

**A.VEERIYA VANDAYAR MEMORIAL SRI PUSHPAM COLLEGE
(AUTONOMOUS),
POONDI, THANJAVUR DIST.**

**Question Pattern for UG and PG Programmes for students to
be admitted during 2014 – 2015 and afterwards**

Total Marks: 75

QUESTIONS PATTERN

**SECTION – A
(Question 1 to 10)**

10 x 2 = 20 Marks

1. Short Answer Questions
2. Two Questions from each unit (All are answerable)

**SECTION – B
(Question 11 to 15)**

5 x 5 = 25 Marks

1. 5 Paragraph type questions with "either / or" type choice.
2. One question from each unit of the Syllabus.
3. Answer all the questions.

**SECTION – C
(Question 16 to 20)**

3 x 10 = 30 Marks

1. 5 Essay type questions – any three are answerable.
2. One questions from each unit of the Syllabus.

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
I	14P1BTC1	BIOCHEMISTRY	6	5

Objectives:

1. To enable the students to understand the co-valent bonds of Chemicals and Principles of Thermodynamics.
2. To give adequate knowledge on the Chemistry of Proteins, Amino Acids and lipids
3. To familiarize the Separation Technique and purifications of biomolecules.

Unit I

Hrs 18

Chemical foundations of Biology – pH, Acids, Bases, Buffers, Weak bonds, Covalent bonds. Principles of Thermodynamics – Classes of organic compounds and functional groups – Atomic, Molecular Dimensions, Space filling Ball and stick models.

Hrs18

Unit II

Carbohydrate – Classification and metabolism – Glycolysis, gluconeogenesis, Glycogenolysis, Pyruvate Oxidation, TCA, Electron Transport chain, Oxidative Phosphorylation and Photophosphorylation, Inborn error of carbohydrates metabolism.

Unit III

Hrs18

Protein – Structure and Classification – Metabolism. Overview of biosynthesis of non-essential amino acids. Catabolism of amino acid nitrogen transamination, deamination, ammonia formation. The urea cycle and regulation of ureogenesis and their inborn error of protein metabolism.

Hrs 18

Unit IV

Lipids – Classification and metabolism. Lipogenesis – Control of Acetyl CoA carboxylase. Oxidation of fatty acids – α , β and ω . Role of ornithine cycle in the regulation of β -oxidation. Lipid inborn error.

Hrs 18

Unit V

Nucleic acid metabolism - Purine and pyrimidine – Biosynthesis. Inborn error metabolism. Heterocyclic compounds and secondary metabolites – prostaglandins, Leukotrienes, Thromboxanes, Interferons, Interleukins, Antibiotics, Alkaloids, Terpenoids and Flavonoids. Pigments and Isoprenoids.

Reference:

1. Principles of Biochemistry by A.L. Lehninger, D.L. Nelson and M.M. Cox (2002), Worth publishers, New York.
2. Biochemistry by L. Stryer (2000) Freeman & Co. New York.
3. Biochemistry by G. Zubay (2004), Macmillan Publishing Co. New York.
4. Harper's Biochemistry by R.K. Murray, P.A. Mayes, D.K. Granne and V.V.W. Rodwell (2002) Lange Medical Book.
5. General Chemistry Linus Pauling, W.H. Freeman & Company.
6. Biochemical Calculations, Irwin H. Segal, John Wiley and Sons Inc.
7. Organic Chemistry, D.J. Cram and G.S. Hammond, McGraw Hill.
8. Physical Biochemistry Freifelder, W.W.H. Freeman & Company.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	14P1BTC2	MICROBIOLOGY	6	5

Objectives:

1. To study the details of various Microbes.
2. To study the diversity of microbes
3. To study the microbial evolution, diseases etc.

Unit I

Hrs 18

Methods in Microbiology – Pure Culture techniques, theory and practice of sterilization: Principles of microbial nutrition, construction of culture - enrichment culture techniques - isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms.

Unit II

Hrs18

Prokaryotic cell – Structure and function – Cell walls of Eubacteria (peptidoglycan related molecules): outer membranes of Gram negative and Gram positive bacteria, cell wall and cell membrane synthesis: flagella and motility: cell inclusions like Endospore.

Unit III

Hrs18

Systematic and Taxonomy – Characteristics of primary domains, Taxonomy, Nomenclature and Bergey's Manual. Microbial growth – Definition of growth. Mathematical expression of growth. Growth curve, measurement of growth and growth yields, synchronous growth: continuous growth. Growth affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen, Culture collection and maintenance of culture.

Unit IV

Hrs 18

Prokaryotic diversity – Bacterial diversity – Purple green bacteria, cyanobacteria, Acetic acid bacteria, budding and appendage bacteria, spirochetes, gliding and sheath bacteria– Pseudomonas, Lactic and Propionic acid bacteria: Endospore forming bacteria, mycobacterium, Rickettsia and Mycoplasma, Archaea. Eukaryotic diversity–Algae, Fungi, Protozoa, Slime mold – Virus.

Unit V

Hrs 18

Microbial Diseases – Disease reservoirs: Epidemiological Terminologies: Infectious disease Transmission: Respiratory infection caused by Bacteria and Viruses: Tuberculosis : Sexually transmitted disease including AIDS, Disease transmitted by animals (Rabies and Plagues) Insects and Ticks (Rickettsias, Lime disease and Malaria). Food and water Borne diseases, Public Health and Water Quality, Pathogenic Fungi.

Reference:

1. Microbiology by M.J. Pelzar E.C.S. Chan and N.R. Krieg (2004) McGraw Hill.
2. Microbiology by Dubey and Maheswari (2002).
3. General Microbiology, Stainer RY, Ingra Ham JL, Whellis ML & Painter PR. (2004). Macmillan Education Ltd London.
4. Advances in Applied Microbiology, Parihar, Pradeep (2008).
5. Fungi, Bacteria and Viruses, Dube, H.C. (2008).

M.Sc. Biotechnology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	14P1BTC3	ENVIRONMENTAL BIOTECHNOLOGY	6	5

Objectives:

1. To understand the environment.
2. To study the sources and effect environmental pollution.
3. To study the measures to treat the treatment of environmental pollution.
4. To study the solid waste management.

Unit I

Hrs 18

Environment – Basic Concepts and Issues. Factor affecting Environment - Environmental Pollution – Types of Pollution, Methods for the measurement of Pollution: Methodology of environmental management – the problem solving approach and its limitation.

Unit II

Hrs18

Air pollution and it's control through Biotechnology. Water pollution and its control: Water as scarce natural resource, need for water management, Measurement of Water Pollution, Sources of Water Pollution, Waste Water Collection, Treatment – Physical, Chemical, biological treatment process.

Unit III

Hrs18

Microbiology of waste water, Aerobic Process – Activated sludge process, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process: Anaerobic digestion, anaerobic filters, Up-flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of Dairy, Distillery, Tannery, Sugar and Antibiotic industries.

Unit IV

Hrs 18

Microbial degradation of xenobiotics in Environment – Ecological consideration, decay behaviour and degradative plastics: Hydrocarbons, substituted hydrocarbon, oil pollution, surfactants, pesticides. Bioremediation of contaminated soils and waste land – Phytoremediation.

Unit V

Hrs 18

Biopesticides in Integrated Pest Management – Soil waste: Sources and Management (Composting, Vermiculture and methane production). Global environmental problems: ozone depletion, UV-B, Green house effect and Acid rain and their impact on Biotechnological approaches for management.

Reference:

1. Air Environment and Pollution, Purohit, S.S. (2008).
 2. Environment Biotechnology–Fundamentals and Application, Parihar and Pradeep (2008).
 3. Industrial Waste their disposal and Treatment, Rudolf, W. (2006).
 4. Environmental Science A New Approach, Purohit, S.S. (2007).
 5. Environmental Awareness and Education, Gupta, D.D. (2008).
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Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
I	14P1BTCP1	Practical – I (Biochemistry, Microbiology and Environmental Biotechnology)	6	3

Objectives:

1. To understand the Chemistry of Proteins, Sugars, Nucleic acids.
2. To study the microbial Techniques.
3. To understand the Biochemistry and advances in Microbiology.

Biochemistry

1. Determination of Pka value of buffers by titration
2. Quantification of sugars
3. Isolation and quantification of Proteins
4. Absorption spectra of Proteins and nucleic acids
5. Precipitation Centrifugation of Macromolecules (Proteins and nucleic acids)
6. Thin layer chromatography of pigments and amino acids
7. Ion exchange and gel permeation chromatography of proteins
8. Determination of molecular weight of proteins by means of electrophoresis.
9. Estimation of blood glucose
10. Estimation of Cholesterol.
11. Estimation of purines and pyrimidines

Microbiology

1. Sterilization techniques .
2. Microscopic examination of bacteria, fungi, protozoa and molds.
3. Biochemical characterization of selected Microbes (Klebsiella, E coli, Salmonella, Shigella, Proteus)
4. Preparation of selective & differential medium.
5. Growth: Growth curve, measurement of fungal growth by linear determination and measurement of bacterial growth by turbidity.
6. Effect of temperature and pH on growth.
7. Pure Culture techniques –Streak, Pour & Spread plate.
8. Enumeration of micro organisms from soil and water
9. Antibiotic sensitivity test
10. Isolation of drug resistant auxotrophic mutants.
11. Study of mutation by Ames test.
12. Immobilization of cell Enzymes.
13. Isolation of Phage DNA.

Environmental Biotechnology

1. Waste water monitoring by TDS, DO, BOD, COD.
2. Detection of coli form to determine water purity using membrane filter method.
3. Detection of arsenic content in leather effluent.
4. Detection of nicotinic acid content in industrial waste.

Reference:

1. Practical Biochemistry : Principles and techniques by Keith Wilson and John Walker, 5th ed., 2000. Cambridge University Press, UK
2. Analytical biochemistry by Dabid J. Holme and Hazel peck, 3rd Ed. 1998. Pearson Edu. Ltd., England.
3. Principles and Practice of Bioanalysis by Richard F. Venn, 2003, Taylor and Francis, London.
4. Microbiology – A laboratory manual Cappuccino, J.G. and Shjeman, N. Addison Wesley (2004)
5. Diagnostic Microbiology by Betty. A. Forbes, aniel F. Sham, 2002.
6. Biochemical methods by A. Pingoud, C. Urbankse, J. Hoggett, 2002, Weiley – Velt Verlag Garbh.
7. Biochemical Analysis, Lab Manual by Gunasekaran – MKU.
Dube(Maheswari) Microbial Manual.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	14P1BTEL1A	Major Elective - I IMMUNOLOGY AND IMMUNOTECHNOLOGY	6	4

Objectives:

1. To study the immune system.
2. To study the immunity against invaded micro-organisms.
3. To study the various immunity Technology.
4. To study the Allergic reactions and Auto immune diseases.

Unit I Outlines of Immunology

Hrs18

Organs and Cells involved in immune responses–Organs of stem cell origin, primary and secondary lymphoid organs–Haemopoietic stem cells, T-cells, B-cells, Macrophages, Monocytes, Polymorphs and Platelets–Immunological memory–Differentiation of Lymphocytes.

Unit II Antigens, Antibodies and Complements

Hrs18

Antigens and antigenicity: Types, structure and requirements for immunogenicity – Antibody specificity – Antigen specific receptor for antibiotics – Regional variation of antigen binding site, Immunoglobulins: Structure, function and biological properties of Ig classes – Organization and expression of Immunoglobulin genes – Ag-Ab reactions: Precipitation, Agglutination, opsonisation and cytolysis. Complement and its activation, biological role of complement activation – Classical and alternate pathways.

Unit III Immune Response, Humoral immune response

Hrs18

Antibody Synthesis–Clonal Selection–Model kinetics of Primary and Secondary responses – Cellular Cooperation–B cell activation for T independent, T-dependent antigens–isotype switching. Cell mediated immune response: Phagocytosis–role of T-cells, macrophages and NK cells subtypes of T-cells and their functions: Cytotoxic T-cells, Helper T cells, Suppressor T cells, and Regulatory T cells–Cell mediated Cytotoxicity – Lymphokines and Cytokines–their biological role.

Unit IV Hypersensitivity

Hrs 18

Types–disorders, - Auto immunity–disease– Auto antibodies. HLA system–disease association. MHC and significance. Immunotherapy–Types: Transplantation–Types. Tumours–Tumours Antigens and immunoresponses to tumours.

Unit V

Hrs18

Immunization–Types. Principles and Methods of Polyclonal and Monoclonal antibody productions and their applications. Principle and Methods in vaccine preparation, Vaccines types.

Immunotechniques–Principle, Methodology and application of LTT, ELISA, ELISPOT, RIST, RAST and Immunoblotting, FACSCAN, Immunofluorescence and RIA.

Reference:

1. Immunology, An introduction (1984)6th Edition–Wiley medical publications; New York.
2. Structure and Functions of Antibodies (1977) Glysm, L. Steward M.W. Johy Wily– New York.
3. Immunology – Dubey (2004).
4. Immunology, 5th Edition, Joshi, K.R. (2007).
5. Immunology, I. Kannan, MJP Publishers (2006).
6. Immunology and Serology, Dr. K.R. Joshi and Dr. N.O. Osamo (2008).
7. Immunobiology, M.S. Aslam (2005).

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	14P1BTEL1B	Major Elective – 1 ENTREPRENEURIAL SKILL DEVELOPMENT	6	4

Objectives:

1. To know Entrepreneurship, Entrepreneurial management and functions.
2. To study the processes, tools and best practices in developing new products.
3. To study about the role of entrepreneurial ventures in the national economy.
4. To understand the entrepreneurial finance.
5. To understand the concept and meaning of science and technology.

UNIT I **18 Hrs.**
ENTREPRENEURSHIP, ENTREPRENEURIAL MANAGEMENT AND FUNCTIONS

Definition-Entrepreneurship and entrepreneur; creativity, innovation and Entrepreneurship; credentials, competencies and traits of an entrepreneur; factors affecting Entrepreneurship development.

UNIT II NEW PRODUCT DEVELOPMENT **18 Hrs.**

Ideation techniques; Concept development; Processes, tools, and best practices used in developing new products; Product positioning Analyzing consumer preferences; Product and market testing; Product launch; Pretest market forecasting; New product commercialization; reasons for new product failure; barriers to new product adoption; Intellectual property protection in new product development efforts.

UNIT III VENTURE CREATION **18 Hrs.**

Role of entrepreneurial ventures in the national economy; Evaluating and creating a new venture; evaluation of business opportunities - as an entrepreneur and an investor; processes involved in starting a new venture; processes involved in funding and investing in a new and growing entrepreneurial venture.

UNIT IV ENTREPRENEURIAL FINANCE **18 Hrs.**

Process of financial forecasting for a new venture, effective financial management of an emerging business, sources of financing, bootstrapping and exit planning; angel investors and venture capital; Govt grants and loans.

UNIT V SCIENCE AND TECHNOLOGY MANAGEMENT **18 Hrs.**

Science and Technology management: Concept and meaning of Science & technology; Evolution and growth of Science & technology, role and significance of management of Science & technology, Impact of S&T on society and business; Product development – from scientific breakthrough to marketable product – Role of Government in Science & Technology Development; Linkage between Science, Technology, Development and competition; Managing research and Managing Intellectual Property.

TEXT BOOKS

- 1.Principles of management –Peter Druker (1979)
- 2.Managing Technology and Innovation for Competitive Advantage - V K Narayanan - Pearson Education Asia

REFERENCE BOOKS:

- 1.Bringing New technology To Market - Kathleen R Allen - Prentice Hall India
- 2.<http://www.techno-preneur.net/>-The Technology Innovation Management and Entrepreneurship Information Service
3. <http://dst.gov.in/scientific-programme/t-d-tdb.htm>
4. <http://www.dsir.nic.in/tpdup/tepp/tepp.htm> - The Technopreneur Promotion Programme.

M.Sc. Biotechnology

Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
I	14P1BTEL1C	Major Elective - I Molecular Modeling And Drug Designing	6	4

Objectives:

1. To study the concept of molecular modeling and Molecular mechanics.
2. To study the Molecular dynamics simulation methods.
3. Recent advances in drug design methodologies.
4. To study the Software tools for modeling bio-molecules.
5. To study the Molecular docking.

Unit I

Hrs 18

Introduction to the concept of molecular modeling, molecular structure and internal energy, applications of molecular graphics, coordinate systems, potential energy surfaces, local and global energy minima. Molecular mechanics: general features of molecular mechanics-force field, bond stretching, angle bending, torsional terms, non-bonded interactions; force field parametrisation and transferability; energy minimization: derivative and non-derivative methods, applications of energy minimization.

Unit II

Hrs 18

Molecular dynamics simulation methods: molecular dynamics using simple models, molecular dynamics with continuous potential-setting up and running a molecular dynamic simulation, constraint dynamics; Monte Carlo simulation of molecules. Simulation for conformational analysis. Ab initio, dft and semi empirical methods.

Unit III

Hrs 18

Recent advances in drug design methodologies-Biomolecular structure, Structure activity relationship, Pharmacokinetics, Pharmacophoric pattern, ADME Properties, quantitative structure activity relationship, Use of genetic algorithms and principle component analysis in the QSAR equations.

Unit IV

Hrs 18

Macromolecular modeling-Software tools for modeling bio-molecules. Molecular electrostatic potentials, charge analyses. Protein conformations, folding and mutation through modeling-design of ligands for known macro molecular target sites. Drug-receptor interaction, classical SAR/QSAR studies and their implications to the 3-D modeler, 2-D and 3-D database searching, pharmacophore identification and novel drug design.

Unit V

Hrs 18

Molecular docking: Docking-Rigid and Flexible Structure-based drug design for all classes of targets- Theories of enzyme inhibition-Enzyme Inhibition strategies.- Enzyme inhibition as a tool for drug development-Examples. Finding new drug targets to treat disease- strategies for target identification and lead design-Use of Genomics and Proteomics for understanding diseases at molecular level- new targets for anti-cancer drugs, Drugs that rescue mutant p53's.

References:

1. Andrew Leach. 1996. Molecular Modelling: Principles and Applications (2nd Edition), Addison Wesley Longman, Essex, England.
2. Alan Hinchliffe. 2003. Molecular Modelling for Beginners, John-Wiley and Sons New York.
3. Cohen, N. (Ed.).1996. Guide Book on Molecular Modeling in Drug Design, Academic Press, San Diego.
4. Frenkel, D. and B. Smit. 1996. Understanding Molecular Simulations. From Algorithms to Applications. Academic Press, San Diego, California.
5. Rauter, C. and K. Horn. 1984. X-ray crystallography and drug design, Elsevier.
6. Kalos, M. and P. A. Whitlock. 1986. Monte Carlo Methods. John Wiley & Sons, New York,
7. McCammon, J.A. and S.C. Harvey. 1987. Dynamics of Proteins and Nucleic Acids. Cambridge University Press, Cambridge.
8. Rapaport, D.C. 2004. The Art of Molecular Dynamics Simulation. Cambridge University Press, Cambridge, England.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	14P2BTC4	MOLECULAR GENETICS	6	5

Objectives:

1. To study the mutation, mutagenesis and genetics of microbes.
2. To study the DNA Replication, Transcription, Translation and Oncogenes.
3. To study the Anti-sense molecules and Ribozyme Technology.

Unit I

Hrs 18

Introduction to Molecular Biology – Structure and function of DNA, RNA - Mutation and Mutagenesis – Chemical and UV – mutagenesis, types of mutation, Ames test for mutagenesis, methods of genetic analysis, Bacterial genetic system – Transformation, Conjugation, Transduction, Recombination, Plasmids and Transposons.

Unit II

Hrs18

DNA – replication – Prokaryotic and Eukaryotic DNA replication, Mechanisms of DNA replication, Enzymes and accessory proteins involved in DNA replication. DNA repair and Recombination, Homologous recombination – Holiday junction, gene targeting. DNA damage by UV alkylating agents, cross links, mechanism of repair – photo reactivation, excision repair, recombinational repair.

Unit III

Hrs18

Transcription – Prokaryotic and Eukaryotic transcription RNA polymerase, general and specific transcription factors, regulatory elements and mechanisms of transcription regulation, transcriptional and post transcriptional gene silencing modifications in RNA 5' cap formation, transcription, termination 3' end processing and poly – adenylation, splicing, editing, Nuclear export of mRNA stability.

Unit IV

Hrs 18

Translation – Prokaryotic and Eukaryotic translation, mechanism, initiation, elongation and Termination regulation of translation. Post translational modifications of proteins – protein localization – synthesis of secretory and membrane proteins import in to nucleus, mitochondria, chloroplast and peroxisomes receptor mediated endocytosis.

Unit V

Hrs 18

Anti-sense and ribosome technology – molecular mechanism of antisense molecules inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping biochemistry of Ribozyme. Hammer head, hairpin – and other Ribozymes, strategies for designing ribozymes, application of ribozymes and anti-sense technologies. Molecular mapping of genome – Genetic and physical maps, physical mapping and map based cloning.

Reference:

1. The Cell and Molecular Biology, Purohit, S.S. (2008).
2. The Gene, Purohit, S.S. (2006).
3. Molecular Biology, P.D. Sharma (2007).
4. Cell and Molecular Biology, Gerald Karp (2004).
5. Gene, Benjamin Lewin (2007).

M.Sc. Biotechnology

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	14P2BTC5	ANIMAL AND PLANT BIOTECHNOLOGY	6	5

Objectives:

1. To understand the Animal and Plant Biotechnology.
2. To study the plant cell & culture aspects.
3. To study the micro propagation of protoplast & culture.
4. To study the mass culture and other Animal cell culture Techniques.

Unit I

Hrs 18

History of plant cell, tissue and organ culture – laboratory organization – aseptic techniques – nutritional requirements and culture media– Types of cultures – solid –liquid – stationary – agitated – batch cultures – Organogenesis– Callus induction – Caulogenesis – Rhizogenesis – techniques of hairy root production.

Unit II

Hrs18

Micropropagation – mass production of plantlets – hardening and mist chambers – somatic embryogenesis – embryo rescue – protoplast culture – exploitation of somaclonal.

Unit III

Hrs18

Mass culture of Cells – manipulation of cell line selection – immobilization of cells and its application – synchronization – Induction of cell line mutants and mutations – cryopreservation – germplasm conservation and establishment of gene banks – Synseed technology.

Unit IV

Hrs 18

Principle of Cell and Tissue Culture; Advantage and Disadvantages of tissue culture methods – cell markers – types of cells – primary and established cell lines – Kinetics of cell growth – genetics of cultured cells – metabolism – applications of Animal Tissue Cultures.

Unit V

Hrs 18

Techniques of cell and Tissue Culture: Sources of cells– techniques of cell culture: Mechanical, biochemical and types of animals cells–equipment– cell culture media– culture procedures–preparation of animal materials–primary culture, cells lines and cloning somatic cell fusion–tissue cultures: Slide and coverslip cultures, washing and feeding, double cover Slip cultures, test tube culture– organ culture – whole embryo culture – specialized culture techniques–cell synchronization–measurement of cell death– stemcell culture and transplantation.

Reference:

1. Kalyan Kumar De, 1992, Plant Tissue Culture, New Central Book Agency, Calcutta.
2. Robert, N. Trigiano, Dennis J. Gray, 1996, Plant tissue Culture Concept and Laboratory Excurses. CRC Press, London.
3. P.S. Srivasta, 1998, Plant Tissue Culture an Molecular Biology, Narosa Publishing Houses, New Delhi.
4. David W. Galbraith, Hand J. Bohnert an Don P.Bourque, 1995, Methods in Plant Cell Biology, Acadmic Press, New York.
5. John H. Dods and Lorrin W. Roberts, 1995, Experiments in Plant Tissue Culture, Cambridge University Press, USA.
6. D.C. Daring and S.J. Morgan, 1994, Animal Cells, Culture and Media, BIOS Scientific Publishers Limited.
7. Jennie P. Mathur and David Barnes, 1998, Methods in Cell Biology, Volume 57 : Animal cell Culture Methods Academic Press.
8. Plant Tissue Culture, S.S. Purohit (2005).
9. Animal Biotechnology, M.M. Ranga (2005).
10. Animal Cell and Tissue Culture, Mathur, Shivangi (2009).

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	14P2BTC6	ENZYME BIOTECHNOLOGY	6	5

Objectives:

1. To study the enzymes and their properties.
2. To study the uses and applications of enzymes.

Unit I

Hrs 18

Enzymes – classification, nomenclature & general properties, factors affecting enzyme action, pH, temperature, ions, substrate concentration, inhibitors, Extraction, assay and purification of enzymes units of activity and kinetics of enzyme catalysed reactions – the transition state.

Unit II

Hrs18

Steady state kinetics – bi-substrate and multi substrate reaction – enzyme catalysed reaction – different types of inhibitors and activators – Michaelis menton, Lineweaver and Burke equations, k_m , k_{cat} and KI value enzyme specificity – absolute and rigid specificity, Nucleophilic & electrophilic attack.

Unit III

Hrs18

Role of co-enzyme in enzyme catalysis: Co-enzyme regeneration, mechanism of enzyme action eg. lysozyme, chymotrypsin, DNA polymerase, ribonuclease & LDH, zymogen & enzyme activation, allosteric enzymes & metabolic regulations. Clinical & industrial uses of enzymes.

Unit IV

Hrs 18

Techniques of enzyme immobilization & their application – medical, food, leather, textile and paper industries. A brief account of modification of enzymes (enzyme engineering) and its products through DNA technology. Biosensors, mechanism of light activation of enzymes.

Unit V

Hrs 18

Industrial utilization of enzymes, practical aspects of large – scale protein purification, use of soluble enzymes, enzyme reactors, membrane reactors, large scale application of microbial enzymes in food and allied industries. Medical application of enzymes in reverse glycosidase synthetic reaction. Interesterification of lipids, Enzyme therapy.

Reference:

1. Enzyme Technology, Parihar, Pradeep (2009).
 2. Cell and Molecular Biology, Gerald Karp, 4th Edition (2004).
 3. The Cell a Molecular Approach, Cooper (2004).
 4. Modern Experimental Biochemistry, Boyer (2004).
 5. Biochemistry, U.Satyanarayana (2004).
 6. Biochemistry, Harper, 25th edition (2002).
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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	14P2BTC7	INDUSTRIAL BIOTECHNOLOGY	6	5

Objectives:

1. To know the Biology of Industrially important organisms.
2. To know the commercial production of Humilin, Ethanol, citric acid etc.
3. To know the Enzyme Technology and other microbial products.

Unit I

Hrs 18

Isolation, preservation and maintenance of industrial microorganisms. Inoculum development – Development of inocula for yeast, bacteria and mycelium. Aseptic inoculation of the fermenter – sterilization techniques.

Unit II

Hrs 18

Fermentation technology:

Bioreactors – types – designs, Airlift, stirred tank bioreactor. Specialised bioreactor (Pulsed, Fluidized, Photobioreactor), Fermentation: Batch, Fed batch and continuous – solid state – submerged.

Unit III

Hrs 18

Industrial production of organic acids - citric acid, lactic acid, Acetic acid. organic solvents – glycerol, Antibiotics – Pencillium, streptomycin, Chloroamphenicol. Amino acids – glutamic acid, lysine, isoleucine, Aspartic acid and proline. Production of SCP. Biomining and oil recovery.

Unit IV

Hrs 18

Downstream Processing – Biomass removal and disruption. Removal of microbial cells: and solid matter, centrifugation, sedimentation, Flocculation, microfiltration, sonication, Bead mills, Homogenizer, Chemical lysis, enzymatic lysis. Membrane based Purification – Ultrafiltration; Reverse osmosis, dialysis Pervaporation, Perstraction, absorption and chromatography. Precipitation, Biological affinity. Electrophoresis. Extraction (solvent aqueous two phase, super critical) Drying and crystallization.

Unit V

Hrs 18

Fuel Biotechnology – Bioethanol, biobutanol, biodiesel. Production of biogas – methane, biohydrogen. Commercialization of microbial products: Objectives, market potential, Economics of microbial products (cost of equipments, raw materials, labour recovery, packaging and marketing).

Reference:

1. Bacterial physiology and metabolism by Sala Tch. R., Academic Press, New York.
2. Comprehensive Bio-Technology V.M. moo-young, Pergamm press, oxford.
3. Environmental chemistry – A-K-De. Wiley Eastern Ltd. New Delhi.
4. Waste water Engineering, treatment, disposal and reuse – Metcal and Eddy. The Tata Mc-Graw Hill, New Delhi.
5. Industrial Microbiology, Prescott, S.C. (2009).
6. Industrial Microbiology: Fundamentals and Applications, Agarwal, A.K.
7. Fermentation Technology, Purohit, S.S. (2008).
8. Dairy Microbiology, Parihar, P. (2008).

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	14P2BTCP2	Core – Practical – II – Molecular genetics, Animal and plant Biotechnology, Enzyme Biotechnology & Industrial Biotechnology	6	3

Objectives:

1. To study the Isolation of DNA, Electrophoresis and GUS Assay.
2. To study the Tissue Culture methods.

Molecular Genetics

1. Plasmid extraction: Alkaline lysis, Mini preparation.
2. Chromosomal DNA isolation (Animal tissue, plants, bacteria and fungi)
3. Quantification of DNA & RNA
4. Electrophoresis of DNA & RNA
5. Bacterial transformation
6. Isolation of drug resistant autotrophic mutants.
7. Study of mutation by Ames test.

Tissue Culture

1. Preparation of Tissue Culture medium for plant and animals.
2. Micro propagation of shoot tip & seed culture.
3. Preparation of single cell suspension from spleen and thymus.
4. Cell counting and cell viability
5. Macrophage monolayer from PBMC and measurement of Phagocyte activity
6. Macrophage monolayer and subculturing
7. Cryopreservation and Thawing
8. Measurement of doubling time
9. Isolation of DNA and demonstration of apoptosis of DNA laddering.
10. MTT assay for cell viability and growth
11. Cell fusion with PEG.

Enzyme Biotechnology

1. ELISA
2. Immobilization of enzymes.
3. Effect of pH & temperature on enzyme activity.

Industrial Biotechnology

1. Production of ethanol and Acetic acid.
2. Production and Estimation of Alkaline phosphatase.

Reference:

1. Genetic Transformation of plants (Molecular Methods of Plant Analysis 2003 Publisher : Springer)
 2. Plant Tissue Culture by S.S. Purohit, 2004, Mrs. Saraswati Purohit for Student edition.
 3. Animal Cell Culture – Practical approach, Ed. Martin Clynes, Springer.
 4. Animal Cell Culture Techniques. Ed. Martin Clyines, Springer.
 5. Culture of Animal Cells, 3rd End, R.Ian Freshney, Wiley Liss.
 6. Animal Cell Culture – Practical Approach, Ed. John R.W. Masters, Oxford.
 7. Animal Cells : Culture and Media : Essential Data (Essential Data Series) by D.C. Darling, S.J. Morgan, 195, John Wiley and Sons Ltd.
 8. Principles of Tissue Engineering by : Rover P. Lanza, Robert Langer, Joseph P. Vacanti, 2000 Academic Press.
 9. Handbook of Industrial Cell Culture : Mammalian, Microbial, and Plant Cells 2002.
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Semester	Subject Code	Title of the Paper	Hours of Teaching /Week	No. of Credits
II	14P2BTEL2A	Major Elective – II BIOINSTRUMENTATION AND BIOMETRY	6	4

Objectives:

1. To enrich the knowledge of students on Bio-instrumentation.
2. To enhance the knowledge on Biometry.
3. To know about chromatography, PCR, ELISA and Electrophoresis.

Unit I

Hrs18

Microscope – Types of microscope, Light, phase contrast, Fluorescent, Bright field, Dark field, Electron microscope TEM and SEM – Principles and applications – Histological preparation of tissues for SEM and TEM.

Unit II

Hrs18

pH meter – Principles, applications. Centrifuge: Types of centrifuge – Ultra centrifuge and cooling centrifuge, Spectrophotometer. Colorimeter, U-V and Atomic Colorimeter, principles and applications.

Unit III

Hrs18

Chromatography – Principles, types and applications G.M. Counter, Scintillation counter – Principle and their application. NMR principles and applications.

Unit IV

Hrs 18

PCR – Principles types and applications – Gel documentation – Immunological Techniques – Immuno electrophoresis – ELISA.

Unit V

Hrs18

Micrometry – Principles and applications – Measures of central tendency, measures of dispersion – correlation and regression.

Reference:

1. Step Guide to Photography, Ebury, Press – London.
 2. Practical methods in Electron Microscopy – Glamet (2000). Vol.3 North Holl and Publishing Co.
 3. Hand book of Immunodiffusion and Immuno Electrophoresis, Ann-Arbor Science Publishers – Michigan.
 4. Principles of Biochemistry, Lehninger (2006).
 5. Basic Biophysics of Biologist, Daniel (2007).
 6. Biostatistics and Biometry, Parihar, P. (2009).
 7. Biochemistry: Fundamental and Application, Purohit, S.S. (2009).
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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	14P2BTEL2B	Major Elective – II Bio-Informatics, Intellectual Property Rights and Nanotechnology	6	4

Objectives:

1. To know the ultra structure of Prokaryotic and Eukaryotic cellular organisms.
2. With the help of instruments, to know the basic principles of protein.
3. To know the internet and E-mail.
4. General aspects of patenting.
5. To know about Nanotechnology.

Unit I

Hrs18

Cell structure, Ultra structure of Prokaryotes and Eukaryotes Cellular Organisms.

Reference:

1. Biotechnology Fundamentals and Application – S.S.Purohit, Agrobios, India.

Unit II

Hrs18

Protein confirmation – Predication of Protein structure – fold recognition, comparative modelling (homology), Basic principles of X – ray diffraction studies, NMR, Mass spectroscope in identifying protein confirmation.

Reference:

1. Sequence Analysis primer by M Gribskov, J. Devercux (1989) Stockton Press.
2. Nucleic acid and protein sequence analysis, A practical approach by MJ Bishop and C.J. Ramslings (1987) IRL Press.
3. Information theory and living system by L.I. Garfield, (1992), Columbia University Press.

Unit III

Hrs18

Basic concepts of Bioinformatics, sequence Databases, sequence formats – Gene basic -Networking – Network access, Internet, E – mail servers – use of databases biology, Sequence databases, Sequence Analysis – Protein and Nucleic acids, Structural comparisons.

Reference:

1. Molecular databases for protein and structure studies by Sillince, J.A. and Sillince M (1991) Springer Verlag.

Unit IV

Hrs18

A general account of patenting, Artificial intelligence, Biosafety and Bioethics.

Reference:

1. Information of Biostatitics by Sokal and Rhld (1973) Toppan Company, Japan.

Unit V

Hrs18

Nanobiotechnology – Basic principles and scope of Nanotechnology – Structural and Brownian assembly – Important characteristics – Molecular manufacturing – Decisive military capabilities – Molecular mills – in the fields of agriculture, Medicine, future perspectives of Nanotechnology in Life Sciences -Applications of Nanotechnology.

Reference:

1. Glossary of Biotechnology and Nanobiotechnology – Narendhra Publications.
2. Nanotechnology – A gentle introduction to the next big idea, Ratner – Tamil Nadu Book House.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	14P2BTEL2C	Major Elective – II Occupational health and industrial safety	6	4

Objectives:

To impart knowledge on various occupational health hazards and also safety measures to be taken in the work place.

Unit I

Hrs 18

Parameters of safety - Factors affecting the conditions of occupational and Industrial safety - Concept of safety organization and Management - Safety Regulations. Definition and Role of Ergonomics in Designing Work-Place

Unit II

Hrs18

Work Environment - Effects of Light, Ventilation, Vibration, Noise etc - The Work Physiology and their Relevance to Safety - Performance Evaluation of Man - Environment systems.

Unit III

Hrs18

Occupational Health and Safety – Occupational Health and Hazards – Physical, Chemical and Biological hazards. Occupational Diseases and their Prevention and Control. Health Protection Measures for Workers. Principles of Arthropod Control

Unit IV

Hrs 18

Health Education Medical First-Aid and Management of Medical Emergencies Industrial Safety management Techniques - Industrial Safety Standards. Accidents-Definition, Frequency Rate, Prevention and Control. Work Study - Method of Study and Measurement. Measurement of Skills. Safety - Cost of Expenses

Unit V

Hrs 18

Principles of Functions in Safety Management Case Study - Visit to an Industry - Preparation of report on safety measures followed in Airport/Industry.

Reference:

1. Environmental Strategies–Hand Book, Kolluru R. V, (1994) Mc Graw Hill Inc., New York.
2. A B C of Industrial Safety, Walsh, W and Russell, L, (1984) Pitma Publishing United Kingdom (1984)
3. Environmental and Industrial Safety, (1989) Hommadi, A. H (1989). I.B.B Publication, New Delhi (1989)

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	14P3BTC8	BIO-PROCESS TECHNOLOGY	6	5

Objectives:

1. To study the Bioprocess engineering.
2. To study the microbial strain involved in Bioprocess.
3. To study the food processing.

Unit I

Hrs18

Introduction and scope of Bioprocess engineering. Microbial growth kinetics, Biomass production. Thermodynamics – energy balance in microbial – metabolic heat generation. Advantages of Bioprocess over chemical process.

Unit II

Hrs18

Microbial strain improvement, increased yield. Upstream processing – Effect of pH, Temperature, Media formulation, carbon source, Nitrogen, vitamin, minerals, inducers, precursors, inhibitors and growth factors.

Unit III

Hrs18

Enzymes – Production and Purification : Amylase, Pectinase and Cellulase.
Protein engineering and its Applications.

Unit IV

Hrs18

Fermentation products: Bread, Cheese, fermented milk products.
Beverages: Beer, Wine. Fermented vegetables.

Unit V

Hrs18

Food processing technology – canning, packing, sterilization, pasteurization, food spoilage, food preservation – modern methods of preservation of Milk, Fruit, Food product, meat and other animal products.

Reference:

1. Bioprocess Technology: Fundamentals and Applications, KTH, Stockholm.
2. Jackson, A.T., Process Engineering in Biotechnology, Prentice Hall, Angelwood Cliffs.
3. Shuler, M.L. and Kargi, F., Bioprocess Engineering: Basic Concepts, Prentice Hall, Engelwood Cliffs.
4. Stanbury, P.F. and A. Whitaker, 1995, Principles of Fermentation Technology, Pergamon Press, Oxford
5. Wulf Crueger and Anneliese Crueger, 2000, A Text Book of Industrial Microbiology, Panima Publishing Corporation, New Delhi.
6. Pharmaceutical Biotechnology, Purohit, S.S. (2009).
7. Pharmaceutical Microbiology, Purohit, S.S. (2008).

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	14P3BTC9	CLINICAL BIOCHEMISTRY	6	5

Objectives:

1. To study the lab setup and safety measures
2. To learn about the metabolic disorders
3. To study about the disorders of kidney and liver
4. To know about drug design and their types

UNIT I: LABORATORY SETUP AND SAFETY

Hrs 18

Requirements of setting up of clinical laboratory, SI units in clinical laboratory, Collection preparation, preservation, and handling of clinical samples, quality control, Safety measures in clinical laboratory. Formulation of clinical and diagnostic kits, Safety aspects

UNIT II: METABOLIC DISORDERS

Hrs 18

Disorders of Carbohydrate Metabolism – Diabetes mellitus, glucose and galactose tolerance tests, sugar levels in blood, renal threshold for glucose, factors influencing blood glucose level, glycogen storage diseases, pentosuria, galactosemia.

Disorders of Lipid metabolism – Plasma lipoproteins, cholesterol, triglycerides & phospholipids in health and diseases - hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, ketone bodies, Abetalipoproteinemia.

UNIT III

Hrs 18

NEUROLOGICAL AND PSYCHIATRIC DISORDERS: Schizophrenia – types, symptoms, antipsychotic drugs - Affective disorders - Unipolar and bipolar disorders, antidepressants, Alzheimer's disease, Wernicke-Korsakoff syndrome, dementia, Wilson's disease

Ageing- Physiological and biochemical changes in ageing. Different theories of ageing, importance of superoxide dismutase in ageing, plasticity and regeneration

UNIT IV

Hrs 18

Disorders of liver and kidney– Jaundice, fatty liver, normal and abnormal functions of liver and kidney. Inulin and urea clearance. Digestive diseases–Maldigestion, malabsorption, creatorrhoea, diarrhoea and steatorrhoea- Electrolytes and acid-base balance – Regulation of electrolyte content of body fluids and maintenance of pH. Disorders of acid-base balance and their respiratory and renal mechanisms

UNIT V

Hrs 18

Inborn errors of Metabolism- Disorders of amino acid metabolism – Phenylalanemia, homocystinuria, tyrosinemia; Disorders of nucleic acid metabolism- Disorders in purine/pyrimidine metabolism

Hormonal imbalances: Protein hormones, steroid hormones, adrenocorticosteroids

Reference:

1. Burger, A., Med. Chem.
2. Wilson and Gisvold, Organic Med. Pharmaceutical Chem.
3. Ariens, Drug Design, Academic press, NY,1975.

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	14P3BTC10	RECOMBINANT DNA TECHNOLOGY	6	5

Objectives:

1. To study about the techniques in gene manipulation.
2. To study the cloning strategies, DNA Amplification.
3. To study the PCR and other Techniques.

Unit I

Hrs 18

Techniques in gene manipulation, cutting and joining of DNA, introduction of DNA into cell.

Unit II

Hrs 18

Cloning strategies, construction of genomic libraries and DNA libraries, probe construction recombinant selection and screening, molecular cloning.

Unit III

Hrs 18

Analysis expression. Analysis of recombinant DNA, sequencing, autogenesis, altered expression and engineering genes, site directed mutagenesis.

Unit IV

Hrs 18

DNA amplification using polymerase chain reaction (PCR). Key concepts. Analysis of amplified products. Applications of PCR: Ligase chain reaction: RFLP, RAPD, DNA finger printing.

Unit V

Hrs 18

Expression systems and their application. E.coli, Bacillus, streptomyces, yeast, Baculovirus and animal cells as cloning hosts, yeast shuttle vectors cosmids, production of antibodies and vaccines.

Reference:

1. Molecular cloning "a Laboratory manual Vol. – III by Sambrook et al., (1989) Cold spring Harbor Laboratory.
 2. PCR Protocols by John M.S. Barlett, David Sterling 2003, Humana press Inc.
 3. RNA Methodologies, 2nd Edn, by Robert E. Farrell Jr. 1996, Academic Press, Inc.
 4. Short Protocols in Molecular Biology Vol I & II, 5th Edn. By Frederick M.Ausubel. Roger Breut, 2002, John Wiley & Sons, Inc.,
 5. Genetic Engineering and its applications, Joshi, P. (2007).
 6. Recombinant DNA Technology and Biotechnology – Guide for Student, Kruzer (2003).
 7. Cell and Molecular Biology, 4th Edition, Gerald Karp (2004).
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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	14P3BTC11	GENOMICS & PROTEOMICS	6	5

Objectives:

1. To learn the Genome mapping, assembly and comparison
2. To understand, Sequence based approaches and Microarray based approaches
3. A thorough study on Proteomics
4. To understand, Protein-protein interactions and Applications of proteomics.

UNIT- I

Hrs 18

Genome mapping, assembly and comparison.

Genome Structure: Genome sizes- microbial and organelle genomes - Centromeres and telomeres, tandem repeats- dispersed repeats (transposons). Genome mapping, Genome sequencing, Genome sequence assembly: Base calling and assembly programs, Genome annotation: Gene ontology, Automated genome annotation, Annotation of hypothetical proteins and Genome economy. Comparative genomics: Whole genome alignment, Finding a minimal genome, Lateral gene transfer, Within-genome approach and Gene order comparison.

UNIT -II

Hrs 18

Functional Genomics.

Sequence based approaches: EST, EST index construction and SAGE. Microarray based approaches: Oligonucleotide design, Data collection, Image processing, Data transformation and normalization, Statistical analysis to identify differentially expressed genes and Microarray data classification. Comparison of SAGE and DNA Microarrays.

UNIT - III

Hrs 18

Proteomics

Technology of protein expression analysis: 2D-PAGE, Mass spectrometry protein identification, protein identification through database searching, Differential in-gel electrophoresis and Protein Microarrays. Post translational modification: Prediction of disulphide bridges and Identification of posttranslational modifications in proteomics analysis. Protein sorting

UNIT- IV

Hrs 18

Protein-protein interactions.

Experimental determination of protein-protein interaction, Prediction of protein-protein interactions: prediction interactions based on domain fusion, predicting interactions based on gene neighbors, predicting interactions based on sequence homology, predicting interactions based on phylogenetic information and prediction interactions using hybrid methods

Unit V

Hrs 18

Applications of proteomics.

Medical proteomics-disease diagnosis: Biomarkers, Biomarker discovery using 2DGE and mass spectrometry and Biomarker discovery and pattern profiling using protein chips. Pharmaceutical proteomics-drug development: The role of proteomics in target identification, Proteomics and target validation, Proteomics in the development of lead compounds and Proteomics and clinical development. Proteomics and Plant

biotechnology: Proteomics in plant breeding and genetics, Proteomics for the analysis of genetically modified plants and Proteomics and the analysis of secondary metabolism.

References:

1. Necia Grant Cooper; (Ed.) 1994. The Human Genome Project; Deciphering the blueprint of heredity University Science books, CA, USA.
2. Gary zweiger, 2003. Transducing the Genome; Information, Anarchy and Revolution in Biomedical Sciences.. Tata McGraw-Hill Publishers, New Delhi.
3. Howard L McLeod¹ and William E Evans. 2001. PHARMACOGENOMICS: Unlocking the Human Genome for Better Drug Therapy. Annu. Rev. Pharmacol. Toxicol. 41:101–121.
4. Evans W.E. and Relling, M.V. 1999. Pharmacogenomics: translating functional genomics into rational therapeutics. Science 286:487
5. Satoskar, R.S., Bhandarkar, S.D and Annapure, S.S. 1999. Pharmacology and Pharmacotherapeutics, Popular Prakashan, Mumbai.
6. Branden, C and J.Troze, 1999. Introduction to Protein Structure. Second Edition. Garland Publishing, New Delhi.
7. Baxevanis, A.D and Ouellette, B.F.F. Eds. 2001. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Wiley Interscience. New York.
8. Higgins, D and Taylor, W (Eds). 2000. Bioinformatics: Sequence, Structure and Databnks. Oxford University Press, Oxford.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	14P3BTCP3	Core – Practical – III – Bio-Process Technology, Recombinant DNA Technology and Clinical Chemistry & Drug Design	6	4

Objectives:

1. To know the r-DNA Technology.
2. To know the Bioprocess Technology.
3. To know the Biodiversity.

Bio-Process Technology

1. Isolation of industrially important microorganisms (Amylase, Pectinase, Cellulase) for microbial process.
2. Study of optimal culture conditions for the production of Amylase, Pectinase and cellulose in a bioreactor.
3. Production of amylase, cellulase, pectinase, wine and beer in a bioreactor.
4. Determination of thermal death point and thermal death time of microorganisms for design of a sterilizer.
5. Microbial production of citric acid using *Aspergillus niger*.
6. Microbial production of Penicillin, (Biosynthesis of Antibiotics).
7. Production and Estimation of Alkaline Phosphatase.
8. Identification of micro organisms in preserved food product (Milk, Fruit juice, animal meet).

Recombinant DNA Technology

1. Restriction analysis of plasmid (PBR322, PUC)
2. Selection methods (Blue white screening, Insertional inactivation).
3. Primer design and PCR amplification of Beta galactosidase.
4. Cloning of PCR product into PBR.
5. Introduction of cloned genes and analysis by SDS – PAGE.
6. SOUTHERN BLOTTING of Beta galactosidase.
7. Reporter gene assay (GUS/beta galactosidase).
8. Isolation of phage DNA.
9. RFLP analysis of 18s r-DNA of genome.
10. Genetic diversity of Pseudomonas by RAPD.

Clinical chemistry

1. Estimation of Haemoglobin in blood samples

2. Estimation of Bile pigments
3. Estimation of Creatinine
4. Estimation of triglycerides, steroids

References

1. Short Protocols in Protein Science – A Compendium Methods from Current Protocols in Protein Science by John E. Coligan, Ben M. Dunn, 2003, John Wiley and Sons Ltd.
 2. Enzymes, Biochemistry, Biotechnology, Clinical Chemistry, Trevor Palmer, Horwood Publishing, Chichester, 2001.
 3. Analytical Biochemistry by David J. Holme and Hazel Peck, 3rd ed., 1998, Pearson Education Ltd., England.
 4. Principles and Practice of Bioanalysis by Richard F. Venn, 2003. Taylor and Francis, London.
 5. Biochemical Methods by A. Pingoud, C. Urbanke, J. Hoggett, 2002. Weiley-Velt Verlag Garbh.
 6. Molecular Cloning, A Laboratory Manual, Vol.I-III by Sambrook et al. (1989), Cold Spring Harbor Laboratory.
 7. Genetic Analysis of Bacteria by Stanley R. Maloy, Valley J. Stewart, 1996, Cold Spring Harbor Laboratory Press.
 8. PCR Protocols by John M.S. Barlett, David Stirling, 2003, Humana Press Inc.
 9. RNA Methodologies, 2nd Edn. by Robert E. Farrel Jr. 1996, Academic Press Inc.
 10. Short Protocols in Molecular Biology, Vol.I & II, 5th Edn., by Frederick M. Ausubel, Roger Breuyt, 2002, John Wiley & Sons, Inc.
 11. PCR Strategies by Mixchael, A. Immis, David, II. Gelfand, 1995, Academic Press, Inc.
 12. Bio-chemical method by A.PINGOUD, C. URBANKE, J.HOGGETT, 2002 – Weily – Valt Verlag Garbh.
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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	14P4BTC12	RESEARCH METHODOLOGY	8	5

Objectives:

1. The course aims to train students in the statistical analysis and presentation of the data.
2. To write the report/thesis/dissertation and or for publications in appropriate research journals,
3. The aim of the paper thus is to lay a strong foundation for the student for thesis writing, editing, analysis and interpretation of the generated data with hands on experience with model sums.

Unit I

Hrs 12

Collection of data- diagrammatic representation :Bar, Pie diagrams; graphic representation- Histogram, frequency polygon; Measures of central tendency: Arithmetic mean, median & mode(direct methods and model sums) Measures of dispersion : Universe and population-delimiting population-sampling methods: random sampling, stratified random sampling-standard deviation-standard error-coefficient of variation: elucidation with model sums.

Unit II

Hrs 12

Bivariate relationship: Types of Correlation and Karl Pearson's correlation coefficient: model sums with elucidation - Regression analysis: Components of regression equation - Confidence intervals of regression line. Fitting simple regression lines: model sums, calculations of equation and fitting of regression line, estimated and calculated Y. Comparison between correlation and regression.

Unit III

Hrs 12

Probability- Theorems: Addition and Multiplication-Patterns of distributions: Poisson, Normal and Binomial; Test of significance - Comparison of means: Chi square test, student t test, ANOVA, model sums on one way ANOVA with interpretation of data - Introduction to MANIVA AND STASTICA - Use of statistical softwares.

Unit IV

Hrs 12

Research: Selection of problem-stages in the execution of research: choosing a topic to publication - preparation of manuscript-report writing-format of journals-proof reading- sources of information: journals, reviews, books, monographs etc-How to write thesis and their standard format-standard organization of bibliography. Planning of research: Research proposals, time scheduling of research, available sources and generation of funds and facilities.

Unit V

Hrs12

Journals: Standard of research journals - paid and refereed journals - impact factor-citation index-choice of journals for publication. Information retrieval: access to archives and databases, search engines: Google, Pubmed, NCBI, etc.,National Informatic Center-Online data base library.

Reference:

1. Davis, G.B. and C.A. Parkar 1997, Writing the doctoral dissertation. Barons Educational series, 2nd edition. Pp 160. ISBN : 0812098005.
2. Duncary, P. 2003. Authoring a Ph.D. thesis: how to plan, draft, write and finish a doctoral dissertation. Plagrave Macmillan, Pp 256. ISBN 1403905843.
3. Saxena, S. 2001, MS office, Vikas Publishing House Pvt. Ltd. New Delhi 110014.
4. Snedecor, G.W. and W.G. Cocharn, 1978. Statistical methods. Oxford and IBH Publishing Co Pvt. Ltd.
5. Sokal, R.R. and F.J. Rohif, 1981. Biometry. W.H. Frecman, New York.
6. Zar.J.H.1996. Biostatistical analysis. Prentice Hall, Uppar Saddle River, New Jersey, USA.
7. Biostatitcal Analysis, Zar (2004).

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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	14P4BTEL3A	Elective – BIOSAFETY AND BIOETHICS (Human values)	6	4

Objectives:

1. To study the Biosafety and its guidelines.
2. To study the IPR and patents.
3. To study the Agreement and Treaties.

Unit I

Hrs 18

Biosafety: Introduction: Biosafety issues in biotechnology – historical background: Introduction to biological safety cabinets: Primary containment for bio hazards: Biosafety levels: Biosafety levels of specific micro organisms: Recommended Biosafety levels for infections agents and infected animals.

Unit II

Hrs18

Biosafety Guidelines: Biosafety guidelines and regulations (National and international) – operation of biosafety guidelines and regulations of 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.

Unit III

Hrs18

Introduction of Intellectual Property: Types IP patents, Trademarks, Copyright & Related rights. Industrial design, Traditional Knowledge. Geographical indications – Importance of IPR – Patentable and non-Patentable – Patenting life – legal protection of biotechnological inventions – world intellectual property rights organization (WIPO).

Unit IV

Hrs 18

Basics of patents and concept of Prior Art: Introduction to patents: Types of patent applications: Ordinary, PCT, Conventional, divisional and patent of Addition: Specifications. Provisional and complete: Forms and fees invention in context of "Prior art". Patent database searching. International databases. Country wise patent searches (USPTO, esp@ ce net CEPO), PATENT scope (WIPO), IPO.

Unit V

Hrs 18

Agreements and Treaties: History of GATT & TRIPS Agreement : Madrid, Agreement : Hague Agreement : WIPO Treaties : Budapest Treaty : PCT Indian Patent Act 1970 and recent amendments.

Reference:

1. Biotechnology and Safety Assessment, Thomas (2003).
2. Environmental Health Hazards, Kumar (2004).
3. Progress in Bioethics, Jonathan *et al.*, 2010.
4. The Ethics of Protocells – Mark 2009.
5. Design and Destiny – Ronald and Turner, 2008.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	14P4BTEL3B	Elective - BIODIVERSITY AND BIORESOURCES	6	4

Objectives:

1. To study the diversity of genes, species of eco system.
2. To study the Loss, uses, values, of conservation of Bio-diverting.

Unit I

Hrs 18

Biodiversity – Definition – Types – Terrestrial, Aquatic and arboreal biodiversity - genetic diversity - Species (species diversity) and ecosystems diversity.

Genetic Diversity – Nature and origin of Genetic Variation – Measuring Genetic variation Allozyme, RFLP, RAPD, DNA sequencing and the polymerase chain reaction (PCR) techniques. (Elementary account on each one of these only) – The need for wild relatives of cultivated plants / animals / microbes. Centres of origin of cultivated plants and domesticated animals.

Species Diversity–Measurement–Concepts of species richness, abundance, and turnover species/area relationship, global distribution of species richness – centres of species diversity (CUP) – megadiversity centres–Hot spot analysis. A general account on Ecosystem diversity.

Unit II

Hrs18

Loss of Biodiversity

Species extinction–Fundamentals causes–Deterministic and stochastic processes–current and future extinction rates- methods of estimating loss of biodiversity – threatened species –The IUCN threat categories (extinct, Endangered, Vulnerable, Rare. Intermediate and insufficiently known). The threat factors (Habital loss, over- exploitation for uses introduction of Exotics, Diseases, habitat fragmentation etc.)–common threat plant and animal taxa of India Red Books.

Unit III

Hrs18

Uses and values of Biodiversity

Uses of Bioresources – plant uses: Food, timber, medicinal ornamental and other uses – animals uses food animals (terrestrial and aquatis) non food uses of animals, Domestic livestock – uses of microbes.

Valuing Biodiversity – Instrumental (Goods, services, information and psychospiritual values) and Inherent or Intrinsic values ethical and aesthetic values – An outline account on methods of valuing biodiversity.

Unit IV

Hrs 18

Conservation and sustainable management of Biodiversity and Bioresources – National policies and Instruments relating the protection of the wild / domesticated flora and fauna as well as habitats – International policies and Instruments – A general account on multilateral treaties – the role of CBD, IUCN, GEF, IBPGR, NBPGR, WWF, FAO, UNESCO and CITES – Bioresources, Biotechnology and Intellectual property rights. Biopyracy right of farmers, breeders and indigenous people – An elementary on biodiversity bioresources data bases.

Unit V

Hrs 18

Social issues and the Environment

Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation – Consumerism and waste products – Environment Production 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.

Reference:

1. Biodiversity Conservation in Managed and Forests and Protected Areas, Kotwal, P.C. (2009).
 2. Biodiversity: Assessment and Conservation, Trivedi, A.C. (2006).
 3. Biodiversity: Principles and Conservation (2nd Ed.).
 4. Trends in Wild Life Biodiversity Conservation and Management in 2 Vols.
 5. Groombridge, B (Ed.) 1992. Global Biodiversity – Status of the Earth's Living Resources. Chapman & Hall, London.
 6. UNEP, 1995, Global Biodiversity Assessment, Cambridge Univ. Press, Cambridge.
 7. Virchow, D. 1998. Conservation & Genetic Resources, Springer-Verlag, Berlin.
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Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	14P4BTEL3C	Elective - ENZYMOLOGY	6	4

Objectives:

1. To learn the Classification, nomenclature & general properties.
2. To study the Enzyme kinetics.
3. To understand the Techniques of enzyme immobilization & their applications.
4. To study the Industrial utilization of enzymes and Enzyme therapy

Unit I

Hrs18

Classification, nomenclature & general properties, Factors, affecting enzyme action pH, temperature, ions, substrate concentration, enzyme concentration, inhibitors, Extraction, assay and purification of enzymes units of activity and kinetics of enzyme catalysed reactions – the transition state.

Unit II

Hrs18

Steady state kinetics – bisubstrate and multisubstrate reaction – enzyme catalysed reaction – different types of inhibitors and activators – Michaelis Menton, Lineweaver and Burke equations, K_m , K_{cat} and K_I value Enzyme specificity – absolute and rigid specificity, Nucleophilic & electrophilic attack

Unit III

Hrs18

Role of co-enzyme in enzyme catalysis: Co-enzyme regeneration, Mechanism of enzyme action eg., lysozyme, chymotrypsin, DNA polymerase, ribonuclease & LDH, zymogen & enzyme activation, allosteric enzymes & metabolic regulations. Clinical & industrial uses of enzymes.

Unit IV

Hrs18

Techniques of enzyme immobilization & their applications – medical, food, leather, textile and paper industries. A brief account of modification of enzymes (enzyme engineering) and its products through r-DNA technology. Biosensors, Mechanism of light activation of enzymes.

Unit V

Hrs18

Industrial utilization of enzymes, practical aspects of large-scale protein purification, use of soluble enzymes, enzyme reactors, membrane reactors, continuous flow, packed bed reactors, large-scale application of microbial enzymes in food and allied industries. Antibiotics production, medical application of enzymes in reverse glycosidase synthetic reaction. Interesterification of lipids, Enzyme therapy.

References:

1. Blazej, A. & Zemek.J. 1987: Interbiotech, 87, Enzyme Technologies, Elsevier
2. Murray Moo – Young 1988 Bioreactor immobilized enzyme and cells.Fundamentals and applications, Elsevier, Applied Science
3. Rehm, H.J. and Reed G. 1988, Biotechnology, Vol 7a, Enzyme Technology, Elsevier
4. Terrance G. Cooper 1977 The tools of Biopchemistry, John Wiley & Son
5. William, b. Jakoby, 1984 Methods in Enzymology, Vol.104, enzyme purification and related techniques.