



DEPARTMENT OF BIOTECHNOLOGY

BUNDELKHAND UNIVERSITY, JHANSI

COURSE CURRICULUM AND SYLLABUS 2018-19

M. Sc. BIOTECHNOLOGY

Semester	Paper Code	TITLE OF THE THEORY / PRACTICAL PAPER	SA	IA	Total marks	
1 st	6001	GENERAL BIOCHEMISTRY	70	30	100	
	6002	CELL BIOLOGY AND GENETICS	70	30	100	
	6003	MICROBIOLOGY	70	30	100	
	6004	BIOINSTRUMENTATION and ANALYTICAL TECHNIQUES.	70	30	100	
	60005	PRACTICAL BIOCHEMISTRY	100	---	100	
	60006	PRACTICAL MICROBIOLOGY	100	---	100	
2 nd	6006	BIO INFORMATICS AND BIostatISTICS	70	30	100	
	6007	IMMUNOLOGY	70	30	100	
	6008	PLANT BIOTECHNOLOGY	70	30	100	
	6009	INTERMEDIARY METABOLISM AND ENZYME TECHNOLOGY	70	30	100	
	60010	PRACTICAL PLANT BIOTECHNOLOGY	100	---	100	
	60011	PRACTICAL IMMUNOTECHNOLOGY	100	---	100	
3 rd	7001	MOLECULAR BIOLOGY	70	30	100	
	7002	GENETIC ENGINEERING	70	30	100	
	7003	INDUSTRIAL BIOTECHNOLOGY	70	30	100	
	7004	ANIMAL BIOTECH, BIOSAFETY and IPR	Elective (only one)	70	30	100
	7005	ENVIRONMENTAL BIOTECH.				
	70006	PRACTICAL INDUSTRIAL AND ANIMAL BIOTECH.	100	---	100	
	70007	PRACTICAL MOLECULAR BIOLOGY AND BIOINFORMATICS	100	---	100	
4 th	70008	PROJECT WORK/ DISSERTATION	200	---	200	
GRANT TOTAL MARKS					2000	



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I SEMESTER

6001 GENERAL BIOCHEMISTRY

UNIT I Carbohydrates

Classification of Carbohydrates. Structure of glucose, fructose, mannose , galactose , lactose, sucrose, glycogen, starch and cellulose. Isomerism, Structural and stereoisomers-optical, geometric. Mutarotation, Enantiomers, epimers, and Diastereoisomers. Anomers.

UNIT II Lipids

Classification. Triglycerides, Waxes, Phospholipids, sphingolipids, Sterols, Cholesterol. Fats and Oils, Classification of fatty acids, essential fatty acids.

Lipoproteins . Glycoproteins and Glycolipids. Self assembly of lipids, micelle, biomembrane organizations.

UNIT III proteins

Classification of proteins - Amino acids, Classification and structure. Essential amino acids, Non protein and non standard amino acids.

Protein structure. Determination of amino acid sequences of proteins. Primary, secondary ,tertiary and quaternary structure of proteins. Forces stabilizing structure of proteins. Salting in and salting out of proteins. Denaturation and renaturation of proteins. Protein degradation and molecular pathways controlling protein degradation. Basic principles of protein purification. Protein folding. Chaperons. Diseases associated with protein folding. Ramachandran plot.

Evolution of protein structure.

UNIT IV Nucleic acids

Structure and properties of purine and pyrimidine bases and DNA and RNA. Functions of nucleic acids. Physical properties Secondary and tertiary structure. Base composition. Base pairing. Helix coil transitions. T_m and relation to GC content. Physical properties of RNA and classes .

UNIT V Porphyrins

Porphyrin nucleus. Classification and structure of porphyrins. Metalloporphyrins. Bile pigments- chemical nature and physiological significance.



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UNIT VI Vitamins and Enzymes.

Fat soluble and water soluble vitamins.

General characteristics of enzymes. Definition of Coenzymes, holoenzyme, Prosthetic group, cofactors. Nomenclature and classification. Enzyme kinetics and Michaelis and Menton equation and inhibition.

1. Lehninger principles of biochemistry. (2013) [David L Nelson](#); [Michael M Cox](#); [Albert L Lehninger](#)
New York : W.H. Freeman. 6th Edition
2. Biochemistry, Berg, J.M., Tymoczko, J.L. and Stryer, L. (2015) 8th edition, W.H. Freeman & Co., New York
3. Biochemistry, Voet, D. and Voet J.G. (2016) 5th Edition, John Wiley & Sons, New York.
4. Zubay, G. L., Biochemistry; 4Ed, Worthington, R., Ed.:McGraw-Hill Companies, Inc.: Dubuque
5. Biochemistry. U. Satyanarayana. (2014)
6. Fundamentals of Biochemistry. J.L. Jain



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I SEM.

6004 BIOINSTRUMENTATION & ANALYTICAL TECHNIQUES

UNIT I Chromatography

Principle, types and applications- partition, adsorption, paper, thin layer, ion exchange, molecular sieve, supercritical fluid, gas chromatography and HPLC.

UNIT II Electrophoresis

Principle, instrumentation and applications of moving boundary and zonal electrophoresis, including paper and gel (SDS-PAGE and Agarose) electrophoresis, isoelectrofocusing, PFGE and Capillary electrophoresis.

UNIT III Centrifugation

Principles of sedimentation & centrifugation, relationship between RCF and RPM, types of centrifuge, differential and density gradient centrifugation (rate zonal and isopycnic).

UNIT IV Microscopy

Principles and applications of light microscope, fluorescence, Phase contrast, Dark field, electron (TEM and SEM), interference, polarization, inverted and stereomicroscope. Freeze fracture, fixation and staining

UNIT V Spectroscopy

Principle, Instrumentation and applications of UV-Visible, IR, NMR, atomic absorption, Fluorescence spectroscopy, X-ray Crystallography and Mass Spectrometry.

UNIT VI Radiation Biology

Radioisotope Techniques: Radio-tracers, interaction of radiation with matter, GM counter, Scintillation counters, autoradiography and radioimmunoassay.

List of suggested reading:

1. *Instrumental Analysis* : D. Skoog
2. *Biophysical Chemistry* : David Sheehan
3. *Principles of Biophysical Chemistry* : David Frifelder
4. *Biophysics* : Upadhyay & Upadhyay
5. *Methods of Instrumental Analysis* : Willard
6. Principles and techniques of practical Biochemistry, by Wilson/Walker : Wiley Publication(2010)



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I SEM.

6002 CELL BIOLOGY AND GENETICS

PART A. MOLECULAR CELL BIOLOGY

UNIT Basics of Cell Biology

Definition of cell- fundamental cell types, difference between Prokaryotic and Eukaryotic cell types, Structure and function of cell organelles, ultra structure of cell membrane, cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin, microtubules etc.) Mitochondria, chloroplasts, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus chromatin).

UNIT II Biomembranes

Structure and functions, Biological membranes and transport of solutes. Molecular structure of membrane. Solute transport across membranes. Types of transport. Simple, passive, facilitated diffusion. Active transport. Transport ATPases. Mobile carriers and pore mechanism. Artificial membranes. Micells, bilayer, monolayer, liposomes.

UNIT III Cell signaling and signal transduction

Types of cellular receptors and chemical signals. G proteins. Second messengers. Role of steroid hormones.

UNIT IV Cell cycle

Cell cycle: mitosis, meiosis, stages of cell cycle, binary fission, amitosis.
Cell-cell interaction, Cell senescence and death: Apoptosis and necrosis

PART B. GENETICS

UNIT I History

Genome organization and gene expression in prokaryotes and eukaryotes. Mendelian Laws of inheritance, gene interactions. Extra chromosomal inheritance, mitochondrial and chloroplast genetic systems.

UNIT II Linkage and crossing over

Linkage and Gene map (Linkage Map) Sex linked inheritance, hereditary defects. Inbreeding depression and heterosis.

UNIT III Mutations

Definition, Types, Structural and numerical changes in chromosomes, Molecular basis of mutations, mechanisms of DNA repair, mutations, frequency, correlation between mutagenicity and carcinogenicity, mutagenic agents (chemical and radiation). Population Genetics: Hardy-Weinberg equilibrium, gene and genotypic frequencies, introduction of eugenics.

List of suggested reading:



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1. Molecular Biology of The Cell, Alberts, B., Johnson, A., Lewis, J., (Author), Raff, M., Roberts, K. and Walter, P. (2008) 5th edition, Garland Science, New York
2. Molecular Cell Biology, Lodish, H., Berk, A., Kaiser, C.A. and Krieger, M. (2007) 6th edition, W.H. Freeman & Co., New York
3. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
4. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
5. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
6. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.



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I SEM.

6003 MICROBIOLOGY

UNIT I Basic concepts

History of Microbiology, Methods of classification and major groups of microorganisms. Taxonomic nomenclature and Bergey's Manual.

UNIT II Introduction

Structure and Culture of Bacteria. Concept of sterilization in microbiology, Concept of microbial growth, effect of environmental factors on growth such as salt concentration, pH, temperature etc., growth monitoring and characteristics.

UNIT III Microbial Metabolism

Mode of Nutrition in Bacteria, Bacterial Metabolism, fermentation and its products, peptidoglycan synthesis and LPS synthesis

UNIT VI Microbial genetics

Bacterial Plasmids-Characters, copy number, compatibility, classification (F, R, Col, degradative, heavy metal resistance, Ti, cryptic), yeast plasmid. Microbial genetics: Conjugation, Transduction and Transformation, mutations, mutant screening, enrichment and selection,.

UNIT V Viruses

Classification of animal and plant viruses, Titration of viruses, General structure and life cycle of bacteriophage, Hepatic virus (HAV, HAB, HAC), Dengue virus (Flavi virus), HIV.

UNIT VI Pathogenicity and Antimicrobial agents

Bacterial and Viral pathogenesis, Microbial mechanisms for escaping host defenses. Endospore formation. **Antibiotics**, Bioassays, Antifungal and Sulpha drugs.

List of suggested reading:

1. WILLEY, J. M., SHERWOOD, L., WOOLVERTON, C. J., PRESCOTT, L. M., & WILLEY, J. M. (2011). Prescott's microbiology. New York, McGraw-Hill.
2. Carl A. Batt (Editor) Encyclopedia of Food Microbiology; Amsterdam: Elsevier, 2015
3. Schaechter, M. Ingraham, J.L. and Neidhardt, F.C. 2006. Microbe. ASM Press, Washington. D.C.
4. Microbiology-a laboratory manual Cappuccino, J.G. and Sherman, N. and Weseleey, Addison.
5. Experiments in Microbiology, Plant Pathology and Biotechnology. Aneja, A.R.
6. Microbiology. Pelczar, C.M.J., Chan, E.C.S and Krieg, N.R.



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7. General Microbiology. Stanier, C.
8. Microbiology an Introduction. Tortora.
9. Microbiology Fundamentals and Applications. Atlas, R.M.

I SEM.

60005 BIOCHEMISTRY PRACTICAL

1. Preparation of buffers

2. Proteins

a) Qualitative tests for proteins

a) Estimation of proteins by Lowry and Bradford method

3. Nucleic acids

a) Estimation of DNA and RNA by Diphenyl Amine and Orcinol Method

4. Carbohydrates

a) Estimation of total carbohydrate content of sample by anthrone method

b) Colour reactions for identification of carbohydrates

c) Extraction and estimation of chlorophyll

5. Amino Acids

a) Qualitative tests

b) Chromatography- TLC and paper

List of suggested reading:

1. Biochemical calculations Segal, I.H. New York: John Wile and Sons, 2004.
3. A Biologists guide to principles and practices in Biochemistry. Wilson, K. and Goulding, K.H.
4. Bioseparations, Principles and Techniques. Sivasankar B. 2007
5. Principles and techniques of practical biochemistry. Ed Keith Wilson and John Walker. Cambridge University Press.



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I SEM.

60006 MICROBIOLOGY PRACTICALS

1. To demonstrate sterilization methods for Glass wares and media.
2. Preparation of LB or nutrient Agar media.
3. To perform Simple staining technique.
4. To perform Gram Staining Technique
5. To perform Negative staining technique
6. To enumerate the bacterial cells by the standard plate count method.
7. To obtain isolated colonies with the help of different streaking methods
8. To observe bacterial growth pattern in nutrient broth and calculate generation time.
9. To observe antibiotic sensitivity to the given bacterial culture by Kirby Bauer method.
10. To determine the MIC of the given dose for given culture by E-Test
11. To observe the presence of catalase enzyme in the given culture
12. Monitor the exposure of the effect of UV light on the given culture.
13. To evaluate the given disinfectant with the help of phenol coefficient
14. To perform IMViC test for the set of bacterial culture
15. To isolate fungi by Warcup Method
16. To observe and identify the fungal cultures with the help of lactophenol cotton blue mount.

Suggested reading:

1. Microbiology. A Laboratory manual. Cappucino, J.G., Sherman, N. and Weseeley
2. Experiments in Microbiology, Plant Pathology and Biotechnology. Aneja, A.R
3. Microbes in Action by Harry W. Seeley, Paul J. VanDemark; Freeman



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IInd SEMESTER

6006 BIOINFORMATICS AND BIOSTATISTICS

A. BIOINFORMATICS

UNIT I Introduction to computers and Bioinformatics

Software and Hardware, storage and memory devices, input and output devices, f internet and e-mail. Bioinformatics- History, scope and applications.

UNIT II Biological databases

EMBL, GENBANK, DDBJ, PIR, PDB, SWISSPROT and TrEMBL. Understanding the structure of each source and using it on the web.

UNIT III Sequence alignments

Pairwise sequence Alignments, FASTA and BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment Phylogenetic Analysis. Open reading frame.

Protein Secondary structure prediction methods, and homology modeling

B. BIOSTATISTICS

UNIT I: Descriptive Statistics

Introduction of Statistics, Applications and drawback of Statistics, Concept of variables in biological systems, Collection, classification, tabulation, graphical and diagrammatic representation of numerical data

Measures of central tendency: Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean and Quartiles.

Measures of Dispersion: Range, Quartile deviation, Mean deviation, Standard deviation and Coefficient of variation.

Correlation and Regression: Correlation Coefficient, Rank correlation, Regression coefficients, Regression lines (Y on X and X on Y).

UNIT II: Probability theory and Tests of Significance

Probability: Introduction, Random experiment, Sample space, Events, Definition of Probability, Addition and Multiplication Law of Probability, Conditional Probability, Bayes theorem, Applications of probability.

Probability Distributions: Random variables, Binomial distribution, Poisson distribution and Normal distribution, Applications of distributions.

Tests of Significance: Based on t, F, Z and Chi-square distributions.

UNIT III: Analysis of Variance and Design of Experiment

ANOVA: One-way and Two way classifications.



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Design of Experiment: Principles of Design of Experiment, Completely Randomized Design (CRD), Randomized Block Design, (RBD), Latin Square Design (LSD), Statistical and graphic software-their use in research for data analysis, interpretation and presentation.

List of suggested reading:

1. Bioinformatics. Baxevanis, A.D. and Quelette, B.F.F.
2. Bio informatics. Des Higgins & Willie Taylor
3. Bioinformatics. Methods and protocols. Macsewer, S.
4. Bioinformatics. Sequence and genome analysis. Mount, D.W.
5. Computer fundamentals. Nagpal, D.P.
6. Methods in Biostatics. Mahajan, B.K.
7. Biostatistics. Arora, P.N. and Malhan, P.K.
8. Elements of Biostatistics .Prasad, S.
9. Practical in statistics. Sharma, H.L.
10. Fundamentals of Mathematical Statistics. Gupta, S.C. and Kapoor, V.K.
11. Mathematics for Biosciences - **Arya J.C and Lardner, R.W**
12. Advanced Engineering Mathematics-**Erwin Kreyszig**
13. Biostatics -**P.N. Arora & P.K. Malhotra**
14. Introduction to Biostatistics- **Sokal & Rohif**
15. Statistical Methods in Bioinformatics: An introduction-**W.Evans.Grant**
16. Computers Today-**S.K .Basandra**
17. Computer fundamentals-**P. K. Sinha**



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II SEMESTER

6007 IMMUNOLOGY

UNIT I

History of immunology, Immune response - Innate and Adaptive Immunity and Characteristics, Anatomical organization of immune system – Primary and secondary lymphoid organs, Secondary lymphoid organs, Cells of the immune system, lymphocyte traffic. Hematopoiesis, Antigens Characters, Haptens, Antigenicity and Immunogenicity, Factors affecting immunogenicity, Properties of T and B cell epitopes, Super antigens.

UNIT II

Complement System Components, activation pathways and their regulation, Complement deficiencies and role of complement system in immune response. Immunoglobulins – structure and functions, Organisation and expression of immunoglobulin genes. Mechanisms of antibody diversity, Class switching, Immunoglobulin Superfamily.

UNIT III

Organization of MHC I and II molecules, polymorphism, distribution and function, organization of MHC complex in Mouse and Humans. Role of MHC in tissue transplantation. T-Cell receptor – Structure and function, T- cell accessory membrane molecules, activation of T-cells B-Cell receptor – Structure, types and functions, activation of B-cells. Antigen presentation – Processing and presentation of exogenous and endogenous antigens.

UNIT IV

Structure and functions, cytokine receptors, signal transduction mediated by cytokine receptors, cytokine related diseases and their therapeutic applications. Hypersensitivity – Definition, Type I, II, III and IV type hypersensitivity, delayed type of hypersensitivity.

UNIT V

Autoimmunity – Organ specific and systemic diseases, mechanisms of autoimmunity and therapeutic approaches, Immunodeficiency Syndromes – Primary and secondary immunodeficiencies, their diagnosis and therapeutic approach

UNIT VI

Antigen and Antibody interactions – Affinity, Avidity, Cross reactivity, forces involved in Ag-Ab interaction, Vaccines – Active and passive immunization, whole organism vaccines, Macromolecules as vaccines, Recombinant-vector vaccines, DNA vaccines, synthetic peptide vaccines and subunit vaccines. Hybridoma technology and production of monoclonal antibodies and Its applications in diagnosis and therapy.

Books/Authors



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1. Immunology. Roitt, Brostoff and Male
2. Essential Immunology. Roitt, Ivan.M.
4. Immunology. Goldsby, R.A., Thomas J Kindt, Barbara, A Osborne and Kuby, Janis. W.H.



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II SEMESTER

6008 PLANT BIOTECHNOLOGY

UNIT I Plant Tissue Culture

Historical background, Concept of totipotency, Basic techniques of plant cell tissue culture, Surface sterilization, Aseptic tissue transfer,

Nutritional requirements of cell *In vitro*- Various type of nutrient media, Development of explants.

Methods of plant micro propagation. Plant tissue culture techniques. Ovary and ovule culture. *In vitro* pollination and fertilization. Embryo culture. Embryogenesis and organogenesis and their practical applications. Micropropagation of elite species. Auxillary bud, shoot tip and meristem culture.

UNIT II Haploid production

Haploids and their application. Anther and pollen culture. Monoploid production. Production of triploids through endosperm culture. Somaclonal variation and applications. Single cell cultures and their application in selection of variants/mutants with or without mutagen treatment.

UNIT III Protoplast and Embryo culture

Protoplast isolation and regeneration and its applications. Various methods of fusing protoplasts-Chemical, electrical.Somatic hybridization. Selection system for hybrids. Role of protoplast culture and somatic hybridization in the improvement of crop plants.

UNIT IV Crop Improvement through genetic engineering

Vectors for the construction of transgenic plants. Plasmid and plant virus vectors. Methods of gene transfer in to plant cells. *Agrobacterium* mediated. Direct gene transfers. Cointegration and binary vectors. Microinjection. Improved Crop productivity. Biotic stress resistant plants. Engineering Herbicide resistant plants. Direct strategy. Indirect strategy. Engineering viral diseases resistant plants. Insect resistant plants. Plants resistant to drought, salt, heat, water freezing etc. Improvement of nutritional quality. Seed storage proteins. Engineering for vitamins and iron deficiency. Terminator and traitor technology. Plant derived vaccines.

UNIT V Practical Concerns



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Impact of genetically modified crops in genomic research and agriculture. Efficacy and Environmental concerns. Legislation for transgenic plants.

List of suggested reading:

1. Molecular Biology and genetic engineering. Gupta, P.K. (2008)
2. Biotechnology and Genomics. Gupta, P.K. (2008)
3. Molecular Biology in crop protection. Marshall, G and Walters, D.
4. Plant Biotechnology in Agriculture. Lindsey, K. and Jones, M .G.
5. Biosynthesis and Manipulation of Plant Products. Grierson, D.
6. Plants, genes, and Agriculture. Maarten J. Chrispeels and David E. Sadava
7. A text Book of Biotechnology R.C.Dubay
8. Biotechnology. Singh, B.D. (2008)
9. A text Book of Biotechnology. Kumar, H.D.



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II SEMESTER.

6009 INTERMEDIARY METABOLISM AND ENZYME TECHNOLOGY

A. INTERMEDIARY METABOLISM

I. Carbohydrate Metabolism

Basic concepts, Glycogenesis, gluconeogenesis : pathway and regulation, Glycolysis, krebs cycle, pentose phosphate pathway, glyoxalate pathway, glycogenolysis : pathway and regulation. E.D. pathway.

II. Lipid Metabolism

Biosynthesis and degradation of odd and even carbon: saturated and unsaturated fatty acids. Formation of Ketone bodies, Regulation of metabolism, associated inborn errors

III. Amino Acid metabolism

Amino acid oxidation and production of urea. Metabolic fates of amino groups. Nitrogen excretion and urea cycle. Overview of nitrogen metabolism.

IV. Electron transport chain and Oxidative phosphorylation

Electron carriers, Complexes I to IV, Chemiosmotic theory, oxidative phosphorylation

B. ENZYME TECHNOLOGY

UNIT I Introduction

Holoenzyme, apoenzymes, coenzymes, cofactors. Activators and inhibitors. Metalloenzymes. Units of enzyme activity. Isoenzymes. Monomeric and oligomeric enzymes. Multienzyme complexes. I.U. Katal, turnover number and specific activity.

Specificity and models of enzyme action

Substrate and reaction specificity. Lock and key hypothesis. Induced fit hypothesis.

UNIT II Enzyme kinetics

Factors affecting enzyme activity. Enzyme concentration, substrate concentration, pH and temperature. Michaelis-Menton equation for unisubstrate reactions. K_m and its significance. Line weaver-Burk plot and its limitations. Enzyme inhibition- reversible and irreversible. Competitive, noncompetitive and uncompetitive inhibitors.



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UNIT III Mechanism of enzyme regulation

Feedback inhibition and feed forward stimulation. Enzyme repression, induction and degradation. Control of enzymatic activity by product and substrates. Reversible and irreversible covalent modification of enzymes. Mechanism of activation of Zymogens.

UNIT IV Enzyme Technology

Isolation and purification and crystallization of enzymes. Applications of enzymes in industries and medicine. Production of immobilized enzyme and their applications. Engineering of enzymes by site directed mutagenesis. Enzyme assays for diagnosis and prognosis of diseases.

List of suggested reading:

1. Understanding Enzymes. Palmer, T.
2. Enzyme. Dixon, M. and Webb, E.C.
3. Fundamentals of Biochemistry. Jain, J.L.
4. Fundamentals of Biochemistry. A.C.
5. General Enzymology. Kulkarni and Deshpande
6. Enzyme reaction Mechanisms. Welsch.
7. Lehninger Principles of Biochemistry. Nelson and Cox
8. Enzyme Kinetics. A modern approach. Marangoni, A.G.
9. Fundamentals of Enzymology. Price, N.C. and Stevens, L.
10. Enzyme Assays: A practical approach. Eisenthal and Danson



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II SEMESTER

60010 PLANT BIOTECHNOLOGY PRACTICAL

1. Preparation of MS Media
2. Preparation of working solution
3. Demonstration of various sterilization techniques
4. Isolation and sterilization of explants
5. Preparation of callus culture from explants



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II SEMESTER

60011 IMMUNOTECHNOLOGY PRACTICAL

1. To determine the blood RH factor of an individual
2. To study the reaction pattern of an antigen with set of antibodies by Ouchterlony method.
3. To study the Immunodiffusion on technique by single radial immunodiffusion and to determine the conc. of unknown antigen
4. To perform Widal test for typhoid (application of agglutination test)



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IIIrd SEMESTER

7001 MOLECULAR BIOLOGY

UNIT I- Introduction of nucleic acids

Nucleic acid as genetic information carriers, experimental evidenced: Bacterial genetic transformation, Hershey-Chase experiment, TMV reconstitute experiment.

Central dogma of molecular biology, Reverse transcription.

Organization of prokaryotic and eukaryotic genome, DNA supercoiling, chromatin-histone and non histone proteins. General properties of histones, Nucleosome model, solenoid structure, C-value and C-value paradox.

Unit II- Replication and DNA repair

Various modes of replication, Semiconservative replication-Messelson and Stahl experiment, Primase and primosome, prokaryotic and eukaryotic DNA replication, Role of different proteins and enzymes involved in DNA replication, Rolling circle model of replication ϕ X174 Phase, inhibitors of Replication. Photoreactivation repair, Base excision repair, nucleotide excision repair, Mismatch repair, SOS and recombination repair.

Unit III-Transcription

Transcription in Prokaryotes and Eukaryotes, initiation, elongation and termination, RNA Polymerase, Promoters, Operators, post-transcriptional processing of RNA in eukaryotes (RNA splicing, poly A tailing, 5'-capping). Concept of intron and exon, Maturation of rRNA, t RNA, mRNA, inhibitors of transcription.

Unit IV- Translation

Genetic code- Basic features of genetic code, codon and anticodon Wobble hypothesis. Mechanism of translation in prokaryotes and eukaryotes- initiation, elongation and termination, charged tRNA, Shine-Dalgarno sequences, role of EF-Tu, EF-Ts in protein synthesis, non-sense codons and release factors, inhibitors of Protein synthesis.

Unit V- Regulation of gene expression

Constitutive genes, Operon concept, negative and positive regulation, *lac*, *trp* operons, DNA methylation, Histone modification, Post transcriptional gene silencing.

Unit VI- Mutation



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Mutagenesis-chemical and physical, types of mutation eg. Transition and transversion, spontaneous and induced, germinal and somatic, frame shift and substitution mutation, backward and forward mutation. Lederberg's replica plating experiment, Random and site directed mutagenesis. Ames's testing.

Books recommended:

1. Molecular Biology of the gene. Watson *et al.*
2. Lehninger Principles of Biochemistry. Nelson and Cox.
3. Gene. VIII Lewin, B.
4. Principles of Genetics. Gardner, Simmons and Snustard.
5. Molecular Biology and Genetics engineering. Gupta, P.K.
6. Molecular Cell Biology. Lodish *et al.*



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III SEMESTER

7002 GENETIC ENGINEERING

Unit-I

1. Recombinant DNA Technology

Enzymes used in DNA technology: DNA manipulating enzymes (Restriction Endonucleases, Polymerases, Ligase, Kinases and Phosphatases Nucleases).
Linker, Adaptor, Homopolymer tailing.

Cloning vectors: Plasmids, Phasmids, Cosmids, Artificial chromosomes, Shuttle vectors and Expression vectors, Viruses as vectors

2. Application of Recombinant DNA technology in agriculture, health and industry.

Unit-II

1. Polymerase Chain Reaction (PCR): Principle, types and its application.

2. Principle and techniques of hybridization: Western, Northern and Southern blotting, Microarray based detection. DNA finger printing.

Unit-III

1. Isolation and purification of DNA, Gel electrophoresis.

2. Molecular Markers: Principles, types and application, Restriction Fragment Length Polymorphism (RFLP), Amplified Fragment Length Polymorphism (AFLP).
Random Amplified Polymorphic DNA (RAPD), Single Nucleotide Polymorphism (SNP).

Unit-IV

1. Gene transfer methods: Electroporation, Microinjection, calcium phosphate co-precipitation, lipofection.

2. Analysis of protein-DNA and protein-protein interactions: Gel retardation assay, DNA footprinting, Modification interference assay, Deletion analysis, Phage display and yeast two hybrids assay.

Unit-V

1. DNA sequencing method: Sanger's method, Maxam and Gilbert Method, Automated method.

2. Transgenic technologies and their applications.

Unit-VI

1. DNA libraries: construction of genomic and cDNA, screening method of DNA libraries.

2. Molecular diagnostic Methods, Biosafety and Ethical considerations.



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List of Suggested Reference Books

1. DNA Technology: The Awesome Skill by Alcamo IE. (2001). 2nd Elsevier Academic Press, USA.
2. Gene Cloning and DNA Analysis by TA Brown. Blackwell Publishing, Oxford, U.K.
3. Molecular Biotechnology by Glick BR and Pasternak JJ. ASM Press Washington D.C.
4. Principle of gene cloning by Old and primrose VthEds.
5. S B Primrose and R M Twyman Principles of Gene Manipulation and Genomics Seventh edition 2006 Blackwell Publisher, Australia.
6. Watson JD, Candy AA, Myers RM and Witkowski JA, Recombinant DNA (Gene and Genome – A short course) WH Freeman and Company, New York, IInd Edition 1992.
7. Biotechnology. Singh, B. D.



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III SEMESTER

7003 INDUSTRIAL BIOTECHNOLOGY

UNIT I Introduction

Definition, Scope and chronological development of the fermentation industry, the component parts of a fermentation process.

UNIT II Media design

Introduction, typical media - energy sources, carbon and nitrogen sources and other components

UNIT III Sterilization

Medium sterilization, design of a batch and continuous sterilization processes, holding time, Scale up of sterilization.

UNIT IV Improvement of industrial micro-organisms

Isolation of industrially important micro-organisms – Screening, selection of mutants overproducing primary metabolites, selection of mutants overproducing secondary metabolites, use of recombination systems for the improvement of industrial micro-organisms and by modifying properties other than the yield of product. Maintenance and preservation of microorganisms

UNIT V Fermenter design

Basic concepts of fermenter-batch, continuous, fed batch, packed bed, bubble column, fluidised bed, trickle, plug flow reactors. Fermentations-Submerged and solid state, body construction, aeration and agitation.

UNIT VI Recovery and purification of fermentation products

Removal of microbial cells and other solid matter, foam separation, precipitation, filtration, centrifugation, cell disruption, Liquid- liquid extraction, drying and crystallization.

UNIT VII Microbial production

Penicillin, Riboflavin, citric acid, vinegar, beer and whisky, Glutamic acid, Bread and Mushroom production

UNIT VIII Effluent treatment

Treatment and Disposal of effluents, B.O.D. and C.O.D.

List of suggested reading:

1. Biochemical Reactors Atkinson, B. Pion Ltd London
2. Biochemical Engineering Fundamentals Baily, J.F. and D F Ollis, D.F.
3. Bioprocess Technology-Fundamentals and Applications KTH Stockholm
4. Principles of fermentation technology Stanbury, P.F. and Whitakar, A.
5. Bioprocess Engineering principles, Pauline M. Doran, Academic Press



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III SEMESTER

7004 ANIMAL BIOTECHNOLOGY, BIOSAFETY AND I.P.R. (Elective)

UNIT I Animal Cell Culture (Equipments, Consumables & Media)

Equipments and materials used in animal cell culture. Sterilization and safety measures. Natural media, Synthetic media. Role of serum in cell culture. Advantages and disadvantages of serum in culture medium. Growth factors. Growth curve. Procedures for coating of culture surface. Cytotoxicity and viability assays. Measuring parameters of growth. Organ and histotypic cultures. Three dimensional culture and tissue engineering. Primary Culture and Tissue disaggregation. Subculture and Establishing Cell lines. Maintenance of cell culture and cell separation. Valuable products from cell culture.

Unit-II Cell Culture Technology

Biology and characterization of the cultured cells, measuring parameters of growth. Basic techniques of mammalian cell culture in vitro; Scaling-up of animal cell culture at commercial level. Cell synchronization. Cell cloning and micromanipulation. Cell transformation. Basics, embryonic & adult stem cells, Transdifferentiation, Applications Application of animal cell culture. Cultivation of Viruses. Molecular Diagnostics development based on cell culture for Virus.

Unit- III Transgenic Animals

In vitro fertilization, ET and cloning. Transgenic Animals and Transfection Methods Introduction, Transfection Methods, Gene transfer through microinjection , Retroviral infection, Targeted gene transfer. Gene disruption, gene replacement. Transgene integration . Gene therapy
Transgenic animal and their applications. Transgenic mice, sheep, goat, Rabbits, Cattle, Pigs and fish. Animal Bioreactors and molecular pharming. Animal cloning.

UNIT IV Applications of Animal Biotechnology

Application of molecular markers for improvement of live stock, Detection of transgenics, Construction of Molecular Maps. Prospects of transgenic livestock. Embryo and gamete sex selection; nuclear transplantation, sperm separation, embryonic sex selection

UNIT V Introduction to Biosafety and Bioethics

Biosafety issues in biotechnology - risk assessment and risk management - safety protocols: risk groups - biosafety levels - biosafety guidelines and regulations (National and International) - operation of biosafety guidelines and regulations - types of biosafety containments.



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Framework for ethical decision making; biotechnology and ethics - biotechnology in agriculture and environment: benefits and risks – benefits and risks of genetic engineering. Ethical and social issues related to transgenic animals.

UNIT VI Introduction to intellectual property and intellectual property rights

types: patents, copy rights, trade marks, design rights, geographical indications - importance of IPR patentable and non patentable - patenting life - legal protection of biotechnological inventions – GATT and other related treaties.

List of suggested reading:

1. Culture of Animal cells. Freshney, R.T. (2000) Alan R. Liss Inc. New York.
2. Biotechnology and genomics. (2008) Gupta, P.K. Rastogi Publications Meerut.
3. Molecular Biology and Genetic engineering. (2008) Gupta, P.K.
4. Text book of Biotechnology. Das, H.K.
5. Biotechnology. Singh, B. D. (2008) Kalyani Publishers, New Delhi.
6. Fundamentals of Genetics. 2004. Singh. B. D. Kalyani Publishers. New Delhi.
7. Bioethics and Biosafety in Biotechnology. Sreeramulu, V. (2007) New Age International Publishers. New Delhi.



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7005 ENVIRONMENTAL BIOTECHNOLOGY (elective)

UNIT-1:

Environmental and Biosensors ☐ Reducing environmental impact of industrial effluents
Toxic sites reclamation, removal of spilled oil and grease deposits and pollutants. Microbial
degradation of textile dyes, timber petroleum products, leather plastics and food product ☐
Biosensors, recent approaches and applications

UNIT-2:

Bio fertilizers ☐ Use of mycorrhizae in forests, ☐ Biofertilizers and biopesticides ☐ Role of
Dienococcus sp. in bioremediation of radioactive waste. Molecular mechanisms of radiation
resistant

UNIT-3:

Environment and energy ☐ Renewable source of energy: Biomass production and Biogas
production. Generation of energy and fuel using microorganisms (Hydrogen production and
Methane production) ☐ Brief account of alternative energy source: Biofuel etc. ☐
Conservation of energy: Global Warming and carbon credit ☐ Heavy metals and its effect on
microbes and higher organisms

UNIT-4:

Biodiversity, bioethics ☐ Biodiversity & species concept ☐ role of Biodiversity, ☐ Factors
threatening Biodiversity ☐ Endangered species management & Biodiversity protection

Books/Authors.

1. Introduction to environmental Biotechnology. Chatterji, A.K.
2. Test Book of Environmental Biotechnology. P.K. Mohapatra
I.K. International Publishers
3. Environmental Biotechnology. Alan H. Scragg.
O.U.Publishers.



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III SEMESTER

70006 INDUSTRIAL AND ANIMAL BIOTECHNOLOGY PRACTICAL

Part A

1. To prepare ginger beer.
2. To prepare sauerkraut, an eastern European fermented cuisine.
3. To prepare Korean fermented cuisine Kimchi and observe how it is different from Saurkraut.
4. To isolate amylase producing species of *Aspergillus species* and test for its presence.
5. To prepare bread using yeast as a leavening agent
6. To produce alcohol from grapes and test for its presence.
7. Isolation of protease producing microorganism and to detect its activity.
8. To cultivate mushroom.
9. To isolate citric acid producing *Aspergillus species* and process its purification.

Part B

1. Sterilization Procedures in Animal Cell Culture Lab.
2. Media Preparation in Animal Cell Culture.
3. Preparation of Serum.
4. BSS, General and Modified Media Preparation for Primary Culture.
5. Isolation and Identification of FMDV by Elisa based diagnostic kit.
6. Splenectomy (Mice) to demonstrate Splenocyte isolation for primary cell culture



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III SEMESTER

70007 MOLECULAR BIOLOGY AND BIOINFORMATICS PRACTICAL

1. Isolation of genomic DNA from blood and saliva
2. Demonstration of Agarose gel electrophoresis.
3. Amplification of desired gene fragment by PCR.
4. Isolation and purification of plasmid DNA
5. Quantification and purity check of DNA by spectrophotometer
6. To perform restriction digestion of λ DNA using *Eco* RI and *Hind* III enzymes.
7. To learn the process of DNA finger printing following RFLP method by restriction digestion of DNA and analysis of digested fragments in agarose gel electrophoresis.
8. To amplify specific RNA fragment by reverse transcription polymerase chain reaction.
9. To perform ORFing of DNA sequence.
10. Acquaintance of database of model organism
11. Making use of gene bank.
12. To perform BLAST of DNA sequence for pairwise sequence alignment
13. To perform multiple sequence alignment for phylogenetic analysis.
14. Retrieving and displaying a 3D structure from PDB data base
15. To perform SDS PAGE for protein.



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