P.K.University
Shivpuri (M.P.)

Syllabus
For
M.Sc. Biotechnology
(I, II, III & IV SEMESTER COURSE)

W.E.F. - Session 2023 - 2024

P.K.UNIVERSITY SHIVPURI (M.P.)

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M.Sc. Biotechnology Examination Scheme (2023-24)

Semester	Course Code	Title of the Paper	Credit	L	T	P	T-CCE	T-UE	P-CCE	P-UE	Marks
First	MMICRBT101	Microbiology	4	4	0	0	40	60	0	0	100
	MBIOCBT102	Biochemistry & Biophysics	4	4	0	0	40	60	0	0	100
	MCELLBT103	Cell biology	4	4	0	0	40	60	0	0	100
	MGENEBT104	Genetics & Molecular biology	4	4	0	0	40	60	0	0	100
	MLABCBI105	Lab Course I	2	0	0	4	0	0	20	30	50
	MLABCBI106	Lab Course II	2	0	0	4	0	0	20	30	50
		TOTAL	**20**				**160**	**240**	**40**	**60**	**500**
Second	MENZYBT107	Enzymology & Enzyme Technology	4	4	0	0	40	60	0	0	100
	MGENEBT108	Genetic Engineering	4	4	0	0	40	60	0	0	100
	MIMMUBT109	Immunology	4	4	0	0	40	60	0	0	100
	MPLANBT110	Plant Biotechnology	4	4	0	0	40	60	0	0	100
	MLABCBI111	Lab Course III	2	0	0	4	0	0	20	30	50
	MLABCBI112	Lab Course IV	2	0	0	4	0	0	20	30	50
		TOTAL	**20**				**160**	**240**	**40**	**60**	**500**
Third	MANIMBT201	Animal Cell Culture	4	4	0	0	40	60	0	0	100
	MENVIBT202	Environmental Biotechnology	4	4	0	0	40	60	0	0	100
	MTOOLBT203	Tools & Techniques in Biotechnology	4	4	0	0	40	60	0	0	100
	MSOCIBT204	Social, Ethical, Legal and Management issue	4	4	0	0	40	60	0	0	100
	MLABCBI205	Lab Course V	2	0	0	4	0	0	20	30	50
	MLABCBI206	Lab Course VI	2	0	0	4	0	0	20	30	50
		TOTAL	**20**				**160**	**240**	**40**	**60**	**500**
Fourth	MBIOPBT207	Bioprocess Engineering & Technology	4	4	0	0	40	60	0	0	100
	MBIOIBT208	Bioinformatics & Biostatistics	4	4	0	0	40	60	0	0	100
	MLABCBT209	Lab Course VII	2	0	0	4	0	0	20	30	50
	MDISSBT210	Dissertation	10	0	0		0	0	0	250	250
		TOTAL	**20**				**80**	**120**	**20**	**280**	**500**
		Total marks of all semester	**80**				**560**	**960**	**140**	**460**	**2000**

L – Lecture T- Theory P- Practical CCE- Continuous comprehensive Exam UE- University Exam

MMICRBT101: MICROBIOLOGY

UNIT I

Microbiology; History, different branches of microbiology

UNIT II

Microbial world; Brief account of bacteria, Cyanobacteria, Rickettsias, Mycoplasmas and Archaebacteria

UNIT III

Cultivation of Bacteria; Isolation, Purification, Enrichment techniques and maintenance, Culture Collection

UNIT IV

Growth: Phase of growth, measurement and growth yield

UNIT V

Identification of bacteria; Nomentclature, classification- new approaches including molecular parameters (16S rRNA sequencing and phylogenetic tree)

UNIT VI

Modes of Nutrition: sources and mode of nitrate reduction, nitrifying and denitrifying bacteria, Biological N_2 fixation and microbes used as biofertilizer

UNIT VII

Viruses: Classification, morphology and composition of viruses in general, viroids and prions

UNIT VIII

Extremophilic microbes – their biotechnological potentials, Microbes-role in human welfare

Reference Books

1. General Microbiology, R.Y. Ingraham, J.L. Wheelis, M.L. and Painter, P.R. The MacMillan Press Ltd.
2. Brock Biology of Microorganism, M.T. Martinko, J.M. and Parker, J. Prentice-Hall.
3. Microbiology, Pelzar, M.J., Chan , E.C.S. and Kreig, N.R., Tata McGraw Hill.
4. Microbial Genetics, Maloy , S.R., Cronan, J.E.Jr and Freifelder, D. Jones, Bartlett Publishers.
5. Microbiology-a Laboratory Manual,cappuccino, J.G. and Sherman, N. Addison Weseley.
6. Microbiological Applications, (A Laboratory Manual in General Microbiology) Benson, H.J. WCB: Wm C. Brown Publishers

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MBIOCBT102: BIOCHEMISTRY & BIOPHYSICS

UNIT I

Carbohydrate; Glycolysis, Gluconeogenesis, Krebs' Cycle, Electron transport chain, Oxidation Phosphorylation

UNIT II

Fatty acids; general properties and β- oxidation

UNIT III

Amino acids (general properties); Amino acid sequencing and composition; end group analysis

UNIT IV

Proteins: Protein structure (primary, secondary, tertiary &quarternary), Globular, Fibrous proteins; Ramachandran plot, Circular Dichroism, Hydrophobic and hydrophilic interactions. PAGE, SDS-PAGE, Diagonal Electrophoresis, MALDI

UNIT V

Protein folding (Introduction / Tools to study folding- unfolding phenomenon)

Reference Books

1 Principles of Biochemistry by Nelson, Cox and Lehninger
2 Biochemistry by G.Zubay
3 Biochemistry by Stryer
4 Biochemistry by Garrett and Grisham
5 Biochemical Calculations, Irwin H. Seigel, John Wiley and Sons Inc.
6 Biochemistry, DVoet and JG. Voet , J Wiley and Sons.
7 Biochemistry, D Freifilder, W.H. Freeman & Company.
8 Laboratory Techniques in Biochemistry and molecular Biology, Work and Work
9 A Biologist's guide to Principles and Techniques of Practical Biochemistry, Wilson &Goulding, ELBS Edition.

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MCELLBT103: CELL BIOLOGY

UNIT I
Cell membranes: methods to study organization of membranes

UNIT II
Transport across biomembranes: facilitated transport, group translocation, Active transport, Na+ -K+ ATPase pump

UNIT III
Cytoskeleton: Composition, organization and functions of Microfilaments, microtubules, intermediate filaments and associated proteins

UNIT IV
Basic concept of signals transduction

UNIT V
Cell adhesion; cell junctions, cell adhesion molecules

UNIT VI
Cell cycle and its control

UNIT VII
Biology of cancer cells and process of oncogenesis

Reference Books

1. Molecular Biology of the Cell, Alberts, *ET AL*
2. Molecular Cell Biology, Lodish, et al
3. Working with Molecular Cell Biology: A study Companion, Storrie*ET AL*
4. The Cell: A Molecular Approach, G.M. Cooper
5. The Word of the Cell, Becker *ET AL*
6. Cell Proliferation and Apoptosis, Hughes and Mehnet
7. Essential Cell Biology, Alberts*ET AL*
8. Biochemistry and Molecular Biology of Plants, Buchanan *ET AL*
9. Harpers Biochemistry Murray *ET AL*

NOTE: All text books are of latest editions.

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MGENEBT104: GENETICS & MOLECULAR BIOLOGY

UNIT I
Introduction to cell division, Mendelian Laws and physical basis of inheritance, dominance and its molecular basis

UNIT II
Basics of gene interaction, cis-trans- test and complementation test, lethal genes, polygenic traits, linkage and gene maps

UNIT III
DNA double helix: Physico- chemical considerations

UNIT IV
Organization of prokaryotic and eukaryotic genomes, supercoiling, repetitive DNA

UNIT V
DNA replication: Mechanism of replication of Prokaryotic & Eukaryotic Chromosome

UNIT VI
Mutation: Types and molecular mechanisms of mutations, mutagens, DNA Repair

UNIT VII
Transposition: Mechanisms of transposition, transposon mutagenesis

UNIT VIII
Recombination: Homologous and site – specific recombination

UNIT IX
Gene expression in eukaryotes: Transcription, general and specific transcriptions factors, regulatory elements and mechanism of regulation, processing of transcripts

UNIT X
Gene expression in bacteria: Transcription and its regulation; operons, attenuation, anti-termination and anti-sense controls

UNIT XI
Prokaryotic translation machinery, mechanism and regulation of translation, Post translational modifications

Reference Books

1. Genes VIII , by Benjamin Lewin
2. Molecular Biology, by Turner *ET AL*
3. Cell and Molecular Biology: Concepts and Experiments, by Gerald Karp
4. Transcriptional Regulation in Eukaryotes, by Carey and Smale
5. Translational control of gene Expression, by Sonenberg*ET AL*
6. Chromatin and Gene Regulation, by Turner
7. An Introduction to Genetic Analysis, by Griffiths *ET AL*
8. Genome, by Brown
9. Concepts of Genetics, by Klug and Cummings
10. Proteins, by Creighton
11. Molecular Cell Biology, by Lodhish*ET AL*
12. Biochemistry and Molecular Biology of Plants, by Buchanan
13. Plant Biochemistry and Molecular Biology, by Lea and Leegood
14. Plant Biochemistry, by Dey and Harborne

NOTE: All text books are of latest editions

MLABCBI105: Lab Course I

MLABCBI106: Lab Course II

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MENZYBT201: ENZYMOLOGY & ENZYME TECHNOLOGY

UNIT I
History of Enzymology

UNIT II
Classification and nomenclature of enzyme

UNIT III
Isolation and Purification of enzymes

UNIT IV
Coenzyme and Cofactors

UNIT V
Steady state kinetics: Methods for estimation of rate of enzyme catalyzed reaction with special reference to Michaelis- Menten equation. Effects of substrate, temperature, pH and inhibitors on enzyme activity and stability

UNIT VI
Active site, chemical modification and regulation (Zymogens and Isozymes)

UNIT VII
Enzyme engineering

UNIT VIII
Immobilization of Enzymes and cells

Reference Books

1 The Nature of Enzymology by R.L. Foster
2 Enzymes by Dixon and Webb
3 Fundamentals of Enzymology by Price and Stevens
4 Enzyme Catalysis and Regulation by Hammes
5 Enzyme Reaction Mechanisms by Walsch
6 The Enzymes vol I and II by Boyer
7 Enzyme Structure and Mechanism by Alan Fersht
8 Enzyme Assays: A Practical Approach by Eisenthal and Danson
9 Enzyme Biotechnology by G. Tripathi
10 Practical Biochemistry by Plummer.
11 Practical Biochemistry by Sawhney and R. Singh

MGENEBT202: GENETIC ENGINEERING

UNIT I

Restriction endonucleases, Modification methylases and other enzymes needed in genetic engineering

UNIT II

Cloning vectors: Plasmids and plasmid vectors, Phages and Phage Vectors, phagemids, cosmids, artificial chromosome vectors (YAC, BAC), Animal virus derived vectors –SV40 and retroviral vectors

UNIT III

Molecular cloning : Chromosomal DNA isolation (Animal, Plant and Bacteria), Transformation, construction of genomic DNA and cDNA libraries, screening of recombinants, Recombinant DNA techniques

UNIT IV

Expression strategies for heterologous genes

UNIT V

DNA analysis: labeling of DNA and RNA probes, Southern and flurorescence in situ hybridization, DNA fingerprinting

UNIT VI

Techniques for gene expression: Northern and Western blotting, gel retardation techniques, DNA footprinting, Primer extension, S1 mapping, Reporter assays.

UNIT VII

Sequencing of DNA, Chemical synthesis of oligonucleotides; techniques of site directed mutagenesis, gene replacement and gene targeting

UNIT VIII

Polymerase chain reaction and its applications

UNIT IX

Applications of genetic engineering : Transgenic animals, production of recombinant pharmaceuticals, gene therapy , disease diagnosis

UNIT X

Biosafety regulation: Physical and biological containment

Reference Books

1. Recombinant DNA – By Watson et al
2. Principles of Gene Manipulation, by Old and Primrose
3. Gene Cloning: An introduction, by Brown
4. Biotechnology: Theory and Techniques (Vol I & II), by Chirikjian
5. Molecular Genetics of Bacteria , Dale
6. Molecular Cloning (Vol I, II & III), by Sambrook& Russell
7. Applied Molecular Genetics, by Miesfeld
8. Genes and Genome, by Singer & Berg
9. Molecular Biotechnology, by Glick & Pasternak
10. Plant Molecular Biology (Vol I & II), by Gilmartin& Bowler

NOTE: All text books are of latest editions:

MIMMUBI203: IMMUNOLOGY

UNIT I
History of immunology

UNIT II
Nature of antigens, Antibody structure and function, Antigen – antibody reactions and applications

UNIT III
Major Histocompatibility Complex

UNIT IV
Complement system

UNIT V
Activation of B and T –lymphocytes, Immunological tolerance

UNIT VI
Cell-mediated cytotoxicity: Mechanism of cytotoxic T- cells and NK cells mediated target cell lysis, Antibody dependent cell-mediated cytotoxicity macrophages mediated cytotoxicity

UNIT VII
Hypersensitivity

UNIT VIII
Autoimmunity

UNIT IX
Transplantation

Reference Books

1 Kubey, Immunology, R.A. Goldsby, Thomas J. Kindt, Barbara, A. Osbarne. (Freeman).
2 Immunology-Ashort Course, -Eli Benjamini, Richard Coico, Geoffrey Sunshine.
3 Immunology by Tizzard
4 Fundamentals of immunology by William Paul.
5 Immunology by Roitt*ET AL*
6 Immunology by Abbas

MPLANBT204: PLANT BIOTECHNOLOGY

UNIT I

Tissue culture media, Initiation and maintenance of callus and suspension cultures; single cell clones

UNIT II

Totipotency: Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil (hardening)

UNIT III

Rapid clonal propagation and production of virus- free plants

UNIT IV

In vitro pollination; embryo culture and embryo rescue

UNIT V

Protoplast Fusion, selection of hybrid cells ; symmetric and asymmetric hybrids, cybrids

UNIT VI

Nuclear cytology of cultured plants cells and somaclonal variations

UNIT VII

Production of haploid plants and their utilization

UNIT VIII

Cryopreservation and slow growth for germplasm conservation

UNIT IX

Production of Biochemicals from cells and tissue cultures

UNIT X

Biochemical production

UNIT XI

Gene transfer in nuclear genome and chloroplasts; Agrobacterium- mediated gene transfer, direct gene transfer, antibiotic marker- free transgenics

UNIT XII

Transgenic plants: insect resistance, virus resistance, abiotic stress tolerance, longer shelf life (including strategies for suppression of endogenous genes), male sterility, enhanced nutrition (golden rice); edible vaccines, patent and IPR

UNIT XIII

Molecular markers: RFLP, RAPD, AFLP, applications of molecular markers, SNP

MLABCBI111: Lab Course III

MLABCBI112: Lab Course IV

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MANIMBT301: ANIMAL CELL CULTURE

UNIT I
Introduction to the balanced salt solutions and simple growth medium. Chemical, physical and metabolic functions of different constituents of culture medium

UNIT II
Basic techniques of mammalian cell cultures in vitro

UNIT III
Organ, organotypic and histotypic cultures

UNIT IV
Serum & protein free defined media and their applications

UNIT V
Measurements of growth, viability and cytotoxicity

UNIT VI
Cell synchronization and transformation

UNIT VII
Application of animal cell culture including stem cell applications

MENVIBTI302: ENVIRONMENTAL BIOTECHNOLOGY

UNIT I

Environment: Basic concepts; Environmental pollution; types of pollution; measurement of pollution and environment of pollution and environmental management

UNIT II

Waste water treatment- basic concept, Primary & secondary treatment, Suspended and attached culture, trickling, rotating and biological contactors, nitrogen and phosphorus removal, ponds systems

UNIT III

Water pollution and its control: Water as a resource; water bodies; need for water management; sources and measurement of water pollution , waste water treatment- basic concepts; physicochemical and biological treatment processes

UNIT IV

Tertiary treatment; disinfection and disposal

UNIT V

Biological treatment processes; biochemistry and microbiology of aerobic and anaerobic treatment processes; Suspended and attached growth type aerobic processes- activated sludge, Oxidation ditch , Aerated lagoons, Oxidation ponds and their variations

UNIT VI

Anaerobic processes – Anaerobic digesters, fixed and fluidized types of anaerobic bioreactors, UASB bioreactors, Treatment of typical industrial effluents – Diary, distillery, sugar and antibiotic industries

UNIT VII

Global environmental problems; Ozone depletion, UV- B radiation and greenhouse gases

UNIT VIII

Brief account of bioremediation

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MTOOLBT303: TOOLS AND TECHNIQUES IN BIOTECHNOLOGY

UNIT I

Principle and applications, simple, compound, phase- contrast and fluorescent microscopes, Electron Microscopy: SEM and TEM. Centrifugation techniques: Principles, type of centrifuges, density gradient centrifugation in isolation of cells, cell organelles and biomolecules.

UNIT II

Electromagnetic spectrum, Beer Lambert's Law.Photometry, UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy, ESR and NMR spectroscopy, Mass spectroscopy (LC-MS, GC-MS), Fluorescent spectroscopy.Application of different spectroscopic techniques in Biology.

UNIT III

Introduction and types of chromatography, paper thin layer, Gas, Gel permeation, ion – exchange, HPLC, FPLC and affinity chromatography and instrumental details of each.Applications of Chromatographic techniques in Biology.

UNIT IV

Paper and gel electrophoresis, Polyacrylamide gel electrophoresis (native and SDS), Agarose gel electrophoresis, Blotting–Southern, Western and Northern blotting, Immunoblotting, Immunoelectrophoresis, DNA finger printing and ELISA.

UNIT V

Nature and types of radiations, preparation of labeled biological samples. Detection and measurement of radioactivity, GM counter, Scintillation counter, Autoradiography, Flow cytometry. Safety measures.

MSOCIBT304: SOCIAL, ETHICAL, LEGAL AND MANAGEMENT ISSUES

UNIT I

IPR – Patent and copyright. Patentability of life forms with special reference to Microorganisms, pharmaceutical Industries, Biodiversity, Naturally occurring substances. Human genome and IPR.Issue on IPR in Public – Private Partnership, Availabilities of Patent facilitating funds, Substantive Patent Law Treaty (SPLT), Word patent, European Patent.

UNIT II

Social- genetic discrimination: insurance and employment, human cloning, foeticide, sex determination, Religious consideration in stem cell therapy

UNIT III

Ethical: somatic and germ line gene therapy, clinical trials, the right to information, ethics committee function. Social and ethical issues Ethics in human stem cell research FDA product and regulatory considerations in stem cell

UNIT IV

Biosafety – Definition, Requirement, Biosafety containment facilities, biohazards, genetically modified organisms (GMOs), living modified organisms (LMOs), Biosafety for human health and environment designing and management of laboratory and culture room as per the norm of GLP, GMP and FDA.

UNIT V

Management – Planning, Organizing, Leading & Controlling; Concepts and characteristics of information; Importance of MIS; Communication – type, channels & barriers; Financial management, planning and control.

MLABCBI205: Lab Course V

MLABCBI206: Lab Course VI

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MSOCIBT401: BIOPROCESS ENGINEERING & TECHNOLOGY

UNIT I
Screening and improvement of industrially important microorganisms

UNIT II
Microbial growth and death kinetics

UNIT III
Introduction to food technology

UNIT IV
Air and media sterilization

UNIT V
Types of fermentation processes – Analysis of batch, Fed – batch and continuous bio reactions, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bio reactors etc.)

UNIT VI
Measurement and control of bioprocess parameters

UNIT VII
Downstream processing

UNITVIII
Industrial production of chemical – Ethanol, Acid (Citric, acetic and gluconic), solvents (glycerol, acetone and butanol), Antibiotics (penicillin, streptomycin and tetracycline), Semisynthetic antibiotics, Amino acids (lysine and glutamic acid), Single cell protein

UNIT IX
Aeration and agitation: Requirement of oxygen in industrial processes. Concept of volumetric oxygen transfer coefficient and its determination (kLa). Factors affecting (kLa)

MSOCIBT402: BIOINFORMATICS & BIOSTATISTICS

UNIT I
Introduction to bioinformatics

UNIT II
Searching database, Alignment of gene sequences, Local and global

UNIT III
Analysis of DNA sequence: Gene prediction and locating genes, location of transcription start point and end point, getting polypeptide sequence of the extracted core nucleotide sequence, Designing primers of specific gene, Generation of restriction maps

UNIT IV
Analysis phylogenetic relationship based on nucleotide and protein sequences

UNIT V
Analysis of proteins: Protein classification, homology modeling, threading, Ab- initio prediction of protein structure (secondary and 3 dimensional), tools for structure prediction, validation and visualization

UNIT VI
Diagrammatic, graphical and tabular representations of data; measures of central tendency, dispersion, skewness and kurtosis

UNIT VII
Pearson correlation coefficient

UNIT VIII
Basic concepts of hypothesis testing, two kinds of error, level significance, p value, t- test for mean and difference between two means, partial t-test, and chi-square test for goodness of fit

UNIT IX
IPR

MLABCBT208: Lab Course VII

MPLANBT209: Dissertation