

BT -801(A) – Molecular & Cellular Diagnostics

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 1

Course: **Molecular & Cellular Diagnostics**

UNIT-I

General Clinical Laboratory Techniques & Procedure: Chemical & Related substrates, volumetric analysis, Balancing & Weighing, Concept of solute & solvent, Units of measurement

Specimen Collection & Processing: Specimen collection (Blood, urine, spinal fluid, saliva synovial fluid, Amniotic fluid), Preservation, transportation

UNIT-II

Selection & Interpretation of Lab. Procedure: Classification of BIAS, Sensitivity and specificity, Receiver Operator Characteristics, Interpretation a test **Quality Management:** Fundamentals of total quality management, Element of QAP, External quality assessment and proficiency testing programme.

UNIT-III

Clinical Enzymology: Principle of diagnostic enzymology, Liver, cardiac and skeletal enzyme, Digestive enzyme, Miscellaneous enzyme

General Function Tests: Liver function test, Cardiac Function Test, Renal Function Test, Thyroid Function test, Reproductive endocrine function test

UNIT-IV

Immunodiagnosics: Introduction, Antigen-Antibody Reactions, Conjugation Techniques, Antibody Production, Enzymes and Signal Amplification Systems, Separation and Solid-Phase Systems, Case studies related to bacterial, viral and parasitic infections.

Product Development: Immunoassay Classification and Commercial Technologies, Assay Development, Evaluation, and Validation, Reagent Formulations and Shelf Life Evaluation, Data Analysis, Documentation, Registration, and Diagnostics Start-Ups.

UNIT-V

DNA based diagnostics: PCR, RFLP, SSCP, Microarrays, FISH, In-situ hybridization, Case studies related to bacterial, viral and parasitic infections.

Cell based diagnostics: Antibody markers, CD Markers, FACS, HLA typing, Bioassays.

Biosensors: Concepts and applications, Biosensors for personal diabetes management, Noninvasive Biosensors in Clinical Analysis, Introduction to Biochips and their application in modern Sciences, Introduction to Nanotechnology.

Text / Reference Books:

1. Tietz Textbook of Clinical Chemistry, Carl A. Burtis, Edward R. Ashwood, Harcourt Brace & Company Aisa Pvt. Ltd.
2. Commercial Biosensors: Graham Ramsay, John Wiley & Son, INC. (1998).
3. Essentials of Diagnostic Microbiology, Lisa Anne Shimeld.
4. Diagnostic Microbiology, Balley & Scott's.
5. Tietz Text book of Clinical Biochemistry, Burtis & Ashwood.
6. The Science of Laboratory Diagnosis, Crocker Burnett.,48

BT -801(B) – Biophysics of Macromolecules

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 1

Course: **Biophysics of Macromolecules**

UNIT-I

Introduction to biophysics, Strong and weak interactions in biomolecules, dielectric properties of biomolecules, electronic properties of biomolecules – conductivity, photoconductivity and piezoelectric effect, conformation and configuration of biomolecules.

UNIT-II

Conformation of proteins and enzymes, effect of amino acids on the structure of proteins, energy status of a protein molecule, helix coil transformation of proteins, structurefunction relations of enzymes, cooperative properties of enzymes, dynamics of protein Folding.

UNIT-III

Conformation of nucleic acids, helix coil transformation, thermodynamics of DNA denaturation, Changes in nucleic acid structures during biochemical processes.

UNIT-IV

Methods for study of biomolecule structure -- X-ray crystallography, optical, uv and ir spectroscopy, luminescence, fluorescence, magnetic resonance and electron microscopy.

Text / Reference Books:

1. Freifelder D., Physical Biochemistry, Application to Biochemistry and Molecular Biology, 2nd Edition, W.H. Freeman & Company, San Fransisco, 1982.
2. Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press, 2000.
3. D. Holme & H. Peck, Analytical Biochemistry, 3rd Edition, Longman, 1998.
4. R. Scopes, Protein Purification - Principles & Practices, 3rd Edition, Springer Verlag, 1994.
5. Selected readings from Methods in Enzymology, Academic Press.

BT- 801 (C) Modeling & Simulation of Bioprocess

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 1

Course: **Modeling and Simulation of Bioprocesses**

UNIT-I

Approach to modeling, Unstructured and structured modeling, Deterministic and stochastic models, Segregated and unsegregated models, Shu's segregated models for Lactic acid fermentation.

UNIT-II

Structured kinetic models: Compartmental models (two and three), Product formation, Unstructured and structured models, Genetically structured models.

UNIT-III

Stochastic model for thermal sterilization of the medium, Modelling for activated sludge process, Model for anaerobic digestion, Models for lactic acid fermentation and antibiotic production.

UNIT-IV

Process simulation techniques, Equation oriented approach, Equation oriented simulators (SPEED UP, ASCEND, FLOWSIM, QUASILIN, DYN SIM).

UNIT-V

Simulation programs based on Euler's methods, Newton – Raphsen methods, Runge – Kutta methods, Simulation of biochemical system models.

Text / Reference Books:

1. G. Francis, Modelling and Simulation
2. A. Haerder and J. A. Roels "Application of simple structured I Bioengineering, and P55 in Advances In Biochemical engineering Vol21, A. Fiechts (ed) Spring –Verlag , Berlin, 1982.
3. J.E. Bailey and D.F. Ollis, Biochemical Engg Fundamentals, 1986, McGraw Hill Book Company

BT- 802 (A) Renewable Energy Technology

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 2

Course: **Renewable Energy Technology**

UNIT-I

Biological fuel generation: Biomass as a renewable energy source; types of biomass – forest, agricultural and animal residues, industrial and domestic organic wastes.

UNIT-II

Conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and / or fermentation processes.

UNIT-III

Sources of biomass; biogas from anaerobic digestion; thermal energy from biomass combustion; ethanol from biomass.

UNIT-IV

Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants.

UNIT-V

Solar energy: solar collectors, solar pond, photovoltaic cells, chemical storage.

Geothermal energy and wind energy: Use of geothermal energy, operating principles of different types of wind energy mills. Nuclear energy: nuclear reactions and power generating tidal wave energy.

Text / Reference Books:

1. J.E. Smith – Biotechnology, 3rd ed. Cambridge Univ Press
2. S. Sarkar – Fuels and combustion, 2nd ed., University Press.

BT- 802(B) Biosensors and Diagnostics

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 2

Course: **Biosensors and Diagnostics**

UNIT-I

Introduction –Immobilization key to biosensor construction, Biosensors diversification.

UNIT-II

Redoxmediated systems, FET's (Field Effect Transistors), Thermistors, Conductimeters, Piezoelectric crystals, Optoelectric biosensors.

UNIT-III

Variations on the biological /biochemical components.

UNIT-IV

Bioaffinity principles, Designing and applications of whole cell biosensors.

UNIT-V

Applications and uses of biosensors in Clinical chemistry, medicine and health care, Veterinary, Agriculture and Food production, Environmental control and pollution monitoring.

Text / Reference Books:

1. Turner, A.P.F, Karube.I.,and Wilson,G.S, Biosensors Fundamentals and applications, Oxford Univ. Press.
2. D.Thomas and J.M. Laval – Enzyme Technology in concepts in Biotechnology by Balasubramaniam et al, Univ. Press, 1996.

BT- 802 (C) Down Stream Processing

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 2

Course: **Down Stream Processing**

UNIT-I

Biomolecules of Commercial importance Ethanol, citric acid, lysine, steroids, penicillin, dextran, trehalose, subtilisin, chymosin, vitamin B12, hepatitis B vaccine, insulin, erythropoietin, monoclonal antibodies.

UNIT-II

Techniques and Instrumentation Filtration, centrifugation, aqueous two phase system, ion exchange chromatography, gel permeation chromatography, affinity chromatography, spectrometry, automation, bioassay, automated sequencers, mass spectrometry, ORD, CD

UNIT-III

Proteins from microbes, plants and animal sources by classical and modern

biotechnology Recombinant versus non-recombinant proteins, Microorganisms as source of proteins, Protein production in genetically engineered microorganism such as E. coli, yeast and fungi, Proteins from plants, Production of heterologous proteins in plants, Animal tissues as protein source, production in transgenic animals, animal cell culture, insect cell culture.

UNIT-IV

Large scale protein purification Production of factor VIII, t-PA, hepatitis B, Asparaginase, insulin, interferon alfa, glucose oxidase, horse radish peroxidase, Alfa amylase, subtilising, lipase, casein, whey protein concentrate.

A General Study of Various Classes of Commercial Proteins Blood products, vaccines, therapeutic antibodies and enzyme hormones and growth factors, interferon, interleukins, industrial enzymes, non-catalytic industrial proteins.

UNIT-V

A General Study of Commercial Products other than Proteins Bulk organics (ethanol), Biomass (Bakers Yeast), Organic acids (Citric Acid), Amino Acids (L-Lysine), Microbial Transformations (Steroids), Antibiotics (Penicillin), Extra Cellular Polysaccharides (Xanthan Gum), Nucleotides (5-GMP), Vitamins (B12), Pigments (Shikonin)

Text / Reference Books:

1. Protein: Biochemistry and Biotechnology by Gary Walsh (2002 John Wiley & Sons Ltd.)
2. Process Biotechnology Fundamentals by S.N. Mukhopadhyay (2001). Viva Books Private Limited.

BT- 803 (A) Biosafety & Bioethics

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 3

Course: **Biosafety & Bioethics**

UNIT-I

Biotechnology and Society: Introduction to science, technology and society, biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs. private funding, biotechnology in international relations, globalisation and development divide.

UNIT-II

Bioethics: Legality, morality and ethics, the principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc.

Biotechnology and Bioethics: The expanding scope of ethics from biomedical practice to biotechnology, ethical conflicts in biotechnology - interference with nature, fear of unknown, unequal distribution of risks and benefits of biotechnology, bioethics vs. business ethics, ethical dimensions of IPR, technology transfer and other global biotech issues.

UNIT-III

Biosafety concepts and issues: Rational vs. subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards, biotechnology and biosafety concerns at the level of individuals, institutions, society, region, country and the world.

Biosafety in the laboratory institution: Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory/ institution.

UNIT-IV

Biosafety regulations in the handling of recombinant DNA processes and products in institutions and industries, biosafety assessment procedures in India and abroad.

Biotechnology and food safety: The GM-food debate and biosafety assessment procedures for biotech foods & related products, including transgenic food crops, case studies of relevance.

UNIT-V

Ecological safety assessment of recombinant organisms and transgenic crops, case studies of relevance (Eg. Bt cotton).

Biosafety assessment of biotech pharmaceutical products such as drugs/vaccines etc.

International dimensions in biosafety: Cartagena protocol on biosafety, bioterrorism and convention on biological weapons

Text / Reference Books:

1. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and Safety Assessment (3rd Ed). Academic Press.
2. Fleming, D.A., Hunt, D.L., (2000). Biological safety Principles and practices (3rd Ed). ASM Press, Washington.
3. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH.
4. Encyclopedia of Bioethics, 49.

BT- 803 (B) Genomics

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 3

Course: **Genomics**

UNIT-I

Introduction

Features of prokaryotic, eukaryotic & organellar genomes, Genome sizes – C value paradox, Gene Counting, Structural, Functional genomics.

UNIT-II

DNA Sequencing

Principles of DNA sequencing, Automated DNA sequencing, Shotgun sequencing – contig assembly.

Analysis of sequence data

Analysis & Annotation – ORF, Exon – Intron boundaries, Other features of nucleic acid sequencing, Protein motifs & domains, Databanks, Sequence comparisons.

UNIT-III

Analysis of Genetic Variation

Nature of genetic variation – SNP, Methods to study variation – RFLP, PCR based methods, Genome – wide comparisons.

Comparative Genomics

Human genome project, *Arabidopsis* genome and other genome projects, Synteny, Genome evolution.

UNIT-IV

Analysis of Gene Expression

Analysing transcription – Northern blot, RNase protection assay, RT-PCR, Primer extension analysis, SI-nuclease protection assay, Comparing transcriptomesubtractive hybridization, differential display, SAGE, Reporter genes.

UNIT-V

Proteomics to Study Genes & Genomes

Biochemical genomics, Yeast – two hybrid assay.

Recent advances in Genomics.

Text / Reference Books:

1. Handbook of Comparative Genomics: Principles and Methodology by Cecilia Saccone, Graziano Pesole. Wiley-LISS Publication (2003).
2. Comparative Genomics by Melody S. Clark. Kluwer Academic Publishers (2001).
3. Essentials of Genomics & Bioinformatics C.W. Sensen, Wiley (2003).
4. Discovering Genomics, Proteomics & Bioinfo, A.M. Campbell, C.S.H. Press, (2003)
5. Various research and review journals like Nature Biotechnology, Current Opinion, Trends and Annual Reviews. 53.

BT- 803 (C) Medical and Pharmaceutical Biotechnology

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 3
Course: **Medical and Pharmaceutical Biotechnology**

UNIT-I

Drug Development in Pharmaceutical Process, Production of pharmaceuticals by genetically engineered cells (hormones, interferons), Microbial transformation for production of important pharmaceuticals (steroids and semi-synthetic antibiotics).

UNIT-II

Techniques for development of new generation antibiotics, Protein engineering, drug design, drug targeting.

UNIT-III

Disease Diagnosis and Therapy, ELISA and hybridoma technology, DNA vaccine, Gene Therapy, Toxicogenomics

UNIT-IV

Proteomics in Drug Development, Role of Proteomics in Drug Development, Diagnosis of disease by Proteomics, Separation and identification techniques for protein analysis, Development of antibody based protein assay for diagnosis.

UNIT-V

Diagnosis and Kit Development, Use of enzymes in clinical diagnosis, Use of biosensors for rapid clinical analysis, Diagnostic kit development for microanalysis.

Text / Reference Books:

1. Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman (ed), Concepts in Biotechnology, University Press, 1996
2. Epenetos A.A.(ed), Monoclonal antibodies: applications in clinical oncology, Chapman and Hall Medical, London.

BT- 804 (A) Writing Skills for Technical Purpose

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 4

Course: **Writing Skills for Technical Purposes**

UNIT-I

Making Technical Text Readable: Logic and Organizational Patterns; Language and Visual display.

Gathering Date: Interviewing; Using the Library/Internet; Listing Reference Material.

UNIT-II

Paper and Report Writing: Organising a Paper; Writing the Discussion or Body of an Article; Writing the exit; Writing the Lead.

UNIT-III

Writing Specific Documents: Letters and Memos; Job Applications, Cover letters and Resume.

UNIT-IV

Designing and Writing for Electronic Media: Using Internet as a Writing Tool; Designing and Writing for Multi-media; Writing and Designing for World Wide Web.

UNIT-V

Oral Presentations: Listening and Speaking Skills

Text / Reference Books:

1. How to Write & Present Technical Information, 3rd Edition, Charles H. Sides, Cambridge University Press. 1999.
2. Garffey, Mary Ellen Business Communication, Cincinnati: South-Western College Publishing, 2000
3. Parley E Stevens and Daniel G Riardaw. Technical Report Writing Today N Delhi AITBS, 1998.

BT- 804 (B) Intellectual property Rights in Biotechnology

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 4

Course: **Intellectual Property Rights in Biotechnology**

UNIT-I

WTO: As an international agency controlling trade among nations. WTO with reference to biotechnological affairs, TRIPs.

General Introduction: Patent claims, the legal decision – making process, ownership of tangible and intellectual property.

UNIT-II

Basic Requirements of Patentability Patentable subject matter, novelty and the public domain, non obviousness

Special issues in Biotechnology Patents Disclosure requirements, Collaborative research, Competitive research, plant

UNIT-III

Plant biotechnology Indian patents and Foreign patents, Plant variety protection act, The strategy of protecting plants.

UNIT-IV

Patent Litigation Substantive aspects of patent litigation, Procedural aspects of patent litigation, different Doctrines

Recent Developments in Patent System and Patentability of biotechnological inventions.

UNIT-V

IPR issues in Indian Context Role of patent in pharmaceutical industry, computer related innovations

Case studies Rice, Haldi, neem, etc. and challenges ahead

Text / Reference Books:

1. The law and strategy of Biotechnological patents by Sibley. Butterworth publications.
2. Intellectual property rights – Ganguli – Tat McGrawhill
3. Intellectual property right – Wattal – Oxford Publishing House

BT- 804 (C) Advances in Agriculture Biotechnology

COURSE CONTENTS

Branch: Biotechnology; Semester – VIII; Paper – 4

Course: **Advances in Agricultural Biotechnology**

UNIT-I

Molecular breeding: Concept and methodology of different types of molecular markers. Role of molecular markers in crop and farm animal improvement, conservation of biodiversity; Marker assisted selection; QTL mapping

UNIT-II

Chloroplast genetic engineering: Methodology, applications in herbicide resistance, production of biopharmaceuticals, edible vaccines, foreign gene expression, Limitations 3. Molecular and biochemical basis of plant disease resistance, signalling pathways, protein kinases, virus induced gene silencing

UNIT-III

Molecular basis of plant resistance to various abiotic stresses like drought, salinity, heavy metals, high temperature, etc.

UNIT-IV

Genetic engineering of plants: production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, drought and other abiotic stress resistance; quality parameters: Modification of nitrogen fixing capabilities; gene pyramiding

UNIT-V

Transgenic animals for better farming, whole genome cloning

Molecular farming: Use of plants and animals for production of nutraceuticals, edible vaccines and other desired products

Text / Reference Books:

1. Agricultural Biotechnology by Arie Altman. Marcel Dekker, Inc. (2001).
2. Plants, Genes and Crop Biotechnology (2003) 2nd Edition by Chrispeels, M.J. & Sadava D.E. American Society of Plant Biologists, Jones and Bartlett Publishers, USA.
3. Biochemistry and Molecular Biology of Plants: Edited by Buchanan B.B., Gruissem W, and Jones RL (2000) American Society of Plant Biologists, USA.
4. Various research and review journals like Nature Biotechnology, Current Opinion, Trends and Annual Reviews.