# COLLEGE OF BIOTECHNOLOGY

## SYLLABUS

## *M.TECH./ M.Sc (BIOTECHNOLOGY)*

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

Syallabus I: 2010 onwards.
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# Details of Courses

| **Core Course** | | | | |
|---|---|---|---|---|
| **S.** | **Code** | **Course Name** | **Credits** | **Department** |
| **1.** | BTB- 510 | Advance Biochemistry | 2(2-0-0) | Physiology & Biochemistry |
| **2.** | BTA- 510 | Advance Techniques in Biotechnology | 3(0-0-3) | All departments |
| **3.** | BTP- 510 | Microbial Physiology & Genetics | 2(2-0-0) | Pathology & Microbiology |
| **4.** | BTI-510 | Principles of Immunology | 2(2-0-0) | Immunology & DM |
| **5.** | BTM-530 | Principles of Molecular Biology and Genetic Engineering | 2(2-0-0) | MDGE |
| **6.** | BTF-510 | Plant Biotechnology | 2(2-0-0) | Finger Printing |
| **7.** | BTC-510 | Recent Developments in Cell Biology | 2(2-0-0) | Cell Biology |
| **8.** | BTS-510 | Seminar | 1(1-0-0) | |
| **9.** | BTT-510 | Thesis | 15 | |
| | | **Credit** | **31** | |
| **Supporting Course** | | | | |
| **10.** | BTP-530 | Advanced Microbial Techniques | 3(2-0-1) | Pathology & Microbiology |
| **11.** | BTM-510 | Principles of Genetics | 3(3-0-0) | MBGE |
| | | **Credit** | **06** | **31+6=37** |
| **Optional Course** | | | | |
| **12.** | BTI- 520 | Bioinformatics | 1(1-0-0) | Immunology & DM |
| **13.** | BTB-520 | Proteomics | 2(2-0-0) | Physiology & Biochemistry |
| **14.** | BTP-520 | Environmental Biotechnology | 2(2-0-0) | Pathology & Microbiology |
| **15.** | BTO-510 | Industrial Biotechnology | 2(2-0-0) | Comm. Biotech. |
| **16.** | BTR-510 | Genomics & Epigenomics | 2(2-0-0) | Recomb. Techniques |
| **17.** | BTC-520 | Cell Signaling | 2(2-0-0) | Cell Biology |
| **18.** | BTM-520 | Molecular Genetics | 2(2-0-0) | MBGE |
| **19.** | BTI-530 | Radioisotopes, Tracer and Diagnostics | 2(1-0-1) | Immunology & DM |
| **20.** | BTM-540 | Protein Engineering | 2(2-0-0) | MBGE |
| **21.** | BTM-550 | Nanotechnology | 2(2-0-0) | MBGE |
| **22.** | BTF-520 | Biosafety, IPR, Patents and Entrepreneurship | 2(2-0-0) | Finger Printing |
| | | **Credit** | **21** | Any **08 Credit** |
| | | **Total Credit** | **45** | |

*A student shall offer minimum 10 and maximum 16 credit hours in one semester.

# Semester wise Distribution of Courses

### First Semester

| Course No | Course Name | Credits | Page No. |
|---|---|---|---|
| BTC-510 | Recent Developments in Cell Biology | 2(2-0-0) | 08 |
| BTI-510 | Principles of Immunology | 2(2-0-0) | 08 |
| BTM-530 | Principles of Molecular Biology and Genetic Engineering | 2(2-0-0) | 09 |
| BTF-510 | Plant Biotechnology | 2(2-0-0) | 09 |
| BTM-510 | Principles of Genetics | 3(3-0-0) | 10 |
| BTP-530 | Advanced Microbial Techniques | 3(2-0-1) | 11 |

### Second Semester

| Course No | Course Name | Credits | Page No. |
|---|---|---|---|
| BTB-510 | Advance Biochemistry | 2(2-0-0) | 11 |
| BTA-510 | Advance Techniques in Biotechnology | 3(0-0-3) | 11 |
| BTM-540 | Protein Engineering | 2(2-0-0) | 12 |
| BTI-530 | Radioisotopes, Tracers and Diagnostics | 2(1-0-1) | 12 |
| BTP-510 | Microbial Physiology & Genetics | 2(2-0-0) | 13 |
| BTF-520 | Biosafety, IPR, Patents and Entrepreneurship | 2(2-0-0) | 13 |
| BTM-520 | Molecular Genetics | 2(2-0-0) | 14 |
| BTS-510 | Seminar | 2(1-0-0) | - |

### Third Semester

| Course No | Course Name | Credits | Page No. |
|---|---|---|---|
| BTC-520 | Cell Signaling | 2(2-0-0) | 16 |
| BTI- 520 | Bioinformatics | 1(1-0-0) | 16 |
| BTO-510 | Industrial Biotechnology | 2(2-0-0) | 17 |
| BTR-510 | Genomics & Epigenomics | 2(2-0-0) | 17 |
| BTB-520 | Proteomics | 2(2-0-0) | 17 |
| BTP-520 | Environmental Biotechnology | 2(2-0-0) | 18 |
| BTM-550 | Nanotechnology | 2(2-0-0) | 18 |

### Fourth Semester

| Course No | Course Name | Credits | Page No. |
|---|---|---|---|
| BTT-510 | Thesis | 15 | - |

# Department wise Distribution of Courses

| S. | Department | Courses |
|---|---|---|
| | **College of Biotechnology** | |
| **1.** | **Physiology & Biochemistry** | BTB 510, BTB 520. |
| **2.** | **Molecular Biology & Genetic Engineering** | BTM510, BTM 520, BTM 530, BTM 540, BTM 550. |
| **3.** | **Pathology & Microbiology** | BTP 510, BTP 520, BTP 530. |
| **4.** | **Recombination Techniques** | BTR 510. |
| **5.** | **Immunology & Defense Mechanism** | BTI 510, BTI 520, BTI 530. |
| **6.** | **Finger Printing** | BTF 510, BTF 520. |
| **7.** | **Cell Biology** | BTC 510, BTC 520. |
| **8.** | **Commercial Biotechnology** | BTO 510. |
| **9.** | **College Level** | BTA 510, BTS 510, BTT 510. |

## Recent Development in Cell Biology 2(2-0-0)
## BTC- 510

Electron Microscopy, Ultrastructures of cell organelles and their functions, Microbodies (Peroxisomes, Glyoxysomes) and their functions, Nucleus, Nuclear Organizing Regions (NOR) and their role, Various models of chromosome organization, C-value paradox, Nucleosome and Solanoid models of chromatin, Euchromatin & Hetrochromatin (Junk protein) and applications, Banding techniques, Plasmagenes, Transposable elements (Transposons) and their applications, Regulatory mechanism of transcription, translation and RNAi, Basic idea of functional genomics and proteomics for commercial cell protein production. Nitrate reductase, Gene transfer for commercial protein production, Delayed ripening genes through anti-sense RNA technology, Transgenesis.

## Principles of Immunology 2(2-0-0), BTI – 210

Components of innate and acquired immunity; Phagocytosis; Complement and Inflammatory responses; Haematopoesis; Organs and cells of the immune system- primary and secondary lymphoid organs; Lymphatic system; Lymphocyte circulation; Lymphocyte homing; Mucosal and Cutaneous associated Lymphoid tissue.(MALT&CALT); Mucosal Immunity; Antigens - immunogens, haptens; Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility, HLA typing; Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, antigenic determinants; Multigene organization of immunoglobulin genes; B-cell receptor; Immunoglobulin superfamily; Principles of cell signaling; Immunological basis of self –non-self discrimination; Kinetics of immune response, memory; B cell maturation, activation and differentiation; Generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; Functional T Cell Subsets; Cell-mediated immune responses, ADCC; Cytokines-properties, receptors and therapeutic uses; Antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens; Cell-cell co-operation, Hapten-carrier system; Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; Surface plasmon resonance, Biosenor assays for assessing ligand –receptor interaction, CMI techniques- lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays, Apoptosis, Microarrays, Transgenic mice, Gene knock outs; Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse

vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries. Immunity to Infection : Bacteria, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity – Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; Transplantation – Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy; Tumor immunology – Tumor antigens; Immune response to tumors and tumor evasion of the immune system, Cancer immunotherapy; Immunodeficiency-Primary immunodeficiencies, Acquired or secondary immunodeficiencies.

## Principles of Molecular Biology & Genetic Engineering 2(2-0-0)
## BTM-530

Structure of DNA and RNA, Different forms of DNA and their relevance, Folding of DNA and RNA, Structural and functional correlation of nuclic acid,, Recent advances in nucleic acid & plant molecular biology research. Introduction and historical perspective; restriction enzymes & vectors; gene cloning identification, isolation and synthesis; *in vitro* regeneration in crop plants; gene transfer systems- *vector* mediated, microinjection, electroporation, microprojectile, other direct and indirect DNA uptake techniques; selection markers and reporter system; gene silencing; application of plant genetic engineering and biotechnology – current status and future prospects; transgenic crops; biochemical and DNA based markers (RFLP, RAPD, AFLP, STS, SCARS, SSLP *etc).*

## Plant Biotechnology 2(2-0-0)
## BTR- 510

Historical perspective; Totipotency; Organogenesis; Somatic embryogenesis; Regulation and applications; Artificial seed production; Micropropagation; Somaclonal variation; Androgenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation. Protoplast isolation; Culture and usage; Somatic hybridization - methods and applications; Cybrids and somatic cell genetics. *Agrobacterium*-plant interaction; Virulence; Ti and Ri plasmids; Opines and their significance; T-DNA transfer; Disarming the Ti plasmid. *Agrobacterium*-mediated gene delivery; Cointegrate and binary vectors and their utility; Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods; Screenable and selectable markers; Characterization of transgenics; Chloroplast transformation; Marker-free methodologies; Gene targeting. Quantitative and qualitative traits; MAS for

genes of agronomic importance, e.g. insect resistance, grain quality and grain yield; Molecular polymorphism, RFLP, RAPD, STS, AFLP, SNP markers; Construction of genetic and physical map; Gene mapping and cloning; QTL mapping and cloning. Herbicide resistance; Drought, salinity, thermal stress, flooding and submergence tolerance. Seed storage proteins; Source-sink relationships for yield increase; Post-harvest bioengineering; Plant architecture; Flowering behaviour Concept of biofactories; Cell cultures for secondary metabolite production; Identification of candidate genes using genetic information (positional cloning), using biochemical and expression analysis (microarray analysis, proteomics, metabolomics); Characterization and functional analysis of candidate genes: Plant genetic resources; Patenting of biological material; Plant breeders rights (PBRs) and farmers rights; Biosafety and containment practices

## Principles of Genetics 3(3-0-0)
## BTM-510

**History of Genetics**, Definition and scope of Genetics, Premendelian genetic concepts – Performation, Epoigenesis, and Inheritance of acquired characters, Germplasm theory. Hereditary and Environment, Genotype and Phenotype; Heredity and Variation. Clones, Purelines and Inbred lines Norms of reaction and Phenocopies. **Bacterial genetics:** Transfromation ; Transduction – generalized, and specialized; conjugation : F factor mediated, Hfr Mediated and Sexduction., gene mapping with bacteria **Bacteriophage Genetics**: Genetic organisation - lytic and lysogenic cycle, regulation of genes - foundations of phage genetics – T-odd coliphages – ss DNA phages – RNA phage.. **Yeast genetics:** genome - mutants and genetic screens – genetic redundancy – cell type determination – cell cycle regulation of mitotic events – genetic interaction: two hybrid systems – *gal* pathway, gene regulation, **Development Genetics**: Factors controlling development. Nuclear changes during development (Nuclear transplantation). Switching genes on and off during development. Fate mapping; Tissue specific methylation. Differential expression of haemoglobin genes. The genetics of development in Drosophila and Arabidopsis. Homoetic genes in genetic control of flower. Flower morphogenesis (Rice and Arabidopsis thaliana)
**Cell cycle regulation genetics:** Regulation of mitotic cell cycle in prokaryotes and eukaryotes and intercellular communication in multi cellular eukaryotes. Properties of cancer cells. Proto oncogences, Oncogenes, Cellular oncogenes, Tumor suppressor genes, Viral oncogenes.

## Advanced Microbial Techniques 2(2-0-1)
## BTP 530

Rapid detection of microorganism by PCR, Isolation of microorganism from air, soil, water, food, animals, plants and environmental samples. Microscopic examination of microorganism, staining methods, Control of microorganism, Preparation of culture media isolation of microorganism from rhizosphere, methods of pure cultures techniques, maintenance of pure cultures, Biochemical characterization of microorganism, identification of unknown microorganism.

## Advanced Biochemistry 2(2-0-0)
## BTR- 510

Biomolecules; Metabloism of carbohydrates, lipids and amino acids; secondary metablolites; Photosynthesis; Protein Structure: amino acids, primary structure, secondary structure, Ramachandran plot, tertiary structure, supramolecular structures, protein-protein interactions, protein 0ligand interactions, protein denaturation anf folding, X-Ray diffraction, nuclear magnetic resonance; Membrane biochemistry: composition and architecture of membranes, membrane dynamics, solute transport across membranes; Industrial enzymes; Novel diagnostic methods including biosensors and treatment of diseases including gene therapy and drug design.

## Advance Techniques in Biotechnology 3(0-0-3)
## BTA- 510

Molecular biology pertains to the study of living systems at the molecular level, especially DNA and RNA, and provides a background appropriate for further work in the rapidly expanding areas of genomics, cell biology, biotechnology, microbiology, diagnostics, and therapeutics. This course will focus on selected aspects of molecular biology that provide the non-specialist with the principles for understanding the structure and functional relationships of molecular biology techniques including DNA manipulation, sequencing, cloning, subcloning, library construction, screening, RNA isolation and characterization, analysis of expression, cDNA synthesis (RT-PCR) and analysis, microarrays and gene chips, and Real-Time-PCR. Multiple modern day molecular biology techniques in the biotechnology and pharmaceutical industries will be presented and several examples of molecular applications will be highlighted.

## Protein Engineering 2(2-0-0)
## BTM-540

**General introduction of protein engineering, Protein Sources:** Introduction, Microorganisms as sources of proteins, Proteins from plants, Animal tissue as a protein source, Direct chemical synthesis, importance**, Protein function and Protein Structure:** Introduction, Overview of protein structure, Higher level structure, Protein post-translational modification, Protein stability and folding.
**Protein Purification and Characterization:** Introduction, Initial recovery of proteins, Removal of whole cells and cell debris Concentration and primary purification, Column chromatography, Protein inactivation and stabilization, Protein characterization. Large-Scale Protein Purification. **Prokaryotic and eukaryotic systems for protein production and expression** , applications , advantages and potential challenges, **Strategies and approaches to protein engineering**: Rational design, directed evolution, denovo desing etc.different method, approaches,used and their advantages, disadvantages and applications.
**Molecular modeling and protein structure prediction**: introduction ,Sec and tertiary structuee prediction: methods and advantages, **Nature of protein engineering**: Molecular probe engineering, enzyme and biosensor engineering, therapeutic protein engineering, antibody engineering, metabolic pathway engineering,peptide engineering and other biocatalysis engineering, **Strategies and approaches to enhance biological properties of proteins:** increasing protein solubility, increasing enzymatic activity, stability and specificity, modifying co-factor requirement,, incorporation of unnatural amino acids etc., **Applications and specific examples of protein engineering:** Industrial enzymes, biocatalysts, therapeutic proteins, agronomically important traits etc.

## Radioisotopes, Tracers and Diagnostics 2(2-0-0)
## BTI-530

Introduction to basics of nuclear forces, terminology, nuclear reactions. Radioactivity, radioactivity units, radioactive half life, Types of radioactivity decays, Radioisotopes, Production of radioisotopes, different systems for detection and measurement of radiations. Advances in applications of radiotracers technology in biological research, diagnosis and therapy. Natural radiation, damage and safety rules. Different types of immunoassays or techniques and development of immunodiagnostic commercial kits. Immuno–molecular technologies including micro array, hybridoma and proteomes in diagnosis of different diseases Antibody for diagnosis and therapy.

## Microbial Physiology & Genetics 2(2-0-0)
## BTP- 510

Anatomy of bacterial cells , Function of bacterial cell parts, Proteins of bacterial membranes , Outer membranes of Gram negative bacteria, Assembly of peptidoglycan, Action of penicillins, Bacterial transport mechanisms, Group translocation; ABC transporters, Protein targeting, Bacterial motility and chemotaxis, Signal transduction in bacterial chemotaxis, Exchange of genetic information in bacteria, Overview of metabolism and assembly reactions, Polymerization reactions, Biosynthetic pathways in bacteria, Physiological adaptive responses in the biosynthetic pathways: control of enzyme activity, Fueling reactions in bacterial metabolism, Cellular differentiation in bacteria, Microorganisms and their environments, Bacterial genetics: physiological adaptive responses involving regulation of gene expression, Regulation of gene expression in bacteria, Multi-gene regulatory systems for controlling gene expression in bacteria, Control of bacterial gene expression by "two-component" regulatory systems, Translation as a regulatory control point, Yeast: overview, cell structure and protein sorting, Regulation of gene expression in yeast, Yeast as a tool in molecular biology Yeast mating and switching, Physiological adaptive responses to nutrient availability in yeast: role of RAS and adenylate cyclase, Yeast cell cycle

## Biosafety, IPR, Patents & Entrepreneurship 2(2-0-0)
## BTF- 520

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of New GMOs; International framework for the protection of IP, IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS, Invention in context of “prior art”; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, India etc.); Analysis and report formation, Types of patents; Indian Patent Act 1970; Recent Amendments; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a PCT application Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures and costs; Financial assistance for patenting-introduction to existing schemes; Publication of patents-gazette of India, status in Europe and US Patenting by research students, lecturers and scientists-University/organizational rules in India and abroad, credit sharing by workers, financial incentives, Patent infringement- meaning, scope, litigation, case studies

and examples, Introduction; Historical Backround; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including- Cartagena Protocol.

## Molecular Genetics 2(2-0-0)
## BTM-530

Anatomy of Prokaryotic genome and Eukaryotic genome: packaging of DNA into chromosomes. The special features of metaphase chromosomes, Nucleosome Structure, Chromatin modeling, Genome functioning: The Repetitive DNA content of genomes. Tendemly repeated DNA, The Role of DNA binding proteins: Methods for studying DNA-binding proteins, interactions between DNA and DNA binding proteins, RNA-binding motifs, contacts between DNA and proteins; Genome replication: the topological problem, variations in semi-conservative theme, DNA topoisomerase. The replication process, Initiation, initiation and termination of replication, the diverse functions of topoisomerase, Regulation of Eukaryotic genome replication. Gene expression: Accessing the gemome, effects of chromatin packaging on eukaryotic gene expression, Heterochromatin, euchromatin and chromatin loops, structural and functional domains, nucleosome positioning, DNA methylation and gene expression, Mechanism of transcription: prokaryotes and eukaryotes - Operon and operon concept - Eukaryotic gene structure and expression - Mechanism of translation: prokaryotes and eukaryotes, Control of gene expression - RNA processing and editing, transcriptional, post transcriptional, translational and post transnational controls, Genome evolution and phylogenetics: The origin of genomes, acquisition of new Genes. The origins of introns, The Human genome, DNA - based phylogenetic trees.

## Cell Signalling 2(2-0-0)
## BTC-520

General signaling mechanism, Cell signals and cell-cell communication, membrane signaling, membrane-lipids and membrane-protein signaling, signaling in nervous system, synapses and transmitters, chemoreception in eukaryotes and prokaryotes, Signaling in plants, Structure and function of ion

channels, Signaling via the action potential, Protein kinase, CAMP dependent protein kinase, Steroid hormone receptors and coactivators, Adenylate cyclase and G protein linked cell surface receptors.

## Bioinformatics 1(1-0-0)

### BTI-520

Sequence databases; Similarity matrices; Pairwise alignment; BLAST; Statistical significance of alignment; Sequence assembly; Multiple sequence alignment; Clustal; Phylogenetics: distance based approaches, maximum parsimony, Motif representation: consensus, regular expressions; PSSMs; Markov models; Regulatory sequence identification using Meme; Gene finding: composition based finding, sequence motif-based finding, Representation of molecular structures (DNA, mRNA, protein), secondary structures, domains and motifs; Structure classification (SCOP, CATH); Visualization software (Pymol, Rasmol etc.); Experimental determination of structures (X-ray crystallography, NMR); Structure databases; Secondary structure prediction; RNA structure prediction; Mfold; Protein structure prediction by comparative modelling approaches (homology modelling, threading); Ab initio structure prediction: force fields, backbone conformer generation by Monte Carlo approaches, side-chain packing; Energy minimization; Molecular dynamics; Rosetta; Structure comparison (DALI, VAST etc.); CASP; Protein-ligand docking; Computer-aided drug design (pharmacophore identification); QSAR;Protein-Protein interactions, Transcriptomics: Microarray technology, expression profiles, data analysis; SAGE; Proteomics: 2D gel electrophoresis; Mass Spectrometry; Protein arrays; Metabolomics: 13C NMR based metabolic flux analysis

## Industrial Biotechnology 2(2-0-0)

### BTO - 510

Introduction to industrial Biotechnology, Primary & Secondary metabolites; Strain isolation; Strain development; Strain maintenance; Growth requirements for bacteria & fungi, Substrates for industrial fermentation: Natural vs. synthetic media; Growth kinetics of microorganism; Types of Fermentation: Solid State, submerged fermentation and continuous fermentation; Brief account of the following products obtained by industrial microbiological fermentation: Alcohol, Alcoholic Beverage – Beer, Organic acid – Citric acid, Antibiotic – Penicillin, Amino acids– Glutamic acid, Vitamin– B12, Brief account of Steroid biotransformation, Production of rDNA products including DNA vaccines,

Insulin; Down stream processing (DSP): Disintegration of cells, Separation, Extraction, Concentration and purification of products.

## Genomics and Epigenomics 2(2-0-0)
## BTR- 510

**Structural Genomics:** Genome organization in prokaryotes and eukaryotes, Cloning strategies, Mapping, Genome sequencing, application of Bioinformatics (Genome Databases). **Functional Genomics:** Forward and Reverse Genetics, **Transcriptomics** (c-DNA library, EST, SAGE, DNA- CHIP). **Proteomics** (proteome, 2-D Gel Electrophoresis, Protein Identification (Immunoaffinity chromatography) and purification, peptide fingerprinting, Mass spectroscopy, protein-Protein interaction (Yeast two Hybrid System), Surface Plasmone Resonance (SPR) technique), application of bioinformatics (Protein Databases), **Metabolomics** (metabolite profiling (Identification and purification)). **Comparative and evolutionary Genomics:** Genome evolution and Synteny. **Epigenomics:** Nucleosome model (Chromatin, Histone, non Histone proteins, epigenetic domain), DNA Modification (Imprinting / methylation), Analysis of DNA methylation patterns, Histone modification, Epigenetic gene regulation.

## Proteomics 2(2-0-0)
## BTB - 520

Introduction to proteomics; samples preparation, protein concentration determination, Isoelectric focusing (IEF), SDS PAGE 2D, electrophoresis (including DIGE), Gel staining, Gel image acquisition and analysis, Gel spot/band cot-out, In gel trypsin digestion, Introduction to mass spectrometry: MALDI-TOF MS mass finger-printing and protein identification, ESI/TOF MS/MS peptide sequencing. FT ICR LC-MS/MS peptide sequencing for protein identification in complex mixtures and for studies on searching for proteomics, Protein identification from Mass Spectral Data. Validation & Reporting of Proteomic Data, Biomedical application of proteomics.

## Environmental Biotechnology 2(2-0-0)
## BTP – 520

Environment; Basic concepts; Resources; Eco system: plants, animals, microbes; Ecosystem management; Renewable resources; Sustainability; Microbiology of degradation and decay; Role of Biotech in environmental protection; Control and management of biological processes, Enviromental pollution; Source of pollution; Air, water as a source of natural resource; Hydrocarbons, substituted

hydro carbons; Oil pollution; Surfactants; Pesticides; Measurement of pollution; Water pollution; Biofilm; Soil pollution; Radioactive pollution; Radiation; Ozone depletion; Green house effect; Impact of pollutants; Measurement techniques; Pollution of milk and aquatic animals, Waste water collection; control and management; Waste water treatment; Sewage treatment through chemical, microbial and biotech techniques; Anaerobic processes; Anaerobic filters; Anaerobic sludge blanket reactors; Bioremediation of organic pollutants and odorous compounds; Use of bacteria, fungi, plants, enzymes, and GE organisms; Plasmid borne metabolic treatment; Bioaugmentation; Bioremediation of contaminated soils and waste land; Bioremediation of contaminated ground water; Macrophytes in water treatment; Phytoremediation of soil metals; Treatment for waste water from dairy, distillery, tannery, sugar and antibiotic industries, Biomass as source of energy; Bioreactors; Rural biotechnology; Biocomposting; Biofertilizers; Vermiculture; Organic farming; Bio-mineralization; Biofuels; Bioethanol and biohydrogen; Solid waste management, Gene and environment; Effect of carbon and other nanoparticles upon health; Gene mutation; Genetic testing; Genetic sensors; Environmental pollution and children; Human biomonitoring.

## Nanotechnology 2(2-0-0)
## BTM-550

**Introduction to Nanotechnology:** Definition of nanobiotechnology, Molecular building blocks for nanostructure systems, **Nano Scale:**Nano-scale 1D to 3D structures, Nano-scale bio and medical applications, Nano-scale functional materials, Nano-scale electronics, Consequences of the nanoscale for technology and society. **Fundamental concepts :** molecular perspective, Molecular nanobiotechnology: long-term view; Current research : Nanomaterials, Bottom-up approaches, Top-down approaches, Functional approaches, Speculative; **Tools and techniques for nanobiotechnology Applications:** Applications in Genetic engineering, drug targeting, energy, bioinformatics, medicine, Diagnostics, Drug delivery, Tissue engineering; Chemistry and environment-Consumer goods-Foods, Household, Optics, Textiles, Cosmetics**; Implications**: Health risks and environmental issues, broader societal implications and challenges