AS PER THE UGC GUIDELINES FOR THE CHOICE BASED CREDIT SYSTEM

St. Aloysius' College (Autonomous), Jabalpur

DEPARTMENT OF BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

Distribution of credits

M. Sc. Biotechnology

S. No.	Type of Subject/Activity	Number of Paper	Credit Per Paper/Practical	Total Credit
1.	Core	11	04	44
2.	Electives	02	02	04
3.	Practical	03	08	24
5.	Soft skills	02	02	04
6.	Dissertation and Comprehensive Viva	01	24	24
				100 Credits

Distribution of Marks and Credits

Course Code	Paper title	End Semester Exam	CIA	Credits
Semester First				
BT 101	**Cell & Developmental Biology (Core)**	**70**	**30**	**4 Credits**
BT 102	**Biomolecules (Core)**	**70**	**30**	**4 Credits**
BT 103	**Molecular Biology (Core)**	**70**	**30**	**4 Credits**
BT 104	**Analytical Techniques (Core)**	**70**	**30**	**4 Credits**
BT 105	**Practical**	**100**		**8 Credits**
Semester Second				
BT 201	**Immunology (Core)**	**70**	**30**	**4 Credits**
BT 202	**Microbiology and Industrial Applications (Core)**	**70**	**30**	**4 Credits**
BT 203	**Genetic Engineering (Core)**	**70**	**30**	**4 Credits**
BT 204	**Biostatistics and Bioinfomatics (Core)**	**70**	**30**	**4 Credits**
BT 205	**Environment and Elementary Ecology (Elective)#**	**100**		**2 Credits**
BT 206	**Basics of Management (Elective)#**	**100**		**2 credits**
BT 207	**Soft Skills**	**50**		**2 Credits**
BT 208	**Practical**	**100**		**8 Credits**
Semester Third				
BT 301	**Bioprocess Engineering & Environmental Biotechnology (Core)**	**70**	**30**	**4 Credits**
BT 302	**Plant Biotechnology (Core)**	**70**	**30**	**4 Credits**
BT 303	**Animal Biotechnology (Core)**	**70**	**30**	**4 Credits**
BT 304	**Medical Biotechnology(Elective)#**	**100**		**2 Credits**
BT 305	**Applied Oncology (Elective)#**	**100**		**2 Credits**
BT 306	**Soft Skills**	**50**		**2 Credits**
BT 307	**Practical**	**100**		**8 Credits**
Semester Four				
BT 301	**Dissertation**	**200**		**24 Credits**
BT 302	**Comprehensive viva-voce**	**50**		
BT 303	**Seminar**	**50**		
#any 1 out of 2 electives should be chosen by the students				
Grand Total (All Semesters) = 2000		**Total no. of Credits (All Semesters) = 100**		

M.Sc. Biotechnology Syllabus
SEMESTER – I

Course Code	Title	Credits
BT 101	Cell & Developmental Biology **(Core)**	**04**
BT 102	Biomolecules **(Core)**	**04**
BT 103	Molecular Biology **(Core)**	**04**
BT 104	Analytical Techniques **(Core)**	**04**
BT 105	Practical	**08**
	TOTAL	**24 Credits**

SEMESTER – II

Course Code	Title	Credits
BT 201	Immunology **(Core)**	**04**
BT 202	Microbiology and Industrial Applications **(Core)**	**04**
BT 203	Genetic Engineering **(Core)**	**04**
BT 204	Biostatistics and Bioinfomatics **(Core)**	**04**
BT 205	Environment and Elementary Ecology (Elective)[#]	**02**
BT 206	Basics of Management (Elective**)** [#]	**02**
BT 207	Soft Skills	**02**
BT 208	Practical	**08**
	TOTAL	**28 Credits**

SEMESTER – III

Course Code	Title	Credits
BT 301	Bioprocess Engineering & Environmental Biotechnology **(Core)**	**04**
BT 302	Plant Biotechnology **(Core)**	**04**
BT 303	Animal Biotechnology **(Core)**	**04**
BT 304	Medical Biotechnology**(Elective)**[#]	**02**
BT 305	Applied Oncology **(Elective)**[#]	**02**
BT 306	Soft Skills	**02**
BT 307	Practical	**08**
	TOTAL	**24 Credits**

[#]any 1 out of 2 electives should be chosen by the students

SEMESTER – IV

Course Code	Title	Credits
BT 301	Dissertation	**24**
BT 302	Comprehensive viva-voce	
BT 303	Seminar	
	TOTAL	**24 Credits**

Total Credits……..100 Credits

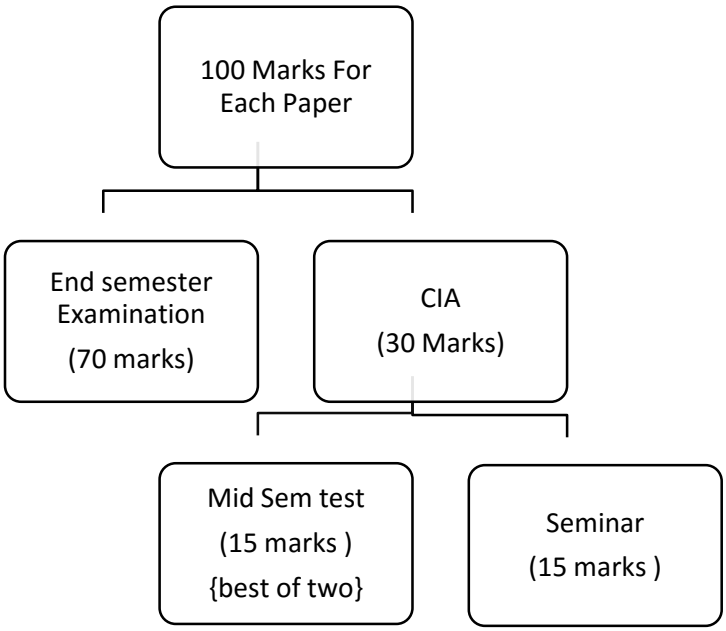
DISTRIBUTION OF MARKS

(i) The scheme of assessment during the semester (30 marks):

(a) The assessment (sessional) in theory courses shall comprise a class test of 1 hour duration for 15 marks and 15 marks will be awarded for the seminar/ paper presentation/tutorial.

(b) The class tests shall be conducted by the teacher (or group of teachers) teaching the course and the marks shall be displayed on the Notice Board. The evaluated test copies will be shown to the students. The tests will be conducted in the middle of each semester.

(ii) End Semester Examination and evaluation (70 marks):



Mode of CIA – Test, Seminars, , Environmental and Immunological Survey etc.,

First Semester

Course Code	Title	Credits	Theory	CIA
BT 101	Cell & Developmental Biology **(Core)**	04	70 marks	30marks
BT 102	Biomolecules **(Core)**	04	70 marks	30marks
BT 103	Molecular Biology **(Core)**	04	70 marks	30marks
BT 104	Analytical Techniques **(Core)**	04	70 marks	30marks
BT 106	Practical	08	100 marks	-
	TOTAL	**24 credits**	**500 marks**	

Paper I

Cell & Developmental Biology

Unit 1

Principles of Microscopy: Optical (including Phase contrast and Differential interference);Fluorescence, Confocal and Electron Microscopy.

Structure of Cell (Bacterial, Plant and Animal): Cell membranes, Composition & architecture of Cell Wall.

Unit 2

Structure and function of organelles (mitochondria, chloroplast, Nucleus, Golgi apparatus, Lysosomes,Ribosomes) and Cytoskeletal elements.

Cell adhesion; cell junctions, cell adhesion molecules & extra-cellular matrix.

Unit 3

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

Basic concepts of signal transduction.

Cell cycle and its control.

Unit 4

Developmental biology- developmental stages in frog.

Spatial and temporal gene expression and developmental stages in drosophila and Arabidopsis.

Organization of Root Apical Meristem (RAM); Pollen germination and pollen tube guidance; Self-incompatibility and its genetic control.

Unit 5

Brief introduction to the biology of following pathogens: AIDS, Malaria, Tuberculosis ,Hepatitis, Filaria and Kalazar.

Paper II
Biomolecules

Unit - I

Chemical basis of life:

Types of chemical bonds- electrostatic, covalent, van der walls' interactions, hydrogen bonding,

Composition of living matter; Water – properties, pH and buffers ,

Nucleic acids- their basic structures and various forms of DNA (A,B,Z). Supercoiling

Unit 2

Proteins:

Primary, secondary, tertiary and quaternary structure of protein; RamachandranPlot , Protein folding; Structure-function relationships in model proteins like ribonuclease A, myoglobin, hemoglobin, chymotrypsin. Protein- protein interaction

Unit - III

Enzyme catalysis:

Classification and nomenclature of enzymes, Steady state kinetics: Methods for estimation of rate of enzyme catalyzed reaction with specialreference to Michaelis-Menten equation. Effects of substrate, temperature, pH and inhibitors on enzyme activity and stability.

Mechanism of enzyme action (active site, chemical modification) and regulation(Zymogens,Isozymes), Applications of enzymes, Immobilization of Enzymes, Coenzymes and Cofactors.

Unit - IV

Sugars and lipids (Carbohydrates):

An overview of structure & function of Carbohydrate and Lipids and properties of important members of storage and membrane lipids; lipoproteins, β-oxidation of fatty acids.

Unit V

Basic principles; Equilibria and concept of free energy; Coupled processes; Glycolytic pathway; Kreb's cycle; Oxidative phosphorylation; Photosynthesis; Elucidation of metabolic pathways; Logic and integration of central metabolism; entry/ exit of various biomolecules from central pathways; Regulatory steps.

Paper III
Molecular Biology

Unit I
Genome organization
Organization of bacterial genome; Structure of eukaryotic chromosomes; Heterochromatin and Euchromatin; DNA re-association kinetics (Cot curve analysis); Repetitive and unique sequences; Satellite DNA; DNA melting and buoyant density; Nucleosome phasing; DNase I hypersensitive regions; DNA methylation & Imprinting.

Unit II
DNA Structure; Replication; Repair & Recombination
Replication initiation, elongation and termination in prokaryotes and eukaryotes; Enzymes and accessory proteins; Fidelity; Replication of single strandedcircular DNA; Gene stability.
DNA repair- enzymes; Photoreactivation; Excision repair; Mismatch correction; SOS repair;
Recombination: Homologous and non-homologous; Site specific recombination.

Unit III
Prokaryotic & Eukaryotic Transcription
Prokaryotic Transcription; Transcription unit; Promoters- Constitutive and Inducible; Operators; Regulatory elements; Initiation; Attenuation; Termination-Rho-dependent and independent; Anti-termination; Transcriptional regulation-Positive and negative; Operon concept-lac, trp, operons; Transcriptional control in lambda phage; Transcript processing; Processing of tRNA and rRNA Eukaryotic transcription and regulation; RNA polymerase structure and assembly; RNA polymerase I, II, III; Eukaryotic promoters and enhancers; General Transcription factors; TATA binding proteins (TBP) and TBP associated factors (TAF); Transcriptional and post-transcriptional gene silencing

Unit IV
Post Transcriptional Modifications
Processing of hnRNA, tRNA, rRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing; RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA.
Translation & Transport
Translation machinery; Ribosomes; Composition and assembly; Universal genetic code;
Degeneracy of codons; Termination codons; Wobble hypothesis; Mechanism of initiation, elongation and termination; Co- and post-translational modifications.

Unit V
Mutations; Oncogenes and Tumor suppressor genes
Physical, chemical and biological mutagens; Nonsense, missense and point mutations; Intragenic and Intergenic suppression; Frame shift mutations; Physical, chemical and biological mutagens; Transposition - Transposable genetic elements in prokaryotes and eukaryotes; Mechanisms of transposition; Role of transposons in mutation; Viral and cellular oncogenes; Tumor suppressor genes from humans; Structure, function and mechanism of action of pRB and p53 tumor suppressor proteins; Activation of oncogenes and dominant negative effect; Suppression of tumor suppressor genes; Oncogenes as transcriptional activators.

Paper IV
Analytical techniques

Unit I

Spectroscopy Techniques

UV, Visible and Raman Spectroscopy; Theory and application of Circular Dichroism; Fluorescence; MS, NMR, PMR, ESR and Plasma Emission spectroscopy

Unit II

Chromatography Techniques

TLC and Paper chromatography; Chromatographic methods for macromolecule separation - Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC.

Electrophoretic techniques

Theory and application of Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis, PAGE and SDS-PAGE

Unit III

Centrifugation

Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc); Types of centrifuge -Micro centrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications (Isolation of cell components); Analytical centrifugation; Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods.

Unit IV

Radioactivity

Radioactive & stable isotopes; Pattern and rate of radioactive decay; Units of radioactivity; Measurement of radioactivity; Geiger-Muller counter; Solid & Liquid scintillation counters (Basic principle, instrumentation & technique; Autoradiography; Measurement of stable isotopes; Falling drop method; Applications of isotopes in biochemistry; Radiotracer techniques; Distribution studies; Isotope dilution technique; Metabolic studies; Clinical application; Radioimmunoassay

Unit V

Advanced Techniques

Protein crystallization; Theory and methods; API-electrospray and MALDI-TOF; Mass spectrometry; Enzyme and cell immobilization techniques; DNA & Peptide Synthesis.

PRACTICALS

Paper 1- Cell and Developmental Biology

1. Study of mitosis and Meiosis from/plant material
2. Principle and practice of microscopy: bright field, phase contrast and fluorescence
3. Microscopic examination of malarial parasite and tuberculosis in permanent slides
4. Microscopic examination of sperms

Paper 2- Biomolecules

1. Titration of amino acids and calculation of pK value.
2. To determine unknown protein concentration by spectrophotometric method.
3. Enzyme Kinetics of alkaline phosphatase from goat liver.
4. Quantitative estimation of DNA by spectrophotometric method.
5. Quantitative estimation of RNA by colorimetric method.

Paper 3- Molecular Biology

1. Isolation of plant genomic DNA from leaves
2. Isolation of bacterial genomic DNA
3. Plasmid DNA isolation.
4. Restriction digestion of bacterial DNA.
5. Bacterial conjugation.

Paper 4- Analytical Techniques

1. Gel filtration chromatography for separation of macromolecules.
2. Native PAGE of given protein sample
3. Agarose gel electrophoresis of given DNA sample
4. Thin layer chromatography of given sample

SEMESTER II

Course Code	Title	Credits	Theory	CIA
BT 201	Immunology **(Core)**	04	70 marks	30 marks
BT 202	Microbiology and Industrial Applications **(Core)**	04	70 marks	30 marks
BT 203	Genetic Engineering **(Core)**	04	70 marks	30 marks
BT 204	Biostatistics and Bioinfomatics **(Core)**	04	70 marks	30 marks
BT 205	Environment and Elementary Ecology **(Elective)**[#]	02	100 marks	-
BT 105	Basics of Management **(Elective)** [#]	02	100marks	-
BT 207	Soft Skills	02	50 marks	-
BT 208	Practical	08	100 marks	-
	TOTAL	**28**	**650 marks**	

Paper V
Immunology

Unit I

Immunology- fundamental concepts and anatomy of the immune system

Components of innate and acquired immunity; Phagocytosis; Complement and Inflammatory responses; Haematopoesis; Organs and cells of the immune system- primary and secondary lymphoid organs; Lymphatic system; lymphocyte circulation; Lymphocyte homing; Mucosal and Cutaneous associated Lymphoid tissue.(MALT&CALT); Mucosal Immunity; Antigens - immunogens, haptens- Hapten-carrier system; Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility, HLA typing.

Unit II

Immune responses generated by B and T lymphocytes

Immunoglobulins-basic structure, classes & subclasses of immunoglobulins, antigenic determinants; Multigene organization of immunoglobulin genes; B-cell receptor; Immunoglobulin superfamily;Basis of self –non-self discrimination; Kinetics of immune response, memory; B cell maturation, activation and differentiation; Generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; Functional T Cell Subsets; Cell-mediated immune responses, ADCC; Cytokines-properties, receptors and therapeutic uses; Antigen processing and presentation- endogenous antigens, exogenous antigens; non-peptide bacterial antigens and super antigens.

Unit III

Antigen-antibody interactions

Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, Western blotting, immunofluorescence, flow cytometry and immunoelectron microscopy; Surface plasmon resonance, Biosensor assays for assessing ligand –receptor interaction, lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays,

Unit IV

Vaccinology

Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; chimeric and hybrid monoclonal antibodies;

Unit V

Clinical Immunology

Immunity to Infection: Bacteria, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity – Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Transplantation – Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy; Tumor immunology – Tumor antigens; Immune response to tumors and tumor evasion of the immune system, Cancer immunotherapy;

Paper VI
Microbiology

UNIT-I

The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields; synchronous growth; growth as affected by environmental factors like temperature, acidity, water availability and oxygen; cult ure collection and maintenance of cultures, continuous culture.

UNIT-II

Metabolic diversity among microorganisms, photosynthesis in microorganisms; role of chlorophylls, carotenoids and phycobilins: Calvin cycle; chemolithotrophy; hydrogen-ironnitrite oxidizing bacteria; nitrate and sulfate reduction; methanogenesis and acetogenesis; fermentations-diversity, syntrophy, role of anoxic decompositions; nitrogen fixation; hydrocarbon transformation.

UNIT-III

Structural diversity of bacteria: purple and green bacteria, cyanobacteria, homoacotogenic bacteria, acetic acid bacteria, budding and appendaged bacteria, spirilla, spriochaetes, gliding and sheathed bacteria, pseudomonads, lactic and propionic acid bacteria, endospore forming rods and cocci, mycobacteria, rickettsias, chlamydias and mycoplasms, methanogens;
Structural diversity of viruses: bacterial, plant, animal and tumor viruses examples of herpes, pox, adenoviruses, retroviruses, viroids and prions.

UNIT-IV

Host-parasite relationship: entry of pathogens into the host; colonization types of toxins: exo-endo-and entero-toxins and their structures, mode of action, Chemotherapy/antibiotics: antimicrobial agents, sulfa drugs, antibiotics, penicillins and cephalosporins, broad spectrum antibiotics, mode of action, resistance to antibiotics.

UNIT-V

Genes, mutation and mutagenesis; UV and chemical mutagens; types of mutation; Ames test for mutagenesis, methods of genetic analysis. Bacterial genetic system: transformation, conjugation, transduction, recombination, plasmids and transposons in bacteria ; bacterial genetics map with reference to E. coli.

Paper- VII
Biostatistics & bioinformatics

Unit- I

Introduction: Definition, scope and limitations of biostatistics; collection, classification, tabulation, graphical and diagrammatic representation of data; measure of central tendency: mean (arithmetic, harmonic & geometric), median and mode; confidence limit of the population mean.

Unit-II

Measure of dispersion: Range, standard deviation, variance, coefficient of variation; definition and basic properties of probability, normal and binomial probability distribution functions, test of significance, hypothesis, error, level of significance; t-statistics, paired 't' test.

Unit –III

F- statistics: one way analysis of variance (sample size equal and unequal), Chi square statistics: test of goodness of fit, test of independence of factors; co-relation and its coefficient; linear regression and its coefficient, regression equation and its diagrams.

Unit-IV

Overview and functions of a computer system, introduction to Database concept, introduction to internet concept and its applications, Introduction to MS Office

Types of modern computers: The work station, the minicomputer, mainframe computers, parallel processing computer, the super computer etc.

Unit-V

Introduction to bioinformatics, searching databases and locating genes, phylogenetic analysis- introduction,

Pair Wise Sequence Alignment of gene sequences- local and global, BLAST and its variants; FASTA,Computer aided drug designing- concepts, methods and practical approaches and various computational methods.

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Paper- VIII
Genetic Engineering

Unit-I

Scope of genetic engineering, milestones in genetic engineering; chemical synthesis of DNA, cloning and patenting of life forms; genetic engineering guidelines; molecular tools and their applications; restriction enzymes, modification enzymes, DNA and RNA markers; nucleic acid purification, yield analysis.

Unit-II

Nucleic acid amplification and its types- RT-PCR, Nested-PCR, Anchored -PCR , gene cloning vectors-plasmids, bacteriophages, phagemids, cosmids, artificial chromosomes; restriction mapping of DNA fragments and map construction; nucleic acid sequencing; cDNA synthesis and cloning; reverse transcription, DNA primers, linkers, adaptors, library construction and screening.

Unit-III

Alternative strategies of gene cloning; cloning interacting genes-two-and three hybrid systems, cloning differentially expressed genes, nucleic acid micro array; site-directed mutagenesis and protein engineering; gene regulation-DNA transfection, Northern blot, primer extension, S1 mapping, RNase protection assay, reporter assays.

Unit-IV

Expression strategies for heterologous genes; vector engineering and codon optimization, host engineering; in vitro transcription and translation, expression in bacteria, yeast, insects and insect cells, mammalian cells, plants; processing of recombinant proteins-purification and refolding, characterization of recombinant proteins, stabilization of proteins; phage display.

Unit-V

Transposons in maize; T-DNA and transposon tagging; transgenic technology in plants and animals and strategies for gene delivery, gene knockout technologies , targeted gene replacement, chromosome engineering; gene therapy ; gene replacement/augmentation, gene silencing; siRNA Technology.

PRACTICALS

Paper 5- Immunology

1. Blood film preparation and identification of cells.
2. Lymphoid organs and their microscopic organization.
3. Double diffusion assay.
4. Immuno-electrophoresis
5. Radial Immuno diffusion.
6. Dot ELISA.
7. Blood smear identification of leucocytes by Giemsa stain.
8. Separation of leucocytes by dextran method.
9. Separation of mononuclear cells by Ficoll-Hypaque.

Paper 6- Microbiology and Industrial Applications

1. Identification and culturing of various microorganisms.
2. Growth curve; measurement of bacterial population by turbidometry and serial dilution methods; effects of temperature, pH, carbon and nitrogen sources on growth.
3. Assay of antibiotics and demonstration of antibiotic resistance.
4. Determination of thermal death point and thermal death time of microorganisms.

Paper 7- Genetic Engineering

1. Isolation of genomic DNA from Bacteria.
2. PCR amplification
3. Isolation of plasmid DNA.
4. Restriction digestion of bacterial DNA.

Paper 8- Biostatistics and Bioinfomatics

1. Computation of various measures of dispersion by using Excel.
2. Student's 't' test, 'F' and ' chi' square test.
3. Pubmed.
4. BLAST.
5. Database- NCBI.

Elective Course - I
Environment and Elementary Ecology

Unit I

Major biomes of the world, tropical rain and seasonal forests, temperate rain and seasonal forests, boreal forests, grasslands, deserts, aquatic ecosystems wetlands, lakes and pond streams and rivers, marine and estuarine habitats.

Unit II

Resource utilization, status and utilization of biodiversity, sustainable development resources from forest, grassland and aquatic habitats. Food forage, fodder, timber and non-wood forest products. Threats to quality and quantity of resources due to overexploitation.

Unit III

Strategies for conservation of resources: classifications of resources. Principles of conservation, *In-situ* conservation sanctuaries , national parks, biosphere reserves for wildlife conservation, habitat conservation practices of conservation for forests range. Soil and water.

Unit IV

Introduction to Ecology: Definition & Scope; Environment: Physical environment, biotic environment, biotic and abiotic interaction.

Population Ecology: Characterstics of a population, population growth curves, population regulation, concept of meta-population.

Unit V

Ecological succession: types, mechanism, models of succession.

Community organization: Types of species interaction, food chain, food web, ecological pyramids, energy flow.

Elective Course -II
Basics of Management

Unit-I
Management Concepts: meaning, thoughts, scope and importance of management, Concept of functions of management, Concept of organization, Delegation, Types of organization and organization charts.

Unit-II
Basic HD concept. Business communication, practical application: letters, memoranda, reports, summaries and notes, group communication, meetings, advertising and public relation.

Unit-III
Financial management: concept of money, accounting, double entry system, vouchers, journals, ledgers, profit and loss account, balance sheet, costing: direct and indirect cost, marginal cost, breakeven point, budgetary control, zero based budgeting..

Unit-IV
Marketing Concept: different between sales and marketing, customer satisfaction, customer retention, CRM, market mix, product mix, product life cycle, distribution.

Unit-V
Organization behavior: motivation techniques, leadership skills, decision making skills, interpersonal skills, negotiation, conflict resolution, individual behavior and group behaviour.

Semester 3

Course Code	Title	Credits	Theory	CIA
BT 301	Bioprocess Engineering & Environmental Biotechnology **(Core)**	04	70 marks	30 marks
BT 303	Plant Biotechnology **(Core)**	04	70 marks	30 marks
BT 304	Animal Biotechnology **(Core)**	04	70 marks	30 marks
BT 305	Medical Biotechnology**(Elective)**#	02	100 marks	-
BT 306	Applied Oncology **(Elective)**#	02	100 marks	-
BT 307	Soft Skills	02	50 marks	-
BT 308	Practical	08	100 marks	-
	TOTAL	**24**	**550 marks**	

Paper-9
Bioprocess Engineering & Environmental Biotechnology

Unit-I

Basic principle of Biochemical engineering

Isolation, screening and maintenance of industrially important microbes; Microbial growth and death kinetics Strain improvement for increased yield

Concepts of basic mode of fermentation processes

Bioreactor designs; Types of fermentation and fermenters; Concepts of basic modes of fermentation - Batch, fed batch and continuous; biotransformation; Solid substrate, surface and submerged fermentation; Fermentation media; Fermenter design – mechanically agitated; Large scale animal and plant cell cultivation and air sterilization; Upstream processing: Media formulation; Sterilization; Aeration and agitation in bioprocess; Measurement and control of bioprocess parameters; Scale up and scale down process.

Unit-II

Downstream processing

Bioseparation - filtration, centrifugation, sedimentation, flocculation; Cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; Reverse osmosis and ultra filtration; Drying; Crystallization; Storage and packaging; Treatment of effluent and its disposal.

Unit-III

Industrial production: Ethyl alcohol, citric and acetic acids; enzymes; amylases, proteases, cellulases; vitamins: vitamin B12, vitamin C, antibiotics (penicillin, streptomycin, tetracycline). Microbes in petroleum industry (oil recovery); whole cell immobilization and their industrial application.

Introduction to Food Technology

Elementary Idea of canning and packing.Dairy Microbiology: Source & types of Micro-organisms, microbial examination of milk, pasteurization & Phophatase test, sterilization of milk, grades of milk, Dairy products- butter & cheese.

Unit-IV

Environment: Basic concepts and issues; environmental pollution; measurement of soil pollution (pesticides and fertilizers) ; air sampling techniques

Microbial degradation and bioremediation of xenobiotics in the environment, decay behaviour & degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides;bioremediation of contaminated soils, bioaccumulation of metals and their detoxification;

Unit-V

Biological N2 fixation, H2 production, biofertilizers and biopesticides; solid wastes; sources and management (composting, vermiculture and methane production). Single cell protein (Spirulina, yeast, mushroom); global environmental problems-ozone depletion, UV-B , green house effect and acid rain, their impact, biotechnological approaches for their management.

Paper -10
Plant Biotechnology

Unit-I

Plant Tissue Culture

Historical perspective; Totipotency; Organogenesis; Somatic embryogenesis; Regulation and applications; Artificial seed production; Micropropagation; Somaclonal variation; Androgenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation.

Protoplast Culture and Somatic Hybridization

Protoplast isolation; Culture and usage; Somatic hybridization – methods and applications; Cybrids and somatic cell genetics.

Unit-II

Agrobiology

Agrobacterium-plant interaction; Virulence; Ti and Ri plasmids; Opines and their significance; T-DNA transfer; Disarming the Ti plasmid.

Genetic Transformation

Agrobacterium-mediated gene delivery; Co integrate and binary vectors and their utility; Direct gene transfer-PEG-mediated, electroporation, particle bombardment and alternative methods; Screen able and selectable markers; Characterization of transgenics; Chloroplast transformation; Marker-free methodologies; Gene targeting.

Unit-III

Molecular Mapping & Marker Assisted Selection (MAS)

Quantitative and qualitative traits; MAS for genes of agronomic importance, e.g. insert resistance, grain quality and grain yield; Molecular polymorphism, Dominant & Co-dominant markers; Construction of genetic and physical map; Gene QTL mapping and cloning; Strategies for Introducing Biotic and Abiotic Stress Resistance/Tolerance

Bacterial resistance; Viral resistance; Fungal resistance; Insects and pathogens resistance; Herbicide resistance; Drought, salinity, thermal stress, flooding and submergence tolerance.

Unit-IV

Genetic Engineering for Plant Architecture and Metabolism

Seed storage proteins; Proteins engineering; Vitamins and other value addition compounds; Source-sink relationships for yield increase;

Fermentation and production of industrial enzymes, vitamins and antibiotics and other biomolecules; Cell cultures for secondary metabolite production; Production of pharmaceutically important compounds; Bioenergy generation.

Unit-V

Chloroplast transformation: advantages, vectors, success with tobacco and potato; metabolic engineering and industrial products; phenyl propanoid pathway, Shikimate pathway:- alkaloids, industrial enzymes; biodegradable plasticsPolyhydroxybutyrate; therapeutic proteins; lysosomal enzymes, antibodies, edible vaccines purification strategies.

Patent & Agencies for patenting PBR & Farmers right and release of new variety.

Paper-11
Animal Biotechnology

Unit-I
Structure and organization of animal cell; equipments and materials for animal cell culture technology; primary and established cell lines cultures; introduction to the balanced salt solutions and simple growth medium; brief account of chemical, physical and metabolic functions of different constituents of culture medium; role of carbon dioxide, serum and supplements.

Unit- II
Serum and protein free defined media and their application, measurement of viability and cytotoxicity; biology and characterization of the cultured cells, measuring parameters of growth; basic techniques of mammalian cell culture in vitro; disaggregation of tissue and primary culture; maintenance of cell culture; cell separation.

Unit- III
Scaling up of animal cell culture, cell synchronization, cell cloning and micromanipulation, cell transformation.

Unit- IV
Embryonic stem cells and their culture, stem cell cultures (epithelial cell culture), Application of animal cell cultures, cell culture based vaccines, somatic cell genetics. Introduction of assisted reproductive technologies for genetic improvement of farm animals.

Unit- V
Organ and histotypic culture, measurement of cell death, apoptosis, three dimensional culture and tissue engineering. culture collection centers for animal cell lines.

PRATICALS

Paper 9 Bioprocess Engineering & Environmental Biotechnology

1. Sauer Kraut fermentation
2. Use of alginate for cell immobilization.
3. Fermentation of ethanol
4. Detection of coliforms for determination of the purity of potable water.
5. Determination of dissolved oxygen concentration of water sample.
6. Determination of biological oxygen demand (BOD) of a sewage sample.
7. To study the impact of heavy metals on growth & survival of microbes.
8. To study the impact of salt and osmotic stress on the growth survival of microbes.

Paper 10 Plant Biotechnology

1. Preparation of media for plant culture.
2. Surface sterilization.
3. Embryo culture.
4. Callus propagation.
5. Protoplast isolation.

Paper 11 Animal Biotechnology

9. Preparation of single cell suspension from spleen and thymus.
10. Cell counting and cell viability.
11. Macrophage monolayer from PEC, and measurement of phagocytic activity.
12. Trypsinization of monolayer and sub-culturing.
13. MTT assay for cell viability and growth.

Elective Course – II
Medical Biotechnology

Unit-I

Classification of genetic diseases. Chromosomal disorders – Numerical disorders e.g. trisomies & monosomies, Structural disorders e.g. deletions, duplications, translocations & inversions, Chromosomal instability syndromes. Gene controlled diseases – Autosomal and X-linked disorders, Mitochondrial disorders.

Unit-II

Molecular basis of human diseases - Pathogenic mutations. Gain of function mutations: Oncogenes, Huntingtons Disease, Pittsburg variant of alpha 1 antitrypsin. Loss of function - Tumour Suppressor. Genomic. Dynamic Mutations - Fragile- X syndrome, Myotonic dystrophy. Mitochondrial diseases

Unit -III

Prenatal diagnosis - Invasive techniques - Amniocentesis, Fetoscopy, Chorionic Villi Sampling (CVS), Microarray technology- genomic and c DNA arrays, application to diseases.

Unit –IV

Gene blocking therapies Gene Knockouts, Gene disruption-p53, prion diseases, immunological, short RNA, Gene therapy for non-inheritable diseases, stem cell therapy, somatic cell gene therapy and germ line gene therapy

Unit -V

Vectors used in gene therapy Biological vectors – retrovirus, adenoviruses, Herpes Synthetic vectors– liposomes, receptor mediated gene transfer.

Elective Course – II
Applied Oncology

Unit-I
Introduction:
Biology of cancer cells, Types and general characteristics of tumors; Chromosomal aberrations in neoplasia; check points in Cell cycle.

Unit-II
Cell Transformation and Tumorigenesis:
Somatic mutation and cancer cells, Oncogenes; Tumour Suppressor genes, telomerase activity

Unit-III
Familial Cancers:
Definition and types of familial cancer, Characteristics and signs of familial cancer Retinoblastoma, colorectal cancer, breast cancer

Unit IV
Tumour progression:
Tumour initiation and tumour promoter, Genetic and epigenetic changes, angiogenesis and metastasis; Tumour specific markers, tumour micro environment and cancer development.

Unit V
Treatment of Cancer: Chemotherapy, Radiation therapy, immunotherapy, targeted therapy and stem cells in cancer therapy. Cancer risk assessment and counseling.

CBCS SYLLABUS HAS BEEN RECOMMENDED BY THE EXPERTS AND ALL THE MEMBERS OF THE BOS FOR M.SC BIOTECHNOLOGY SUBJECT TO APPROVAL OF RELEVANT STATUTORY BODY.