COLLEGE OF SUGARCANE SCIENCE & TECHNOLOGY

SYLLABUS

B. Tech. (Sugarcane Science & Technology)

SARDAR VALLABH BHAI PATEL
UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
MEERUT- 250 110

EXECUTIVE SUMMARY

The State of Uttar Pradesh is the highest producer of Sugarcane in the country. Consequently large segment of State's economy and development is contributed by the Sugarcane farming and Sugar Mills. Thus Sugarcane Industry plays an important role in the State of Uttar Pradesh and is the main source of income for almost 50 lakh cane farming families of the State. The total worth of Sugarcane based industry in the state is worth Rs.35,000 Crores. This makes it the largest Agro Industry in the State and also in the country. The Cane Development Department of the state caters to more than 35 lakh cane growers and approx. 175 lakh dependents of the farmers and around 10 Lac farm labourers for farm activities. In addition, there are around 75,000 direct employees in the Sugar Mills. By efficient running of 119 Sugar Mills crushed around 1,031.99 lakh tons of sugarcane resulting in 118.22 lakh tons of Sugar production. Keeping in view the important role of Sugarcane Industry in the growth of the State as well as the well- being of the stakeholders associated with the Sugarcane industry; like Cane Farmers, Cane Development Societies and Sugar Mills; the Uttar Pradesh Government has decided to establish College of Sugarcane Science & Technology as constituent college, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. The college will offer B. Tech. (Sugarcane Science & Technology) for 10+2 (PCM) students.

India's national agricultural education and research system - the agricultural universities and ICAR institutes, through creating desired trained human ware, ushered in the Rainbow Revolution, led by the Green Revolution launched in the 1960s. The Indian Council of Agricultural Research (ICAR), an autonomous organization under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers Welfare, Government of India is one of the largest national agricultural research and education system in the world. With **103 ICAR Institutes and 73 agricultural universities** spread across the country, the ICAR, the apex body for coordinating, guiding and managing research and education in agriculture in the entire country, must address the asymmetries. The Education Division of the Council, towards addressing the veritable asymmetries, undertakes planning, development, coordination and quality assurance in higher agricultural education in the country and, thus, strives for maintaining and upgrading quality and relevance of higher agricultural education thought partnership and efforts of the components of the ICAR-Agricultural Universities(AUs) System comprising 61 State Agricultural Universities (SAUs), 5 Deemed to be Universities (DUs), 3 Central Agricultural Universities (CAUs) and 4 Central Universities (CUs) with Agriculture Faculty.

Quality assurance in higher agricultural education in the country has been pursued through policy support, accreditation, framing of minimum standards for higher agricultural education, academic regulation, personnel policies, review of course curricula and delivery systems, development support for creating/strengthening infrastructure and facilities, improvement of faculty competence and admission of students through All India competitions. As first and most important step for quality improvement of education, the Indian Council of Agricultural Research has been periodically appointing Deans Committees for revision of course curriculum. In the series, Fifth Deans Committee was constituted and given terms of reference considering contemporary challenges for employability of passing out graduates and to adopt a holistic approach for quality assurance and effective governance in agricultural education. However, Fifth Deans Committee has not given any recommendations with reference to under graduate course on Sugarcane Science & Technology.

In particular the course curricula relevant to practical skills, entrepreneurial aptitude, leadership qualities self-employment and confident among graduates contributes to enhance rural livelihood which among other thinks will be helpful in implementing the new initiatives and technology of the government such as stat-up -India, make in-India etc. Technology and globalization are accompanying an era of un paralleled change. The need and pressure for change and innovation is immense. To enrich the practical knowledge of the students, industrial training shall be mandatory. Hands-on training aims to make conditions as realistic as possible. The biggest benefit of hands-on training is the opportunity for repeat practice. Student project work provides several opportunities to students to learn several aspects that cannot be taught in a class room or laboratory. In order to provide such facilities and opportunities to the graduates of agricultural engineering student’s project is proposed, so they are able to overcome upcoming challenges. The SVPUAT, Meerut follows examination and evaluation system as per Fifth Deans' Committee of Indian Council of Agricultural Research, New Delhi, the same will be followed in colleges Sugarcane Science & Technology

EXAMINATION AND EVALUATION SYSTEM

Fifth Deans' Committee of Indian Council of Agricultural Research, New Delhi deliberated on the examination and evaluation system being followed in different Colleges of SVPUAT, Meerut. The same would be followed in College of Sugarcane Science & Technology for B. Tech. (Sugarcane Science & Technology). The Committee recommended Uniform Grading system to be followed with uniform OGPA requirements for award of degrees at all levels and uniform conversion formulae to be followed for declaration of I, II and III divisions, distinctions etc. Declaration of division in the degree certificate to be made compulsory. By all universities:

I. Examination

• External theory (50%)

• Internal Theory + Practical (50%)

Courses with Theory and Practical

Mid-term Exam (30%) + Assignment (5%) in practical oriented courses + Practical (15%)

Courses with only Theory

Mid-term Exam (40%) + Assignment (10%)

Courses with only Practical:

(100%) Internal

• Paper to be set by external: HOD shall ensure the coverage of syllabus. If needed moderation can be done

• Evaluation to be done internally by the faculty other than the Course Instructor. Syllabus of the concerned shall be sent to the external examiner, who shall prepare the question papers. For practical, it is recommended that examination shall be conducted by course instructor(s) and one teacher nominated by HOD.

2. Evaluation Degree	**Percentage of Marks Obtained**	**Conversion into Points**
All	100	10 points
90 to <100	9 to <10	
80 to <90	8 to <9	
70 to <80	7 to <8	

Student READY Programme

Student READY "Rural Entrepreneurship Awareness Development Yojana" programme is a new initiative of Indian Council of agricultural Research to reorient graduates of Agriculture and allied subjects for assuring employability and develop entrepreneurs for emerging knowledge intensive agriculture. This envisages introduction of the programme in all the Agricultural Universities as an essential prerequisite for the award of degree to ensure hands on experience and practical training depending on the requirements of respective discipline and local demands. This programme includes five components i.e. Experiential Learning. Rural Awareness Works Experience, In-Plant Training Industrial attachment, Hands-on training/ Skill development training and Students Projects. All these components are interactive and are conceptualized for building skills in project development and execution, decision-making. Individual and team coordination, Approach to problem solving, accounting, Quality control, marketing and resolving conflicts, etc. with end-to-end approach. The students will be required to have any three of the five components listed above depending on the requirement of their graduate education. In the discipline of Agriculture Engineering, there will be in- plant training in place of RAWE. Student READY Program will be taken up during VII and VIII semesters and will have the following components:

Semester -VII

1. Student READY - Skill Development Training-II (Student READY) Registration only credit load of 0+05 credit hours through relevant develop skill as learning of software
2. Student READY - 10- weeks Industrial Attachment /Internship Student READY, credit load of 0+10 students go to different industries acquiring technical skills.
3. Student READY - 10- weeks Experiential Learning on campus credit load of 0+10 the training give to exposer to the students on the practical aspects of the discipline the may also work on a specified task or project which may be assign to him/her, the outcomes of training should be presenting in the form of report.
4. Student READY Educational Tour (Registration only) students go to various sugar industries, educational institute, and place for learning technical knowledge.

(Student READY) Semester - VIII

1. Student READY — Project Planning and Report Writing with a credit load of 0+10 credit hours to undertake investigation of selected problems of special interests in sugarcane production technology, sugar production technology, alcohol fermentation technology, sugarcane byproducts and effluent treatment to individual student. The work includes library work, field or laboratory research, recording data, analyzing data and writing of report, etc.

Names of Departments

1. Department of Sugarcane Crop Production
2. Department of Chemistry & Biotechnology
3. Department of Sugar Technology
4. Department of Sugar Engineering
5. Department of Basic Science

DEPARTMENT-WISE COURSES

S. No.	Names of Department	CODE	CREDIT
Department of Sugarcane Crop Production			
	Crop Production Technology	**SCP-121**	**3(2-0-1)**
	Sugarcane Agriculture	**SCP-211**	**3(2-0-1)**
	Genetics & Plant Breeding	**SCP-212**	**3(2-0-1)**
	Introductory Soil and Water Conservation Engineering	**SCP-213**	**3(2-0-1)**
	Fundamentals of Crop Protection	**SCP-221**	**3(2-0-1)**
	Farm Machinery and Power	**SCP-222**	**3(2-0-1)**
	Irrigation and Drainage Engineering	**SCP-311**	**3(2-0-1)**
			21
Department of Chemistry & Biotechnology			
	Fundamentals of Plant Biochemistry and Biotechnology	**SCB-111**	**3(2-0-1)**
	Applied Chemistry – I Organic & Sugar Chemistry	**SCB-121**	**3(2-0-1)**
	Applied Chemistry – II Physical & Inorganic Chemistry	**SCB-211**	**3(2-0-1)**
	Applied Chemistry – III Physical & Analytical Chemistry	**SCB-221**	**3(2-0-1)**
	Instrumentation and Process Control	**SCB-222**	**3(2-0-1)**
	Sugarcane Tissue Culture	**SCB-311**	**3(2-0-1)**
	IPR, Biosafety and Bioethics	**SCB-321**	**2(2-0-0)**
	Sugarcane Byproducts	**SCB-321**	**2(2-0-0)**
			22
Department of Sugar Technology			
	Water Management & Effluent Treatment	**SST-221**	**2(2-0-0)**
	Sugar Technology	**SST-311**	**2(2-0-0)**
	Sugar manufacture – I Juice Extraction and Clarification	**SST-312**	**3(2-0-1)**
	Sugar manufacture – II Evaporation & Crystallization	**SST-321**	**3(2-0-1)**
	Industrial Fermentation & Alcohol Technology	**SST-322**	**3(2-0-1)**
			13
Department of Sugar Engineering			
	Engineering Drawing	**SSE-111**	**2(0-0-2)**
	Heat & Mass Transfer	**SSE-112**	**2(2-0-0)**
	Environmental Studies and Disaster Management	**SSE-113**	**2(1-0-1)**
	Workshop Technology & Practices	**SSE-121**	**3(1-0-2)**
	Fluid Mechanics	**SSE-122**	**3(2-0-1)**
	Post Harvest Engineering	**SSE-123**	**3(2-0-1)**
	Electronics and Instrumentation	**SSE-211**	**3(2-0-1)**
	Chemical Engineering	**SSE-221**	**3(3-0-0)**

	Basic Electrical Engineering	**SSE-222**	**3(2-0-1)**
	Thermodynamics	**SSE-311**	**3(2-0-1)**
	Boilers and Steam Generation	**SSE-312**	**2(2-0-0)**
	Sugar Engineering-I Milling	**SSE-313**	**3(2-0-1)**
	Sugar Engineering –II Boilers and Prime Movers	**SSE-321**	**3(3-0-0)**
	Equipment design & General Engineering	**SSE-322**	**3(2-0-1)**
	Biochemical Engineering	**SSE-323**	**3(2-0-1)**
			41
Department of Basic Science			
	Engineering Mathematics-I	**SBS 111**	**3(2-0-1)**
	Communication Skill and Personality Development	**SBS-112**	**3(2-0-1)**
	General Microbiology	**SBS-113**	**3(2-0-1)**
	Basic Botany	**SBS-114**	**3(2-0-1)**
	Engineering Mathematics-II	**SBS- 121**	**3(2-0-1)**
	Computer and Application Software Packages	**SBS-122**	**3(2-0-1)**
	Statistical Methods and Numerical Analysis	**SBS-211**	**3(2-0-1)**
	Applied Physics - Optics and Crystallography	**SBS-212**	**3(2-0-1)**
	Biodiversity and its Conservation	**SBS-221**	**2(2-0-0)**
			26
OTHER SUPPORTING COURSES			
	National Service Scheme/NCC	**NCC/NSS - 111/121/211/221**	**1(0-0-1)**
	Human Ethics	**SEY-121**	**2(2-0-0)**
	Physical Education	**SEY-311**	**1(0-0-1)**
	Economics and Marketing	**SEY-312**	**3(2-0-1)**
	Business Management and Economics	**SEY-321**	**2(2-0-0)**
	Project Preparation and Management	**SEY-411**	**2(1-0-1)**
	Entrepreneurship Development	**SEY-412**	**3(2-0-1)**
			14
	Educational tour (During first VIth/VIIth semester)	**SEY-322/413**	**2 (0+2)**
	One-year Student READY (Rural and Entrepreneurship Awareness Development Yojana) programme **40 (0+40)**		
	8-weeks Skill Development Trainings (I and II, each of 4-weeks) during semester break after IVth and VIth semester	SEY-222/323	**10 (0+10)**
	20-weeks Project Planning and Report Writing	SEY-414	**10 (0+10)**
	10- weeks Industrial Attachment/ Internship	SEY-421	**10 (0+10)**
	10- weeks Experiential Learning On campus	SEY-422	**10 (0+10)**
			42

S. No.	**Names of Department**	**CREDIT HOURS**
1.	Department of Sugarcane Crop Production	**21**
2.	Department of Chemistry & Biotechnology	**22**
3.	Department of Sugar Technology	**13**
4.	Department of Sugar Engineering	**41**
5.	Department of Basic Science	**25**
6.	Other Supporting Courses	**14**
	Educational Tour & Student READY	**42**
	Total	**178**

B.Tech. (SST) I Year I Semester		
Course Code	**Course Name**	**Credit Hrs**
SCB-111	Fundamentals of Plant Biochemistry & Biotechnology	3 (2-0-1)
SSE-111	Engineering Drawing	2 (0-0-2)
SCP-111	Irrigation and Drainage Engineering	3(2-0-1)
SSE-113	Environmental Studies & Disaster Management	2(1-0-1)
SBS-111	Engineering Mathematics-I	3 (2-0-1)
SBS-112	Communication Skills and Personality Development	3 (2-0-1)
SBS-113	General Microbiology	3 (2-0-1)
SBS-114	Basic Botany	3 (2-0-1)
NCC/NSS-111	NCC/NSS/PEY (NG)	1(0-0-1)
	TOTAL	23
B.Tech. (SST) I Year II Semester		
SCP-121	Crop Production Technology	3(2-0-1)
SCB-121	Applied Chemistry – I Organic & Sugar Chemistry	3(2-0-1)
SSE-121	Workshop Technology & Practices	3 (2-0-1)
SSE-122	Fluid Mechanics	3 (2-0-1)
SSE-123	Post Harvest Engineering	3 (2-0-1)
SBS-121	Engineering Mathematics II	3 (2-0-1)
SBS-122	Computer and Application Software Packages	3(2-0-1)
SEY-121	Human Ethics	2(2-0-0)
NCC/NSS-121	NCC/NSS/PEY (NG)	1(0-0-1)
	TOTAL	22
B.Tech. (SST) II Year I Semester		
SCP-211	Sugarcane Agriculture	3(2-0-1)
SCP-212	Genetics & Plant Breeding	3(2-0-1)
SCP-213	Introductory Soil and Water Conservation Engineering	3(2-0-1)
SCB-211	Applied Chemistry – II Physical & Inorganic Chemistry	3(2-0-1)
SSE-211	Electronics and Instrumentation	3(2-0-1)
SBS-211	Statistical Methods and Numerical Analysis	3(2-0-1)
SBS-212	Applied Physics - Optics and Crystallography	3(2-0-1)
NCC/NSS-211	NCC/NSS/PEY (NG)	1(0-0-1)
	TOTAL	22
B.Tech. (SST) II Year II Semester		
SCP-221	Fundamentals of Crop Protection	3(2-0-1)
SCP-222	Farm Machinery and Power	3(2-0-1)
SCB-221	Applied Chemistry – III Physical & Analytical Chemistry	3(2-0-1)
SCB-222	Instrumentation and Process Control	3(2-0-1)

SST-221	Water Management & Effluent Treatment	2(2-0-0)
SSE-221	Chemical Engineering	3(3-0-0)
SSE-222	Basic Electrical Engineering	3(2-0-1)
SBS-221	Biodiversity and its Conservation	2(2-0-0)
NCC/NSS-221	NCC/NSS/PEY (NG)	1(0-0-1)
	TOTAL	25
SEY-222	Skill Development Training-I June-July (Student READY)	5(0-0-5)
	B.Tech. (SST) III Year I Semester	
SSE-311	Heat and Mass Transfer	2(2-0-0)
SCB-311	Sugarcane Tissue Culture	3(2-0-1)
SST-311	Sugar Technology	2(2-0-0)
SST-312	Sugar manufacture – I Juice Extraction and Clarification	3(2-0-1)
SSE-311	Thermodynamics	3(2-0-1)
SSE-312	Boilers and Steam Generation	3(2-0-1)
SSE-313	Sugar Engineering-I Milling	3(2-0-1)
SEY-311	Physical Education	1(0-0-1)
SEY-312	Economics and Marketing	3(2-0-1)
	TOTAL	23
	B.Tech. (SST) III Year II Semester	
SCB-321	IPR, Biosafety and Bioethics	2(2-0-0)
SCB322	Sugarcane Byproducts	2(2-0-0)
SST-321	Sugar manufacture – II Evaporation & Crystallization	3(2-0-1)
SST-322	Industrial Fermentation & Alcohol Technology	3(2-0-1)
SSE-321	Sugar Engineering –II Boilers and Prime Movers	3(2-0-1)
SSE-322	Equipment Design & General Engineering	3(2-0-1)
SSE-323	Biochemical Engineering	3(2-0-1)
SEY-321	Business Management and Economics	2(2-0-0)
SEY-322	Educational Tour	1(0-0-1)
	TOTAL	22
SEY 323	Skill Development Training-II June-July (Student READY)	5(0-0-5)
	B.Tech. (SST) IV Year I Semester	
SEY-411	Project Preparation and Management	2(1-0-1)
SEY-412	Entrepreneurship Development	3(2-0-1)
SEY-413	Educational tour	1(0-0-1)
SEY-414	20-weeks Project Planning and Report Writing	10(0-0-10)
	B.Tech. (SST) IV Year II Semester	
SEY-421	10- weeks Industrial Attachment/ Internship	10(0-0-10)
SEY-422	10- weeks Experiential Learning On campus	10(0-0-10)

DEPARTMENT-WISE COURSES

DEPARTMENT OF SUGARCANE CROP PRODUCTION

Course Title : Crop Production Technology
Course No. : SCP-121
Credit Hours : 3 (2-0-1)

UNIT I Soil and its components; Soil morphological, physical, chemical and biological properties; Acidic, saline and alkali soils and their reclamation; Essential plant nutrients: Functions and deficiency symptoms; Soil micro-organisms; Rhizosphere and its domain in soil; Organic manures and inorganic fertilizers.

UNIT II Agriculture; Agronomy and its relation with other sciences; Classification of crops; Tillage and tillage practices, concepts of tillage and objectives; Seed, its characteristics and different sowing methods; Weed management: definition of weed, losses and benefits of weeds, different weed control methods and their suitability under different conditions; Irrigation: Soil water classification, methods of irrigation, approaches for scheduling irrigation.

UNIT III Soil fertility and productivity; Concept of essentiality of plant nutrients; Fertilizers, manures and their types, methods of fertilizer application; Concepts of crop rotation, multiple cropping and intercropping - their principles, advantages and limitations; Cropping intensity; Production technology of major crops: Rice, maize, cotton, soybean, mung bean, mash, wheat, rapeseed and mustard, gram and Egyptian clover.

Practical

Study of soil profile and its characteristics; Determination of soil particle size distribution, particle density and bulk density; Determination of soil pH, electrical conductivity and organic carbon; Study of soil micro-flora (bacteria, fungus and actinomycetes).

Land measurement; Practice in seedbed preparation and seeding methods; Identification of crop seeds, crops, weeds and fertilizers; Identification and use of hand tools and implements; Computation of fertilizer doses and their method of application.

Suggested Readings

Acquaah G. 2005. Principles of Crop Production: Theory, Techniques and Technology. Prenice Hall.

Alexander M. 1977. Introduction to Soil Microbiology, 2nd Edition. John Wiley & Sons.

Balasubrananiyan P &Palaniappan SP. 2010. Principles and Practices of Agronomy. Agrobios.

Brady NC & Well RR. 2002. The Nature and Properties of Soils, Thirteenth Edition. Pearson Prentice Hall.

Chandrasekaran B, Annadural K &Samasundaram E. 2010. A Text Book of Agronomy. New Age International (P) Limited Publishers.

Das DK. 2011. Introductory Soil Science. Third Revised Edition, Kalyani Publishers.

Reddy SR. 2011. Principles of Agronomy. Kalyani Publishers.

Course Title : Sugarcane Agriculture
Course No. : SCP-211
Credit Hours : 3 (2-0-1)

Sugar Producing Crops. History, origin and distribution of Sugarcane, Sugarcane producing countries in the world. Area under sugarcane in different states of India. Cultivation of sugarcane, brief lectures on climatic requirements, preparation of land, period of sowing, cane seed, methods of planting, germination, tillering, irrigation and maturity of sugarcane crop. Nutrition of sugarcane: Major (macro) nutrients, Minor (Micro)nutrients, fertilizer management of sugarcane, Nitrogen, Phosphorus and Potash, sources and their applications:

Morphology of sugarcane plant. Deterioration of sugarcane- effect of staling and burnt cane on sugar and fibre content. Plant Protection Measures for sugarcane- major diseases and pests of sugarcane and their integrated control measures. Characteristics of the sugarcane fibre. Mechanization of sugarcane cultivation, harvesting and transportation. Pre- harvest maturity survey of sugarcane. Methods of testing maturity in sugarcane. Methods of harvesting and transport of sugarcane. Measures to control harvesting and transport in order to supply fresh and mature cane to sugar factory. Procurement practices in different states. Sugarcane control Act, FRP and SAP.Factors affecting sugar yield.

Practical:

Determination of maturity of Sugarcane using cane puncturing needle and Hand Refractometer. Brix, Pol, Purity determination of Cane Juice. Reducing sugar estimation. Brix survey of sugarcane. Determination in Pol in Cane and Fiber percent in Cane. Determination of Extraneous matter in Cane. Determination of pH &Titratable acidity in Cane Juice. Determination of pH, EC, OC, Available N, P & K in soil. Determination of Dextran in Cane Juice (with the collaboration of Organic Chemistry)

Reference Books-

Agriculture of the Sugarcane by A. C. Barnes, Leonard Hill Ltd., London
Hand Book of Agriculture by J.D. Jameson, I.C.A.R., New Delhi.

Course Title : Genetics & Plant Breeding
Course No. : SCP-212
Credit Hours : 3 (2-0-1)

UNIT I

History of Genetics; Mendel's principles and rediscovery; Cell division; Chromosomes structure and function; Chromosome theory of inheritance; Sex-linked, sex-limited and sex-influenced inheritance; Sex determination and sex differentiation.

UNIT II

Multiple allelism; Linkage and crossing-over; Gene-gene interaction; Genetic analysis in prokaryotes and eukaryotes; Extra chromosomal inheritance; Mutations; Hardy-Weinberg law; Quantitative inheritance; Introduction to Human genetics; Genetic basis of evolution. Historical development, concept, nature and role of plant breeding, major achievements and future prospects; Genetics in relation to plant breeding, modes of reproduction and apomixes, self-incompatibility and male sterility- genetic consequences, cultivar options. Domestication, Acclimatization and Introduction; Centres of origin/diversity, components of Genetic variation; Heritability and genetic advance; Genetic basis and breeding methods in self- pollinated crops - mass and pure line selection, hybridization techniques and handling of segregating population; Multiline concept. Concepts of population genetics and Hardy-Weinberg Law, Genetic basis and methods of breeding cross pollinated crops, modes of selection; Population improvement Schemes- Ear to row method, Modified Ear to Row, recurrent selection schemes; Heterosis and inbreeding depression, development of inbred lines and hybrids, composite and synthetic varieties; Breeding methods in asexually propagated crops, clonal selection and hybridization; Maintenance of breeding records and data collection; Wide hybridization and pre-breeding; Polyploidy in relation to plant breeding, mutation breeding-methods and uses; Breeding for important biotic and abiotic stresses; Biotechnological tools-DNA markers and marker assisted selection. Participatory plant breeding.

Practical

Life cycle in model plants and animals; microscopy; Mitosis and meiosis; Monohybrid crosses (segregation); Dihybrid crosses (independent assortment); Probability and use of Chi-square; Sex-linked inheritance; Multiple allelism; Detection and estimation of linkage. Plant Breeder's kit, Study of germplasm of various crops. Study of floral structure of self-pollinated and cross pollinated crops. Emasculation and hybridization techniques in self & cross pollinated crops. Consequences of inbreeding on genetic structure of resulting populations. Study of male sterility system. Handling of segregation populations. Methods of calculating mean, range, variance, standard deviation, heritability. Designs used in plant breeding experiments, analysis of Randomized Block Design. To work out the mode of pollination in a given crop and extent of natural out-crossing. Prediction of performance of double cross hybrids.

Suggested Readings

Gupta PK. 2014. Genetics 4th ed. Rastogi Publications.
Inbasekar P. 2009. Cell Biology and Genetics. Panima Publications.
Miglani GS. 2000. Basic Genetics. Narosa Publishing house, New Delhi.
Russell PJ. 2013. iGenetics: Pearson New International Edition: A Molecular Approach. Pearson.
Watson JD, Bakee TA, Bell SP, Gann A, Levine M &Losick R. 2008. Molecular Biology of the Gene. 6th Ed. Pearson Education International.

Course Title : Introductory Soil and Water Conservation Engineering
Course No. : SCP-213
Credit Hours : 3(2-0-1)
Theory

Introduction to Soil and Water Conservation, causes of soil erosion. Definition and agents of soil erosion, water erosion: Forms of water erosion. Runoff, factors affecting runoff, estimation and measurement. Gully classification and control measures. Soil loss estimation by universal Loss Soil Equation. Soil loss measurement techniques. Principles of erosion control: Introduction to contouring, strip cropping. Contour bund. Graded bund and bench terracing. Grassed water ways and their design. Water harvesting and its techniques. Wind erosion: mechanics of wind erosion, types of soil movement. Principles of wind erosion control and its control measures.

Practical

General status of soil conservation in India. Calculation of erosion index. Estimation of soil loss. Measurement of soil loss. Preparation of contour maps. Design of grassed water ways. Design of contour bunds. Design of graded bunds. Design of bench terracing system. Problem on wind erosion.

Course Title : Fundamentals of Crop Protection
Course No. : SCP-221
Credit Hours : 3 (2-0-1)

UNIT I

Insects - their general body structure; Importance of insects in agriculture; Life cycle of insects; Insects diversity; Feeding stages of insects and kinds (modifications) of mouth parts; Concepts in population build-up of insects – GEP, DB, EIL, ETH and pest status; Causes of insect-pests out break; General symptoms of insects attack; Principles and methods of insect-pests management; Integrated Pest Management concept; Bioecology and management of important pests of major crops and storage products.

UNIT II

Importance and scope of plant pathology; Concept of disease in plants; Nature and classification of plant diseases; Importance and general characters of fungi, bacteria, fastidious bacteria, nematodes, phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa and phanerogamic parasites; Pathogenesis due to obligate and facultative parasites; Variability in plant pathogens; Conditions necessary for development of disease epidemics; Survival and dispersal of plant pathogens; Management of key diseases and nematodes of major crops.

Practical

Familiarization with generalized insect's body structure and appendages; Life stages; Acquaintance with insect diversity; Identification of important insect-pests of cereals, cotton, oilseeds, pulses, sugarcane, fruit and vegetables crops and stored-grains, and their symptoms of damage; Acquaintance with useful insects: predators, parasitoids, pollinators, honey bees and silk worms; Acquaintance with various pesticidal formulations; Principles and working of common plant protection appliances; Calculation for preparing spray material; Acquaintance to plant pathology laboratory equipment; Preparation of culture media for fungi and bacteria; Demonstration of Koch's postulates; Study of different groups of fungicides and antibiotics and methods of their evaluation; Diagnosis and identification of important diseases of sugarcane and their characteristic symptoms.

Suggested Readings

Agrios, GN. 2010. Plant Pathology. Acad. Press.

Atwal AS & Dhaliwal GS. 2002. Agricultural Pests of South-Asia and Their Management. Kalyani Publishers.

Dhaliwal GS & Arora R. 1996. Principles of Insect Pest Management. National Agriculture Technology Information Centre.

Dhaliwal GS, Singh R &Chhillar BS. 2006. Essentials of Agricultural Entomology. Kalyani Publishers.

Mehrotra RS & Aggarwal A. 2007. Plant Pathology. 7th Ed. Tata Mc Graw Hill Publ. Co. Ltd.

Singh H. 1984. House-hold and Kitchen Garden Pests - Principles and Practices. Kalyani Publishers.

Singh RS. 2008. Plant Diseases. 8th Ed. Oxford & IBH. Pub. Co.

Singh RS. 2013. Introduction to Principles of Plant Pathology. Oxford and IBH Pub. Co.

Stakman EC &Harrar JG. 1957. Principles of Plant Pathology. Ronald Press, USA.

Tarr SAJ. 1964. The Principles of Plant Pathology. McMillan, London.

Vander Plank, JE. 1975. Principles of Plant Infection. Acad. Press.

Course Title : Farm Machinery and Power

Course No. : SCP-222

Credit Hours : 3(2-0-1)

Theory

Status of Farm Power in India, Sources of Farm Power , I.C. engines, working principles of I C engines, comparison of two stroke and four stroke cycle engines , Study of different components of I.C. engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Comprehension, ignition and spark ignition engine, Air cleaning, cooling, lubrication, fuel supply and hydraulic control system of a tractor, Familiarization with Power transmission system : clutch, gear box, differential and final drive of a tractor , Tractor types, Cost analysis of tractor power and attached implement, Familiarization with Primary and Secondary Tillage implement, Implement for hill

agriculture, implement for intercultural operations, Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

Practical

Study of different components of I.C. engine. To study air cleaning and cooling system of engine, Familiarization with clutch, transmission, differential and final drive of a tractor, Familiarization with lubrication and fuel supply system of engine, Familiarization with brake, steering, hydraulic control system of engine, Learning of tractor driving, Familiarization with operation of power tiller, Implements for hill agriculture, Familiarization with different types of primary and secondary tillage implements: mould plough, disc plough, disc harrow and rotavator . Familiarization with seed-cum-fertilizer drills, Zero till drill their seed metering mechanism and calibration, planters and transplanter Familiarization with different types of sprayers and dusters Familiarization with different inter-cultivation equipment, Familiarization with harvesting and threshing machinery.

Course Title : Irrigation and Drainage Engineering
Course No. : SCP-311
Credit Hours : 3(2-0-1)

Theory

Major and medium irrigation schemes of India, purpose of irrigation, environmental impact of irrigation projects, source of irrigation water, present status of development and utilization of different water resources of the country; measurement of irrigation water: weir, flumes and orifices and other methods; open channel water conveyance system : design and lining of irrigation field channels, on farm structures for water conveyance, control & distribution; underground pipe conveyance system: components and design; land grading: criteria for land levelling, land levelling design methods, estimation of earth work; soil water plant relationship: soil properties influencing irrigation management, soil water movement, infiltration, soil water potential, soil moisture characteristics, soil moisture constants, measurement of soil moisture, moisture stress and plant response; water requirement of crops: concept of evapotranspiration (ET), measurement and estimation of ET, water and irrigation requirement of sugarcane, depth of irrigation, frequency of irrigation, irrigation efficiencies; surface methods of water application: border, check basin and furrow irrigation- adaptability, specification and design considerations. Water logging- causes and impacts; drainage, objectives of drainage, familiarization with the drainage problems of the state; surface drainage coefficient, types of surface drainage, design of surface drains; sub-surface drainage: purpose and benefits, investigations of design parameters-hydraulic conductivity, drainable porosity, water table; derivation of Hooghoudt's and Ernst's drain spacing equations; design of subsurface drainage system; drainage materials, drainage pipes, drain envelope; layout, construction and installation of drains; drainage structures; vertical drainage; bio- drainage; mole drains; salt balance, reclamation of saline and alkaline soils, leaching requirements, conjunctive use of fresh and saline water.

Practical

Measurement of soil moisture by different soil moisture measuring instruments; measurement of irrigation water; measurement of infiltration characteristics; determination of bulk density, field capacity and wilting point; estimation of evapotranspiration; land grading methods; design of underground pipeline system; estimation of irrigation efficiency; study of advance, recession and computation of infiltration opportunity time; infiltration by inflow-outflow method; evaluation of border irrigation method; evaluation of furrow irrigation method; evaluation of check basin irrigation method. In-situ measurement of hydraulic conductivity by single auger hole and inverse auger hole method; Estimation of drainage coefficients; installation of piezometer and observation wells; preparation of iso-bath and isobar maps; determination of drainable

porosity; design of surface drainage systems; design of gravel envelop; design of subsurface drainage systems; determination of chemical properties of soil and water; study of drainage tiles and pipes; installation of sub-surface drainage system; cost analysis of surface and sub-surface drainage system.

Suggested Readings

Majumdar D. K. 2013. Irrigation Water Management Principles. PHI learning Private Limited New Delhi 2nd Edition.

Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing House New Delhi.

Allen R. G., L. S. Pereira, D. Raes, M. Smith. 1998. Crop Evapotranspiration guidelines for computing crop water requirement. Irrigation and drainage Paper 56, FAO of United Nations, Rome.

Murthy VVN. 2013. Land and Water Management Engineering. Kalyani Publishers, New Delhi.

Israelsen O W. and Hansen V. E and Stringham G. E. 1980. Irrigation Principles and Practice, John Wiley & Sons, Inc. USA. Bhattacharya AK and Michael AM. 2013. Land Drainage, Principles , Methods and Applications.

Vikas Publication House, Noida (UP).

Ritzema H.P.1994 Drainage Principles and Applications, ILRI Publication 16, Second Edition (Completely Revised).

Michael AM. and Ojha TP. 2014. Principles of Agricultural Engineering Vol-II 5th Edition. Jain Brothers Publication, New Delhi.

Kadam U.S., Thokal R.T., Gorantiwar S.D. and Powar A.G. 2007. Agricultural Drainage-Principles and Practices, Westville Publishing House.

DEPARTMENT-WISE COURSES

DEPARTMENT OF CHEMISTRY & BIOTECHNOLOGY

Course Title : Fundamentals of Plant Biochemistry and Biotechnology
Course No. : SCB-111
Credit Hours : 3(2-0-1)
Theory

Importance of Biochemistry. Properties of Water, pH and Buffer. Carbohydrate: Importance and classification. Structures of Monosaccharides, Reducing and oxidizing properties of Monosaccharides, Mutarotation; Structure of Disaccharides and Polysaccharides. Lipid: Importance and classification; Structures and properties of fatty acids; storage lipids and membrane lipids. Proteins: Importance of proteins and classification; Structures, titration and zwitterions nature of amino acids; Structural organization of proteins. Enzymes: General properties; Classification; Mechanism of action; Michaelis & Menten and Line Weaver Burk equation & plots; Introduction to allosteric enzymes. Nucleic acids: Importance and classification; Structure of Nucleotides, A, B & Z DNA; RNA: Types and Secondary & Tertiary structure. Metabolism of carbohydrates: Glycolysis, TCA cycle, Glyoxylate cycle, Electron transport chain. Metabolism of lipids: Beta oxidation, Biosynthesis of fatty acids.

Concepts and applications of plant biotechnology: Introduction to recombinant DNA methods: physical (Gene gun method), chemical (PEG mediated) and Agrobacterium mediated gene transfer methods; Transgenics and its importance in crop improvement; PCR techniques and its applications; RFLP, RAPD, SSR; Marker Assisted Breeding in crop improvement; Biotechnology regulations. Introduction to nanotechnology; Concepts and Terminology; Nano-Bio Interface; Biological based Nanosystems, molecular motors, biosensors and other devices. Self assembly of molecules for nanotechnology applications; Biomimetics, Biotemplating and de novo designed nanostructures and materials; DNA-Nanotechnology; Nanomanipulations, material design, synthesis and their applications.

Practical

Preparation of solution, pH & buffers, Qualitative tests of carbohydrates and amino acids. Quantitative estimation of glucose/ proteins. Titration methods for estimation of amino acids/lipids, Effect of pH, temperature and substrate concentration on enzyme action, Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides. Sterilization techniques. Composition of various tissue culture media and preparation of stock solutions for MS nutrient medium. Callus induction from various explants. Micro-propagation, hardening and acclimatization. Demonstration on isolation of DNA. Demonstration of gel electrophoresis techniques and DNA finger printing.

Course Title : Applied Chemistry – I Organic & Sugar Chemistry
Course No. : SCB-121
Credit Hours : 3(2-0-1)

UNIT – 1 Stereochemistry of organic compounds : Stereoisomerism – Introduction. Optical isomerism –Introduction. Elements of symmetry. Chiral centre. (Explanation with lactic acid.) Optical isomerism in tartaric acid, Enantiomers and diastereoisomers. Racemic modifications. Geometrical isomerism – Cause of geometrical isomerism. Geometrical isomerism in maleic and fumaric acids.

Unit – 2 : Carbohydrates Introduction and Classification of Carbohydrates with suitable examples, Reactions of Monosaccharide such as, Mutarotation, Alkaline degradation, Rearrangements, Acidic degradation, Polymerization, Caramelisation.

Unit – 3 : Di and Polysaccharides Structures and properties of sucrose, Maltose, Lactose, Starch and Cellulose (Chain structures).
Unit – 4 : Organic acids and Polyphenols Organic acids and their effects on the processing of sugar house products, Polyphenols : Occurrence, Classification and their effects on processing of sugar house products.
Unit – 5: Organosulphur compounds: Introduction and nomenclature.
Unit – 6 : Carboxylic acids and their derivatives Monocarboxylic acids: Introduction, Method of formation of haloacids, mono – di- and trichloroacetic acids,; Dicarboxylic acid - oxalic acid: Methods of formation and reactions of oxalic acid: action of heat, action of $NaHCO_3$. Uses of Oxalic acid. Carboxylic acid derivatives: Acetyl chloride and acetic anhydride, Acid halide derivative.

Reference books: Organic & Sugar Chemistry

1. Organic Chemistry: Hendrickson, Cram, Hammond.
2. Organic Chemistry: Morrison and Boyd.
3. Organic Chemistry: Volume I & II. I. L. Finar.
4. Organic Chemistry: Pine
5. Advanced Organic Chemistry: Sachin Kumar Ghosh.
6. Advanced Organic Chemistry: B. S. Bahl& Arun Bahl.
7. A Guide book to Mechanism in Organic Chemistry: Peter Sykes.
8. Stereochemistry of Organic Compounds: Kalsi.
9. Stereochemistry of Carbon Compounds: Eliel.

Course Title : Applied Chemistry - II Physical & Inorganic Chemistry
Course No. : SCB -211
Credit Hours : 3(2-0-1)

Unit – 1. Solution and strength of solution Definitions of the terms: Solute, solvent, solution and dilute solution. Concentration units: Normality, Molarity, Molality, Mole fraction, Weight reaction, Percentage composition by weight and volume. Preparation of standard solutions (HCl, H_2SO_4, HNO_3 and Ammonia) Numerical Problems.

UNIT - 2. Chemical Kinetics: Introduction: Rate of reaction, Definition and units of rate constants, Factors affecting the rate of reaction, First order reaction, Second order reaction: Derivation of rate constants for equal and unequal concentrations of the reactants. Numerical problems.

Unit – 3 Chemical Bonding: Introduction and definition with example of each.
Ionic bond, Covalent bond, Coordinate bond, Metallic bond, Hydrogen bond, Vander Waal's forces

Unit – 4. Corrosion and its prevention Introduction, corrosion and its causes, classification, Atmospheric corrosion : Corrosion due to oxygen and other applications of metallic coatings by hot dipping, metal cladding, spraying and electroplating.

Reference books

1. Mathematical preparation of Physical Chemistry: F. Daniel, Mc-Graw Hill Book company.
2. Elements of Physical Chemistry: S. Glasstone and D. Lewis (D. Van Nostrand Co-Inc)
3. Physical Chemistry: W. J. Moore (Orient Longman)
4. Principles of Physical Chemistry: Maron – Prutton

5. University Chemistry: B. H. Mahan (Addision – Weseley Publ. Co.)
6. Chemistry – Principle & Applications: P. W. Atkins, M. J. Clugsto, M. J. Fiazer, R. A. Y. Jone (Longman)
7. Physical Chemistry: G. M. Barrow (Tata Mc-Graw Hill)
8. Essentials of Physical Chemistry: B. S. Bahl& G. D. Tuli (S. Chand)
9. Physical Chemistry: A. J. Mee
10. Physical Chemistry: Daniels – Alberty.
11. Principles of Physical Chemistry: Puri – Sharma (S. Nagin)
12. Text Book of Physical Chemistry: Soni – Dharmarha.
13. University General Chemistry: CNR. Rao (McMillan)
14. Chemistry: Sienko – Plane (Recent Edn.)

Course Title : Applied Chemistry – III Physical & Analytical Chemistry
Course No. : SCB-221
Credit Hours : 3(2-0-1)

Unit – 1. Distribution Law Nernst distribution law : Its limitations, and modification with reference to association and dissociation of solute in one of the solvents. Application of Distribution law in i) Process of extraction (derivation expected) ii) Determination of solubility iii) Distribution of indicators iv) Determination of molecular weight.

Unit - 2. Colloidal State: Definition of colloids, Types of colloidal systems. Solids in liquids (sols): i) Preparation of sols: Dispersion and Aggregation methods ii) Purification of Sols: Dialysis, Electrodialysis and Ultra-filteration. iii) Properties of sols: Colour, optical, kinetic and electrical properties. iv) Stability of sols, Types of emulsions, preparation, Emulsifier. Liquids in solids (gels): Classification, preparation and properties, inhibition. General applications of colloids.

Unit–3. Introduction to Analytical chemistry Basic concept, errors, types of errors, accuracy, precision, statistical representation of analytical data.

Unit-4. Chromatography – Introduction, Classification of chromatographic methods, introduction of the terms used in chromatography. Thin Layer chromatography: introduction of basic concept of the technique, methodology, applications. Gas chromatography: General introduction to the terminology used, stationery phases, supports used in making GLC columns.

Practical's :

Determination of purity of phosphoric acid by Sodium hydroxide method/ Phosphomolybdate method. Determination of purity of hydrogen peroxide Determination of purity of hydros. Determination of purity of caustic soda Determination of purity of washing soda. Introduction to the instrumentation of GLC (Demonstration). Determination of CaO content in lime by using pattern and Redder indicator. Determination of content of mill sanitation chemical –Dithocarbamate. Determination of percentage of hydrochloric acid in commercial hydrochloric. Analysis of amino acids from the given sample with TLC. Estimation of amino acids from sugar solution or sugarcane juice. spectrophotometrically Determination of polyphenols spectrophotometrically.

Reference books

1) Basic concepts of analytical chemistry – S M. Khopkar
2) Instrumental methods of chemical analysis – G. M. Ewing
3) A quantitative Inorganic analysis – A. I. Vogel
4) Gas Chromatography – J. H. Knox
5) Instrumental Methods of analysis – Willand, Merrit& Olean
6) Mathematical preparation of Physical Chemistry : F. Daniel, Mc-Graw Hill Book company.
7) Elements of Physical Chemistry : S. Glasstone and D. Lewis (D. Van Nostrand Co-Inc)

Course Title : Instrumentation and Process Control
Course No. : SCB-222
Credit Hours : 3(2-0-1)

Theory

Instrumentation scheme & characteristics: Measurands. Some basic discussion about electric field, potential, capacitance, resistance etc. Definition, Application and types of measurements, instrument classification, Functional elements of an instrument, standards, calibration, introduction to static characteristics and dynamics characteristics, selection of instruments, loading effects. Dynamic characteristics of measurement systems. *Introduction to various types of sensors:* Definition, principle of sensing & transduction, classification, selection and applications of Sensors., Measurement of parameter : Measurement of length, angle, area, temperature , pressure flow , speed, force, torque, vibration, level, concentration (conductivity and pH) measurement. Flow measurement using magnetic flow measurement. Piezoelectric transducer. *Micro-sensors and smart sensors:* Construction, characteristics and applications. *Electronic Instruments:* Role and importance of general purpose test instruments, Electronic Millimeter, Cathode Ray Oscilloscope, Measurement of amplitude, frequency and phase using CRO Advantages of digital meter over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, Signal generator. Display devices and recorders like X-Y & X-T recorders. *Automation:* Introduction to plant automation, automation hierarchy, PLC, SCADA.

Practical

Strain gauge characteristics and weight measurement. Measurement of pressure using bellows and diaphragm. Preparation and calibration of thermocouple. Study the construction and working of Bourden pressure gauge. Test and calibration of pressure gauges using dead weight tester. Study the mechanism of pH meter and its electrodes. Study a Proximity sensor. Study the different parts and working of pressure switch. Study the different parts of an indicating instrument. Study of RTD and Thermister. Study of different speed measurement sensor/ instruments. Study of LVDT. Study of level/flow controller. Study of PLC. Visit to a automatic controlled dairy plant.

Course Title : Sugarcane Tissue Culture
Course No. : SCB-311
Credit Hours : 3(2-0-1)

UNIT I

History of plant tissue culture; concept of totipotency; Concept of aseptic culture practices; Components of in vitro culture media and role of different macro and micro nutrients, vitamins, plant growth regulators and growth supplements; Sterilization techniques.

UNIT II

Various plant cell, tissue and organ culture techniques and uses; Somatic cell cultures; morphogenesis: organogenesis and somatic embryogenesis; Micropropagation: In vitro

grafting, meristem culture; Anther, pollen, embryo, ovule, ovary culture; Protoplast culture and somatic hybridization; Somaclonal variation.

Practical

Good laboratory practices; Media preparation and sterilization; Surface sterilization of explants; Establishment of callus/cell suspension cultures; Micropropagation; Embryo culture; Anther and pollen culture; Induction of plant regeneration; Hardening and transfer to soil.

Suggested Readings

Bhojwani SS &Razdan MK. 1996. Plant Tissue Culture: Theory and Practice. Elsevier.
Bhojwani SS &Dantu PK. 2013. Plant Tissue Culture: An Introductory Text. Springer
Dixon RA & Gonzales RA. 2003. Plant Cell Culture: A Practical Approach. Oxford University press.
Helgason CD & Miller CL. 2005. Basic Cell Culture Protocols. 3rd Ed. Humana Press.

Course Title : IPR, Biosafety and Bioethics
Course No. : SCB-321
Credit Hours : 2 (2-0-0)

UNIT I

Introduction to Intellectual Property, concepts and types; International treaties for protection of IP's; Indian Legislations for the protection of various types of Intellectual Property; Patent search, filing process; Material transfer agreements.

UNIT II

Biodiversity definition, importance and geographical causes for diversity; Species and population biodiversity, maintenance of ecological biodiversity hot spots in India; Convention on biological diversity; Cartagena Protocol of bio-safety, and risk management for GMO's; Bio-safety guidelines, rules and regulations and regulatory frame work for GMOs in India.

Suggested Readings

Singh BD. 2007. Biotechnology: Expanding Horizon. Kalyani Publishers.
http://patentoffice.nic.in
www.wipo.org
www.dbtindia.nic.in
www.dbtbiosafety.nic.in

Course Title : Sugarcane Byproducts
Course No. : SCB-322
Credit Hours : 2(2-0-0)

1. BAGASSE: Characteristics of bagasse, production of biogas & biomanure from bagasse, production of pulp, paper and different boards, production of furfural. Use of bagasse for cattle feed. Bagasse gasification.
2. PRESSMUD: Characteristics of press mud, extraction of cane wax – its purification & bleaching, use of sulphitation press mud as manure, production of biogas & biomanure from press mud and use of press mud for biocompost production in distillery.
3. MOLASSES: Different types of molasses & their characteristics, alcoholic fermentation of molasses – Manufacture of rectified spirit & denatured spirit, industrial alcohol, absolute alcohol, potable liquors, manufacture of citric acid, lactic acid, manufacture of bakers yeast.
4. EFFLUENT TREATMENT: Pollution Control Norms, Water Management in sugar production both in Plantation white sugar and refined sugar. Reuse of surplus condensate.

Effluent Treatment Plant and its process. Online Monitoring System. Fresh water consumption and control.

5. ALCOHOL: Raw materials for fermentative production of alcohol, Molasses: Composition grades and classification of molasses, Outline of alcohol production by different fermentation process. Fermentation, types of fermentations and role of microorganism and other condition on fermentation. Production of grain spirit. Chemical control, Theoretical Yield, Fermentation & Distillation Efficiency, etc. Different method of spent wash treatment including bio-methanation, incineration and bio composting. Brewing technology: Malting, mashing, fermentation and pasteurization of beer, defects of beer. Alcoholometry: Reduction and blending of spirits, denaturation, obscuration & shrinkage, potable liquors, country liquors & Indian Made Foreign Liquors (IMFL).

Reference Books— By Products of Cane Sugar Industry by J.M. Paturau, Elsevier Pub. Co.Ltd., New York

DEPARTMENT OF SUGAR TECHNOLOGY

Course Title : Water Managment & Effluent Treatment
Course No. : SST-221
Credit Hours : 2(2-0-0)

Sources and characteristics of industrial effluents, physical and chemical water quality parameters, classification of water pollutants and their impact, assessment of pollutants strength industrial effluents, and its management. Tolerance limits for effluent discharges and legal aspects of water quality. self-purification of streams, preliminary, primary, secondary, and tertiary treatment technologies. Theories of physico-chemical treatment methods, screening, equalization, grit removal facilities, coagulation, settling operations, filtration. Principles of biological treatment, role of microorganisms in wastewater treatment, types of biological processes for wastewater treatment. Aerobic and anaerobic treatment of wastewater, suspended and attached growth biological treatment processes, Concept of Common Effluent Treatment Plants.

Course Title : Sugar Technology
Course No. : SST-311
Credit Hours : 2(2-0-0)

Brief idea about manufacture of Raw, Plantation white Sugar and refined Sugar.: Juice extraction from sugarcane; Maceration and imbibition; Different maceration schemes; Use of cold and hot water for maceration; Importance of mill sanitation.

Measurement and weighment of Juice water measuring tanks, heaters, single and double beet valves, use of vapour and steam in heaters.

Juice heaters- Operation of tubular and plate type juice heaters, Single and double beet valves, Use of Vapour and steam in heaters.

Specifications of lime and sulphur used for clarification of juice. Air used for SO2 production, Lime Kilns. Operation of lime slaker, lime classifier, batch and continuous sulphur furnaces, Importance of gas cooler and gas scrubbers.

Composition of cane and cane juice; different processes of cane juice clarification-defecation, double sulphitation (continuous liming and sulphitation), Phosphotlation and carronation process of melt clarification comparison of different clarification methods.

Preliminary idea about settling-settling rats and factors affecting it, Stoke's Law, batch settling, continuous settling its advantages over batch settling; types of continuous clarifiers (Graver, Rapi Dorr,444 etc.) and their details of working. Importance of settling aids and disinfectants in clarifiers.

Types of filters-Plate & Frame type filter presses, their construction and operation. Rotary Vacuum filter, its construction and details of its operation, pressure filtration, leaf filters, Deep head filters and Decanters. Capacity of machinery &equipments

Selection of site, cane feeding, cane carrier, cane knives; power required for cane carrier, cane knives & mills; crushing capcity of milling tandems and power required; boilers, maceration pumps, mixed juice pumps, mixed juice tanks, mixed juice weighment scale, lime kiln, ,lime slaker, lime storage tanks, milk of lime pumps, sulphur furnaces, air compressors, juice heaters, juice sulphiter, continuous clarifiers, vacuum filters, plate & frame filter presses for carbonation and sulphitationfactoriers. Evaporators, condensers, injection and spray pumps, condensate extraction pumps, syrup sulphiter, syrup pump, syrup and molasses tanks, supply tanks, vacuum pans, crystallizers, batch and continuous centrifugals machines.

Chemical Control: Milling control- Technical definitions, calculation of brix percent bagasse, fibre percent bagasse, fibre percent cane, undiluted juice lost in bagasse percent fibre, added water percent fibre, added water extracted in mixed juice percent added water, primary and secondary mill extraction, ideal extraction, mill extraction, brix curves, brix free cane water. Dirt and foam correction, reduced mill extraction, E.R.Q.V. ratios, mill sanitation, comparison of milling efficiencies of factories. Capacity utilization.
Boiling House Control: Brix balance, pol balance and non-sugar balance, Clarification efficiency, E.S.G. value of commercial sugar, Boiling House recovery, Basic Boiling House Recovery, Boiling House performance and Boiling House Recovery (ESG), Reduced Boiling House Recovery. Noel Deer and Gundu Rao Reduced overall extraction.
Reference Books: 1- Principles of Sugar Technology, Vol 1-3 by Peter Honig, ElsaevierPoh, Co., Newyork.
2- Training manual for sugar mills by Mangal Singh, Somaiya Pvt. Ltd. Mumbai.

Course Title : Sugar Manufacture – I Juice Extraction and Clarification
Course No. : SST-312
Credit Hours : 3(2-0-1)
Unit – 1 Extraction of Juice from cane, maceration and imbibitions use of cold and hot water, maceration schemes and mill sanitation. Measurement and weighment of juice – Measuring tanks, level meters, counters, weighing machines – hand operated, semiautomatic and automatic system – equipment details and operation. Sulphur burning for production of SO_2 (Sulphur- di-oxide) different types of sulphur furnaces, batch type, continuous and Acme type-their contruction and operation, gas scrubbers, cooling of gas, composition of sulphur, different methods of melting and addition., air compressors of different types.
Unit – 2 Lime kilns-batch type and continuous type, milk of lime preparation, slaker and grit removal CO_2 scrubbers and cooling of gases. Juice heaters, plate type heat, exchanges, use of vapors for steam economy.
Unit – 3 Composition of cane and juice – their difference, principles of cane juice clarification, influence of lime on the different constituents of juice, effect of pH, effect of heating, different processes of cane juice clarification, simple clarification compound clarification. Process, cold and hot sulphitation, continuous sulphitation, double sulphitation. carbonation, single and double, de-Hans' process, comparison of different clarification modern techniques middle juice carbonation, processes etc.
Unit – 4 Setting tanks, system of draining clear juice and dirty juice, continuous subsiders, door, graver, batch trayless and other types of clarifiers. Plate and frame type filter presses, continuous filters. leaf filters, oliver filter KCP filters, pressure filters. Sweetenting off different systems.
Practical
Determination of following constituents in juices & molasses: (i) Brix (ii) Pol (iii) Apparent purity (iv) pH (v) Reducing sugars (by Lane Eynon Method). Determination of sucrose and Calculation of gravity purity in juices and molasses. By Jackson and Gills Method Analysis of sugar for Pol and moisture per cent determination. Analysis of bagasse for (i) pol per cent and (ii) Moisture percent. Preparation of solutions and determination of sugar traces by Naphthol Test in condensate water and boiler feed water. Determination of pH, hardness and alkalinity etc. in condensate water and boiler feed water. Determination of Preparatory Index of the prepared cane.

Reference books :
Hand of book of cane sugar – Meade & Chen
Introduction to cane sugar technology – Jenkins G. H.

Unit operation in cane sugar production – John H. Payne
Manufacture of sugar from sugarcane – C. C. M. Perk
Efficient Management for sugar factories – Mangal Singh
Cane sugar manufacture in India – D. P. Kulkarni

Course Title : Sugar manufacture – II (Evaporation & Crystallization)
Course No. : SST-321
Credit Hours : 3(2-0-1)
Unit – 1 : Evaporators: Study of different types of evaporators, single effect and multiple effect, vapour cell and preevalaporators,
Unit – 2 : Vapor bleeding system: condensers – barometric, multijet, built in condensers, catchalls, scale formation and their removal , factor affecting evaporator performance.
Unit – 3 : Operation: Operational problems, removal of condensate and non condensable gases, Brix measuring devices, automatic juice level regulators, Rising & falling film evaporator, Scale removal: soda boiling & descaling procedures followed on general cleaning day.
Unit – 4 : Treatment : Syrup treatment, batch and continuous suspiration versels, sulphurrring – setting – filtering – pH and brix control of syrup.Different methods of graining. Merits of true seeding graining method over other methods;2,3 and 4 Massecuits boiling schemes giving purities of syrup, Massecuits, molasses etc.; false grain and conglomerate type of vacuum pans-Coil and Calendria pans. Circulation inside pans, pan control instruments.
Unit – 5 : Specifications of raw sugar. A brief description of the process for its production. Storage of raw sugar.
Unit – 6 : Crystallization : Objective and function of crystallizers. Different types of air cooled, water cooled and vacuum crystallizers. Treatment of low grade Massecuits in crystallizers. Rotary sugar driers, grass hopper drier elevators, sugar graders. Indian Standard Specifications of plantation white sugar, Refined sugar and Raw Sugar.
Practicals
To determine the Brix of the given sample by Bx Hydrometer & Hand refractomegter, To find out the Purity of given sample of Juice. To determine the Purity of Syrup and Molasses, To determine the purity of the Massecuite, To determine the Pol % and Moist % of the Bagasse, To determine the Pol % and Moist % of the Filltercake, To determine the pH of the given sample by a. Test Paper b. Helige comparator c. pH meter, To determine the phosphate contents in the given sample by Spectrophotometer, To determine the Reducing sugar by Eyon& lane Method, To determine the Reducing sugar by Potassium Ferrocynide Method, To determine the Reducing sugar by Luffs Method, To determine the Reducing sugar by Colorimetric Method. To calculate size of crystallizer, shaft dia, cooling surface for batch & continuous crystallizer. Drawing of water cooled crystallizer.
Reference books : Sugar manufacture
1. Hand of book of cane sugar – Meade & Chen
2. Introduction to cane sugar technology – Jenkins G. H.
3. Unit operation in cane sugar production – John H. Payne
4. Manufacture of sugar from sugarcane – C. C. M. Perk
5. Efficient Management for sugar factories – Mangal Singh
6. Cane sugar manufacture in India – D. P. Kulkarni
7. Hand Book of cane Sugar Engineering by E. Hugot, Elsevier Puh. Co. Ltd. New York.

Course Title : Industrial Fermentation & Alcohol Technology
Course No. : SST-322

Credit Hours : 3(2-0-1)

Introduction: Fermentation, types of fermentations and role of microorganism and other condition on fermentation. Raw Materials for fermentative production of alcohol: Molasses: Composition, storage, spontaneous combustion, grades and classification of molasses, clarification of molasses.

Other Saccharine Materials: cane juice, beet juice, sweet sorghum, mahua flowers, fruits' juices, etc. Starchy and Cellulosic Materials. Isolation and purification of cultures. Outline of alcohol production by batch fermentation process Alcohol production by continuous fermentation process

Modern Techniques of Fermentation: Batch, Semi-continuous, Continuous (Biostil, Multicont or Cascade, Encillium), Melle- Bionet process of yeast Cell Recycling, Bacterial Fermentation &lmmobilised Cell Technique, etc. Production of industrial and power alcohol by azeotrotic distillation. Membrane technology and molecular sieves. Production of grain spirit. Chemical control, Theoretical Yield, Fermentation & Distillation, Efficiency, etc. including calculation. Working of distillery, Working of brewery.

Practical

Analysis of molasses for brix, pol, purity and total reducing sugar content. Determination of starch content in grains. Microscopic examination of microorganisms like bacteria, yeast, fungi etc. Preparation and sterilization of culture media like nutrient agar medium, malt extract medium, molasses agar medium etc., preparation of slants and stabs. Acquaintance with different microbiological techniques like inoculation, streaking, plating etc., aseptic handling of culture media and pure cultures. Isolation and development of a pure yeast culture. Preparation of bacterial culture slides and staining by Gram stain. Dilution and plating of culture for total viable cell count. Differential counting of living and dead yeast cells by direct microscopic examination. Analysis of alcohol for ethanol content.

Reference Books—

Industrial Fermentations By L.A. Under Koeffler, Chemica Pub.Co.,Newyork
Comprehensive Biotechnology Vol.3 By M. M. Young, Pergamon Press Ltd., Oxford

DEPARTMENT OF SUGAR ENGINEERING

Course Title : Engineering Drawing
Course No. : SSE-111
Credit Hours : 2(0-0-2)
Practical

Drawing of lines, lettering and dimensioning types of lines, types, types of lettering, types of dimensioning. Drawing of scales. Plain scale, diagonal scale, comparative scale and Vernier scale. Drawing of projections; Orthographic projections, methods of projections. Drawing of screw threads; Types of threads and terminologies used in lit. Screw fastening: Types of nuts, types of bolts, stud, locking arrangements for nuts and Foundation bolt. Drawing of rivets and riveted joints forms of vivet heads, types of riveted; joints, failure of riveted joints. Drawing of welded joints: Forms of welds, location and dimensions of welds. Drawing of keys, cotter joint, pin joints types of keys, types of cotter joints, pin joints. Drawing of shaft couplings: Rigid couplings, loose couplings, flexible couplings universal coupling. Drawing of shaft bearings. Journal bearings, pivot bearings, collar bearings.

References:

- Fundamentals of Machine Drawing by Sadhu Singh & Shah, PHI
- Engineering Drawing by Bhat, & Panchal, Charotar Publishing House
- Machine Drawing with AutoCAD by Pohit and Ghosh, Pearson
- Machine Drawing-KL Narayana, P Kannaiah, KV Reddy, New Age
- Machine Drawing, N. Siddeshswar, P Kannaiah, VVS Shastry, Tata McGraw Hill
- Engineering Drawing, Pathak, Wiley
- Textbook of Machine Drawing, K C John, PHI
- AutoCAD 2014 for Engineers & Designers, Bhatt, WILEY
- Engineering Graphics with AutoCAD, Bethune, PHI

Course Title: Heat & Mass Transfer
Course No.: SSE-112
Credit Hours: 2(2-0-0)
Theory

Basic heat transfer process: thermal conductivity, convective film co-efficient, Stefan Boltzman's constant and equivalent radiation co-efficient, Overall heat transfer co-efficient, physical properties related to heat transfer. Working principles and application of various instruments for measuring temperature. *One-dimensional steady state conduction:* Theory of heat conduction, Fourier's law, Derivation of Fourier's equation in Cartesian coordinates, Linear heat flow through slab, cylinder and sphere. Heat flow through slab, cylinder and sphere with non-uniform thermal conductivity. Concept of electrical analogy and its application for thermal circuits, Heat transfer through composite walls and insulated pipelines.

Steady-state heat conduction with heat dissipation to environment: Introduction to extended surfaces (FINS) of uniform area of cross-section. Equation of temperature distribution with different boundary conditions. Effectiveness and efficiency of the FINS. Introduction to unsteady state heat conduction. *Convection:* Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer, Concept of Nusselt number. Prandtl number, Reynolds number, Grashoff number, Some important empirical relations used for determination of heat transfer coefficient. *Heat Exchangers:* General

discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, Shell and tube and plate heat exchangers, Heat exchanger design. Application of different types of heat exchangers in dairy and food industry. *Mass transfer:* Fick's Law of diffusion, steady state diffusion of gases and liquids through solids. Equimolal diffusion. Mass transfer co-efficient and problems on mass transfer.

Practical

Determination of thermal conductivity: milk, solid dairy & food products. Determination of overall heat transfer co-efficient of: Shell and tube, plate heat exchangers and Jacketted kettle used in Dairy & Food Industry. Studies on heat transfer through extended surfaces. Studies on temperature distribution and heat transfer in HTST pasteuriser. Design problems on heat exchangers. Study of various types of heat exchangers. Design problems on Mass Transfer Heat transfer in tubular heat exchanger: co current/ counter flow Heat transfer through composite wall. Heat transfer through legged pipes. Heat transfer through natural and forced convection

References:

- Fundamentals of Heat and Mass Transfer, by Incroperra& DeWitt, John Wiley and Sons
- Heat and Mass Transfer by Cengel, McGraw-Hill
- Heat Transfer by J.P. Holman, McGraw-Hill
- Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education
- Heat Transfer by Ghoshdastidar, Oxford University Press
- A text book on Heat Transfer, by Sukhatme, University Press.
- Heat Transfer by Venkateshan, Ane Books Pvt Ltd
- Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill
- Heat and Mass Transfer by R Yadav, Central Publishing House

Course Title : Environmental Studies and Disaster Management
Course No. : SSE-113
Credit Hours : 2(1-0-1)
Theory

Multidisciplinary nature of environmental studies Definition, scope and importance. Natural Resources: Renewable and non-renewable resources, Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles.

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland

ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Environmental Pollution: definition, cause, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. dies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.

Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

Disaster Management

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold aves, Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Disaster Management- Effect to migrate natural disaster 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.

Practical

Pollution case studies. Case Studies- Field work: Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site-Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.

Course Title : Workshop Technology & Practices

Course No. : SSE-121

Credit Hours : 3(1-0-2)

Theory

Introduction to basic materials: Ferrous and non-ferrous materials and important engineering materials such as timber, abrasive materials, silica, ceramics, glasses, graphite, diamond,

plastic polymers and composite materials, their properties and applications; Safety measures in workshop; Indian Factory Acts on safety; Measuring and Gauging: Basic measuring instruments and gauges; Heat treatment processes: Introduction to hardening, tempering, annealing, normalizing, etc.; Welding: Introduction, types of welding, types of electrodes, types of flames, types of welding joints, edge preparation, welding techniques and equipments; Gas welding and gas cutting, arc welding; Introduction to soldering and brazing and their uses; Estimation of welding and soldering cost; Smithying and forging: Introduction to different tools and their uses; Different forging operations, defects of forging; Brief ideas about power hacksaw, etc.; Carpentry: Introduction to various carpentry tools and materials; Type of woods and their characteristics, brief ideas about band saw, wooden lathe circular saw, wood planner, etc.; Machinery: Introduction to various workshop machines (1) Lathe, (2) Milling machine, (3) Shaper and planner, (4) Drilling and boring machine, (5) Grinder and (6) CNC machines; Length of cut, feed, depth of cut, RPM, cutting speed, time, time allowances; Estimation of machining time for different lathe operations; Estimation of machining time for casting, shaping, slotting and planning operations, work holding and tool holding devices; Sheet-metal: Introduction, different operations, sheet metal joints; Allowances for sheet metal, operations and joints, estimate of cost.

Practical

Identification of different materials of manufacture; Demonstration of different measuring instruments and measurement technique; Identification of various hand tools; Demonstration of various power tools and machine tools; Simple exercises in filing, fitting, chipping, hack sawing, chiseling, tapping, etc.; Introduction to welding machine, processes, tools, their use and precautions; Simple exercises on arc welding; Simple exercises in gas welding; Demonstration of various casting processes and equipments, tools and their use; Exercises on mould making using one piece pattern and two piece pattern; Demonstration of mould making using sweep pattern and match plate pattern; Simple exercises on turning: Step turning, taper turning, drilling and threading; Introduction to shaper and planner machine and preparations of various jobs on them; Introduction to drilling machines and preparation of a related jobs; Demonstration of other important operations and preparation of additional jobs.

Suggested Reading

B.S. Raghuwamsi. 1996. A Course in Workshop Technology, Vols. I and II. Dhanpet Rai & Sons, New Delhi.

W.A.J. Chapman. 1989. Workshop Technology, Parts I and II. Arnold Publishers (India) Pvt. Ltd., New Delhi.

S.K. HazraChoudari and S.K. Bose. 1982. Elements of Workshop Technology, Vols. I and II. Media Promoters and Publishers Pvt. Ltd., Mumbai.

Course Title : Fluid Mechanics
Course No. : SSE-122
Credit Hours : 3(2-0-1)

Theory

Units and dimensions, Properties of fluids. *Static pressure of liquids:* Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid. Pressure on vertical rectangular surfaces. Compressible and non compressible fluids. Surface tension, capillarity. Pressure measuring devices, simple, differential, micro, inclined manometer, mechanical gauges, Piezometer. *Fluid flow:* Classification, steady uniform and non uniform flow, Laminar and turbulent, continuity equation, Bernolli's theorem and its applications. *Flow through pipes:* Loss of head, determination of pipe diameter. Determination of discharge, friction factor, critical velocity. Flow through orifices, mouthpieces, notches and weirs, Vena contracta,

hydraulic coefficients, discharge losses, Time for emptying a tank. Loss of head due to contraction, enlargement at entrance and exit of pipe. External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs. Venturimeters, pitot tube, Rota meter. Water level point gauge, hook gauge. *Dimensional analysis:* Buckingham's theorem application to fluid flow phenomena. Froude Number, Reynolds number. Weber number and hydraulic similitude. *Pumps:* Classification, reciprocating, centrifugal pump. Pressure variation, work efficiency. Pump selection and sizing.*Turbine:*Classification, (Impulse turbines, Reaction Turbines, Francis and Kaplan turbines) Application of momentum and moment of momentum equation to flow through hydraulic machinery, Euler's fundamental equation, Introduction to the hydrodynamic thrust of jet on a fixed and moving surface (flat &curve).

Practical

Study of various types of pipes and pipe fittings. Study of different types of valves. Study of reciprocating pump. Study of rotary gear pump. Study of piezometer. Study of U tube Manometer. Study of inclined tube Manometer. Study of Venturi meter. Determination of frictional coefficient of given pipe. Determination of minor head loss. Study of Pitot tube. Study the construction and working principle of centrifugal pump. Study of Reciprocating pump. Study and measurement of flow of liquid by V- notch.

References:

Fluid Mechanics by Modi & Seth.
Fluid Mechanics : Basic Concepts and Principles by Shiv Kumar
Basics of Fluid Mechanics by M. A. Zaher
Basics of Fluid Mechanics by Genick Bar-Meir
Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.
Hydraulic Machines by K Subramanya, Tata McGraw Hill
Fluid Mechanics and Machinery by C.S.P.Ojha, R. Berndtsson, P.N. Chandramouli,Oxford University Press
Fluid Mechanics and Fluid Power Engineering by D S Kumar, S K Kataria&Sons
Fluid Mechanics and Turbo machines by Das, PHI
Fluid Power with Applications, by Esposito, Pearson.

Course Title : Post Harvest Engineering
Course No. : SSE-123
Credit Hours : 3(2-0-1)

Theory

Overview of post harvest technology: Concept and science, production and post harvest losses, reasons for losses, importance of loss reduction; Water activity, water binding and its effect on enzymatic and non-enzymatic reactions and food texture, control of water activity and moisture; Post Harvest Handling operations; Cleaning: Cleaning of grains, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of sugarcane (air cleaners, washers), cleaning efficiency, care and maintenance; Sorting and grading: Sorting, grading, methods of grading; Grading Size grading, colour grading, specific gravity grading; screening, equipment for grading of fruits and vegetables, grading efficiency, care and maintenance; Separation: Magnetic separator, destoners, electrostatic separators, pneumatic separator; Drying theory, Liquid dryers; Materials handling: Introduction to different conveying equipments used for handling of sugarcane; Scope and importance of material handling devices; Study of different material handling systems: Classification, principles of operation, conveyor system selection/design; Belt conveyor: Principle,

characteristics, design, relationship between belt speed and width, capacity, inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper; Chain conveyor: Principle of operation, advantages, disadvantages, capacity and speed, conveying chain; Screw conveyor: Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors; Bucket elevator: Principle, classification, operation, advantages, disadvantages, capacity, speed, bucket pickup, bucket discharge, relationship between belt speed, pickup and bucket discharge, buckets types; Pneumatic conveying system: Capacity and power requirement, types, air/product separators; Gravity conveyor design considerations, capacity and power requirement.

Practical

Study of a RF/MW/tray dryer; Study of hot air dryer and modelling drying kinetics; Study of vacuum dryer and modelling drying kinetics; Study of working principle of spray dryer and spray drying process; Study of drum dryer and liquid dehydration using drum drying; Study of fluidized bed dryer and drying process; Study of freeze dryer and freeze drying process; Study of different materials handling equipment.

Suggested Reading

AmalenduChakraverty and R. Paul Singh. 2014. Post Harvest Technology and Food Process Engineering. CRC Press, Boca Raton, FL, USA.

A. Chakraverty. 2008. Post Harvest Technology of Cereals, Pulses and Oilseeds, 3rd Ed. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw-Hill Co., Inc., NY, USA.

James G. Brennan. 2006. Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.

K.M. Sahay and K.K. singh. 2001. Unit Operations of Agricultural Processing. Vikas Publishing House Pvt. Ltd., Noida, UP.

G. Boumans. 1985. Grain Handling and Storage. Elsevier Science Publishers, Amsterdam, The Netherlands.

R.L. Earle. 1983. Unit operations in Food Processing. Pergamon Press, New York, USA.

Carl W. Hall and Denny C. Davis. 1979. Processing Equipment for Agricultural Products. The AVI Publishing Company, Inc., Connecticut, MA, USA.

S.M. Henderson and R.L. Perry. 1966. Agricultural Process Engineering, 2nd Ed. The AVI Publishing Company, Inc., Connecticut, MA, USA.

Course Title : Electronics and Instrumentation
Course No. : SSE-211
Credit Hours : 3(2-0-1)

Theory

Semiconductors, intrinsic and extrinsic semiconductor, PN junction, V-I characteristics of PN junction, diode as a circuit element, rectifier, clipper, clamper, filter circuits; Diode circuits for OR and AND (both positive and negative logic). Zener diode voltage regulator, light emitting diode (LED), bipolar junction transistor: CE, CB and CC configurations, BJT as an amplifier, characteristics of BJT, operating point, classification (A, B and C) of amplifier, various biasing methods (fixed, self, potential divider); Operation of oscillator, phase shift oscillator, OP-AMP characteristics, ideal OP-AMP and linear and non-linear applications of OP-AMP : adder, subtractor, integrator, comparator, differentiator and instrumentation amplifier, OP-AMP voltage regulators, Introduction of digital electronics, number systems, conversation from decimal to binary, octal and hexadecimal number system, conversation from binary, octal and hexadecimal to decimal number system, gates, basic theorem of

Boolean algebra, SOP rule, 3 and 4-variables K-map, Combinational logic circuits; half adder, full adder, half subtractor, full subtractor , multiplexer, demultiplexer, Transducer, active and passive transducer, types of transducer, generalized instrumentation system, working principle and applications of Linear Variable Differential Transformer (LVDT), operation, construction and applications of strain gauge, working principle and applications of RTD), operation, construction and applications of thermocouple, measurement of physical quantities like of displacement, temperature, velocity, force and pressure using potentiometer, resistance thermometer, thermocouples.

Practical

Study of V-I characteristics of PN junction diode; Study of Zener diode; Study of half wave rectifier; Study of full wave center-tap rectifier, Study of full wave bridge rectifier; Study of diode as clipper and clamper, Study of transistor characteristics in CE configuration; Study of OP-Amp IC 741 as differential amplifier; Study of OP-AMP IC 741 as a active rectifier, Verification of logic gates; Verification of half adder, Verification of full adder, Verification of half subtractor, Verification of full subtractor, Verification of multiplexer; Study of temperature characteristics of resistor; measurement of displacement using LVDT; Study the performance characteristics of load cell; Study the performance characteristics of strain gauge.

Suggested Reading

A. Anand Kumar. 2014. Fundamentals of Digital Circuits. PHI Pvt. Ltd., New Delhi.

A.K. Sawhney. 2010. Course in Electrical and Electronics Measurements and Instrumentation. Dhanpat Rai Publications (P) Limited, New Delhi.

V.K. Mehta and Rohit Mehta. 2008. Principles of Electronics. S. Chand and Co., New Delhi.

D. Choudhury Roy. 2003. Linear Integrated Circuits. John Wiley International, NY.

Sanjeev Gupta. 2002. Electronic Devices and Circuits. Dhanpat Rai Publications (P) Limited, New Delhi.

Course Title : Chemical Engineering
Course No. : SSE-221
Credit Hours : 3(3-0-0)

1. Introduction to chemical engineering Concept of unit operations and unit processes. Unit operations and processes in sugar manufacture Stoicheometric Calculations. Mass and energy balance computation and application to sulphur dioxide & steam generation process. Enthalpy balances in evaporator systems.
2. Process fluid mechanics Classification of fluids and fluid flow phenomena. Non-Newtonian fluids in sugar industry practice. Bernoulli's Theorem and its applications to compressible and incompressible process fluids. Process pumps-classification, selection and sizing. Parallel and series arrangement. Pumping practice in sugar manufacture. Process piping and pipe components. Pipeline sizing for steam and condensates; juices, molasses and massecuite as per standards and codes (ASME 31.3)-Modes of failure of piping systems. Piping networks.
3. Process heat transfer Conductive and Convective and radiant heat transfer. Boiling and condensation. Effect of various parameters on sugar process and operating conditions.

Selection and sizing of heat exchange equipments- heaters, condensers and condensate heat recovery systems, evaporators-

Reference Books—1. Introduction to Chemical Engineering by Badger &Banchero
2.Unit Operation of Chemical Engineering by W.L. Mccabe& J.C. Smith Mc Graw Hill co.,New York
3. Transport Process and Separation Process Principles by Chemist John Geanoplis (PHI)
4.Heat Transfer: Principles and Applications by B.K. Dutta (PHI)
5. Introduction to Chemical Engineering- Ghosal/ Sanyal/ Datta (Tata Mchnaw-Hill)

Course Title : Basic Electrical Engineering
Course No. : SSE-222
Credit Hours : 3(2-0-1)

Theory Unit -1: DC Circuits Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity, unilateral and bilateral elements. Kirchhoff‟s laws, Mesh and nodal methods of analysis.

Unit-2: : Steady State Analysis of Single Phase AC Circuits Representation of Sinusoidal waveforms – Average and effective values, Form and peak factors. Analysis of single-phase AC Circuits consisting R-L-C combination (Series and Parallel) Apparent, active & reactive power, Power factor. Concept of Resonance in series & parallel circuits, bandwidth and quality factor. Three phase balanced circuits, voltage and current relations in star and delta connections.

Unit-3: Transformers Magnetic circuits, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.

Unit-4: Electrical machines DC machines**:** Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems) Three Phase Induction Motor: Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only) Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications. Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.

Unit-5: Electrical Installations Introduction of Switch Fuse Unit (SFU), MCB, ELCB, MCCB, ACB. Types of Wires, Cables and Bus-bars. Fundamentals of earthing and lightning protection. Types of Batteries

Practical Hardware based experiments Verification of Kirchhoff's laws. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency. Connection and measurement of power consumption of a fluorescent lamp (tube light). Measurement of power in 3- phase circuit by two-wattmeter method and determination of its power factor for star as well as delta connected load. Determination of parameters of ac single phase series RLC circuit. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase Transformer. Determination of efficiency of a dc shunt motor by load test. To study running and speed reversal of a three phase induction motor and record speed in both directions. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.

Experiments available on virtual lab Kirchhoff‟s laws. Virtual lab link: http://vlab.amrita.edu/?sub=3&brch=75&sim=217&cnt=2. Thevenin Theorem. Virtual lab link: https://vlab.amrita.edu/?sub=1&brch=75&sim=313&cnt=1. RLC series resonance. Virtual lab link: https://vlab.amrita.edu/?sub=1&brch=75&sim=330&cnt=1. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load. Virtual lab link: http://vp-dei.vlabs.ac.in/Dreamweaver/measurement.html.

Determination of parameters of ac single phase series RLC circuit. Virtual lab link: https://vlab.amrita.edu/?sub=1&brch=75&sim=332&cnt=1. To observe the B-H loop of a ferromagnetic material in CRO. Virtual lab link: https://vlab.amrita.edu/?sub=1&brch=282&sim=1507&cnt=2. Determination of the efficiency of a dc motor by loss summation method (Swinburne's test). Virtual lab link: http://em-iitr.vlabs.ac.in/exp5/index.php?section=Theory

References:

1. Ritu Sahdev, "Basic Electrical Engineering", Khanna Publishing House, 2018.
2. P.V. Prasad, S.Sivanagaraju,"Electrical Engineering:Concepts and Applications" Cengage, 2018
3. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
4. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
5. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
6. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
7. V. D. Toro, "Electrical Engineering Fundamentals", Pearson India, 1989.

Course Title : Thermodynamics
Course No. : SSE-311
Credit Hours : 3(2-0-1)

Theory

Basic concepts: Thermodynamic systems, properties, state, processes, cycles, energy, The Zeroth Law of Thermodynamics. *Ideal gases:* Equation of state, Compression and expansion of gases. The first Law of Thermodynamics: Internal energy, enthalpy. Analysis of non-flow and flow processes. *The second Law of Thermodynamics:* Thermodynamic temperature scale, Carnot cycle, heat engine, entropy, reversibility, availability. *Air Cycles:* Otto, Diesel, dual cycles and their efficiencies, Plotting the air cycles on p-V, T-S, p-h diagram etc. *I.C. Engines:* Concepts, Classification, Working of two stroke and four stroke cycle S.I. engines and C.I. engines. Parts of I.C. engine, Performance of IC engines.

Practical

A visit to sugar industry showing the thermodynamics applications/ devices. Study of 2-stroke and 4-strokes IC engines working. Study of S.I. and C.I. engines working Study of modern fuel injection systems of I.C. engines. Study of diesel fuel supply system (pump and fuel injector) of I.C. engine. Study of fuel supply system of a petrol engine. Study of cooling system of an I.C. engine (air cooling and water cooling). Study of lubrication system of I.C. engine. Study of Solar water heater and biogas plants and applications.

References:

- Basic and Applied Thermodynamics by PK Nag, MCGRAW HILL INDIA.
- Thermodynamics for Engineers by Kroos& Potter, Cengage Learning.
- Thermodynamics by Shavit and Gutfinger, CRC Press.
- Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL INDIA.
- Basic Engineering Thermodynamics, Joel, Pearson.
- Fundamentals of Engineering Thermodynamics by Rathakrishnan, PHI.
- Engineering Thermodynamics by Dhar, Elsevier.
- Engineering Thermodynamics by Onkar Singh, New Age International.
- Engineering Thermodynamics by CP Arora. 1
- Engineering Thermodynamics by Rogers, Pearson.

- Fundamentals of Engineering Thermodynamics by Moran, Shapiro, Boettner, & Bailey, John Wiley.
- Engineering Thermodynamics by Mishra, Cengage Learning.
- Thermal Engineering by Kulshrestha, Vikas Publishing.
- Thermal Engg. By P.L. Ballaney, Khanna Publisher
- Thermal Engg. By R.K. Rajput, Laxmi Publication

Course Title : Biochemical Engineering
Course No. : SSE-323
Credit Hours : 3(2-0-1)

Effluent composition ; The meaning, and relevance to distillery effluent of: biological oxygen demand ; chemical oxygen demand; suspended solids ; pH ; Relative contributions of different departments to composition of effluent : Typical of water use in spirit production; effluent volume from spirit production BOD and COD (dichromate) of main effluent streams; suspended solids of main effluent streams; pH and temperature range; Effluent analyses BOD, COD total suspended solids; Awareness of official requirements for effluent discharges; Precautions and requirements for disposal of used detergents/sanitizers. Effluent treatment; Calculation of effluent treatment. The basic principles of treatment of effluent discharges pH control prior to treatment; aerobic digestion (bio-filters); anaerobic digestion spraying on farmland; discharge to sea; Environmental implications of these methods; Removal of copper from effluent (precipitation, electrolysis); Processing of distillery stillage (spent wash); Processing of co-products; Separation of solids and liquid of spent wash decanter centrifuge; Factors affecting their capacity to clarify to desired solids concentration; Evaporation: basic principles of natural- and forced-circulation evaporators; falling film evaporator; multiple effect evaporation. Drying of animal feed; disc dryer drum dryer; spray dryer, cyclone dryer, Energy efficiency in processing; Separation of useful sub-products; Preparation as fodder or fertilizer; Preparation as substrate for further distilled products. Carbon dioxide; Collection of CO_2 from fermentation vessels; Processing of CO_2 purity requirements ; layout of purification plant knowledge of the function of each column Mixing, type of impellers, processes affected by mixing.

Reference Books— Methods in Microbiology Vol-III by J.R. Norris & D.W. Ribbons, Academic Press Inc.,London

Course Title : Boilers and Steam Generation
Course No. : SSE-312
Credit Hours : 3(2-0-1)
Theory
Fuels: Chemical properties, Calorific value and its determination, Fuel Burners, Fuel combustion analysis. *Renewable energy sources:* Concepts, classification, Types and description of of renewable energy sources. *Properties of steam:* Properties of wet, dry saturated, superheated steam, Use of steam tables and Mollier charts, Analysis of energy input in steam generation and heat gain in steam consumption. *Steam generators:* Definition, classification, fire tube boilers, water tube boilers, Boiler performance parameters, Boiler mountings and Boiler accessories. Layout of steam pipe-line and expansion joints. Introduction to Indian Boiler Regulation Act. *Boiler Draught:* Definition, importance and classification of draught, Natural and artificial draught, Calculation of Height of chimney,

Draught analysis. *Air Compressors:* Definition, classification, Reciprocating, Single and multi-stage reciprocating compressors and their theoretical analysis.

Practical

To study different types of boilers with the help of Lab models. To study Boiler mountings and steam-line layout and steam traps. Industrial exposure visit to plant with steam utilization. Study of Fire tube low pressure boiler installed in a dairy processing plant. Study of water softening plant installed with boiler in a dairy processing plant. Study the construction and working of Cochran boiler. Study of Babcok& Wilcox boiler. Study of different Boiler accessories.

References:

- Steam Turbines for Modern Fossil-Fuel Power Plants- By Alexander S. Leyzerovich
- Steam its generation and use - By Babcox and willcox
- Boiler for power and process (HRSG) - By Kumar Rayaprolu
- Practical Boiler Operation Engineering and Power Plant - By Amiya Ranjan Mallick
- Boiler Operation Engineering - By P K Chattopadhay
- Boiler Operator - By Wayne Smith
- A Manual of Steam-Boilers: Their Design, Construction, and Operation - By Robert henry Thurston
- Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man
- Gas Turbine, by V. Ganeshan, Tata Mc Graw Hill Publishers.
- Steam & Gas Turbine by R.Yadav, CPH Allahabad
- Thermal Engineering by Kulshrestha, Vikas Publishing.
- Thermal Engg. By P.L. Ballaney, Khanna Publisher
- Thermal Engg. By R.K. Rajput, Laxmi Publication

Course Title : Sugar Engineering-I Milling
Course No. : SSE-313
Credit Hours : 3(2-0-1)

1. CANE HANDLING Modes of transportation, Percentage of cane supply by different modes and their effect on cane unloading systems. Unloading of cane by different systems and equipments. Overhead traveling crane (two and three motion grab and sling bar system, Both mechanical and Hydraulic type with their advantages and disadvantages), Provision for cart unloading, truck-tippler, Trolley tippler, lateral feeder table, auxiliary cane carrier (dimension, speed and power), Hilo unloaders.

2. CANE CARRIER Types of cane conveyors. Advantages and disadvantages of each type, Determination of slope, length, speed, width and power consumption for each type. Different methods of drives, cane carrier controls, equalizer (speed and power). Tramp Iron Separator.

3. CANE PREPARATION Principle and design of different types of cane preparatory devices, kicker, chopper, leveler and cutter, Head-on-cutter, fibrizer, shredders, on line shredder, mincer. Methods of their drives i.e., steam engines/steam turbines/electric motors. Types of couplings, speed of rotation and power requirement- principle, different types; methods of drives, speed and power requirement of shredder, fibrizer and Mincer. Assessment of bulk density and preparatory index and their methods of analysis.

4. MILLS Function, different types of housings, squire housing, inclined housing, self setting mill and constant ratio mill, Two roller Mill, cast steel and fabricated housing; trash plate and its function, trash beam, mill rollers, bearings, pinions, roller scrappers, juice rings.

5. MILL FEEDING: Equation governing the mill feeding in a three roller mill , self-feeding angle, angle of tip, angle of contact, open and closed gravity chutes, continuous pressure feeder-light duty and heavy duty; intermediate carriers, rotary feeders, dirty top roller.
Milling terms like Novoid Volume, Escribed Volume, Compression Ratio, Filling ratio, Capacity Number, etc.
6. MILL DRIVES, MILL GEARING AND MILL SPEED Type-steam engines, steam turbines and electric motors AC and DC and the dive systems used- their merits and demerits. Combined and individual drives and hydraulic drives. Speed reduction, gear arrangement, types of gears used, type of couplings. Selection of speed, sequence of speed and effect on crushing rate, power consumption. Re-absorption factor etc.
7. PRESSURE IN MILLING Pressure-volume relationship, reabsorption factor, compression ratio, filling ratio, fibre loading, specific fibre loading, hydraulic pressure, specific hydraulic pressure, polygon of forces in a mill, distribution of pressure on feed and discharge rollers, equation for the pressure developed on a roller, pressure regulating appliances-hydraulic accumulators(dead weight, pneumatic and air oil type). Calculations of hydraulic pressure, sequence of hydraulic pressure in the milling tandem, horizontal reaction and measure to control, pinion reaction and measures to control.
8. IMBIBITION Principle, different systems of imbibition, methods of application of imbibitions system, hot and cold imbibition, optimum imbibition and its efficiency.
9. MILL CAPACITY AND PERFORMANCE Factors affecting mill capacity and performance, such as, cane preparation, specific hydraulic loading, length of tandem, roller speed, specific fibre loading and imbibition.

Course Title : Sugar Engineering –II Boilers and Prime Movers
Course No. : SSE-321
Credit Hours : 3(3-0-0)
1. **COMBUSTION OF FUELS** Chemical composition of bagasse, air for combustion, products of combustion, excess air and percentage of CO2. Calorific value- gross calorific value and net calorific value, heat loss in flue gases, loss due to incomplete combustion.
2. **FURNANCE** Different types of furnaces for bagasse, i.e., step grate, horse shoe, ward, spreader stoker, travelling and dumping grate. Requirement of grate area, furnace volume, combustion chamber volume and application of secondary air. Performance of different types of furnaces-capacity of burning of fuel per unit grate area. Limitation of these furnaces and their relative merits and demerits. Boiler Heat Balance Boiler efficiency, condensation loss, sensible heat loss, unburnt and unknown losses. Estimated quantity of steam obtainable, weight of steam per unit weight of fuel. Typical examples, observations and analysis for determination of boiler efficiency. Methods of improving the boiler efficiency.
3. **SUPER HEATER** Different types of super heaters-convection and radiation, their location in the flue path. Calculation of heating surface, degree of superheat.
4. **ECONOMISER** Different types of economizer-vertical and horizontal, plain tubes and finned tubes, their merits and demerits, role and limitations in improving boiler plant efficiency, assessment of fuel saving, determination of heating surface and checking the performance of an existing installation.
5. **AIR HEATER** Different types of air heaters-Tubular and Plate type. Limitations of these air heaters. Determination of heating surface, checking of the performance of a existing installation. Flue gas recirculation, comparison between air heater and economizer. Possibilities of installation of air heaters and economizer in a boiler plant.
6. **DRAUGHT** Natural and artificial draught, balanced draught, chimney-location, calculation of height and cross-sectional area. Mechanical draught systems-forced and

induced draught, ejector draught. Types of impeller blades, fan and their efficiencies, capacities of different fans and their power requirement.
7. **FEED WATER** Use of condensate, make up water, temporary and permanent hardness. Method of treatment. Internal treatment of boiler components. External treatment-water softener and demineralisation plants. The effect of oxygen on corrosion, deaerators. caustic embrittlement.
8. **PRESSURE REDUCING AND DESUPERHEATING OF STEAM** Their description and working, merits and demerits, typical layout of steam reducing valves and precautions for their smooth operations. Need of a de super heater, typical layouts and design of de super heater. High pressure Boilers. Advantages of high pressure Boilers. Introduction, Benefits of Co-generation Potential for exportable power.
9. **Incineration boilers**- Description , application with respect to Distilleries & drawback.
Reference Books—
Machinery &Equipments of Cane Sugar Factory by L.A.Tromp, Twentieth Century ,New Delhi
Hand Book of Cane Sugar Engineering by E. Hugot, Elsevier Pub. Co., New York

Course Title : Equipment design & general engineering
Course No. : SSE-322
Credit Hours : 3(2-0-1)
General Design Considerations: Functional design, Production design & Maintenance design. Economic considerations. **Methods of Fabrications**: fusion welding, welding standards. Types of welded joints, Fillet and Butt joint and their details. Calculation of strength of different welding joints. **General Design Procedures**: Study of B.I.S. codes, their application to the equipment. Failure criteria - excessive elastic deformation, elastic instability, plastic instability, brittle rupture, creep & corrosion. **Material of construction & properties**: General considerations, Ferrous & Non Ferrous metals, Properties at low and high temperatures. Vessel Design: Open vessels-horizontal & vertical – flat bottom, semi-cylindrical, conical bottom & dished. Closed Vessels-vertical & horizontal. Vessels subjected to internal pressures and external pressures. Optimum tank proportions, stress analysis of tanks – shell thickness calculations. Reinforcement of shell courses, reinforcement of openings. Roof design–self supporting conical roof & structural supported conical roofs. Common types of formed heads & their selections, stress analysis of heads. Design of supports – supports for horizontal & vertical vessels.

General features of sugar manufacturing process and equipments. Structures and buildings-open and sheltered structures, gravity & non-gravity plants and their layonts. Engineering economics: Economic criteria in process engineering and design. Measures of profitability. Depreciation, amortization, capitalized costs and present and future value and internal rate of return. Project evaluation. Energy economics and carbon credits. Engineering flow sheets-Computation of mass and energy balances. Preparation of process flow diagrams and P & I diagrams for mill and boiling house. Design and rating of sugar process equipments- Fired and unfired exchangers- heaters, pre-heaters, economizers, super heaters and condensers and jet ejection and cooling Towers. Equipment specification sheets.

Reference Books— 1.Computer Aided Degines in Mechanical Engineering by V. Ramamurthy,Tata mc Graw Hill pub. Co. Ltd., New Delhi

2.Plant Design and Economics For Chemical Engineers by Peter Timmerhaus, McGraw Hill Co. Ltd.,New York

3. Chemical Engineering Design- Coulson- Richardson (Vol-6) Elsevier Publication

4. Hand Book of Cane Sugar Engineering by E. Hugot, Elaevier Pub. Co., New York

Course Title : Engineering Mathematics-I
Course No. : SBS-111
Credit Hours : 3(2-0-1)
Theory

Matrices: Elementary transformations, rank of a matrix, reduction to normal form, Gauss-Jordon method to find inverse of a matrix, consistency and solution of linear equations, Eigen values and Eigen vectors, Cayley-Hamilton theorem, linear transformation, orthogonal transformations, diagonalisation of matrices, bilinear and quadratic forms.

Differential Calculus: Taylor's and Maclaurin's expansions, indeterminate form; Curvature, asymptotes, tracing of curves, function of two or more independent variables, partial differentiation, homogeneous functions and Euler's theorem, composite functions, total derivatives, derivative of an implicit function, change of variables, Jacobians, error evaluation, maxima and minima.

Integral Calculus: Double and Triple integrals, change of order of integration, gamma and beta functions, application of double and triple integrals to find area and volume. Reduction formulae, rectification of standard curves.

Vector Calculus: Differentiation of vectors, scalar and vector point functions, vector differential operator Del, Gradient of a scalar point function, Divergence and Curl of a vector point function and their physical interpretations, identities involving Del, second order differential operator; Line, surface and volume integrals, Stoke's, divergence and Green's theorems.

Suggested Reading

B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers Delhi.
Shanti Narayan. 2004. Differential Calculus. S. Chand and Co. Ltd., New Delhi.
Shanti Narayan. 2004. Integral Calculus. S. Chand and Co. Ltd. New Delhi.
Shanti Narayan. 2004. A Textbook of Vector Calculus. S. Chand and Co. Ltd. New Delhi.

Course Title : Communication Skill and Personality Development
Course No. : SBS-112
Credit Hours : 2 (1-0-1)

UNIT I Communication skills: Structural and functional grammar; Meaning and process of communication; Verbal and nonverbal 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; Precise writing, summarizing, abstracting; Individual and group presentations; Impromptu presentation; Public speaking; Group discussion and interviews; Organizing seminars and conferences.

UNIT II Voice modulation basics and their usage for meaningful impact on people; Attributes of an effective leader; Stress and conflict management; Time management: Personal organization, prioritizing and balancing; Cosmopolitan culture; Impact of non verbal communication; Science of body language; Role of team work.

Practical

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, precise writing, summarizing, abstracting; Individual and group

presentations; Mock group discussions and interviews; Attitude management; Setting and achieving a short term goal; Creating a personal vision statement of life; Voice modulation; Practicing conscious body postures and movements; Rapport building; Team work exercises; Time management.

Suggested Readings

Carnegie, Dale. 2012. How to Win Friends and Influence People in the Digital Age. Simon & Schuster.

Covey Stephen R. 1989. TheSeven Habits of Highly Successful People. Free Press.

Spitzberg B, Barge K &Morreale, Sherwyn P. 2006. Human Communication: Motivation, Knowledge &Skills.Wadsworth.

Verma, KC. 2013. The Art of Communication. Kalpaz.

Course Title : General Microbiology
Course No. : SBS-113
Credit Hours : 3 (2-0-1)

UNIT I

History of Microbiology-its applied areas; Microorganisms and their role in fermentation; Germ theory of diseases; Koch's postulates. Introduction to eukaryotic and prokaryotic cell; Major groups of eukaryotes- fungi, algae and protozoa; Major groups of prokaryotes – Actinomycetes, Cyanobacteria, Archaebacteria, Rickettsias and Chlamydia; Preservation of microorganisms; Microbial repositories at national and international level.

UNIT II

Bacterial growth; Metabolism in bacteria- ATP generation, chemoautotrophy, photoautotrophy, respiration, fermentation; Viruses: Bacteriophages - structure and properties, lytic and lysogenic cycles; viroids, prions. Causes of spoilage in foods products. Spoilage of canned foods.

UNIT III

Microbial groups in soil; Microbes in biotic and abiotic stressed environments; Microbial transformation of carbon, nitrogen and sulphur; Biological nitrogen fixation; Beneficial microorganisms in agriculture-biofertilizers, microbial pesticides; Plant microbe interaction; Microbes in composting and biodegradation; Microbiology of water. Food intoxication & infection

Practical

Microscope and other instruments in a microbiological laboratory; Media preparation, sterilization and aseptic methods for isolation, identification, preservation and storage; Identification of bacteria by staining methods; Enumeration of bacteria by pour plate and spread plate methods; Micrometery.

Suggested Readings

Brock TD. 1961. Milestones in Microbiology. Infinity Books.

Pelczar MJ, Chan ECS &Kreig NR. 1997. Microbiology: Concepts and Application. Tata McGraw Hill.

Stainier RY, Ingraham JL, Wheelis ML & Painter PR. 2003. General Microbiology. MacMillan.

Tauro P, Kapoor KK & Yadav KS. 1996. Introduction to Microbiology. Wiley Eastern.

Course Title : Basic Botany
Course No. : SBS-114
Credit Hours : 3 (2-0-1)

UNIT I

Plant kingdom and features of each group; Morphology, modifications and functions of root, stem, leaf, flower and inflorescence; Pollination and fertilization; Fruit types; Structure of dicot and monocot seed, seed germination.

UNIT II

Cell structure; DNA, chromosome and genes; Cell and tissue types; Internal structure of root, stem and leaf.

UNIT III

Plant taxonomy, systems of classification; Characteristics and economic importance of Poaceae, Brassicaceae, Fabaceae, Malvaceae, Rutaceae, Rosaceae, Asteraceae and Solanaceae families.

Practical

Description of one plant species from each group of plant kingdom; Study of morphology and modifications of root, stem, leaf, flower; Types of inflorescence; Structure of various types of seeds and fruits; Demonstration of cell structure, tissue types; Structure of monocot and dicot root, stem and leaf; One flower from each family.

Suggested Readings

Bendre A & Kumar A. 1999. Textbook of Practical Botany. Vol. 2, 7th Ed., Rastogi Publications.

Bendre AM & Pande PC. 2009. Introduction to Botany. Rastogi publications.

Dutta AC. 1995. A Class Book of Botany, 16th Edition. Oxford University Press.

Course Title: Engineering Mathematics-II

Course No. : SBS 121

Credit Hours: 3(2-0-1)

Theory

Ordinary differential equations: Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut's equation, differential equations of higher orders, methods of finding complementary functions and particular integrals, method of variation of parameters, Cauchy's and Legendre's linear equations, simultaneous linear differential equations with constant coefficients. Numerical solutions of ODEs by Picard's method, Taylor's series method, Euler's and modified Euler's method, Runge-Kutta method of order four.

Functions of a Complex Variable: Limit, continuity and derivative of complex functions, analytic function, Cauchy-Riemann equations, conjugate functions, and harmonic functions;

Series: Infinite series and its convergence, periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, functions having arbitrary period, even and odd functions, half range series.

Partial differential equations: Formation of partial differential equations, Lagrange's linear equation, higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations, Charpit's method. Classification of second order linear PDEs into elliptic, parabolic and hyperbolic types.

Suggested Reading

1. B.V. Ramana. 2008. Engineering Mathematics. Tata McGraw-Hill Book Co., New Delhi.

2. B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers, Delhi.

3. Shanti Narayan 2004. A Textbook of Matrices. S. Chand and Co. Ltd., New Delhi.

4. R.K. Jain, S.R.K. Iyengar 2016 (Fifth Edition). Advanced Engineering Mathematics. Narosa Publishing House, New Delhi.

5. Erwin Kreyszig (Reprint 2023) (Tenth Edition), Advanced Engineering Mathematics. J. Wiley and Sons; Wiley India Pvt. Ltd.
6. H. K. Dass 2007, Advanced Engineering Mathematics, S. Chand & Company Pvt. Ltd, New Delhi.

Course Title : Computer and Application Software Packages
Course No. : SBS-122
Credit Hours : 3(2-0-1)
Theory
History, features, classification and organization and I/O peripheral devices for computers; Features of modern operating systems; number systems and coding schemes; Basics of networking and communications; Internet, email concepts and application, Word-processing and desktop publishing, Electronic spreadsheet basics and operations, Database management system basics and operations; Fundamental of presentation-graphic packages. Recent strides in computing. Internet of Things, Concept and application of Sugarcane Technology.
Practical
Windows Operating System, Word Processing software operations, Presentation Graphics software operations, Internet Surfing/Email usage, RDBMS software package basic operations, Spreadsheet software package basic operations.

Course Title : Statistical Methods and Numerical Analysis
Course No. : SBS-211
Credit Hours : 3(2-0-1)
Theory
Statistical methods, testing of hypothesis, concepts, testing of significance based on Z-test, t-test, F-test, Chi-square test, contingency table, correlation, regression, testing of significance of correlation and regression, multiple linear regression, ANOVA, one-way and two-way classifications, factorial experiment concepts (22, 23, mixed factorials); Numerical analysis: Finite differences, various difference operators and their relationships, factorial notation, interpolation with equal intervals, Newton's forward and backward interpolation formulae, numerical integration, numerical integration by Trapezoidal, Simpson's and Weddle's rules; Numerical solution of ordinary differential equations by Picard's method, Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta method; Laplace transforms: Definition of Laplace transform, Laplace transforms of elementary functions, properties of Laplace transforms, inverse Laplace transforms, transforms of derivatives, integrals, transform of function multiplied by tn, transform of function divided by t, convolution theorem, application of Laplace transforms to solve ordinary differential equations and simultaneous differential 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; Response surface methodology.
Practical
Problems on one sample, two sample Z-tests when population S.D. is known and unknown; Problems on one sample, two sample and paired t-test; Chi-square test – 2×2 and m×n; Contingency table and F-test; Calculation of correlation coefficient and its testing; Fitting of simple linear regressions; Fitting of multiple regression equations; ANOVA: One way/two way; 22, 23 and mixed factorial experiments; Problems on Newton's forward and backward interpolation formula for equal intervals; Problems on trapezoidal rule; Problems on Simpson's 1/3 and 3/8 rules; Problems on solution of ordinary differential equations of first order and second orders by Runge-Kutta method; Problems on Euler's method; Problems on

Laplace transforms; Problems on inverse transformations; Problems on solutions of first order differential equations. Problems on response surface methodology.

Suggested Reading

Erwin Kreyszig, 2006. Advanced Engineering Mathematics, 9th Ed. John Wiley & Sons, New York, USA.

B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers, Delhi. 52

P.P. Gupta and C.C. Malik. 1993. Calculus of Finite Differences and Numerical Analysis. Krishna Prakash Mandor, Meerut.

Course Title : Applied Physics - (Optics and Crystallography)
Course No. : SBS-212
Credit Hours : 3 (2-0-1)

Unit -1 : Interference and Diffraction: Coherent sources, condition for sustained Interference in thin films (parallel and wedge shaped film), Newton's rings and its applications. Types of Diffraction, plane diffraction grating, construction, theory and its application to determine wavelength of light, resolving power, r.p. of plane transmission grating.

Unit -2 : Polarisation Concept of polarisation, polarisation by reflection, Brewster's law, polarization by refraction, pile of plates, double refraction, Huygens theory, Nicol prism, optical activity, half shade polarimeter.

Unit -3 : Laser and Fibre Optics Interaction of radiation with matter- absorption, spontaneous and stimulated emission, meta- stable state, pumping, population inversion, types of lasers, properties of laser light, uses of lasers (Medical and industrial), qualitative idea of holography. Structure and types of fibres, propagation of light through fibre, properties of fibre, fibre optical communication system, sensors.

Unit -4 : Crystallography Space lattice, the basis and the crystal structure, unit cell, coordination number, packing fraction, calculation of lattice constants, Miller indices of plane, sketches of different planes, relation between interplanar distance and Miller indices, Bragg's law, Bragg's X-ray spectrometer, X-ray diffraction, Laue method and powder method.

Reference books:

Geometrical and Physical optics by D.S.Mathur.
Textbook of optics (New Edition) by Subramananyam&Brijlal
Fundamentals of Optics by Jenkins & White.
Optics (Second Edition) by Ajay Ghatak.
Laser and non-linear optics by B. B. Laud.
Introduction to solid state Physics by Charles Kittle.
Solid state physics by S. O. Pillai, Estern Ltd, New age international Ltd.

Course Title : Biodiversity and its Conservation
Course No. : SBS-221
Credit Hours : 2 (2-0-0)

UNIT I Concepts of biodiversity, bioresource and wildlife management, conservation strategies:in situ and ex situ conservation; Wild life conservation projects in India; Protection ofbiodiversity for its suitable utilization; Threats to biodiversity; WCU Red data book;Biodiversity hotspots in India; National bureaus of genetic resources.

UNIT II Sustainable development; Diversification of cropping system; Diversity of indigenouslivestock; Vulnerability and extinction of flora and fauna; Endangered species in

variousecosystems; Germplasm banks; Environmental impact assessment; Bioremediation andbiosafety; Introduction to regulatory agencies and legislation.

Suggested Readings

Das MK & Choudhury BP. 2008. A Text book on Plant Nomenclature and BiodiversityConservation. Kalyani Publishers.

Hopsetti BB. &Venketashwarlaru M. 2001. Trends in Wild Life Conservation andManagement. Vol. 2, Daya Publishing House.

Singh MP & Singh BS. 2002. Plant Biodiversity and Taxonomy. Daya Publishing House,Delhi.

OTHER SUPPORTING COURSES

Course Title : National Service Scheme/ NCC
Course No. : SEY-111
Credit Hours : 1(0-0-1)
Practical
Orientation of students towards national problems; Study of the philosophy of N.S.S., fundamental rights, directive principles of state policy, socio-economic structure of Indian society, population and five year plans; Functional literacy: Non-formal education of rural youth, eradication of social evil, awareness programmes, consumer awareness, highlights of the Consumer Act, environment enrichment and conservation, health, family welfare and nutrition; Right to information act.

Course Title : Human Ethics
Course No. : SEY-121
Credit Hours : 2 (2-0-0)
UNIT I Universal human aspirations: Happiness and prosperity; Human values and ethics: Concept, definition, significance and sources; Fundamental values: Right conduct, peace, truth, love and non-violence; Ethics: professional, environmental, ICT; Sensitization towards others particularly senior citizens, developmentally challenged and gender.
UNIT II Spirituality, positive attitude and scientific temper; Team work and volunteering; Rights and responsibilities; Road safety; Human relations and family harmony; Modern challenges and value conflict: Sensitization against drug abuse and other social evils; Developing personal code of conduct (SWOT Analysis); Management of anger and stress.
Suggested Readings
Gaur RR, Sangal R &Bagaria GP. 2011. A Foundation Course in Human Values and Professional Ethics. Excel Books.
Mathur SS. 2010. Education for Values, Environment and Human Rights. RSA International.
Sharma RA. 2011. Human Values and Education -Axiology, Inculcation and Research. R. Lall Book Depot.
Sharma RP & Sharma M. 2011. Value Education and Professional Ethics. Kanishka Publishers.
Srivastava S. 2011. Human Values and Professional Ethics. S K Kataria& Sons.
Srivastava S. 2011. Environmental Science. S K Kataria& Sons.
Tripathi A.N. 2009. Human Values. New Age International (P) Ltd Publishers.

Course Title : Business Management and Economics
Course No. : SEY-322
Credit Hours : 2(2-0-0)
Theory
Definitions, management principles, scientific principles, administrative principles; Maslow's Hierarchy of needs theory; Functions of management: Planning, organizing, staffing, directing, controlling; Organizational structures, principles of organization; Types of organization: Formal and informal, line, line and staff, matrix, hybrid; Introduction to economics: Definitions, nature, scope, difference between microeconomics and macroeconomics; Theory of demand and supply, elasticity of demand, price and income elasticity; Markets: Types of markets and their characteristics; National income: GDP, GNP, NNP, disposable personal income, per capita income, inflation; Theory of production:

Production function, factors of production. Law of variable proportions and law of returns to scale; Cost: Short run and long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost; Break even analysis; Finance management: Definition, scope, objective; Different systems of accounting: Financial accounting, cost accounting, management accounting; Human resource management: Definitions, objectives of manpower planning, process, sources of recruitment, process of selection; Corporate social responsibility: Importance, business ethics.

Suggested Reading

L.M. Prasad. 2001. Principles and Practices of Management, 9th Ed. S. Chand & Sons, New Delhi.
Koontz Harold. Principles of Management. Tata McGraw-Hill Education Private Limited, New Delhi.
P.C. Thomas. Managerial Economics, 9th Ed. Kalyani Publishers.
K.K. Dewett and M.H. Navalur. Modern Economic Theory. S. Chand & Sons, New Delhi.
P. Subba Rao. Human Resource Management. Himalaya Publications.
S.P. Jain. Financial Accounting. Kalyani Publications, Ludhiana.

Course Title : Physical Education
Course No. : SEY-311
Credit Hours : 1(0-0-1)
Practical

Introduction to physical education: Definition, scientific machine principles, objectives, scope, history, development and importance; Physical training and health; Fartlek training and circuit training; Body mechanism and body type: Kretchmark's and Sheldon's classification; Theories of learning; Exercises for good posture; Exercises to develop physical fitness, growth, flexibility - components, speed, strength, endurance, power, flexibility, agility, coordination and balance; Test and measurement in physical education: Physical fitness test, motor fitness test, ability test, cardiovascular efficiency test and physical fitness index; Calisthenics, weight training, aerobic and anaerobic exercises; Circuit training, interval training, far trek training, pressure training and resistance training; Importance of *Asanas*, free hand exercises and yoga; Recreation: Definition, agencies promoting recreation, camping and re-recreation; Governance of sports in India; Organization of tournaments; National and international events; Drawing of fixtures; Rules and regulations; Coaching and fundamentals of skill development of major games, coaching and tactic development of athletic events.

Course Title : Economics and Marketing
Course No. : SEY-312
Credit Hours : 3 (2-0-1)

UNIT I

Economics – Terms and definitions; Consumption, demand, price and supply; Factors of production; Gross Domestic Product; Role of Sugarane/ Agriculture sector in national GDP.

UNIT II

Marketing – definition; Marketing process; Need for marketing; Role of marketing;Marketing functions; Classification of markets; Marketing of various channels; Pricespread; Marketing efficiency; Constraints in marketing of agricultural produce; Marketintelligence.

UNIT III

Basic guidelines for preparation of project reports; Bank norms; Insurance; SWOTanalysis; Crisis management.

Practical

Techno-economic parameters for preparation of projects; Preparation of bankableprojects for various biotechnology/ agricultural products and value added products;Identification of marketing channel; Calculation of price spread; Identification of marketstructure; Visit to different markets, market institutions; Study of SWC, CWC and STC;Analysis of information of daily prices; Marketed and marketable surplus of differentcommodities.

Suggested Readings

Acharya SS & Aggarwal NL. 2011. Agricultural Marketing in India. Fifth Edition.Oxford and IBH Publishing Company Pvt. Ltd.

Ahuja HL. 2007. Advanced Economic Theory. S Chand and Company.

Chandra P. 1984. Projects: Preparation, Appraisal & Implementation. McGraw Hill Inc.

Dewett KK. 2005. Modern Economic Theory. S Chand and Company.

Gupta RD &Lekhi RK. 1982. Elementary Economic Theory. Kalyani Publishers.

Sampat Mukherjee. 2002. Modern Economic Theory. New Age International.

Course Title : Project Preparation and Management

Course No. : SEY-411

Credit Hours : 2(1-0-1)

Theory

Overview of project management: Functions and viewpoints of management, evolution of project management, forms and environment of project management; Project life cycle; Project selection: Project identification and screening, project appraisal, project charter, project proposal, project scope, statement of work; Project planning and scheduling: Work breakdown structure, planning and scheduling of activity networks, network scheduling, precedence diagrams, critical path method, program evaluation and review technique, assumptions in PERT modelling, decision CPM, GERT; Project cost estimating: Types of estimates and estimating methods, dynamic project planning and scheduling, time-cost trade-offs, resource considerations in projects, resource profiles and levelling, limited resource allocation; Project implementation, monitoring and control: Project management process and role of project manager, team building and leadership in projects, organizational and behavioural issues in project management, project monitoring and control, PERT/cost method, earned value analysis; Project completion and future directions: Project completion and review; Project management: Recent trends and future directions; Computers in project management.

Suggested Reading

R. Panneerselvam. 2004. Operations Research, 2nd Ed. International Book House, Mumbai.

Prasanna Chandra. Projects. Tata McGraw-Hill Publication, New Delhi.

John M. Nicholas. Project Management for Business and Technology – Principles and Practices. Pearson Prentice Hall.

Harold Kerzner. Project Management – A System Approach to Planning, Scheduling, and Controlling. CBS Publishers & Distributors.

Prasanna Chandra. Projects – Planning, Analysis, Selection, Financing, Implementation, and Review. Tata McGraw-Hill Publishing Company Ltd.

P. Gopalakrishnan and V.E. Rama Moorthy. Textbook of Project Management. Macmillan

Course Title : Entrepreneurship Development
Course No. : SEY-412
Credit Hours : 3 (2+1)
Theory

Entrepreneurship: Importance and growth, characteristics and qualities of entrepreneur, role of entrepreneurship, ethics and social responsibilities; 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; Globalization and the emerging business/entrepreneurial environment; 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, generation, incubation and commercialization of ideas and innovations; Women entrepreneurship: Role and importance, problems; Corporate entrepreneurship: Role, mobility of entrepreneur; Entrepreneurial motivation; Planning and evaluation of projects: Growth of firm, project identification and selection, factors inducing growth; Project feasibility study: Post planning of project, project planning and control; New venture management; Creativity. Government schemes and incentives for promotion of entrepreneurship; Government policy on small and medium enterprises (SMEs)/SSIs; Export and import policies relevant to food processing sector; Venture capital; Contract farming and joint ventures, public-private partnerships; Overview of food industry inputs; Characteristics of Indian food processing industries and export; Social responsibility of business.

Practical

Visit to public enterprise; Visit to private enterprise; Visit to agro-processing/food business centres; SWOT analysis of public enterprises; SWOT analysis of private enterprises; Project proposals as entrepreneur – individual and group; Presentation of project proposals in the class.

Suggested Reading

C.B. Gupta and N.P. Srinivasan. 2012. Entrepreneurship Development. S. Chand & Sons, New Delhi. 43

Anil Kumar, S., Poornima, S.C., Mini, K., Abraham and Jayashree, K. 2003. Entrepreneurship Development. New Age International Publishers, New Delhi.

Gupta, C.B. 2001. Management: Theory and Practice. Sultan Chand & Sons, New Delhi.

Vasant Desai. 2000. Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, New Delhi.