactors, enzyme reactors.

UNIT IV

Principles of recovery of fermented products in bio-processing, instrumentation, transport phenomenon.

Practical

Kinetics of one substitute reactions, kinetics of growth in batch cultures, design consideration for bioreactors, media preparation and sterilization, microprocessor based monitoring of bioprocess parameters.

PFE 595 INDUSTRY/INSTITUTE TRAINING 0+1 (NC)

Objective

To expose the students to the industry.

Theory

In-plant training in the relevant food industry during processing operation of the plant to study the actual working of the equipment and various unit operations. The evaluation will be based on the written report of the student and the comments of the factory managers. The duration of training shall be three weeks. The student shall be required to do training in the institute other than the institute in which he/she is enrolled.

PFE 601 TEXTURAL & RHEOLOGICAL CHARACTERISTICS OF FOOD MATERIALS 2+1

Objective

To acquaint and equip the students with the textural & rheological properties of food materials.

Theory

UNIT I

Texture classification. Relation of food texture with structure and rheology. Principles and practices of objective texture measurements, viscosity measurements.

UNIT II

Sensory methods of texture and viscosity measurements and their correlation. Rheological properties of foods.

UNIT III

Mathematical models and their application along with pipe line design and pump selection for non-Newtonian fluids. Recent advances in textural, rheological and viscoelastic characteristics of foods and their associated mathematical models.

Practical

Determination of viscosity of liquid foods, guminess, chewiness, springiness and hardness of various fruits, vegetables and processed foods using texture profile analysis. Determination of force-distance relationship. Sensory evaluation/ subjective measurement and correlation between subjective and objective measurements of foods.

PFE 602 ADVANCES IN FOOD PROCESSING 3+0

Objective

To acquaint and equip the students with the modern and latest techniques of food engineering

Theory

UNIT I

Preservation of foods - physical and chemical methods-microbiological aspects thermo bacteriology, process calculation and selection.

UNIT II

Low temperature preservation - cooling and cold storage - freeze concentration and membrane separation process - hurdle technology - principles and applications - food irradiation - advantages and applications, microwave processing - interaction with food materials- microwave equipment - hydrostatic pressure treatment of food - equipment, processing and effect on microorganisms.

UNIT III

Application of heat energy and ultrasound - inactivation of microorganisms and enzymes -electrical resistance heating of food - heat generation, ohmic heater, heating models - pulsed electric field preservation- principles and application - influence on microorganisms and food ingredients - decontamination of microorganisms by surface treatment.

UNIT IV

Extrusion cooking - recent developments, methods, equipment, design criteria of extruders.

PFE 603 MATHEMATICAL MODELS IN FOOD PROCESSING 3+0

Objective

To acquaint and equip the students with the mathematical modeling techniques and their applications in food processing

Theory

UNIT I

An overview of the modeling process. Introduction to mathematical, correlative and explanatory models. Formulation, idealization and simplification of the problems.

UNIT II

Probability models, series and linear mathematical approximation, dynamic and interacting dynamic processes.

UNIT III

Applications of mathematical modelling techniques to food processing operations like parboiling, convective drying, pasteurization, dehydration, shelf-life prediction, fermentaiton, aseptic processing, moisture diffusion, deep fat drying, microwave processing, infrared heating and ohmic heating. Stochastic finite element analysis of thermal food processes. Neural networks approach to modelling food processing operations.

PFE 604 ADVANCES IN DRYING OF FOOD MATERIALS 2+1

Objective

To acquaint and equip the students with the latest technologies of dehydration of food products and the design features of different dryers.

Theory

UNIT I

Importance of drying, principles of drying, moisture determination, equilibrium moisture content, determination of EMC, methods and isotherm models, psychrometry, psychrometric terms, construction and use of psychrometric charts.

UNIT II

Air flow and resistance, principles and equipments for air movement and heating, drying methods and theory of drying, driers, classification and other allied equipment, thin layer drying of cereal grains, deep bed and continuous flow drying, drying models.

UNIT III

Heat requirements and thermal efficiency of drying system, aeration, tempering and dehydration, operation of driers and their controls, selection of driers, performance testing of grain driers, drying characteristics of cereals, pulses and oilseeds, microwave drying, radio frequency drying and tunnel drying, principles and equipment.

UNIT IV

Drying of liquid foods, spray drying, drum drying, freeze drying, foam mat drying, heat pump drying, osmotic dehydration; Principles, methods, construction and adjustments, selection of dryers, heat utilization factor and thermal efficiency.

Practical

Experiments on batch type thin layer drier, fluidized bed drier, continuous flow mixing type drier, continuous flow non mixing type drier, sand medium drier (conduction type drying), agricultural waste fired furnace drier, spray dryer, drum dryer, foam mat drying and osmotic dehydration, to evaluate the thermal efficiency and heat utilization factor.

PFE 605 AGRICULTURAL WASTE AND BY-PRODUCTS UTILIZATION 2+1

Objective

To acquaint and equip the students with the proper utilization of agricultural waste and by-products and also about development of value added products from wastes.

Theory

UNIT I

Generation of by-products, agricultural and agro industrial byproducts/ wastes, properties, on site handling, storage and processing.

UNIT II

Collection of wastes, utilization pattern as fuel, agricultural waste fired furnaces: Mechanism, construction and efficiency, suitability of wastes as fuel, fuel briquettes, briquetting process, equipment, factors affecting briquetting.

UNIT III

Utilization of wastes for paper production, production of particle board, utilization, by-products from rice mill, rice husk, rice bran, utilisation.

UNIT IV

Thermo-chemical conversions, densification, combustion and gasification, extraction, biological conversions, anaerobic digestion, biochemical digestion process, digestion systems, energy from anaerobic digestion, cellulose degradation, fermentation process.

Practical

Exercises on stepped grate and fixed grate rice husk furnaces, waste fired furnace, briquette machine, production of alcohol from waste materials, production and testing of paperboards and particleboards from agricultural wastes.

AGRICULTURE EXTENSION

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
EXT 501*	DEVELOPMENT PERSPECTIVES OF EXTENSION EDUCATION	1+1
EXT 502*	DEVELOPMENT COMMUNICATION AND INFORMATION MANAGEMENT	2+1
EXT 503*	DIFFUSION AND ADOPTION OF INNOVATIONS	2+1
EXT 504*	RESEARCH METHODS IN BEHAVIORAL SCIENCES	2+1
EXT 505*	E-EXTENSION	2+1
EXT 506*	ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT IN EXTENSION	2+1
EXT 507*	HUMAN RESOURCE DEVELOPMENT	2+1
EXT 508	VISUAL COMMUNICATION	2+1
EXT 509	PARTICIPATORY METHODS FOR TECHNOLOGY DEVELOPMENT AND TRANSFER	1+1
EXT 510	GENDER SENSITIZATION FOR DEVELOPMENT	2+1
EXT 511	PERSPECTIVES OF DISTANCE EDUCATION	2+0
EXT 512	MARKET-LED EXTENSION	2+0
EXT 591	MASTER'S SEMINAR	1+0

EXT 599	MASTER'S RESEARCH	20
EXT 601**	ADVANCES IN AGRICULTURAL EXTENSION	2+1
EXT 602**	ADVANCED DESIGN AND TECHNIQUES IN SOCIAL SCIENCE RESEARCH	2+1
EXT 603**	ADVANCES IN TRAINING TECHNOLOGY	2+1
EXT 604**	ORGANIZATIONAL DEVELOPMENT	2+1
EXT 605**	ADVANCED INSTRUCTIONAL TECHNOLOGY	2+1
EXT 606	THEORY CONSTRUCTION IN SOCIAL SCIENCES	2+0
EXT 607	ADVANCED MANAGEMENT TECHNIQUES	2+1
EXT 608	MEDIA MANAGEMENT	2+1
EXT 609	TRANSFER OF TECHNOLOGY IN AGRICULTURE	2+1
EXT 691	DOCTORAL SEMINAR I	1+0
EXT 692	DOCTORAL SEMINAR II	1+0
EXT 699	DOCTORAL RESEARCH	45

* Compulsory for Master's programme; ** Compulsory for Doctoral programme

The following Basic Supporting courses (5 credits) are recommended for M. Sc. / Ph. D. programmes

M. Sc.

STAT	STATISTICAL METHODS FOR SOCIAL SCIENCES	2+1
STAT	NON-PARAMETRICS	2+0

Ph. D.

STAT	STATISTICS	2+1
STAT	COMPUTER APPLICATION	1+1

AGRICULTURAL EXTENSION

Course contents

EXT 501 DEVELOPMENT PERSPECTIVES OF EXTENSION EDUCATION 1+1

Objective

The course is intended to orient the students with the concept of extension education and its importance in Agriculture development and also to expose the students with various Rural development programmes aimed at poverty alleviation and to increase employment opportunites and their analysis. Besides, the students will be learning about the new innovations being brought into the Agricultural Extension in India.

Theory

UNIT I

Extension Education - Meaning, objectives, concepts, principles and philosophy, critical analysis of definitions - Extension Education as a Profession - Adult Education and Distance Education.

UNIT II

Pioneering Extension efforts and their implications in Indian Agricultural Extension - Analysis of Extension systems of ICAR and SAU - State Departments Extension system and NGOs - Role of Extension in Agricultural University.

UNIT III

Poverty Alleviation Programmes - SGSY, SGRY, PMGSY, DPAP, DDP, CAPART - Employment Generation Programmes - NREGP, Women Development Programmes - ICDS, MSY, RMK, Problems in Rural Development.

UNIT IV

Current Approaches in Extension: Decentralised Decision Making, Bottom up Planning, Farming System Approach, Farming Situation Based Extension, Market - Led - Extension, Farm Field School, ATIC, Kisan Call Centres, NAIP.

Practical

Visit to Gram Panchayat to study on-going Rural Development Programmes, Visit to KVK, NGO and Extension centers of State Agricultural University and State Departments, Bottom up planning, Report preparation and presentations.

EXT 502 DEVELOPMENT COMMUNICATION AND INFORMATION MANAGEMENT 2+1

Objective

In this course, students will learn about the concept, meaning and process of communication and various methods and modern media of communication.Besides, the students will also learn the information management and journalistic writing of various information materials and also study their readability.

Theory

UNIT I

Communication process - concept, elements and their characteristics - Models and theories of communication - Communication skills- fidelity of communication, communication competence and empathy, communication effectiveness and credibility, feedback in communication, social networks and Development communication - Barriers in communication, Message - Meaning, dimensions of a message, characteristics of a good message, Message treatment and effectiveness, distortion of message.

UNIT II

Methods of communication - Meaning and functions, classification. Forms of communication - Oral and written communication, Non-verbal communication, interpersonal communication, organizational communication. Key communicators - Meaning, characteristics and their role in development.

UNIT III

Media in communication - Role of mass media in dissemination of farm technology, Effect of media mix for Rural People. Modern communication media - Electronic video, Tele Text, Tele conference, Computer Assisted Instruction, Computer technology and its implications.

UNIT IV

Agricultural Journalism as a means of mass communication, Its form and role in rural development, Basics of writing - News stories, feature articles, magazine articles, farm bulletins and folders. Techniques of collection of materials for news stories and feature articles; Rewriting Art of clear writing, Readability and comprehension testing procedures; photo journalism, communicating with pictures, Radio and TV Journalism, Techniques of writing scripts for Radio and TV.

EXT 503 DIFFUSION AND ADOPTION OF INNOVATIONS 2+1

Objective

The students will learn how the agricultural innovations spread among the farmers in the society by getting into the insights of diffusion concept and adoption process, stages of adoption and innovation decision process, adopter categories and their characteristics, opinion leaders and their characteristics, attributes of innovations, and factors influencing adoption. In addition, the students would be learning various concepts related to diffusion and adoption of innovations.

Theory

UNIT I

Diffusion - concept and meaning, elements; traditions of research on diffusion; the generation of innovations; innovation-development process; tracing the innovation-development process, converting research into practice.

UNIT II

The adoption process- concept and stages, dynamic nature of stages, covert and overt processes at stages, the innovation-decision process - a critical appraisal of the new formulation.

UNIT III

Adopter categories - Innovativeness and adopter categories, adopter categories as ideal types, characteristics of adopter categories; Perceived attributes of Innovation and their rate of adoption, factors influencing rate of adoption.

UNIT IV

Diffusion effect and concept of over adoption, opinion leadership- measurement and characteristics of opinion leaders, monomorphic and polymorphic opinion leadership, multi-step flow of innovation; concepts of homophily and heterophily and their influence on flow of innovations; Types of innovation-decisions - Optional, Collective and Authority and contingent innovation decisions; Consequences of Innovation-Decisions - Desirable or Undesirable, direct or indirect, anticipated or unanticipated consequences; Decision making - meaning, theories, process, steps, factors influencing decision - making.

Practical

Case studies in individual and community adoption process, content analysis of adoption studies, Identification of adopter categories on a selected technology, study of attributes of current farm technologies, Identification of opinion leaders, Sources of information at different stages of adoption on a selected technology, study of factors increasing or retarding the rate of adoption, presentation of reports on adoption and diffusion of innovations.

EXT 504 RESEARCH METHODS IN BEHAVIOURAL SCIENCE 2+1

Objective

This course is designed with a view to provide knowledge and skills in methods of behavioural sciences research and student will learn the Statistical Package for Social Sciences (SPSS) for choosing appropriate statistics for data analysis.

Theory

UNIT I

Research - Meaning, importance, characteristics. Behavioural sciences research - Meaning, concept and problems in behavioural sciences research. Types and methods of Research - Fundamental, Applied and Action research, Exploratory, Descriptive, Diagnostic, Evaluation, Experimental, Analytical, Historical, Survey and Case Study. Review of literature - Need, Search Procedure, Sources of literature, Planning the review work. Research problem - Selection and Formulation of research problem and guiding principles in the choice of research problem, Factors and criteria in selection of research problem, statement of research problem and development of theoretical orientation of the research problem.

UNIT II

Objectives - Meaning, types and criteria for judging the objectives. Concept and Construct - Meaning, role of concepts in research and Conceptual frame work development in research. Variable - Meaning, types and their role in research. Definition - Meaning, characteristics of workable definitions, types and their role in research. Hypothesis - Meaning, importance and functions of hypothesis in research, Types of hypothesis, linkages, sources, problems in formulation and criteria for judging a workable hypothesis. Measurement - Meaning, postulates and levels of measurement, Use of appropriate statistics at different levels of measurement, criteria for judging the measuring instrument and importance of measurement in research. Validity - Meaning and methods of testing. Reliability - Meaning and methods of testing. Sampling - Universe, Sample and Sampling- Meaning, basis for sampling, advantages and limitations, size and factors affecting the size of the sample and sampling errors - Methods of elimination and minimizing, Maximincon Principle, Sampling - Types of sampling and sampling procedures.

UNIT III

Research Designs - Meaning, purpose and criteria for research design, Types, advantages and limitations of each design. Experimental design - Advantages and limitations. Data Collection devices - Interview - Meaning, purpose,

types, techniques of interviewing and advantages and limitations. Enquiry forms and Schedules - Meaning, types of questions used, steps in construction and advantages and limitations in its use. Questionnaires - Meaning, difference between schedule and questionnaire, types of questions to be used, pre - testing of the questionnaires or schedules and advantages and limitations. Check lists - Meaning, steps in construction, advantages and limitations in its use. Rating scales - Meaning, types, limits in construction, advantages and limitations in its use. Observation - Meaning, types, tips in observation, advantages and limitations in its use. Case studies - Meaning, types, steps in conducting, advantages and limitations in its use. Social survey - Meaning, objectives, types and steps in conducting, advantages and limitations.

UNIT IV

Data processing - Meaning, coding, preparation of master code sheet, analysis and tabulation of data, Statistical Package for Social Sciences (SPSS) choosing appropriate statistics for data analysis based on the level of measurement of variables. Report writing - Meaning, guidelines to be followed in scientific report writing, References in reporting.

Practical

Selection and formulation of research problem - Formulation of objectives and hypothesis-Selection of variables based on objectives-Developing the conceptual framework of research. Operationally defining the selected variables-Development of data collection devices.-Testing the validity and reliability of the data collection instruments.- Pre-testing of the data collection instrument-Techniques of interviewing and collection of data using the data collection instruments-Data processing, hands on experiences on SPSS, coding, tabulation and analysis. Formulation of secondary tables based on objectives of research.Writing report, Writing of thesis and research articles-Presentation of reports.

EXT 505 E- EXTENSION 2+1

Objective

Students will gain knowledge and skills in understanding the concepts of Information and communication technologies and how these ICT tools can be used for Agricultural Extension. Besides, he studies various ICT projects which are successful in delivering the services to the clientele fulfilling the objective of Transfer of Technology i.e. Reaching the unreached.

Theory

UNIT I

ICTs- Concept, definition, tools and application in extension education. Reorganizing the extension efforts using ICTs, advantages, limitations and opportunities.

UNIT II

ICTs projects, case studies in India and developing world. Different approaches (models) to ICTs. ICT use in field of extension- Expert systems on selected crops and enterprises; Self learning CDs on package of practices, diseases and pest management, Agricultural web sites and portals related crop production and marketing etc.

UNIT III

Community Radio, Web, Tele, and Video conferencing. Computer Aided Extension. Knowledge management, Information kiosks, Multimedia. Online, Offline Extension. Tools-Mobile technologies, e-learning concepts.

UNIT IV

ICT Extension approaches-pre-requisites, information and science needs of farming community. Need integration. Human resource information. Intermediaries. Basic e-extension training issues. ICT enabled extension pluralism. Emerging issues in ICT.

Practical

Agril.content analysis of ICT Projects. Handling of ICT tools. Designing extension content. Online extension service. Project work on ICT enabled extension. Creation of extension blogs. Visit to ICT extension projects.

EXT 506 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT IN EXTENSION 2+1

Objective

The first part of the course is intended to provide overall picture of planning and development of enterprises for extending sustainable livelihoods for rural people. The second part of the course is structured to help the students to gain knowledge and skills in different concepts and techniques of management in extension organizations.

Theory

UNIT I

Entrepreneurship - Concept, characteristics, Approaches, Theories, Need for enterprises development. Agri - entrepreneurship - Concept, characteristics, Nature and importance for sustainable Livelihoods. Traits of entrepreneurs - Risk taking, Leadership, Decision making, Planning, Organising, Coordinating and Marketing, Types of Entrepreneurs. Stages of establishing enterprise - Identification of sound enterprise, steps to be considered in setting up an enterprise, feasibility report, product selection, risk and market analysis, legal requirements. Project Management and Appraisal - Market, Technical, Financial, Social Appraisal of Projects.

UNIT II

Micro enterprises - Profitable Agri enterprises in India - Agro Processing, KVIC industries. Micro financing - meaning, Sources of Finance, Banks, Small scale industries development organizations. Marketing for enterprises - Concept, planning for marketing, target marketing, Competition, market survey and strategies, Product sales and promotion. Gender issues in entrepreneurship development - Understanding gender and subordination of women, Gender as a development tool, Policy approaches for women entrepreneurship development. Success and Failure stories for enterprises - Issues relating to success and failure of enterprises - Personal, Production, Finance, Social, Marketing.

UNIT III

Management - Meaning, concept, nature and importance, Approaches to management, Levels of management, Qualities and skills of a manager. Extension Management - Meaning, Concept, Importance, Principles of management, Classification of Functions of Management. Planning - Concept, Nature, Importance, Types, Making planning effective. Change Management - factors, process and procedures. Decision making - Concept, Types of decisions, Styles and techniques of decision making, Steps in DM Process, Guidelines for making effective decisions. Organizing - Meaning of Organization, Concept, Principles, Organizational Structure, Span of Management, Departmentalization, Authority and responsibility, Delegation and decentralization, line and staff relations.

UNIT IV

Coordination - Concept, Need, Types, Techniques of Coordination. Interpersonal relations in the organization. Staffing - Need and importance, Manpower planning, Recruitment, Selection, Placement and Orientation, Training and Development - Performance appraisal - Meaning, Concept, Methods. Direction - Concept, Principles, Requirements of effective direction, Giving orders, Techniques of direction. Leadership - Concept, Characteristics, Functions, Approaches to leadership, Leadership styles. Organizational Communication - Concept, Process, Types, Net Works, Barriers to Communication. Managing work motivation - Concept, Motivation and Performance, Approaches to motivation. Supervision - Meaning, Responsibilities, Qualities and functions of supervision, Essentials of effective supervision. Managerial Control - Nature, Process, Types, Techniques of Control, Budgeting, Observation, PERT and CPM, MIS.

Practical

Field visit to Successful enterprises-Study of Characteristics of Successful entrepreneurs Development of Project Proposal -Case Studies of Success / Failure enterprises-Exercise on Market Survey-Field visit to Financial institutions-Simulated exercise to understand management process-Field visit to extension organizations to understand the functions of management -Group exercise on development of short term and long term plan-Simulated exercise on techniques of decision making-Designing organizational structure -Group activity on leadership development skills.

EXT 507 HUMAN RESOURCE DEVELOPMENT (HRD) 2+1

Objective

To orient the students about key concepts importance, scope & conceptual frame work, growth & development of Human Resource Development, Subsystems of Human Resource Development for extension organization and process of HRD.

Theory

UNIT I

Human Resource Development - Definition, Meaning, Importance, Scope and Need for HRD; Conceptual frame work, inter disciplinary approach, function systems and case studies in HRD; HRD Interventions - Different Experiences; Selection, Development & Growth- Selection, Recruitment, Induction Staff Training and Development, Career planning; Social and Organizational Culture: Indian environment perspective on cultural process and social structure, society in transition; Organizational and Managerial values and ethics, organizational commitment ; Motivation productivity - job description - analysis and evaluation; Performance Appraisal.

UNIT II

Human Resource management: Collective bargaining, Negotiation skills; Human Resource Accounting (HRA): What is HRA? Why HRA? Information Management for HRA and Measurement in HRA; Intra personal processes: Collective behaviour, learning, and perception ; Stress and coping mechanisms; Inter-Personal Process, Helping Process - communication and Feedback and interpersonal styles; Group & Inter group process: group information and group processes; Organizational communication, Team building Process and functioning, Conflict management, Collaboration and Competition; HRD & Supervisors: Task Analysis; Capacity Building - Counseling and Mentoring; Role of a Professional Manager: Task of Professional Manager - Responsibility of Professional Manager; Managerial skills and Soft Stills required for Extension workers; Decision Making: Decision Making models, Management by Objectives; Behavioural Dynamics :Leadership styles - Group dynamics.

UNIT III

Training - Meaning, determining training need and development strategies - Training types, models, methods and evaluation; Facilities for training - Trainers training - techniques for trainees participation; Research studies in training extension personnel; Main issues in HRD: HRD culture and climate - organizing for HRD - emerging trends and Prospective.

Practical

Visit to different training organizations to review on going activities & facilities; Analysis of Training methods followed by training institutions for farmers and extension workers Studies on evaluation of training programmes; Study of HRD in organization in terms of performance, organizational development, employees welfare and improving quality of work life and Human resource information, Presentation of reports.

EXT 508 VISUAL COMMUNICATION 2+1

Objective

This course is intended to give a clear perspective about the importance of visuals and graphics in communication. The course starts with the delineating about the characteristics of visuals and graphics followed by its main functions, theories of visual perception and its classification and selection. Further, the course deals with the designing the message, graphic formats and devices and presentation of data. It makes the students to understand, prepare and present the scientific data effectively by using low cost visuals. The course also exposes the students to various Digitized video material in multimedia and also enable to design visuals for print, TV and know-how about scanning of visuals.

Theory

UNIT I

Role of visuals & graphics in Communication. Characteristics of visuals & graphics. Functions of visuals and graphics. Theories of visual perception. Classification and selection of visuals.

UNIT II

Designing message for visuals, Graphic formats and devices. Presentation of Scientific data. Principles and procuction of low cost visuals.

UNIT III

Photographs- reprographic visuals. PC based visuals. Degitized video material in multimedia production. Designing visuals for print and TV and video.

UNIT IV

Pre-testing and evaluation of visuals. Scanning of visuals.

Practicals

Preparation of low cost projected and Non-Projected visuals. Designing and layout of charts, posters, flash cards etc. Power point presentations. Generating computer aided presentation graphics. Scanning and evaluation of visuals.

EXT 509 PARTICIPATORY METHODS FOR TECHNOLOGY DEVELOPMENT AND TRANSFER 1+1

Objective

This course is intended to orient the students with the key concepts, principles process of different participatory approaches for technology development and transfer and also to expose the students with various participatory tools and techniques like space related, time related, relation oriented methods. Besides the students will be learning the preparation of action plans participatory monitoring and evaluation.

Theory

UNIT I

Participatory extension - Importance, key features, principles and process of participatory approaches; Different participatory approaches (RRA, PRA, PLA, AEA, PALM, PAR, PAME, ESRE, FPR) and successful models.

UNIT II

Participatory tools and techniques. Space Related Methods : village map (social & resource), mobility services and opportunities map and transect; Time related methods : time line, trend analysis, seasonal diagram. Daily activity schedule, dream map; Relation oriented methods : cause and effect diagram (problem tree), impact - diagram, well being ranking method, Venn diagram, matrix ranking, livelihood analysis.

UNIT III

Preparation of action plans, concept and action plan preparation; Participatory technology development and dissemination; Participatory planning and management, phases and steps in planning and implementation aspects; Process monitoring, participatory evaluation.

Practical

Simulated exercises on space related methods, time related method and relation oriented methods; Documentation of PTD and dissemination; Preparation of action plan; Participatory monitoring and evaluation of developmental programmes.

EXT 510 GENDER SENSITIZATION FOR DEVELOPMENT 1+1

Objective

In this course the students will learn about an overview of the concept of gender and gender balance on development and develop skills of identifying gender roles, rights, responsibilities and relationships on development. Besides the students will also learn the attitudinal change to internalize gender equity concerns as fundamental human rights and also enhance the capability for identifying and analyzing gender issues in agriculture and allied sectors.

Theory

UNIT I

Gender concepts, issues and challenges in development; Gender roles, gender balance, status, need and scope; Gender analysis tools and techniques.

UNIT II

National policy for empowerment of women since independence; Developmental programmes for women; Gender mainstreaming in agriculture and allied sectors -need and relevance; Gender budgeting - A tool for empowering women.

UNIT III

Women empowerment -Dimensions; Women empowerment through SHG approach; Women entrepreneurship and its role in economic development; Public Private Partnership for the economic empowerment of women; Building rural institution for women empowerment; Women human rights ; Action plans for gender mainstreaming.

Practical

Visits to rural institutions of women for studying in the rural institutions engaged in Women empowerment; Visits to entrepreneurial unit of women for studying the ways and means of establishing entrepreneurship units for Women and their development and also SWOT analysis of the Unit; Visit to Center for women development - NIRD to study the different activities related to projects and research on gender; Visit to gender cell, Office of the Commissioner and Director of Agriculture, Hyderabad, to study the mainstreaming of gender concerns and gender budget of the department.

EXT 511 PERSPECTIVES OF DISTANCE EDUCATION 1+1

Objective

The course is intended to orient the students with the concept of Distance Education, Characteristics of Distance Education, Evolution, Methods of Distance Education, Different Approaches in Planning Distance Education, Educational Technology in Distance Education, Management of Resources for distance education, Strategies for maximizing the reach and programme evaluation and quality assessment.

Theory

UNIT I

Distance Education - Introduction Meaning, Concept, Philosophy and its work ethics, characteristics of Distance Education - Evolution and Historical view of Distance Education - Theory Methodology, and Epistemology. Dimensions of Distance Education, Scope and difficulties. Open Education - Non-formal Education, Continuing Education, Education by correspondence.

UNIT II

Forms and systems of Distance and Open Education, Modes of Teaching and Learning in Distance Education, Methods of Distance Education, Significance of Distance Education in Teacher Education.

UNIT III

Planning Distance Education - A Systems Approach Student Learning - Course Planning, The target groups - Barriers to learning in Distance Education - Planning and Management of Networked Learning.

UNIT IV

Educational Technology is Distance Education Application of information and Educational Technologies in Distance Education, Development of Course and Course material, Management of resources, processes, Forms of Instructional material in Distance Education and Media Development and Production in Distance Education - Video Classroom Strategy in Distance Education - Strategies for maximizing the reach - services to students, programme Evaluation - performance indicators and Quality Assessment.

Practical

Visit to the University which is implementing the Distance Education Programmes. Detailed Study of their programme in relation to Educational Technology, Methodology, Curriculum Development, Evaluation and Assessment. Exercise on development of curriculum for Distance Education exclusively for farming community.

EXT 512 MARKET LED EXTENSION MANAGEMENT 1+1

Objective

The student will learn the significance of post harvest management& value addition in present market environment and the challenges and future strategy for market led extension management. Also identifies the information sources and develop strategy for market intelligence and the marketing infrastructure, multilevel marketing and linkages for market led extension. In addition the students would be learning the public private partnerships for market led extension management, the features of contract farming, WTO its implications on agriculture and Understanding the role of IT for market intelligence.

Theory

UNIT I

Agricultural extension at cross roads; Changing scenario of agricultural extension at the national level; Market led extension - emerging perspectives; Market led extension - issues and challenges; Dimensions of market led extension.

UNIT II

Agricultural marketing an overview; Development of a marketing plan, pricing concepts and pricing strategy; Consumer behaviour; Marketing communication and promotional strategies; The marketing research process; Agricultural trade liberalization and its impact; International marketing opportunities; Implications of AOA, TRIPS and IPRs agreements on agriculture; Agreement on SPS and TBT - an over view; Commodity features marketing.

UNIT III

Public private linkages in market led extension; Role of SHG in market led extension; Contact farming - a viable approach to meet market challenges; IT enabled approaches for market led extension and communication; Weather service and crop modeling - An effective tool in market led extension.

Practical

Identification and analysis of different marketing sources for agricultural commodities. Development of strategy for an effective market intelligence system; Development of suitable marketing plan to suite rural situation; Visit to APEDA, Rythu Bazaars to study the processes and procedures related to market-led extension.

EXT 601 ADVANCES IN AGRICULTURAL EXTENSION 2+1

Objective

By the End of the course student will be able to

- Critically analyze different Agricultural Extension approaches
- Understand Agricultural Knowledge Information System (AKISs) ITK
- Understand Advances in Extension - Cyber extension, ICT enabled extension services; Market Led Extension, Public Private Partnership, Mainstreaming gender in extension organizational Innovations.
- Visualize implications of WTO - AOA and develop extension strategies.
- Understand extension reforms and Farmer Field Schools Decentralized Decision Making, bottom up planning, ATMA, FSBE & CIGs etc., ATIC, IVLP & Kisan Call Centres

Theory

UNIT I

Approaches of Agricultural Extension: A critical analysis of different approaches of agricultural extension. Importance and relevance of indigenous knowledge system, identification and documentation of ITK, Integration of ITK system

in research formulation, Concept of Agricultural Knowledge and Information System, Training of Stakeholders of AKIS.

UNIT II

Cyber Extension - Concept of cyber extension, national and international cases of extension projects using ICT and their impact of agricultural extension, alternative methods of financing agricultural extension - Scope, limitations and experience and cases. Research - Extension -Farmer - Market linkage: Importance, Scope, Implications etc., Market - Led Extension, Farmer - Led Extension, Concept of Farm Field School, Farm School, Public - Private Partnership: Meaning, Models, Identification of various areas for partnership. Stakeholder's analysis in Extension. Main streaming gender in Extension - Issues and Prospects.

UNIT III

Implications of WTO - AOA for extension services, re-orientation of extension services for agri-business and marketing activities, GOI-NGO collaboration to improve efficiency of extension.

UNIT IV

Extension and contemporary issues: Extension and issues related to rural poverty. Privatization of Extension. Intellectual Property Rights (IPRs). Extension Reforms in India - Decentralized decision making, Bottom up planning, Farming System and Situation based Extension Delivery System, Extension delivery through Commodity Interest Groups. Organization innovations in Extension - ATIC, IVLP, Kisan Call Centres.

Practical

Analysis of ITK systems, cases on integration of ITK and formal research system, Analysis of cases on cyber extension and privatization of extension. Analysis of ATMA and SREP. Practicing bottom up planning. Visit to Public-Private -Farmer partnership. Learnings from Food and Nutritional Security and bio-diversity Projects and Programmes.

EXT 602 ADVANCED DESIGNS AND TECHNIQUES IN SOCIAL SCIENCE RESEARCH 2+1

Objective

By the End of the course student will be able to

- Develop & Standardize Attitude scale using different techniques of attitude scale construction.
- Develop skills of using Projected & Semi Projected & Semi Projected Techniques, Computer Package analysis and PRO Tools in Extension Research.

Theory

UNIT I

Scaling technique - meaning, types, principles, steps and quality, techniques of attitude scale construction - Paired comparison, Equal appearing intervals, Successive Intervals, Summated ratings, Scalogram analysis, Scale discrimination technique, Reliability and Validity of Scales. Sociometrics, content analysis, case studies, Q-sort techniques, Semantic different technique.

UNIT II

Projective and Semi projective techniques, Critical incident techniques, Computer packages for analysis - usage in Extension Research. Knowledge scale measurement. Participatory tools and techniques in behaviour Research - Data collection and Evaluation. Impact analysis, e-data collection and information analysis.

Practical

Practice in constructing a scale and use of scale in various situations. Reliability and validity of the scales developed, Application of Semi Projective and Projective techniques. Content analysis, case studies. Practicing participatory tools and techniques. Hands on experience on Computer Preparation and Data Collection instruments, review of previous studies.

EXT 603 ADVANCES IN TRAINING TECHNOLOGY 2+1

Objective

By the end of the Course student will be able to

- Plan and design a training programme
- Plan & Develop effective training sessions
- Manage difficult situations while organizing training programmes
- Use different advanced participatory training methods

Theory

UNIT I

Paradigm shift in training - learning scenario, Training Approaches - Experiential learning - laboratory - organization development (system) approaches; Training Design, Designing an effective training programme, Harmonizing training needs, Course Objective, content and methods.

UNIT II

Designing an effective training session - the semantics involved, Designing experiential training sessions, simulation exercises, and openness in training transaction - managing dilemmas, ambivalence and conflicts and confusion (for both trainers and trainees).

UNIT III

Recent Training Techniques for understanding and facilitation team building, group dynamics, motivation and empowerment, laboratory methods: micro-lab process work, and sensitivity training, Psychological instruments as training tools: TAT, Inventories, Cases, etc.

UNIT IV

Participatory Training Techniques - Lecture, Brainstorming, Group discussion and Training Games. Role Play, Psycho-drama, Coaching, Counseling, etc., Trainer's roles and dilemmas, Factors Effecting Training Effectiveness and Training Evaluation.

Practical

Techniques of participatory training need assessment. Formulation of Course Objective, design of training programmes. Simulation exercises. Participatory training methods - Role Play & Brainstorming, Group discussion and Counseling and Conducting experiential learning sessions. Training evaluation - Techniques of Knowledge, Skill & Attitude evaluation. Visit to training institutions and study of training technologies followed.

EXT 604 ORGANIZATIONAL DEVELOPMENT 2+1

Objective

By the end of the course student will be able to

- Understand & Study the Organization in terms of types, Characteristics, Needs, Motives, Organization behaviour, Organization Communication, Organization development and Individual behaviour in organization.
- To anlayse the factors effecting organizational effectiveness and distinguish between functional and non functional organization.

Theory

UNIT I

Introduction to organizations: Concept and Characteristics of organizations, Organizational Behvaiour - Context and concept - levels of organizations - formal and informal organizations, Theories of organizations: Nature of organizational theory - classical theories - features of Bureaucracy - administrative theory and Scientific management - Neo-classical theories - the human relations movement - modern theory.

UNIT II

Systems approach to study organization needs and motives - Attitude, values and ethical behaviour - alienation and work - work motivation - communication and interpersonal behaviour - organization communication - leadership behaviour - decision making, problem solving techniques - organizational climate - change proneness and resistance to change, Organizational change, Organizational structure - Process in organizing - Dimension of Motivation Climate.

UNIT III

Departmentation - Span of Management - Delegation of authority - Centralization and decentralization - line and staff organization - functional organization - divisonalisation - Project organization - Matrix organization - free form organization - top management structure.

UNIT IV

Individual behaviour in organization. Fundamentals of Human relations and Organizational behaviour, Groups and teams - Organisational culture and performance. Dynamics of Organization behaviour - leadership conflict situations and inter group behavior- Organisational Development - Factors effecting organization effectiveness. Creativity, leadership, motivation and organization development.

Practical

Analysis of organization in terms of process - attitudes and values, motivation, leadership. Simulation exercises on problem-solving - Study of organizational climate in different organizations. Study of organizational structure of development departments, Study of departmentalization, span of control delegation of authority, decisions making patterns, Study of individual and group behaviour at work in an organization. Conflicts and their management in an organization. Comparative study of functional and non-functional organsiations and drawing factors for organizational effectiveness.

EXT 605 ADVANCED INSTRUCTIONAL TECHNOLOGY 2+1

Objective

By the end of the course student will be able to

- Understand Agricultural Education Scenario in the country and Curriculum development process
- Plan & Prepare and present course outline, Lesson Plan & Skill plan
- Develop appropriate Teaching & Learning Styles
- Use innovative instructional aids & methods

Theory

UNIT I

Concepts in Instructional Technology, Scope of Instructional Technology. History of agricultural education in India. Guidelines for curriculum development in Agricultural Universities. Curriculum design development.

UNIT II

Course outline, Lesson plans for theory and practicals. Teaching and learning styles. Theories of learning. Cognitive levels. Instructional Course Objective. Motivation of students.

UNIT III

Instructional Methods. Experiential learning cycle. Innovative Instructional Aids. Computer Assisted Instruction. Programmed instruction technique. Team Teaching. E-Learning, Art of Effective Communication. Distance education. Student evaluation - Question Bank. Appraisal of Teacher Performance. Review of research in Instructional Technology.

Practical

Formulation of instructional Course Objective. Development and presentation of course outlines. Preparation & presentation of lesson plans for theory & practical with CAI design. Preparation of innovative low cost instructional aids. Development of model question bank. Preparation of schedule for teacher evaluation. Visit to Distance Education centre. Study of research reviews and Presentation of reports.

EXT 606 THEORY CONSTRUCTIONS IN SOCIAL SCIENCES 2+0

Objective

By the end of the course student will be able to develop skills of theory building and scientific application of theoretical concept in Social Sciences by applying appropriate statistical tests.

Theory

UNIT I

Importance of theory constructions in social science. Theory: Meaning, elements, Ideal Criteria, Functions, Types. Definitions: Meaning, types and Rules.Generalizations: Meaning, Classification. Relationship: Meaning Types.

UNIT II

Terminologies used in theory constructions: Axiom, Postulate, Proposition, Theorem, Fact, Concept, Construct, Probability and Measurement Basic Derived. Steps in theory building - Axiomatic Techniques, Historical approaches. Scientific application Theoretical concept in Social Sciences. Test of Theory: Applying appropriate statistical tests.

EXT 607 ADVANCED MANAGEMENT TECHNIQUES 2+1

Objective

By the end of the course student will be able to

- Develop understanding on concept of MIS, its scope in Agriculture Extension Organization.
- Understand, Develop and Evaluate the MBO System
- To cope up with stress, Resolve conflicts and develop effective inter personal communication skills using Transactional analysis.
- To plan & use, DSS, AI, ES, PERT, CPM

Theory

UNIT I

Management Information System (MIS): Basic concepts, types of information needed at various levels, design of MIS in an agricultural extension organization. Scope for computerization, system alternatives and Evaluation. Implementation, operation and maintenance of the system.

UNIT II

Management by Course Objective (MBO): Elements of the MBO system. The Process of MBO. Making MBO effective. Evaluation of the MBO system - strengths and weaknesses. Transactional Analysis (TA): Ego states, transactions, inter relationships, strokes, stamps.

UNIT III

Managing Organizational Stress: Sources of stress in organization, effect of stress. Coping mechanisms and managing stress, Stress management, Team Building Process: Types of teams. Steps in teamwork, Facilitators and barriers to effective relationships, nature of prejudice, tips in reducing interpersonal conflicts, intergroup conflict, resolving techniques. Confect management, tips in reducing interpersonal conflicts.

UNIT IV

Decision Support Systems (DSSs): Basic information about Artificial Intelligence (AI) Expert System (ESs), their future applications in extension system. Forecasting techniques - time series analysis and Delphi, decision making and talent management PERT, CPM Techniques and time management.

Practical

Managements Information system, in research & development organizations. Study of Management by Course Objective in an organization. Transactional Analysis, exercises on Team building process, coping skills with organizational stress, exercises on Decision Support Systems (DSSs). Practicals exercise on forecasting techniques, Visit to Management organizations.

EXT 608 MEDIA MANAGEMENT 2+1

Objective

- To familiarize the students with the working of print, electronic, New Media & Traditional folk media.
- To develop working skills needed for Print, Radio and T.V. Journalism to reach farming community.
- To develop in students an understanding on Mass Communication Process and Media Management its impact on the society.
- To develop writing skills for different media.

Theory

UNIT I

Media Management - Introduction, Definition, Principles and Significance of Management. Media Ownership patterns in India - Proprietorship, Partnership, private Ltd, Public companies, Trusts, Co-operatives, Religious Institutions (Societies) & Franchisees (Chains). Marketing Function - Product, Price, and Placement & Promotions.

UNIT II

Mass Communication - Meaning, Concept, Definition and Theories of Mass Communication. The Mass Media - History, functions, uses and Theories of Media. Journalism - Meaning, definition, Scope, functions and different types of Journalism. Journalism as communication tool. Farm Journalism - meaning and Developments in Farm Journalism in India. Different problems with Farm Journalism. Print Media - History, the role of the press, news, Types of News, electronics of News and Sources of News, the making of newspaper & magazines, press codes and ethics, Media Laws. News story - Principles of writing, structure a news story, procedure in writing the news story and the elements of style. Success stories & feature articles - writing for success & feature articles, Types of Feature articles. Information materials - Types of information materials and user. Techniques in book Publishing. Editing - Principles, Tools & Techniques and art of Proof Reading - Techniques, Measuring Readability of writing.

UNIT III

Electronic Media-Role and Importance of Radio -History, Radio Role in TOT, writing and presentation techniques, Different Programmes of Farm Broadcast, developing content for farm broadcast, Role of FM Radio in Agriculture, Ethics of Broad casting, Broadcasting Policy and code. Community Radio - Concept, meaning, role in TOT, Cases of Community radio. Television - History - Role in TOT, Fundamentals of Television Production, Techniques of Script writing for TV, Visual Thinking, language & Style, Farm Telecast programmes, cable and satellite TV and their impact, Ethics of Telecasting, policy and code. Video Production Technology - Potential and its utilization, Typology of farm Video production, Types of Video Production and equipment used in the production, Procedure or Technique of video production. Cassette Technology - Role in TOT, Techniques of production of cassettes for the farming community. Traditional Media - Role of Folk Media in TOT and integration with electronic media.

UNIT IV

Advances in communication Technology - Management of Agricultural Information System (MAIS). Use of computers in Agriculture - Application of IT in Agriculture. Use of Modern Communication Medium- Electronic Video, Teletext, tele conference, Computer assisted instruction, Video conferencing, - Features, Advantages, Limitations and risk factory involved in New Media. Designing and developing of communication and media strategy for developmental programmes. Online journalism scope & importance.

Practical

Exercise on Writing for Print Media - Writing News / Success Stories / Feature articles for different topics related to Agriculture & allied fields. Exercise of editing & proof reading the Farm News for News papers - different types of intro and leads. Exercise of Writing for Radio, TV, Preparation of story board for farm Video Production - Script writing for Radio and T.V. Visit to media management organizations for studying the principles, procedures and processes in managing the media. Participation and Interaction through video conference. Developing communication & Media Strategy for selected developmental programme / activity.

EXT 609 TRANSFER OF TECHNOLOGY IN AGRICULTURE 2+1

Objective

By the end of the Course student will be able to

- Develop thorough understanding on different systems of Technology Transfer
- Develop appropriate communication & Media Strategy suitable to the System of Technology Transfer
- Analyse the constraints in Systems of Technology Transfer Technology and Suggest suitable Strategies.

Theory

UNIT I

Technology - Meaning and Concepts - Appropriate technology, transfer of technology - meaning and concepts. Systems of transfer of technology - Knowledge Generating System (KGS) - Knowledge Disseminating System (KDS) - Knowledge Consuming System (KCS) - Input Supplying Agencies System (ISAS).

UNIT II

Appropriateness of communication media in the system of technology transfer. New communication strategy for transfer and adoption of Agricultural technology. Extension training in transfer of technology.

UNIT III

Analysis. Constraints in Transfer of Technology, agencies or departments involved in TOT. Extension professional in TOT. Attributes of Technology and its Relation in TOT process. TOT to resource poor farmers. Role of Key communicators or local leaders in TOT. Private and Public partnership in TOT.

Practical

Analysis of Transferred technology. Analysis of knowledge generation and consuming systems. Formulation of communication strategies, Study of attributes of selected fast spreading technologies and slow technologies, study of constraints in TOT, visit to TOT centres of ICAR and SAU, Identification of key communicators, Case studies of Public-Private Partnerships, Visits to the print and electronic media centres to study their role in TOT.

ANIMAL HUSBANDRY

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
AAH-410	Poultry Breeding	2+1
AAH-420	POULTRY FEEDING	2+1
AAH-430	EGG AND MEAT TECHNOLOGY	1+1
AAH-440	Poultry Farm Management	2+1
AAH-450	HATCHERY AND BROODING MANAGEMENT	0+2
AAH-460	BROILER AND LAYER MANAGEMENT	0+2
AAH-470	SHEEP GOAT AND SWINE PRODUCTION	4+0
AAH-480	SHEEP GOAT AND SWINE BREEDING	4+0
AAH-490	FEED ADDITIVES	2+0
AAH-510	Dairy Cattle Breeding	2+1
AAH-520	DAIRY CATTLE FEEDING	2+1
AAH-530	DAIRY FARM MANAGEMENT	2+1
AAH-540	NUTRITIONAL PHYSIOLOGY OF ANIMALS	3+0
AAH-550	Speciation and Evolution as Applied to Livestock Population	3+0
AAH-560	Livestock Physiology	3+0
AAH-570	APPLICATION OF SELECTION THEORY	2+1
AAH-580	DISEASES OF DAIRY ANIMALS	2+0

AAH-590	EXPERIMENTAL TECHNIQUES IN ANIMAL NUTRITION	1+1
AAH-630	POPULATION GENETICS	3+1
AAH-640	QUANTITATIVE GENETICS AS APPLIED TO ANIMAL BREEDING - I	1+1
AAH-650	QUANTITATIVE GENETICS AS APPLIED TO ANIMAL BREEDING - II	1+1
AAH-660	Non-Ruminant Nutrition	2+1
AAH-670	FEED STUFF EVALUATION	0+2
AAH-680	Ruminant Nutrition	3+1
AAH-710	ADVANCES IN DAIRY ANIMAL PRODUCTION	3+0
AAH-720	Commercial Dairy Herd Management	2+1
AAH-730	Feed and Fodder Technology	2+1
AAH-740	ENERGY NUTRITION	2+0
AAH-750	PROTEIN NUTRITION	2+0
AAH-760	VITAMIN NUTRITION	2+0
AAH-770	MINERAL NUTRITION	2+0
AAH-780	ADVANCED ANIMAL BREEDING	2+1

ANIMAL HUSBANDRY

Course Contents

AAH-410 Poultry Breeding 2+1

Origin and history of poultry species, poultry industry of India and abroad and goal of breeder, Biology of egg laying phenomenon and economically important traits. Qualtitative genetics of plumage, skin pigmentation, skeleton and its mutation and manor variants. Autosomal, sex influenced, sex limited traits, Random bred control population and its role poultry breeding experiments.

Inheritance of egg. and meat production traits in layer and broiler. Behavioural genetics, GxE interaction, heterosis, genetic controls in selections, inbreeding and non crossbreeding of inbred lines. Breeding for disease resistance its scope and limitation in poultry. Immuno genetics, molecular genetics and genetic engineering in poultry. Industrial breeding and selection in poultry. Poultry breeding projects in India, their goal, achievements and limitations Various strains of egg and meat type chickens available in India and their methods of production Random sample test for broilers and layers and practicals on above.

AAH-420 POULTRY FEEDING 2+1

Anatomy and physiology of digestive systems of avian species, development of poultry feeding systems, highlighting the requirements of protein, energy, vitamins, minerals and feed additives, Nutrient inter-relationships, ant metabolites, inhibitory substances, antagonists and toxic substances in feeds.

Feeding management 'of starters, growers, layers, broilers and breeding stock, effect of feeding on eggs & meat quality, feeding management under stress conditions, feeding of Turkeys, Quails and Ducks. Practicals for the above.

AAH-430 EGG AND MEAT TECHNOLOGY 1+1

Egg and poultry meat industry in India, structure, formation composition and food value of an egg; chemical composition of egg, yolk, albumen and egg shell. Physb-chemical and biological properties of egg. Quality critaria and factors affecting egg quality. Grading and judging of quality of egg. External and internal quality of egg and its measurement. Preservation in shell form and opened egg for Packing and transportation of shelled egg and marketing organisation.

Definitions and terms of poultry meat technology. Physical and chemical composition of poultry meat. Dressing of birds, killing, scalding and culling. Pre and post marturn examination. Marketing of birds, grading.and classification. of live and dressed birds. Preservation of dressed poultry. Handling, packing and transportation of dressed poultry and marketing organisation of poultry meat. Design and operation of small poultry dressing plant. Practicals for the above.

AAH-440 POULTRY FARM MANAGEMENT 2+1

History of poultry breeding in India, present status of commercial poultry farming in India; establishing a poultry farm and factors affecting profitability, hatchery building and equiprnents, incubation and hatching of egg, selection, grading & setting of hatching eggs, various management systems of poultry rearing, poultry housing and equipments, brooding management. care & feeding and management of growers, layers and broilers, sanitation, deworming and vaccination programme, other routine practices at poultry farm, poultry waste management, record management, economic of different poultry enterprises. Practicals for the above.

AAH-450 HATCHERY AND BROODING MANAGEMENT 0+2

Hatchery building, size, location design and construction. Selection of eggs for hatching. Storage, handling and transportation of hatching eggs. Incubation and embryonic development, pedigree hatching, sexing, wing banding of chicks. Fumigation and disinfecting of hatchery building of chicks. Fumigation and disinfection of hatchery equipments. Hatchery operations, organization and management. Hatchery operations, grading, packing, dispatch, marketing, transportation and economic aspects of hatchery operations and economics of hatching day-old chicks. Visit to a modem commercial hatchery.

Brooder house, design, construction and equipments. Brooding requirements, vaccination and preventive operations, various brooding managemental systems

AAH-460 BROILER AND LAYER MANAGEMENT 0+2

Site selection, layout, design and construction of commercial broiler and layer houses. Equipments and automization of various poultry operations. Breeding and management of grower breeders including temperature and light management, Feeding of broiler, chicks,. growers and breeders. Economics of broiler production.

Temperature ventilation and light management of layers. Deep litter and cage management systems for layers. Effect of various climatic stresses. Moulting and pigmentation. Poultry health management, waste management and biosecurity, packing transportation and marketing of eggs and economics of layer production. Visit to a modern broiler/layer farm.

AAH-470 SHEEP GOAT AND SWINE PRODUCTION 4+0

Classes and breeds of sheep and goats in India, Selection of lambs, ewes and rams. Reproductive phenomenon, growth rate and conformation. Inheritance of fleece characteristics, classification of wool, physical and chemical properties of wool, analysis methods. Effect of nutrition on wool production and general management, practices for wool quality grading & marketing of woo1. Goat for milk and meat production, management and- equipment's care during breeding season, feeding roughages, concentrates and mineral requirements, pasture versus stall feeding. Goat products and market prospects. Breeds of swine, market requirement, breeding season growth rate swine rations and effect of rations on cost of production and meat quality, housing and management practices for breeding and slaughter stock.

AAH-480 SHEEP GOAT AND SWINE BREEDING 4+0

Sheep, goat and swine breeding and their role in national economy, inheritance of economic traits, lethals and other genetic defects in sheep, goat and swine, correlated traits influencing productivity like fertility, prolificacy, lambing, kidding and farrowing percentage etc., selection plans and breeding methods for improvement of wool and meat in sheep, milk, meat and hair in goat, growth rate and carcass quality traits in swine and methods of progeny of males in sheep, goat and swine. Practicals for the above.

AAH-490 FEED ADDITIVES 2+0

Justification for the use of feed additives, history of the use of feed additives, nutrient and non-nutrient feed additives, classification of feed additives.

Binders, flavoring agents their effect on feed consumption and nutritional value of the feed. Recommended levels of additives for stabilizing fats and vitamins, their properties, potency, action recommended levels of use. Antifungals, their action, effect on the feeding value of stored feeds, safe levels of use.

Antibiotic, their classification, properties, theories for the action of antibiotics, study of sultable antibiotics for growth and production, practices in the use of antibiobcs in feeds. Pigments, their properties, sources and recommended levels of use.

Thyroactive compounds, their effect on the metabolism of feed, growth and other forms of production. Current status of the use of thyroactive compounds. Iodinated casein and its uses.

Hormones, their properties, effect on growth and other forms of production. Available steroids and their use Adverse effects of steroids. Tranquillizers, their effect on metabolism, growth and production, Uses and abuses oftranquillizers.

Coccidiostats, their function and levels of use in feed and water. Effect of coccidiostats, on the nutritional allowances. Economics of use of coccidiostats, Developing immunity to coccidia vis-a-vis coccidiostats use. Arsenicals, their history of use for beneficial results, Their dIects on growth and production. Theories of action of arsenicals.

Miscellaneous feed additives i.e. enzymes, deforming agents, condiments. Ethical and legal considerations involved in the uses of feed additives.

AAH-510 DAIRY CATTLE BREEDING 2+1

Ongin evolution and domestication of cattle & buffalo, dairy cattle breeding in India, biological aspects of under development, milk secretion and reproduction in dairy cattle sigmanance and inheritance of quantitative traits, genetic and non-genetic factors affecting the variation in milk yield and composition, concept of breeding value, its estimation in case of cows and bulls its evaluation, to find out the carriers for unfavourable genes, methods of program testing of dairy sires, a selective breeding V/s crossbreeding, heterosis in milk production traits, performance of various crossbreeds in different zones of India, body size and growth with traits, feed efficiency traits etc. of different crossbreeds produced in India various national projects related to dairy cattle and buffalo breeding and their achievement and new development like MOET, controlled breeding etc. and practicals on the above.

AAH-520 DAIRY CATTLE FEEDING 2+1

Review of the anatomy and physiology of ruminants stomach, relationship between type of gastro intestinal tract and type of diet, factors affecting feed consumption. Feeding standards for maintenance, growth, lactation and reproduction. Principles and practices in ration formulation Feeding of various classes of dairy animals. Feeding of dairy animals in scarcity and stress.

Characteristics of rations, preparation of mixed mineral supplements, elect of inhibitory and toxic anti-metabolites, role of Bureau of Indian Standards in regulating the quality of feed ingredients and compounded feeds. Practicals for the above.

AAH-530 DAIRY FARM MANAGEMENT 2+1

Place of dairy farming in the national economy, considerations in establishment of a dairy farm enterprise, types and arrangements of dairy buildings, dairy housing and equi~ments.

Care and management of calves, heifers, lactating, dry and pregnant cows and buffaloes, dairy bulls and bullocks; forage production, feeding guides for various categories of dairy animals, tips of breeding efficiency management, herd health management, dairy record management and marketing of dairy animals and products. Practicals for the above.

AAH-540 NUTRITIONAL PHYSIOLOGY OF ANIMALS 3+0

An over view of provision of nutrients, basic principles and mechanism of regulation of nutrient utilization and nutrient supply within the animal body fetal & neonatal nutrition, nutritional requirements for growth. fattening, egg production, wool growth and milk production under different climatic and socio-economic conditions.

Nutrition and environmental stresses, GIT parasitism. Micro-nutrients as regulators of nutrient utilization and manipulation of micro-nutrint metabolism. Manipulation of feeding and eco-system in digestive tract.

Guidelines for developing socially acceptable, balanced & economical feeding systems.

AAH-550 SPECIATION AND EVOLUTION AS APPLIED TO LIVESTOCK POPULATION 3+0

Concept of evolution and speculation. theories of evolution. meaning of evolution. evolutionary mechanism and their role in species formation; variation in natural population and selection. Racial life and death, Simpront's hypothesis, recall sterility, loss of adaptation. evolutionary traps and alleys, Drganic diversity and adaptiveness, adaptive peak and valleys, Evolution in relation to heredity and mutation, phenocopies, types of mutation, artificial methods of causing mutation and their effects, genetic control of mutations and mutants in wild population.

Selection and its effect on evolution of livestock, historical evidences, selection coefficient, selection intensity etc., Adaptive polymorphism and their role in evolution. ecological opportunity; genetics of race formation. polygenic racial variability, genetic drift, population size and race formation. Effect of isolating mechanism on evolution of livestock, hybrid invariability, spatial and reproductive isolation; hybrid sterility and its causes, status of mule and catallo; pattern of evolution. polyploidy in animals, introgressive hybridization. retrogressive of sexuality; concept of co-existence of speciesbovine, ovine, equidae and bubaIine etc.

AAH-560 LIVESTOCK PHYSIOLOGY 3+0

Elements of physiology of reproduction and lactation: Endocrine glands and their secretions. Study of male and female genital organs. Physi910gy of female reproduction -Puberty. Oogenesis, ovulation and formation of corpus luteum, oestrus cycle, fertilization implementation, embryonic and foetal development and parturition. Physiology of male reproduction - Erection, ejaculaton, spermatogenesis, movement of spermatozoa, accessory sex gland secretions. Infertility and sterlity, their causes and prevention. Structure of mammary gland of cow. Mammogenesis, lactogenesis, Milk ejection.

Digestion Physiology : Digestive system of ruminants and non-ruminants. Digestion and absorption carbohydrates, proteins and fats. Elementary knowledge of metabolism of carbohydrates, proteins and fats in ruminants and non-ruminants.

AAH-570 APPLICATION OF SELECTION THEORY 2+1

Introduction to selection theory, general, selection process, natural and artificial selection. intrapopulation and interpopulation selection. genotype environment interactions, co~ervation of genetic variance, genetic homeostasis, population size and effects of chance, gaines under selection. selection reach, accuracy of selection. combined selection, individual versus family selection. collateral relatives, their efficiency, progeny testing, sire evaluation and number of progeny per sire and accuracy of progeny tests, selection index, selection for cross performance general and specific combining ability, selection of breeds, strains, flocks for different environmental conditions, selection under artificial insemination and embryo transfer technology, selection in desirable and opposite directions, selection on the basis of marker genes, biochemical polymorphism and role of variants as an aid to selection, control population and its role in selection experiments, selection for threshold characters. Practicals for the above.

AAH-580 DISEASES OF DAIRY ANIMALS 2+0

Disease caused by viruses: Rinderpest, FMD, Rabies, Pock Diseases, Maliganant Catarrhal Fever, Ephemeral Fever, Vesicular Stomatitis, Bluetongue, Infectious Bovine Rhinotracheitis, Bovine Leukemia, Peste Des Petis Ruminants, Bovine Virus Diahhroes,

Diseases Caused by Bacteria and Fungi: Actinobacillosis, Anthrax, TB, Johne's Disease, Pasteurellosis H.S., Brucellosis, Vibriosis, Leptospirosis, Lister~, B.Q., Tetanus, Clostridium, Botulism, Bovine Mastitis, Caseous Lymphadenitis, Ploynephritis in Cattle, Foot rot, Calf dipthri~ Salmonellosis, Mycoplasmosis, Ringworm, Aspergillosis, Actonomysis, Miscellaneous Disease: Bovine Enzootic Hameaturia, Urinary Calculi. Metabolic Disease: Milk Fever, Grass Tetany, Acetonaemia in Ruminant. Non Infectious Nutritional Dificiency Disease.
Parasities Disease

AAH-590 EXPERIMENTAL TECHNIQUES IN ANIMAL NUTRITION 1+1

Study of techniques employed in determining the nutritive value of feeds and in determining the essentiality of nutrients and evaluation of protein value of foods. Animal calorimetry to detennine the energy requirements of animals. Isotopic studies in animal nutrition. Experimental design and statistical methods used in animal nutrition studies. Practicals for the above.

AAH-630 POPULATION GENETICS 3+1

An introduction to various populations, groups, demography and growth aspects, estimation of variance, covariance and their partitioning, large random mating populations, application and extension of the equilibrium law, genetic variance and correlation, multiple alleles and equilibrium popu1ations, sex-linked gene and equilibrium proportions, two pairs of genes and panmictic populations, selfing and sib-mating, equilibrium populations with inbreeding, path coefficients and path relations between relatives, systems of inbreeding, heterozygosis in [mite groups, irregular

pedigrees of inbreeding, phenotypic assortative mating, gene mutations, selection, joint effects of mutation and selection, small populations and effective size. Practicals for the above.

AAH-640 QUANTITATIVE GENETICS AS APPLIED TO ANIMAL BREEDING - I 1+1

Introduction to quantitative genetics, continuous variation, metric traits, effective population size, sampling, values and means, variance and its partition, covariances, estimation of variances and co *variances,* resemblance between relatives Repeatability, heritability and its estimation, precision of estimates. Selection of the response and its prediction, selection differential. intensity of selection, effect.of selection on variance, measurement of response, realized heritabi1ity, change of gene frequency under artificial selection. Practicals for the above.

AAH-650 QUANTITATIVE GENETICS AS APPLIED TO ANIMAL BREEDING - II 1+1

Selection results. Information from relatives, inbreeding and crossbreeding change of variance applications of inbreeding and crossbreeding, scale effect, threshold characters, correlated response, indirect selection, simultaneous selection for more than one character, metric characters under natural selection. Practicals for the above.

Sheep, Goat and Swine Breeding 3(2-0-1)

Sheep, goat and swine breeding and their role in national economy, inheritance of economic traits, lethals and other genetic defects in sheep, goat and swine, correlated traits influencing productivity like fertility, prolificacy, lambing, kidding and farrowing percentage etc., selection plans and breeding methods for improvement of wool and meat in sheep, milk, meat and hair in goat, growth rate and carcass quality traits in swine and methods of progeny of males in sheep, goat and swine. Practicals for the above.

AAH-660 NON-RUMINANT NUTRITION 2+1

Monogastic animal nutrition in a historical perspective, carbohydrate. lipid ind protein nutrition. translation of feeding standards into meal mixture. Physiological roles, deficiency symptoms and requirements of vitamins and minerals. Mode of action and effect of feed additives on animal perfornance.

Feeding standards, methods of measuring the nutrient needs and efficiency of feed utilization. Practicals for the above.

AAH-670 FEED STUFF EVALUATION 0+2

Laboratory exercises on sample preparation. Principles and methods, equipment's, reagents and other facilities required for evaluation of feed stuffs in terms of crude protein, true protein, non-protein nitrogen, ether extract, crude fibre$_1$ neutral detergent fibre, acid detergent fibre, acid detergent lignin, tannins, oxalates, affiatoxins and mimosin.

Analysis of feed stuffs for critical nutrients viz. Ca, P, Na, Fe, Cu and Zn vitamin A, C & B2, lysine, methionine & tryptophan.

Evaluation of feed stuffs using in vitro or nylon bag technique in terms of dry matter and protein disappearance in the rumen

AAH-680 RUMINANT NUTRITION 3+1

The role of ruminant animals, study of their digestive tract. its development, rumen environment, ruminal movements, role of microbes and manipulation of rumen eco-system.

Ingestion of food, passage of digestation through GIT, theories of regulation of feed intake digestion and metabolism of carbohydrates, nitrogenous compounds and lipids. Synthesis of lactose, glycerol, long chain fatty acids and non-essential amino-acids, composition of rrllcrobial protein and its biological value. Study of *problems* associated with non-protein nitrogenous substances utilization. Consequences of ruminal biohydrogenation on utilization of dietary lipids and protection of lipids for their efficient utilization. Water metabolism and requirements.

Energy nutrition of rumen micro-organisms, manipulation of rumen fermentation, energy metabolism of host animal, host animal control of microbial fermentation and utilization of the energy of absorbed nutrients.

Vitamin and mineral nutrition, function, metabolism, deficiency symptoms and their sources, inter-relationships between vitamins and minerals.

Nutrition of young ruminants, nutrient requirements for maintenance, growth production and reproduction. Nutrient inter-relationship, genetic-nutrient inter-relationship and species comparison, Effect of environment on nutritional requirements of ruminants. Methanogenesis and its control. rumen dysfunction and metabolic problems peculiar to ruminants. Practicals for the bove.

AAH-710 ADVANCES IN DAIRY ANIMAL PRODUCTION 3+0

Reviewing of current development in nutritional requirements of dairy animals, Feeding high producing animals on crops residue based rations, Liner programming in feed formulation! Least cost ration formulation, Climatic stress in relation to growth reproduction and milk production, Feeding strategies under drought conditions, Breeding efficiency in crossbred and high producing cattle buffaloes and goat, Management requirements of crossbred and buffalo calves under varying agro-climatic conditions, Physiological stress,

Housing designs for cattle buffalo under varying environmental condition, The concept complete ration, Modem techniques in forage conservation and processing and their effect on nutritive value and intake.

AAH-720 COMMERCIAL DAIRY HERD MANAGEMENT 2+1

Current trends and projections in dairy industry in India, trends in cattle & buffaloes production system, establishment of modern dairy enterprise, site selection, layout of dairy buildings, provision for. future expansion, social behaviour of dairy animals, feeding management of various categories of dairy animals, breeding management ovuluation and insemination time, synchronization of heat, breeding at desired time for efficient production and management, replacement rate of bulls & cows; role of selection differential marketing, transportation of dairy animals and related goods, quarantine and insurarlce of dairy animals, marketing of milk, efficient labour management, business management decisions in dairy farming and record management. Practicals for the above.

AAH-730 FEED AND FODDER TECHNOLOGY 2+1

Indian feed industry and its scope, raw-materials of feed industry and their mutritive values, Feed processing equipment's effects of processing on nutritive value of feeds for ruminants and non-ruminats.

Auxiliary feed plant operations & equipment's feed plant establishment & its management, methods of feed formulation, quality control of feeds and practical on above.

AAH-740 ENERGY NUTRITION 2+0

Introduction: Energy metabolism in relation to nutrition of livestock and poultry.

Energy expenditure by the animals: Basal metabolism and factors affecting it, energy expenditure in movement and effect of 'environment, energy need of work, growth, reproduction. lactation and other function (wool etc.). Measurements of energy expenditure of animals direct and indirect calorimetry and other approaches.

Utilization of food energy, Digestion, its end products, use of end products of digestion for various body functions and productions. Factors affecting its use, Evaluation of feeds as source of energy. Regulation of energy intake. Energy feeding standards, their limitations and newer formulation towards feeding standards.

AAH-750 PROTEIN NUTRITION 2+0

Development of the concept of amino acids, superior & inferior proteins & its importance in nutrition. Amino acid requirements & objectives individuality of amino acid needs, utilization of dietary protein and criteria of protein nutrition utilization,utilization of D-amino acids; amino acid supplementation of feed & foods. Amino acid imbalances & antagonism

Nitrogen balances; anomalies of protein metabolism. Protein nutrition under stress & evaluation of dietary protein; determination of protein needs for different physiological functions.

AAH-760 VITAMIN NUTRITION 2+0

Characteristics and differentiation of fat soluble and water soluble vitamins. Importance of fat soluble vitamins to different species of Livestock and Poultry, Chemistry, absorption, transport and physiology functions, deposition, structure and functions affected during deficiency. Role of vitamins in carbohydrate, fats and protein nutrition, their

relation with other vitamin and hormones, functions, dietary requirements for various classes of livestock and the factors affecting their availability sources and hypervitaminosis of different fat soluble vitamins. Physiological functions, chemistry, deficiency symptoms, sources and requirements of various water soluble vitamins like Thiamine, Riboflavin, Niacin, Pyridoxine, Cyanocobalamine, Folic Acid, Pantothenic Acid, Biotin, Choline, Inositol Para Amino benzoic Acid and Ascorbic Acid. Inter-relationship between vitamins, minerals and· harmones and their requirements for poultry and laboratory animals.

AAH-770 MINERAL NUTRITION 2+0

Fundamental concepts in mineral nutrition, general information on minerals, biogeochemical regions, mineral composition of feeds, bodies and tissue of animals.

Distribution on animal system, absorption from the intestine & physiological functions, metabolism of major minerals, deficiency Symptoms, their content in feeds, methods of estimation 'of requirements for various classes of livestock.

Distribution in the body, physiological functions, absorption and metabolism, requirements of trace minerals, their sources and toxicity, in both ruminants and non-ruminants.

Inter-relationship among minerals (I.nd between minerals & vitamins, kinetics of mineral metabolism in blood, organs and tissues, soil-plant and animal inter-relationships.

AAH-780 ADVANCED ANIMAL BREEDING 2+1

Application of population and quantitative genetics in the improvement of livestock, changing demands for new selection and breeding methods for the changing trends in animal productivity, selective breeding, breeding for combining ability, recurrent selection. reciprocal recurrent selection. diallel crossing, hybrid stocks, synthetic population, breeding for disease resistance, polymorphism, polymorphism traits, Bio-chemical polymorphism, Blood group systems in livestock and poultry, present status and future scope in Animal Breeding.

Techniques and procedures in animal breeding, statistical models, least square analysis, theory and analysis of diallel crosses, major technical development in the field of animal breeding, major genes, their significance in mimal breeding, Breeding for economic livestock and poultry production. feed utilization efficiency- its genetic nature; selection for net profit, development of breed suited to changing environment. Practicals for the above.

ENTOMOLOGY

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
ENT 501*	INSECT MORPHOLOGY	1+1
ENT 502*	INSECT ANATOMY, PHYSIOLOGY AND NUTRITION	2+1
ENT 503	PRINCIPLES OF TAXONOMY	2+0
ENT 504*	CLASSIFICATION OF INSECTS	2+1
ENT 505*	INSECT ECOLOGY	1+1
ENT 506	INSECT PATHOLOGY	1+1
ENT 507*	BIOLOGICAL CONTROL OF CROP PESTS AND WEEDS	1+1
ENT 508*	TOXICOLOGY OF INSECTICIDES	2+1
ENT 509	PLANT RESISTANCE TO INSECTS	1+1
ENT 510*	PRINCIPLES OF INTEGRATED PEST MANAGEMENT	1+1
ENT 511*#	PESTS OF FIELD CROPS	1+1
ENT 512*#	PESTS OF HORTICULTURAL AND PLANTATION CROPS	1+1
ENT 513	STORAGE ENTOMOLOGY	1+1
ENT 514	INSECT VECTORS OF PLANT VIRUSES AND OTHER PATHOGENS	1+1
ENT 515	GENERAL ACAROLOGY	1+1
ENT 516	SOIL ARTHROPODS AND THEIR MANAGEMENT	1+1
ENT 517	VERTEBRATE PEST MANAGEMENT	1+1

ENT 518*	TECHNIQUES IN PLANT PROTECTION	0+1
ENT 519	COMMERCIAL ENTOMOLOGY	1+1
ENT 520	PLANT QUARANTINE	2+0
ENT 591	MASTER'S SEMINAR	1+0
ENT 599	MASTER'S RESEARCH	20
ENT 601	ADVANCED INSECT SYSTEMATICS	1+2
ENT 602	IMMATURE STAGES OF INSECTS	1+1
ENT 603	ADVANCED INSECT PHYSIOLOGY	2+0
ENT 604	ADVANCED INSECT ECOLOGY	1+1
ENT 605	INSECT BEHAVIOUR	1+1
ENT 606	RECENT TRENDS IN BIOLOGICAL CONTROL	1+1
ENT 607	ADVANCED INSECTICIDE TOXICOLOGY	2+1
ENT 608	ADVANCED HOST PLANT RESISTANCE	1+1
ENT 609	ADVANCED ACAROLOGY	1+1
ENT 610	AGRICULTURAL ORNITHOLOGY	1+1
ENT 611**	MOLECULAR APPROACHES IN ENTOMOLOGICAL RESEARCH	1+1
ENT 612**	ADVANCED INTEGRATED PEST MANAGEMENT	2+0
ENT 613/		
PL PATH 606$	PLANT BIOSECURITY AND BIOSAFETY	2+0
ENT 691	DOCTORAL SEMINAR 1	1+0
ENT 692	DOCTORAL SEMINAR II	1+0
ENT 699	DOCTORAL RESEARCH	45

Compulsory for Master's programme*; * Compulsory for Ph.D. programme*
#One out of 511 or 512 is compulsory; ***$*** *Cross-listed with Plant Pathology*

ENTOMOLOGY

Course Contents

ENT 501 INSECT MORPHOLOGY 1+1

Objective

To acquaint the students with external morphology of the insect's body i.e., head, thorax and abdomen, their appendages and functions.

Theory

UNIT I

Principles, utility and relevance: insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation.

UNIT II

Head- Origin, structure and modification; types of mouthparts and antennae, tentorium and neck sclerites.

UNIT III

Thorax- Areas and sutures of tergum, sternum and pleuron, pterothorax; Wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; Legs: structure and modifications.

UNIT IV

Abdomen- Segmentation and appendages; Genitalia and their modifications; Embryonic and post-embryonic development; Types of metamorphosis. Insect sense organs (mechano-, photo- and chemoreceptors).

Practical

Study of insect segmentation, various tagmata and their appendages; preparation of permanent mounts of different body parts and their appendages of taxonomic importance including male and female genitalia. Sense organs.

ENT 502 INSECT ANATOMY, PHYSIOLOGY AND NUTRITION 2+1

Objective

To impart knowledge to the students on basic aspects of anatomy of different systems, elementary physiology, nutritional physiology and their application in entomology.

Theory

UNIT I

Scope and importance of insect anatomy and physiology.

UNIT II

Structure, modification and physiology of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands.

UNIT III

Thermodynamics; physiology of integument, moulting; growth, metamorphosis and diapause.

UNIT IV

Insect nutrition- role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents; extra and intra-cellular microorganisms and their role in physiology; artificial diets.

Practical

Dissection of different insects to study comparative anatomical details of different systems; preparation of permanent mounts of internal systems; chromatographic analysis of free amino acids of haemolymph; determination of chitin in insect cuticle; examination of insect haemocytes; determination of respiratory quotient; preparation and evaluation of various diets; consumption, utilization and digestion of natural and artificial diets.

ENT 503 PRINCIPLES OF TAXONOMY 2+0

Objective

To sensitize the students on the theory and practice of classifying organisms and the rules governing the same.

Theory

UNIT I

Introduction to history and principles of systematics and importance. Levels and functions of systematics. Identification, purpose, methodscharacter matrix, taxonomic keys. Descriptions- subjects of descriptions, characters, nature of characters, analogy vs homology, parallel vs convergent evolution, intraspecific variation in characters, polythetic and polymorphic taxa, sexual dimorphism.

UNIT II

Classification of animals: Schools of classification- Phenetics, Cladistics and Evolutionary classification. Components of Biological Classification: Hierarchy, Rank, Category and Taxon. Species concepts, cryptic, sibling and etho- species, infra-specific categories. Introduction to numerical, biological and cytogenetical taxonomy.

UNIT III

Nomenclature: Common vs Scientific names. International Code of Zoological Nomenclature, criteria for availability of names, validity of names. Categories of names under consideration of ICZN. Publications, Principles of priority, and homonymy, synonymy, type concept in zoological nomenclature. Speciation, anagenesis vs cladogenesis, allopatric, sympatric and parapatric processes.

ENT 504 CLASSIFICATION OF INSECTS 2+1

Objective

To introduce the students to the classification of insects up to the level of families with hands-on experience in identifying the families of insects.

Theory

UNIT I

Brief evolutionary history of Insects- introduction to phylogeny of insects and Major Classification of Superclass Hexapoda - Classes - Ellipura (Collembola, Protura), Diplura and Insecta- Orders contained.

UNIT II

Distinguishing characters, general biology, habits and habitats of Insect orders and economically important families contained in them. Collembola, Protura, Diplura. Class Insecta: Subclass Apterygota - Archaeognatha, Thysanura. Subclass: Pterygota, Division Palaeoptera - Odonata and Ephemeroptera. Division: Neoptera: Subdivision: Orthopteroid and Blattoid Orders (=Oligoneoptera: Plecoptera, Blattodea, Isoptera, Mantodea, Grylloblattodea, Dermaptera, Orthoptera, Phasmatodea, Mantophasmatodea, Embioptera, Zoraptera), Subdivision: Hemipteroid Orders (=Paraneoptera): Psocoptera, Phthiraptera, Thysanoptera and Hemiptera.

UNIT III

Distinguishing characters, general biology, habits and habitats of Insect orders and economically important families contained in them (Continued). Division Neoptera - Subdivision Endopterygota, Section Neuropteroid- Coleopteroid Orders: Strepsiptera, Megaloptera, Raphidioptera, Neuroptera and Coleoptera, Section Panorpoid Orders Mecoptera, Siphonaptera, Diptera, Trichoptera, Lepidoptera, and Section Hymenopteroid Orders: Hymenoptera.

Practical

Study of Orders of insects and their identification using taxonomic keys. Keying out families of insects of different major Orders: Odonata, Orthoptera, Blattodea, Mantodea, Isoptera, Hemiptera, Thysanoptera, Phthiraptera, Neuroptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera. Field visits to collect insects of different orders.

ENT 505 INSECT ECOLOGY 1+1

Objective

To teach the students the concepts of ecology, basic principles of distribution and abundance of organisms and their causes. Study life tables, organization of communities, diversity indicies. Train students in sampling methodology, calculation of diversity indicies, constructing life tables, relating insect population fluctuations to biotic and/or abiotic causes.

Theory

UNIT I

History and Definition. Basic Concepts. Organisation of the Biological world. Plato's Natural Balance vs Ecological Dynamics as the modern view. Abundance and diversity of insects, Estimates and Causal factors. Study of abundance and distribution and relation between the two. Basic principles of abiotic factors and their generalised action on insects. Implications for abundance and distribution of organisms including insects- Law of the Minimum, Law of Tolerance, and biocoenosis, Systems approach to ecology.

UNIT II

Basic concepts of abundance- Model vs Real world. Population growthbasic models - Exponential vs Logistic models. Discrete vs Continuous growth models. Concepts of Carrying capacity, Environmental Resistance and Optimal yield. Vital Statistics- Life Tables and their application to insect biology. Survivorship curves. Case studies

of insect life tables. Population dynamics- Factors affecting abundance- Environmental factors, dispersal and migration, Seasonality in insects. Classification and mechanisms of achieving different seasonality- Diapause (Quiescence) - aestivation, hibernation.

UNIT III

Biotic factors- Food as a limiting factor for distribution and abundance, Nutritional Ecology. Food chain- web and ecological succession. Interspecific interactions- Basic factors governing the interspecific interactions- Classification of interspecific interactions - The argument of cost-benefit ratios. Competition- Lotka-Volterra model, Concept of nicheecological homologues, competitive exclusion. Prey-predator interactions- Basic model- Lotka-Volterra Model, Volterra's principle. Functional and numerical response. Defense mechanisms against predators/parasitoids- Evolution of mimicry, colouration, concept of predator satiation; evolution of life history strategies.

UNIT IV

Community ecology- Concept of guild, Organisation of communities- Hutchinson Ratio, May's *d/w*, Relation between the two and their association with Dyar's Law and Przibram's law. Relative distribution of organisms, Concept of diversity- the Wallacian view. Assessment of diversity. Diversity- stability debate, relevance to pest management. Pest management as applied ecology.

Practical

Types of distributions of organisms. Methods of sampling insects, estimation of densities of insects and understanding the distribution parameters- Measures of central tendencies, Poisson Distribution, Negative Binomial Distribution. Determination of optimal sample size. Learning to fit basic population growth models and testing the goodness of fit. Fitting Holling's Disc equation, Assessment of prey-predator densities from natural systems and understanding the correlation between the two. Assessing and describing niche of some insects of a single guild. Calculation of niche breadth, activity breadth and diagramatic representation of niches of organisms. Calculation of some diversity indices- Shannon's, Simpson's and Avalanche Index and understanding their associations and parameters that affect their values. Problem solving in ecology. Field visits to understand different ecosystems and to study insect occurrence in these systems.

ENT 506 INSECT PATHOLOGY 1+1

Objective

To teach the students about various microbes that are pathogenic to insects, factors that affect their virulence; provide hands-on training in identification, isolation, culturing various pathogens and assessing pathogenicity.

Theory

UNIT I

History of insect pathology, infection of insects by bacteria, fungi, viruses, protozoa, rickettsiae, spiroplasma and nematodes.

UNIT II

Epizootiology, symptomatology and etiology of diseases caused by the above and the factors controlling these. Defense mechanisms in insects against pathogens.

UNIT III

Examples of successful instances of exploitation of pathogens for pest management and mass production techniques of pathogens. Safety and registration of microbial pesticides. Use of insect pathogens in integrated management of insect pests.

Practical

Familiarization with equipment used in insect pathology laboratory. Identification of different groups of insect pathogens and symptoms of infection. Isolation, culturing and testing pathogenicity of different groups of pathogens. Testing Koch's postulates. Estimation of pathogen load. Extraction of pathogens from live organisms and soil. Bioassays to determine median lethal doses.

ENT 507 BIOLOGICAL CONTROL OF CROP PESTS AND WEEDS 1+1

Objective

To train the students with theory and practice of biological control, mass production techniques and field evaluation of various biological control agents like parasitoids, predators and various entomopathogenic microorganisms.

Theory

UNIT I

History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation and conservation.

UNIT II

Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa etc., their mode of action. Biological control of weeds using insects.

UNIT III

Mass production of quality biocontrol agents- techniques, formulations, economics, field release/application and evaluation.

UNIT IV

Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of natural enemies- Quarantine regulations, biotechnology in biological control. Semiochemicals in biological control.

Practical

Identification of common natural enemies of crop pests (parasitoids, predators, microbes) and weed killers. Visits (only where logistically feasible) to bio-control laboratories to learn rearing and mass production of egg, egg-larval, larval, larval-pupal and pupal parasitoids, common predators, microbes and their laboratory hosts, phytophagous natural enemies of weeds. Field collection of parasitoids and predators. Hands-on training in culturing, identification of common insect pathogens. Quality control and registration standards for biocontrol agents.

ENT 508 TOXICOLOGY OF INSECTICIDES 2+1

Objective

To orient the students with structure and mode of action of important insecticides belonging to different groups, development of resistance to insecticides by insects, environmental pollution caused by toxic insecticides and their toxicological aspects.

Theory

UNIT I

Definition and scope of insecticide toxicology; history of chemical control; pesticide use and pesticide industry in India.

UNIT II

Classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature. Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrozoles, insect growth regulators, microbials, botanicals, new promising compounds, etc.

UNIT III

Principles of toxicology; evaluation of insecticide toxicity; joint action of insecticides- synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity.

UNIT IV

Insecticide metabolism; pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence.

UNIT V

Insecticide residues, their significance and environmental implications. Insecticide Act, registration and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning.

Practical

Insecticide formulations and mixtures; quality control of pesticide formulations; laboratory and field evaluation of bioefficacy of insecticides; bioassay techniques; probit analysis; evaluation of insecticide toxicity and joint action. Toxicity to beneficial insects. Pesticide appliances. Working out doses and concentrations of pesticides; visit to toxicology laboratories. Good laboratory practices.

ENT 509 PLANT RESISTANCE TO INSECTS 1+1

Objective

To familiarize the students with types, basis, mechanisms and genetics of resistance in plants to insects and role of plant resistance in pest management.

Theory

UNIT I

History and importance of resistance, principles, classification, components, types and mechanisms of resistance.

UNIT II

Insect-host plant relationships; theories and basis of host plant selection in phytophagous insects.

UNIT III

Chemical ecology, tritrophic relations, volatiles and secondary plant substances; basis of resistance. Induced resistance - acquired and induced systemic resistance.

UNIT IV

Factors affecting plant resistance including biotypes and measures to combat them.

UNIT V

Screening techniques; breeding for insect resistance in crop plants; exploitation of wild plant species; gene transfer, successful examples of resistant crop varieties in India and world.

UNIT VI

Role of biotechnology in plant resistance to insects.

Practical

Screening techniques for measuring resistance; measurement of plant characters and working out their correlations with plant resistance; testing of resistance in important crops; bioassay of plant extracts of susceptible/resistant varieties; demonstration of antibiosis, tolerance and antixenosis.

ENT 510 PRINCIPLES OF INTEGRATED PEST MANAGEMENT 1+1

Objective

To familiarize the students with principles of insect pest management, including concept and philosophy of IPM. Train students in computation of ETL, implementing IPM programmes.

Theory

UNIT I

History and origin, definition and evolution of various related terminologies.

UNIT II

Concept and philosophy, ecological principles, economic threshold concept, and economic consideration.

UNIT III

Tools of pest management and their integration- legislative, cultural, physical and mechanical methods; pest survey and surveillance, forecasting, types of surveys including remote sensing methods, factors affecting surveys; political, social and legal implications of IPM; pest risk analysis; pesticide risk analysis; cost-benefit ratios and partial budgeting; case studies of successful IPM programmes.

Practical

Characterization of agro-ecosystems; sampling methods and factors affecting sampling; population estimation methods; crop loss assessmentdirect losses, indirect losses, potential losses, avoidable losses, unavoidable losses. Computation of EIL and ETL; crop modeling; designing and implementing IPM system.

ENT 511 PESTS OF FIELD CROPS 1+1

Objective

To familiarize the students about nature of damage and seasonal incidence of insect pests that cause loss to major field crops and their effective management by different methods.

Theory

Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors.

UNIT I

Insect pests of cereals and millets and their management. Polyphagous pests: grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs etc.).

UNIT II

Insect pests of pulses, tobacco, oilseeds and their management.

UNIT III

Insect pests of fibre crops, forages, sugarcane and their management.

Practical

Field visits, collection and identification of important pests and their natural enemies; detection and estimation of infestation and losses in different crops; study of life history of important insect pests.

ENT 512 PESTS OF HORTICULTURAL AND PLANTATION CROPS 1+1

Objective

To impart knowledge on major pests of horticultural and plantation crops regarding the extent and nature of loss, seasonal history, their integrated management.

Theory

Systematic position, identification, distribution, host range, bionomics and seasonal abundance, nature and extent of damage and management of insect pests of various crops.

UNIT I

Fruit Crops- mango, guava, banana, jack, papaya, pomegranate, litchi, grapes, *ber*, fig, citrus, *aonla*, pineapple, apple, peach and other temperate fruits.

UNIT II

Vegetable crops- tomato, potato, radish, carrot, beetroot, cole crops, French beans, chow-chow, brinjal, okra, all gourds, gherkin, drumstick, leafy vegetables etc.

UNIT III

Plantation crop- coffee, tea, rubber, coconut, arecanut, cashew, cocoa etc.; Spices and Condiments- pepper, cardamom, clove, nutmeg, chillies, turmeric, ginger, beetlevine etc.

UNIT IV

Ornamental, medicinal and aromatic plants and pests in polyhouses/protected cultivation.

Practical

Collection and identification of important pests and their natural enemies on different crops; study of life history of important insect pests and noninsect pests.

ENT 513 STORAGE ENTOMOLOGY 1+1

Objective

To focus on requirement and importance of grain and grain storage, to understand the role of stored grain pests and to acquaint with various stored grain pest management techniques for avoiding losses in storage.

Theory

UNIT I

Introduction, history of storage entomology, concepts of storage entomology and significance of insect pests. Post-harvest losses *in toto visà-vis* total production of food grains in India. Scientific and socio-economic factors responsible for grain losses.

UNIT II

Important pests namely insects, mites, rodents, birds and microorganisms associated with stored grain and field conditions including agricultural products; traditional storage structures; association of stored grain insects with fungi and mites, their systematic position, identification, distribution, host range, biology, nature and extent of damage, role of field and cross infestations and natural enemies, type of losses in stored grains and their effect on quality including biochemical changes.

UNIT III

Ecology of insect pests of stored commodities/grains with special emphasis on role of moisture, temperature and humidity in safe storage of food grains and commodities. Stored grain deterioration process, physical and biochemical changes and consequences. Grain storage- types of storage structures i.e., traditional, improved and modern storage structures in current usage. Ideal seeds and commodities' storage conditions.

UNIT IV

Important rodent pests associated with stored grains and their non-chemical and chemical control including fumigation of rat burrows. Role of bird pests and their management. Control of infestation by insect pests, mites and microorganisms. Preventive measures- Hygiene/sanitation, disinfestations of stores/receptacles, legal methods. Curative measures- Non-chemical control measures- ecological, mechanical, physical, cultural, biological and engineering. Chemical control- prophylactic and curative- Characteristics of pesticides, their use and precautions in their handling with special emphasis on fumigants. Integrated approaches to stored grain pest management.

Practical

Collection, identification and familiarization with the stored grains/seed insect pests and nature of damage caused by them; detection of insect infestation in stored food grains; estimation of losses in stored food grains; determination of moisture content in stored food grains; familiarization of storage structures, demonstration of preventive and curative measures including fumigation techniques; treatment of packing materials and their effect on seed quality. Field visits to save grain campaign, central warehouse and FCI warehouses and institutions engaged in research or practice of grain storage like CFTRI, IGSMRI, Hapur etc. (only where logistically feasible).

ENT 514 INSECT VECTORS OF PLANT VIRUSES AND OTHER PATHOGENS 1+1

Objective

To teach the students about the different groups of insects that vector plant pathogens, vector-plant pathogen interaction, management of vectors for controlling diseases.

Theory

UNIT I

History of developments in the area of insects as vectors of plant pathogens. Important insect vectors and their characteristics; mouth parts and feeding processes of important insect vectors. Efficiency of transmission.

UNIT II

Transmission of plant viruses and fungal pathogens. Relation between viruses and their vectors.

UNIT III

Transmission of plant viruses by aphids, whiteflies, mealy bugs and thrips.

UNIT IV

Transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers.

UNIT V

Transmission of plant viruses by psyllids, beetles and mites. Epidemiology and management of insect transmitted diseases through vector management.

Practical

Identification of common vectors of plant pathogens- aphids, leafhoppers, whiteflies, thrips, beetles, nematodes; culturing and handling of vectors; demonstration of virus transmission through vectors- aphids, leafhoppers and whiteflies.

ENT 515 GENERAL ACAROLOGY 1+1

Objective

To aquaint the students with external morphology of different groups of mites, train in identification of commonly occurring families of plant associated mites, provide information about important mite pests of crops and their management.

Theory

UNIT I

History of Acarology; importance of mites as a group; habitat, collection and preservation of mites.

UNIT II

Introduction to morphology and biology of mites and ticks. Broad classification- major orders and important families of Acari including diagnostic characteristics.

UNIT III

Economic importance, seasonal occurrence, nature of damage, host range of mite pests of different crops, mite pests in polyhouses, mite pests of stored products and honeybees. Management of mites using acaricides, phytoseiid predators, fungal pathogens *etc*. Culturing of phytophagous, parasitic and predatory mites.

Practical

Collection of mites from plants, soil and animals; extraction of mites from soil, plants and stored products; preparation of mounting media and slide mounts; external morphology of mites; identification of mites up to family level using keys; studying different rearing techniques for mites.

ENT 516 SOIL ARTHROPODS AND THEIR MANAGEMENT 1+1

Objective

To impart knowledge about the different groups of arthropods found in soil, interaction between the different groups, and role of soil arthropods in humus formation. Hands-on training in sampling and identification of different groups of soil arthropods.

Theory

UNIT I

Soil arthropods and their classification, habitats and their identification.

UNIT II

Estimation of populations; sampling and extraction methods.

UNIT III

Role of soil arthropods in detritus feeding, litter breakdown and humus formation. Soil arthropods as bio-indicators of habitat qualities. Effect of soil arthropod activity on soil properties.

UNIT IV

Harmful and beneficial soil arthropods and their management, interrelationship among arthropods and other soil invertebrates and soil microorganisms. Anthropogenic effects on soil arthropods.

Practical

Sampling, extraction methods and identification of various types of soil fauna; estimation and assessment of soil arthropod population; techniques and culturing soil invertebrates.

ENT 517 VERTEBRATE PEST MANAGEMENT 1+1

Objective

To impart knowledge on vertebrate pests like birds, rodents, mammals etc., of different crops, their biology, damage they cause and management strategies.

Theory

UNIT I

Vertebrate pests of different crops; biology of vertebrate pests such as rodents, birds and other mammals. Biology of beneficial birds.

UNIT II

Population dynamics and assessment, patterns of pest damage and assessment, roosting and nesting systems in birds.

UNIT III

Management strategies- physical (trapping, acoustics and visual), chemical (poisons, repellents, fumigants and anticoagulants), biological (predators, parasites), cropping practices, alteration of habitats, diversion baiting and other eco-friendly methods- Operational practices- baiting, bioassays (LD50 studies), equipments and educative programmes.

Practical

Identification of important rodent and other vertebrate pests of agriculture, food preference and hoarding, social behaviour, damage assessment, field survey, population estimation, control operation and preventive methods.

ENT 518 TECHNIQUES IN PLANT PROTECTION 0+1

Objective

To acquaint the students with appropriate use of plant protection equipments and techniques related to microscopoy, computation, pest forecasting, electrophoresis etc.

Theory

UNIT I

Pest control equipments, principles, operation, maintenance, selection, application of pesticides and biocontrol agents, seed dressing, soaking, root-dip treatment, dusting, spraying, application through irrigation water.

UNIT II

Soil sterilization, solarization, deep ploughing, flooding, techniques to check the spread of pests through seed, bulbs, corms, cuttings and cut flowers.

UNIT III

Use of light, transmission and scanning electron microscopy.

UNIT IV

Protein isolation from the pest and host plant and its quantification using spectrophotometer and molecular weight determination using SDS/PAGE.

UNIT V

Use of tissue culture techniques in plant protection. Computer application for predicting/forecasting pest attack and identification.

ENT 519 COMMERCIAL ENTOMOLOGY 1+1

Objective

To familiarize the students with entrepreneurial opportunities in entomology, provide information on productive insects and their products, as well as insect pests of public health and veterinary importance and their management.

Theory

UNIT I

Bee keeping- General colony management during different seasons. Seasonal management. Managing colonies for honey production and pollination. Artificial queen rearing. Pests and diseases of honey bees. Bee poisoning. Production and marketing of quality honey and value added honey products. Establishment and maintenance of apiaries.

UNIT II

Study of different species of silkworms, characteristic features, moriculture, silk and its uses, pests and diseases of silkworms, rearing and management of silkworms. Lac insect- natural enemies and their management.

UNIT III

Economic and public health importance of insect pests in human habitation and habitats, biology, damage and control of mosquitoes, houseflies, bed bugs, ants, termites, cockroaches, flies, silverfish, head and body lice, carpet beetles, cloth moths, crickets, wasps, house dust mites, insect pests of cattle, poultry, pet animals and their management.

UNIT IV

Principles and methods of pest management in residential places and public buildings, insecticides for domestic use and their safety, pre- and postconstruction termite proofing of buildings, appliances for domestic pest control. Rodent control methods. Organic methods of domestic pest management.

Practical

Assessing pest status in dwellings (labs, canteen or hostel), implementation of pest control against flies, mosquitoes, bed bugs, cockroaches and rodents. Pre- and post-construction termite proofing methods, control of silverfishes in the library. Visit to poultry units and assessing pest status in poultries. Evaluation of commercially available domestic insect pest control products through bioassays. Identification of honey bee species, bee castes and special adaptations, identification and handling of bee-keeping equipments. Handling of honey bees-hive and frame inspection. Honey

extraction and processing methods of hive products extraction. Preparation of bee-keeping projects for funding. Visit to bee nursery and commercial apiaries. Silkworm rearing and management. Lac host and crop management technology and processing of lac. Products and bye-products of lac.

ENT 520 PLANT QUARANTINE 2+0

Objective

To acquaint the learners about the principles and the role of Plant Quarantine in containment of pests and diseases, plant quarantine regulations and set-up.

Theory

UNIT I

Definition of pest, pesticides and transgenics as per Govt. notification; relative importance; quarantine - domestic and international. Quarantine restrictions in the movement of agricultural produce, seeds and planting material; case histories of exotic pests/diseases and their status.

UNIT II

Plant protection organization in India. Acts related to registration of pesticides and transgenics. History of quarantine legislations, PQ Order 2003. Environmental Acts, Industrial registration; APEDA, Import and Export of bio-control agents.

UNIT III

Identification of pest/disease free areas; contamination of food with toxigens, microorganisms and their elimination; Symptomatic diagnosis and other techniques to detect pest/pathogen infestations; VHT and other safer techniques of disinfestation/salvaging of infected material.

UNIT IV

WTO regulations; non-tariff barriers; Pest risk analysis, good laboratory practices for pesticide laboratories; pesticide industry; Sanitary and Phytosanitary measures.

ENT 601 ADVANCED INSECT SYSTEMATICS 1+2

Objective

To familiarize the students with different schools of classification, phylogenetics, classical and molecular methods, evolution of different groups of insects. International Code of Zoological Nomenclature. Ethics and procedure for taxonomic publications.

Theory

UNIT I

Detailed study of three schools of classification- numerical, evolutionary and cladistics. Methodologies employed. Development of phenograms, cladograms, molecular approaches for the classification of organisms. Methods in identification of homology. Species concepts and speciation processes and evidences. Zoogeography.

UNIT II

Study of different views on the evolution of insects- alternative phylogenies of insects: Kukalova Peck and Kristensen. Fossil insects and evolution of insect diversity over geological times.

UNIT III

Detailed study of International Code of Zoological Nomenclature, including appendices to ICZN- Ethics.

UNIT IV

Concept of Phylocode and alternative naming systems for animals. A detailed study of selected representatives of taxonomic publications - small publications of species descriptions, revisionary works, monographs, check lists, faunal volumes, etc. Websites related to insect taxonomy and databases. Molecular Taxonomy, barcoding species.

Practical

Collection, curation and study of one taxon of insects- literature search, compilation of a checklist, study of characters, development of character table, construction of taxonomic keys for the selected group. Development of descriptions, photographing, writing diagrams, and preparation of specimens for "type like" preservation. Submission of the collections made of the group. Multivariate Analysis techniques for clustering specimens into different taxa, and development of phenograms. Rooting and character polarisation for developing cladograms and use of computer programmes to develop cladograms.

ENT 602 IMMATURE STAGES OF INSECTS 1+1

Objective

To impart knowledge on morphology of immature stages of different groups of insects. Train students in identification of common pest species during their immature stages.

Theory

UNIT I

Types of immature stages in insect orders, morphology of egg, nymph/larva and pupa, identification of different immature stages of crop pests and stored product insects

UNIT II

Comparative study of life history strategies in hemi-metabola and holometabola, immature stages as ecological and evolutionary adaptations, significance of immature stages for pest management.

Practical

Types of immature stages; their collection, rearing and preservation. Identification of immature insects to orders and families, in endopterygote orders viz., Diptera, Lepidoptera, Hymenoptera and Coleoptera using key.

ENT 603 ADVANCED INSECT PHYSIOLOGY 2+0

Objective

To impart knowledge to the students on detailed physiology of various secretory and excretory systems, moulting process, chitin synthesis, physiology of digestion, transmission of nerve impulses, nutrition of insects, pheromones etc.

Theory

UNIT I

Physiology and biochemistry of insect cuticle and moulting process. Biosynthesis of chitin, chitin-protein interactions in various cuticles, types of sclerotization.

UNIT II

Digestive enzymes, digestive physiology in phytophagous, wood boring and wool feeding insects, efficiency of digestion and absorption, role of endosymbionts in insect nutrition, nutritional effects on growth and development; physiology of excretion and osmoregulation, water conservation mechanisms.

UNIT III

Detailed physiology of nervous system, transmission of nerve impulses, neurotransmitters and modulators. Production of receptor potentials in different types of sensilla, pheromones and other semiochemicals in insect life, toxins and defense mechanisms.

UNIT IV

Endocrine system and insect hormones, physiology of insect growth and development- metamorphosis, polyphenism and diapause. Energetics of muscle contractions.

ENT 604 ADVANCED INSECT ECOLOGY 1+1

Objective

To impart advanced practical knowledge of causal factors governing the distribution and abundance of insects and the evolution of ecological characteristics.

Theory

UNIT I

Characterisation of distribution of insects- Indices of Dispersion, Taylor's Power law. Island Biogeography. Population dynamics- Life tables, Leslie Matrix, Stable age distribution, Population projections. Predator-Prey Models- Lotka-Volterra and Nicholson-Bailey Model. Crop Modeling- an introduction.

UNIT II

Insect Plant Interactions. Fig-figwasp mutualism and a quantitative view of types of Associations. Role of insects in the environment. Adaptations to terrestrial habitats. Evolution of Insect diversity and role of phytophagy as an adaptive zone for increased diversity of insects. Evolution of resource harvesting organs, resilience of insect taxa and the sustenance of insect diversity- role of plants. Herbivory, pollination, predation, parasitism. Modes of insect- plant interaction, tri-trophic interactions. Evolution of herbivory, monophagy vs polyphagy. Role of plant secondary metabolites. Host seeking behaviour of parasitoids. Meaning of stress- plant stress and herbivory. Consequences of herbivory to plant fitness and response to stress. Constitutive and induced plant defenses.

UNIT III

Biodiversity and Conservation- RET species, Ecological Indicators. Principles of Population genetics, Hardy Weinberg Law, Computation of Allelic and Phenotypic frequencies, Fitness under selection, Rates of Evolution under selection. Foraging Ecology- Optimal foraging theory, Marginal Value Theorem, and Patch departure rules, central place foraging, Mean-variance relationship and foraging by pollinators, Nutritional Ecology.

UNIT IV

Reproductive ecology- Sexual selection, Mating systems, Reproductive strategies - timing, egg number, reproductive effort, sibling rivalry and parent-offspring conflict. Agro-ecological vs Natural Ecosystems - Characterisation, Pest Control as applied ecology- case studies.

Practical

Methods of data collection under field conditions. Assessment of distribution parameters, Taylor's power law, Iwao's patchiness index, Index of Dispersion, etc. Calculation of sample sizes by different methods. Fitting Poisson and Negative Binomial distributions and working out the data transformation methods. Hardy-Weinberg Law, Computation of Allelic and Phenotypic Frequencies - Calculation of changes under selection, Demonstration of genetic drift. Assessment of Patch Departure rules. Assessment of Resource size by female insects using a suitable insect model, fruit flies/*Goniozus*/Female Bruchids etc.- A test of reproductive effort and fitness. Construction of Life tables and application of Leslie Matrix - population projections, Stable age distribution. Exercises in development of Algorithms for crop modeling.

ENT 605 INSECT BEHAVIOUR 1+1

Objective

To acquaint the students with a thorough understanding of how natural selection has led to various survival strategies manifested as behaviour in insects.

Theory

UNIT I

Defining Behaviour- Concept of umwelt, instinct, fixed action patterns, imprinting, complex behaviour, inducted behaviour, learnt behaviour and motivation. History of Ethology- development of behaviorism and ethology, contribution of Darwin, Frisch, Tinbergen and Lorenz; Studying behaviour- Proximate and Ultimate approaches, behavioural traits under natural selection, genetic control of behaviour and behavioural polymorphism.

UNIT II

Orientation- Forms of primary and secondary orientation including taxes and kinesis; Communication- primary and secondary orientation, responses to environmental stimuli, role of visual, olfactory and auditory signals in inter- and intra-specific communication, use of signals in defense, mimicry, polyphenism; evolution of signals.

UNIT III

Reproductive behaviour- mate finding, courtship, territoriality, parental care, parental investment, sexual selection and evolution of sex ratios; Social behaviour- kin selection, parental manipulation and mutualism; Selforganization and insect behaviour.

UNIT IV

Foraging- Role of different signals in host searching (plant and insects) and host acceptance, ovipositional behaviour, pollination behaviour, coevolution of plants and insect pollinators. Behaviour in IPM- Concept of super-normal stimuli and behavioural manipulation as potential tool in pest management, use of semio-chemicals, auditory stimuli and visual signals in pest management.

Practical

Quantitative methods in sampling behaviour; training bees to artificial feeders; sensory adaptation and habituation in a fly or butterfly model, physical cues used in host selection in a phytophagous insect, chemical and odour cues in host selection in phytophagous insect (DBM or gram pod borer), colour discrimination in honey bee or butterfly model, learning and memory in bees, role of self-organization in resource tracking by honeybees. Evaluation of different types of traps against fruit flies with respect to signals; Use of honey bees/*Helicoverpa armigera* to understand behavioural polymorphism with respect to learning and response to pheromone mixtures, respectively.

ENT 606 RECENT TRENDS IN BIOLOGICAL CONTROL 1+1

Objective

To appraise the students with advanced techniques in handling of different bioagents, modern methods of biological control and scope in cropping system-based pest management in agro-ecosystems.

Theory

UNIT I

Scope of classical biological control and augmentative biocontrol; introduction and handling of natural enemies; nutrition of entomophagous insects and their hosts, dynamics of biocontrol agents *vis-à-vis* target pest populations.

UNIT II

Mass culturing techniques, insectary facilities and equipments, basic standards of insectary, viable mass-production unit, designs, precautions, good insectary practices.

UNIT III

Colonization, techniques of release of natural enemies, recovery evaluation, conservation and augmentation of natural enemies, survivorship analysis and ecological manipulations, large-scale production of biocontrol agents, bankable project preparation.

UNIT IV

Scope of genetically engineered microbes and parasitoids in biological control, genetics of ideal traits in biocontrol agents for introgressing and for progeny selections, breeding techniques of biocontrol agents.

Practical

Mass rearing and release of some commonly occurring indigenous natural enemies; assessment of role of natural enemies in reducing pest populations; testing side effects of pesticides on natural enemies; effect of semiochemicals on natural enemies, breeding of various biocontrol agents, performance of efficiency analyses on target pests; project document preparation for establishing a viable mass-production unit /insectary.

ENT 607 ADVANCED INSECTICIDE TOXICOLOGY 2+1

Objective

To acquaint the students with the latest advancements in the field of insecticide toxicology, biochemical and physiological target sites of insecticides, and pesticide resistance mechanisms in insects.

Theory

UNIT I

Penetration and distribution of insecticides in insect systems; insecticide selectivity; factors affecting toxicity of insecticides.

UNIT II

Biochemical and physiological target sites of insecticides in insects; developments in biorationals, biopesticides and newer molecules; their modes of action and structural - activity relationships; advances in metabolism of insecticides.

UNIT III

Joint action of insecticides; activation, synergism and potentiation.

UNIT IV

Problems associated with pesticide use in agriculture: pesticide resistanceresistance mechanisms and resistant management strategies; pest resurgence and outbreaks; persistence and pollution; health hazards and other side effects.

UNIT V

Estimation of insecticidal residues- sampling, extraction, clean-up and estimation by various methods; maximum residue limits (MRLs) and their fixation; insecticide laws and standards, and good agricultural practices.

Practical

Sampling, extraction, clean-up and estimation of insecticide residues by various methods; calculations and interpretation of data; biochemical and biological techniques for detection of insecticide resistance in insects.

ENT 608 ADVANCED HOST PLANT RESISTANCE 1+1

Objective

To familiarize the students with recent advances in resistance of plants to insects and acquaint with the techniques for assessment and evaluation of resistance in crop plants.

Theory

UNIT I

Importance of plant resistance, historical perspective, desirable morphological, anatomical and biochemical adaptations of resistance; assembly of plant species - gene pool; insect sources - behaviour in relation to host plant factors.

UNIT II

Physical and chemical environment conferring resistance in plants, role of trypsin inhibitors and protease inhibitors in plant resistance; biochemistry of induced resistance - signal transduction pathways, methyl jasmonate pathways, polyphenol oxidase pathways, salicylic acid pathways; effects of induced resistance; exogenous application of elicitors.

UNIT III

Biotechnological approaches in host plant resistance- genetic manipulation of secondary plant substances; incorporation of resistant gene in crop varieties; marker-aided selection in resistance breeding.

UNIT IV

Estimation of plant resistance based on plant damage- screening and damage rating; evaluation based on insect responses; techniques and determination of categories of plant resistance; breakdown of resistance in crop varieties.

Practical

Understanding mechanisms of resistance for orientation, feeding, oviposition *etc.*, allelochemical bases of insect resistance; macroculturing of test insects like aphids, leaf/plant hoppers, mites and stored grain pests; field screening- microplot techniques, infester row technique, spreader row technique and plant nurseries; determination of antixenosis index, antibiosis index, tolerance index, plant resistance index.

ENT 609 ADVANCED ACAROLOGY 1+1

Objective

To acquire a good working knowledge of identification of economically important groups of mites up to the species level, a detailed understanding of the newer acaricide molecules and utilization of predators.

Theory

UNIT I

Comparative morphology of Acari, phylogeny of higher categories in mites, knowledge of commonly occurring orders and families of Acari in India. Diagnostic characteristics of commonly occurring species from families Tetranychidae, Tenuipalpidae, Eriophyidae, Tarsonemidae, Phytoseiidae, Bdellidae, Cunaxidae, Stigmaeidae, Pymotidae, Cheyletidae, Acaridae, Pyroglyphidae, Orthogalumnidae, Argasidae, Ixodidae, Sarcoptidae. Soil mites in India.

UNIT II

Management of economical important species of mites in agriculture, veterinary and public health; storage acarology.

UNIT III

Mites as vectors of plant pathogens; mode of action, structure-activity relationships of different groups of acaricides; problem of pesticide resistance in mites, resurgence of mites.

UNIT IV

Predatory mites, their mass production and utilization in managing mite pests, acaropathogenic fungi- identification, isolation and utilization.

Practical

Identification of commonly occurring mites up to species, preparation of keys for identification. Collection of specific groups of mites and preparing their identification keys. Rearing phytoseiid mites and studying their role in suppression of spider mites. Management of mite pests of crops usingacaricides, phytoseiid predators, fungal pathogens *etc.*

ENT 610 AGRICULTURAL ORNITHOLOGY 1+1

Objective

To expose the students to the prevalence of birds in agricultural fields, their habitat associations and the beneficial and harmful role played by birds in crop fields and management of pest situations.

Theory

UNIT I

Status of agricultural ornithology in India, groups of birds associated with agro-ecosystems. Habitat associations of birds in both wet and dry agricultural systems. Association of birds with different cultivation practices and crop stages, their seasonality and succession. Pestiferous and beneficial birds associated with different crops, their general biology and ecology. Food and feeding habits of birds in crop fields.

UNIT II

Nature of damage caused by birds in different crops. Foraging ecology of birds in agricultural fields. Birds affecting stored grains in houses and godowns. Beneficial role of birds in agriculture and attracting them to field. Use of bird excreta in agriculture. Management of bird pests in agriculture: physical, cultural, ecological and chemical methods.

Practical

Study of different groups of birds associated with agriculture, their morphology and field identification. Field visits to different agroecosystems. Study of bird associations with different crop stages. Study of nesting and roosting habits of birds in agricultural habitats. Study of the feeding habits, nature and types of damage caused by birds in selected crops. Visits to godowns. Analysis and study of the use of bird excreta in agriculture at a bird sanctuary. Field visits to paddy growing command areas to study birds in crop fields. Assignments on assessing bird damage, estimation of populations etc.

ENT 611 MOLECULAR APPROACHES IN ENTOMOLOGICAL RESEARCH 1+1

Objective

To familiarize the students with DNA recombitant techonology, marker genes, transgenic plants, biotechnology in sericulture and apiculture.

Theory

UNIT I

Introduction to molecular biology; techniques used in molecular biology.

UNIT II

DNA and RNA analysis in insects- transcription and translocation mechanisms. DNA recombinant technology, identification of genes/nucleotide sequences for characters of interest. Genetic improvement of natural enemies. Cell lines, genetic engineering in baculoviruses, *Bt* and entomopathogenic fungi.

UNIT III

Genes of interest in entomological research- marker genes for sex identification, neuropeptides, JH esterase, St toxins and venoms, chitinase, CPTI; lectins and proteases. Peptides and neuropeptides, JH esterase, St toxins and venoms, chitinase, Bt toxin, CPTI; trypsin inhibitors, lectins and proteases, neuropeptides. Transgenic plants for pest resistance and diseases.

UNIT IV

Insect gene transformation; biotechnology in relation to silkworms and honey bees; introduction of lectin genes for pest suppression; DNA finger printing for taxonomy and phylogeny. Genetic improvement of inebriate tolerance of natural enemies.

UNIT V

DNA-based diagnostics; insect immune systems in comparison to vertebrates; molecular basis of metamorphosis; Sf transgenic technology and implications; molecular biology of baculoviruses; insecticide resistance. Resistance management strategies in transgenic crops.

Practical

Isolation of DNA/RNA; purity determinations; base pair estimation; agarose gel electrophoresis; restriction mapping of DNA; demonstration of PCR, RFLP and RAPD techniques.

ENT 612 ADVANCED INTEGRATED PEST MANAGEMENT 2+0

Objective

To acquaint the students with recent concepts of integrated pest management. Surviellance and data base management. Successful national and international case histories of integrated pest management, non conventional tools in pest management.

Theory

UNIT I

Principles of sampling and surveillance; database management and computer programming, simulation techniques and system analysis and modeling.

UNIT II

Case histories of national and international programmes, their implementation, adoption and criticisms, global trade and risk of invasive pests.

UNIT III

Genetic engineering and new technologies- their progress and limitations in IPM programmes, deployment of benevolent alien genes for pest management- case studies; scope and limitations of bio-intensive and ecological based IPM programmes. Application of IPM to farmers' realtime situations.

UNIT IV

Challenges, needs and future outlook; dynamism of IPM under changing cropping systems and climate; insect pest management under protected cultivation; strategies for pesticide resistance management.

ENT 613/ PL PATH 606 PLANT BIOSECURITY AND BIOSAFETY 2+0

Objective

To facilitate deeper understanding on plant biosecurity and biosafety issues in agriculture.

Theory

UNIT I

History of biosecurity, Concept of biosecurity, Components of biosecurity, Quarantine, Invasive Alien Species, Biowarfare, Emerging/resurgence of pests and diseases.

UNIT II

National Regulatory Mechanism and International Agreements/ Conventions viz., Agreement on Application of Sanitary and Phytosanitary (SPS) Measures/World Trade Organization (WTO), Convention on Biological Diversity (CBD), International Standards for Phytosanitary Measures, pest risk analysis, risk assessment models, pest information system, early warning and forecasting system, use of Global Positioning System (GPS) and Geographic Information System (GIS) for plant biosecurity, pest/disease and epidemic management, strategies for combating risks and costs associated with agroterrorism event, mitigation planning, integrated approach for biosecurity.

UNIT III

Biosafety, policies and regulatory mechanism, Cartagena Protocol on Biosafety and its implications, Issues related to release of genetically modified crops.

GENETICES AND PLANT BREEDING

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
GP 501*	PRINCIPLES OF GENETICS	3 (2 + 1)
GP 502*	PRINCIPLES OF CYTOGENETICS	3 (2 + 1)
GP 503*	PRINCIPLES OF PLANT BREEDING	3 (2 + 1)
GP 504*	PRINCIPLES OF QUANTITATIVE GENETICS	3 (2 + 1)
GP 505	MUTAGENESIS AND MUTATION BREEDING	3 (2 + 1)
GP 506	POPULATION GENETICS	2 (1 + 1)

GP 507*	HETEROSIS BREEDING	2 (1 + 1)
GP 508*	CELL BIOLOGY AND MOLECULAR GENETICS	3 (2 + 1)
GP 509*	BIOTECHNOLOGY FOR CROP IMPROVEMENT	3 (2 + 1)
GP 510	BREEDING FOR BIOTIC AND ABIOTIC STRESS RESISTANCE	3 (2 + 1)
GP 511	BREEDING CEREALS, FORAGES AND SUGARCANE	3 (2 + 1)
GP 512	BREEDING LEGUMES, OILSEEDS AND FIBRE CROPS	3 (2 + 1)
GP 513	BREEDING FOR QUALITY TRAITS	2 (1 + 1)
GP 514	GENE REGULATION AND EXPRESSION	2 (2 + 0)
GP 515	MAINTENANCE BREEDING, CONCEPTS OF VARIETY RELEASE AND SEED PRODUCTION	2 (1 + 1)
GP 516	GERMPLASM COLLECTION, EXCHANGE AND QUARANTINE	3 (2 + 1)
GP 517	DATABASE MANAGEMENT, EVALUATION AND UTILIZATION OF PGR	3 (2 + 1)
GP 591	MASTER'S SEMINAR	1(1+0)
GP 599	MASTER'S RESEARCH	20
GP 601	PLANT GENETICS RESOURCES AND PRE-BREEDING	2 (2 + 0)
GP 602	ADVANCED BIOMETRICAL AND QUANTITATIVE GENETICS	3 (2 + 1)
GP 603**	GENOMICS IN PLANT BREEDING	3 (2 + 1)
GP 604**	MOLECULAR AND CHROMOSOMAL MANIPULATIONS FOR CROP BREEDING	2 (2 + 0)
GP 605**	ADVANCED PLANT BREEDING SYSTEMS	2 (2 + 0)
GP 606	CROP-EVOLUTION	3 (2 + 1)
GP 607	BREEDING DESIGNER CROPS	2 (1 + 1)
GP 608	ADVANCES IN BREEDING OF MAJOR FILED CROPS	3 (3 + 0)
GP 609	MICROBIAL GENETICS	3 (2 + 1)
GP 610**	*IN SITU* AND *EX SITU* CONSERVATION OF GERMPLASM	3 (2 + 1)
GP 691	DOCTORAL SEMINAR I	1(1+0)
GP 692	DOCTORAL SEMINAR II	1(1+0)
GP 699	DOCTORAL RESEARCH	45

Note : *Compulsory for Master's Programme; ** Compulsory for Ph.D. Programme

GENETICS AND PLANT BREEDING

Course Contents

GP 501 PRINCIPLES OF GENETICS 2+1

Objective

This course is aimed at understanding the basic concepts of genetics, helping students to develop their analytical, quantitative and problem solving skills from classical to molecular genetics.

Theory

UNIT I

Beginning of genetics; Cell structure and cell division; Early concepts of inheritance, Mendel's laws; Discussion on Mendel's paper, Chromosomal theory of inheritance.

UNIT II

Multiple alleles,Gene interactions. Sex determination, differentiation and sex-linkage, Sex-influenced and sex-limited traits; Linkage-detection, estimation; Recombination and genetic mapping in eukaryotes, Somatic cell genetics, Extra chromosomal inheritance.

UNIT III

Population - Mendelian population - Random mating population - Frequencies of genes and genotypes-Causes of change: Hardy-Weinberg equilibrium.

UNIT IV

Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Organization of DNA in chromosomes, Genetic code; Protein biosynthesis.

UNIT V

Genetic fine structure analysis, Allelic complementation, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Gene families and clusters.

UNIT VI

Regulation of gene activity in prokaryotes; Molecular mechanisms of mutation, repair and suppression; Bacterial plasmids, insertion (IS) and transposable (Tn) elements; Molecular chaperones and gene expression. Gene regulation in eukaryotes, RNA editing.

UNIT VII

Methods of studying polymorphism at biochemical and DNA level; Transgenic bacteria and bioethics; Gene silencing; genetics of mitochondria and chloroplasts.

UNIT VIII

Concepts of Eugenics, Epigenetics, Genetic disorders and Behavioural genetics.

Practical

Laboratory exercises in probability and chi-square; Demonstration of genetic principles using laboratory organisms; Chromosome mapping using three point test cross; Tetrad analysis; Induction and detection of mutations through genetic tests; DNA extraction and PCR amplification Electrophoresis - basic principles and running of amplified DNA -Extraction of proteins and isozymes - use of *Agrobacterium* mediatedmethod and Biolistic gun; practical demonstrations - Detection of transgenes in the exposed plant material; visit to transgenic glasshouse and learning the practical considerations.

GP 502 PRINCIPLES OF CYTOGENETICS 2+1

Objective

To provide insight into structure and functions of chromosomes, chromosome mapping, polyploidy and cytogenetic aspects of crop evolution.

Theory

UNIT I

Architecture of chromosome in prokaryotes and eukaryotes; Chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere; Artificial chromosome construction and its uses; Special types of chromosomes.

UNIT II

Cell Cycle and cell division - mitosis and meiosis; Differences and significance - Synapsis, structure and function of synaptonemal complex and spindle apparatus, anaphase movement of chromosomes and crossing over-mechanisms and theories of crossing over- recombination models, cytological basis, - Variation in chromosome structure:

Evolutionary significance - Introduction to techniques for karyotyping; Chromosome banding - *in situ* hybridization and various applications.

UNIT III

Structural and Numerical variations of chromosomes and their implications - Symbols and terminologies for chromosome numbers - euploidy - haploids, diploids and polyploids ; Utilization of aneuploids in gene location - Variation in chromosome behaviour - somatic segregation and chimeras - endomitosis and somatic reduction ; Evolutionary significance of chromosomal aberrations - balanced lethals and chromosome complexes.

UNIT IV

Inter-varietal chromosome substitutions; Polyploidy and role of polyploids in crop breeding; Evolutionary advantages of autopolyploids vs allopolyploids -- Role of aneuploids in basic and applied aspects of crop breeding, their maintenance and utilization in gene mapping and gene blocks transfer - Alien addition and substitution lines - creation and utilization; Apomixis - Classification and role in plant Breeding..

UNIT V

Reversion of autopolyploids to diploids; Genome mapping in polyploids - Interspecific hybridization and allopolyploids; Synthesis of new crops (wheat, triticale and brassica) - Hybrids between species with same chromosome number, alien translocations - Hybrids between species with different chromosome number; Gene transfer using amphidiploids - Bridge species.

UNIT VI

Fertilization barriers in crop plants at pre-and postfertilization levels- *In vitro* techniques to overcome the fertilization barriers in crops; Chromosome manipulations in wide hybridization ; Production and use of haploids, dihaploids and doubled haploids in genetics and breeding.

Practical

Learning the cytogenetics laboratory, various chemicals to be used for fixation, dehydration, embedding, staining, cleaning etc. - Microscopy: various types of microscopes, - Observing sections of specimen using Electron microscope; Preparing specimen for observation - Fixative preparation and fixing specimen for light microscopy studies in cereals - Studies on the course of mitosis in wheat, pearl millet - Studies on the course of mitosis in onion - Studies on the course of meiosis in cereals, millets and pulses - Studies on the course of meiosis in oilseeds and forage crops - Using micrometers and studying the pollen grain size in various crops -Various methods of staining and preparation of temporary and permanent slides - Pollen germination *in vivo* and *in vitro;* Microtomy and steps in microtomy; Agents employed for the induction of various ploidy levels; Solution preparation and application at seed, seedling level - Identification of polyploids in different crops - Induction and identification of haploids; Anther culture and Ovule culture - Morphological observations on synthesized autopolyploids - Observations on C-mitosis, learning on the dynamics of spindle fibre assembly - Morphological observations on alloploy ploids - Morphological observations on aneuploids - Cytogenetic analysis of interspecific and intergeneric crosses - Maintenance of Cytogenetic stocks and their importance in crop breeding -Various ploidy levels due to somaclonal variation ;
Fluorescent *in situ* hybridization (FISH)- Genome *in situ* hybridization GISH.

GP 503 PRINCIPLES OF PLANT BREEDING 2+1

Objective

To impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement.

Theory

UNIT I

History of Plant Breeding (Pre and post-Mendelian era); Objectives of plant breeding, characteristics improved by plant breeding; Patterns of Evolution in Crop Plants- Centres of Origin-biodiversity and its significance.

UNIT II

Genetic basis of breeding self- and cross - pollinated crops including mating systems and response to selection - nature of variability, components of variation; Heritability and genetic advance, genotype environment interaction; General and specific combining ability; Types of gene actions and implications in plant breeding; Plant introduction and role of plant genetic resources in plant breeding.

UNIT III

Self-incompatibility and male sterility in crop plants and their commercial exploitation; concept of plant Ideotype and its role in crop improvement.

UNIT III

Pure line theory, pure line selection and mass selection methods; Line breeding, pedigree, bulk, backcross, single seed descent and multiline method; Population breeding in self-pollinated crops (diallel selective mating approach).

UNIT IV

Breeding methods in cross pollinated crops; Population breeding-mass selection and ear-to-row methods; S1 and S2 progeny testing, progeny selection schemes, recurrent selection schemes for intra and interpopulation improvement and development of synthetics and composites; Hybrid breeding - genetical and physiological basis of heterosis and inbreeding, production of inbreds, breeding approaches for improvement of inbreds, predicting hybrid performance; seed production of hybrid and their parent varieties/inbreds.

UNIT V

Breeding methods in asexually/clonally propagated crops, clonal selection apomixes, clonal selection.

UNIT VI

Special breeding techniques- Mutation breeding; Breeding for abiotic and biotic stresses.

UNIT VII

Cultivar development- testing, release and notification, maintenance breeding, Participatory Plant Breeding, Plant breeders' rights and regulations for plant variety protection and farmers rights.

Practical

Floral biology in self and cross pollinated species, selfing and crossing techniques. Selection methods in segregating populations and evaluation of breeding material; Analysis of variance (ANOVA); Estimation of heritability and genetic advance; Maintenance of experimental records;

GP 504 PRINCIPLES OF QUANTITATIVE GENETICS 2+1

Objective

To impart theoretical knowledge and computation skills regarding component of variation and variances, scales, mating designs and gene effects.

Theory

UNIT I

Mendelian traits *vs* polygenic traits - nature of quantitative traits and its inheritance - Multiple factor hypothesis - analysis of continuous variation; Variations associated with polygenic traits - phenotypic, genotypic and environmental - non-allelic interactions; Nature of gene action - additive, dominance, epistatic and linkage effects.

UNIT II

Principles of Anaylis of Variance (ANOVA) - Expected variance components, random and fixed models; MANOVA, biplot analysis; Comparison of means and variances for significance.

UNIT III

Designs for plant breeding experiments - principles and applications; Genetic diversity analysis - metroglyph, cluster and D2 analyses - Association analysis - phenotypic and genotypic correlations; Path analysis and Parent - progeny

regression analysis; Discriminant function and principal component analyses; Selection indices - selection of parents; Simultaneous selection models- concepts of selection - heritability and genetic advance.

UNIT IV

Generation mean analysis; Mating designs- Diallel, partial diallel, line x tester analysis, NCDs and TTC; Concepts of combining ability and gene action; Analysis of genotype x environment interaction - adaptability and stability; Models for GxE analysis and stability parameters; AMMI analysis - principles and interpretation.

UNIT V

QTL mapping; Strategies for QTL mapping - desired populations for QTL mapping - statistical methods in QTL mapping - QTL mapping in Genetic analysis.

Practical

Problems on multiple factors inheritance - Partitioning of variance - Estimation of heritability and genetic advance - Covariance analysis - Metroglyph analysis - D2 analysis - Grouping of clusters and interpretation - Cluster analysis - Construction of cluster diagrams and dendrograms - interpretation - Correlation analysis - Path analysis - Parent-progeny regression analysis - Diallel analysis: Griffing's methods I and II - Diallel analysis: Hayman's graphical approach - Diallel analysis: interpretation of results - NCD and their interpretations - Line x tester analysis and interpretation of results - Estimation of heterosis : standard, mid-parental and better-parental heterosis - Estimation of inbreeding depression - Generation mean analysis: Analytical part and Interpretation - Estimation of different types of gene actions.Partitioning of phenotypic variance and co-variance into components due to genotypes, environment and genotype x environment interactions - Construction of saturated linkage maps and QTL mapping - Strategies for QTL mapping; statistical methods in QTL mapping; Phenotype and Marker linkage studies - Working out efficiency of selection methods in different populations and interpretation, Biparental mating, Triallel analysis, Quadriallel analysis and Triple Test Cross (TTC) - use of softwares in analysis and result interpretation, Advanced biometrical models for combining ability analysis, Models in stability analysis Additive Main Effect and Multiplicative Interaction (AMMI) model - Principal Component Analysis model - Additive and multiplicative model - Shifted multiplicative model - Analysis and selection of genotypes - Methods

GP 505 MUTAGENESIS AND MUTATION BREEDING 1+1

Objective

To impart the knowledge about general principles of radiation and various tests/methods for detection of radiation effects on the living cells, genetic risks involved and perspectives of advances made.

Theory

UNIT I

Mutation and its history - Nature and classification of mutations: spontaneous and induced mutations, micro and macro mutations.

UNIT II

Mutagenic agents: physical — Radiation types and sources: Ionising and non-ionizing radiations *viz*., X rays, γ rays, and β particles, protons, neutrons and UV rays - Radiobiology: mechanism of action of various radiations (, photoelectric absorption, Compton scattering and pair production) and their biological effects -RBE and LET relationships.

UNIT III

Effect of mutations on DNA - Repair mechanisms operating at DNA, chromosome, cell and organism level to counteract the mutation effects - Dosimetry - Objects and methods of treatment - Factors influencing mutation: dose rate, acute *vs* chronic irradiation, recurrent irradiation, enhancement of thermal neutron effects - Radiation sensitivity and modifying factors: External and internal sources- Oxygen, water content, temperature and nuclear volume.

UNIT IV

Chemical mutagens- Classification - Base analogues, antibiotics, alkylating agents, acridine dyes and other mutagens: their properties and mode of action - Dose determination and factors influencing chemical mutagenesis - Treatment methods using physical and chemical mutagens - Combination treatments; Comparative evaluation of physical and chemical mutagens.

UNIT V

Observing mutagen effects in M1 generation: plant injury, lethality, sterility, chimeras *etc*., - Observing mutagen effects in M2 generation - Estimation of mutagenic efficiency and effectiveness - spectrum of chlorophyll and viable mutations -- Mutations in traits with continuous variation.

UNIT VI

Factors influencing the mutant spectrum: genotype, type of mutagen and dose, pleiotropy and linkage *etc*. - Individual plant based mutation analysis and working out effectiveness and efficiency in M3 generation - Comparative evaluation of physical and chemical mutagens for creation of variability in the same species - Case studies.

UNIT VII

Use of mutagens in creating oligogenic and polygenic variations - Case studies - *In vitro* mutagenesis - callus and pollen irradiation; Handling of segregating genrations and selection procedures; Validation of mutants; Mutation breeding for various traits (disease resistance, insect resistance, quality improvement,etc) in different crops- Procedures for micromutations breeding/polygenic mutations- Achievements of mutation breeding- varieties released across the world- Problems associated with mutation breeding.

UNIT VIII

Use of mutagens in genomics, allele mining, TILLING.

Practical

Learning the precautions on handling of mutagens; Dosimetry - Studies of different mutagenic agents: Physical mutagens - Studies of different mutagenic agents: Chemical mutagens - Learning on Radioactivity - Production of source and isotopes at BRIT, Trombay - Learning about gamma chamber; Radiation hazards - Monitoring - safety regulations and safe transportation of radioisotopes - Visit to radio isotope laboratory ; learning on safe disposal of radioisotopes - Hazards due to chemical mutagens - Treating the plant propagules at different doses of physical and chemical mutagens - Learning combined mutagenic treatments; Raising the crop for observation - Mutagenic effectiveness and efficiency; Calculating the same from earlier literature - Study of M1 generation - Parameters to be observed; Study of M2 generation - Parameters to be observed; Mutation breeding in cereals and pulses - Achievements made and an analysis - Mutation breeding in oilseeds and cotton - Achievements and opportunities - Mutation breeding in forage crops and vegetatively propagated crops; Procedure for detection of mutations for polygenic traits in M2 and M3 generations.

GP 506 POPULATION GENETICS 2+1

Objective

To impart knowledge on structure, properties and their breeding values of different population.

Theory

UNIT I

Population - Properties of population - Mendelian population - Genetic constitution of a population through time, space, age structure etc. Mating systems - Random mating population - Frequencies of genes and genotypes-Causes of change: population size, differences in fertility and viability, migration and mutation.

UNIT II

Hardy-Weinberg equilibrium - Hardy-Weinberg law - Proof - Applications of the Hardy-Weinberg law - Test of Hardy-Weinberg equilibrium - Mating frequencies - Non-dominance - Codominance - Snyder's ratio, importance and its effect over random mating in succeeding generations.

UNIT III

Multiple alleles - More than one locus - Sex linked genes; Use of gene and genotypic frequencies evaluation in field population level; Interpretations - Changes of gene frequency - Migration - Mutation - Recurrent and nonrecurrent - Selection - Balance between selection and mutation - Selection favouring heterozygotes - Overdominance for fitness.

UNIT IV

Non random mating: selfing -inbreeding coefficient - panmictic index - sibmating - Assortative mating and disassortative mating - Pedigree populations and close inbreeding - Estimation of selection - Estimation of disequilibrium - Estimation of linkage - Correlation between relatives and estimation of F; Effect of inbreeding and sibbing in cross pollinated crops.

UNIT V

Gene substitution and average effects; Breeding value- Genetic drift; Genetic slippage, Co-adapted gene complexes; Homoeostasis- Adapative organization of gene pools, Polymorphism- Balanced and Non-balanced polymorphism, heterozygous advantage- Survival of recessive and deleterious alleles in populations.

Practical

Genetic exercise on probability; Estimation of gene frequencies; Exercises on factors affecting gene frequencies; Estimation of average affect of gene substitution and breeding value; Exercises on inbreeding and linkage disequilibrium- Cavalli's joint scaling test; Exercises of different mating designs; Estimation of different population parameters from experimental data; Measurement of genotype-environment interaction; Genetic divergence.

GP 507 HETEROSIS BREEDING 1+1

Objective

To provide understanding about mechanisms of heterosis and its exploitation for yield improvement through conventional and biotechnological approaches.

Theory

UNIT I

Historical aspect of heterosis - Nomenclature and definitions of heterosis - Heterosis in natural population and inbred population; Evolutionary aspects - Genetic consequences of selfing and crossing in self-and cross-pollinated and asexually propagated crops crops.

UNIT II

Pre Mendelian and Post-Mendelian ideas - Genetic theories of heterosis - Physiological, Biochemical and molecular factors underlining heterosis; theories and their estimation; - Evolutionary concepts of heterosis.

UNIT III

Prediction of heterosis from various crosses- Inbreeding depression, frequency of inbreeding and residual heterosis in F2 and segregating populations, importance of inbreeding in exploitation of heterosis - case studies. - Relationship between genetic distance and expression of heterosis - case studies; Divergence and Genetic Distance analyses- morphological and molecular genetic distance in predicting heterosis, Development of heterotic pools in germplasm/ genetic stocks and inbreds, their improvement for increasing heterosis.

UNIT IV

Types of male sterility and use in heterosis breeding; Maintenance, transfer and restoration of different types of male sterility; Use of selfincompatibility in development of hybrids; Hybrid seed production system: 3-line, 2-line and 1-line system; Development of inbreds and parental lines-A, B and R lines - functional male sterility; Commercial exploitation of heterosis- maintenance breeding of parental lines in hybrids.

UNIT V

Fixation of heterosis in self, cross and often cross pollinated crops, asexually/clonally propagated crops; Male sterile line creation and diversification in self pollinated, cross pollinated and asexually propagated crops; problems and prospects; Apomixis in fixing heterosis-concept of single line hybrid.

UNIT VI

Organellar heterosis and complementation - Creation of male sterility through genetic engineering and its exploitation in heterosis.

UNIT VII

Heterosis breeding in wheat, rice, cotton, maize, pearl millet, sorghum and oilseed crops.

Practical

Selection indices and selection differential - Calculations and interpretations - Male sterile line characterization in millets; Using morphological descriptors; Restorer line identification and diversification of male sterile sources - Male sterile line creation in dicots comprising oilseeds, pulses and cotton ; problems in creation of CGMS system; Ways of overcoming them - Male sterile line creation, diversification and restoration in forage crops; Understanding the difficulties in breeding apomicts; Estimation of heterotic parameters in self, cross and asexually propagated crops - Estimation from the various models for heterosis parameters -Hybrid seed production in field crops - an account on the released hybrids; their potential; Problems and ways of overcoming it; hybrid breeding at National and International level; Opportunities ahead.

GP 508 CELL BIOLOGY AND MOLECULAR GENETICS 2+1

Objective

To impart knowledge in theory and practice about cell structure, organelles and their functions, molecules like proteins and nucleic acids.

Theory

UNIT I

Ultrastructure of the cell; Differences between eukaryotic and prokaryotic cells, macromolecules; Structure and function of cell wall, nuclear membrane and plasma membrane; Cellular Organelles - nucleus, plastidschloro/ chromoplast, mitochondria endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes.

UNIT II

Bioenergetics; Ultrastructure and function of mitochondria and biological membranes; Chloroplast and other photosynthetic organelles; Interphase nucleus- Structure and chemical composition; Physiology of cell division.

UNIT III

Historical background of molecular genetics; Genetic material in organisms; Structure and properties of nucleic acid, DNA transcription and its regulation - Transcription factors and their role; Genetic code, regulation of protein synthesis in prokaryotes and eukaryotes - ribosomes, t-RNAs and translational factors.

UNIT IV

Transposable elements; Mechanisms of recombination in prokaryote; DNA organization in eukaryotic chromosomes - DNA content variation, types of DNA sequences - Unique and repetitive sequences; organelle genomes; Gene amplification and its significance; Proteomics and protein-protein interaction; Signal transduction; Genes in development; Cancer and cell aging.

UNIT V

Gene isolation, synthesis and cloning, genomic and cDNA libraries, PCRbased cloning, positional cloning; Nucleic acid hybridization and immunochemical detection; DNA sequencing; DNA restriction and modification, Anti-sense RNA and ribozymes; Micro-RNAs (miRNAs).

UNIT VI

Genomics and proteomics; Functional and pharmacogenomics; Metagenomics.

Practical

Morphological and Gram staining of natural bacteria; Cultivation of bacteria in synthetic medium; Determination of growth rate and doubling time of bacterial cells in culture; Demonstration of bacteriophage by plaque assay method; Determination of soluble protein content in a bacterial culture.Isolation, purification and raising clonal population of a bacterium; Biological assay of bacteriophage and determination of phage population in lysate;
Study of lytic cycle of bacteriophage by one step growth experiment; determination of latent period and burst size of phages per cell; Quantitative estimation of DNA, RNA and protein in an organism; Numericals: problems and assignments.

GP 509 BIOTECHNOLOGY FOR CROP IMPROVEMENT 2+1

Objective

To impart knowledge and practical skills to use biotechnological tools in crop improvement.

Theory

UNIT I

Biotechnology and its relevance in agriculture; Definitions, terminologies and scope in plant breeding.

UNIT II

Tissue culture- History, callus, suspension cultures, cloning; Regeneration; Somatic embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation.

UNIT III

Techniques of DNA isolation, quantification and analysis; Genotyping; Sequencing techniques; Vectors, vector preparation and cloning, Biochemical and Molecular markers: morphological, biochemical and DNA-based markers (RFLP, RAPD, AFLP, SSR,SNPs, ESTs etc.), mapping populations (F2s, back crosses, RILs, NILs and DH).

UNIT IV

Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Robotics; Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding.

UNIT V

Marker assisted selection and molecular breeding; Genomics and genoinformatics for crop improvement; Integrating functional genomics information on agronomically/economically important traits in plant breeding; Marker-assisted backcross breeding for rapid introgression, Generation of EDVs.

UNIT VI

Recombinant DNA technology, transgenes, method of transformation, selectable markers and clean transformation techniques, vector-mediated gene transfer, physical methods of gene transfer. Production of transgenic plants in various field crops: cotton, wheat, maize, rice, soybean, oilseeds, sugarcane etc. Commercial releases.

UNIT VII

Biotechnology applications in male sterility/hybrid breeding, molecular farming.

UNIT VIII

MOs and related issues (risk and regulations); GMO; International regulations, biosafety issues of GMOs; Regulatory procedures in major countries including India, ethical, legal and social issues; Intellectual property rights

UNIT IX

Bioinformatics & Bioinformatics tools.

UNIT X

Nanotechnology and its applications in crop improvement programmes.

Practical

Requirements for plant tissue culture laboratory-Techniques in plant tissue culture - Media components and media preparation -Aseptic manipulation of various explants ; observations on the contaminants occurring in media - interpretations - Inoculation of explants; Callus induction and plant regeneration - Plant regeneration; Standardizing the protocols for regeneration; Hardening of regenerated plants; Establishing a greenhouse and hardening procedures - Visit to commercial micropropagation unit. Transformation using *Agrobacterium* strains, GUS assay in transformed cells / tissues. DNA isolation, DNA purity and quantification tests, gel electrophoresis of proteins and isozymes, PCR-based DNA markers, gel scoring and data analysis for tagging and phylogenetic relationship, construction of genetic linkage maps using computer software.

GP 510 BREEDING FOR BIOTIC AND ABIOTIC STRESS RESISTANCE 2+1

Objective

To apprise about various abiotic and biotic stresses influencing crop yield, mechanisms and genetics of resistance and methods to breed stress resistant varieties.

Theory

UNIT I

Importance of plant breeding with special reference to biotic and abiotic stress resistance; Classification of biotic stresses - major pests and diseases of economically important crops - Concepts in insect and pathogen resistance; Host defence responses to pathogen invasions- Biochemical and molecular mechanisms; Acquired and induced immunity and systemic acquired resistance (SAR); Host-pathogen interaction, gene-for-gene hypothesis, molecular evidence for its operation and exceptions; Concept of signal transduction and other host-defense mechanisms against viruses and bacteria.

UNIT II

Types and genetic mechanisms of resistance to biotic stresses -Horizontal and vertical resistance in crop plants. Quantitative resistance/Adult plant resistance and Slow rusting resistance - Classical and molecular breeding methods - Measuring plant resistance using plant fitness; Behavioural, physiological and insect gain studies.

UNIT III

Phenotypic screening methods for major pests and diseases; Recording of observations; Correlating the observations using marker data - Gene pyramiding methods and their implications.

UNIT IV

Classification of abiotic stresses - Stress inducing factors -moisture stress/drought and water logging & submergence; Acidity, salinity/alkalinity/sodicity; High/low temperature, wind, etc. Stress due to soil factors and mineral toxicity; Physiological and Phenological responses; Emphasis of abiotic stresses in developing breeding methodologies.

UNIT V

Genetics of abiotic stress resistance; Genes and genomics in breeding cultivars suitable to low water regimes and water logging & submergence, high and low/freezing temperatures; Utilizing MAS procedures for identifying resistant types in important crops like rice, sorghum, wheat, cotton etc; Breeding for resistance to stresses caused by toxicity, deficiency and pollutants/contaminants in soil, water and environment.

UNIT VI

Exploitation of wild relatives as a source of resistance to biotic and abiotic factors in major field crops - Transgenics in management of biotic and abiotic stresses, use of toxins, protease inhibitors, lectins, chitnases and Bt for diseases and insect pest management- Achievements.

Practical

Phenotypic screening techniques for sucking pests and chewing pests -Traits to be observed at plant and insect level - Phenotypic screening techniques for nematodes and borers; Ways of combating them; Breeding strategies - Weeds - ecological, environmental impacts on the crops; Breeding for herbicide resistance - Evaluating the available populations like RIL, NIL etc. for pest resistance; Use of standard MAS procedures - Phenotypic screening methods for diseases caused by fungi and bacteria; Symptoms and data recording; use of MAS procedures - Screening forage crops for resistance to sewage water and tannery effluents; Quality parameters evaluation - Screening crops for drought and flood resistance; factors to be considered and breeding strategies - Screening varieties of major crops for acidity and alkalinity- their effects and breeding strategies; Understanding the climatological parameters and predisposal of biotic and abiotic stress factors- ways of combating them.

GP 511 BREEDING CEREALS, FORAGES AND SUGARCANE 2+1

Objective

To provide insight into recent advances in improvement of cereals and forage crops and sugarcane using conventional and modern biotechnological approaches.

Theory

UNIT I

Rice: Evolution and distribution of species and forms - wild relatives and germplasm; Genetics - cytogenetics and genome relationship - Breeding objectives- yield, quality characters, biotic and abiotic stress resistance *etc*.- Hybrid rice breeding- potential and outcome - Aerobic rice, its implications and drought resistance breeding.

UNIT II

Wheat: Evolution and distribution of species and forms - wild relatives and germplasm; cytogenetics and genome relationship; Breeding objectivesyield, quality characters, biotic and abiotic stress resistance, exploitation of heterosis etc; Sorghum: Evolution and distribution of species and forms - wild relatives and germplasm - cytogenetics and genome relationship - Breeding objectives- yield, quality characters, biotic and abiotic stress resistance etc; Pearl millet: Evolution and distribution of species and forms - wild relatives and germplasm; Cytogenetics and genome relationship; Breeding objectives- yield, quality characters, biotic and abiotic stress resistance etc.

UNIT III

Maize: Evolution and distribution of species and forms - wild relatives and germplasm; Cytogenetics and genome relationship; Breeding objectives: yield, quality characters, biotic and abiotic stress resistance etc - QPM and Bt maize - strategies and implications - Heterosis breeding attempts taken in Sorghum, Pearl Millet and Maize; Minor millets: Evolution and distribution of species and forms - wild relatives and germplasm; Cytogenetics and genome relationship - Minor millets: breeding objectivesyield, quality characters, biotic and abiotic stress resistance etc.

UNIT IV

Sugarcane: Evolution and distribution of species and forms - wild relatives and germplasm; Cytogenetics and genome relationship - Breeding objectives- yield, quality characters, biotic and abiotic stress resistance etc - Forage grasses: Evolution and distribution of species and forms - Wild relatives and germplasm; Cytogenetics and genome relationship; Breeding objectives- yield, quality characters and palatability studies; Biotic and abiotic stress resistance etc., synthetics, composites and apomixes.

UNIT V

Forage legumes: Evolution and distribution of species and forms; Wild relatives and germplasm; Cytogenetics and genome relationship; Breeding objectives- yield, quality characters, biotic and abiotic stress resistance etc - Tree fodders: Evolution and distribution of species and forms; Wild relatives and germplasm; Cytogenetics and genome relationship; Breeding objectives- yield, quality characters, biotic and abiotic stress resistance *etc*, palatability studies.

UNIT VI

Distinguishing features of popular released varieties in Rice and Sorghum - Wheat, Pearl millet, Maize and other millets - Sugarcane, forage grasses and legumes and their application to DUS testing - Maintenance of seed purity - Nucleus and Breeder Seed Production.

Practical

Floral biology - emasculation - pollination techniques ; Study of range of variation for yield and yield components - Study of segregating populations and their evaluation - Trait based screening for stress resistance in crops of importance- Use of descriptors for cataloguing Germplasm maintenance; learning on the Standard Evaluation System (SES) and descriptors; Use of softwares for database management and retrieval.Practical learning on the cultivation of fodder crop species on sewage water; analysing them for yield components and palatability; Laboratory analysis of forage crops for crude protein, digestibility percent and other quality attributes; Visit to animal feed producing factories, learning the practice of value addition; visiting the animal husbandry unit and learning the animal experiments related with palatability and digestibility of fodder.

GP 512 BREEDING LEGUMES, OILSEEDS AND FIBRE CROPS 2+1

Objective

To provide insight into recent advances in improvement of legumes, oilseeds and fibre crops using conventional and modern biotechnological approaches.

Theory

UNIT I

Pigeonpea: Evolution and distribution of species and forms; Wild relatives and germplasm; Genetics, cytogenetics and genome relationship; Morphological and molecular descriptors used for differentiating the accessions; Breeding objectives- yield, quality characters, biotic and abiotic stress *etc* - Hybrid technology; maintenance of male sterile, fertile and restorer lines, progress made at ICRISAT and other Institutes.

UNIT II

Chickpea: Evolution and distribution of species and forms - Wild relatives and germplasm - cytogenetics and genome relationship; Breeding objectives- yield, quality characters, biotic and abiotic stress etc; Protein quality improvement; Conventional and modern plant breeding approaches, progress made - Breeding for anti nutritional factors.

UNIT III

Other pulses: Greengram, blackgram, fieldpea, lentil,, lathyrus, cowpea, lablab, mothbean: Evolution, cytogenetics and genome relationship; Learning the descriptors; Breeding objectives- yield, quality characters, biotic and abiotic stress etc; Interspecific crosses attempted and its implications, reasons for failure, ways of overcoming them.

UNIT IV

Groundnut: Evolution and distribution of species and forms; Wild relatives and germplasm; Cytogenetics and genome relationship; Pod and kernel characters; Breeding objectives- yield, quality characters, biotic and abiotic stress etc.

UNIT V

Rapeseed and Mustard: Breeding objectives, utilization of wild relatives for yield and quality improvement, biotic and abiotic stress etc; Oil quality - characteristics in different oils; Evolution and distribution of species and forms; Wild relatives and germplasm; Genetics, cytogenetics and genome relationship.

UNIT VI

Soybean: Breeding objectives, utilization of wild relatives for yield and quality improvement, biotic and abiotic stress etc. - Oil quality - characteristics; Evolution and distribution of species and forms; Wild relatives and germplasm; Genetics, cytogenetics and genome relationship.

UNIT VII

Other oilseed crops: Sunflower, sesame, safflower, niger: Evolution and distribution of species and forms; Wild relatives and germplasm; Cytogenetics and genome relationship; breeding objectives- yield, quality characters, biotic and abiotic stress; Sunflower: Evolution and distribution of species and forms; Wild relatives and germplasm; Cytogenetics and genome relationship, hybrid sunflower, constraints and achievements.

UNIT VIII

Castor: Evolution and distribution of species and forms; Wild relatives and germplasm; Cytogenetics and genome relationship, breeding objectivesyield, quality characters, biotic and abiotic stress *etc* - Hybrid breeding in castor - opportunities, constraints and achievements.

UNIT IX

Cotton: Evolution of cotton; Breeding objectives- yield, quality characters, biotic and abiotic stress etc; Development and maintenance of male sterile lines - Hybrid development and seed production - Scenario of Bt cottons, evaluation procedures for Bt cotton. Jute: Evolution and distribution of species and forms; Wild relatives and germplasm; Cytogenetics and genome relationship; breeding objectives- yield, quality characters, biotic and abiotic stress etc; Mesta and minor fibre crops: Evolution and distribution of species and forms; Wild relatives and germplasm; Cytogenetics and genome relationship; breeding objectives- yield, quality characters, biotic and abiotic stress etc.

UNIT X

Distinguishing features of the released varieties in pulses, oilseeds and cotton; Maintenance of seed purity and seed production.

Practical

Use of descriptors for cataloguing - Floral biology - emasculation - pollination techniques; Study of range of variation for yield and yield components - Study of segregating populations in Redgram, Greengram, Blackgram and other pulse crops; Attempting crosses between blackgram and greengram. Use of descriptors for cataloguing - Floral biology, emasculation, pollination techniques of oilseed crops like Sesame, Groundnut, Sunflower and Castor, Cotton: Use of descriptors for cataloguing - Floral biology - Learning on the crosses between different species - Cotton: Study of range of variation for yield and yield components - Study of segregating populations - evaluation - Trait based screening for stress resistance - Cotton fibre quality evaluation - conventional and modern approaches; analysing the lint samples of different species, interspecific and interracial derivatives for fibre quality and interpretation - Development and maintenance of male sterile lines Evaluation of cotton cultures of different species for insect and disease resistance - Learning the mechanisms of resistance, quantifying the resistance using various parameters; Evaluating the germplasm of cotton for yield, quality and resistance parameters - learning the procedures on development of Bt cotton - Visit to Cotton Technology Laboratory and Spinning Mills - Learning on cotton yarn production, its quality evaluation and uses.

GP 513 BREEDING FOR QUALITY TRAITS 2+1

Objective

To provide insight into recent advances in improvement of quality traits in rice, millets, legumes, oilseeds and forage crops and for physiological efficiency using conventional and modern biotechnological approaches.

Theory

UNIT I

Developmental biochemistry and genetics of carbohydrates, proteins, fats, vitamins, aminoacids and anti-nutritional factors - Nutritional improvement - A human perspective - Breeding for grain quality parameters in rice and its analysis - Golden rice and aromatic rice - Breeding strategies, achievements and application in Indian context - Molecular basis of quality traits and their manipulation in rice - Post harvest manipulation for quality improvement.

UNIT II

Breeding for baking qualities in wheat; Characters to be considered and breeding strategies - Molecular and cytogenetic manipulation for quality improvement in wheat - Breeding for quality improvement in barley and oats.

UNIT III

Breeding for quality improvement in Sorghum and pearl millet; Quality protein maize - Concept and breeding strategies - Breeding for quality improvement in forage crops - Genetic resource management for sustaining nutritive quality in crops.

UNIT IV

Breeding for quality in pulses - Breeding for quality in groundnut, sesame, sunflower and minor oilseeds - Molecular basis of fat formation and manipulation to achieve more PUFA in oil crops; Genetic manipulation for quality improvement in cotton.

UNIT V

Genetic engineering protocols for quality improvement - Achievements made - Value addition in crops; Classification and importance - Nutritional genomics and Second generation transgenics.

Practical

Grain quality evaluation in rice; Correlating ageing and quality improvement in rice - Quality analysis in millets; Estimation of antinutritional factors like tannins in different varieties/hybrids; A comparison - Quality parameters evaluation in wheat; Quality parameters evaluation in pulses - Quality parameters evaluation in oilseeds; Value addition in crop plants ; Post harvest processing of major field crops; Quality improvement in crops through tissue culture techniques; Evaluating the available populations like RIL, NIL etc. for quality improvement using MAS procedures.

Singh RK, Singh UK & Khush GS. 2000. *Aromatic Rices*. Oxford & IBH.

GP 514 GENE REGULATION AND EXPRESSION 2+0

Objective

To provide insight into recent advances in the phenomenon of gene regulation and mechanisms by which plants and microbes express different traits and how these are modified during different stages.

Theory

UNIT I

Introduction: Gene regulation-purpose; Process and mechanisms in prokaryotes and eukaryotes; Levels of gene controls.

UNIT II

Coordinated genetic regulation-examples- Anthocyanin and gene families and maize; Genetic and molecular basis depending on tissue specificity.

UNIT III

Gene expression-Transposons in plant gene expression, cloning-transposon tagging; Light regulated gene expression-model systems in *Arabidopsis* and maize; Paramutations and imprinting of genes and genomes.

UNIT IV

Transgene expression and gene silencing mechanisms; Regulatory geneshorizontal and vertical homology; Transformation-regulatory genes as visible markers; Reporter systems to study gene expression; Combinatorial gene control.

UNIT V

Eukaryotic transcriptional control; Translational and post-translational regulation; Signal transduction; Stress-induced gene expression; Gene traps and enhancer traps.

GP 515 MAINTENANCE BREEDING AND CONCEPTS OF VARIETY RELEASE AND SEED PRODUCTION 1+1

Objective

To apprise the students about the variety deterioration and steps to maintain the purity of varieties & hybrids and principles of seed production in self & cross pollinated crops.

Theory

UNIT I

Variety Development and Maintenance; Definition- variety, cultivar,extant variety, essentially derived variety, independently derived variety, reference variety, farmers' variety, hybrid,and population; Variety testing, release and notification systems in India and abroad.

UNIT II

DUS testing- DUS Descriptors for major crops; Genetic purity concept and maintenance breeding.

UNIT III

Factors responsible for genetic deterioration of varieties - safeguards during seed production; Maintenance of varieties in self and cross-pollination crops- isolation distance; Principles of seed production; Methods of nucleus and breeder seed production.

UNIT IV

Generation system of seed multiplication -nucleus, breeders, foundation, certified, - Quality seed production technology of self and cross-pollinated crop varieties viz. cereals & millets (wheat, barley, paddy, pearlmillet, sorghum, maize and ragi etc.); Pulses (greengram, blackgram, cowpea, pigeonpea, chickpea, fieldpea, lentil); Oilseeds (groundnut, soybean, sesame, castor, sunflower, safflower, linseed, rapeseed and mustard); fibres (cotton, jute) and forages (guar, forage sorghum, oats, berseem, lucerne).; Seed certification procedures; Seed laws and plant variety protection regulations in India and international systems.

Practical

Identification of suitable areas/locations for seed production; Ear-to-row method and nucleus seed production - Main characteristics of released and notified varieties, hybrids and parental lines; Identification of important weeds/ objectionable weeds; Determination of isolation distance and planting ratios in different crops; Seed production techniques of varieties in different crops; Hybrid seed production technology of important crops.

GP 516 GERMPLASM COLLECTION, EXCHANGE AND QUARANTINE 2+1

Objective

To provide information about collection, germplasm exchange, quarantine, maintenance and use of plant genetic resources including genetically modified plants.

Theory

UNIT I

History and importance of germplasm exploration; Distribution and extent of prevalent genetic diversity; Phyto-geographical regions/ecological zones and associated diversity; Mapping eco-geographic distribution of diversity, threatened habitats, use of flora.

UNIT II

Concept of population and gene pool; Variations in population and their classification; Gene frequencies in populations, rare and common alleles; Gene pool sampling in self and cross pollinated and vegetatively propagated species; Non-selective, random and selective sampling strategies; Strategies and logistics of plant exploration and collection; Coarse and fine grid surveys; Practical problems in plant exploration; Use of *in vitro* methods in germplasm collection.

UNIT III

Ethnobotanical aspects of PGR; Crop botany, farming systems, collecting wild relatives of crop plants; Collection and preservation of specimens;Importance and use of herbaria and preparation of herbarium specimens.

UNIT IV

Post-exploration handling of germplasm collections; Present status and future strategies in collection of major crops of Indian origin such as rice, maize, sorghum, sesame, *Brassica*, okra, eggplant, cotton, mango etc; approaches for collection including indigenous knowledge.

UNIT V

History, principles, objectives and importance of plant introduction; Prerequisites, conventions, national and international legislations and policies on germplasm collection and exchange; Documentation and information management; Plant quarantine- introduction, history, principles, objectives and relevance; Regulations and plant quarantine set up in India; Pest risk analysis, pest and pathogen information database; Quarantine in relation to integrated pest management; Economic significance of seed-borne pests (insects, mites, non-insect pests, nematodes, fungi, bacteria, viruses, phytoplasma etc.).

UNIT VI

Detection and identification of pests including use of recent techniques like ELISA, PCR etc., Symptoms of pest damage, salvaging techniques for infested/infected germplasm, post-entry quarantine operation, seed treatment and other prophylactic treatments and facilities; Domestic quarantine; seed certification; International linkages in plant quarantine; weaknesses and future thrust.

UNIT VII

Genetically modified organisms (GMOs) or genetically engineered plants (GEPs), Concepts of biosafety, risk analysis and consequences of spread of GE crops on the environment; Treaties and multilateral agreements governing trans-boundary movement of GEPs or GMOs, Indian regulatory system for biosafety.

Practical

Plant exploration and collection; Techniques of coarse and fine grid surveys; Identification of wild relatives of crop plants- Example of collection, cataloguing and preservation of specimens; Sampling techniques of plant materials; Visiting ports, airports to study the quarantine regulations; Techniques for the detection of insects, mites, nematodes, bacteria, weeds, pathogens and viruses on seed and planting materials and salvaging; Use of visual, qualitative, quantitative, microscopic, molecular and plant growth related techniques(controlled green houses/growth chambers, etc); Detection of GMOs and GEPs; Study of post-entry quarantine operation, seed treatment and other prophylactic treatments.

GP 517 DATA BASE MANAGEMENT, EVALUATION AND UTILIZATION OF PGR 2+1

Objective

To train the students in germplasm data base management using modern tools and softwares.

Theory

UNIT I

Statistical techniques in management of germplasm; Core identification, estimation of sample size during plant explorations, impact of sampling on population structure, sequential sampling for viability estimation; Introduction of binomial, normal and negative cumulative normal, use of Probit scales, viability equations and numograms; Estimation of sample size for storage and viability testing.

UNIT II

Germplasm documentation; Basics of computer and operating systems; Database management system, use of statistical softwares, pictorial and graphical representation of data; introduction to communication network.

UNIT III

Germplasm management system- global scenario; Genetic variation in crop plants and management of germplasm collection, limitations in use of germplasm collections; necessity of germplasm evaluation; Predictive methods for identification of useful germplasm; Characterization of germplasm and evaluation procedures including specific traits; Gene markers and their use in PGR management.

UNIT IV

Management and utilization of germplasm collections; Concept of core collection, molecular markers and their use in characterization; Evaluation and utilization of genetic resources; Pre-breeding/ genetic enhancement, utilizing wild species for crop improvement; Harmonizing agrobiodiversity and agricultural development crop diversificationparticipatory plant breeding.

Practical

Basics of computer and operating systems; Identification of useful germplasm, evaluation of crop germplasm; Statistical techniques in management of germplasm- estimation of sample size for storage and viability testing; Evaluation procedure and experimental protocols (designs and their analysis), Assessment of genetic diversity; Techniques of Characterization of germplasm; Molecular markers and their use in characterization.

GP 601 PLANT GENETIC RESOURCES AND PRE-BREEDING 2+0

Objective

To provide information about collection, evaluation, documentation, maintenance and use of plant genetic resources for crop improvement.

Theory

UNIT I

Historical perspectives and need for PGR conservation; Importance of plant genetic resources; Taxonomical classification of cultivated plants; Gene pool: primary, secondary and tertiary; Centres of origin and global pattern of diversity; Basic genetic resources and transgenes.

UNIT II

Principles, strategies and practices of exploration, collection, characterization, evaluation and cataloging of PGR; Plant quarantine and phytosanitary certification; Germplasm introduction and exchange; Principles of *in vitro* and cryopreservation.

UNIT III

Germplasm conservation- *in situ, ex situ*, and on-farm; short, medium and long term conservation strategies for conservation of orthodox seed and vegetatively propagated crops; Registration of plant genetic resources.

UNIT IV

PGR data base management; Multivariate and clustering analysis, descriptors; National and international protocols for PGR management; PGR for food and agriculture (PGRFA); PGR access and benefit sharing; Role of CGIAR system in the germplasm exchange; PBR, Farmers rights and privileges; Seed Act, *sui generis* system; Geographical indicators, Intellectual property; Patents, copyrights, trademarks and trade secrets.

UNIT V

Journey from wild to domestication; Genetic enhancement- need for genetic enhancement; Genetic enhancement in pre Mendelian era and 21st century; Genetic enhancement and plant breeding; Reasons for failure in genetic enhancement; Sources of genes/ traits- novel genes for quality.

UNIT VI

Distant Hybridization: Inter-specific, inter-generic hybridization, scope and limitations, techniques to overcome the limitations; Gene transfer tools and techniques into cultivated species; Validation of transferred genes and their expression.

UNIT VII

Post-genomic tools for genetic enhancement of germplasm; Prebreeding through chromosome manipulation; Application of biotechnology for Genetic enhancement-Achievements.

UNIT VIII

Utilization of genetic resources, concept of core and mini-core collections, genetic enchancement/Prebreeding for crop improvement including hybrid development.

GP 602 ADVANCED BIOMETRICAL AND QUANTITATIVE GENETICS 2+1

Objective

To impart theoretical knowledge and computation methods for non allelic interactions, mating designs and component analysis and their significance in plant breeding.

Theory

UNIT I

Basic principles of Biometrical Genetics; Selection of parents; Advanced biometrical models for combining ability analysis; Simultaneous selection models; Use of Multiple regression analysis in selection of genotypes; Designs and Systems; Selection of stable genotypes.

UNIT II

Models in stability analysis - Pattern analysis - Additive Main Effect and Multiplicative Interaction (AMMI) analysis and other related models; Principal Component Analysis.

UNIT III

Additive and multiplicative model - Shifted multiplicative model; Analysis and selection of genotypes; Methods and steps to select the best model - Biplots and mapping genotypes.

UNIT IV

Genetic architecture of quantitative traits; Conventional analyses to detect gene actions - Partitioning of phenotypic/ genotypic variance - Construction of saturated linkage maps, concept of framework map development; QTL mapping- Strategies for QTL mapping - desired populations, statistical methods; Marker Assisted Selection (MAS) - Approaches to apply MAS in Plant breeding - selection based on markers - simultaneous selection based on marker and phenotype - Factors influencing MAS; Heritability of the trait, proportion of genetic variance, linkage disequilibrium between markers and traits and selection methods.

Practical

Working out efficiency of selection methods in different populations and interpretation - Biparental mating - use of softwares in analysis and result interpretation - Triallel analysis- use of softwares in analysis and result interpretation - Quadriallel analysis - use of softwares in analysis and result interpretation - Triple Test Cross (TTC) - use of softwares in analysis and result interpretation - Advanced biometrical models for combining ability analysis - Selection of stable genotypes using stability analysis; Models in stability analysis Additive Main Effect and Multiplicative Interaction (AMMI) model - Principal Component Analysis model - Additive and multiplicative model - Shifted multiplicative model - Analysis and selection of genotypes - Methods and steps to select the best model - Selection systems - Biplots and mapping genotypes. Construction of linkage maps and QTL mapping - Strategies for QTL mapping; statistical methods in QTL mapping; Phenotype and Marker linkage studies.

GP 603 GENOMICS IN PLANT BREEDING 2+1

Objective

To impart practical skills in advanced molecular techniques in genome mapping structural/functional genomics and development of transgenic crops.

Theory

UNIT I

Introduction to the plant genome- Plant nuclear genomes and their molecular description - The chloroplast and the mitochondrial genomes in plants - Genome size and complexity.

UNIT II

Establishment of plant genome mapping projects - Genome mapping and use of molecular markers in plant breeding; Strategies for mapping genes of agronomic traits in plants- Approaches for mapping quantitative trait loci; Map based cloning of plant genes.

UNIT III

Regulation of Plant gene expression - Functional genomics - Expression Analysis using Microarrays - Transposon tagging and Insertional mutagenesis- methods and significance- Diversity Array Technology.

UNIT IV

Genome sequencing in plants-Principles and Techniques; Applications of sequence information in plant genome analyses; Comparative genomics- Genome Comparison Techniques- Classical and advanced approaches.

UNIT V

Detection of Single Nucleotide Polymorphism; TILLING and Eco- TILLING; Role of transcriptomics, proteomics and metabolomics in linking genome and phenome; Importance of understanding the phenotypes for exploiting the outcome of genomic technologies- Knock out mutant studies and high throughput phenotyping.

UNIT VI

Concept of database development, management and bioinformatics; Plant genome projects and application of bioinformatics tools in structural and functional genomics.

Practical

Chromosome analysis in major field crops - Fluorescence *in situ* hybridization - Comparative genomic hybridization - Comparative analysis of plant genomes using molecular markers - Genetic map construction using molecular markers - Mapping major genes using molecular markers - QTL mapping in plants - Comparison across mapping populations - Understanding the need genetic algorithms in QTL mapping - Plant Genome Databases - Computational tools to explore plant genome databases - Comparative genomics - Comparison of genome sequences using tools of bioinformatics- Advanced genomic technologies: TILLING and Eco-TILLING - DNA Array Technology - Linking genome sequences to phenotypes: Tools of transcriptomics, proteomics and metabolomics.

GP 604 MOLECULAR AND CHROMOSOMAL MANIPULATIONS FOR CROP BREEDING 2+0

Objective

This course focuses on the advanced techniques in analyzing chromosome structure and manipulations for genome analysis in crop species.

Theory

UNIT I

Organization and structure of genome - Genome size - Organization of organellar genomes - Nuclear DNA organization - Nuclear and Cytoplasmic genome interactions and signal transduction; Transcriptional and Translational changes, Inheritance and expression of organellar DNA; Variation in DNA content - C value paradox; Sequence complexity - Introns and Exons - Repetitive sequences - Role of repetitive sequence.

UNIT II

Karyotyping - Chromosome banding and chromosome painting; Tracking introgressions using FISH, GISH, loclalization and mapping of genes/genomic segments; Distant hybridization - Role of polyploids in crop evolution and breeding - auto and allopolyploids.

UNIT III

Applications of cytogenetical methods for crop improvement; Location and mapping of genes on chromosomes: deficiency method; Interchangegenetic consequence, identification of chromosomes involved and gene location; balanced lethal systems, their maintenance and utility; Multiple interchanges-use in producing inbreds, transfer of genes-linked marker methods; Duplication - production and use; Inversions and location of genes; B/A chromosome translocations and gene location.

UNIT IV

Trisomics- types, production, breeding behavior and location of genes, use of balanced tertiary trisomics in hybrid seed production; Monosomicsmethods of production, breeding behavior and location of genes; Intervarietal substitutions-allelic and non-allelic interactions; Telocentric method of mapping.

UNIT V

Barriers to interspecific and intergeneric hybridization- Behaviour of interspecific and intergeneric crosses; Totipotency of cells - Morphogenesis: *in vivo* and *in vitro* - Meristem culture - anther and pollen culture - ovule, ovary, embryo and endosperm culture - protoplast isolation and culture - protoplast fusion, Different pathways of *in vitro* morphogenesis - organogenesis and somatic embryogenesis; *in vitro* mutant/somaclone selection for biotic and abiotic stresses.

GP 605 ADVANCES IN PLANT BREEDING SYSTEMS 2+0

Objective

To impart theoretical knowledge and computation methods for non allelic interactions, mating designs and component analysis and their significance in plant breeding.

Theory

UNIT I

Facts about plant breeding before the discovery of Mendelism; Evolutionary concepts of genetics and plant breeding - Flower development and its importance; genes governing the whorls formation and various models proposed; Mating systems and their exploitation in crop breeding; Types of pollination, mechanisms promoting cross pollination.

UNIT II

Self- incompatability and sterility - Types of self incompatability: Homomorphic (sporophytic and gametophytic) and heteromorphic - Breakdown of incompatibility - Floral adaptive mechanisms - Spatial and temporal - Genetic and biochemical basis of self incompatibility; Sterility: male and female sterility - Types of male sterility: genic, cytoplasmic and cytoplasmic-genic; Exploitation in monocots and dicots, difficulties in

exploiting CGMS system in dicots - Case studies and breeding strategies; Nucleocytoplasmic interactions with special reference to male sterility - Genetic, biochemical and molecular bases.

UNIT III

Population formation by hybridization - Types of populations - Mendelian population, gene pool, composites, synthetics etc.; Principles and procedures in the formation of a complex population; Genetic basis of population improvement.

UNIT IV

Selection in self fertilizing crops; Creation of genetic variability selection methods - Selection methods: mass selection, pureline selection, pedigree method (selection in early generations vs advanced generations); Backcross, polycross and test cross.

UNIT V

Selection in cross fertilizing crops - Polycross and topcross selections, Mass and recurrent selection methods and their modifications - Mass selection: grided mass selection, ear to row selection, modified ear to row selection; Convergent selection, divergent selection; Recurrent selection: Simple recurrent selection and its modifications (restricted phenotypic selection, selfed progeny selection and full sib recurrent selection)-

Recurrent selection for general combining ability (GCA) - Concepts and utilization - Recurrent selection for specific combining ability (SCA) - usefulness in hybrid breeding programmes - Reciprocal recurrent selection (Half sib reciprocal recurrent selection, Half sib reciprocal recurrent selection with inbred tester and Full sib reciprocal recurrent selection); Selection in clonally propagated crops - Assumptions and realities.

UNIT VI

Genetic engineering technologies to create male sterility; Prospects and problems - Use of self- incompatability and sterility in plant breeding -case studies; - Fertility restoration in male sterile lines and restorer diversification programmes - Conversion of agronomically ideal genotypes into male steriles - Concepts and breeding strategies; Case studies - Generating new cytonuclear interaction system for diversification of male steriles - Stability of male sterile lines - Environmental influence on sterility- Environmentally Induced Genic Male Sterility (EGMS) - Types

of EGMS; Influence on their expression, genetic studies; Photo and thermo sensitive genetic male sterility and its use in heterosis breeding - Temperature sensitive genetic male sterility and its use heterosis breeding - Apomixis and its use in heterosis breeding - Incongruity - Factors influencing incongruity - Methods to overcome incongruity mechanisms.

GP 606 CROP EVOLUTION 2+0

Objective

To impart knowledge on crop evolutionary aspects and manipulation at ploidy level for crop improvement.

Theory

UNIT I

Origin and evolution of species; Centres of diversity/origin, diffused centres; Time and place of domestication; Patterns of evolution and domestication-examples and Case studies.

UNIT II

Domestication and uniformity - Characteristics of early domestication and changes - Concept of gene pools and crop evolution; Selection and Genetic drift - Consequences.

UNIT III

Speciation and domestication - The process of speciation - Reproductive isolation barriers - Genetic differentiation during speciation - Hybridization - speciation and extinction.

UNIT IV

Exploitation of natural variation - Early attempts to increase variation - Distant hybridization and introgression- Inter-specific, inter-generic hybridization, scope and limitations, techniques to overcome the limitations; Gene transfer into cultivated species, tools and techniques; Validation of transferred genes and their expression; Controlled introgressions.

UNIT V

Processes in crop evolution and stabilization of polyploids, cytogenetic and genetic stabilization; Genome organization - Transgenesis in crop evolution - Multifactorial genome - Intragenomic interaction - Intergenomic interaction - Genome introgression.

UNIT VI

Methods to study crop evolution - Contemporary Methods - Based on morphological features - Cytogenetic analysis - Allozyme variations and crop evolution - DNA markers, genome analysis and comparative genomics.

UNIT VII

Evolutionary significance of polyploidy, Evolution of crop plants through ploidy manipulations; polyploids: methods, use of autopolyploids; haploidy-method of production and use; allopolyploids- synthesis of new crops; - Case studies - Cereals - Pulses - Oilseeds -

GP 607 BREEDING DESIGNER CROPS 2+1

Objective

To impart theoretical knowledge and practical know-how towards physiological efficiency, nutritional enhancement, biofortification and industrial/pharma applications in plant breeding.

Theory

UNIT I

Breeding of crop ideotypes; Genetic manipulations through recombination breeding, genomics and transgenics for physiological efficiency, nutritional enhancement, special compounds-proteins, vaccines, gums, starch and fats.

UNIT II

Physiological efficiency as a concept, parametric and whole plant physiology in integrated mode; Physiological mechanism of improvement in nutrient use efficiency, water use efficiency, osmotic adjustment, photosynthetic efficiency, stay green trait and its significance in crop improvement.

UNIT III

Improvement in yield potential under sub-optimal conditions by manipulating source and sink, canopy architecture, plant-water relationships, effect of suboptimal conditions on cardinal plant growth and development processes, enhancing input use efficiency through genetic manipulations.

UNIT IV

Breeding for special traits viz. oil, protein, vitamins, amino acids etc.; Concept of biopharming and development of varieties producing targeted compounds, nutraceuticals and industrial products; Success stories in vaccines, modified sugars, gums and starch through biopharming

UNIT V

Biosafety management, segregation and isolation requirements in designer crop production and post-harvest management

Practical

Demonstration of plant responses to stresses through recent techniques; Water use efficiency, transpiration efficiency, screening techniques under stress conditions such as electrolyte leakage, TTC, chlorophyll fluorescence, canopy temperature depression, stomatal conductance, chlorophyll estimation, heat/drought/salt shock proteins.

GP 608 ADVANCES IN BREEDING OF MAJOR FIELD CROPS 3+0

Objective

To provide insight into recent advances in improvement of cereals, millets and non cereal crops using conventional and modern biotechnological approaches.

Theory

UNIT I

History, description, classification, origin and phylogenetic relationship, genome status in cultivated and alien species of major cereals, millets and non cereal crops like Rice, Wheat, Maize, Pearlmillet, Sorghum, Pulses, oilseeds, cotton, sugarcane, arid legumes and other forage crops etc.

UNIT II

Breeding objectives in rice, wheat, maize, pearlmillet, sorghum, pulses, oilseeds, cotton, sugarcane, arid legumes and other forage crops etc. Genetic resources and their utilization; Genetics of quantitative and qualitative traits.

UNIT III

Breeding for value addition and resistance to abiotic and biotic stresses.

UNIT IV

Conventional (line breeding, population improvement, hybrids) and other approaches (DH Populations, Marker Assisted Breeding, Development of new male sterility systems), transgenics.

UNIT V

National and International accomplishments in genetic improvement of major field crops and their seed production.

GP 609 MICROBIAL GENETICS 2+1

Objective

The objective of this course is to apprise the students of molecular processes at DNA and RNA level in different microorganisms, especially bacteria and viruses.

Theory

UNIT I

Nature of bacterial variation; Molecular aspects of mutation; Episomes and plasmids; Gene mapping in bacteria; Life cycle of bacteriophages; Genetic fine analysis of rII locus; Circular genetic map of phage T4; Transposable elements; Gene manipulation; Biochemical genetics of *Neurospora and Sacharomyces* ; One gene - one enzyme hypothesis.

UNIT II

Regulation of gene activity in prokaryotes; Molecular mechanisms of mutation, repair and suppression; Molecular chaperones and gene expression; Genetic basis of apoptosis.

UNIT III

Transgenic bacteria and bioethics; genetic basis of nodulation, nitrogen fixation and competition by rhizobia, genetic regulation of nitrogen fixation and quorum sensing in rhizobia; genetics of mitochondria and chloroplasts.

Practical

Preparation and sterilization of liquid and agar bacterial nutrient media; Assessment of generation time in the log-phage bacterial cultures.Handling of microorganisms for genetic experiments; Isolation of rhizobia from nodules; Gram staining of rhizobial cells; Examination of polyhydroxy butyrate (PHB) production in rhizobia; Demonstration of N2-fixing nodules/bacterial inoculation in the legume- *Rhizobium* symbiotic system.Induction, isolation and characterization of auxotrophic and drug resistant mutants in bacteria; determination of spontaneous and induced mutation frequencies; Discrete bacterial colony counts for the preparation of survival curves and determination of LD50 of a mutagen. Tn-mediated mutagenesis; Analysis and isolation of plasmid DNA; Curing of plasmids.

GP 610 ***IN SITU*** AND ***EX SITU*** CONSERVATION OF GERMPLASM 2+1

Objective

To impart knowledge on the methods of germplasm conservation.

Theory

UNIT I

Concept of natural reserves and natural gene banks, *In situ* conservation of wild species in nature reserves: *in situ* conservation components, factors influencing conservation value, national plan for *in situ* conservation; *in situ* conservation of agro-biodiversity on-farm; scientific basis of *in situ* conservation on-farm, building on-farm conservation initiatives, implementation of on-farm conservation, management of *in situ* conserved genetic diversity on-farm, enhancing benefits for farmers from local crop diversity.

UNIT II

Ex situ conservation: components, plant genetic resources conservation in gene banks, national gene banks, gene repositories, preservation of genetic materials under natural conditions, *perma-frost* conservation, guidelines for sending seeds to network of active/ working collections, orthodox, recalcitrant seeds- differences in handling,clonal repositories, genetic stability under long term storage condition.

UNIT III

In vitro storage, maintanence of *in vitro* culture under different conditions, *in vitro* bank maintanence for temporate and tropical fruit crop species, spices, tubers, bulbous crops, medicinal and endangered plant species, conservation of embryos and ovules, cell/suspension cultures, protoplast and callus cultures, pollen culture, micropropagation techniques, problems, prospects of *in vitro* gene bank.

UNIT IV

Cryopreservation- procedure for handling seeds of orthodox and recalcitrants-cryoprotectants,dessication, rapid freezing, slow freezing, vitrification techniques, encapsulation/dehydration techniques, national facilities, achievements, application of cryopreservation in agriculture, horticulture and forestry crops.Problems and prospects; challenges aheads.

Practical

In situ conservation of wild species -case studies at national and international levels- *ex situ* techniques for active and long-term conservation of collections- Preparation and handling of materials, packaging, documentation; design of cold storage modules- Conservation protocols for recalcitrant and orthodox seeds; Cytological studies for assessing genetic stability, *in vitro* cultures- embryo,cell/suspension cultures,pollen cultures, study of cryotank facility and vitrification techniques, visit to NBPGR/NBAGR -study using fruit crops and other horticultural crops.

HORTICULTURE

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
APH-503	SYSTEMATIC HORTICULTURE	2+1
APH-511	PLANT PROPAGATION AND NURSERY MANAGEMENT	2+1
APH-513	ORCHARD MANAGEMENT	2+1
APH-515	ADVANCE POMOLOGY	2+1
APH-516	ADVANCE OLERICULTURE	2+1
APH-521	ADVANCE FLORICULTURE	2+1
APH-531	MEDICINAL AND AROMATIC PLANT	2+1
APH-711	NUTRITION OF HORTICUTURAL CROPS	3+1
APH-731	POST HARVEST PHYSIOLOGY OF HORTICULTURAL CROPS	2+1
APH- 733	RESEARCH METHODS IN HORTICULTURE	0+2

HORTICULTURE

Course Contents

APH-503 SYSTEMATIC HORTICULTURE 2+1

Introduction to horticultural crops Systematic classification, nomenclature and botanical relationship of fruits, vegetable and ornamental plants.

APH-511 PLANT PROPAGATION AND NURSERY MANAGEMENT 2+1

Basic concept and principles of propagation, origin and development of seed, seed treatment, factor influencing success in seed propagation. Asexual propagation of plants and the recent development in the field. Techniques of propagation and equipment Poly embryony and its importance in Horticulture. Lay out and management of commercial nursery.

APH-513 ORCHARD MANAGEMENT 2+1

Importance of orchard management, making fruit culture as applying impact of various operation like planting, irrigation and drainage, fertilizer application, pruning, soil management practices etc. On growth and productivity of fruit trees, problems being faced in these practice and method of solving them.

APH-515 ADVANCE POMOLOGY 2+1

Control on growth, flowering, unfruitfulness, high-density planting system of training and pruning, protected cultivation of fruit plants, steonic relationship and new promising root stock stress and pollutant influence on fruit crops. Varietals status and latest production technique including major problems and solution of important fruit crops.

APH-516 ADVANCE OLERICULTURE 2+1

Importance of vegetable and its prospects for improvement, origin, taxonomy and cytogenetics of important vegetable crops. Possibilities of breeding of important vegetable crops for higher yield, earliness, disease and pest resistance etc. Cultivars and environmental factor in relation to growth, development and productivity of important vegetable crop. Seed production technique for important vegetable crops.

APH-521 ADVANCE FLORICULTURE 2+1

Advance in flower plants improvement, nutrition, irrigation, pruning and training, physiology of flowering and color development. Post harvest handling of cut flowers for export and exhibition.

APH-531 MEDICINAL AND AROMATIC PLANT 2+1

Importance, classification and usage, studies on importance, botanical description, distribution, composition, climate and soil, culture practices, yield and constituents of important medicinal and aromatic plants.

APH-711 NUTRITION OF HORTICUTURAL CROPS 3+1

Review of nutritional problems of fruit crops. Factors affecting fruit tree nutrition. Characteristic symptoms of deficiency and toxicity of individual elements in fruits plants, possible causes and their control. Standardization of leaf sampling Techniques and uses of tissue analysis as a guide for orchard nutrition. Nutritional problems of saline, alkakine,sodic and waterlogged soils and roots-stocks fruits -crops suitable for such soils. Nutrition of important fruit crops with special reference to their growth, productivity and quality :mango, oitrus, banana, guava, litchi, grapes, papaya, pome fruits, stone fruits,and other fruits

APH-731 POST HARVEST PHYSIOLOGY OF HORTICULTURAL CROPS 2+1

Maturity and ripening process and factors affecting them quality examination for fresh market and processing.Biochemical changes in harvested produce. Factors responsible for deterioration of harvested produce.Role of plant regulators and irradiation in decay control. storage conditions and their influence of fresh fruits and symtoms of chilling injury Post harvest physiology of important crops; Mango,citrus,banana,grapes,papaya,apple & pear,stone fruits,tomato,potato,onion,peas,leafy vegetables

APH- 733 RESEARCH METHODS IN HORTICULTURE 0+2

Practical training in plant hormone bioassay for the estimation of auxins, gibberellins, cytokinins, ethylene and inhibitors; histology of tree crops in relation to growth, differientation and flowering. Asceptic culture of nucellar embryos and induction of polymemroyny. organogenesis in horticultural crops in relative to plant hormones. Experimental design in tree crops.

PLANT PATHOLOGY

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
PL PATH 501*	MYCOLOGY	2+1
PL PATH 502*	PLANT VIROLOGY	2+1
PL PATH 503*	PLANT BACTERIOLOGY	2+1
PL PATH 504*	PRINCIPLES OF PLANT PATHOLOGY	3+0
PL PATH 505*	DETECTION AND DIAGNOSIS OF PLANT DISEASES	0+2
PL PATH 506	PRINCIPLES OF PLANT DISEASE MANAGEMENT	2+1

PL PATH 507	DISEASES OF FIELD AND MEDICINAL CROPS	2+1
PL PATH 508	DISEASES OF FRUITS, PLANTATION AND ORNAMENTAL CROPS	2+1
PL PATH 509	DISEASES OF VEGETABLE AND SPICES CROPS	2+1
PL PATH 510	SEED HEALTH TECHNOLOGY	2+1
PL PATH 511	CHEMICALS IN PLANT DISEASE MANAGEMENT	2+1
PL PATH 512	ECOLOGY OF SOIL-BORNE PLANT PATHOGENS	2+1
PL PATH 513	DISEASE RESISTANCE IN PLANTS	2+0
PL PATH 514/ ENT 514$	INSECT VECTORS OF PLANT VIRUSES AND OTHER PATHOGENS	1+1
PL PATH 515	BIOLOGICAL CONTROL OF PLANT DISEASES	2+1
PL PATH 516	INTEGRATED DISEASE MANAGEMENT	2+1
PL PATH 517	MUSHROOM PRODUCTION TECHNOLOGY	2+1
PL PATH 518	EPIDEMIOLOGY AND FORECASTING OF PLANT DISEASES	2+1
PL PATH 519	POST HARVEST DISEASES	2+1
PL PATH 520/ ENT 520$	PLANT QUARANTINE	2+0
PL PATH 591	MASTER'S SEMINAR	1+0
PL PATH 599	MASTER'S RESEARCH	20
PL PATH 601	ADVANCED MYCOLOGY	2+1
PL PATH 602	ADVANCED VIROLOGY	2+1
PL PATH 603	ADVANCED BACTERIOLOGY	2+1
PL PATH 604**	MOLECULAR BASIS OF HOST-PATHOGEN INTERACTION	2+1
PL PATH 605	PRINCIPLES AND PROCEDURES OF CERTIFICATION	1+0
PL PATH 606	PLANT BIOSECURITY AND BIOSAFETY	2+0
PL PATH 691	DOCTORAL SEMINAR I	1+0
PL PATH 692	DOCTORAL SEMINAR II	1+0
PL PATH 699	DOCTORAL RESEARCH	45

*Compulsory for Master's programme; ** Compulsory for Ph. D. programme; $ Cross-listed with Entomology

PLANT PATHOLOGY

Course Contents

PL PATH 501 MYCOLOGY 2+1

Objective

To study the nomenclature, classification and characters of fungi.

Theory

UNIT I

Introduction, definition of different terms, basic concepts.

UNIT II

Importance of mycology in agriculture, relation of fungi to human affairs, history of mycology.

UNIT III

Concepts of nomenclature and classification, fungal biodiversity, reproduction in fungi.

UNIT IV

The comparative morphology, ultrastructure, characters of different groups of fungi up to generic level: (a) Myxomycota and (b) Eumycota- i) Mastigomycotina ii) Zygomycotina, iii) Ascomycotina, iv) Basidiomycotina, v) Deuteromycotina. Lichens types and importance, fungal genetics and variability in fungi.

Practical

Detailed comparative study of different groups of fungi; collection, identification and preservation of specimens. Isolation and identification of plant pathogenic fungi.

PL PATH 502 PLANT VIROLOGY 2+1

Objective

To acquaint with the structure, virus-vector relationship, biology and management of plant viruses.

Theory

UNIT I

History of plant viruses, composition and structure of viruses.

UNIT II

Symptomatology of important plant viral diseases, transmission, chemical and physical properties, host virus interaction, virus vector relationship.

UNIT III

Virus nomenclature and classification, genome organization, replication and movement of viruses.

UNIT IV

Isolation and purification, electron microscopy, protein and nucleic acid based diagnostics.

UNIT V

Mycoviruses, phytoplasma arbo and baculoviruses, satellite viruses, satellite RNAs, phages, viroids, prions. Principles of the working of electron-microscope and ultra-microtome.

UNIT VI

Origin and evolution, mechanism of resistance, genetic engineering, ecology, and management of plant viruses.

Practical

Study of symptoms caused by viruses, transmission, assay of viruses, physical properties, purification, method of raising antisera, serological tests, electron microscopy and ultratomy, PCR.

PL PATH 503 PLANT BACTERIOLOGY 2+1

Objective

To acquaint with plant pathogenic prokaryote (procarya) and their structure, nutritional requirements, survival and dissemination.

Theory

UNIT I

History and introduction to phytopathogenic procarya, viz., bacteria, MLOs, spiroplasmas and other fastidious procarya. Importance of phytopathogenic bacteria.

UNIT II

Evolution, classification and nomenclature of phytopathogenic procarya and important diseases caused by them.

UNIT III

Growth, nutrition requirements, reproduction, preservation of bacterial cultures and variability among phytopathogenic procarya.

UNIT IV

General biology of bacteriophages, L form bacteria, plasmids and bdellovibrios.

UNIT V

Procaryotic inhibitors and their mode of action against phytopathogenic bacteria.

UNIT VI

Survival and dissemination of phytopathogenic bacteria.

Practical

Isolation, purification, identification and host inoculation of phytopathogenic bacteria, staining methods, biochemical and serological characterization, isolation of plasmid and use of antibacterial chemicals/antibiotics.

PL PATH 504 PRINCIPLES OF PLANT PATHOLOGY 3+0

Objective

To introduce the subject of Plant Pathology, its concepts and principles.

Theory

UNIT I

Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases.

UNIT II

Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development.

UNIT III

Host parasite interaction, recognition concept and infection, symptomatology, disease development- role of enzymes, toxins, growth regulators; defense strategies- oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens.

UNIT IV

Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance.

UNIT V

Disease management strategies.

PL PATH 505 DETECTION AND DIAGNOSIS OF PLANT DISEASES 0+2

Objective

To impart training on various methods/techniques/instruments used in the study of plant diseases/pathogens.

Practical

UNIT I

Methods to prove Koch's postulates with biotroph and necrotroph pathogens, pure culture techniques, use of selective media to isolate pathogens.

UNIT II

Preservation of plant pathogens and disease specimens, use of haemocytometer, micrometer, centrifuge, pH meter, camera lucida.

UNIT III

Microscopic techniques and staining methods, phase contrast system, chromatography, use of electron microscope, spectrophotometer, ultracentrifuge and electrophoretic apparatus, disease diagnostics, serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides, bactericides etc.; field experiments, data collection and preparation of references.

PL PATH 506 PRINCIPLES OF PLANT DISEASE MANAGEMENT 2+1

0bjectives

To acquaint with different strategies for management of plant diseases.

Theory

UNIT I

Principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods of plant disease control, integrated control measures of plant diseases. Disease resistance and molecular approach for disease management.

UNIT II

Foliage, seed and soil application of chemicals, role of stickers, spreaders and other adjuvants, health vis-a-vis environmental hazards, residual effects and safety measures.

UNIT III

History of fungicides, bactericides, antibiotics, concepts of pathogen, immobilization, chemical protection and chemotherapy, nature, properties and mode of action of antifungal, antibacterial and antiviral chemicals.

Practical

In vitro and *in vivo* evaluation of chemicals against plant pathogens; ED and MIC values, study of structural details of sprayers and dusters.

PL PATH 507 DISEASES OF FIELD AND MEDICINAL CROPS 2+1

Objective

To educate about the nature, prevalence, etiology, factors affecting disease development and control measures of field and medicinal crop diseases.

Theory

UNIT I

Diseases of Cereal crops- wheat, barley, rice, pearl millet, sorghum and maize.

UNIT II

Diseases of Pulse crops- gram, urdbean, mungbean, lentil, pigeonpea, soybean.

UNIT III

Diseases of Oilseed crops- rapeseed and mustard, sesame, linseed, sunflower, groundnut, castor.

UNIT IV

Diseases of Cash crops- cotton, sugarcane.

UNIV V

Diseases of Fodder legume crops- berseem, oats, guar, lucerne, cowpea.

UNIT VI

Medicinal crops- plantago, liquorice, *mulathi,* rosagrass, sacred basil, mentha, *ashwagandha*, *Aloe vera*.

Practical

Detailed study of symptoms and host parasite relationship of important diseases of above mentioned crops. Collection and dry preservation of diseased specimens of important crops.

PL PATH 508 DISEASES OF FRUITS, PLANTATION AND ORNAMENTAL CROPS 2+1

Objective

To acquaint with diseases of fruits, plantation, ornamental plants and their management.

Theory

UNIT I

Introduction, symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like apple, pear, peach, plum, apricot, cherry, walnut, almond, strawberry, citrus, mango, grapes, guava, *ber,* banana, pineapple, papaya, fig, pomegranate, date palm and management of the fruits diseases.

UNIT II

Symptoms, mode of perpetuation of diseases of plantation crops such as tea, coffee, rubber and coconut and their management.

UNIT III

Symptoms and life cycle of pathogens. Factors affecting disease development of ornamental plants such as roses, gladiolus, tulip, carnation, orchids, marigold, chrysanthemum and their management.

Practical

Detailed study of symptoms and host parasite relationship of representative diseases of plantation crops. Collection and dry preservation of diseased specimens of important crops.

PL PATH 509 DISEASES OF VEGETABLE AND SPICES CROPS 2+1

Objective

To impart knowledge about symptoms, epidemiology of different diseases of vegetables and spices and their management.

Theory

UNIT I

Nature, prevalence, factors affecting disease development of bulb, leafy vegetable, crucifers, cucurbits and solanaceaous vegetables. Diseases of protected cultivation.

UNIT II

Symptoms and management of diseases of different root, bulb, leafy vegetables, crucifers, cucurbits and solanaceaous vegetable crops.

UNIT III

Symptoms, epidemiology and management of diseases of different spice crops such as black pepper, saffron, cumin, coriander, turmeric, fennel, fenugreek and ginger.

Practical

Detailed study of symptoms and host pathogen interaction of important diseases of vegetable and spice crops.

PL PATH 510 SEED HEALTH TECHNOLOGY 2+1

Objective

To acquaint with seed-borne diseases, their nature, detection, transmission, epidemiology, impacts/loses and management.

Theory

UNIT I

History and economic importance of seed pathology in seed industry, plant quarantine and SPS under WTO. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds.

UNIT II

Recent advances in the establishment and subsequent cause of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens.

UNIT III

Seed certification and tolerance limits, types of losses caused by seed-borne diseases in true and vegetatively propagated seeds, evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens. Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection.

UNIT IV

Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogen/diseases and procedure for healthy seed production, seed health testing, methods for detecting microorganism.

Practical

Conventional and advanced techniques in the detection and identification of seed-borne fungi, bacteria and viruses. Relationship between seed-borne infection and expression of the disease in the field.

PL PATH 511 CHEMICALS IN PLANT DISEASE MANAGEMENT 2+1

Objective

To impart knowledge on the concepts, principles and judicious use of chemicals in plant disease management.

Theory

UNIT I

History and development of chemicals; definition of pesticides and related terms; advantages and disadvantages of chemicals.

UNIT II

Classification of chemicals used in plant disease control and their characteristics.

UNIT III

Chemicals in plant disease control, viz., fungicides, bactericides, nematicides, antiviral chemicals and botanicals.

UNIT IV

Formulations, mode of action and application of different fungicides; chemotherapy and phytotoxicity of fungicides.

UNIT V

Handling, storage and precautions to be taken while using fungicides; compatibility with other agrochemicals, persistence, cost-benefit ratio, factor affecting fungicides.

UNIT VI

General account of plant protection appliances; environmental pollution, residues and health hazards, fungicidal resistance in plant pathogens and its management.

Practical

Acquaintance with formulation of different fungicides and plant protection appliances. Formulation of fungicides, bactericides and nematicides; *in vitro* evaluation techniques, preparation of different concentrations of chemicals including botanical pesticides based on active ingredients against pathogens; persistence, compatibility with other agro-chemicals; detection of naturally occurring fungicide resistant mutants of pathogen; methods of application of chemicals.

PL PATH 512 ECOLOGY OF SOIL-BORNE PLANT PATHOGENS 2+1

Objective

To provide knowledge on soil-plant disease relationship.

Theory

UNIT I

Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi. Types of biocontrol agents.

UNIT II

Inoculum potential and density in relation to host and soil variables, competition, predation, antibiosis and fungistasis.

UNIT III

Suppressive soils, biological control- concepts and potentialities for managing soil borne pathogens.

Practical

Quantification of rhizosphere and rhizoplane microflora with special emphasis on pathogens; pathogenicity test by soil and root inoculation techniques, correlation between inoculum density of test pathogens and disease incidence, demonstration of fungistasis in natural soils; suppression of test soil-borne pathogens by antagonistic microorganisms. Isolation and identification of different biocontrol agents.

PL PATH 513 DISEASE RESISTANCE IN PLANTS 2+0

Objective

To acquaint with disease resistance mechanisms in plants.

Theory

UNIT I

Introduction and historical development, dynamics of pathogenicity, process of infection, variability in plant pathogens, gene centres as sources of resistance, disease resistance terminology.

UNIT II

Disease escapes, disease tolerance, disease resistance, types of resistance, identification of physiological races of pathogens, disease progression in relation to resistance, stabilizing selection pressure in plant pathogens.

UNIT III

Host defence system, morphological and anatomical resistance, preformed chemicals in host defence, post infectional chemicals in host defence, phytoalexins, hypersensitivity and its mechanisms.

UNIT IV

Gene-for-gene concept, protein-for-protein and immunization basis, management of resistance genes. Strategies for gene deployment.

PL PATH 514/ ENT 514 INSECT VECTORS OF PLANT VIRUSES AND OTHER PATHOGENS 1+1

Objective

To teach the students about the different groups of insects that vector plant pathogens, vector-plant pathogen interaction, management of vectors for controlling diseases.

Theory

UNIT I

History of developments in the area of insects as vectors of plant pathogens. Important insect vectors and their characteristics; mouth parts and feeding processes of important insect vectors. Efficiency of transmission.

UNIT II

Transmission of plant viruses and fungal pathogens. Relation between viruses and their vectors.

UNIT III

Transmission of plant viruses by aphids, whiteflies, mealy bugs and thrips.

UNIT IV

Transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers.

UNIT V

Transmission of plant viruses by psyllids, beetles and mites. Epidemiology and management of insect transmitted diseases through vector management.

Practical

Identification of common vectors of plant pathogens- aphids, leafhoppers, whiteflies, thrips, beetles, nematodes; culturing and handling of vectors; demonstration of virus transmission through vectors- aphids, leafhoppers and whiteflies.

PL PATH 515 BIOLOGICAL CONTROL OF PLANT DISEASES 2+1

Objective

To study principles and application of ecofriendly and sustainable management strategies of plant diseases.

Theory

UNIT I

Concept of biological control, definitions, importance, principles of plant disease management with bioagents, history of biological control, merits and demerits of biological control.

UNIT II

Types of biological interactions, competition, mycoparasitism, exploitation for hypovirulence, rhizosphere colonization, competitive saprophytic ability, antibiosis, induced resistance, mycorrhizal associations, operational mechanisms and its relevance in biological control.

UNIT III

Factors governing biological control, role of physical environment, agroecosystem, operational mechanisms and cultural practices in biological control of pathogens, pathogens and antagonists and their relationship, biocontrol agents, comparative approaches to biological control of plant pathogens by resident and introduced antagonists, control of soil-borne and foliar diseases. Compatibility of different bioagents.

UNIT IV

Commercial production of antagonists, their delivery systems, application and monitoring, biological control in IDM, IPM and organic farming system, biopesticides available in market. Quality control system of biocontrol agents.

Practical

Isolation, characterization and maintenance of antagonists, methods of study of antagonism and antibiosis, application of antagonists against pathogen *in vitro and in vivo* conditions. Study of cfu/g.

PL PATH 516 INTEGRATED DISEASE MANAGEMENT 2+1

Objective

To emphasize the importance and need of IDM in the management of diseases of important crops.

Theory

UNIT I

Introduction, definition, concept and tools of disease management, components of integrated disease management- their limitations and implications.

UNIT II

Development of IDM- basic principles, biological, chemical and cultural disease management.

UNIT III

IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, rapeseedmustard, pearlmillet, *kharif* pulses, vegetable crops and fruit crops.

Practical

Application of biological, cultural, chemical and biocontrol agents, their compatibility and integration in IDM; demonstration of IDM in certain crops as project work.

PL PATH 517 MUSHROOM PRODUCTION TECHNOLOGY 2+1

Objective

To develop mushroom cultivation skills for entrepreneurial activity. Historical development of mushroom cultivation and present status of mushroom industry in India.

Theory

UNIT I

Historical development of mushroom cultivation and present status, taxonomy, classification, food, medicinal value, uses of mushroom, edible and poisonous mushrooms.

UNIT II

Life cycle of cultivated mushrooms, reproduction and strain improvement, maintenance of pure culture, preparation of spawn and facilities required for establishing commercial spawn lab.

UNIT III

Preparation of substrate for mushroom cultivation, long, short and indoor composting methods, formulae for different composts and their computation, qualities and testing of compost, uses of spent mushroom compost/substrate.

UNIT IV

Facilities for setting up mushroom farm for seasonal and environmentally control cultivation, requirement and maintenance of temperature, relative humidity, CO2, ventilation in cropping rooms, cultivation technology of *Agaricus bisporus, Pleurotus* sp., *Calocybe indica, Lentinus edodes* and *Ganoderma lucidum.*

UNIT V

Insect pests, diseases and abnormalities of cultivated mushroom and their management, post harvest processing and value addition, economics of mushroom cultivation, biotechnology and mushroom cultivation.

Practical

Preparation of spawn, compost, spawning, casing, harvesting and postharvest handling of edible mushroom; identification of various pathogens, competitors of various mushroom.

PL PATH 518 EPIDEMIOLOGY AND FORECASTING OF PLANT DISEASES 2+1

Objective

To acquaint with the principles of epidemiology and its application in disease forecasting.

Theory

UNIT I

Epidemic concept and historical development, pathometry and crop growth stages, epidemic growth and analysis.

UNIT II

Common and natural logrithms, function fitting area under disease progress curve and correction factors, inoculum dynamics, population biology of pathogens, temporal spatial variability in plant pathogens.

UNIT III

Survey, surveillance and vigilance, crop loss assessment and models.

UNIT IV

Principles and pre-requisites of forecasting, systems and factors affecting various components of forecastings, some early forecasting, procedures based on weather and inoculum potential, modeling disease growth and disease prediction.

Practical

Measuring diseases, spore dispersal and trapping, weather recording, survey, multiplication of inoculum, computerized data analysis, function fitting, model preparation and validation.

PL PATH 519 POST HARVEST DISEASES 2+1

Objective

To acquaint with post harvest diseases of agricultural produce and their ecofriendly management.

Theory

UNIT I

Concept of post harvest diseases, definitions, importance with reference to environment and health, principles of plant disease management as preharvest and post-harvest, merits and demerits of biological/phytoextracts in controlling post-harvest diseases.

UNIT II

Types of post harvest problems both by biotic and abiotic causes, rhizosphere colonization, competitive, saprophytic ability, antibiosis, induced resistance, microbial associations, concept, operational mechanisms and its relevance in control.

UNIT III

Factors governing post harvest problems both as biotic and abiotic, role of physical environment, agro-ecocystem leading to quiescent infection, operational mechanisms and cultural practices in perpetuation of pathogens, pathogens and antagonist and their relationship, role of biocontrol agents and chemicals in controlling post-harvest diseases, comparative approaches to control of plant pathogens by resident and introduced antagonists. Isolation, characterization and maintenance of pathogens, role of different storage.

UNIT IV

Integrated approach in controlling diseases and improving the shelf life of produce, control of aflatoxigenic and mycotoxigenic fungi, application and monitoring for any health hazard, knowledge of Codex Alimentarious for each product and commodity.

Practical

Isolation characterization and maintenance of pathogens, role of different storage conditions on disease development, application of antagonists against pathogens *in vivo* and *in vitro* conditions. Comparative efficacy of different chemicals, fungicides, phytoextracts and bioagents.

PL PATH 520/ ENT 520 PLANT QUARANTINE 2+0

Objective

To acquaint the learners about the principles and the role of Plant Quarantine in containment of pests and diseases, plant quarantine regulations and set-up.

Theory

UNIT I

Definition of pest, pesticides and transgenics as per Govt. notification; relative importance; quarantine - domestic and international. Quarantine restrictions in the movement of agricultural produce, seeds and planting material; case histories of exotic pests/diseases and their status.

UNIT II

Plant protection organization in India. Acts related to registration of pesticides and transgenics. History of quarantine legislations, PQ Order 2003. Environmental Acts, Industrial registration; APEDA, Import and Export of bio-control agents.

UNIT III

Identification of pest/disease free areas; contamination of food with toxigens, microorganisms and their elimination; Symptomatic diagnosis and other techniques to detect pest/pathogen infestations; VHT and other safer techniques of disinfestation/salvaging of infected material.

UNIT IV

WTO regulations; non-tariff barriers; Pest risk analysis, good laboratory practices for pesticide laboratories; pesticide industry; Sanitary and Phytosanitary measures.

PL PATH 601 ADVANCED MYCOLOGY 2+1

Objective

To acquaint with the latest advances in Mycology.

Theory

UNIT I

General introduction, historical development and advances in mycology.

UNIT II

Recent taxonomic criteria, morphological criteria for classification. Serological, Chemical (chemotaxonomy), Molecular and Numerical (Computer based assessment) taxonomy.

UNIT III

Interaction between groups: Phylogeny. Micro conidiation, conidiogenesis and sporulating structures of fungi imperfecti. Morphology and reproduction of representative plant pathogenic genera from different groups of fungi. Sexual reproduction in different groups of fungi.

UNIT IV

Population biology, pathogenic variability/vegetative compatibility.

UNIT V

Heterokaryosis and parasexual cycle. Sex hormones in fungi. Pleomorphism and speciation in fungi. Mechanism of nuclear inheritance. Mechanism of extra-nuclear inheritance. Biodegradation.

Practical

Study of conidiogenesis- phialides, porospores, arthospores. Study of fruit bodies in Ascomycotina. Identification of fungi up to species level. Study of hyphal anastomosis. Morphology of representative plant pathogenic genera from different groups of fungi.

PL PATH 602 ADVANCED VIROLOGY 2+1

Objective

To educate about the advanced techniques and new developments in the field of Plant Virology.

Theory

UNIT I

Mechanism of virus transmission by vectors, virus-vector relationship, bimodal transmission and taxonomy of vectors and viruses, vector specificity for classes of viruses, virus replication, assembly and architecture, ultrastructural changes due to virus infection, variation, mutation and virus strains.

UNIT II

Immunoglobulin structure and functions of various domains, methods of immunodiagnosis, hybridoma technology and use of monoclonal antibodies in identification of viruses and their strains, Polymerase Chain Reaction.

UNIT III

Genome organization, replication, transcription and translational strategies of pararetroviruses and gemini viruses, satellite viruses and satellite RNA genome organization in tobamo-, poty-, bromo, cucummo, ilar and tospoviruses.

UNIT IV

Gene expression and regulation, viral promoters, molecular mechanism of host virus interactions, virus induced gene, molecular mechanism of vector transmission, symptom expression, viroids and prions.

UNIT V

Genetic engineering with plant viruses, viral suppressors, a RNAi dynamics, resistant genes. Viruses potential as vectors, genetically engineered resistance, transgenic plants.

UNIT VI

Techniques and application of tissue culture. Origin, evolution and interrelationship with animal viruses.

Practical

Purification of virus(es), SDS-PAGE for molecular weight determination, production of polyclonal antiserum, purification of IgG and conjugate preparation, serological techniques (i) DAC-ELISA (ii) DAS -ELISA (iii) DIBA (iv) Western blots (v) (ab) 2-ELISA, vector transmission (one each with aphid, leaf hopper and whitefly), methods for collecting vectors and their maintenance, nucleic acid isolation, DOT-blot, southern hybridization, probe preparation and autoradiography, PCR application and viral genome cloning, sequencing annotation of genes.

PL PATH 603 ADVANCED BACTERIOLOGY 2+1

Objective

To provide knowledge about the latest advances in phytobacteriology.

Theory

UNIT I

Current approaches for the characterization and identification of phytopathogenic bacteria. Ultrastructures and biology of bacteria.

UNIT II

Current trends in taxonomy of phytopathogenic procarya.

UNIT III

Role of enzyme, toxin, expolysaccharide, polypeptide signals in disease development. Mechanism of wilt (*Ralstonia solanacearum*) development, mechanism of soft rot (*Erwinia* spp.) development, mechanism of Crown gall formation (*Agrobacterium tumifaciens*).

UNIT IV

Host-bacterial pathogen interaction, quorum-sensing phenomenon, Type III secretion system, HR/SR reactions, R-genes, Avr-genes, hrp genes, Effector protein.

UNIT V

Molecular variability among phytopathogenic procarya and possible host defense mechanism(s). Genetic engineering for management of bacterial plant pasthogens-gene silencing, RNAi technology.

UNIT VI

Epidemiology in relation to bacterial plant pathogens. Development of diagnostic kit.

UNIT VII

Beneficial prokaryotes- Endophytes, PGPR, phylloplane bacteria and their role in disease management. Endosymbionts for host defence.

Practical

Pathogenic studies and race identification; plasmid profiling of bacteria; fatty acid profiling of bacteria; RAPD prolfiling of bacteria and variability status; Endospore, Flagiler staining; test for secondary metabolite production, cyanides, EPS, siderophore; specific detection of phytopathogenic bacteria using species/pathovar specific primers. Basic techniques in diagnostic kit development, molecular tools to identify phytoendosymbionts.

PL PATH 604 MOLECULAR BASIS OF HOST-PATHOGEN INTERACTION 2+1

Objective

To understand the concepts of molecular biology and biotechnology in relation to host-pathogen interactions.

Theory

UNIT I

Importance and role of biotechnological tools in Plant Pathology- Basic concepts and principles to study host pathogen relationship.

UNIT II

Molecular basis of host-pathogen interaction- fungi, bacteria and viruses; recognition system, signal transduction.

UNIT III

Induction of defense responses- pathogenesis related proteins, HR, reactive oxygen species, phytoalexins and systemic acquired resistance, Programmed Cell Death, Viral induced gene silencing.

UNIT IV

Molecular basis of gene-for-gene hypothesis; R-gene expression and transcription profiling, mapping and cloning of resistance genes and marker-aided selection, pyramiding of R genes.

UNIT V

Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, different methods of gene transfer, biosafety issues related to GM crops.

Practical

Protein, DNA and RNA isolation, Plasmids extraction,PCR analysis, DNA and Protein electrophoresis, bacterial transformation.

PL PATH 605 PRINCIPLES AND PROCEDURES OF CERTIFICATION 1+0

Objective

To acquaint with certification procedures of seed and planting material.

Theory

UNIT I

Introduction to certification. International scenario of certification and role of ISTA, EPPO, OECD etc. in certification and quality control.

UNIT II

Case studies of certification systems of USA and Europe. National Regulatory mechanism and certification system including seed certification, minimum seed certification standards. National status of seed health in seed certification. Methods for testing genetic identity, physical purity, germination percentage, seed health etc.

UNIT III

Fixing tolerance limits for diseases and insect pests in certification and quality control programmes. Methods used in certification of seeds, vegetative propagules and *in vitro* cultures. Accreditation of seed testing laboratories. Role of seed/ planting material health certification in national and international trade.

PL PATH 606 PLANT BIOSECURITY AND BIOSAFETY 2+0

Objective

To facilitate deeper understanding on plant biosecurity and biosafety issues in agriculture.

Theory

UNIT I

History of biosecurity, Concept of biosecurity, Components of biosecurity, Quarantine, Invasive Alien Species, Biowarfare, Emerging/resurgence of pests and diseases.

UNIT II

National Regulatory Mechanism and International Agreements/Conventions viz., Agreement on Application of Sanitary and Phytosanitary (SPS) Measures/World Trade Organization (WTO), Convention on Biological Diversity (CBD), International Standards for Phytosanitary Measures, pest risk analysis, risk assessment models, pest information system, early warning and forecasting system, use of Global Positioning System (GPS) and Geographic Information System (GIS) for plant biosecurity, pest/disease and epidemic management, strategies for combating risks and costs associated with agroterrorism event, mitigation planning, integrated approach for biosecurity.

UNIT III

Biosafety, policies and regulatory mechanism, Cartagena Protocol on Biosafety and its implications, Issues related to release of genetically modified crops.

SOIL SCIENCE

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
SOILS 501*	SOIL PHYSICS	2+1
SOILS 502*	SOIL FERTILITY AND FERTILIZER USE	3+1
SOILS 503*	SOIL CHEMISTRY	2+1
SOILS 504*	SOIL MINERALOGY, GENESIS, CLASSIFICATION AND SURVEY	2+1
SOILS 505	SOIL EROSION AND CONSERVATION	2+1
SOILS 506*	SOIL BIOLOGY AND BIOCHEMISTRY	2+1
SOILS 507	GEOMORPHOLOGY AND GEOCHEMISTRY	2+0
SOILS 508	RADIOISOTOPES IN SOIL AND PLANT STUDIES	1+1
SOILS 509	SOIL,WATER AND AIR POLLUTION	2+1
SOILS 510	REMOTE SENSING AND GIS TECHNIQUES FOR SOIL AND CROP STUDIES	2+1
SOILS 511	ANALYTICAL TECHNIQUES AND INSTRUMENTAL METHODS IN SOIL AND PLANT ANALYSIS	0+2
SOILS 512	SYSTEM APPROACHES IN SOIL AND CROP STUDIES	2+1
SOILS 513	MANAGEMENT OF PROBLEMATIC SOILS AND WATERS	2+1
SOILS 514	FERTILIZER TECHNOLOGY	1+0
SOILS 515	LAND DEGRADATION AND RESTORATION	1+0
SOILS 591	MASTER'S SEMINAR	1+0
SOILS 599	MASTER'S RESEARCH	20
SOILS 601	ADVANCES IN SOIL PHYSICS	2+0
SOILS 602	ADVANCES IN SOIL FERTILITY	2+0
SOILS 603	PHYSICAL CHEMISTRY OF SOILS	2+0
SOILS 604	SOIL GENESIS AND MICROPEDOLOGY	2+0
SOILS 605	BIOCHEMISTRY OF SOIL ORGANIC MATTER	2+0
SOILS 606	LAND USE PLANNING AND WATERSHED MANAGEMENT	2+0
SOILS 691	DOCTORAL SEMINAR I	1+0
SOILS 692	DOCTORAL SEMINAR II	1+0
SOILS 699	DOCTORAL RESEARCH	45

*Compulsory for Master's programme

SOIL SCIENCE

Course Contents

SOILS 501 SOIL PHYSICS 2+1

Objective

To impart basic knowledge about soil physical properties and processes in relation to plant growth.

Theory

UNIT I

Scope of soil physics and its relation with other branches of soil science; soil as a three phase system.

UNIT II

Soil texture, textural classes, mechanical analysis, specific surface.

UNIT III

Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage - basic concepts.

UNIT IV

Soil structure - genesis, types, characterization and management soil structure; soil aggregation, aggregate stability; soil tilth, characteristics of good soil tilth; soil crusting - mechanism, factors affecting and evaluation; soil conditioners; puddling, its effect on soil physical properties; clod formation.

UNIT V

Soil water: content and potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential, soil-moisture characteristic curve; hysteresis, measurement of soil-moisture potential.

UNIT VI

Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity in saturated and unsaturated soils.

UNIT VII

Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum.

UNIT IX

Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management.

UNIT X

Modes of energy transfer in soils; energy balance; thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth; soil temperature management.

Practical

- Mechanical analysis by pipette and international methods
- Measurement of Atterberg limits
- Aggregate analysis - dry and wet
- Measurement of soil-water content by different methods
- Measurement of soil-water potential by using tensiometer and gypsum blocks
- Determination of soil-moisture characteristics curve and computation of pore-size distribution
- Determination of hydraulic conductivity under saturated and unsaturated conditions
- Determination of infiltration rate of soil
- Determination of aeration porosity and oxygen diffusion rate
- Soil temperature measurements by different methods
- Estimation of water balance components in bare and cropped fields

SOILS 502 SOIL FERTILITY AND FERTILIZER USE 3+1

Objective

To impart knowledge about soil fertility and its control, and to understand the role of fertilizers and manures in supplying nutrients to plants so as to achieve high fertilizer use efficiency.

Theory

UNIT I

Soil fertility and soil productivity; nutrient sources - fertilizers and manures; essential plant nutrients - functions and deficiency symptoms.

UNIT II

Soil and fertilizer nitrogen - sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation - types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.

UNIT III

Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behavior in soils and management under field conditions.

UNIT IV

Potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions.

UNIT V

Sulphur - source, forms, fertilizers and their behavior in soils; calcium and magnesium- factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers.

UNIT VI

Micronutrients - critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.

UNIT VII

Common soil test methods for fertilizer recommendations; quantity-intensity relationships; soil test crop response correlations and response functions.

UNIT VIII

Fertilizer use efficiency; blanket fertilizer recommendations - usefulness and limitations; site-specific nutrient management; plant need based nutrient management; integrated nutrient management.

UNIT IX

Soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture.

Practical

- Principles of colorimetry
- Flame-photometry and atomic absorption spectroscopy
- Chemical analysis of soil for total and available nutrients
- Analysis of plants for essential elements

SOILS 503 SOIL CHEMISTRY 2+1

Objective

To introduce the classical concepts of soil chemistry and to familiarize students with modern developments in chemistry of soils in relation to using soils as a medium for plant growth.

UNIT I

Chemical (elemental) composition of the earth's crust and soils.

UNIT II

Elements of equilibrium thermodynamics, chemical equilibria,

electrochemistry and chemical kinetics.

UNIT III

Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories

of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids; soil organic matter - fractionation of soil organic matter and different fractions, clay-organic interactions.

UNIT IV

Ion exchange processes in soil; cation exchange- theories based on law of mass action (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept), adsorption isotherms, donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement, thermodynamics, statistical mechanics; anion and ligand exchange - innersphere and outer-sphere surface complex formation, fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions, shift of PZC on ligand exchange, AEC, CEC; experimental methods to study ion exchange phenomena and practical implications in plant nutrition.

UNIT V

Potassium, phosphate and ammonium fixation in soils covering specific and non-specific sorption; precipitation-dissolution equilibria; step and constant-rate K; management aspects.

UNIT VI

Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity.

UNIT VII

Chemistry of salt-affected soils and amendments; soil pH, ECe, ESP, SAR and important relations; soil management and amendments.

UNIT VIII

Chemistry and electrochemistry of submerged soils.

Practical

- Determination of CEC and AEC of soils
- Analysis of equilibrium soil solution for pH, EC, Eh by the use of Eh-pH meter and conductivity meter
- Determination of point of zero-charge and associated surface charge characteristics by the serial potentiometric titration method
- Potentiometric and conductometric titration of soil humic and fulvic acids
- (E4/E6) ratio of soil humic and fulvic acids by visible spectrophotometric studies and Ä (E4/E6) values at two pH values
- Adsorption-desorption of phosphate/sulphate by soil using simple adsorption isotherm
- Construction of adsorption envelope of soils by using phosphate/fluoride/sulphate and ascertaining the mechanism of the ligand exchange process involved
- Determination of titratable acidity of an acid soil by BaCl2-TEA method
- Determination of lime requirement of an acid soil by buffer method
- Determination of gypsum requirement of an alkali soil

SOILS 504 SOIL MINERALOGY, GENESIS, CLASSIFICATION AND SURVEY 2+1

Objective

To acquaint students with basic structure of alumino-silicate minerals and genesis of clay minerals; soil genesis in terms of factors and processes of soil formation, and to enable students conduct soil survey and interpret soil survey reports in terms of land use planning.

Theory

UNIT I

Fundamentals of crystallography, space lattice, coordination theory, isomorphism and polymorphism.

UNIT II

Classification, structure, chemical composition and properties of clay minerals; genesis and transformation of crystalline and non-crystalline clay minerals; identification techniques; amorphous soil constituents and other non-crystalline silicate minerals and their identification; clay minerals in Indian soils.

UNIT III

Factors of soil formation, soil formation models; soil forming processes; weathering of rocks and mineral transformations; soil profile; weathering sequences of minerals with special reference to Indian soils.

UNIT IV

Concept of soil individual; soil classification systems - historical developments and modern systems of soil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps - usefulness.

UNIT V

Soil survey and its types; soil survey techniques - conventional and modern; soil series - characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretations; soil mapping, thematic soil maps, cartography, mapping units, techniques for generation of soil maps.

UNIT VI

Landform - soil relationship; major soil groups of India with special reference to respective states; land capability classification and land irrigability classification; land evaluation and land use type (LUT) - concept and application; approaches for managing soils and landscapes in the framework of agro-ecosystem.

Practical

- Identification and quantification of minerals in soil fractions
- Morphological properties of soil profile in different landforms
- Classification of soils using soil taxonomy
- Calculation of weathering indices and its application in soil formation
- Grouping soils using available data base in terms of soil quality
- Aerial photo and satellite data interpretation for soil and land use
- Cartographic techniques for preparation of base maps and thematic maps, processing of field sheets, compilation and obstruction of maps in different scales
- Land use planning exercises using conventional and RS tools

SOILS 505 SOIL EROSION AND CONSERVATION 2+1

Objective

To enable students to understand various types of soil erosion and measures to be taken for controlling soil erosion to conserve soil and water.

Theory

UNIT I

History, distribution, identification and description of soil erosion problems in India.

UNIT II

Forms of soil erosion; effects of soil erosion and factors affecting soil erosion; types and mechanisms of water erosion; raindrops and soil erosion; rainfall erosivity - estimation as EI30 index and kinetic energy; factors affecting water erosion; empirical and quantitative estimation of water erosion; methods of measurement and prediction of runoff; soil losses in relation to soil properties and precipitation.

UNIT III

Wind erosion- types, mechanism and factors affecting wind erosion; extent of problem in the country.

UNIT IV

Principles of erosion control; erosion control measures - agronomical and engineering; erosion control structures - their design and layout.

UNIT V

Soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands.

UNIT VI

Watershed management - concept, objectives and approach; water harvesting and recycling; flood control in watershed management; socioeconomic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds; use of remote sensing in assessment and planning of watersheds.

Practical

- Determination of different soil erodibility indices - suspension percentage, dispersion ratio, erosion ratio, clay ratio, clay/moisture equivalent ratio, percolation ratio, raindrop erodibility index
- Computation of kinetic energy of falling rain drops
- Computation of rainfall erosivity index (EI30) using rain gauge data
- Visits to a watersheds

SOILS 506 SOIL BIOLOGY AND BIOCHEMISTRY 2+1

Objective

To teach students the basics of soil biology and biochemistry, including biogeochemical cycles, plant growth promoting rhizobacteria, microbial interactions in soil and other soil activities.

Theory

UNIT I

Soil biota, soil microbial ecology, types of organisms in different soils; soil microbial biomass; microbial interactions; un-culturable soil biota.

UNIT II

Microbiology and biochemistry of root-soil interface; phyllosphere; soil enzymes, origin, activities and importance; soil characteristics influencing growth and activity of microflora.

UNIT III

Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil; biochemical composition and biodegradation of soil organic matter and crop residues, humus formation; cycles of important organic nutrients.

UNIT IV

Biodegradation of pesticides, organic wastes and their use for production of biogas and manures; biotic factors in soil development; microbial toxins in the soil.

UNIT V

Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost.

UNIT VI

Biofertilizers - definition, classification, specifications, method of production and role in crop production.

Practical

- Determination of soil microbial population
- Soil microbial biomass
- Elemental composition, fractionation of organic matter and functional groups
- Decomposition of organic matter in soil
- Soil enzymes
- Measurement of important soil microbial processes such as ammonification, nitrification, N2 fixation, S oxidation, P solubilization and mineralization of other micro nutrients
- Study of rhizosphere effect

SOILS 507 GEOMORPHOLOGY AND GEOCHEMISTRY 2+0

Objective

To impart knowledge about the landforms, physiography and morphology of the earth surface, and distribution and weathering elements in the earth crust.

Theory

UNIT I

General introduction to geology and geochemistry, major and minor morphogenic and genetic landforms, study of schematic landforms and their elements with special reference to India.

UNIT II

Methodology of geomorphology, its agencies, erosion and weathering; soil and physiography relationships; erosion surface of soil landscape.

UNIT III

Geochemical classification of elements; geo-chemical aspects of weathering and migration of elements; geochemistry of major and micronutrients and trace elements.

SOILS 508 RADIOISOTOPES IN SOIL AND PLANT STUDIES 1+1

Objective

To train students in the use of radioisotopes in soil and plant research

Theory

UNIT I

Atomic structure, radioactivity and units; radioisotopes - properties and decay principles; nature and properties of nuclear radiations; interaction of nuclear radiations with matter

UNIT II

Principles and use of radiation monitoring instruments - proportional, Geiger Muller counter, solid and liquid scintillation counters; neutron moisture meter, mass spectrometry, auto radiography

UNIT III

Isotopic dilution techniques used in soil and plant research; use of stable isotopes; application of isotopes in studies on organic matter, nutrient transformations, ion transport, rooting pattern and fertilizer use efficiency; carbon dating

UNIT IV

Doses of radiation exposure, radiation safety aspects regulatory aspects, collection, storage and disposal of radioactive wastes

Practical

- Storage and handling of radioactive materials
- Determination of half life and decay constant
- Preparation of soil and plant samples for radioactive measurements
- Setting up of experiment on fertilizer use efficiency and cation exchange equilibria using radioisotopes
- Determination of A, E and L values of soil using 32P/ 65Zn
- Use of neutron probe for moisture determination
- Sample preparation and measurement of 15N enrichment by mass

SOILS 509 SOIL, WATER AND AIR POLLUTION 2+1

Objective

To make the students aware of the problems of soil, water and air pollution associated with use of soils for crop production.

Theory

UNIT I

Soil, water and air pollution problems associated with agriculture, nature and extent.

UNIT II

Nature and sources of pollutants - agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants - their CPC standards and effect on plants, animals and human beings.

UNIT III

Sewage and industrial effluents - their composition and effect on soil properties/health, and plant growth and human beings; soil as sink for waste disposal.

UNIT IV

Pesticides - their classification, behavior in soil and effect on soil microorganisms.

UNIT V

Toxic elements - their sources, behavior in soils, effect on nutrients availability, effect on plant and human health.

UNIT VI

Pollution of water resources due to leaching of nutrients and pesticides from soil; emission of greenhouse gases - carbon dioxide, methane and nitrous oxide.

UNIT VIII

Remediation/amelioration of contaminated soil and water; remote sensing applications in monitoring and management of soil and water pollution.

Practical

- Sampling of sewage waters, sewage sludge, solid/liquid industrial wastes, polluted soils and plants
- Estimation of dissolved and suspended solids, chemical oxygen demand (COD), biological demand (BOD), nitrate and ammoniacal nitrogen and phosphorus, heavy metal content in effluents
- Heavy metals in contaminated soils and plants
- Management of contaminants in soil and plants to safeguard food safety
- Air sampling and determination of particulate matter and oxides of sulphur
- Visit to various industrial sites to study the impact of pollutants on soil and plants

SOILS 510 REMOTE SENSING AND GIS TECHNIQUES FOR SOIL, WATER AND CROP STUDIES 2+1

Objective

To impart knowledge about the basic concepts of remote sensing, aerial photographs and imageries, and their interpretation; application of remote sensing in general and with special reference to soil, plants and yield forecasting; to impart knowledge about geo-statistical techniques with special reference to krigging, and GIS and applications in agriculture.

Theory

UNIT I

Introduction and history of remote sensing; sources, propagation of radiations in atmosphere; interactions with matter.

UNIT II

Sensor systems - camera, microwave radiometers and scanners; fundamentals of aerial photographs and image processing and interpretations.

UNIT III

Application of remote sensing techniques - land use soil surveys, crop stress and yield forecasting, prioritization in watershed and drought management, wasteland identification and management.

UNIT IV

Significance and sources of the spatial and temporal variability in soils; variability in relation to size of sampling; classical and geo-statistical techniques of evolution of soil variability.

UNIT V

Introduction to GIS and its application for spatial and non-spatial soil and land attributes.

Practical

- Familiarization with different remote sensing equipments and data products
- Interpretation of aerial photographs and satellite data for mapping of land resources
- Analysis of variability of different soil properties with classical and geostatistical techniques
- Creation of data files in a database programme
- Use of GIS for soil spatial simulation and analysis
- To enable the students to conduct soil survey and interpret soil survey reports in terms of land use planning

SOILS 511 ANALYTICAL TECHNIQUES AND INSTRUMENTAL METHODS IN SOIL AND PLANT ANALYSIS 0+2

Objective

To familiarize the students with commonly used instruments - their working, preparations of common analytical reagents for qualitative and quantitative analysis of both soil as well as plant samples.

Practical

UNIT I

Preparation of solutions for standard curves, analytical reagents, qualitative reagents, indicators and standard solutions for acid-base, oxidationreduction and complexometric titration; soil, water and plant sampling techniques, their processing and handling.

UNIT II

Determination of nutrient potentials and potential buffering capacities of soils for phosphorus and potassium; estimation of phosphorus, ammonium and potassium fixation capacities of soils.

UNIT III

Principles of visible, ultraviolet and infrared spectrophotometery, atomic absorption, flame-photometry, inductively coupled plasma spectrometry; chromatographic techniques, mass spectrometry and X-ray defractrometery; identification of minerals by X-ray by different methods.

UNIT IV

Electrochemical titration of clays; determination of cation and anion exchange capacities of soils; estimation of exchangeable cations (Na, Ca, Mg, K); estimation of root cation exchange capacity.

UNIT V

Analysis of soil and plant samples for N, P, K, Ca, Mg, S, Zn, Cu, Fe, Mn, B and Mo; analysis of plant materials by digesting plant materials by wet and dry ashing and soil by wet digestion methods.

UNIT VI

Determination of lime and gypsum requirement of soil; drawing normalized exchange isotherms; measurement of redox potential.

UNIT VII

Analysis of soil extracts and irrigation waters for their soluble cations and anions and interpretation of results.

SOILS 512 SYSTEM APPROACHES IN SOIL AND CROP STUDIES 2+1

Objective

To train the students in concepts, methodology, technology and use of systems simulation in soil and crops studies.

Theory

UNIT I

Systems concepts - definitions, general characteristics; general systems theory; systems thinking, systems dynamics, systems behavior and systems study.

UNIT II

Model: definition and types; mathematical models and their types; modeling: concepts, objectives, processes, abstraction techniques; simulation models, their verification and validation, calibration; representation of continuous systems simulation models - procedural and declarative.

UNIT III

Simulation - meaning and threats; simulation experiment, its design and analysis.

UNIT IV

Application of simulation models in understanding system behavior, optimizing system performance, evaluation of policy options under different soil, water, nutrient, climatic and cultural conditions; decision support system, use of simulation models in decision support system.

Practical

- Use of flow chart or pseudo-code in the program writing
- Writing a small example simulation model program - declarative (in Vensim PLE, Stella or Simile) and procedural (in Java, Fortran, QBasic or V Basic)
- Conducting simulation experiments in DSSAT, WOFOST or EPIC with requirement of report and conclusion

SOILS 513 MANAGEMENT OF PROBLEM SOILS AND WATERS 2+1

Objective

To educate students about basic concepts of problem soils and brackish water, and their management. Attention will be on management of problem soils and safe use of brackish water in relation to crop production.

Theory

UNIT I

Area and distribution of problem soils - acidic, saline, sodic and physically degraded soils; origin and basic concept of problematic soils, and factors responsible.

UNIT II

Morphological features of saline, sodic and saline-sodic soils; characterization of salt-affected soils - soluble salts, ESP, pH; physical, chemical and microbiological properties.

UNIT III

Management of salt-affected soils; salt tolerance of crops - mechanism and ratings; monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic and dry land soils.

UNIT IV

Acid soils - nature of soil acidity, sources of soil acidity; effect on plant growth, lime requirement of acid soils; management of acid soils; biological sickness of soils and its management.

UNIT V

Quality of irrigation water; management of brackish water for irrigation; salt balance under irrigation; characterization of brackish waters, area and extent; relationship in water use and quality.

UNIT VI

Agronomic practices in relation to problematic soils; cropping pattern for utilizing poor quality ground waters.

Practical

- Characterization of acid, acid sulfate, salt-affected and calcareous soils
- Determination of cations (Na+, K+, Ca++ and Mg++) in ground water and soil samples
- Determination of anions (Cl-, SO4—, CO3— and HCO3-) in ground waters and soil samples
- Lime and gypsum requirements of acid and sodic soils

SOILS 514 FERTILIZER TECHNOLOGY 1+0

Objective

To impart knowledge about how different fertilizers are manufactured using different kinds of raw materials and handling of fertilizers and manures.

Theory

UNIT I

Fertilizers - production, consumption and future projections with regard to nutrient use in the country and respective states; fertilizer control order.

UNIT II

Manufacturing processes for different fertilizers using various raw materials, characteristics and nutrient contents.

UNIT III

Recent developments in secondary and micronutrient fertilizers and their quality control as per fertilizer control order.

UNIT IV

New and emerging issues in fertilizer technology - production and use of slow and controlled release fertilizers, supergranules fertilizers and fertilizers for specific crops/situations.

SOILS 515 LAND DEGRADATION AND RESTORATION 1+0

Objective

To impart knowledge related to various factors and processes of land degradation and their restoration techniques.

Theory

UNIT I

Type, factors and processes of soil/land degradation and its impact on soil productivity, including soil fauna, biodegradation and environment.

UNIT II

Land restoration and conservation techniques - erosion control, reclamation of salt-affected soils; mine land reclamation, afforestation, organic products.

UNIT III

Extent, diagnosis and mapping of land degradation by conventional and modern RS-GIS tools; monitoring land degradation by fast assessment, modern tools, land use policy, incentives and participatory approach for reversing land degradation; global issues for twenty first century.

SOILS 601 ADVANCES IN SOIL PHYSICS 2+0

Objective

To provide knowledge of modern concepts in soil physics.

Theory

UNIT I

Soil-water interactions, soil water potential, free energy and thermodynamic basis of potential concept, chemical potential of soil water and entropy of the system.

UNIT II

Fundamentals of fluid flow, Poiseuilles law, Laplace's equation, Darcy's law in saturated and unsaturated flows; development of differential equations in saturated and unsaturated water flow, capillary conductivity and diffusivity; limitations of Darcy's law; numerical solution for one dimensional water flow.

UNIT III

Theories of horizontal and vertical infiltration under different boundary conditions.

UNIT IV

Movement of salts in soils, models for miscible-immiscible displacement, diffusion, mass flow and dispersion of solutes and their solutions through differential equations; break-through curves.

UNIT V

Soil air and aeration, mass flow and diffusion processes; thermal properties of soil, heat transfer in soils, differential equation of heat flow, measurement of thermal conductivity of soil.

UNIT VI

Soil crust and clod formation; structural management of puddled rice soils; soil conditioning- concept, soils conditioners - types, characteristics, working principles, significance in agriculture.

UNIT VII

Solar and terrestrial radiation measurement, dissipation and distribution in soil-crop systems; prediction of evapotranspiration using aerodynamic and canopy temperature-based models; canopy temperature and leaf diffusion resistance in relation to plant water deficit; evaluation of soil and plant water status using infra-red thermometer.

SOILS 602 ADVANCES IN SOIL FERTILITY 2+0

Objective

To provide knowledge of modern concepts of soil fertility and nutrient use in crop production.

Theory

UNIT I

Modern concepts of nutrient availability; soil solution and plant growth; nutrient response functions and availability indices.

UNIT II

Nutrient movement in soils; nutrient absorption by plants; mechanistic approach to nutrient supply and uptake by plants; models for transformation and movement of major micronutrients in soils.

UNIT III

Chemical equilibria (including solid-solution equilbria) involving nutrient ions in soils, particularly in submerged soils.

UNIT IV

Modern concepts of fertilizer evaluation, nutrient use efficiency and nutrient budgeting.

UNIT V

Modern concepts in fertilizer application; soil fertility evaluation techniques; role of soil tests in fertilizer use recommendations; site-specific nutrient management for precision agriculture.

UNIT VI

Monitoring physical, chemical and biological changes in soils; permanent manurial trials and long-term fertilizer experiments; soil productivity under long-term intensive cropping; direct, residual and cumulative effect of fertilizer use.

SOILS 603 PHYSICAL CHEMISTRY OF SOILS 2+0

Objective

To impart knowledge about modern concepts of physical chemistry of soils and clays, with emphasis on understanding the processes involved with practical significance.

Theory

UNIT I

Colloidal chemistry of inorganic and organic components of soils - their formation, clay organic interaction.

UNIT II

Predictive approaches for cation exchange equilibria - thermodynamics, empirical and diffuse double layer theory (DDL) - relationships among different selectivity coefficients; structure and properties of diffuse double layer.

UNIT III

Thermodynamics of nutrient transformations in soils; cationic and anionic exchange and their models, molecular interaction.

UNIT IV

Adsorption/desorption isotherms - Langmuir adsorption isotherm, Freundlich adsorption isotherm, normalized exchange isotherm, BET equation; selective and non-selective adsorption of ions on inorganic surfaces and organic surfaces of soil materials (citation of utility in agricultural system).

UNIT V

Common solubility equilibria - carbonates, iron oxide and hydroxides, aluminum silicate, aluminum phosphate; electrochemical properties of clays (citation of examples from agricultural use).

SOILS 604 SOIL GENESIS AND MICROPEDOLOGY 2+0

Objective

To impart knowledge about the pedogenic processes in soils and to acquaint with the micro-pedological study of soil profile.

Theory

UNIT I

Pedogenic evolution of soils; soil composition and characterization.

UNIT II

Weathering and soil formation - factors and pedogenic processes; stability and weathering sequences of minerals.

UNIT III

Assessment of soil profile development by mineralogical and chemical analysis.

UNIT IV

Micro-pedological features of soils - their structure, fabric analysis, role in genesis and classification.

SOILS 605 BIOCHEMISTRY OF SOIL ORGANIC MATTER 2+0

Objective

To impart knowledge related to chemistry and reactions of organic substances and their significance in soils.

Theory

UNIT I

Organic matter pools in soil; composition and distribution of organic matter in soil and its functions; environmental significance of humic substances; decomposition of organic residues in soil in relation to organic matter pools.

UNIT II

Biochemistry of the humus formation; different pathways for humus synthesis in soil; soil carbohydrates and lipids.

UNIT III

Nutrient transformation - N, P, S; trace metal interaction with humic substances, significance of chelation reactions in soils.

UNIT IV

Reactive functional groups of humic substances, adsorption of organic compounds by clay and role of organic substances in pedogenic soil aggregation processes; clay-organic matter complexes.

UNIT V

Humus - pesticide interactions in soil, mechanisms.

SOILS 606 LAND USE PLANNING AND WATERSHED MANAGEMENT 2+0

Objective

To teach the better utilization of land for agricultural purposes, and better management of run-off or surplus/ excessive rain-water in the catchment area for agricultural purposes in a watershed.

Theory

UNIT I

Concept and techniques of land use planning; factors governing present land use.

UNIT II

Land evaluation methods and soil-site suitability evaluation for different crops; land capability classification and constraints in application.

UNIT III

Agro-ecological regions/sub-regions of India and their characteristics in relation to crop production.

UNIT IV

Water harvesting - concept, significance, types, methodology; use of harvested water in agriculture to increase water productivity.

UNIT V

Watershed development/management - concept, objectives, characterization, planning, execution, community participation and evaluation; rehabilitation of watershed; PRA; developing economically and ecologically sustainable agro-forestry systems for watershed; case studies.

MCA 502 INTRODUCTION TO NETWORKING AND INTERNET APPLICATIONS 1+1

Objective

The course is aimed to provide fundamentals of networking and application protocols with the emphasis on developing web based applications.

Theory

UNIT I

Networking fundamentals, types of networking, network topology; Introduction to File Transfer Protocol (FTP), Telnet, Simple Mail Transfer Protocol (SMTP).

UNIT II

World Wide Web (WWW), working with Internet; Web pages, web sites, web servers; Web Applications.

UNIT III

Hyper Text Markup Language (HTML), DHTML, web based application development.

Practical

Network and mail configuration; Using Network Services; Browsing of Internet; Creation of web pages; Creation of websites using HTML and Creation of websites using DHTML.

STAT 511 / BST 511 STATISTICAL METHODS FOR APPLIED SCIENCES 3+1

Objective

This course is meant for students who do not have sufficient background of Statistical Methods. The students would be exposed to concepts of statistical methods and statistical inference that would help them in understanding the importance of statistics. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

Theory

UNIT I

Classification, tabulation and graphical representation of data. Box-plot, Descriptive statistics. Exploratory data analysis; Theory of probability. Random variable and mathematical expectation.

UNIT II

Discrete and continuous probability distributions: Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications. Concept of sampling distribution: chi-square, *t* and *F* distributions. Tests of significance based on Normal, chi-square, *t* and *F* distributions. Large sample theory.

UNIT III

Introduction to theory of estimation and confidence-intervals. Correlation and regression. Simple and multiple linear regression model, estimation of parameters, predicted values and residuals, correlation, partial correlation coefficient, multiple correlation coefficient, rank correlation, test of significance of correlation coefficient and regression coefficients. Coefficient of determination. Polynomial regression models and their fitting. Probit regression analysis by least squares and maximum likelihood methods, confidence interval for sensitivity; Testing for heterogeneity.

UNIT IV

Non-parametric tests - sign, Wilcoxon, Mann-Whitney U-test, Wald Wolfowitz run test, Run test for the randomness of a sequence. Median test, Kruskal- Wallis test, Friedman two-way ANOVA by ranks. Kendall's coefficient of concordance.

UNIT V

Introduction to multivariate analytical tools- Hotelling's T2 Tests of hypothesis about the mean vector of a multinormal population. Classificatory problems and discriminant function, D2-statistic and its applications; Cluster analysis, principal component analysis, canonical correlations and Factor analysis.

Practical

Exploratory data analysis, Box-Cox plots; Fitting of distributions ~Binomial, Poisson, Negative Binomial, Normal; Large sample tests, testing of hypothesis based on exact sampling distributions ~ chi square, t and F; Confidence interval estimation and point estimation of parameters of binomial, Poisson and Normal distribution; Correlation and regression analysis, fitting of orthogonal polynomial regression; applications of dimensionality reduction and discriminant function analysis; Nonparametric tests.

STAT 563 /BST 563 MULTIVARIATE ANALYSIS 2+1

Objective

This course lays the foundation of Multivariate data analysis. Most of the data sets in agricultural sciences are multivariate in nature. The exposure provided to multivariate data structure, multinomial and multivariate normal distribution, estimation and testing of parameters, various data reduction methods would help the students in having a better understanding of agricultural research data, its presentation and analysis.

Theory

UNIT I

Concept of random vector, its expectation and Variance-Covariance matrix. Marginal and joint distributions. Conditional distributions and Independence of random vectors. Multinomial distribution. Multivariate Normal distribution, marginal and conditional distributions. Sample mean vector and its distribution. Maximum likelihood estimates of mean vector and dispersion matrix. Tests of hypothesis about mean vector.

UNIT II

Wishart distribution and its simple properties. Hotelling's T2 and Mahalanobis D2 statistics. Null distribution of Hotelling's T2. Rao's U statistics and its distribution. Wilks' » criterion and statement of its properties. Concepts of discriminant analysis, computation of linear discriminant function, classification between *k* (e"2) multivariate normal populations based on LDF and Mahalanobis D2.

UNIT III

Principal Component Analysis, factor analysis (simple and multi factor models). Canonical variables and canonical correlations. Cluster analysis, similarities and dissimilarities, Hierarchical clustering. Single and Complete linkage methods.

UNIT IV

Path analysis and computation of path coefficients, introduction to multidimensional scaling, some theoretical results, similarities, metric and non metric scaling methods. Concepts of analysis of categorical data.

Practical

Maximum likelihood estimates of mean-vector and dispersion matrix; Testing of hypothesis on mean vectors of multivariate normal populations; Cluster analysis, Discriminant function, Canonical correlation, Principal component analysis, Factor analysis; Multivariate analysis of variance and covariance, multidimensional scaling.

1.4. COMPULSORY NON-GRADIAL COURSES

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary

Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/ Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; eresources access methods

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing **-** Various forms of scientific writings - theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills **-** Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and ranscription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

PGS 503 (e-Course) INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE 1+0

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

PGS 504 (e-Course) BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; Electric wiring and earthing. Preparation of media

and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

PGS 505 (e-Course) AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES 1+0

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group - Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co- operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

PGS 506 (e-Course) DISASTER MANAGEMENT 1+0

Objectives

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters - Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: Global warming, Sea level rise, Ozone depletion

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media.Central, state, district and local administration; Armed forces in disaster response; Disaster response: Police and other organizations.

2. COLLEGE OF BIOTECHNOLOGY

College of biotechnology offers undergraduate program (B.Tech, Biotechnology) which is accredited from all India council for technical education(AICTE). The undergraduate curricula have been designed to generate human resource with skills in the field of tissue culture, development of bio-pestisides, development of genetically engineered crop plants with improved quality and resistance to biotic and abiotic stresses. In addition to undergraduate program in biotechnology there is also a master program with the nama M.Tech (Biotectnology) there are eight constituent departments in the college of biotechnology as given below;

1- Immunology and Defence Mechanisms
2- Cell Biology
3- Physiology and Biochemistry
4- Commercial bio-technology
5- Melecolar biology and genetic engineering
6- Recombinant DNA Technology
7- Finger printing
8- Microbiology and Pathology

1. B.Tech (Biotechnology)

Course No.	Name of Course	Credits
BBB 110	Elementary Biology	3(2,0,1)
BPM 110	Elementary Mathematics	3(3,2,0)
APA 110	Elementary Agriculture	3(2,0,1)
BCP 110	Elementary Physics	2(1,0,1)
BHE 110	Elementary English	2(2,1,0)
BPC 110	Elements of Organic Chemistry	3(2,0,1)
BHE 210	Structural and Spoken English	2(1,1,1)
BTF 110	Structural Property of Nucleic Acid	2(2,0,0)
AET 110	Principles of Food Processing	3(2,0,1)
BTW 110	Work Program	1(0,0,1)
BPM 110	Fundamental of Computer	3(2,1,1)
BPS 210	Elementary Statistics	2(1,1,1)
BTB 310	Biochemistry -I	3(2,0,1)
BTM 210	Fundamental of Genetics	4(3,0,1)
BTC 110	Organic Evaluation of Life & molecules	2(2,0,0)
AET 120	Fluid Mechanics	3(2,1,1)
BTM 220	Principles of Molecular Genetics	3(2,0,1)
BTB 320	Biochemistry - II	3(2,0,1)
BTP 310	Microbiology	3(2,0,1)
BTC 310	Cell & Molecular Biology	4(3,0,1)
BPM 220	Information Technology	2(2,1,0)
BTR 310	Introductory to RDT Technology	3(2,0,1)
AET 210	Solid Mechanics	3(2,1,1)
AET 220	Thermodynamics	2(2,1,0)
BTC 320	Protein Synthesis	3(3,0,0)
BTC 330	Metabolism	3(3,0,0)

BTB 330	Biophysical Chemistry	4(3,0,1)
BPM 310	Data Management	2(2,1,0)
AET 340	Basics of Electronics	3(2,1,1)
BTI 310	Immunology	3(2,0,1)
AET 350	Basics of Instrumentation	3(2,0,1)
BTM 320	Gene Regulation	3(2,0,1)
BTP 410	Industrial Microbiology	3(2,0,1)
BPM 320	Computer Graphics	3(2,1,1)
AET 360	Heat Transfer Operation	3(2,0,1)
BTB 340	Enzymology	3(2,0,1)
BTO 310	Fermentation Technology	4(3,0,1)
BTR 410	Genomics & Functional Genomics	2(2,1,0)
BTR 320	Bioinformatics	2(2,1,0)
ACD 330	Communication Skills	3(2,0,1)
BTO 320	Bioseparation & Downstream Process	3(2,0,1)
BTM 330	Principles & Application of Genetic Engineering	4(3,0,1)
BTO 330	Bioprocess Engineering	3(2,0,1)
BTB 350	Enzyme Kinetics	3(2,0,1)
BTS 110	Seminar	1(0,0,1)
BTJ 110	Project	5
BTO 340	IPR, Biothics & Biosafety	2(2,0,0)
BTO 210	Tissue Culture Technology	3(2,0,1)
BTC 310	Environmental Biotechnology	3(2,0,1)
BTI 320/BTF 310	Animal Biotechnology / Plant Biotechnology	3(2,0,1)
BTJ 120	Project	10

DESCRIPTION OF COURSES

BBB 110 ELEMENTARY BIOLOGY 3 (2-0-1)

Introduction to the living world, Diversity and characteristics of life, Systems of classification. Theory of Binomial nomenclature. Classification of plants and animals, Histology of plants and animal tissues. Diversity of plants. Brief study of Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. Morphology of root, stem, leaf, inflorescence and flower. Systematics and ecology. Structure of cell and cell division. Heredity and genetics. Origin of life and evolution. Economic importance of plants.

Practicals based on above course.

BPM 110 ELEMENTARY MATHEMATICS 3 (3-2-0)

Co-ordinates: Distance between two points, coordinates of a point of divisions of straight line joining two points, area of triangle and quadrilateral, equation of straight line, change of axis, circle, parabola and ellipse. Simple problems based on them. Functions: Limit continuity, differentiation, equations of tangent and normal, maxima and minima. Methods of integration including integration by part. Definite integrals, application of definite integrals in finding areas under curves. Determinants: Matrices, matrix addition and matrix multiplication, transpose of matrix, solution of linear equations using Crammers rule.

APA 110 ELEMENTARY AGRICULTURE 3 (2-0-1)

Indian agriculture-scope and resources; crop plants and their significance as source of food, feed, fuel, and raw material for various industries; crop seasons and classification of crops. Soils- their formation, classification and physical properties. Essential plant nutrients, manures and fertilizers, uptake of N, P, & K by important crops, methods of manure and fertilizer application, composition of bulky organic manures, concentrated organic manures, green manures and various types of inorganic fertilizers. Irrigation and drainage- importance of water, quality of irrgation water; sources, methods and measurement of irrigation water. Cultivation of important crops in U.P.- wheat, rice, cotton, sorghum, maize, groundnut, rape seed and mustard, chickpea, pigeonpea, tobacco, berseem, potato and sugarcane. Acquaintance with horticultural crops such as- cabbage, cauliflower, onion, garlic, cucurbits, root crops, peas, tomato, brinjal, banana, apple, mango, litchi, guava. Introductory economics Factors of production, exchange, different types of markets, pricing, banks and credits. Study of main breeds of animals such as cows, buffalo, goat, sheep, and poultry. Care of animals and poultry management, common medicines. Different types of plough, mechanical devices, their management and cost. Necessity for drainage, prevention and formation of acidic and alkaline soils.

Practicals based on above course.

BCP 110 ELEMENTARY PHYSICS 2 (1-0-1)

Measurement of physical quantities, measurement of thickness, velocity and acceleration units and dimensions, Laws of motion: particle linematics, average velocity, instantaneous velocity, motion with constant acceleration. Freely falling bodies, force.. Newton's laws of motion, work and energy: work done by a constant force, kinetic and potential energy, power, conservation of energy, Oscillations: oscillating systems, simple harmonic motion, simple pendulum, Rotational dynamics: moment of inertia, kinetic energy of rotation, torque, combined rotational and translational motion. Temperature and heat: temperature and its measurements, heat capacity and specific heat, heat capacities of ideal gas. Light: visible light, speed of light, laws of reflection and refraction, Doppler Effect.

Practicals based on above course.

BHE 110 ELEMENTARY ENGLISH 2 (2-1-0)

Testing comprehension, interpretation and writing skills through - Unseen comprehension passages and Précis writing; Composition- letter writing, purpose / objective; Kinds: formal and informal; Letter Components: essential & optional elements; Letter Formats (Formal & Informal); Criteria for different types of letters: inquiry, complaint, placing order, sales, quotation, application, letters urging action, good news letters, bad news letters, letters of introduction, letters of certification, letters to friends, relatives, family members & acquaintances ; Bio-data writing - definition, characteristic features and writing of Bio-data; Dialogue- writing : definition, salient features of a well -written and spoken dialogue ; Single Sentence Definitions ; Grammar & Punctuation : For spotting errors / Editing in different parts of speech ; Punctuation - apostrophe, comma, period, colon, semi-colon, hyphen, dash, exclamation mark, ellipsis, parenthesis, mark of interrogation, quotation marks and capital letters ; Vocabulary Enrichment - Homonyms : their definition, meaning and usage in sentences.

Practicals based on above course.

BPC 110 ELEMENTS OF ORGANIC CHEMISTRY 3 (2-0-1)

Introduction, historical development, importance of organic compounds. The properties of carbon atom, bonding and electronic structures of organic compounds. Hydrocarbons, sources of hydrocarbons. Preparation, properties and importance of saturated and unsaturated hydrocarbons, halogen derivatives of hydrocarbons, alcohols, ethers, aldehydes and ketones, acids and their derivatives and amines. Cyclic compounds- hydrocarbons, benzene and its homologues, halogen derivatives, alcohols, phenols, aldehydes and ketones, acids and their derivatives and amines; heterocyclic compounds. Carbohydrates - introduction, classification, reactions of monosaccharides, disaccharides and poly saccharides. Lipids- classification, general properties, fat and oils, soaps and detergents, waxes, phospholopids, glycolipids and sterols. Amino acids and proteins- amino acids and their properties, sources of proteins, classification, structure, physical properties and function.

Practicals based on above course.

BHE 210 STRUCTURAL & SPOKEN ENGLISH 2 (1-1-1)

Structural patterns of communicative grammar; modern usages; functional language disorders and common structural errors in parts of speech- noun, pronoun, verb, adjective, adverb, preposition, conjunction, articles; word-formation and vocabulary building- affixes, prefixes, suffixes, synonyms, antonyms, one word substitutions and foreign words; prepositions; phrases and idioms; gerunds; participles; infinitives; time and tense; modal verbs; conditional parities; synthesis; transformation; controlled writing - paragraph writing; study of modern technical prose; listening and reading skills; comprehension; phonetic and scientific systems of Spoken English - speech mechanism; symbols and sounds; stress and intonation.

Practicals based on above course.

BTF 110 Structural Properties of Nucleic Acid 2 (2-0-0)

Discovery of DNA as a genetic material (history with contribution of different workers). Chemical component of DNA (Purines, pyrimidines, sugar, different bonds), Model of DNA (Watson and Crick, R-L model, Tertiary structures, A-type, B-type, Z-type), Reassociation kinetics (Cot value, chemical complexity, kinetic complexity, repetitive and Non-repetitive DNA), Nucleosome model (Chromatin, histone and non histone proteins, nucleosome phasing, higher order chromatin structures, nucleosomes during DNA replication and transcription, chromatin domains, heterochrmatin structure, epigenetic domains and epigenetic gene regulation), Bacterial chromosomes, Structure and functioning of mRNA, tRNA and rRNA.

AET 110 PRINCIPLES OF FOOD PROCESSING 3 (2-0-1)

Introduction, concept and scope of food processing unit operations: Cleaning, Grading, drying, milling, handling and transport and packaging and storage etc. Processing of cereals, pulses, oil seeds, fruits and vegetables, dairy product etc. By- product utilization. Low temperature preservation, thermal processing of food, fermented food, dehydration process for foods, concentration / evaporation.

Practicals based on above course.

BPM 120 FUNDAMENTAL OF COMPUTERS 3 (2-1-1)

Introduction of computer : Basic components and their functions, hardware and software, input-output devices, basic concepts and information. Binary, octal, decimal, hexadecimal number system. Bits and bytes, computer words coding (ASCII and EBCDIC), numeric data, Problem solving process, development of flow-chart, developing algorithms. Introduction to programming language 'C'. Program structure. Application of computers (Particularly database) in biology. Concept of operating system: functions, GUI, command based.

Practicals based on above course.

BPS 210 ELEMENTARY STATISTICS 2 (1-1-1)

Introduction: Meaning and definition of Statistics, scope, importance, use and limitations of Statistics. Variables, random variables, frequency, frequency distributions, discrete and continuous data. Measure of central tendency: meaning of measure of central tendency, requirements of good averages. Types of averages, arithmetic averages, positional averages, A.M, G.M, H.M, Median, Mode with their relative merit and demerit, uses and properties. Measure of Dispersion: Meaning of measure of dispersion. Different kinds of measure of dispersion, range quartile deviation, mean deviation, standard deviation. Merit, demerit and coefficients of different kinds of measure of dispersion. Coefficient of variation, Simple correlation and regression analysis.

Probability Theory: Definition probability: classical or Mathematical probability definition, Statistical definition, axiomatic definition. Examples based on above definition. Theorems of probability; additive theorem of probability and mathematical theorem of probability. Conditional probability. Hypothesis and test of significance: Definition of hypothesis, null hypothesis, alternative hypothesis. Two types of errors, type first error and type second error. Testing of significance, level of significance. Different test of significance, T-test, F-test, Z-test, Chi-square tests. Sampling theory: Census v/s sampling, advantages of sampling over census, limitations of sampling. Errors in sampling: sampling errors and non-sampling errors. Different sampling methods: probability sampling, simple random sampling, stratified sampling, systematic sampling, cluster sampling and non probability sampling, convenience sampling, area sampling.

Practicals based upon above course.

BTB 310 Biochemistry I 3 (2-0-1)

Properties of carbon & organic compounds. Properties of water, pH and buffer. Structure & function of Biomolecules: Amino acids & peptides, Proteins, Enzymes, Carbohydrates, Lipids, Biological membranes & transport across them and bioenergetics. Vitamins & coenzymes, Hormones, Nucleotides & Nucleic acids. Carbohydrate metabolism: Glycolysis & Citric acid cycle. Structural and functional studies of myoglobin, catalase, lysozymes.

Practicals based on above course.

BTM 210 Fundamental of Genetics 4 (3-0-1)

History and development of Genetics, Mendel's laws of inheritance, Lethality and gene interactions - pleiotropic genes, penetrance and expressivity, multiple alleles, structure of nucleus and chromosome - special types of chromosome, chromosome theory of inheritance, cell division - mitosis & meiosis, linkage, crossing over, Sex linked, sex influenced and sex limited traits, sex determination & differentiation, chromosome aberrations, structural & numerical mutations and mutagenic agents, cytoplasmic inheritance and maternal effects, fine structure of gene, organization of genetic material, quantitative inheritance.

Practicals based on above course.

BTC 110 ORGANIC EVOLUTION OF LIFE & MOLECULES 2 (2-0-0)

Origin of life: our universe, origin of solar system, origin of earth, origin of life (Biopolesis), Various theories of origin of life, naturalistic theory of origin of life, chemogony (nature of primitive life and its evolution), Evolution of life: organic evolution, diversity in living organism. Maintenance of life: the living crust of the earth, ecosystem, ecological pyramid, role of man in nature, theory of evolution- New Lamarckism, Darwin theory, mutation in evolution, New Darwinism, Human evolution

AET 120 FLUID MECHANICS 3 (2-1-1)

Introduction, fluid properties, fluid statistics, manometers, static forces on immersed and curved surfaces, Buoyancy, fluid kinematics, conservation of mass, stream function and velocity potential flow net, Euler's equation, Bernoulli's equation, momentum and angular momentum equations, Kinetic energy and momentum. Dimensional analysis- Rayleigh's method and Buckingham Pi theorem, dimensionless numbers, model scales. Pipe, flow energy losses, Darcy-Weibach equation, estimation of friction factor, minor loses, pipe flow computations, hydraulic gradient and total energy line. Open channel flow, velocity distribution, uniform flow, flow resistance equation, flow computations, flow measuring devices.

Practicals based on above course.

BTM 220 PRINCIPLES OF MOLECULAR GENETICS 3 (2-0-1)

Concept of the gene- molecular basis of inheritance, Molecular anatomy of the hereditary material- DNA structure, topology and topoisomerases, gene structure, chromosome structure and fundamental genome structure, Mechanism and regulation of cell division, Molecular mechanism of DNA replication and repair, Mutations- molecular basis, Recombination-mechanism and models, Molecular genetics of bacteria- plasmid, methods and hypotheses of conjugation, transformation and transduction, Molecular genetics of bacteriophage lamda- the genome packaging, replication and recombination, regulation of lytic cycle, regulation of lysogeny, *in-vitro* packaging, Molecular genetics of eukaryotes - gene structure & gene families, Genomic rearrangements-transposons/retroposons, Molecular genetics of organelles-mitochondria and chloroplast, Plant molecular genetics techniques and applications

Practicals based on above course.

BTB 320 BIOCHEMISTRY II 3 (2-0-1)

Introduction to thermodynamics. Carbohydrate metabolism Pentose phosphate pathway, galactose metabolism, gluconeogenesis, electron transport & oxidative phosphorylation, photosynthesis. Lipid biosynthesis, biosynthesis of fatty acids, membrane phospholipids, triacylglycerols, cholesterol and isoprenoid. Fatty acid oxidation. Amino acid oxidation (nitrogen extraction & urea cycle), Amino acid biosynthesis. Nucleotide biosynthesis (*DE novo* &

salvage pathways for purine/ pyrimidine biosynthesis). Degradation of nucleotides. Protein biosynthesis. Nitrogen metabolism.

Practicals based on above course.

BTP 310 Microbiology 3 (2-0-1)

Brief history and importance of microbiology. Prokaryotic and eukaryotic microbes: their cell structure. General account of fungi, bacteria and virus, their structural organization and classification. Microbial growth, nutrition and reproduction. Nature of viruses, organization of virion. Animal, plant and bacterial viruses. Bacterial reproduction. Distribution of microorganisms in nature. Soil microbes and their role in soil fertility and crop production. Microbes in human welfare- biofertilizers, biopesticides, antibiotics and compost. Microbial decomposition of agricultural waste. General account of fungal bacterial and viral diseases of plants, animals and human beings, causative agents, symptoms, mode of transmission and control.

Practicals based on above course.

BTC 310 CELL & MOLECULAR BIOLOGY 4 (3-0-1)

Basis of life, Introduction and history of Cell Biology, diversity of cell size and shape, cell theory, structure of prokaryotic and eukaryotic cells, nature of cytoplasmic matrix, chemical organization of cytosol, inorganic and organic compounds, Structure and functions of plasma membrane and cell wall, organelles of eukaryotic cell: Endoplasmic reticulum, Golgi apparatus, Lysosomes, Mitochondria, Plastids, Nucleus, Ribosomes.

Cytoskeleton, cell cycle, cell growth and cell division. Cell differentiation in plants and animals, difference between normal and cancer cells, Organization of genes and genome, Structure and functions of chromosomes, DNA and RNA. Cellular communication, Programmed cell death, Signal transduction.

Practicals based on above course.

BPM 220 INFORMATION TECHNOLOGY 2 (2-1-0)

Fundamental concepts of information: Definition of information, Need of information, Quality of information, Value of information, Concept of information Entropy, Information contents, Introduction to information representation in Digital Media, Text, Images, Graphics, Animation, Audio, Video etc. Introduction to JPEG, MPEG, MHEG and other IT industry Standards, Concepts of business data processing.

Computer & basic network concepts: Software development, Software Coding, Testing, Software Maintenance, QA, ISO, CMM, Need for data transmission over distances, Types of data transmission, Media for data transmission, Networking of Computers-Introduction of Lan and WAQN, Network Topologies, Basic Concepts in Computer networks, Client-Server Architecture, Communication protocols, Education Research Network (ERNET).

Internet and web technologies: Hypertext markup languages, DHTML, WWW, gopher, FTP, Telnet, Web browsers, Net Surfing, Search engines, Email, Basic concepts in E-commerce, Public key cryptography, Digital signatures, Network, Security, Firewall.

BTR 310 INTRODUCTION TO RECOMBINANT DNA TECHNOLOGY 3 (2-0-1)

DNA isolation, purification, handling and analysis: DNA isolation, purification and handling, Quantification of DNA content of a species (C-value, Chemical complexity), Microdensitometric analysis, Flow-Cytometery. Quantification of DNA in solution: Spectrophotometery, Gel Electrophoresis. Analysis of sequence Composition: Renaturation Kinetics (Kinetic Complexity), Sequencing, and Hybridization / DNA Probe (Radio & non Radiolabeled Probes)/ Southern Blotting. RNA isolation, purification, handling and analysis: RNA isolation, purification, and handling. Quantification of RNA in solution: spectrophotometery, Gel Electrophoresis. Analysis and / or quantification of RNA. Renaturation Kinetics, RT- reaction / c-DNA, Sequencing, EST, SAGE, Microarray/ DNA Chip, Hybridization / DNA Probes (radio & non radio labeled Probes)/ Northern Blotting, Subtractive Hybridization. Organization of Genomes of Viruses, prokaryotes and Eukaryotes. Mapping: Cytological, Genetic, and Physical maps. Cytological Maps, Mendel's laws of inheritance, Recombination frequency, Genetic maps, Molecular maps based on RAPD, RFLP, AFLP, SSR, SNP, AP-PCR, Sequencing, Physical mapping; FISH, STS/STMS, Restriction endonuclease maps, Genome Sequencing Projects (Human, Rice, etc.). Vectors; Cloning and Expression. Gene Identification and Isolation Strategies: Gene Identification and isolation based on Genomic and cDNA libraries,

PCR, Map based, Mutation using T -DNA, Transposons, and RNA-I, Antibody, and Protein. Cloning Strategies. General, Shot Gun and Hierarchical Cloning Strategies. Analysis and Modification of DNA Sequences. Transformation and Expression of Cloned Fragments. Uses of Recombinant DNA Technology in :Research; Medicine, Agriculture, Forensics, Other Commercial and Industrial Applications.

Practicals based on above course.

AET 210 SOLID MECHANICS 3 (2-1-1)

Introduction, fundamental of Engineering mechanics, concept of equilibrillum: general equilibrium equation, statistically determinate and indeterminate system, classification, Moment of forces and effect, Laws of Mechanics and properties of materials, principle of moments, stresses and strains and kinds of stresses and strains. Analysis of two dimensional stress and strains: Transformation equation for plane stress and strain, Mohr's circles for stress and strain. Mechanical behavior of materials, types of materials, tests of materials and strengths. Analysis of bars of varying sections, Tapering circular rods, Rectangular bar, Elastic constants, Support reactions, Types of loads, Analysis of frames, Center of gravity and Moment of interior shear stresses in beams, Bending stresses in beams, Deflection of beams, Deflection of Cantilevers, Shear force and bending moment diagrams. Torsion of circular shafts, deformation of circular shafts.

Practicals based on above course.

AET 220 THERMODYNAMICS 2 (2-1-0)

Introduction to thermodynamics Systems; Closed system, adiabatic system, isolated system, open system, homogenous system, intensive, extensive and specific properties, thermodynamics state, thermodynamics equilibrium. Temperature and zeroth law of thermodynamics. Pressure; Density, specific weight, specific volume and specific gravity, Energy; Internal energy, kinetic energy, potential energy, process, cycle. Different laws of thermodynamics. Pure substance; Phase of pure substance, P.V. diagram of vaporization process, ideal gases. First law of thermodynamics; For closed system, heat, work, electrical work, comparison between heat and work. Quasi equilibrium work; Isochoric process, isobaric process, isothermal process, polytropic process, adiabatic process, specific heat, P-V-T relations, Principle of conservation of energy, steady flow process, conservation of mass for steady flow process. Second Law of thermodynamics; Heat reservoirs, refrigerators and heat pumps, Air conditioners, Kelvin-Planck statements, clausius theorem and Entropy, Enthalpy. Thermodynamics Cycles; Diesel cycle, Otto Cycle. Heat engines; Types of engines, terminology related to engine, nomenclature of I.C. engine, working of two stroke and four stroke cycle engine, difference between two stroke and four stroke cycle engine, different parts of I.C. engine and their functions.

BTC 320 PROTEIN SYNTHESIS 3 (3-0-0)

General Consideration, Major Breakthrough in Protein Synthesis, Ribosome, rRNA and mRNA, Adaptor hypothesis, Central Dogma of molecular Genetics, Phases of Protein synthesis, Components in protein synthesis, Ribosome, tRNA, Activation of amino acids, Aminoacyl tRNA synthetases, Proof reading of some aminoacyl-tRNA synthetase, Genetic code, Direction of the growth of polypeptide chain, initiation of protein synthesis, translation of messenger RNA in 5'-3' direction, Shine- Dalgarno sequences, elongation of polypeptide chain, Codon recognition, peptide bond formation, Inhibitors of protein synthesis, eukaryotic protein synthesis, salient features of ribosomal protein synthesis, evolution of protein synthesis.

BTC 330 METABOLISM 3 (3-0-0)

Introduction and outlines of metabolism. Experimental approaches to study metabolism. High-energy compounds. Oxidation-reduction reactions. Carbohydrate Metabolism-glycolysis, TCA cycle and oxidative phosphorylation, metabolism of hexoses other than glucose, glycogen metabolism, pentose phosphate pathway. Metabolic pathways specific for microorganisms- fermentation: Anaerobic fate of pyruvate, Entner Duodroff Pathway, Glyoxylate cycle, Transketolase Cycle. Nitrogen metabolism-biological nitrogen fixation, plant growth regulators. Xenobiotic metabolism.

BTB 330 Biophysical Chemistry 4 (3-0-1)

Solution, Buffers and Media: Stock solutions, standard solutions, saturated solutions, buffers preparations. Centrifugation: Introduction, principle, types of centrifuges, type of rotors, ultra centrifugation, differential centrifugation, density gradient centrifugation, application and safety aspects. Electrophoresis: Introduction, principle, agarose gel electrophoresis of nucleic acids, ploy acrylamide gel electrophoresis, DNA sequencing gels, PFGE (pulse field gel electrophoresis), electrophoresis of proteins (SDS PAGE, Native gels, gradient gels, isoelectric focusing gels, 2-D PAGE, detection, estimation and recovery of proteins), capillary electrophoresis. Chromatographic techniques: Introduction, principle, sample preparation, adsorption chromatography, ion exchange chromatography, gas liquid chromatography, thin layer chromatography, paper chromatography, high performance liquid chromatography, affinity chromatography. Radiotracer techniques: Radioactivity, radio isotopes, types of radioactive decay, half life, measurement of radioactivity in biological samples (gas counters, scintillation counters), methods of labeling nucleic acids, auto radiography (principle and methods), use of radio isotopes and auto radiography in biological sciences, radiation exposure and biological affects, lethal dose, radioactive waste disposal, safety aspects. Spectroscopic techniques: Introduction, principal, ultraviolet and visible light spectroscopy.

Practicals based on above course.

BPM 310 DATA MANAGEMENT 2 (2-1-0)

Elements of database management system : Data base system concepts and architecture, data models scheme and instances, data independence and data base languages and interface, data definition languages, DML, Overall database structure, ER- model concepts, notation for ER diagrams, mapping constraints, Keys, Concept of super key, Candidate key, Primary key, Generalization, aggregation, reduction ER diagrams to tables, extended ER model, relationships of higher degree, relational data model concepts, integrity constraints, keys, domain constraints, referential integrity, assertions, foreign key, relational algebra.

RDBMS design & SQL: Functional dependencies, normal forms, first, second and third functional personal normal forms BCNF, Multi valued dependencies Codd's Rules, Examples of DBMS, SQL, Data definition queries and updates in SQL, Basic architecture, Data definition and manipulation.

AET 340 BASICS OF ELECTRONICS 3 (2-1-1)

Initial development in electronics, recent development in electronics, applications, evolution of electronics, evolution of transistors, evolution of computers, electronic components; passive components, resistors, classification of resisters, linear resistors, fixed resisters, variable resistors, non linear resistors. Thermistors; application of thermistors, resistor designation, capacitance, capacitors, classification of capacitors, inductance, inductors, type of inductors, voltage and current source, battery, regulated D.C. supply, concept of voltage source, ideal voltage source, practical voltage source, conversion of voltage source in to current source, conversion of current source in to voltage source. Structure of solids: classification of solid materials, insulators, metals and semiconductors on the basis of band gap, classification of semiconductors.Mobility and conductivity: conductivity and mobility for intrinsic semiconductors, mass action law, charge densities in N-type and P- type semiconductors. The hall effect and applications.Electrical properties of semiconductors, PN junction, biasing of a PN-junction.

Practicals based on above course.

BTI 310 IMMUNOLOGY 3 (2-0-1)

Non specific defense, Skin and mucous membranes, Phagocytosis, Inflammation, Fever, Antimicrobial substance, Immunity, Types of immunity, Types of immune system (Innate and Acquired immunity), Acquired immune response, Complement system, Antigens, Antigen processing and presentation, Antibodies (Structure, classes of Immunoglobulis), Genetics of antibodies, Antibody diversity, Cell culture products, Vaccines, Interferon, Recombinant proteins, Hybrid antibodies, Polyclonal and Monoclonal antibody, Antigens-Antibody interactions, Precipitation reactions, Immunodiffusion test, Counter current immnuoelectrophoresis, Agglutation reactions, Neutralization reactions, Radioimmunoassay, ELISA, DIBA, NASH, ISEM, Fluorescent antibody technique.

Practicals based on above course.

AET 350 BASICS OF INSTRUMENTATION 3 (2-0-1)

Introduction to instrumentation, functional elements of instruments and their preservation. Static performance characteristics, error and uncertainties in measurement systems. Dynamic performance characteristics. formulation of system equation, frequency response and Bode plot. Transducer elements: analog transducer, electromechanical and optoelectrical, digital transducer frequency domain, digital encoder, A-D converter, Intermediate elements: signal amplifiers, differentiating and integrating elements, indicating, recording & display elements. Digital voltmeter, CROS, servo potentiometric recorder, magnetic tape recorder, galvanometric recorders. Measurements and control of food processing parameters: temperature, pressure, flow measurement, specific gravity, viscosity, pH, humidity, moisture content etc.

Practicals based on above course.

BTM 320 GENE REGULATION (2-0-1)

Introduction of gene expression and regulation, Levels of gene expression and regulation, Prokaryotic gene regulation- Basic mechanism of transcription, structure of promoter, DNA binding proteins, sigma factors, mechanism of attenuation, operon systems (lac, trp and others), Eukaryotic gene regulation- general structure of eukaryotic promoter, cis acting elements and trans acting factors, control points to control gene expression, genomic control, transcriptional control, post transcriptional control, translational regulation, Regulatory RNAs (RNAi, Sn RNA etc), Antisense RNA technology, Reporter genes, Protein stability

Practicals based on above course.

BTP 410 INDUSTRIAL MICROBIOLOGY 3 (2-0-1)

History and scope of industrial microbiology. Major classes of products and processes. Microorganisms used in industrial processes. Industrial uses of microorganisms in production of lactic acid, vinegar, amino acid, insulin, alcohol, penicillin, citric acid and enzymes. Baker's and food yeasts. Fermentation and fermenting microbes: history and design of fermenters (bioreactors), basic function of fermenters, types of fermenters, design and operation, types of fermentations. Preparation of culture; methods of preservation and maintenance of microorganisms. Microbiology of milk and milk products: yoghurt, kefir, and koumiss, butter milk, butter cheese, perin. Microbial contamination of meat: types of meat spoilage. Food preservation methods. Petroleum microbiology.

Practical based on above course.

BPM 320 COMPUTER GRAPHICS 3 (2-1-1)

Graphics input, Storage and communications. Display devices, Scan conversion. Introduction of programming Languages for CAD. An overview of C Programming Languages. Computer graphics, Transformations. Graphics programming; Graphics standards, Graphical Kernal System (GKS): Introduction, output, Co-ordinate system and transformations, input, segments, Metafiles operating states, levels, Programming examples in GKS, Computer aided draftings.

Practical based on above course.

AET 360 HEAT TRANSFER OPERATION 3 (2-0-1)

Introduction, unit operations and classification, conversion factors, conduction through rectangular block, thick cylinder, sphere, concept of long mean radius for thick walled cylinders. Variation of thermal conductivity with temperature, critical thickness of insulation, convection, natural and forced convection, film coefficient and its comparison with thermal conductivity. Derivation of overall heat transfer coefficient from hot fluid to cold fluid through a metal wall. Effect of surface coefficient on overall heat transfer. Dimensional analysis for heat transfer. Co-current and counter current heat exchanger. Knowledge of various types of heat transfer equipments and their specific uses. Diffusion and mechanism, molecular diffusion, concept of distillation, concept of degrees of freedom, Constant boiling diagram, methods of distillation.

Practical based on above course.

BTB 340 ENZYMOLOGY 3 (2-0-1)

Introduction and historical perspective: Introduction to enzymes; Enzyme structure, Classification & nomenclature, Specificity of enzyme action; Types of Specificity, Active site, Fischer lock & key hypothesis, Koshland induced fit hypothesis, Hypothesis involving strain transition state stabilization. Monomeric and oligomeric enzymes. Introduction to enzyme kinetics. Investigation of active site structure (Mapping the enzyme-substrate complex, use of substrate analogues, enzyme modification by chemical procedures). Effect of pH & enzyme stability, Effect of temperature & Transition state theory. Allosteric enzymes, basic concepts, positive & negative effectors. Investigation of enzymes in biological preparations: Extraction, Assay and Purification of enzymes, Application of enzymes in medicine and industry, Biotechnological application of enzymes (Large scale production), Immobilized enzymes and their applications, Enzymes and recombinant DNA technology.

Practicals based on above course.

BTO 310 FERMENTATION TECHNOLOGY 4 (3-0-1)

Introduction to fermentation. Selection for new metabolites. Strain development. Microbial growth kinetics. Substrates for industrial fermentation. Batch, Fed batch & Continuous culture of microbial cells. Microbial production of industrial enzymes: Proteolytic enzymes (Protease), Hydrolytic enzymes (Pectinases, Lipases), others like Glucose isomerase. Industrial fermentation for the production of antibiotics (Penicillins, Streptomycin, Cephalosporins), Healthcare products (Anticancer agents, pharmacologically active products), Food & Beverages (Ethanol, Lysine, Glutamic acid, Cheese, Starters) & other chemicals (Citric acid, Acetic acid).

Practical based on above course.

BTR 410 GENOMICS & FUNCTIONAL GENOMICS 2 (2-1-0)

Structural Genomics: Genome organization in prokaryotes and eukaryotes, Mapping, genome sequencing, Bioinformatics (Genome Databases). Functional Genomics: Forward Reverse Genetics, Transcriptomics (c-DNA library, EST, SAGE, DNA-CHIP). Proteomics (proteome, 2-D Gel Electrophoresis, Protein identification (immunoaffinity chromatography) and purification, Peptide fingerprinting, Mass Spectroscopy, Protein--Protein interaction (Yeast Two Hybrid System), Surface Plasmone Resonance (SPR) technique), Bioinformatics (protein databases), Metabolomics (Metabolite profiling (identification and purification)). Comparative and Evolutionary Genomics: Genome evolution and Synteny.

BTR 320 BIOINFORMATICS 2 (2-1-0)

Historical Introduction and Overview: Networks, Databases, and Information submission, retrieval and analysis. Information Networks: Internet, World Wide Web, Web browsers, HTTP, HTML, URLs, EMBnet, NCBI. Protein information Resources Databases: Biological databases, Primary sequence databases, Composite protein sequence databases, Secondary databases, Composite protein pattern databases, structure classification databases. Genome information Resources / Databases: DNA sequence databases (Genome sequence, EST, Gene expression, Transcription factor binding sites, Maps etc.), Specialized genomic resources. Submission of Sequences (protein, DNA, RNA) in Databases: Sequencing, Submission, Sequence accuracy, Computer storage of Sequence, Sequence formats, Conversion of one sequence format to another, Multiple sequence formats, Storage of information in a sequence database, Using the database access program ENTERZ. Pairwise sequence alignment: Definition, Significance and Methods of sequence alignment. Multiple sequence alignment: Uses, Relationship of multiple sequence alignment to phylogenetic analysis and Methods. Database searching: Introduction (Sequence similarity search with a single query sequence, fast searches, DNA V/s Protein searches, Scoring matrices for similarity searches PAM250, BLOSUM62, other scoring matrices), Methods (FASTA, BLAST, PSI-BLAST and other methods). Analysis of Information in Databases: Phylogenetic Predictions, Gene Predictions, Prediction of RNA secondary structure, Analysis of sequences (Genome, Transcriptome, Proteome etc.).

ACD 330 COMMUNICATION SKILLS 3 (2-0-1)

Fundamental of Communication; Meaning, Process and importance of Communication, models of communication, barriers to communication, essentials of good Communication. Modes of Human Communication; Styles of communication, speaking, reading, writing & listening and non-verbal communication. Spoken Communication; Meaning and importance of this mode, effective presentation techniques, structure of an extension talk, Essential

qualities of a speaker. Written Communication; Fundamental of sentence & paragraph structure, tips for effective news and paragraph writing, features of written communication. Writing for easy reading. The Silent Communication; Non-verbal Communication meaning, type and characteristics. Use of Audio-Visual Aids for effective communication; The role of audio-visuals in communication, designing overhead transparencies. Meeting; Purpose, types, procedure, planning, strategies and minute.

Practicals based on above course.

BTO 320 BIOSEPARATION & DOWNSTREAM PROCESS 3 (2-0-1)

Introduction: An overview of Bioseparation, Separation of cells from fermented broth. Filteration & ultrafilteration. Centrifugation. Cell Disruption: Physical methods (osmotic shock, grinding with abrasives, solid shear, liquid shear), Chemical methods (alkali, detergents), Enzymatic methods. Product Isolation: Liquid-liquid extraction, Chromatography (Molecular sieve, Affinity, Hydrophobic, Ion Exchange & HPLC), Distillation.

Practicals based on above course.

BTM 330 PRINCIPLES AND APPLICATION OF GENETIC ENGINEERING 4 (3-0-1)

Basic concepts of gene cloning, Different types of gene transfer systems in plants and animals, Host-vector system - general characteristics of the vectors used in genetic engineering-viz. plasmid vectors, M 13 vectors, lambda vectors, cosmids, phagemids, artificial chromosomes, Tools of genetic engineering- enzymes used in gene cloning, Strategies of ligation and cloning, Genomic DNA and cDNA cloning, Genomic and cDNA library preparation, screening of libraries, Genome mapping and Marker assisted selection, Gene sequencing: Sanger's Method, Maxam- Gilbert method and automated sequencing, Site-directed mutagenesis & applications, Expression vectors, Expression of cloned genes, Applications of genetic engineering

Practicals based on above course.

BTO 330 BIOPROCESS ENGINEERING 3 (2-0-1)

Bioreactor Design, Operation & Control: transport phenomena in bioprocess. Brief overview of bioreactors, design features & operation of stirred tank, air lift & fluidized bed reactors. Techniques of immobilization of enzymes of whole cells. Application of immobilized enzymes & whole cell system. Secondary metabolite production through hairy root cultures, bioprocess parameters for scale up of hairy root cultures. Upstream Processing: media for industrial fermentation, media sterilization, aeration & agitation in aerobic fermentations, selection criteria for fermentation, air filters.

Practical based on above course.

BTB 350 ENZYME KINETICS 3 (2-0-1)

Kinetics of single--substrate enzyme-catalyzed reactions. Effect of substrate concentration, Derivation of Michealis Menton equation, Line-weaver berk plot. Ks, Km, Vmax, Kcat & their significance. Methods to determine Km & Vmax. Enzyme inhibition (Competitive, Uncompetitive, Non-competitive, Mixed, Partial, Substrate, Allosteric, and Irreversible inhibition). Introduction to kinetics of multi-substrate enzyme catalyzed reactions (ping-pong bi-bi mechanism, random order). Chemical nature of enzyme catalysis (Acid base, electrostatic, covalent and enzyme catalysis), Mechanism of enzymes without cofactors, Metal activated enzymes and metalloenzymes, Coenzymes. Binding of ligands to proteins (Cooperativity, positive, homotropic cooperativity and Hill equation, Adair equation). Sigmoidal kinetics and allosteric enzymes - Monad- Wyman- Changeux (MWC) model, Koshland-Nemethhy-Filmer (KNF) model. Enzyme reaction mechanism, group transfer reactions, oxidation - reduction reaction, elimination - substitution reaction. Kinetics of mixed inhibition. Computer simulation of regulatory enzyme.

Practicals based on above course.

BTO 340 IPR, BIO-ETHICS & BIOSAFETY 2 (2-0-0)

Salient features: Intellectual property, Patents, Copyright, and Trademarks. Patent Act (1970), Patent Act (2002). Different types of patents & specifications. Filing & processing of applications for patents. Biopiracy. Biodiversity in context to IPRs.

Ethical Issues: definition & scope of bioethics, approaches for ethics, ethical issues in transgenics, gene therapy & cloning.

Biosafety of Transgenics: requirement for the assessment of food safety, limitations of risk assessment, Codex Alimentarious Commission (CAC). International biosafety protocol & CBD.

BTO 210 TISSUE CULTURE TECHNOLOGY 3 (2-0-1)

Planning & organization of a tissue culture laboratory. Basic techniques in plant & animal tissue culture, culture media & culture methods. Animal Cell Culture: Basic principles, Serum free & serum based media, Scaling up, characterization & preservation of cell lines. Plant Tissue Culture: Fundamentals, Cellular totipotency, Callus, Direct organogenesis. Induction & maintenance of callus/ suspension cultures. Measurements of growth parameters. Role of tissue culture in rapid clonal propagation, production of pathogen free plants. Somatic embryogenesis & synthetic seeds. Somaclonal variations. Haploid production. Isolation & culture of protoplasts, protoplast fusion, Identification & characterization of somatic hybrids.

Practicals based on above course.

BTP 320 ENVIRONMENTAL BIOTECHNOLOGY 3 (2-0-1)

Introduction, pollution monitoring, biotechnological treatment of waste, introduction of water microbiology, water borne infectious agents, detection and control of pathogenic microbes in water, sewage and sludge, physical, chemical and biological characteristics of waste water, waste water treatment, activated sludge process, biological nutrient removal, biotransformation and biodegradation of pollutants, Biodegradation of lignocelluloses and agricultural residues, use of fungi in biodegradation, molecular and biological techniques in characterization of microorganism in environment, Emerging technologies: bioreporters, biosensors and microprobes.

Practicals based on above course.

BTI 320 / BTF 310 ANIMAL BIOTECHNOLOGY / PLANT BIOTECHNOLOGY 3 (2-0-1)

Animal biotechnology

Introduction to Animal biotechnology, objectives of gene transfer, Vectors, Gene constructs, Promoters, Reporter or Marker Genes, Transfection methods, Heterologus gene expression, Embryonic stem cell transfer, Targetted gene transfer, Transgene interaction, Recovery of genes transferred into animal cells, High levels expression of transgene in animals cells, Detection of transgenes and development of transgene function, Transgenic animal, Enhanced trapping, Cell culture products, *In-vitro* fertilization, Embryo transfer, Animal cloning, Animal tissue culture, Organ culture, Cell culture, Culture media, Initiation of cell culture, Somatic cell fusion, Hybridoma technology, Bioethics.

Practicals based on above course.

Plant Biotechnology

Historical perspectives of Biotechnology: Genetic engineering tools: Restriction enzymes, Ligases, Different vectors, Transformation of E.coli, Screening methods of recombinant clones, Construction & screening of genomic library, construction of cDNA library and its screening, Laboratory organization and tissue culture media; Cell, Tissue and Organ culture, Cryopreservation; Protoplast culture and applications; Plant regeneration and hardening; Micro-propagation of disease free plants; Somaclonal variation, Production of haploid plants; Bio-transformation. Production of secondary metabolites; Transgenic plants: gene constructs, vectors and transformation methods Commercialization of transgenic plants, Development of insect resistance herbicide resistance, salt and drought resistance in plants. IPRs and biosafety guidelines, Molecular markers and construction of maps; Molecular breeding and DNA fingerprinting. PCR: Principle, Types of PCR and Application.

Practicals based on above course.

POST GRAGUATE PROGRAMME

M.Tech/M.Sc Biotechnology

Core Course

S. No.	Code	Course Name	Credits	Offering Department
1.	BTB- 510	Advance Biochemistry	(2+0)	Biochemistry & Physiology
2.	BTA- 510	Advance Techniques in Biotechnology	(0+3)	All departments 3.
	BTP- 510	Microbial Physiology & Genetics	(2+0)	Pathology & Microbiology 4.
	BTI-510	Principles of Immunology	(2+0)	Immunology & DM
5.	BTM-530	Principles of Molecular Biology and Genetic Engineering	(2+0)	MDGE
6.	BTF-510	Plant Biotechnology	(2+0)	Finger Printing 7.
	BTC-510	Recent Developments in Cell Biology	(2+0)	Cell Biology
		Total Credit	15	

Optional Course

8.	BTI- 520	Bioinformatics	(1+0)	Immunology & DM
9.	BTB-520	Proteomics	(2+0)	Biochemistry & Physiology
10.	BTP-520	Environmental Biotechnology	(2+0)	Pathology & Microbiology
11.	BTO-510	Industrial Biotechnology	(2+0)	Commercial Biotechnology
12.	BTR-510	Genomics & Epigenomics	(2+0)	Recombination Technique
13.	BTC-520	Cell Signaling	(2+0)	Cell Biology 14. BTM-520
	Molecular Genetics		(2+0)	MBGE 15. BTI-530
	Radio Isotopetracer diagnostic		(1+1)	Immunology & DM 16.
	BTM-540	Protein Engineering	(2+0)	MBGE 17. BTM-550
	Nanotechnology		(2+0)	MBGE 18. BTF-520
	Bio-safety, IPR, Patents and entreprensurship		(2+0)	Finger Printing

Supporting Course

19.	BTP-530	Advanced Microbial Techniques	(2+1)	Pathology & Microbiology
20.	BTM-510	Principles of Genetics	(3+0)	MBGE
21.	BTS-510	Seminar	(1+0)	
		Total credits	28	
22.	BTT-510	Thesis	15	
		Total credits	45	

*A student shall offer minimum ten and maximum fifteen credit hours in one semester.

First Semester

Course No	Course Name	Credits
BTC-510	Recent Developments in Cell Biology	(2+0)
BTI-510	Principles of Immunology	(2+0)
BTM-530	Principles of Molecular Biology and Genetic Engineering	(2+0)
BTF-510	Plant Biotechnology	(2+0)
BTM-510	Principles of Genetics	(3+0)
BTP-530	Advanced Microbial Techniques	(2+1)

Second Semester

Course No	Course Name	Credits
BTB- 510	Advance Biochemistry	(2+0)
BTA- 510	Advance Techniques in Biotechnology	(0+3)
BTM-540	Protein Engineering	(2+0)
BTI-530	Radio Isotopetracer diagnostic	(1+1)
BTP- 510	Microbial Physiology & Genetics	(2+0)

BTF-520	Bio-safety, IPR, Patents and entreprensurship	(2+0)
BTM-520	Molecular Genetics	(2+0)

Third Semester

Course No	Course Name	Credits (
BTC-520	Cell Signaling	2+0)
BTI- 520	Bioinformatics	(1+0) (
BTO-510	Industrial Biotechnology	2+0)
BTS-510	Seminar	(1+0)
BTR 510	Genomics & Epigenomics	(2+0)
BTB 520	Proteomics	(2+0)

Fourth Semester

Course No	Course Name	Credits
BTT-510	Thesis	15
BTP 520	Environmental Biotechnologies	(2+0)
BTM 550	Nanotechnology	(2+0)

BTR- 510 ADVANCED BIOCHEMISTRY (2-0-0)

Biomolecules; Metabloism of carbohydrates, lipids and amino acids; secondary metablolites; Photosynthesis; Protein Structure: amino acids, primary structure, secondary structure, Ramachandran plot, tertiary structure, supramolecular structures, protein-protein interactions, protein 0ligand interactions, protein denaturation anf folding, X-Ray diffraction, nuclear magnetic resonance; Membrane biochemistry: composition and architecture of membranes, membrane dynamics, solute transport across membranes; Industrial enzymes; Novel diagnostic methods including biosensors and treatment of diseases including gene therapy and drug design.

BTA- 510 ADVANCE TECHNIQUES IN BIOTECHNOLOGY (0+3)

Molecular biology pertains to the study of living systems at the molecular level, especially DNA and RNA, and provides a background appropriate for further work in the rapidly expanding areas of genomics, cell biology, biotechnology, microbiology, diagnostics, and therapeutics. This course will focus on selected aspects of molecular biology that provide the non-specialist with the principles for understanding the structure and functional relationships of molecular biology techniques including DNA manipulation, sequencing, cloning, subcloning, library construction, screening, RNA isolation and characterization, analysis of expression, cDNA synthesis (RT-PCR) and analysis, microarrays and gene chips, and Real-Time-PCR. Multiple modern day molecular biology techniques in the biotechnology and pharmaceutical industries will be presented and several examples of molecular applications will be highlighted.

BTP 530 ADVANCED MICROBIAL TECHNIQUES (2-1)

Rapid detection of microorganism by PCR, Isolation of microorganism from air, soil, water, food, animals, plants and environmental samples. Microscopic examination of microorganism, staining methods, Control of microorganism, Preparation of culture media isolation of microorganism from rhizosphere, methods of pure cultures techniques, maintenance of pure cultures, Biochemical characterization of microorganism, identification of unknown microorganism.

BTP- 510 MICROBIAL PHYSIOLOGY & GENETICS (2-0)

Anatomy of bacterial cells, Function of bacterial cell parts, Proteins of bacterial membranes, Outer membranes of Gram negative bacteria, Assembly of peptidoglycan, Action of penicillins, Bacterial transport mechanisms, Group translocation; ABC transporters, Protein targeting, Bacterial motility and chemotaxis, Signal transduction in bacterial chemotaxis, Exchange of genetic information in bacteria, Overview of metabolism and assembly reactions, Polymerization reactions, Biosynthetic pathways in bacteria, Physiological adaptive responses in the biosynthetic pathways: control of enzyme activity, Fueling reactions in bacterial metabolism, Cellular differentiation in bacteria, Microorganisms and their environments, Bacterial genetics: physiological adaptive responses involving regulation of gene expression, Regulation of gene expression in bacteria, Multi-gene regulatory systems for controlling gene

expression in bacteria, Control of bacterial gene expression by "two-component" regulatory systems, Translation as a regulatory control point, Yeast: overview, cell structure and protein sorting, Regulation of gene expression in yeast, Yeast as a tool in molecular biology Yeast mating and switching, Physiological adaptive responses to nutrient availability in yeast: role of RAS and adenylate cyclase, Yeast cell cycle

BTI - 210 PRINCIPLES OF IMMUNOLOGY (2-0)

Components of innate and acquired immunity; Phagocytosis; Complement and Inflammatory responses; Haematopoesis; Organs and cells of the immune system- primary and secondary lymphoid organs; Lymphatic system; Lymphocyte circulation; Lymphocyte homing; Mucosal and Cutaneous associated Lymphoid tissue.(MALT&CALT); Mucosal Immunity; Antigens - immunogens, haptens; Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility, HLA typing; Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, antigenic determinants; Multigene organization of immunoglobulin genes; B-cell receptor; Immunoglobulin superfamily; Principles of cell signaling; Immunological basis of self -non-self discrimination; Kinetics of immune response, memory; B cell maturation, activation and differentiation; Generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; Functional T Cell Subsets; Cell-mediated immune responses, ADCC; Cytokines-properties, receptors and therapeutic uses; Antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens; Cell-cell co-operation, Hapten-carrier system; Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; Surface plasmon resonance, Biosenor assays for assessing ligand -receptor interaction, CMI techniques- lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays, Apoptosis, Microarrays, Transgenic mice, Gene knock outs; Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries. Immunity to Infection : Bacteria, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity - Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; Transplantation - Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy; Tumor immunology - Tumor antigens; Immune response to tumors and tumor evasion of the immune system, Cancer immunotherapy; Immunodeficiency-Primary immunodeficiencies, Acquired or secondar y immunodeficiencies.

BTM-530 PRINCIPLES OF MOLECULAR BIOLOGY & GENETIC ENGINEERING (2-0-0)

Structure of DNA and RNA, Different forms of DNA and their relevance, Folding of DNA and RNA, Structural and functional correlation of nuclic acid,, Recent advances in nucleic acid & plant molecular biology research. Introduction and historical perspective; restriction enzymes & vectors; gene cloning identification, isolation and synthesis; *in vitro* regeneration in crop plants; gene transfer systems- *vector* mediated, microinjection, electroporation, microprojectile, other direct and indirect DNA uptake techniques; selection markers and reporter system; gene silencing; application of plant genetic engineering and biotechnology - current status and future prospects; transgenic crops; biochemical and DNA based markers (RFLP, RAPD, AFLP, STS, SCARS, SSLP *etc).*

BTR- 510 PLANT BIOTECHNOLOGY (2 +0)

Historical perspective; Totipotency; Organogenesis; Somatic embryogenesis; Regulation and applications; Artificial seed production; Micropropagation; Somaclonal variation; Androgenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation. Protoplast isolation; Culture and usage; Somatic hybridization - methods and applications; Cybrids and somatic cell genetics. *Agrobacterium*-plant interaction; Virulence; Ti and Ri plasmids; Opines and their significance; T-DNA transfer; Disarming the Ti plasmid. *Agrobacterium*-mediated gene delivery; Cointegrate and binary vectors and their utility; Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods; Screenable and selectable markers; Characterization of transgenics; Chloroplast transformation; Marker-free methodologies; Gene targeting. Quantitative and qualitative traits; MAS for genes of agronomic importance, e.g. insect resistance, grain quality and grain yield; Molecular polymorphism, RFLP, RAPD, STS, AFLP, SNP markers; Construction of genetic and physical map; Gene mapping and cloning;

QTL mapping and cloning. Herbicide resistance; Drought, salinity, thermal stress, flooding and submergence tolerance. Seed storage proteins; Source-sink relationships for yield increase; Post-harvest bioengineering; Plant architecture; Flowering behaviour Concept of biofactories; Cell cultures for secondary metabolite production; Identification of candidate genes using genetic information (positional cloning), using biochemical and expression analysis (microarray analysis, proteomics, metabolomics); Characterization and functional analysis of candidate genes: Plant genetic resources; Patenting of biological material; Plant breeders rights (PBRs) and farmers rights; Biosafety and containment practices

BTC- 510 RECENT DEVELOPMENT IN CELL BIOLOGY (2-0-0)

Electron Microscopy, Ultrastructures of cell organelles and their functions, Microbodies (Peroxisomes, Glyoxysomes) and their functions, Nucleus, Nuclear Organizing Regions (NOR) and their role, Various models of chromosome organization, C-value paradox, Nucleosome and Solanoid models of chromatin, Euchromatin & Hetrochromatin (Junk protein) and applications, Banding techniques, Plasmagenes, Transposable elements (Transposons) and their applications, Regulatory mechanism of transcription, translation and RNAi, Basic idea of functional genomics and proteomics for commercial cell protein production. Nitrate reductase, Gene transfer for commercial protein production, Delayed ripening genes through anti-sense RNA technology, Transgenesis.

BTI-520 BIOINFORMATICS (1-0)

Sequence databases; Similarity matrices; Pairwise alignment; BLAST; Statistical significance of alignment; Sequence assembly; Multiple sequence alignment; Clustal; Phylogenetics: distance based approaches, maximum parsimony, Motif representation: consensus, regular expressions; PSSMs; Markov models; Regulatory sequence identification using Meme; Gene finding: composition based finding, sequence motif-based finding, Representation of molecular structures (DNA, mRNA, protein), secondary structures, domains and motifs; Structure classification (SCOP, CATH); Visualization software (Pymol, Rasmol etc.); Experimental determination of structures (X-ray crystallography, NMR); Structure databases; Secondary structure prediction; RNA structure prediction; Mfold; Protein structure prediction by comparative modelling approaches(homology modelling, threading); Ab initio structure prediction: force fields, backbone conformer generation by Monte Carlo approaches, side-chain packing; Energy minimization; Molecular dynamics; Rosetta; Structure comparison (DALI, VAST etc.); CASP; Protein-ligand docking; Computer-aided drug design (pharmacophore identification); QSAR;Protein-Protein interactions, Transcriptomics: Microarray technology, expression profiles, data analysis; SAGE; Proteomics: 2D gel electrophoresis; Mass Spectrometry; Protein arrays; Metabolomics: 13C NMR based metabolic flux analysis.

BTB - 520 PROTEOMICS (2-0-0)

Introduction to proteomics; samples preparation, protein concentration determination, Isoelectric focusing (IEF), SDS PAGE 2D, electrophoresis (including DIGE), Gel staining, Gel image acquisition and analysis, Gel spot/band cot-out, In gel trypsin digestion, Introduction to mass spectrometry: MALDI-TOF MS mass finger-printing and protein identification, ESI/TOF MS/MS peptide sequencing. FT ICR LC-MS/MS peptide sequencing for protein identification in complex mixtures and for studies on searching for proteomics, Protein identification from Mass Spectral Data. Validation & Reporting of Proteomic Data, Biomedical application of proteomics.

BTP - 520 ENVIRONMENTAL BIOTECHNOLOGY (2-0)

Environment; Basic concepts; Resources; Eco system: plants, animals, microbes; Ecosystem management; Renewable resources; Sustainability; Microbiology of degradation and decay; Role of Biotech in environmental protection; Control and management of biological processes, Enviromental pollution; Source of pollution; Air, water as a source of natural resource; Hydrocarbons, substituted hydro carbons; Oil pollution; Surfactants; Pesticides; Measurement of pollution; Water pollution; Biofilm; Soil pollution; Radioactive pollution; Radiation; Ozone depletion; Green house effect; Impact of pollutants; Measurement techniques; Pollution of milk and aquatic animals, Waste water collection; control and management; Waste water treatment; Sewage treatment through chemical, microbial and biotech techniques; Anaerobic processes; Anaerobic filters; Anaerobic sludge blanket reactors; Bioremediation of organic pollutants and odorous compounds; Use of bacteria, fungi, plants, enzymes, and GE organisms; Plasmid borne metabolic treatment; Bioaugmentation; Bioremediation of contaminated soils and waste land; Bioremediation of contaminated ground water; Macrophytes in water treatment; Phytoremediation of soil metals; Treatment for waste water from dairy, distillery, tannery, sugar and antibiotic industries, Biomass as source

of energy; Bioreactors; Rural biotechnology; Biocomposting; Biofertilizers; Vermiculture; Organic farming; Bio-mineralization; Biofuels; Bioethanol and biohydrogen; Solid waste management, Gene and environment; Effect of carbon and other nanoparticles upon health; Gene mutation; Genetic testing; Genetic sensors; Environmental pollution and children; Human biomonitoring

BTO - 510 INDUSTRIAL BIOTECHNOLOGY (2-0-0)

Introduction to industrial Biotechnology, Primary & Secondary metabolites; Strain isolation; Strain development; Strain maintenance; Growth requirements for bacteria & fungi, Substrates for industrial fermentation: Natural vs. synthetic media; Growth kinetics of microorganism; Types of Fermentation: Solid State, submerged fermentation and continuous fermentation; Brief account of the following products obtained by industrial microbiological fermentation: Alcohol, Alcoholic Beverage - Beer, Organic acid - Citric acid, Antibiotic - Penicillin, Amino acids-Glutamic acid, Vitamin- B12, Brief account of Steroid biotransformation, Production of rDNA products including DNA vaccines, Insulin; Down stream processing (DSP): Disintegration of cells, Separation, Extraction, Concentration and purification of products.

BTR- 510 GENOMICS AND EPIGENOMICS (2-0-0)

Structural Genomics: Genome organization in prokaryotes and eukaryotes, Cloning strategies, Mapping, Genome sequencing, application of Bioinformatics (Genome Databases). Functional Genomics: Forward and Reverse Genetics, Transcriptomics (c-DNA library, EST, SAGE, DNA- CHIP). Proteomics (proteome, 2-D Gel Electrophoresis, Protein Identification (Immunoaffinity chromatography) and purification, peptide fingerprinting, Mass spectroscopy, protein-Protein interaction (Yeast two Hybrid System), Surface Plasmone Resonance (SPR) technique), application of bioinformatics (Protein Databases), Metabolomics (metabolite profiling (Identification and purification)). Comparative and evolutionary Genomics: Genome evolution andsynteny. Epigenomics: Nucleosome model (Chromatin, Histone, non Histone proteins, epigenetic domain), DNA Modification (Imprinting / methylation), Analysis of DNA methylation patterns, Histone modification, Epigenetic gene regulation.

BTC-520 CELL SIGNALLING (2-0-0)

General signaling mechanism, Cell signals and cell-cell communication, membrane signaling, membrane-lipids and membrane-protein signaling, signaling in nervous system, synapses and transmitters, chemoreception in eukaryotes and prokaryotes, Signaling in plants, Structure and function of ion channels, Signaling via the action potential, Protein kinase, CAMP dependent protein kinase, Steroid hormone receptors and coactivators, Adenylate cyclase and G protein linked cell surface receptors.

BTM-530 MOLECULAR GENETICS (2-0-0)

Anatomy of Prokaryotic genome and Eukaryotic genome: packaging of DNA into chromosomes. The special features of metaphase chromosomes, Nucleosome Structure, Chromatin modeling, Genome functioning: The Repetitive DNA content of genomes. Tendemly repeated DNA, The Role of DNA binding proteins: Methods for studying DNA-binding proteins, interactions between DNA and DNA binding proteins, RNA-binding motifs, contacts between DNA and proteins; Genome replication: the topological problem, variations in semi-conservative theme, DNA topoisomerase. The replication process, Initiation, initiation and termination of replication, the diverse functions of topoisomerase, Regulation of Eukaryotic genome replication. Gene expression: Accessing the gemome, effects of chromatin packaging on eukaryotic gene expression, Heterochromatin, euchromatin and chromatin loops, structural and functional domains, nucleosome positioning, DNA methylation and gene expression, Mechanism of transcription: prokaryotes and eukaryotes - Operon and operon concept - Eukaryotic gene structure and expression - Mechanism of translation: prokaryotes and eukaryotes, Control of gene expression - RNA processing and editing, transcriptional, post transcriptional, translational and post transnational controls, Genome evolution and phylogenetics: The origin of genomes, acquisition of new Genes. The origins of introns, The Human genome, DNA
- based phylogenetic trees.

BTI-530 RADIOISOTOPES, TRACERS AND DIAGNOSTICS (2-0-0)

Introduction to basics of nuclear forces, terminology, nuclear reactions. Radioactivity, radioactivity units, radioactive half life, Types of radioactivity decays, Radioisotopes, Production of radioisotopes, different systems for detection

and measurement of radiations. Advances in applications of radiotracers technology in biological research, diagnosis and therapy. Natural radiation, damage and safety rules. Different types of immunoassays or techniques and development of immunodiagnostic commercial kits. Immuno-molecular technologies including micro array, hybridoma and proteomes in diagnosis of different diseases Antibody for diagnosis and therapy.

BTM-550 NANOTECHNOLOGY (2-0-0)

Introduction to Nanotechnology: Definition of nanobiotechnology, Molecular building blocks for nanostructure systems, Nano Scale:Nano-scale 1D to 3D structures, Nano-scale bio and medical applications, Nano-scale functional materials, Nano-scale electronics, Consequences of the nanoscale for technology and society. Fundamental concepts : molecular perspective, Molecular nanobiotechnology: long-term view; Current research : Nanomaterials, Bottom- up approaches, Top-down approaches, Functional approaches, Speculative; Tools and techniques for nanobiotechnology Applications: Applications in Genetic engineering, drug targeting, energy, bioinformatics, medicine, Diagnostics, Drug delivery, Tissue engineering; Chemistry and environment- Consumer goods-Foods, Household, Optics, Textiles, Cosmetics; Implications: Health risks and environmental issues, broader societal implications and challenges

BTM-540 PROTEIN ENGINEERING (2-0-0)

General introduction of protein engineering, Protein Sources: Introduction, Microorganisms as sources of proteins, Proteins from plants, Animal tissue as a protein source, Direct chemical synthesis, importance, Protein function and Protein Structure: Introduction, Overview of protein structure, Higher level structure, Protein post-translational modification, Protein stability and folding.

Protein Purification and Characterization: Introduction, Initial recovery of proteins, Removal of whole cells and cell debris Concentration and primary purification, Column chromatography, Protein inactivation and stabilization, Protein characterization. Large-Scale Protein Purification. Prokaryotic and eukaryotic systems for protein production and expression, applications, advantages and potential challenges, Strategies and approaches to protein engineering: Rational design, directed evolution, denovo desing etc.different method, approaches,used and their advantages, disadvantages and applicatios.

Molecular modeling and protein structure prediction: introduction,Sec and tertiary structuee prediction: methods and advantages, Nature of protein engineering: Molecular probe engineering, enzyme and biosensor engineering, therapeutic protein engineering, antibody engineering, metabolic pathway engineering,peptide engineering and other biocatalysis engineering, Strategies and approaches to enhance biological properties of proteins: increasing protein solubility, increasing enzymatic activity, stability and specificity, modifying co-factor requirement,, incorporation of unnatural amino acids etc., Applications and specific examples of protein engineering: Industrial enzymes, biocatalysts, therapeutic proteins, agronomically important traits etc.

BTF- 520 BIOSAFETY, IPR, PATENTS & ENTREPRENSURSHIP (3-0-0)

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP, IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS, Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.); Analysis and report formation, Types of patents; Indian Patent Act 1970; Recent Amendments; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; Financial assistance for patenting-introduction to existing schemes; Publication of patents-gazette of India, status in Europe and US Patenting by research students, lecturers and scientists-University/ organizational rules in India and abroad, credit sharing by workers, financial incentives, Patent infringement- meaning, scope, litigation, case studies and examples, Introduction; Historical Backround; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO

applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

BTM-510 PRINCIPLES OF GENETICS (3-0-0)

History of Genetics, Definition and scope of Genetics, Premendelian genetic concepts - Performation, Epoigenesis, and Inheritance of acquired characters, Germplasm theory. Hereditary and Environment, Genotype and Phenotype; Heredity and Variation. Clones, Purelines and Inbred lines Norms of reaction and Phenocopies. Bacterial genetics: Transfromation ; Transduction - generalized, and specialized; conjugation : F factor mediated, Hfr Mediated and Sexduction., gene mapping with bacteria Bacteriophage Genetics: Genetic organisation - lytic and lysogenic cycle, regulation of genes - foundations of phage genetics - T-odd coliphages - ss DNA phages - RNA phage. Yeast genetics: genome - mutants and genetic screens - genetic redundancy - cell type determination - cell cycle regulation of mitotic events - genetic interaction: two hybrid systems - *gal* pathway, gene regulation, Development Genetics: Factors controlling development. Nuclear changes during development (Nuclear transplantation) Switching genes on and off during development. Fate mapping ; Tissue specific methylation. Differential expression of haemoglobingenes. The genetics of development in Drosophila and Arabidopsis. Homoetic genes in genetic control of flower. Flower morphogenesis (Rice and Arabidopsis thaliana)

Cell cycle regulation genetics: Regulation of mitotic cell cycle in prokaryotes and eukaryotes and intercellular communication in multi cellular eukaryotes. Properties of cancer cells. Proto oncogences, Oncogenes, Cellular oncogenes, Tumor suppressor genes, Viral oncogenes.

3. COLLEGE OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY

The college of veterinary science and animal husbandry is offering, unde graduate degree program in veterinary sciences i.e. B.VSc. and AH. This college has in total fifteen different departments as mentioned bellow.

NAME OF DEPARTMENTS

1. Anatomy
2. Veterinary physiology & Biochemistry
3. Pharmocology and Toxicology
4. Veterinary Parasitology
5. Veterinary Microbiology
6. Veterinary Pathology
7. Public health & Epidemiology
8. Animal Nutrition
9. Animal Genetics Breeding
10. Livestock Production and Management
11. Livestock Production Technology
12. Gynecology and Obstetrics
13. Surgery & Radiology
14. Veterinary Medecine
15. Veterinary and Animal Husbandry Extension

Syllabus and Courses

Semesterwise Distribution of Courses

First Professional

Semester-I

VAN-111	Veterinary Gross Anatomy-I (Osteology, Arthrology & Biomechanics)	1+2=3
VPB-111	Veterinary Physiology-I (Blood, Cardiovascular & Excretory Systems, Body Fluids)	2+1=3
VPB-112	General Veterinary Biochemistry	1+1=2
LPM-111	Livestock Production Management-I (General Principles and Ruminants)	3+1=4
AGB-111	Biostatistics and Computer Application	2+1=3
ANN-111	Principles of Animal Nutrition & Feed Technology	2+1=3
Total Credits		11+7=18

Semester-II

VAN-121	Veterinary Gross Anatomy-II (Myology, Neurology, Angiology & Aesthesiology)	2+2=4
VPB-121	Veterinary Physiology-II (Neuromuscular, Digestive & Respiratory Systems)	2+1=3
VPB-122	Veterinary Intermediary Metabolism	2+1=3
LPM-121	Fodder Production & Grassland Management	1+1=2
LPM-122	Livestock Production Management-II (Monogastric and Laboratory Animals)	1+1=2
AGB-121	Principles of Animal Genetics and Population Genetics	2+1=3
ANN-121	Applied Animal Nutrition-I (Ruminants)	2+1=3
Total Credits		12+8=20

Second Professional

Semester-III

VAN-211	Veterinary Histology & Embryology	2+2=4
VPA-211	General Veterinary Parasitology & Helminthology	3+1=4
VPP-211	General Veterinary Pathology	1+1=2
VMC-211	General Veterinary Microbiology	1+1=2

LPM-211	Avian Production Management	1+1=2
ANN-211	Applied Animal Nutrition-II (Non-ruminants, Poultry & Laboratory Animals)	2+1=3
AGB-211	Livestock and Poultry Breeding	2+1=3
LFP-211	Livestock Farm Practice (Non-Credit)	0+1=1
Total Credits		12+9=21

Semester-IV

VAN-221	Veterinary Splanchnology & Applied Anatomy	1+1=2
VPB-221	Veterinary Physiology-III (Endocrinology, Reproduction, Growth & Environmental Physiology)	3+1=4
VPA-221	Veterinary Entomology & Acarology	1+1=2
VPA-222	Veterinary Protozoology	2+1=3
VMC-221	Veterinary Immunology and Serology	1+1=2
VPP-221	Systemic Veterinary Pathology	2+1=3
LPM-221	Commercial Poultry Production and Hatchery Management	1+1=2
LPM-222	Livestock Production Management-III (Regional interest)	1+1=2
LFP-221	Livestock Farm Practice (Non-Credit)	0+1=1
Total Credits		12+9=21

Third Professional

Semester-V

VPT-311	General and Systemic Veterinary Pharmacology	2+1=3
VMC-311	Systematic Veterinary Bacteriology & Mycology	2+1=3
VPP-311	Special Veterinary Pathology	2+1=3
VPE-311	Milk and Meat Hygiene, Food Safety and Public Health	2+1=3
LPT-311	Milk and Milk Products Technology	1+1=2
LPT-312	Abattoir Practice and Animal Product Technology	1+1=2
VAE-311	Principles and Techniques of Veterinary and A.H. Extension	2+1=3
Total Credits		12+7=19

Semester-VI

VPT-321	Veterinary Neuropharmacology	2+1=3
VMC-321	Systematic Veterinary Virology	2+1=3
VPP-321	Avian Pathology	1+1=2
VPP-322	Aquatic Animal Diseases, Health Care and Management	1+1=2
VPE-321	Veterinary Epidemiology and Zoonosis	2+1=3
LPT-321	Meat Science	1+1=2
VPB-321	Animal Biotechnology	2+1=3
VAE-321	Livestock Economics, Marketing and Business Management	2+1=3
Total Credits		13+8=21

Fourth Professional

Semester-VII

VPT-411	Veterinary Chemotherapy	2+0=2
VSR-411	General Veterinary Surgery, Anaesthesiology and Diagnostic Imaging	2+2=4
VGO-411	Veterinary Gynecology	2+1=3
VMD-411	Veterinary Clinical Medicine-I (General & Systemic)	2+1=3
	Veterinary Preventive Medicine-I (Bacterial, Fungal & Rickettsial Diseases)	2+0=2
VMD-412	Veterinary Clinical Biochemistry and Laboratory Diagnosis-I	0+1=1
VLD-411	Veterinary Clinical Practice	0+5=5
VCP-411		10+10=20
Total Credits		

Semester-VIII

VPT-421	Veterinary Toxicology	2+0=2
VSR-421	Regional Veterinary Surgery	2+1=3
VGO-421	Veterinary Obstetrics	1+1=2
VMD-421	Veterinary Clinical Medicine-II (Metabolic & Deficiency Diseases)	2+0=2
VMD-422	Veterinary Preventive Medicine-II (Viral & Parasitic Diseases)	2+0=2
VLD-421	Veterinary Clinical Biochemistry and Laboratory Diagnosis-II	0+1=1
VCP-421	Veterinary Clinical Practice	0+5=5
TVC-421	Veterinarian in Society (Non Credit)	1+0=1
Total Credits		10+8=18

Fifth Professional

Semester-IX

VSR-511	Veterinary Orthopedics and Lameness	1+1=2
VMD-511	Animal Welfare, Ethics & Jurisprudence	2+0=2
VMD-512	Zoo/Wild Animal Breeding, Management, Nutrition and Health Care	1+1=2
VMD-513	Pet Animal Breeding Management, Nutrition and Health Care	1+1=2
VGO-511	Veterinary Andorlogy and Reproductive Techniques	1+1=2
VPE-511	Environment and Environmental Hygiene	2+1=3
VAE-511	Livestock Entrepreneurship	1+0=1
VCP-511	Veterinary Clinical Practice	0+5=5
Total Credits		9+10=19

Semester-wise Distribution of Theory and Practical

Professional Year	Semester	Theory	Practical	Total
First	I	11	7	18
	II	12	8	20
Second	III	12	9	21*
	IV	12	9	21*
Third	V	12	7	19
	VI	13	8	21
Fourth	VII	10	10	20
	VIII	10	8	18**
Fifth	IX	9	10	19
		101	76	177

*1 credit (0+1) each for two courses on Livestock Farm Practice (non credit) included

** 1 credit (1+0) for Veterinarian in Society (non credit) included

Other Non-Credit Course (4 Credits)

Tracking Programmes - Two Programmes of 2 Credits each = 4 Credits

Subject-wise Courses and Credit Hours

Course No.	Course Title	Credit hours	Semester
1. Veterinary Anatomy			
VAN-111	Veterinary Gross Anatomy-I (Osteology, Arthrology & Biomechanics)	1+2	I
VAN-121	Veterinary Gross Anatomy-I I (Myology, Neurology, Angiology & Aesthesiology)	2+2	II
VAN-211	Veterinary Histology & Embryology	2+2	III
VAN-221	Veterinary Splanchnology & Applied Anatomy	1+1	IV
Total Credits		6+7=13	

2. Veterinary Physiology and Biochemistry

VPB-111	Veterinary Physiology-I (Blood, Cardiovascular & Excretory Systems and Body Fluids)	2+1	
VPB-112	General Veterinary Biochemistry	1+1	
VPB-121	Veterinary Physiology-II (Neuromuscular Digestive & Respiratory Systems)	2+1	II
VPB-122	Veterinary Intermediary Metabolism	2+1	II
VPB-221	Veterinary Physiology-III (Endocrinology, Reproduction Growth & Environmental Physiology)	3+1	IV
VPB-321	Animal Biotechnology (To be taught jointly with VMC & VGO)	2+1	VI
Total Credits			12+6=18

3. Veterinary Pharmacology & Toxicology

VPT-311	General and Systemic Veterinary Pharmacology	2+1	V
VPT-321	Veterinary Neurophamacology	2+1	VI
VPT-411	Veterinary Chemotherapy	2+0	VII
VPT-421	Veterinary Toxicology	2+0	VIII
Total Credits			8+2=10

4. Veterinary Parasitology

VPA-211	General Veterinary Parasitology & Helminthology	3+1	III
VPA-221	Veterinary Entomology and Acarology	1+1	IV
VPA-222	Veterinary Protozoology	2+1	IV
Total Credits			6+3=9

5. Veterinary Microbiology

VMC-211 General Veterinary Microbiology	1+1	III
VMC-221 Veterinary Immunology and Serology	1+1	IV
VMC-311 Systematic Veterinary Bacteriology and Mycology	2+1	V
VMC-321 Systematic Veterinary Virology	2+1	VI
Total credits	6+4=10	

6. Veterinary Pathology

VPP-211	General Veterinary Pathology	1+1	III
VPP-221	Systemic Veterinary Pathology	2+1	IV
VPP-311	Special Veterinary Pathology	2+1	V
VPP-321	Avian Pathology	1+1	VI
VPP-322	Aquatic Animal Diseases, Health Care and Management (To be taught jointly with VMD and LPM)	1+1	VI
Associated with the teaching of VLD-411, VLD-421, VMD-512 & VMD-513			
Total Credits			7+5=12

7. Veterinary Public Health & Epidemiology

VPE-311	Milk & Meat Hygiene, Food Safety and Public Health	2+1	V
VPE-321	Veterinary Epidemiology and Zoonosis	2+1	VI
VPE-511	Environment and Environmental Hygiene	2+1	IX
Total Credits			6+3=9

8. Animal Nutrition

ANN-111	Principles of Animal Nutrition & Feed Technology	2+1	I
ANN-121	Applied Animal Nutrition-I (Ruminants)	2+1	II
ANN-211	Applied Animal Nutrition-II (Non-ruminants, Poultry & Laboratory Animals)	2+1	III
Associated with the teaching of VMD-512 & VMD-513			
Total Credits			6+3=9

9. Animal Genetics & Breeding

AGB-111	Biostatistics and Computer Application	2+1	I
AGB-121	Principles of Animal Genetics and Population Genetics	2+1	II
AGB-211	Livestock and Poultry Breeding	2+1	III
Associated with the teaching of VMD-512 & VMD-513			
Total Credits			6+3=9

10. Livestock Production Management

LPM-111	Livestock Production Management-I (General Principles and Ruminants)	3+1	I
LPM-121	Fodder Production & Grassland Management	1+1	II
LPM-122	Livestock Production Management-II (Monogastric and Laboratory Animals)	1+1	II
LPM-211	Avian Production Management	1+1	III
LPM-221	Commercial Poultry Production and Hatchery Management	1+1	IV
LPM-222	Livestock Production Management (Regional interest) (Optional: to be developed on the basis of regional interest)	1+1	IV
Associated with the teaching of VPP-322, VMD-512 & VMD-513			
Total Credits		8+6=14	

11. Livestock Products Technology

LPT-311	Milk and Milk Products Technology	1+1	V
LPT-312	Abattoir Practice and Animal Product Technology	1+1	
	VLPT-321	Meat Science	
	1+1	VI	
Total Credits		3+3=6	

12. Veterinary Gynaecology & Obstetrics

VGO-411	Veterinary Gynaecology	2+1	VII
VGO-421	Veterinary Obstetrics	1+1	VIII
VGO-511	Veterinary Andrology & Reproductive Techniques	1+1	IX
Total Credits		4+3=7	

13. Veterinary Surgery & Radiology

VSR-411	General Veterinary Surgery, Aanaesthesiology and Diagnostic Imaging	2+2	VI
VSR-421	Regional Veterinary Surgery	2+1	VIII
VSR-511	Veterinary Orthopedics and Lameness	1+1	IX
Associated with the teaching of VMD-512 & VMD-513)			
Total Credits			5+4=9

14. Veterinary Medicine

VMD-411	Veterinary Clinical Medicine-I (General & Systemic)	2+1	VII
VMD-412	Veterinary Preventive Medicine-I (Bacterial, Fungal & Rickettsial Diseases)	2+0	VII
VMD-421	Veterinary Clinical Medicine-II (Metabolic & Deficiency Diseases)	2+0	VIII
VMD-422	Veterinary Preventive Medicine-II (Viral & Parasitic Diseases)	2+0	VIII
VMD-511	Animal Welfare, Ethics & Jurisprudence	2+0	IX
VMD-512	Zoo/Wild Animal Breeding, Management, Nutrition and Health Care (To be taught jointly with AGB, LPM, ANN, VPP and VSR)	1+1	IX
VMD-513	Pet Animal Breeding, Management, Nutrition and Health Care (To be taught jointly with AGB, LPM, ANN, VPP and VSR)	1+1	IX
Associated with the teaching of VPP-312			
Total Credits		12+3=15	

15. Veterinary & Animal Husbandry Extension Education

VAE-311	Principles & Techniques of Veterinary and A.H. Extension	2+1	V
VAE-321	Livestock Economics, Marketing and Business Management	2+1	VI
VAE-511	Livestock Entrepreneurship	1+0	IX
Total Credits			5+2=7

16. Teaching Veterinary Clinical Complex

VCP-411 Veterinary Clinical Practice	0+5	VII
VCP-421 Veterinary Clinical Practice	0+5	VIII
VCP-51 1 Veterinary Clinical Practice	0+5	IX
VLD-411 Veterinary Clinical Biochemistry and Laboratory Diagnosis-I (To be taught jointly by VPB &VPP)	0+1	VII
VLD-421 Veterinary Clinical Biochemistry and Laboratory Diagnosis-II (To be taught by VPB, VPP VMC &VPT)	0+1	VIII
TVC-421 Veterinarian in Society (Non Credit)	1+0	VIII
Total Credits 1+17= 18		

17. Instructional Livestock Farm Complex

LFP-211 Livestock Farm Practice (Non-Credit)	0+1=1	III
LFP-221 Livestock Farm Practice (Non-Credit)	0+1=1	IV
Total Credits		0+2=2

GRAND TOTAL

Courses: 65

Credits: Core Courses: 177 (101+76)

Including Non Credit Courses: 1+0 (Veterinarian in Society) and 2 credits (0+1) x 2 (Livestock Farm Practice)

Non-Core Course: 4 credits (tracking programmes)

Group of subject-wise credit distribution:

1. Basic Veterinary Subjects	23+15=38
2. Production Subjects 3.	23+15=38
Pre-Clinical Subjects	27+14=41
4. Clinical Subjects	27+13=40
5. Teaching Veterinary Clinical Complex	0+17=17
Total:	100+74=174

DEPARTMENT OF VETERINARY ANATOMY

SEMESTER I

VAN-111 VETERINARY GROSS ANATOMY-I (OSTEOLOGY, ARTHROLOGY AND BIOMECHANICS)
Credit hours 1+2=3

Theory

Osteology: Definition of the terms used in Veterinary Anatomy in general and osteology in particular. Classification, physical properties and structure of bones, Gross study of bones of appendicular and axial skeleton of Ox/ Buffalo as type species and comparison with Sheep / Goat, Pig, Horse, Dog and Fowl with particular emphasis on their topography, contour, landmarks and functional anatomy from clinical and production point of view. Detail study of bones of head, neck, thorax, abdomen. pelvis, tail, forelimb and hindlimb,

Arthrology: Classification and structure of joints. Articulation and ligaments of head, neck, thorax, abdomen, pelvis, tail, forelimb and hindlimb of Ox / Buffalo as type species, their structure, functional anatomy and comparison with other domestic animals from clinical and production point of view.

Biomechanics: Biomechanics and its application with reference to quadruped locomotion, kinetics of locomotion, stress and strains falling on locomotor apparatus, landmarks, angulation and weight bearing bones of Ox, Buffalo and comparison with other animals particularly horse and dog.

Practical

Comparative study of the bones of appendicular and axial skeleton, their structure, landmarks, angulation, weight bearing and function in Ox/Buffalo and comparison with that of Sheep/Goat, Pig, Horse, Dog and Fowl and relate them in live animals. Dissection of joints of all the body regions of Ox/Buffalo to study the structure and function and comparison with other domestic animals.Biomechanics and kinetics of locomotion.

SEMESTER II

VAN-121 VETERINARY GROSS ANATOMY—Il (MYOLOGY, NEUROLOGY, ANGIOLOGY AND AESTHESIOLOGY) Credit Hours: 2+2=4

Theory

Myology: Structural and functional classification of muscles. Gross study of skeletal muscles of head, neck, thorax, abdomen, pelvis, tail, forelimb and hindlimb with their origin, insertion and action and their structural and functional importance from clinical and production point of view in Ox / Buffalo as a type. species. Comparative study of muscles in other domestic animals.

Neurology: Study of central, peripheral and autonomic nervous system. Gross study of meninges, brain, spinal cord, cranial and spinal nerves and their functional importance from clinical and production point of view. Gross morphology and disposition of the nerves of head, neck, thorax, abdomen, pelvis, tail, forelimb and hindlimb in Ox/ Buffalo as a type and comparative study in other domestic animals.

Angiology: Gross morphology of heart and disposition of arteries, veins and lymphatic of head, neck, thorax, abdomen, pelvis, tail, forelimb and hindlimb in Ox/ Buffalo as type and comparison with that of Sheep / Goat, Pig, Horse, Dog and Fowl. Their importance from clinical and production point of view.

Aesthesiology: Gross morphological study of the eye, ear, nose, hoof, horn and skin in Ox / Buffalo. Their functional importance and comparative study in other domestic animals.

Computer simulation for dissection and study of body parts.

(Note: The general outline of muscular, circulatory and nervous system be taken up in the beginning of this course to be followed by gross disposition of group of muscles, arteries, veins and lymphatics simultaneously region-wise.)

Practical

Demonstration of embalming of the carcass and preservation. Dissection/computer simulation models for dissection and demonstration of body parts.

Dissection of muscles of all body regions of Ox/Buffalo, their location, functional role in the body and comparison with other species.

Study of brain and spinal cord in different domestic animals. Study of heart and major blood vessels in different species of animals. Area of auscultation of heart.

Dissection of blood vessels, lymphatics and nerves of head, neck, thorax, abdomen, pelvis tail forelimb and hindlimb in Ox/Buffalo and comparative study in other domestic animals Demonstration of palpable Lymph nodes of the body. Study of the sites of cornual, auriculo palpebral, peterson's, infraorbital, radial, ulnar, median, paravertebral, epidural, pudendal, perineal and tibial nerve blocks and their clinical importance.

Dissection for study of eye, ear, nose, hoof and horn.

SEMESTER Ill

VAN-211 VETERINARY HISTOLOGY AND EMBRYOLOGY Credit Hours 2+2=4

Theory

General Histology: Structure of animal cell and basic tissues and their functional activity. Epithelia and their modifications. Connective tissue and its components including blood and bone Muscular tissue types and their functional peculiarities. Neuron, nerve fibre and ganglion.

Systemic Histology: Study of microscopic structure of the organs of digestive, respiratory, urinary, reproductive, nervous and cardiovascular systems, sense organs, endocrines and lymphoid organs of domestic animals and birds.

Embryology: Gametogenesis, fertilization, cleavage, gastrulation, and the development of foetal membranes in birds and mammals. Structure and types of mammalian placenta. Development of the organs of digestive, respiratory, urogenital, cardiovascular, nervous and locomotor system and organs of special sense and endocrine glands. Fetal circulation.

Practical

Microscopy and micrometry. Comparison of light and electron microscopy Histological techniques, Processing of tissues for paraffin sectioning and Haematoxylin and Eosin staining.

Microscopic examination and identification of basic tissue and their components Examination of histological sections of various organs/systems of domestic animals and birds.

Study of structure of mammalian ova and spermatozoa and egg of fowl. Study of the whole mount and serial sections of avian and mammalian embryo / foetus at different stages of development. Microscopic anatomy of fetal membranes and placenta of various domestic animals.

SEMESTER IV

VAN-221 VETERINARY SPLANCHNOLOGY AND APPLIED ANATOMY Credit Hours 1+1=2

Theory

Gross morphological and topographical study of various organs of digestive, respiratory, urinary, male and female reproductive, lymphatic and endocrine systems, Pleura and Peritoneum in Ox/ Buffalo as type and their comparison with that of Sheep/Goat, Pig, Horse, Dog and Fowl.

Different Terminology used in applied Anatomy. Palpable Anatomical body structures and their use in Health and disease.

Practical

Demonstration and description of palpable anatomical structures on the body surface of live animal (head, neck, thorax, pectoral bones, pelvic bones, limbs). Outline of body cavities and study of organs of digestive, respiratory, urinary, reproductive, lymphatic and endocrine systems of Ox/Buffalo and their comparative anatomy in other species, Pleural and peritoneal reflections. Comparative topographic anatomy in live animals. Nerve blocks and their sites,

Applied anatomy of sites for thoraco-centesis, auscultation, abdominocentesis, rumenotomy, laparotomy, spleenectomy, enterotomy, palpation of anatomical structures in the abdominal and perineal regions. Radiographic visualisation of gross anatomical features of various regions of the body.

(Note: Computer simulation model studies shall be used for better understanding of the subject.)

DEPARTMENT OF VETERINARY PHYSIOLOGY AND BIOCHEMSITRY

SEMESTER I

VPB-111 VETERINARY PHYSIOLOGY (BLOOD, CARDIOVASCULAR, EXCRETORY SYSTEM AND BODY FLUIDS) Credit Hours: 2+1=3

Theory

Introduction to Blood; Properties of blood as a body fluid, metabolism and fate of R.B.C; Hemoglobin-chemical structure, synthesis, physiological functions, derivatives of hemoglobin; Anemia; Plasma proteins, lipids —origin and function; Coagulation mechanisms and regulation of haemostasis; fibronolysis; anticoagulation mechanism. Blood pH, blood volume and their determination. Osmotic fragility, erythrocyte sedimentation rate, haemtocrit and haemolysis; Leucocyte— phagocytic and immunogenic functions.

Heart- morphological characteristic, systemic excitability conduction & transmission processes. Cardiac Cycle:- Regulation of cardiac output; coronary circulation; properties of pulse; metabolism & energetic of working myocardial cell, extrinsic and intrinsic regulation; ECG and its significance in Veterinary Sciences — Echocardiography.

Haemodynamics of circulation, circulatory mechanics, resistance to flow, vasoconstriction, nervous and circulating fluid volume controls of blood pressure, neurohormonal control of vascular smooth muscle. Circulatory controls- shock stresses, regional arid fetal circulations. Capillary exchange, control of blood pressure. Adjustments of circulation during exercise.

Kidney: Functional morphology of nephron, factors determining filtration pressure, determination of glomerular filtration rate (GFR) and renal plasma flow -Reabsorption mechanisms for glucose, protein, amino acids, electrolytes; ammonium mechanism, glomerulotubular balance, methods of studying renal functions; urine concentration; micturition, uraemia.

Fluid, water balance, fluid therapy, dehydration, water concentration mechanisms. Acid base balance and H+ regulation, correction and evolution of imbalances, total osmotic pressure, potassium balance, electrolyte and water imbalances, thirst.

Formation and excretion of urine in Birds.

Cerebrespinal fluid, synovial fluids —composition, formation and flow; Joints. Regulations of bone metabolism and homeostasis.

Practical

Collection of blood samples — Separation of serum and plasma — Preservation of defribrinated blood — enumeration of erythrocytes, leucocytes — differential leucocytic count —platelet count — estimation of hemoglobin — haemotocrit — erythrocyte sedimentation rate — packed cell volume — coagulation time bleeding time — Erythrocyte fragility and viscosity — blood grouping — recording of ECG —measurement of arterial blood pressure (Sphygmomanornetry). Recording of cardiogram of frog heart- Study the effect of heat and cold on heart —effect of vagus stimuli on heat — vagal escape — factors affecting blood flow through blood vessels- urine analysis — physiological constituents , pathological determinates, determined of GFR. Titerable acidity, determination of inorganic phosphorus, urine ammonia and creatinine in urine.

SEMESTER II

VPB-121 VETERINARY PHYSIOLOGY-IL (NEUROMUSCUIAR, DIGESTIVE AND RESPIRATORY SYSTEMS) Credit Hours: 2+1=3

Theory

Muscle Physiology- basic muscle unit characteristic-electrical phenomenon in muscle cell Membrane potential ionic basis of resting membrane potential, muscle action potential, excitation and propagation of impulse characteristics- latent period refractive ness, threshold level-all & none characteristics - contractile mechanism- excitation —contraction coupling- neuro-muscular transmission types of muscle contraction, phenomenon of fatigue, rigor mortis.

Organization of nervous system- Mechanism of information processing, hierarchical control. Major functional system- sensory, consciousness, emotion, motor and visceral control and basic functional unit— neuron structure, type- functional characteristics of sub-units of neuron. Membrane potential- ionic basis of resting membrane potential (RMP) nerve action potential, excitation and propagation of impulse characteristics- latent period —refractive ness, threshold level-all & none characteristics Degeneration and regeneration of nerve fibre. Synaptic and junctional transmission.

Functions of nervous system-reflexes—control of posture and movements, autonomic nervous system and visceral control. Neurotransmitter wakefulness, sleep cycle. Higher function of neurons system —learning memory. Familiarization with common equipments used in neurophysiology (oscilloscope electroencephalography, machine stimulators etc).

Sense organs and receptors physiology of special senses — EYE: functional morphology nourishment and protection neural pathway, receptors — optics, ocular muscles and movements, photochemistry, eye defects and eye examinations (as an aid to clinical evaluation). EAR: Physiology of hearing and common hearing impairment. Vestibule apparatus. Physiology of Olfaction And Taste.

Morphological characteristic of monogastric and poly gastric digestive system. Prehension rumination; daefecation; vomition; regulation of secretory function of saliva, stomach, intestine, pancreas. bile secretion; hunger, appetite control, developmental aspects of digestion: luminous, membranous and microbial digestion in rumen and intestine, permeability characteristics of intestine, forces governing absorption, control intestinal transport of electrolyte and water, enzymatic digestion in monogastric and fermentative digestion in rumen, modification of toxic substances in rumen. Digestion in birds.

Functional morphology of respiratory apparatus. Mechanics of breathing. Transport of blood gases, foetal and neonatal oxygen transport, dissociation curves, pressures, recoil tendency, elasticity surfactants, pleural liquid, compliance, exchanges of gases in lungs and tissues, neural and chemical regulation of breathing, diffusion, perfusion, hypoxia. Frictional resistance to air flow, airways smooth muscle contraction, respiratory muscle work, panting, adaptation of respiration during muscles exercise high altitude hypoxia, Non-respiratory lung functions. Respiration in birds.

Practical

Counting of romeo motility, estimation of volatile fatty acids and ammonia in rumen. Bacterial and protozoal count. In-vitro action of proteolytic enzymes — pepsin and trypsin.

Experimental physiology: Pithing of frog, preparation of nerve muscle-Recording of twitch response effect of single stimulus-effect of heat and cold. Fatigue — summation, tetanus.

Recording of respiration, spirometry. Recording of volume and capacities in different physiological states including determination of vital capacities Recording of rumen / intestinal movements (Demonstration).

SEMESTER IV

VPB-221 VETERINARY PHYSIOLOGY - III (ENDOCRINOLOGY, REPRODUCTION, GROWTH AND ENVIRONMENTAL PHYSIOLOGY) Credit Hours: 3+1=4

Theory

Hormone cell interaction, sub-cellular mechanisms-metabolism of hormones-methods of study of endocrine system; Receptors- mechanism of regulation; Chemistry of hypothalamo —hypophyseal hormones, target organ, pineal, thyroid, thymus, pancreas, adrenal, prostaglandins, hormones of calcium metabolism, disorders rennin-angiotensin system, atrial natriuretic factors, erythropoietin, GI hormones, pheromones.

Genetic & endocrine control of gonadal development, modification of gonadotrophin release, ovarian functions, follicular development, dynamics, endocrine and receptor profiles, sexual receptivity, ovarian cycle, post partum ovarian activity, ovum transport, capacitation, fertilization, reproductive cycles in farm animals- hormones present in the biological fluids during pregnancy and their uses for the diagnosis of pregnancy —maternal foetal placental participation in pregnancy & parturition, immunology of gestation, preparturient endocrine events.

Spermatogenic cycle and wave- function of sertoli cell-leydig cell- semen — composition- evaluation; Testosterone — function and regulation — cryptorchidism. Puberty—photoperiod- uses of androgens, progestogens, estrogens.

Functional and metabolic organization of mammary glands —structure and development; effect of estrogens and progesterone; hormonal control of mammary growth; lactogenesis and galctogenesis; biosynthesis of milk constituents- secretion of milk, mastitis and metabolism, prolactin and mammary tumours-lactation cycle.

Biochemical and genetic determinants of growth, regulation of growth, metabolic and hormone interactions, factors affecting efficiency of growth and production in ruminants and single stomach animals. Growth in meat producing animals & birds, growth curves. Recombinant gene transfer technologies for growth manipulation- advantages and limitations. Protein deposition in animals and poultry.

Heat balance, heat tolerance, hypothermia, hyperthermia, thermo-regulation in farm animals, role of skin, responses of animals to heat and cold, fever, body temperature and hibernation. Temperature regulation in birds.

Climatology —various parameters and their importance. Effect of different environmental variables like temperature, humidity, light, radiation, altitude on animal performance Acclimation, acclimatization — general adaptive syndrome. Clinical effect on endocrine —reproductive function, circadian rhythm.

Neurophysiology of behaviour, types of behaviour, communication, Learning and memory, behavioural plasticity.

Practical

Oestrus and phases of oestrous cycle in animals (vaginal mucus). Behavioural signs of oestrus. Bio assay for trophic hormone. Demonstration of hormone estimation. Rectal palpation of reproductive organs. Sperm motility, sperm concentration — live and dead —abnormal sperm count. Measurement of growth in various species. Measuring surface area of animals. Health parameters of animals- body temperature, pulse, respiration and heart rate. Measurement of animal environmental conditions. Behaviour of animals- mating behaviour, milking behaviour, feeding behaviour (live/videographic/computer simulated demonstration)

SEMESTER I

VPB-112 GENEAL VETERINARY BIOCHEMISTRY — Credit Hours 1+1=2

Theory

Scope and importance of biochemistry. Structure of biological membranes and transport across membranes. Donnan membrane equilibrium. Dissociation of acids, pH, buffer systems, Henderson-Hasselbalch equation.

Biochemistry of carbohydrates. Biological significance of important Monosaccharides (ribose, glucose, fructose, galactose, mannose and amino sugars), Disaccharides (maltose, isomaltose, lactose, sucrose & cellobiose), Polysaccharides, (starch, dextrins, dextrans, glycogen, cellulose, inulin, chitin) and Mucopolysaccharides including bacterial cell wall polysaccharides.

Biochemistry of lipids: Properties and biological significance of simple, compound and derived lipids and lipoproteins. Structure and functions of prostaglandins. Chemistry of bile and bile acids.

Biochemistry of proteins: Structure, properties and biological significance of proteins. Amino acids, classification and structure of neutral, basic and acidic amino acids. Properties of amino acids: amphoteric nature, optical activity, and peptide bond formation. Chemical reactions of proteins.

Biochemistry of nucleic acids: Chemistry of purines, pyrimidines, nucleosides and nucleotides. Biological significance of nucleosides & nucleotides. Structures and functions of deoxyribonucleic acid (DNA) and a typical ribonucleic acid (RNA).

Practical

Concentration of solutions - System International (S.I.) Units. Preparation/standardization of acids & alkalies. Preparation of buffers and determination of pH. Titration curve of acid versus base. Reactions of mono-, di-, and polysaccharides and their identification. Estimation of lactose in milk. Determination of acid number of an oil. Colour reactions of proteins. Precipitation reactions of proteins. Estimation of amino acids (Sorensen's method).

SEMESTER II

VPB-122 VETERINARY INTERMEDIARY METABOLISM — Credit Hours 2+1=3

Theory

Enzymes: Definition and classification, EC numbering of enzymes, Coenzymes, cofactors & iso-enzymes.

Properties: Protein nature, enzyme-substrate complex formation, modern concept of the active center of enzyme. Specificity of enzyme action: Substrate specificity, group specificity, stereo or optical specificity.

Factors influencing enzyme action: Effects of temperature, pH, concentration of substrate and enzyme.

Enzyme units: International Units, katal, turnover number & specific activity.

Enzyme inhibition: Competitive, non-competitive, uncompetitive inhibition & suicidal inhibition. Allosteric enzymes.

Biological oxidation: Enzymes and coenzymes involved in oxidation and reduction viz. Oxidoreductases, oxidases, oxygenases, dehydrogenases, hydroperoxidases & cytochromes.

Respiratory chain/electron transport chain, oxidative phosphorylation, inhibitors, uncouplers and other factors influencing electron transport chain.

Carbohydrate metabolism: Glycolysis, Kreb's cycle, glyoxylate cycle, HMP shunt, gluconeogenesis, Con cycle, glycogenesis, glycogenolysis, hormonal control of carbogydrate metabolism & regulation of blood sugar. Bioenergetics of carbohydrate metabolism.

Lipid metabolism: Beta oxidation of fatty acids, ketone body formation, biosysntheses of fatty acids, triacylglycerol, phospholipids & lipoprotein metabolism. Bioenergetics of lipid metabolism.

Protein metabolism: Biosynthesis and degradation. Deamination, transamination and decarboxylation of amino acids. Ammonia transport and urea cycle.

Nucleic acids: Metabolism of purines and pyrimidines. DNA & RNA biosynthesis.

Integration of metabolism: Metabolic functions of macro and micro nutrients, Metabolic functions of lipid and water soluble vitamins. Uses of isotopes in metabolic studies.

Practical

Effect of pH and temperature on enzyme activity: Estimation of normal/abnormal constituents of urine. Electrophoretic separation of proteins. Paper chromatography. Estimation of bilirubin, blood glucose, electrolytes and other metabolic intermediaries in blood (colorimetry/ spectrophotometry/ flame photometry).

SEMESTER VI

VPB-321 ANIMAL BIOTECHNOLOGY Credit Hours 2+1=3

Theory

Definitions, basic concepts and scope of animal biotechnology. Recombinant DNA technology. Gene cloning, vectors and expression vectors. Transformation and transfection. Polymerised chain reaction (PCR), construction of genomic library and cDNA library. DNA sequencing. Principles of transfer of nucleic acids and proteins (Southern, Northern and Western blotting), Nucleic acid hybridization, DNA probes and DNA fingerprinting.

Biotechnological application in animal improvements:

Embryo biotechniques, in vivo and in vitro embryo production and preservation, sexing, micromanipulation and cloning, transgenic animal and biopharming.

Mapping of genome and genome sequencing. Marker assisted selection. Gene banking.

Nutritional biotechnology including bioconversion of lignocelluloses, genetic manipulation of microbes for Nutritional biotechnology including bioconversion of lignocelluloses, genetic manipulation of microbes for improved feed utilization and health. Animal tissue culture, transformation and cell lines, tumor markers and acute phase proteins.

Molecular diagnosis including PCR and DNA probes. Hybridoma and monoclonal antibodies. New generation vaccines: Subunit, recombinant and recombinant vectored vaccines.

Fermentation process and technologies for milk, meat and leather.

Ethics and regularly issues in Biotechnology, IPR, Bioinformatics.

Practical

DNA and plasmid isolation, Gel electrophoresis. PCR. Screening of gametes and embryo. Use of Multimedia and audio-visual aids for molecular biology aspects.

(The course is to be taught jointly with the Departments of Veterinary Microbiology and Veterinary Gynaecology and Obstetrics)

DEPARTMENT OF VETERINARY PHARMACOLOGY AND TOXICOLOGY

SEMESTER V

VPT-311 GENERAL AND SYSTEMIC VETERINARY PHARMACOLOGY Credit Hours 2+1=3

Theory

Historical development, branches and scope of Pharmacology. Sources and nature of drugs. Pharmacological terms and definitions. Principles of drug activity: Pharmacokinetics - Routes of drug administration, absorption, distribution, biotransformation and excretion of drugs. Pharmacodynamics-concept of drug and receptor, dose-

response relationship, terms related to drug activity and factors modifying the drug effect and dosage. Fundamentals of drug-screening and assay of drugs. Adverse drug reactions, drug interaction, drug designing and development, bio prospecting of drugs. Introduction to biopharmaceutics and gene therapy.

Drugs acting on digestive system: Stomachics, antacids and antiulcers, prokinetics, carminatives, antizymotics, emetics, antiemetics, purgatives, antidiarrhoeals, cholerectics and cholagogues, Rumen pharmacology.

Drugs acting on Cardiovascular system, cardiac glycosiders, antiarrhythmic drugs, vasodilators and antihypertensive agents, haematinics, coagulants and anticoagulants.

Drugs acting on respiratory system: Expectorants and antitussives, respiratory stimulants, bronchodilators and mucolytics.

Drugs acting on urogenital system: Diuretics, urinary alkalizers, and acidifiers, fluid therapy, ecobolics and tocolytics.

Pharmacotherapeutics of hormones and vitamins.

Drugs acting on skin and mucous membranes: emollients, demulcents and counter irritants.

Bio-enhancers, Immunostimulants and immunosuppressants.

New drugs and drug formulations.

Practical

Pharmacy appliances. Principles of compounding and dispensing.

Metrology: systems of weights and measures, pharmacy calculations. Pharmaceuticals processes. Pharmaceutical dosage forms. Prescription writing, incompatibles. Drug standards and regulations, Custody of poisons. Compounding and dispensing of powders, ointments, mixtures, liniments, lotions, liquors, tinctures, emulsions, and electuaries.

SEMESTER VI

VPT-321 VETERINARY NEUROPHARMACOLOGY — Credit Hours 2+1=3

Theory

Drugs acting on autonomic nervous system: Neurohumoral transmission, adreneceptors agoinists and antagonists, adrenergic neuron blockers, cholinocepters agonists and antagonists, ganglionic stimulants and blockers.

Autacoids: Histamine and antihistaminic agents, 5-Hydroxytryptamine and its antagonists prostaglandins, angiotensin and bradykinin.

Drugs acting on central nervous system (CNS): Pharmacology of neurotransmitters. History of general anaesthetics and theories of anaesthesia. Inhalant, intravenous and dissociative anaesthetics, hypnotics and sedatives, tranquilizers, psychotropic drugs, anticonvulsants, opioid analgesic, non-steroidal anti-inflammatory drugs, analeptics and other CNS stimulants, central muscle relaxants.

Drugs acting on somatic nervous system: Local anaesthetics and peripheral muscle relaxants.

New drugs and drug formulations.

Practical

Demonstration of the effect of CNS depressants, analgesics, CNS stimulants, muscle relaxants anticonvulsants, local and anaesthetics in laboratory animals.

Demonstration of the action of adrenergic and cholinergic agonists and antagonists on isolated and intact preparations of the animals.

Alternate use of animals as model for demonstration.

SEMESTER VII

VPT-411 VETERINARY CHEMOTHERAPY — Credit Hours 2+0=2

Theory

Antibacterial agents: Classification, general principles in antibacterial chemotherapy, antibacterial resistance. Sulphonamides and their combination with diaminopyrimidines, sulfones, nitrofurans, nalidixic acid and fluoroquinolones.

Antibiotics: Penicillins and cephalopsorins, aminoglycosides, tetracyclines, chloramphenicol, macrolides, plypeptides. Miscellaneous agents: methenamine, bacitracin. Rifampin, novobiocin, viginamycin, lincosamides and vancomycin.

Antifugal agents: Topical and systemic agents including anti-fugal antibiotics.

Anthelmintics: Drugs used against cestodes, trematodes, nematodes, drug resistance, broad-spectrum anthelminitics.

Antiprotozoal agents: Drugs used in trypanosomosis, theileriosis, babesiosis, coccidiosis, amoebiosis, giardiosis and trichomonoisis.

Ectoparasitcides, Antiviral and anticancer agents, Antiseptics and disinfectants, Growth promoters.

Common indigenous drugs of plant origin with proven pharmacological and therapeutic efficacies in various animal ailments.

New drugs and drug formulations.

SEMESTER VIII

VPT-421 VETERINARY TOXICOLOGY Credit Hours 2+0=2

Theory

General Toxicology: Definitions, fundamentals and scope of toxicology. Sources and mode of action of poisons. Factors modifying toxicity. General approaches to diagnosis and treatment of poisoning.

Toxicity caused by metal and non-metals: Arsenic, lead, mercury, copper, selenium, molybdenum, phosphorus, nitrates and nitrites, common salt and fluoride.

Toxicity caused by plants and weeds: Cyanogenetic plants, abrus, lantana, ipomoea, nerium, datura, nux vomica, castor, selenium containing plants oxalate producing plants, plants causing thiamine deficiency.

Drug toxicity and toxicity caused by agrochemicals: organophosphates, carbonates, chlorinated hydrocarbons, pyrethroids, herbicides, fungicides, rodenticides and urea.

Residue toxicology: Hazards of residues, concept of withdrawal time and MRLs, minimizing drug and toxic residues in animal products.

Venomous bites and stings: Snake bite, scorpion, spider, wasp stings and toad poisioning. Radiation hazards and industrial toxicants. Toxicity caused by food additives and preservatives.

DEPARTMENT OF VETERINARY PARASITOLOGY

SEMESTER III

VPA-211 GENEAL VETERINARY PARASITOLOGY AND HELMINTHOLOGY Credit Hours 3+1=4

Theory

Parasites and parasitism. Types of Parasitism. Commensalism, symbiosis and predatorism. Types of hosts: Final and intermediate hosts, paratenic hosts and reservoir hosts, natural and unnatural hosts. Host parasite relationship; mode of transmission of parasites and methods of dissemination of the infective stages of the parasite. Parasite specificity in relation to species, breed, sex and location. Tissue reactions caused by parasites to the host. Resistance of hosts to parasitic infections/infestation. Immunity against parasitic infections. Standardized Nomenclature of Animal Parasitic Diseases (SNOAPAD).

General description of helminth parasites affecting domestic animals and birds.

Classification of helminthes. Characteristics of phylum (Platyhelminthes, Nemathelminthes and Acanthocephala). Salient morphological features of diagnostic importance. Life cycle of the helminthes in relation to transmission, pathogenesis, epidemiology, diagnosis, general control measures of following helminthes of animals and birds.

Trematodes

Liver flukes (Fasciola, Dicrocoelium and Opisthorchis), intestinal flukes (Fasciolopsis), blood flukes (nasal schistosomosis), cercarial dermatitis (Schistosoma and Ornithobilharzia), visceral schistosomosis (S. spindale, S. indica, S. incognitum), Amphistomes/immature amphistomosis (Paramphistomum, Cotylophoron, Gastrothylax, Gastrodiscus, Gigantocotyl, Gastrodiscoides, Pseudodiscus) Lung flukes (Paragonimus) and oviduct flukes (Prosthogonimus) their importance in the diagnosis.

Cestodes

Metacestodes (bladder worm), Ruminant tape worms (Moniezia, Avitellina, Stilesia), Dog tape worms (Dipylidium, taenia, Multiceps and Echinococcus), Equine tape worms (Anoplocephala, Paranoplocephala), Poultry tape worms (Davainea, Cotugnia, Raillietina, Amoebotaenia) and Broad fish tape worms (Diphyllobothrium), Dwarf tape worm (Hymenolepis).

Nematodes

Ascaris, Parascaris, Toxocara, Toxascaris, Ascaridia, Heterakis and Oxyuris.

Bursate Worms (Strongyloides, Strongyles, Chabartia, Syngamus, Oesophagostomum), Kidney worms (Stephanurus, Dioctophyma), Hook worms (Ancylostoma, Agriostomum, Bunostomum, Trichostrongylus, Ostertagia, Cooperia, Nematodirus). Stomach worms (Haemonchus, Mecistocirus). Tissue roundworms. (Habronema, Thelazia, Spirocerca, Gongylonema). Filarial worm Dirofilaria, Parafilaria, Onchocerca, Setaria, Stephanofilaria). Lung worms (Dictyocaulus, Mullerius and Protostrogylus) Guinea worms (Dracunculus).

International regulations for control of different helminthic diseases.

Practical

Methods of collection, fixation, preservation and mounting of helminth parasites. Study of morphological characters of adults and their larval stages and damages caused by them. Identification of important trematodes, cestodes and neamotode. Examination of faecal samples of eggs of trematode, cestode and nematode. Demonstration of the life cycle and development of the species of Trematode, Cestode and Nematode.

SEMESTER IV

VPA-221 VERERINARY ENTOMOLOGY AND ACAROLOGY Credit Hours 1+1=2

Theory

General description of insecta and arachnida affecting domestic animals and birds. Arthropoda as direct/indirect parasites. Classification. Life Cycle and vector potentially in relation to disease transmission, pathogenesis and control of following arthropods affecting animals and birds.

The biting midges (Culicoides), buffalo/Black fly, gnats (Simulium), sandflies (Phlebotamus). The mosquitoes (Culex, Anopheles and Aedes). Horse fly (Tabanus), Musca, Stomoxys, Sarcophaga, Warbles (Hypoderma) and bots (Gasterophilus), Nasal bot (Oestrus ovis), Myiasis, Wingless flies (Hippobosca, Melophagus), bugs, lice (Haematopinus, Linognathus, Trichodectus, Damalina, Menopon, Lipeuris, Menacanthus (Poultry lice). Fleas (Pulex, Ctenocephalides, Echidnophaga, Xenopsylla) Arachnids (Ticks and mites of Veterinary importance. Soft tick (Argasidae), (Argus, Orthinodorus and Otobius).

Hard ticks (Boophilus, Hyalomma, Rhipicephalus, Haemophysalis, Amblyomma, Ixodes), Mites (Demodex, Sarcoptes, Psoroptes, Notoedrus, Chorioptes) Anti-tick immunoprophylaxis.

Damages to hide and skins due to ectoparasitic infestation.

Practical

Demonstration of the type representatives of various groups of insects, ticks and mites through charts, specimen and mounted slides. Demonstration of different characters of Insecta and Arachnida (Ticks and mites). Procedure for diagnosis of arthropod infestation to hides and skin. Demonstration of enteric myasis. Procedure for the collection, fixation, preservation and mounting of arthropods parasites.

SEMESTER IV

VPA-222 VETERINARY PROTOZOOLOGY Credit Hours 2+1=3

Theory

Introduction and general description to protozoa and their development. Differentiation from protophyta, bacteria and rickettsia, classification. Life Cycle in relation to transmission, pathogenesis, diagnosis and control of protozoa of veterinary importance.

Kalazar (visceral and cutaneous leishmanaiasis, Animal trypanosomosis (Surra), trypanosomosis (due to african Trypanaosoma) in cattle and man.

Bovine and avian trichomonosis, black head in turkeys (Histomonas), Bovine amoebae (Entamoeba and Balantidium), Glardia sp, Coccidia and coccidiosis of poultry and animals. Cryptosporidiosis, Cyst forming coccidian (Toxoplasma, sarcocystis), Neospora (Neospora caninum), Malaria parasite of animals and poultry (Plasmodium and Haemoproteus), Piroplasmosis (Babesia), Theilerosis (Theileria).

Recent developments in protozoan vaccines for field use.

International regulations for control of different protozoan diseases.

Practical

Examination of faecal materials for identification of intestinal protozoa, coccidian and flagellates.

Preparation of blood smears, their staining and examination of slides for haemoprotozoan parasites.

Methods of collection, fixation, preservation and mounting of protozoan parasites. Identification of representatives slides of protozoan parasites.

DEPARTMENT OF VETERINARY MICROBIOLOGY

SEMESTER III

VMC-211 GENERAL VETERINARY MICROBIOLOGY Credit Hours 1+1=2

Theory

Introduction and history of Microbiology, Morphology, structure, growth and nutrition of bacteria. Classification and nomenciature of bacteria. Sources and transmission of infection. Pathogenicity, virulence and infection. Resistance and susceptibility of host, bacteraemia, paeticaemia, toxaemia, endotoxins and exotoxins; Bactorial genetics, Plasmids, Antibiotic reisistance.

Introduction, morphology, growth, nutrition, reproduction in fungi, classification of fungi.

Introduction to viruses: General properties, replication, cultivation and purification of viruses, Cell-Virus interactions. Viral genetics. Interferon.

Practical

Equipment, Sterilization, disinfection and asepsis, staining (simple & grams, acid fast, lactophenol cotton blue), Special staining (metachromatic granules, capsular, spore). Bacterial motility, preparation of culture media. Aerobic and anaerobic cultivation, isolation of bacteria in pure culture, Morphological and cultural characteristics, biochemical characters, Antibiogram, Phenol coefficient test, Slide culture technique for fungus.

SEMESTER IV

VMC-221 VETERINARY IMMUNOLOGY AND SEROLOGY Credit Hours: 1+1=2

Theory

Concepts in Veterinary and Medical Immunology. Immune system organs. tissues and cells. Types of immunity. Development of humoral and cellular immune responses. Antigens: definition, specificity, types and factors affecting immunogenicity, blood group antigens.

Antibodies: Structure, properties and function of different classes of immunoglobulins. Site mechanism and theories of antibody production, Monoclonal antibodies Major histocompatability complex, Complement system; Cytokines Major types and functions Serological reactions: Agglutination, precipitation, haemagglutination: Phagocytosis, opsonic index, cytolysis, Complement fixation, neutralization, toxin and antitoxin reaction. immunofluorescence Hypersensitivity classification and mechanism of induction.

Autoimmunity and immunotolerance Immunisation of animals.

Biologicals: Role of conventional and modern vaccines in immunoprophylaxis adjuvants Quality control of biologicals.

Practical

Preparation of antigen, Raising of antisera, Concentration of Immunoglobulins Agglutination (plate, tube) Precipitation {Agar gel precipitation test (AGPT), Crossed immunoelectrophoresis (CIE), Rocket Immunoelectrophoresis (RIE), Indirect agglutination (Latex co-agglutination, Passive haemagglutination (PHA), Reversed passive haemagglutination (RPHA)}, Haemagglutination. Complement fixation test immunoperoxidase test (IPT), Fluorescent antibody technique (FAT), Enzyme linked immunosorbent: assay (ELISA), Cell mediated immune (CMI) response, Veterinary biologicals (visits and appraisal)

SEMESTER V

VMC- 311 SYSTEMATIC VETERINARY BACTERIOLOGY AND MYCOLOGY

Credit Hours: 2+1=3

Theory

Study of following important pathogenic bacteria and fungi in relation to their morphology, isolation, growth, colonial, biochemical and antigenic characters. Pathogenicity and diagnosis of bacterial and fungal diseases caused by the following genera:

Bacteria: Staphylococcus, Streptococcus, Bacillus, Clostridium, Mycobacterium, Enterobacteriaceae (E,coli, Salmonella, Yersinia, Klebsifffla and Proteus), Campylobacter. Brucella) Pasteurella and Mannheimia. Pseudomonas and Burkholderia, Moraxella, Haemophilus and Taylorella, Listeria, Actinobacillus, Actinomyces, Arcanobacterium and Corynebacterium, Nocardia. Dermatophilus, Spirochetes, Gram negative anaerobes, Mycoplasma, Rickettsia, Chlamydia and Chlamydophi/a Fungi: Dermatophytes, Rhinosporidium, Sporotrichum, Candida, Mycetomal fungi Cryptococcus Aspergillus, Zylomycetes and Dimorphic fungi. Mycotic mastitis and abortion, Mycotoxicoses

Practical

Laboratory identification of agents of Mastitis, Haemorrhagic septicaemia, Enteric infections, Brucellosis, Tuberculosis and Johne's disease, Clostridial infections, Wooden tongue and Lumpy Jaw, Anthrax, Glanders, Aspergillosis, Dermatophytosis, Demonstration of other agents of importance (Phycomycetes, yeasts etc.).

SEMESTER VI

VMC- 321 SYSTEMATIC VETERINARY VIROLOGY

Credit Hours 2+1=3

Theory

Brief history, classification and characteristics of various families of DNA and RNA viruses causing diseases in livestock and poultry, laboratory diagnostic techniques, immunity to viral infections, systemic virology including: DNA viruses: Poxviridae: Pox viruses of cow, sheep, goat and fowl. Asfarviridae: African swine fever, Herpesviridae: Aujeszky's disease, malignant catarrhal fever, infectious bovine rhinotracheitis, equine abortion, Marek's disease, infectious laryngeotracheitis. Adenoviridae - Infectious canine hepatitis, egg drop syndrome (EDS), Inclusion body hepatitis-Hydropericardium syndrome (IBHHPS). Papillomaviridae: Papillomatosis, Parvoviridae: Canine Parvovirus. Circoviridae: Chicken infectious anaemia. RNA viruses: Orhomyxoviridae: Swine, equine and Avian influenza. Paramyxoviridae: Rinderpest, PPR, canine distemper and Ranikhet disease, Flaviviridae: Classical swine fever, bovine viral diarrhoea. Picornaviridae: - foot and mouth disease (FMD), duck viral hepatitis, Rhabdoviridae: Rabies, vesicular stomatitis, ephemeral fever, Coronaviridae: - Avian Infectious bronchitis, transmissible gastroenteritis,

Togaviridae: - Equine encephalitis, Arteriviridae: equine viral arteritis, Caliciviridae: vesicular-exanthema, Retroviridae: Avian leucosis group. Lentiviruses- Equine infectious anemia virus, Sheep pulmonary adenomatosis, Maedi/visna. Reoviridae: African horse sickness and blue tongue, Calf Rotavirus, Birnaviridae: Infectious bursal disease.

Prions, Exotic and emerging animal and poultry viruses.

Practical

Glassware and media preparation, Demonstration of Cell culture, Virus propagation by egg inoculation, animal inoculation and cell culture, study of cytopathogenesis, viral inclusions, diagnostic procedures, serological techniques, preservation and transportation of clinical samples for virological investigations.

Diagnostic procedures for Peste des petits ruminants (PPR), FMD, Ranikhet disease (RD), Blue tongue, Infectious bronchitis (IB), Infectious bursal disease (IBD) and other viral agents.

DEPARTMENT OF VETERINARY PATHOLOGY

SEMESTER III

VPP-211 GENERAL VETERINARY PATHOLOGY Credit Hours 1+1=2

Theory

Introduction and scope of Veterinary Pathology, Brief outline of major intrinsic and extrinsic causes of disease. Pathology of hyperaemia, congestion, haemorrhage, edema, thrombosis, embolism, infarction and shock.

Acute cellular swelling and its variants. Glycogen overload and fatty change. Heat shock proteins and lysosomal storage diseases.

Causes and mechanism of reversible and irreversible cell injury, necrosis and its types, apoptosis, differences between post-mortem autolysis and necrosis. Gangrene. Major exogenous and endogenous pigments. Metastatic and dystrophic calcification. .

Jaundice in animals. Photosensitizational dermatitis. Aplasia, hypoplasia, atrophy, hypertrophy, hyperplasia, metaplasia and dysplasia. Inflammation: definitions, classification, various cell types and their functions, mediators, cardinal signs and systemic effects.

Cell cycle and cyclins, soluble and insoluble mediators (including growth factors).

Wound healing by primary and secondary intention. Pathology of autoimmune diseases and amyloidosis.

Definitions, general characteristics and classification of neoplasms. Differences between benign and malignant tumours. etiology and spread of neoplasms, immunity and neoplasia, effects and diagnosis of neoplasia, stages and grades of neoplasms.

Practical

Study of gross pathological specimens and recognition of pathological lesions Post-mortem (P M) techniques Collection of morbid materials for pathological diagnosis Techniques for preservation and despatch of materials. Section cutting, staining and identification of microscopic lesions Examination of slides depicting changes in cells and tissues Study of histopathological slides showing haemorrhage congestion, oedema, infarction, hyperplasia, metaplasis, hypertrophy, necrosis, cloudy swelling, amyloid degeneration, fatty changes, calcification , infiltration etc. Examination and interpretation of oncological tissue slides.

SEMESTER IV

VPP-221 SYSTEMIC VETERINARY PATHOLOGY Credit Hours 2+1 =3

Theory

Pathological changes including neoplasms in non-infectious disease conditions affecting Digestive System (mouth, pharynx, salivary glands, oesophagus, stomach, intestines, liver, gall bladder, pancreas), Respiratory System (nasal

cavity, larynx, bronchi, trachea, lungs and pleura), Musculo-skeletal System (muscle, bone, joints, ligaments, tendons), Cardio-vascular System (pericardium, myocardium epicardium, endocardium, arteries, veins), Haematopoietic System (bone marrow), Lymphoid System (lymph nodes, vessels and spleen), Urinary System (kidneys, ureter; bladder and urethra), Reproductive System (male and female genital organs), Nervous System (brain, spinal cord and peripheral nervous system), Endocrine System (adrenal, thyroid, thymus, pituitary, parathyroid and pancreas)
Skin and Appendages (hoof and horn), Ear and Eye

Practical

Post-mortem examination of large and small animals, recording of gross lesions and compiling the postmortem report (including vetero-legal cases), despatch of morbid material in vetero-legal cases, study of gross specimens and histopathological slides pertaining to systemic pathology. Collection and examination of c1inico-pathological specimens (blood, urine, body fluids, etc.) for diagnosis of systemic affections.

SEMESTER V

VPP- 311 SPECIAL VETERINARY PATHOLOGY Credit Hours 2+1=3

Theory

General pathology of viral infections. Pathogenesis, gross and microscopic pathology of Foot and mouth disease, Rinderpest, malignant catarrhal fever, blue tongue, infectious bovine rhinotracheitis, bovine viral diarrhoea, caprine encephalitis-arthritis complex, PPR, equine infectious anaemia, equine influenza, equine viral arteritis, equine rhinopneumonitis, African horse sickness, classical swine fever, Aujeszkey's disease, swine influenza, rabies, canine distemper, infectious canine hepatitis, canine parvovirus, feline panleukopenia, maedi, jaagziekte, scrapie, bovine and feline spongioform encephalopathies, pox virus diseases in different animals. Vesicular stomatitis, vesicular exanthema, equine encephalomyelitis, diseases caused by rota and corona viruses.

General pathology of bacterial infections. Pathogenesis, gross and microscopic pathology of Tuberculosis, Johne's diseases actinomycosis, actinobacillosis, anthrax, clostridial group of diseases, streptococosis including strangles in horses, staphylococosis, glanders, pasteurellosis, leptospirosis, listeriosis, swine erysipelas, brucellosis, corynebacterium infections, nocardiosis, campylobacteriosis, Hemophilus, salmonellosis and colibacillosis in swine.

General pathology of mycoplasmal, chlamydial and rickettsial infections and their differentiation. Pathogenesis, gross and microscopic pathology of contagious bovine pleuropneumonia (CBPP), contagious caprine pleuropneumonia (CCPP), porcine enzootic pneumonia, chlamydial group of diseases and anaplasmosis, Q-fever and ehrilichosis.

General pathology of mycotic infections. Pathogenesis, gross and microscopic pathology of superficial and deep mycoses - ringworm, favus, aspergillosis, zygomycosis, histoplasmosis, cryptococosis and candidiasis.

General pathology of helminthic and protozoal infections. Pathogenesis, gross and microscopic pathology of fascioliasis, amphistomiasis, ascariasis, strongylosis, hemonchosis, spirocercosis, filariasis, hookworm, tapeworm infections, coccidiosis, toxoplasmosis, babesiosis, theileriasis and trypanosomiasis.

Pathogical changes in nutritional and metabolic diseases: (deficiency/excess of carbohydrates, proteins, fats, minerals and vitamins and in conditions like milk fever, pregnancy toxaemia, post-parturient haemoglobinuria, ketosis, hypomagnesemic tetany, azoturia, piglet anaemia and sway back/enzootic ataxia and Rheumatism like syndrome).

General pathology of toxicosis. Pathogenesis, gross and microscopic pathology of heavy metal toxicities like arsenic, copper, lead, mercury, cadmium, strychnine, nitrate/nitrite, hydrocyanic acid (HCN), fluoride, oxalate toxicities, insecticide/pesticide poisoning. Pathogenesis, gross and microscopic pathology of ' aflatoxicosis, ochratoxicosis, trichothecosis and ergotoxicosis. Pathology of exotic and emerging diseases.

Practical

Post-mortem examination of large and small animals for diagnosis of special diseases. Study of gross lesions particularly those of pathognomonic significance. Study of histopathological slides pertaining to special pathology including special staining of causative agents. Study of rapid diagnostic techniques like biopsy, exfoliative cytology, frozen sectioning.

SEMESTER VI

VPP-321 AVIAN PATHOLOGY Credit Hours 1+1=2

Theory

Viral Diseases: Pathogenesis, gross and microscopic pathology of Ranikhet disease, infectious bursal disease, infectious bronchitis, infectious laryngotracheitis, fowl pox, avian influenza, Marek's disease, leukosis/sarcoma group of diseases, avian encephalomyelitis, inclusion body hepatitis, hydropericardium syndrome, chicken infectious anaemia. Avian nephritis, egg drop syndrome, infectious stunting syndrome, reovirus infections.

Bacterial Diseases: Pathogenesis, gross and microscopic pathology of Colibacillosis (colisepticaemia, yolk sac infecion, egg peritonitis, coligranuloma), infectious coryza, clostridial diseases (botulism, necrotic enteritis, gangrenous dermatitis, ulcerative enteritis), salmonellosis (Pullorum disease, fowl typhoid, paratyphoid infection), fowl cholera, tuberculosis and spirochaetosis

Mycoplasmal and Chlamydial Diseases: Pathogenesis, gross and microscopic pathology of Mycoplasma gallisepticum infection (chronic respiratory disease), Mycoplasma synoviae infection, Avian chlamydiosis (psittacosis).

Fungal Diseases: Pathogenesis, gross and microscopic pathology of aspergillosis, thrush and favus.

Mycotoxicosis: Pathogenesis, gross and microscopic pathology of Aflatoxicosis, ochratoxicosis and trichothecenes.

Parasitic Diseases: Pathogenesis, gross and microscopic pathology of Helminthic diseases (flukes, cestodes, nematodes), protozoal diseases (coccidiosis, histomoniasis), ectoparasites, Avian malaria

Nutritional and metabolic diseases: Pathogenesis, gross and microscopic pathology of major diseases due to deficiency/excess of carbohydrates, proteins, minerals and vitamins in poultry.

Vices and Miscellaneous Diseases: Pathology of important vices and miscellaneous conditions.

Pathology of exotic and emerging poultry diseases.

Practical

Post mortem examination and diagnosis of poultry diseases based upon clinical signs and gross lesions. Writing of postmortem report. Collection, preservation and dispatch of morbid materials in poultry diseases. Clinical examination of blood, faeces and other tissues/fluids for poultry disease diagnosis. Submission of feed samples for analysis.

Study of gross specimens and histopathological slides of different diseases of poultry.

SEMESTER VI

VPP-322 AQUATIC ANIMAL DISEASES, HEALTH CARE AND MANAGEMENT

Credit Hours 1+1=2

Theory

Introduction to aquatic animals, aquatic animal ecology and national economy Fishery as a method of recycling animal and poultry wastes and feed surplus. Types of common aquatics animals, fresh and saline water fish, their collection. Care and breeding, egg and spawn management Integrated aquaculture. Ornamental fisheries. Aquatic animal feeds and feeding. Economic production; Pond and nursery management Inland and marine capture fisheries, Stock assessment and population dynamics Fish harvesting and process technology, fish preservation, inspection, utilization of fish In animal feed Anatomy, physiology, immunology and inflammatory response in finfish and shellfish (crustaceans and mollusks).

OIE regulations related to aquatic animal health Viral, bacterial, mycotic and parasitic diseases affecting aquatic animals. Nutritional and toxic pathology Miscellaneous non-infectious diseases associated with physicochemical abnormalities of water Neoplasia of teleosts.

Vaccines and vaccination.

Practical

Identification of culturable fishes. Techniques to study growth and age in fishes, Composite fish culture techniques. Management of artificial diets, induced breeding techniques. Determination of hydrological parameters, qualitative and quantitative analysis of phyto-and zoo-planktons Fishing gears and crafts Management of a typical fish farm.

Normal anatomy and histology of finfish and shellfish. Ante-mortem and post-mortem examination of fish Haematology. Histopathology of important viral, bacterial, fungal and parasitic diseases Visit to organized fishery.

(To be taught jointly with Departments of Livestock Production Management and Veterinary Medicine)

DEPARTMENT OF VETERINARY PUBLIC HEALTH AND EPIDEMIOLOGY

SEMESTER V

VPE- 311 MILK AND MEAT HYGIENE, FOOD SAFETY AND PUBLIC HEALTH

Credit Hours 2+1=3

Theory

Milk hygiene in relation to public health. Microbial flora of milk and milk products. Sources of milk contamination during collection and transport of milk and processing of dairy products, Control of milk and milk product contamination. Hygienic handling/ management of dairy equipment. Quality control of milk and milk products. Milk hygiene practices in India and other countries. Legislation and standards for milk and milk products. Milk as a source of disease transmission.

Pathological conditions associated with the transport of food animals. Elements of meat inspection Hygiene in abattoirs. Ante-mortem inspection of meat animals. Humane slaughter of animals Postmortem inspection of meat animals. Methods of inspection of meat Rigor mortis and examination of lymph nodes. Speciation of meat. Health implications of emergency and causality slaughter. Hygienic disposal of unsound meat. Inspection of poultry and aquatic foods (fish) for human consumption Occupational health hazards in meat processing plants. Meat as a source of disease transmission Food safety, definition, hazard analysis and critical control point (HACCP) system and chemical and microbial toxicities associated with milk, meat and aquatic foods. Risk analysis assessment and management and food safety measures. Toxic residues (pesticides, antibiotics, metals and hormones) ·and microbial toxins in food and their health hazards. Types of bio-hazards. Sanitary and phytosanitary measures in relation to foods. of animal origin and aquatic foods. International and national food safety standards {Office International des Epizooties (OIE), World Trade Organisation (WTO) , Sanitary and Phytosanitary (SPS) and Codex A1imentarius}.

Practical

Sanitary collection of samples for chemical and bacteriological examination. Grading of milk by MBR test. Test for pasteurization and plant sanitation. Microbiological examination of raw and pasteurized milk, milk products and water. Standard plate, coliform, faecal streptococcal, psychrophilic, mesophilic and thermophilic counts. Detection of adulterants and preservatives in milk and milk products. Isolation and identification of organisms of public health significance from milk.

Visit to abattoirs, meat processing' plants, marketing centers and food service establishments. Antemortem and post mortem inspection of food animals. Methods of slaughter (demonstration at the slaughter houses). Demonstration of speciation of meat. Physical and bacteriological quality of meat and aquatic foods (fish). Demonstration of toxic chemical and microbiological residues in milk and meat.

SEMESTER VI

VPE-321 VETERINARY EPIDEMIOLOGY AND ZOONOSES

Credit Hours 2+1 =3

Theory

Definitions and aims of epidemiology. Factors influencing occurrence of livestock diseases and production. Ecological basis and natural history of diseases. Sources, Storage, retrieval and representation of disease information/data.

Epidemiological hypothesis. Epidemiological methods: descriptive, analytical (observational), experimental, theoretical (modeling), serological and molecular. Survey of animal diseases. Surveillance and monitoring of livestock diseases. Animal disease forecasting. Strategies of disease management: prevention, control and eradication. Economics of animal diseases. National and International regulations on livestock diseases. Role of OlE and laws on international trade on animals and animal products.

Definition, history and socio-economic impact of zoonotic diseases. Classification of zoonoses and approaches to their management. New, emerging, re-emerging and occupational zoonoses. Role of domestic, wild, pet and laboratory animals and birds in transmission of zoonoses. Zoonotic pathogens as agents of bio-terrorism. Reservoirs, clinical manifestations in animals and humans, and the management of the following zoonoses: rabies, Japanese encephalitis, Kyasanur forest disease, influenza, anthrax, brucellosis, tuberculosis, leptospirosis, listeriosis, plague, rickettsiosis, chlamydiosis and dermatophytosis.

Food borne zoonoses: salmonellosis, staphylococcosis, clostridial food poisoning, campylobacteriosis, helminthosis, toxoplasmosis and sarcocystosis. Veterinary Public Health Administration.

Practical

Collection of epidemiological samples. Measurement of disease: determination of morbidity and mortality rates/ ratios. Generation of epidemiological protocols and reports. Demonstration of selected software programmes/ models e.g. EPIZOO, HandiSTATUS and lndia-Admas-EPITRAK. Evaluation of vaccines and diagnostic tests. Determination of Associations and risks: relative risk. Odd's ratio and attributable risk. Survey of an animal disease on a farm.

Field survey of zoonotic diseases. Concurrent isolation and identification of important pathogens of zoonotic importance from animal and human sources including foods of animal origin and their interpretation. Study of rural environment and health status of rural community. Visit to primary health.

centre/human hospital and study of the common diseases affecting rural/urban population, and probable relationships of these human disease conditions with animal diseases present in the area.

SEMESTER IX

VPE- 511 ENVIRONMENT AND ENVIRONMENTAL HYGIENE Credit Hours 2+1=3

Theory

Definition, scope and importance. Ecosystem: types, structure and functions Food chains. Bio-diversity uses, threats and conservation. Natural resources: forest, mineral, soil and water-thril' uses and abuses Environmental pollution-causes, and effects, Control measures of air, water, soil, marine, thermal and noise pollution. Nuclear hazards. Bio-safety and risk assessment. Environment Protection Acts and related issues. Disaster management.

Sources of water supply and water quality. Sources of water contamination Bacteriology of water Physical, chemical, microbiological and biological evaluation of water. Water purification Disposal of sewage and farm wastes. Health implications of farm wastes. Sanitation and disinfection of animal houses. Recycling of farm wastes. Sources of air pollution within animal houses and Its effect on animal health and production. Ventilation and ventilation systems within animal houses and specialized laboratories. Prevention and control of air and water-borne diseases.. Problems of atmospheric pollution (acid rain, depletion of ozone layer, methane production, green house effect and global warming).

Tannery, wool, bone and blood meal industry pollution and its control. Stray and fallen animal management. Pollution due to industrial wastes.

Practical

Sampling of water for sanitary examination. Physical examination of water estimation of colour, turbidity total hardness, solids, alkalinity and acidity of water. Chemical and Microbiological evaluation of water quality. Disinfection of animal houses. Determination of the efficacy of disinfectants Demonstration of water purification system. Disposal of carcasses. Pathogenic microbes in air. Demonstration of various ventilation systems in animal houses. Demonstration of toxic residues in water and air Visit to local polluted sites and documentation of local environmental problems.

DEPARTMENT OF ANIMAL NUTRITION

SEMESTER I

ANN-111 PRINCIPLES OF ANIMAL NUTRITION AND FEED TECHNOLOGY

Credit Hours 2+1=3

Theory

Importance of nutrients in animal production and health. Composition of animal body and plants. Nutritional terms and their definitions. Importance of minerals (major and trace elements) and vitamins in health and production, their requirements and supplementation in feed. Common feeds and fodders, their classification, availability and importance for livestock and poultry production. Measures of food energy and their applications - gross energy, digestible energy, metabolisable energy, net energy, total digestible nutrients, starch equivalent, food units, physiological fuel value. Direct and indirect calorimetry, carbon and nitrogen balance studies. Protein evaluation of feeds - Measures of protein quality in ruminants and non-ruminants, biological value of protein, protein efficiency ratio, protein equivalent, digestible crude protein. Calorie protein ratio. Nutritive ratio. Various physical, chemical and biological methods of feed processing for improving the nutritive value of inferior quality roughages. Preparation, storage and conservation of livestock feed through silage and hay and their uses in livestock feeding. Harmful natural constituents and common adulterants of feeds and fodders. Feed additives in the rations of livestock and poultry; Antibiotics and hormonal compounds and other growth stimulants, and their uses

Practical

Familiarisation of various feedstuff, fodders and their selection Preparation and processing of samples for chemical analysis - herbage. faeces, urine and silages. Weende's System of analysis - Estimation of dry matter, total ash, acid insoluble ash, crude protein, ether extract, crude fibre, nitrogen free extract, Calcium and phosphorus in feed samples. Demonstration of detergent methods of forage analysis Qualitative detection of undesirable constituents and common adulterants of feed Demonstration of laboratory ensilini of green fodders. Silage pit preparation.

SEMESTER II

ANN-121 APPLIED NUTRITION-I (RUMINANTS) Credit Hours 2+1=3

Theory

Importance of scientific feeding. Feeding experiments. Digestion and metabolism trial. Norms adopted in conducting digestion trial. Measurement of digestibility. Factors affecting digestibility of a feed. Feeding standards, their uses and significance, merit and demerits of various feeding standards with reference to ruminants. Nutrient requirements of livestock-energy and protein requirement for maintenance and production. Methods adopted for arriving at energy and protein requirements for maintenance and production in terms of growth, reproduction, milk, meat, wool and work. Balanced ration and its characteristics. General principles of computation of rations. Formulation of rations and feeding of dairy cattle and buffaloes during' different phases of growth, development and production (neonate, young, mature, pregnant, lactating and dry animals; breeding bull and working animals). Formulation of ration and feeding of sheep and goat during different phases of growth, development and production (milk, meat and wool). Use of NPN compound for ruminants.

Practical

Demonstration of conducting digestion trial in ruminants. Calculation of nutritive value of different feedstuffs in terms of digestible crude protein (DCP), total digestible nutrient (TDN), Nitrogen retention (NR) and starch equivalent (SE). Calculation of requirements of nutrients in terms of DCP, TDN and metabolisable energy (ME) for maintenance, growth, and other types of production like meat, milk, wool, reproduction and work. Formulation of rations for different categories of livestock under different conditions. Demonstration of the methods for improving the nutritive quality of straws and other crop residues. Formulation of rations for feeding of livestock during scarcity periods, Visit to feed factories.

SEMESTER III

ANN-211 APPLIED NUTRITION-II (NON-RUMINANTS POULATRY AND LABORATORY ANIMALS) Credit Hours: 2+1=3

Theory

Factors affecting digestibility of a feed. Nutrient requirements in poultry, swine and equine - Energy and protein requirement for maintenance and production. Methods adopted for arriving at energy and protein requirements for maintenance and production in terms of growth, reproduction and production (egg, meat and work). Formulation of rations as per Bureau of Indian Standards (BIS), National Research Council (NRC) and Agricultural Research Council (ARC) specifications. Feeding standards, their uses and significance, merit and demerits of various feeding standards with reference to monogastric animals and poultry. Feeding of swine (Piglets, Growers, Lactating and pregnant sows, Breeding boar, Fattening animals), equine (foal yearling, broodmare, stallion and race horses) and poultry (Starter, Growers, Broilers, Layers) With conventional and unconventional feed ingredients. Feeding of ducks. Laboratory Animal Nutrition: Nutrient requirements of mice, rat, rabbit and guinea pig. Significance of carbohydrates, lipids, proteins and amino, acids, minerals and vitamins in lab animal nutrition. Diet formulation and preparation and feeding practices. Feed supplements.

Practical

Calculation of requirements of nutrients in terms of DCP, TDN and ME for maintenance, growth, reproduction and other types of production like egg and meat Formulation of rations for poultry and swine with conventional and unconventional feed ingredients. Principles of compounding and mixing of feeds.

Visit to poultry farms.

DEPARTMENT OF ANIMAL GENETICS AND BREEDING

SEMESTER I

AGB-111 BIO-STATISTICS AND COMPUTER APPLI CATION Credit Hours 2+1 =3

Theory

A. Basic Statistics:

Introduction and importance. Statistics, parameters, observation, recording and graphical representation of data. Probability and probability distributions: binomial, Poisson and normal. Measures of central tendency and measures of dispersion (simple and grouped data): Moments and skewness to kurtosis.

Correlation and regression. Tests of hypothesis and t, Z, X_2 and F tests of significance and their interrelationship. Livestock census procedure and census. Introduction to sample survey methods for livestock and livestock products. Bioassay - meaning and uses.

B. Experimental designs:

Completely Randomized Design (C.R.D.) and Randomized Block Design (R.B.D). Analysis of variance.

C. Computer application:

Computer and its components; Types of computers; Hardware., software, human ware and firm ware. Type of memories. Computer languages and their scope and limitations. Computer programming: Data types: Constants, variables, expressions, operations, functions, flow charts, commands, simple programs and their execution- scope and limitations. Data base management system: Storage of data, filing, retrieving, reproduction. Use of computer in animal husbandry and veterinary practices.

Practical

Systematic approach of data, tabulation; simple probability problems. Estimation of measures of central tendency (mean, median, mode) and estimation of measures of dispersion (variance, standard deviation, standard error and coefficient of variation): for simple and grouped data. Graphical representation of data.

Tests of. significance -t, Z, X_2 and F tests. Estimation of correlation. Estimation of regression. Analysis of variance: C.R.D., R.B.D. Computer basics and components of computer. Simple operations: Entering and saving biological data, database management systems. MS-Office. Spread sheet. Internet, e-mail and geographic information system (GIS).

Demonstration

Use of word processor and spreadsheet. Graphics and their uses. Data retrieving and analysis through computer (Data base). Use of local area network (LAN) and other network systems. Retrieving library information through network. G.I.S. and its use.

SEMESTER II

AGB-121 PRINCIPLES OF ANIMAL GENETICS AND POPULATION GENETICS

Credit Hours: 2+1=3

Theory

History of Genetics, Chromosome numbers and types in livestock and poultry. Mitosis, Meiosis and gametogenesis. Overview of Mendelian principles; Modified Mendelian inheritance: gene interaction; multiple alleles; lethals; sex-linked, sex limited and sex influenced traits; linkage and crossing over, Mutation, Chromosomal. aberrations; Cytogenetics, Extra-chromosomal inheritance. Gene concept -classical and molecular.

Population genetics: Genetic structure of population: Gene and genotypic frequency: Hardy - Weinberg law and its application; Forces (e.g. Mutation, migration, selection and drift) changing gene and genotypic frequencies.

Quantitative genetics: Nature and properties, Values and means, Components of phenotypic and genotypic variance; Concept of genotype and environment interaction. Resemblance between relatives; Heritability, repeatability, genetic and phenotypic correlations.

Practical

Demonstration of karyotype of Farm animal species; Solving problems on inheritance.of Mendelian traits, Linkage and Crossing over. Calculation of gene and genotypic frequencies, Testing a population for Hardy-Weinberg equilibrium; Calculation of eftects of various forces that change gene frequencies; Computation of population mean; Estimation of heritability. repeatability, Most probable producing ability, {MPPA}, genetic and phenotypic correlations.

SEMESTER III

AGB-211 LIVESTOCK AND POULTRY BREEDING

Credit Hours 2+1=3

Theory

History of Animal Breeding; Classification of breeds; Economic characters of livestock and poultry and their importance; Breeding/Selection techniques for optimal production, selection, response to selection and factors affecting it; Bases of selection individual, pedigree, family, sib, progeny and combined; Indirect selection; Multitrait selection.

Classification of mating systems; Inbreeding and outbreeding-genetic and phenotypic consequences viz., inbreeding depression and heterosis: Systems of utilization of heterosis; Selection for combining ability;

Breeding methods for the improvement of dairy cattle and buffaloes {crossbreeding, sire evaluation, field progeny testing, open nucleus breeding system {ONBS}}, sheep, goat, swine and poultry; Bleed development; Conservation of germplasm, Current livestock and poultry breeding programmes in the state and country.

Practical

Description and measurement of economic traits of Livestock & poultry. Standardization, of performance records, Computation of selection differential, generation interval and expected genetic gain; Construction of selection index; Sire indices, Measurement of inbreeding and relationship coefficients; Estimation of heterosis.

DEPARTMENT OF LIVESTOCK PRODUCTION MANAGEMENT

SEMESTER I

LPM-111 LIVESTOCK PRODUCTION MANAGEMENT-I (GENERAL PRINCIPLES AND RUMINANTS) Credit Hours 3+1=4

Theory

Livestock in India: association of livestock to Indian society during vedic, medieval and modern era. Demographic distribution of livestock and role in economy. Animal holding and land holding patterns in different agro-ecologies.

Introductory animal husbandry. Common animal husbandry terms. Body conformation and identification.

Dentition and ageing of animals. Transport of livestock by rail, road, air and on foot. Common farm management practices including disinfection, isolation, quarantine and disposal of carcass. Introduction to methods of drug administration. Common vices of animals, their prevention and care. Livestock production systems of different agro-climatic zones. Livestock resources and resources management.

Livestock produce and products and their availability and their role in rural/urban health/economy.

Organic livestock production.

General principles affecting the design and construction of building for housing for various livestock species. Selection of site. Arrangements of the building with special reference to Indian conditions.

Utilisation of local materials. Building materials used for construction of wall, roof and floor of animal houses, their characteristics, merits and demerits.

Demography of cattle and buffalo population. Breeds and descriptors of important breeds. Important traits of cattle and buffaloes. General management and feeding practices of calves, heifers, pregnant, lactating and dry animals, and bulls and working animals. Draughtability of cattle and buffaloes. Raising of buffalo males for meat production. Housing systems, layout and design of different buildings for dairy animals including backyard dairy and mixed farms. Routine dairy farm operations and labour management. Methods of milking and precautions. Factors affecting quality and quantity of milk production. Clean milk production. Dairy farm accounts and records. Concepts of input and output cost of dairy farming (small and large holdings).

Demography of sheep and goat population and their role in economy. Breeds and breed descriptors. Important traits for meat, milk and fibre. General management and feeding practices during different stages of growth, development and production (milk, meat and wool) in small and large holdings. Breeding schedule and management of ram and buck. Weaning and fattening of lambs and kids, Glossaries of terms in wool industry. Shearing of sheep. Physical and chemical properties of wool. Impurities in wool. Factors influencing the quality of wool. Wool grading. Recovery of wool wax and its use. Housing systems, layout and design of different buildings of small ruminants.

Judging for the quality and confirmation of body parts of cattle, buffalo, sheep and goat. Culling of animals. Preparation of animals for show.

Problems and prospects of dairy, meat and wool industry in India. Animal and animal products market and marketing. Animal Fairs and Melas. Animal pounds and Goshalas.

Practical

Identification of various breeds of cattle, buffalo, sheep and goat. Familiarization with body points of animals. Approaching, handling and restraining of cattle, buffalo, sheep and goat. Clipping, shearing, dipping, spraying and spotting sick animals. Detection of vices. Feeding of animals. Methods of identification (marking, tattooing, branding, tagging and electronic chip). Determination of age Determination of body weight using different measurements. Preparation of animals for show and judging. Layout plans for dairy and sheep/goat farms. Familiarization with routine farm operations. Selection and culling of animals. Milking of dairy animals. Training of breeding males. Detection of heat. Identification and care of pregnant animals. Care of neonatal and young stock. Maintenance, cost accounting economic analysis and preparation of balance sheet of dairy and sheep/goat farm records. Structure of wool and its differentiation from hair fibre. Determination of staple length, crimps, diameter and strength of wool fibre. Sorting, packaging and grading of wool. Recovery of wax from wool. Scouring and carbonisation of wool. Visit to different animal farms/ demonstration centres/ individual rural. Urban and peri-urban animal units/ wool production centres & industries/ wool, meat and live animal markets. Preparation of project proposals.

SEMESTER II

LPM - 121 FODDER PRODUCTION AND GRASSLAND MANAGEMENT Credit Hours: 1+1=2

Theory

Importance of grasslands and fodders in livestock production. Agronomical practices for production of leguminous and non-leguminous fodders in different seasons. Soil and water conservation and irrigation drainage for fodder production. Farm power and agro-energy. Farm machinery and equipment. Harvesting and post harvest techniques for fodder preservation. Storage of feeds and fodders. Scarcity fodders. Feed and fodder management for individual animals. Fodder production for small units through inter cropping or back yard cultivation. Recycling of animals washings and wasters in fodder production.

Practical

Visit to the fodder farm. Familiarisation with the various types of fodder crops utilised in the state and the samples of fodder in India. Fodder cropping routines-familiarisation. Collection, preservation and storage of feed and fodder, possible damages/loss and methods to prevent them. Cost calculations of fodder production. Familiarisations with the back yard fodder cropping and intercropping of fodder. Livestock waste utilisation and recycling. Calculation on the economic aspects of fodder cropping and procurement of feed.

SEMESTERR II

LPM - 122 LIVESTOCK PRODUCTION MANAGEMENT II (MONOGASTRIC AND LABORATORY ANIMALS) Credit Hours: 1+1= 2

Theory

Introduction and scope of swine farming in the country. Demography of swine population. Breeds and their role in economy. Management of different categories of swine for optimal production: breeding and pregnant sows; sows at farrowing and after farrowing; pig-lets, growing stock, lactating sows, feedlot stock. Mating technique in swine. Housing of swine. Swine feeds and feeding. Economics of pig farming. Equine population of India. Horses, donkeys and mules and their utility. Identification of breeds of horses. Dentition and ageing of horses. Handing, restraining, care and routine management of equines including grooming, saddling, and exercise. Stable and its management. Feeding routine for horse, donkeys and mules. Vices of horses. Care of stallion. Mating of Horses broodmare and its care. Foaling and care of newborn. Breeding mules. Care of race horses and preparing horses for show. Doping and its detection. Visit to races, polo, horse show.

Importance of laboratory animal breeding care and housing standards of mice, rats and guinea pigs. General consideration of feeding and breeding of laboratory animals. Prophylactic measures for commonly occurring laboratory animal diseases. Concept of production of specific pathogen free (SPF) and germ free laboratory animals.

Scope of rabbit farming in the country, breeds and their distributions in India and abroad. Limitation of rabbit animal production. Selection, care, and management of breeding stock for commercial purpose. Identification. Care and management of kindling animals and kindling. Care of new born, growing stock. Harvesting of products. Breeding and selection techniques for optimal production. feeds and feeding for rabbit production. Housing of rabbit. Shearing/slaughtering and preservation of products. Diseases and parasite control, hygienic care. Disposal, utilization and recycling of wastes etc. Economic aspects of rabbit production, accounting their expenditure, income etc. Manpower requirements and personnel/labour management. Preparing projects for micro (backyard) mini, and major rabbit farms.

Practical

Identification of Indian and exotic breeds of swine, handling of swine, Routine inspection. Identification of diseases, examination and control of parasites, vaccination, Identification of pregnant animals. Care during pregnancy, isolation and care of farrowing sows, care of pig lings, Castration; culling, tooth cutting. Calculation of profits and preparation of feasibility reports and projects for piggery. Layout plans of swine houses; routine operations of swine farms. Marketing of swine. Feeding of swine. Preparation of swine for show and judging.

Identification of body parts and handling of laboratory animals. Housing system and space requirements for laboratory animals. Weighing, sexing and weaning of laboratory animals. Marking for identification of laboratory animals for purpose of their individual recording. Computation and compounding of balance diet for laboratory animal mainly Mice, Rats, Guinea-pigs and Rabbits. Feeding schedule of laboratory animals for high breeding efficiency. Maintenance of breeding records of laboratory animals. Prophylactic measures against common disease of lab animals. Hygienic care and control of parasites (routines).

Visit to the University Rabbitary. Handling and restraint. Body parts. Identification of breeds. Judging. Feeds and feeding. Housing requirement and equipment. Farrowing. Care of newly born young ones-tagging, tattooing for identification. Shearing. Dressing of carcass.

Horse riding: walking, trotting, cantering and galloping. Preparation of equines for show and judging. Layout plans for stables.

SEMESTER III

LPM - 211 AVIAN PRODUCTION MANAGEMENT 1+1=2

Theory

Indian Poultry Industry-brief outline of the different segments-poultry statistics.

Classification of poultry, common breeds of poultry including duck, quail, turkey & guinea fowl and their descriptions. Description of indigenous fowls.

Reproduction in fowl, male and female reproduction systems, formation of eggs, structure of eggs.

Important economic traits of poultry, egg production, egg weight, egg quality, growth, feed consumption and feed efficiency, fertility and hatchability, plumage characteristics and comb types. Scavenging system of management raising of chicks, scavenger feed base of village. Low input technology backyard and semi intensive unit of various sizes their description, management and economic achievements.

New colored feathered birds developed in public and private sectors for meat and egg production for rural poultry; their acceptability and assimilation in rural eco-system.

Mixed farming and poultry raising. Concept of self-local market unit.

Brooding and rearing practices used for chicken, duck, quail, turkey and guinea fowl.

Economic production of chicken, and other classes of poultry.

Hatching and feeding norms for different species of poultry. Marketing of poultry and poultry products. Setting of farms for different classes of poultry. Organic and hill farming.

Practical

Morphological description of common exotic poultry breeds like White Leghorn (WLH). Rhode Island Red (RIR), Plymouth Rock, Cornish and New Hampshire. Diagrammatic illustration of body parts of chicken, duck, quail, guineas fowl and turkey. Descriptive specialities of indigenous birds, listing of its advantageous value in rural areas. Diagrammatic representation of scavenging, backyard and semi intensive units; with habitats, feed base and shelter. Conservation of indigenous germ plasm; listing of conservation techniques. Demonstration of newly developed breeds in rural environment. Housing, equipments, nesting and brooding requirements. Vaccination, medication and incubation requirements. Preparation of projects for rural people on poultry and other species (duck, quail, guinea fowl and turkey).

SEMESTER IV

LPM -221 COMMERCIAL POULTRY PRODUCTION AND HATCHER MANAGEMENT

Credit Hours: 1+1=2

Theory

Housing - Location of poultry. Types of poultry houses. Different types of rearing- advantages and disadvantages. Space requirement for different age groups under different rearing systems. Environmentally controlled housing.

Brooding Management - Brooding: Types of brooder; preparation of shed to receive chicks; importance of environment (temperature, humidity and ventilation); Feeding and vaccination in early stage of chicks.

Little Management - Litter materials, litter-borne diseases and control; potential for poultry litter used as fertilizers; recycling for livestock feeding and power generation; Special management care in adverse weather conditions/ stress; summer management; modification of housing light reflectors; insulators, sprinklers, foggers and other methods; dietary modification to minimize heat stress; special management during rainy and winter season; other stress management-vices in poultry and its remedial measures.

Water Management- Standard for drinking water in terms of total solids, pH, minerals levels, sanitizers and water sanitations, diseases spread through water contamination-prevention.

Biosecurity- Proactive measures to minimize entry of infections in farm premises-farm fencing, disinfectant pits, personnel management, restriction of movement, etc. Poultry welfare and behaviour.

Feeding- digestive system and digestion in chicken. Classification, selection of common feed ingredients and their nutrient composition. Nutrient requirement for different age groups. Feed formulation, economics of feed formulation-cost/ unit nutrient. Feeding systems and feeding management, economization of poultry feeding. Feed restriction, separate male feeding, non-nutrient feed additives including herbal bio-enhancers; anti-nutritional factors and toxins.

Health Care - Common poultry diseases bacterial, viral, fungal, parasitic and nutritional deficiencies. Vaccination schedule for commercial layers and broilers factors that govern vaccination schedule vaccination principles type, methods, pre and post vaccination care. Medication: Types of administration general principles and precautions with emphasis on administering medication through water and feed; commonly used drugs in poultry diseases. Disinfection; Types of disinfectants mode of action; recommended procedure; precaution and handling.

Economics- Economics of layer and broiler production, Projects reports layer in different systems of rearing. Projects reports for broilers. Feasibility studies on poultry rearing- in context of small units and their profitability. Designer meat and egg production. Export/import of poultry and poultry products.

Breeder Flock Management - Layer and broiler breeder flock management, housing & space requirements. Different stage of management during life cycle; Light management during growing and laying period, Artificial insemination.

Feeding: Feed restriction, separate male feeding. Nutrient requirement of layer and broiler breeders of different age groups. Healthcare vaccination of breeder flock; difference between vaccination schedule of broilers and commercial birds. Common diseases of breeders (Infectious and metabolic disorders) prevention. Fertility disorder- etiology, diagnosis and corrective measures. Selection and culling of breeder flocks. Economic parameters on returns from breeders- for example saleable chicks/hen/production cycle etc.

Hatchery Practices - Management principals of incubation. Factors affecting fertility and hatchability, selection, care and incubation of hatching eggs. Fumigation; sanitation and hatchery hygiene. Disposal of hatchery waste; Sexing, grading, packing and dispatch of day old chicks. Economics of hatchery business; Trouble shooting hatch failure: importance of hatchery records, break even analysis of unhitched eggs. Bio security in the hatchery. Computer applications for hatchery management.

Practical

Male and female reproductive system. Artificial insemination. Selection of breeder flock.

Working of hatchery incubation requirement; incubators working, care. Hatchery layout and equipments. Handling of eggs prior and during incubation. Candling. Fumigation. Project reports of setting up a hatchery. Hatchery records and maintenance.

Exposure to commercial broiler and layer farms-different system of housing.

Demonstration of litter and cage rearing systems. Feed equipments and maintenance; hammer mill, mixture, pellet mill-types, principle of working, comparison of different types, premix preparations, quality control of raw materials. Feed mill operation. Demonstration of different types of feeder, waterer, fogger, sprinklers etc. Maintenance of farm records. Medication -demonstration of routinely employed methods of administration.

Vaccination practice in general and demonstration of different roots of administration in particular.

SEMESTER-IV

LPM-222 LIVESTOCK PRODUCTION MANAGEMENT (REGIONAL INTEREST)

Credit Hours: 1+1=2

Course Contents to be developed by the University/Veterinary College on the basis of regional Interest.

DEPARTMENT OF LIVESTOCK PRODUCTS TECHNOLOGY

SEMESTER V

LPT-311 MILK AND MILK PRODUCTS TECHNOLOGY

Credit Hours: 1+1=2

Theory

Milk industry in India. Layout of milk processing plant and its management. Composition and nutritive value of milk and factors affecting composition of milk. Physico-chemical properties of milk. Microbiological deterioration of milk and milk products collection chilling standardization pasteurization homogenization, bactofugation. Principles of dehydration. Preparation of butter, paneer/channa, ghee, khoa, lassi, dahi, ice-cream, chedder cheese and dairy by products. Good manufacturing Practices. Implementation of HACCP. Toxic/pesticides residues in milk and milk products packaging, transportation, storage and distribution of milk and milk products. Organic milk food products legal and BIS standards of milk and milk products sanitation in milk plant.

Practical

Sampling of milk, estimation of fat solid not fat (S.N.F.) and total solids Platform tests. Cream separation Detection of adulteration of milk. Determination of efficiency of pasteurization microbiological quality evaluation of milk and milk products. Preparation of milk products like curd, ghee, paneer/channa, khoa, ice-cream, milk beverages. Visit to modern milk processing and milk manufacturing plants.

SEMESTER V

LPT- 312 ABATTOIR PRACTICES AND ANIMAL PRODUCTS TECHNOLOGY

Credit Hours: 1+1=2

Theory

Layout and management of rural, urban and modern abattoirs. BIS standards on organization and layout of abattoirs, Pre-slaughter care, handling and transport of meat animals including poultry. Ante-mortem and post-mortem examination. Slaughtering and dressing of carcasses. Evaluation grading and fabrication of dressed carcasses including poultry.

Abattoir by-products meat, bone, fish meal and by-products of pharmaceutical value. Skin and hides methods of flaying, defects and preservation management of organic wastes emanating from animal industries, failen animals and abattoir effluent. HACCP concepts in abattoir management. Introduction to wool, fur, pelt and specialty fibers with respect to processing industry . Glossary of terms of wool processing. Basic structure and development of wool follicle. Post shearing operations of wool classification and grading of wool, physical and chemical properties of wool. Impurity of wool, factors influencing the quality of wool. Brief outline of processing of wool Tests for identification of wool.

Practical

Methods of ritual and humane slaughter, flaying and dressing of food animals including poultry. Carcass evaluation. Determination of meat yield, dressing percentage, meat bone ratio and cut up parts Preparation of different abattoir byproducts. Visit to leather processing unit and slaughterhouses/meat plants.

Wool sampling techniques, determination of fleece density, fiber diameter staple length crimp and medulation percentage, scouning/clean fleece yield. Visit to wool production/processing centre.

SEMESTER VI

LPT-321 MEAT SCIENCE Credit Hours: 1+1=2

Theory

Retrospect and prospect of meat industry in India. Structure and composition of muscle (including poultry muscle), conversion of muscle to meat, nutritive value of meat. Fraudulent substitution of meat preservation of meat and aquatic foods - drying, salting, curing, smoking, chilling, freezing, canning, irradiation, antibiotic and chemicals. Ageing of meat. Modern processing technologies of meat and meat products. Packaging of meat and meat products. Formulation and development of meat and sea foods - kabab, sausages, meat balls/patties, tandoori chicken, soup, pickles, surimi, smoked fish. Physico-chemical and microbiological quality of meat and aquatic food and food products. Basics of sensory evaluation of meat products. Nutritive value, preservation, packaging of egg and egg products. Laws governing national/International trade in meat and meat products. Organic meat food products. Food products of genetically modified animal and marine origin.

Practical

Chilling/freezing of meat, meat products and aquatic foods. Ageing of meat preservation and packaging of meat, aquatic foods and shell eggs and their products. Determination of microbial loads in various animal food products, estimation of deteriorative changes in meat and meat products. Preparation of ready-to-eat meat/poultry products. Evaluation of external and internal egg quality, preservation technique of eggs.

DEPARTMENT OF VETERINARY GYNAECOLOGY AND OBSTETRICS

SEMESTER VII

VGO-411 VETERINARY GYNAECOLOGY Credit Hours: 2+1=3

Theory

Clinical evaluation and abnormalities of reproductive tracts in domestic animals. Delayed Puberty and sexual maturity. Estrus detection. Aberrations of estrus and estrous cycle. Seasonal breeding. Pregnancy diagnosis- different methods- in different species. Superfoetation and Superfecundation. Fertility, Infertility & sterility- Anatomical, hereditary, nutritional, managerial, hormonal and infectious causes. Anoestrus, ovulatory defects and cystic ovarian degeneration. Repeat breeding: Fertilization failure, early embryonic mortality. Specific & non- specific infections affecting genital organs-endometritis, cervicitis, vaginitis. Fertility parameters. Sexual health control and reproductive health management. Clinical use of hormones in female infertility. Breeding management, mismating, psuedopregnancy, transmissible venereal tumor (TVT) in bitches.

Induction of estrus, Synchronization of estrus, Follicular Dynamics, Ovulation, Superovulation, and embryo Transfer Technology. Immuno-modulation for enhancement of fecundity.

Practical

Study of female genitalia and its biometry. Methods of estrus detection in farm and companion animals including vaginal cytology. Collection and examination of vaginal mucus by various techniques. Demonstration of different hormonal preparations and their uses. Different protocols for induction and Synchronization of estrus, superovulation and embryo transfer. Pregnancy diagnosis and its differential diagnosis. Use of gynaecological instruments and appliances. Evaluation of female animals for breeding soundness. Demonstration of reproductive pathological conditions using museum specimens. Sexual health control, life history card for the female, recording system for reproductive performance.

Demonstration of ultrasonographic imaging of reproductive organs and pregnancy, Oocyte collection and grading.

SEMESTER VIII

VGO-421 VETERINARY OBSTETRICS Credit Hours: 1+1=2

Theory

Types and functions of placenta in different species. Diseases & accidents during gestation- Abortion in domestic animals-diagnosis & control. Dropsy of fetal membrances and fetus. Fetal mummification, maceration, pyometra and mucometra. Prolonged gestation. Teratology. Premature birth. Uterine torsion.

Cervico-vaginal prolapse. Termination of pregnancy. Parturition. Puerperium and involution of uterus in domestic animals. Care and management of dam and newborn.

Dystocia- Types of dystocia - maternal & fetal- approach, diagnosis and treatment. Epidura & other anesthesia in obstetrical practice. Obstetrical operations- mutation, forced extractions, fetotomy and caesarean section. Injuries and diseases in relation to parturition.

Postpartum diseases and complications uterine prolapsed, retention of fetal membrances, metritis postpartum paraplegia.

Animal birth control - ovariohysterectomy and non surgical interventions.

Practical

Study of pelvis and Pelvimetry. Assessment of fetal age. Demonstration of different types of palcenta. Use of obstetrical instruments. Epidural and other obstetrical anaesthesia. Manipulation of fetal malpresentation in Phantom Boxes. Approach and treatment of obstetrical cases. Handling of prolapsed of genitalia-application of vulvar sutures. Foetotomy. Caesarean section Post operative care and management of obstetrical cases. Demonstration of ovariohysterectomy.

SEMESTER IX

VGO-511 VETERINARY ANDROLOGY AND REPRODUCTIVE TECHNIQUES

Credit Hours: 1+1=2

Theory

Introduction to Andrology. Development of male genitalia and gonads. Puberty, sexual maturity, sexual behaviour and libido. Factors affecting maturity and sex drive in bulls. Forms of male infertility. Factors causing infertility in male, its diagnosis and treatment. Testicular hypoplasia and degeneration. Diseases of the accessory sex glands. Introduction, history, development, advantages and limitations of artificial insemination (A.I). methods of semen collection in various species. Factors affecting quality and quantity of semen. Macroscopic/physical, microscopic, biochemical and biological tests for evaluation of semen. Extenders used for semen preservation. Extension of semen, preservation of semen at different temperatures. Storage and shipment of semen. Technique of A.I.

Practical

Planning and organization of A.I. Centre. Selection, care, training and maintenance of breeing bulls for A.I. Andrological investigations for breeding soundness of bulls. Castration in different species. Preparation of teaser bulls. Care, sterilization, storage and upkeep of equipments used for artificial Insemination. Preparation of A.V. Collection of semen. Evaluation of semen (Macroscopic/physical, microscopic, biochemical and biological tests). Preparation of extender and Extension of semen. Preservation techniques at different temperatures. Freezing of semen. Insemination techniques for chilled and frozen semen. Recording Systems. Handling and shipment of frozen semen and liquid nitrogen containers at field level.

DEPARTMENT OF VETERINARY SURGERY AND RADIOLOGY

SEMESTER VII

VSR-411 GENERAL VETERINARY SURGER, ANAESTHESIOLOGY AND DIAGNOSTIC IMAGING

Credit Hours: 2+2=4

General Surgery

Theory

Introduction, history, classification, surgical terminology and development of veterinary surgery. Asepsis-antisepsis, their application in veterinary surgery. Surgical risk and judgemet. Management of shock, haemorrhage. Principles of fluid therapy in surgical patients. Differential diagnosis and surgical treatment of abscess, tumors, cyst, haematoma, necrosis, gangrene, burn. Wound: classification, symptoms, diagnosis and treatment, complications, their treatment and prevention.

Practical

Surgical instruments and equipment. Operation theatre routines. Surgical pack:

Preparation, sterilization and handling. Familiarisation with suture materials, surgical knots, suture patterns and their use. Familiarisation to live surgery haemostasis.

Anaesthesiology

Theory (Region specific)

Preanaesthetic considerations and preanaesthetics. Anaesthesia, local analgesia/anaesthesia, General anaesthesia, anaesthetic agents (like barbiturates, dissociative agents). Inhalation anaesthesia and agents, maintenance and monitoring of general anaesthesia. Anaesthetic emergencies and their management. Only awareness of neuroleptanalgesia, electro-anaesthesia, acupuncture, hypothermia, muscle relaxants. Post operative pain management. General principles of chemical restraint of wild /zoo animals and anaesthesia of lab animals.

Practical

Familiarisation with anaesthetic apparatus, endotracheal tubes. Laryngoscope, gadgets for monitoring. Pre anaesthetic preparation, induction of general anaesthesia in small and large animals and endotracheal intubation in dogs.

Demonstration of inhalant anaesthesia, monitoring of general anaesthesia and the management of anaesthetic emergencies. Use of artificial/ assisted respiration. Various methods of local infiltration anaesthesia and regional block, for surgical procedures of different regions of body in large and Small animals. Chemical restraint of lab and wild animals (Visit of a wild animal facility and audiovisual aids).

Diagnostic Imaging

Theory

Production and properties of X-rays. Factors influencing production of X-ray.

Principles of viewing and interpreting X-ray films, classification of radiographic lesions. Contrast radiography: classification, materials, uses, indications and contra indications. Biological effects of radiation, radiation hazards and their prevention by adoption of safety measures. Principles of ultrasonography and its applications in veterinary practice. Awareness on principles of radiation therapy, Isotopes and their uses in diagnosis and therapy: Principles and application of CT scan, MRI, echocardiography, scintigraphy, gamma camera, xeroradiography and Doppler.

Practical

Familiarisation with operation of the X-ray equipment, X-ray accessories and adoption of safety measures in radiography. Dark room equipments, X-ray film and its processing. Intensifying screen and its uses. Radiographic technique-positioning of small and large animals. Handling, viewing and interpretation of X-ray films.

Familiarisation with film contrasts, density and detail, common defects of X-ray films. Radiographic anatomy and interpretation of radiographic lesions. Demonstration of contrast technique in small animals. Familiarisation with ultrasonography of small and large animals (demonstration).

SEMESTER VIII

VSR-421 REGIONAL SURGERY VETERINARY Credit Hours: 2+1=3

Theory

Head and Neck

Affections of the lips and cheek and their treatment. Affections of the tongue and their treatment. Treatment of cleft palate. Nasal polyps. Affections and treatment of Guttural pouch, empyema, chondroids, tympanitis. Sinusitis, pus in the sinus. Affections of the horn and their treatment (avulsion of the horn, fracture of the horn, horn cancer and fissure in horn). Debudding and amputation of the horn. Affections of the teeth and their treatment congenital abnormalities, irregular molars. (shear mouth, sharp teeth, wave form mouth, step formed mouth) dental tartar and dental caries, dental tumor and periodontal disease. Bishoping. Affections of salivary glands and their treatment (Trauma, sialoliths, salivary cysts, salivary fistula). Affections of the upper and lower jaw and treatment. Affections of the ear and their treatment. (haematoma and chronic otorrhoea). Eye; clinical examination of the eye. Surgical affections of the eye: Entropion, ectropin, tumor of eyelid. Conjunctiva; Conjunctivitis, occlusion of nasolacrimal duct, squint. Eyeball; affections of the eye; hydropthalmia, glaucoma, tumors of eye, panopthalmia, injuries and infections of anterior and posterior chambers. Worm in the eye. Affections of esophagus; choke, esophageal stenosis dilation and diverticulum. Tracheal injuries and tracheal collapse. Affections of pharynx and larynz. Foreign bodies (Oral cavity).

Thorax and Abdomen

Fracture of rib. Perforated wounds, sternal fistula, pneumocele, traumatic pneumothorax. Hernia; classification, etiology, diagnosis and treatment, (umbilical, ventral, inguinal, perineal, diaphragmatic). Surgical affections of the stomach in dogs (cardia, pylonc stenosis, torsion). Surgical affections, diagnosis and treatment of stomach in ruminants (ruminal impaction, traumatic reticulitis, diaphramatic hernia abomasal displacement, omasal impaction). Surgical affections of intestines: intestinal obstruction, intussusception, strangulation (volvulus) in large and small animals. Caecal dation, torsion. Affections of rectum: prolapse, rectal tear, anal adenitis. Congenital anomalies of colon, rectum, anus. Surgical affections of liver, spleen. Surgical affections of kidney,ureters, urinary bladder. Urolithiasis and urethral stenosis their sequlae and surgical treatment Surgical affections of penis and sheath, affections of testicle, scrotum. Surgical affections of udder and teat. Canine mammary neoplasms.

Practical

Head and Neck

Demonstration of following: Examination of oral cavity. Location of trephining of sinus in equines. Bovine:Amputation of horn, Debudding. Ligation of Stenson's duct, Tooth rasping / floating, otoscopy in dogs, ear haematoma, tracheotomy, tracheostomy, oesophagotomy. Opthalmoscopy, tests for blindness, operation for ectropion, and entroplon, enucleation / extirpation of the eye.

Thorax and Abdomen

Demonstration of followings: Surgical approaches to the thorax and abdomen in animals with landmarks for approach to various organs. Thoracocentesis, abdominocentesis. Rumenotomy, gastrotomy, eneterotomy, eneteronastomosis, urethrotomy, vasectomy, ovariohysterectomy, spaying, cystotomy and cystorrhaphy. Caesarean section. Amputation of tail.

SEMESTER IX

VSR-511 VETERINARY ORTHOPAEDICS AND LAMENESS Credit Hours 1+1=2

Theory

Body conformation of the horse in relation to Lameness (trunk, fore limb and hind limb) Lameness: definition, classification and diagnosis. Shoulder slip (sweeny), bicipital bursitis, omarthntis, capped elbow, radial paralysis, carpitis, bent knee, and knock-knee. Hygrorna of knee, open knee, blemished knee. Fracture of carpal bone, fracture

of accessory carpal, contraction of digital flexors. Splints, sore shin, wind puffs, sesamoiditis. Osslets, ringbone, quittor, side bone, Navicular disease, pyramidal disease. Laminitis, sand crack, seedy toe, fractures of third phalanx, pedal osteitis, and sole penetration. Canker, thrush and corn. Monday morning disease, cording up, myositis of psoas, iliac thrombosis, Crural paralysis, subluxation of sacroiliac joint, rupture of round ligament, trochantric bursitis. Upward luxation fixation of patella, stringhalt, gonitis, chondromalacia of patella, rupture of tendoachilles, rupture of peroneus tertius, fibrotic myopathy and ossifying myopathy. Thoroughpin, bog spavin, spavin, curb, capped hock. Bovine lameness: contusion of sole, ulceration of sole, septic laminitis, avulsion of hoof and subluxation of patella. lnterdigital fibroma, cyst, sand crack, hoof deformities. Specific joint disease (septic arthritis, osteochondritis dessicans, degenerative joint disease) in large animals and their treatment. Specific joint disease in dogs and their treatment. (Intervertebral disc protrusion, spondylosis) elbow and hip dysplasiaRupture of cruciate ligament. Fracture and dislocation: Classification and general principles of fracture repair. Application of external and internal immobilization for different bone fractures in small and large animals. Complications of fracture healing. Affections of tendon, tendon sheath, bursa and ligaments, Principles of physiotherapy, classification, scope and limitations,

Practical

Examination of the horse for confirmation of body (head, trunk, fore limbs and hind limbs) and diagnosis of lameness. Demonstration of equine shoeing. First aid in orthopaedic patients (splint application, Robert Jones's bandage) Plaster of paris cast- application in dogs and calves. Hanging pin and transfixation pinning (demonstration) Intra medullary pinning in dogs(demonstration). Diagnostic nerve block in equine(demonstration) Demonstration of: claw trimming of bovine foot, neurological examination for evaluation of spinal trauma, tenectomies of lateral digital extensor tendon, medial patellar desmotomy, Techniques and application of diathermy, electrical stimulators, ultrasonic, therapy, infra red and ultra- violet rays.

(Courses on Zoo/Wild Animal Breeding, Nutrition, Management and Health Care under VMD — 512 (2+1) and Pet/Companion Animal Breeding, Feeding, Management and Health Care under VMD- 513 (1+1) shall be taught jointly by Departments of Veterinary Medicine, Livestock Production Management, Animal Genetics and Breeding, Animal Nutrition, Veterinary Pathology, and Veterinary Surgery and Radiology).

DEPARTMENT OF VETERINARY MEDICINE

SEMESTER VII

VMD-411 VETERINARY CLINICAL MEDICINE-I (GENERAL & SYSTEMIC) Credit Hours 2+1=3

Theory

History and scope of Veterinary Medicine, Concept of animal diseases. Concepts of diagnosis, differential diagnosis and prognosis. General systemic. states, hyperthermia, hypothermia, fever, septicemia, toxemia, shock and dehydration. Aetiology, clinical manifestations, diagnosis, differential diagnosis, treatment, prevention and control of the following diseases of cattle, buffalo sheep/goat, equine, pig and pet animals. Diseases of digestive system with special reference to rumen dysfunction and diseases of stomach in non-ruminants. Affections of peritoneum, liver and pancreas. Diseases of respiratory and cardiovascular systems Including blood and blood forming organs. Diseases of uro-genital system & lymphatic system. Emergency medicine and critical care.

Practical

Clinical examination and diagnosis: Methods of clinical examination of individual alling animals including history taking. Examination of animal including behaviour and general appearance: demeanour, voice, eating, drinking, defecation, urination, posture, gait, condition of skin and body coats. Inspection of body: examination of head and neck, thorax, respiratory rates, rhythm, respiratory depth, type of respiration, cardiac sounds, cheat symmetry, abdomen, external genitalia, mammary glands and limbs. Physical examination: temperature taking, palpation, percussion, auscultation. Examination of ears, eyes, conjunctiva, eye balls, mouth, submaxillary and other superficial lymph nodes, jugular furrow, oesophagus, trachea. Passing of stomach tube for locating obstruction if any.
Examination of specific condition of thorax: pneumothorax, haemothorax and hydrothorax. Percussion/ auscultation

of lung and cardiac areas. Examination of abdomen: ruminal motility, consistency, microbial population and their motility in ruminal fluid, use of trochar and canula. Examination of liver and kidneys. Liver and kidney function tests.

SEMESTER VII

VMD-412 VETERINARY PREVENTIVE MEDICINE-I (BACTERIAL, FUNGAL & RICKETTSIAL DISEASES) Credit Hours 2+0=2

Theory

Clinical manifestation, diagnosis, prevention and control of infectious diseases, namely mastitis, haemorrhagic septicaemia, brucellosis, tuberculosis, Johne's disease, black quarter, tetanus, listeriosis, leptospirosis, campylobacteriosis, actinomycosis, actinobacillosis, enterotoxaemia glanders, strangles, ulcerative lymphangitis, colibacillosis, fowl typhoid, pullorum disease, fowl cholera, avian mycoplasmosis, spirochaetosis, salmonellosis, swine èrysipelas. Other important bacterial diseases of regional importance (e.g. contagious caprine pleuropneumonia, contagious bovine pleuropneuonia etc.). Bacterial diseases of bio terrorism importance — anthrax, botulism etc. Chlamydiosis, Q fever, anaplasmosis, Dermatophillosis, aspergillosis (brooders pneumonia), candidiasis, histoplasmosis, sporotrichosis, coccidiodomycosis. mycotoxicosis, etc.

SEMESTER VIII

VMD-421 VETERINARY CLINICAL MEDICINE-Il (METABOLIC & DEFICIENCY DISEASES) Credit Hours 2+0=2

Theory

Aetiology, clinical manifestations, diagnosis, differential diagnosis, treatment, prevention and control of metabolic disorders/production diseases. Milk fever, acute parturient hypocalcaemia in goats, sows and bitches, osteodystrophy fibrosa, lactation tetany in mares, downer cow syndrome, ketosis, hypomagnesaemia in cattle and buffalo, azoturia in equines, hypothyroidism and diabetes in dogs Diagnosis and management of diseases caused by deficiency of iron, copper, cobalt, zinc, manganese selenium, calcium, phosphorus, magnesium, vitamin A, D, E, B. complex, K and C in domestic animals and poultry. Nutritional haemoglobinuria. Diseases of neonates. Diseases of skin, musculo-skeletal system, nervous system and sense organs of domestic animals. Management of common clinical poisonings. Role of alternative/integrated/ethno veterinary medicine in animal disease management.

SEMESTER VIII

VMD-422 VETERINARY PREVENTIVE MEDICINE-II (VIRAL & PARASITIC DISEASES) Credit Hours 2+0=2

Theory

Clinical manifestation, diagnosis, prevention and control of infectious diseases, namely foot and mouth disease, rinderpest, bovine viral diarrhoea, malignant cattarhal fever, infectious bovine rhinotracheitis, enzootic bovine leucosis, ephemeral fever, blue tongue, sheep and goat pox, PPR, classical swine fever. Important exotic diseases for differential diagnosis - African swine fever, swine vesicular disease, vesicular stomatitis, Rift valley fever, Aujeszky's disease. Rabies, African horse sickness, equine influenza, equine infectious anaemia, equine rhinopneumonitis, canine distemper, infectious canine hepatitis, canine parvoviral disease. Highly pathogenic avian influenza, Newcastle (Ranikhet) disease, Marek's disease, avian leucosis, infectious bronchitis, infectious laryngotracheitis, avian encephalomyelftis, fowl pox, infectious bursal disease, inclusion body hepatitis-hydropericardium syndrome. Other emerging and exotic viral diseases of global importance. Amphistomosis, fascioliosis, gastrointestinal nematodiasis, schistosomosis, echinococcosis, tapeworm infestations (cysticercosis), verminous bronchitis, coeneurosis, trichomonosis, blood protozoan infections (trypanosomosis, thelleriosis, babesiosis etc.), canine eperythrozoon infection, coccidiosis.

SEMESTER IX

VMD-511 ANIMAL WELFARE, ETHICS AND JURISPRUDENCE Credit Hours 2+0=2

Theory

Definition of animal welfare and ethics. Human and animal welfare in relation to ecosystem and environmental factors. Role of veterinarians in animal welfare. Animal welfare organisations, Animal Welfare Board of India — their role, functions and current status. Rules, regulations, laws on animal welfare. Prevention of Cruelty to Animals (PCA) Act, 1960 (59 of 1960). Role and function of Committee for the purpose of Controlling and Supervising Experiments in Animals (CPCSEA). Protection of wild life in nature and captivity. Protection and welfare of performing animals. Welfare of animals during transportation. Animal welfare in commercial livestock farming practices. Protection and welfare of working animals. Pet and companion animal welfare. Animal welfare during natural calamities and disaster management Legal duties of veterinarians, Forensic and State Medicine laws. Common offences against animals and laws related to these offences, Examination of living and dead animals in criminal cases. Cruelty to the animals and bestiality. Legal aspects of Examination of animals for soundness, examination of injuries and post-mortem examination. Causes of sudden death in animals. Collection and despatch of materials for chemical examination, detection of frauds-doping, alternation of description, bishoping etc. Cattle slaughter and evidence procedure in courts. Provincial and Central Acts relating to animals. Glanders and Farcy Act, 1899 (13 of 1899). Dourine Act 1910 (5 of 1910), Laws relating to offences affecting Public Health. Laws relating to poisons and adulteration of drugs. Livestock Importation Act. Evidence, liability and insurance. Code of Conduct and Ethics for veterinarians the Regulations made under Indian Veterinary Council Act, 1984,

SEMESTER IX

VMD-512 ZOO/WILD ANIMAL BREEDING, NUTRITION, MANAGEMENT AND HEALTH CARE Credit Hours 1+1=2

Theory

Taxonomy of various genera of wild/zoo animals of India along with their descriptions. Ethology of wild life species. Basic principles of habitat and housing of various classes of wild and zoo animals. Population dynamics of wild animals, effective population size of wild animals in captivity/zoo/natural habitats. Planned breeding of wild animals. Controlled breeding and assisted reproduction. Breeding for conservation of wild animals,

Feeding habits, feeds and feeding schedules of zoo animals. Nutrient requirements of wild animals, Diet formulation and feeding of various age groups, sick and geriatric animals. Restrain, capture, handling, physical examination and transport of wild and zoo animals. Principles of anaesthesia, anaesthetics, chemicals of restraining, common surgical interventions. Capture myopathy.

Principles of zoo hygiene, public health problems arising from zoos. Prevention, control and treatment of infectious, parasitic, nutritional and metabolic diseases in zoo and wild animals. Acts and Rules related to Zoo and wild animals. National and international organisations and institutions interlinked to wild and zoo animals - role and functioning.

Practical

Visit of nearby wildlife sanctuary/zoo/wild animal centres to study the care and management restraint, examinations, administration of medicines etc. in zoo animals. To study the housing feeds and feeding schedule of zoo animals. To study the implementation of various Acts and Rules related to Zoo animal management Post mortem examination of wild and zoo animals. Handling, processing and interpretation of pathological materials from zoo and wild animals. Attending to common surgical interventions on zoo and wild animals. Planning for balanced feeding. Diet charts, preparation of balanced diet for new born, growing and sick animals as oral and intravenous feeds. Preparation of modified diet under selected conditions. Hygienic preparation, preservation and storage of foods.

(This course shall be taught jointly with the Departments of Livestock Production Management. Animal Nutrition, Animal Genetics and Breeding, Veterinary Pathology, and Veterinary Surgery and Radiology)

SEMESTER IX

VMD-513 PET/ANIMAL BREEDNG, MANAGEMENT, NUTRITION AND HEALTH CAFE

Credit Hours 1+1=2

Theory

Breeds of dogs- international pedigree breeds and those commonly seen in India. Pedigree sheet an major breed traits. Detection of oestrus and breeding of dogs. Selecting a breed to keep, selection of a pup.

Feeding of dogs- nutritional requirements of important breeds and different age groups. Management of dog-kennels, care of pups and pregnant bitch. Dog shows- preparation for the shows kennel clubs, important characters for judgement. Whelping Utility of dogs- guarding, defence, patrolling riot control, scouting, espionage, mine detection, tracking, guiding, hunting, races, retrieving rescue and other uses. Principles of training of dogs.

Common diseases effecting dogs (bacterial, viral, parasitic, fungai, manifestations, diagnosis, treatment and control. Vaccination/deworming schedules.

Common surgical interventions in dogs- docking, ear cropping, nail cutting, sterilization. Common anaesthetics and anaesthesia in dogs.

Common breeds of cats, their habits, feeding, breeding and management. Common disease of cats, their diagnosis, treatment and control. Common surgical interventions in cats.

Common pet birds seen in India. Introduction to their caging, breeding, feeding, management, disease control and prevention.

Practical

Recognising various breeds. Handling of dogs. Types and use of leads and collars. Brushing/grooming and bathing of dogs. Restraining of dogs for examination/medication. Detection of Oestrus mating, whelping (through demonstration), Care of pups, weaning, administration of medicine. Nail and tooth care, clipping of hairs for show purposes. Hygiene of kennel/pens, feeding utensils. Visit to dog show. Vaccination and surgical interventions (nail clipping, docking, sterilization).

Common breeds of cats, handling, restraint, examination, medication and surgical intervention in cats and kittens.

Identification of common pet birds. Handling of pet birds their examination and administration of medicines.

(This course shall be offered jointly by the Departments of Veterinary Medicine, Livestock, Production, Management, Animal Nutrition, Animal Genetics and Breeding. Veterinary Pathology, and Veterinary Surgery and Radiology).

DEPARTMENT OF VETERINARY & ANIMAL HUSBANDRY EXTENSTION EDUCATION

SEMESTER V

VAE- 311 PRINCIPLES AND TECHNIQUES OF VETERINARY AND ANIMAL HUSBANDRY EXTENSION

Credit Hours 2+1=3

Theory

Concept of Sociology. Man-animal relationship (Society, Community, Association, Institutions). Difference in livestock production practices of rural, urban and tribal communities including rearing patterns, Social change and factors of change. Social groups, its types and functions. Social transformation in relation to animal rearing.

Evolution of veterinary and animal husbandry extension in India. Extension education: definition, philosophy and principles. Concept of Community development. Teaching learning process, steps of teaching. Extension teaching methods; their classification and use. Information delivery system in Veterinary and Animal Husbandry extension. Information communication technology.

Role of animals in economy, health and socio-psychology of rural, semi urban and urban society. Client and stakeholder dealings: techniques and procedures including tools for data collection, analysis, history taking, follow- up and appraisal on prognosis. Adoption and diffusion of livestock innovations. Leadership and role of leaders in animal husbandry extension.

Farming in rural India - large and small scale farming, mixed farming, co-operative and collective farming, contractual farming, Co-operative Farming for Live Stock Production, Advantages and limitations of cooperatives. Economic principles underlying co-operative societies, co-operative milk unions in India. Social survey and its types. Social sampling. Identification of key communicators and operating through them. Identifying organizational difficulties in the way of organizing animal husbandry extension programmes. Identification of constraints in the adoption of improved animal husbandry practices.

Animal Husbandry programme planning and evaluation. Feedback evaluation of extension programmes and their impact analysis. Panchayati Raj Institutions, Krishi Vigyan Kendra (KVK), Animal Husbandry Development Programmes in Cattle, buffalo, sheep, goat, poultry, rabbit and piggery. Key village scheme, Gosadan/Goshala, Integrated Cattle Development Programme (ICDP), Integrated Rural Development Programme (IRDP), Agricultural Technology Management Agency (ATMA).

Gender considerations in Veterinary practice. Changing expectations from new recruits to the profession and employers of veterinarians. Growing changes in corporate, client influence and changes in work ethics.

Information communication technologies. Virtual class room and self learning. E-learning. Information kiosks. Agriculture portals. E-commerce- scope and local application. Computer aided teaching/learning, web-sites dedicated to veterinary and animal sciences education, web directories and virtual learning institutions (e-institutions).

Practical

Audio-visual equipments. Principles and use of overhead, slide arid multimedia projectors, digital video/still camera. Preparation and use of visual aids like posters, charts, flash cards, flipcharts, etc. Use of literature and media in Extension. Identification of key elements in social sampling of data. Collection and analysis of data. Identification of key communicators and operation programme. Enumeration of organizational difficulties in animal husbandry extension programmes. Identification of constraints in the adoption of improved animal husbandry practices. Constraint analysis.

Group discussions, techniques and procedures for awareness campaigns on different veterinary and animal husbandry practices - signs of diseases, preservation of eggs, clean milk production, controlling of ectoparasites, pail feeding of calves, sexing and culling of birds, first aid for minor wounds, disinfection of byres, branding, use of horn cauterization, timely A. I., choice of good progeny, care in pregnancy, infertility, environmental hygiene, preparation of feeds and feeding schedules, deworming, preventive hygiene, vaccination etc. Organization of animal welfare camps, exhibition, livestock shows etc. Hands on training in the use of computers for teaching and information dissemination. Rapid Rural Appraisal/Participatory Rural Appraisal in identifying livestock production/health care practices.

SEMESTER VI

VAE-321 LIVESTOCK ECONOMICS, MARKETING AND BUSINESS MANAGEMENT

Credit Hours 2+1=3

Theory

Economics

Introduction, definition and scope (production, consumption, exchange and distribution) of economic principles as applied to livestock. Common terms - wants, goods, wealth, utility, price, value, real and money income. Important features of land, labour, capital and organization.

Livestock produce and products. Livestock contributions to national economy. Demand projections of livestock produce. Theory of consumer behaviour: law of diminishing marginal utility and indifference curve analysis. Theory of demand; meaning, types of demand, demand curve and law of demand, individual and market demand, elasticities of demand and factors affecting demand. Laws and types of supply. Elasticity of supply. Cost concepts and principle of fixed and variable costs. Theory of production, law of diminishing returns, laws of returns to scale and concept of short and long run periods. Economics of animal disease and disease losses.

Marketing

Livestock business- concepts, nature and scope. Components, characteristic of small business Marketable livestock commodities. Concept of market; meaning and classification of markets Market price and normal price, price determination under perfect competition in short and long run.

Marketing of livestock, and perishable and non-perishable livestock products. Merchandising product planning and development. Marketing functions: exchange functions- buying, selling and demand creation. Physical functions- grading, transportation, storage and warehousing. Facilitative functions, standardization, risk bearing, market information and market intelligence. Market opportunities marketing channels of livestock and livestock products, organized/unorganized markets and cattle fairs Import and export of animal and animal products. International Agreements/Regulations (WTO and General Agreement on Trade and Tariff -GATT) for marketing/trade of live animals and products.

Management

Resource Management- Organizational aspects of livestock farms, sources and procurement of inputs and financial resources. Break- even — analysis. Personnel (Labour) Management- Identification of work and work (job) analysis/ division of labour.

Accounting

Definition, objectives, common terms. Different systems of book keeping- single and double entry system. Various types of account books including books of original entry. Classification of accounts and rules of debit and credit. Recording of business transactions. Analysis of financial accounts income and expenditure accounts, trading account, profit and loss accounts.

Practical

Book keeping; general entry, writing of journal and ledger, cash book (two and three column), purchase- sale and purchase-sale return registers, trading account, profit and loss accounts, income and expenditure accounts, balance sheet, bills of exchange (bill of receivable and bill of payable) bank reconciliation statement.

Economics of a dairy unit, poultry, piggery, sheep and goat units. Visit to farms, markets and cattle fairs, backyard units and preparation of report.

SEMESTER IX

VAE-511 LIVESTOCK ENTERPRENEURSHIP Credit Hours 1+0=1

Theory

Livestock Entrepreneurship. Avenues of entrepreneurship/employment in private and public sectors. Key concepts and theories of self-employment and entrepreneurship. Essential criteria for development of entrepreneurship in livestock sector - basic requirements for entrepreneurship initiatives in livestock and allied sectors (i.e. techno economic feasibility of the enterprises under different conditions, training and management skills, business acumen, business communication, inter-personnel skills for establishing an enterprise, etc.). Entrepreneurial training/development programmes at the State and National, level. Animal Insurance. Bank support for entrepreneurship. Financial credit and financial management- general Principles and practices, analysing project appraisals and reports, capital expenditure decisions, reinvestment and payback. Preparing projects for bank appraisal, banking requirements. Assessing project profits. Procurement management, quality issues, standardisation, grading and packaging. Marketing channels. Retail marketing, sales operations and management, advertising, marketing of services. Expectations from a Veterinary professional. Eco-jobs and sustainable development through livestock.

Approach to preparation of Entrepreneurial Project on livestock.

TEACHING VETERINARY CLINICAL COMPLEX (TVCC)

A. Veterinary Clinical Practice

VCP-411 (Semester-VII)	Credit Hour- 0+5=5
VCP-42I (Semester-VIII)	Credit Hour- 0+5=5
VCP-511 (Semester-IX)	Credit Hour- 0+5=5
Total	15

The students shall be imparted the trainings on rotation basis in the following sections of Teaching Veterinary Clinical Complex (TVCC):

1. Ambulatory Section

Handling, examination, diagnosis and treatment of sick animals under field conditions under the supervision of faculty designated for Ambulatory Clinical activity. Ambulatory Clinics shall be operated by small groups of students and faculty through an equipped mobile unit in which the departments of Veterinary Medicine, Veterinary Gynaecology and Obstetrics and Veterinary Surgery and Radiology shall be involved.

2. Diagnostic Laboratory Section

The Clinical Diagnosis Laboratory will form an important component of Teaching Veterinary Clinical Complex. The Diagnostic Laboratory will impart training to groups of students for laboratory evaluation and interpretation of clinical samples leading to diagnosis/comparative diagnosis of diseases. This activity will involve training in examining clinical samples (biochemical, toxicological, pathological, parasitological and bacteriological) at the clinical complex, analyzing and correlating with clinical findings and interpreting the results.

Note: The Laboratory shall be run in collaboration with the Department of Pathology.

3. Medicine Section

Orientation to Veterinary Clinics including hospital set up, administration and functioning. Methods of record keeping. Retrieval, processing, analysis and interpretation of data. Hospital management involving out patient department (OPD), Indoor patient, Critical care/intensive care unit, sanitation, up keeping, practice management etc. Doctor client interaction: Orientation to local language/dialect/ local terminology of the diseases.

Registration, filling up registration cards, history taking. Relating generic and trade names of drugs along with their doses, indications and contraindications to prescribed treatment regimens. Familiarization and practice of first aid procedures and emergency medicine. Practice of collection, labeling, packaging and evaluation of laboratory samples.

Clinical practice comprising of clinical examination of the patient, with emphasis on history taking, examination techniques- palpation, percussion and auscultation, systematic examination of various systems, recording of clinical observations viz. temperature, respiration, pulse, cardiac sounds, cardiac function, pulmonary function, functional motility of digestive system, routes and techniques of administration of medicaments. Diagnosis and treatment of common clinical cases like pharyngitis, laryngitis, stomatitis, indigestion, ruminal impaction, tympany, enteritis, traumatic reticulo-peritonitis, traumatic pericarditis, pneumonia, haemoglobinurea, haematuria, milk fever, ketosis, rickets, osteomalacia, common poisoning, and others.

Collection of materials like urine, faeces, skin scraping, blood, milk and other body fluids for laboratory tests. Preparation of case records; follow-up records etc. Treatment of causalities and other emergencies. Screening of livestock/poultyr through tests, mass diagnostic campaigns Vaccination and other disease prevention arid control programmes in the field.

Practice of feeding of sick animals. Acts and regulations pertaining to generation disposal of biomedical wastes in veterinary institutions. Biomedical waste generation, handling storage, sorting, coding, transportation and disposal. Hazards of biomedical waste, and impact of biomedical waste on the environment.

4. Gynecology & Obstetrics Section

Practice of pregnancy diagnosis, examination of cases of anoestrus, silent oestrus and conception failure. Treatment of cases of metritis, cervicitis and vaginits. Handling of case of retention of placenta. Management of Ante and post partum prolapse of vagina. Examination and preliminary handling of dystocia cases, faetotomy, caesarian, operation Castration of male calves. Breeding soundness evaluation of bulls. Collection of cervical and vaginal mucus for cytology. Rectal examination of genitalia vaginal examination, Familiarization with common drugs & hormones used in reproductive disorders, epidural and local anaesthesia for gynaecological cases. Filling of clinical case records and their maintenance.

5. Surgery & Radiology Section

Familiarization with equipments used in different sections of the Hospital. Restraining and positioning of different species of animals for examinations, diagnosis and surgical treatment. Prescription of common drugs, their doses and uses in clinical surgical practice. Filling of clinical case records and their maintenance. Preparation of surgical packs, sterilization procedures for surgical instruments, drapes, operation theaters. Passing of stomach tube and gastric tube. Catheterization and urine collection.

Techniques of examination of neuromuscular and skeletal functions, Familiarisation with antisepticc dressing techniques, bandaging, abdomino-centesis, thoracocentesis. Topography anatomy of Cattle, Horse and Dog. Radiographic positioning and terminology.

Treatment and Management of inflammation, wounds, abscess, cysts, tumors, hernia, haematoma hemorrhage, sinus, fistula, necrosis, gangrene, burn, sprain and tendinits. First aid in fractures and dislocations and other affections of joints, facial paralysis, Eye worm & other minor affections of Eye, Irregular teeth and their rasping, tail amputation, knuckling, upward fixation of patella (medical patellar desmotomy) etc.

Familiarisation with the landmarks for the approach to various visceral organs thoraco-centesis, abdominocentesis. Laparotomy, palpation and visualisation of viscera. Urethrotomy, castration, vasectomy, caudectomy, ovario-hysterectomy, thoracotomy, cystotomy, cystorraphy and spleenectomy. Examination of horse for soundness and preparation of certificate for soundness. Tenotomies suturing of tendon, shortening of tendon.

Note: The skills required for the Comprehensive Examination of Core Competence to be held for the purpose of assessment/evaluation of Internship shall be imparted under these courses.

SEMESTER VII

B. 1. VLD-411 VETERINARY CLINICAL BIOCHEMSITRY AND LABORATORY DIAGNOSIS - 1

Credit Hours 0+1=1

Training In examining clinical samples (biochemical, pathological, parasitological and bacteriological). Analyzing and correlating with clinical findings and interpreting the results. Collection, labeling, transportation, and preservation of body fluid samples. Writing results and report. Interpretation of data in relation to specific diseases.

Clinical significance and interpretation of serum glucose, lipids, proteins, blood urea nitrogen, creatinine, uric acid, ketone bodies, bilirubin & electrolytes from samples.

Clinical significance and interpretation of examination of urine samples.

Clinical evaluation of blood (Haemoglobin, packed cell volume, total erythrocytic count, erythrocytic sedimentation rate, total leukocytic count and differential leucocytic count) from clinical samples.

Laboratory evaluation and diagnosis of samples for parasitic diseases (routine faecal examinations- direct smear method, simple sedimentation and floatation methods, Quantitative faecal examination, pastural larval counts), Examination of skin scrapings, examination of blood smear/blood for diagnosis of blood protozoan diseases.

SEMESTER VIII

B. 2. VLD-421 VETERINARY CLINICAL BIOCHEMSITRY AND LABORATORY DIAGNOSIS-II

Credit Hours 0+1=1

Evaluation of acid-base balance and interpretation. Biochemical aspects of digestive disorders, endocrine functions. Liver, kidney and pancreatic function tests. Role of enzymes for detection of tissue / organ affections.

Preparation of microscopic slides from tissue collected for diagnosis and its' histopathological interpretation. Examination of biopsy and morbid material for laboratory diagnosis.

Orientation to a clinical Microbiology laboratory, Collection, transport and processing of specimens from clinical cases for diagnosis of important bacterial, fungal and viral diseases, Isolation of bacteria from clinical samples, Identification of bacteria by Grams staining and cultural/biochemical characteristics. Drug sensitivity and rationale for therapy. Diagnosis of diseases by employing tests like Agar Gel precipitation Test. Enzyme linked Immunosorbent assay, Dot immuno-assay, tube agglutination test, slide agglutination tests etc.

Practice for separation of toxic materials from samples. Detection of arsenic, lead, antimony, mercury, copper, zinc, fluorides, Nitrates/nitrites cyanides and tannins in body fluids/tissues of animals. Evaluation of samples of toxic residues. Appreciation and differentiation of symptoms caused by various types of toxic materials including agrochemicals plants and drugs.

SEMESTER VIII

C. TVC-421 VETERINARIAN IN SOCIETY Non-Credit Course: 1+0=1

Man-Animal and Society. Social - ecological interactions in animal rearing. Client oriented approach to physical examination of animals. Concepts in interaction with animal owner/clients. Bio-medical ethics and clinical evaluation. Communication skills, Anima/owner information management. Human-animal bonds. Health maintenance in individual animals and population. Veterinary public health as component of society. Professional development. Societal responsibilities of veterinarians. Societal responsibilities with respect to Private and Public Hospital and practice management. Social conduct and personality profiles in management of clinical practice. Veterinary professional interactions with Health Authorities, Drug and Food Regulatory Authorities, Zoo/Animal Welfare organisations and Civil Administration. Role of Veterinarian in Natural Calamities and Disaster Management.

SEMESTER III and IV

D. LFP-211 and LFP-221 INSTRUCTIONAL LIVESTOCK FARM COMPLEX

Non-Credit Course: (0+1) X 2=2 Credits

Hands on training of the students on the overall farm practices of livestock management including cleaning feeding, watering, grooming, milking, routine health care, record keeping, sanitation, housing fodder production.

These courses shall be non-credit courses and the performance of students shall be assessed and recorded as grades: A- Excellent, B- Good, C- Average and recorded on the Degree Transcript.