

Semester V

S. No	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
1	Core 1 A Major	4	-	2	4	2	6
2	Core 1 B Major	4	-	2	4	2	6
3	Core 2 Minor	4	-	2	4	2	6
4	Core 3 Minor	4		2	4	2	6
5	Communication Skills	3	-	-	3		3
6	Value Education	3	-	-	3		3
7	Seminar	2	-	-	2		2
							32

Semester VI

S. No	Subject	Lecture (Hr.)	Tutorial (Hrs.)	Practical (Hrs.)	Credits		Total Credits
					L	P	
1	Core 1A Major	4	-	2	4	2	6
2	Core 1B Major	4	-	2	4	2	6
3	Core 2 Minor	4		2		2	6
4	Core 3 Minor	4	-	2	4	2	6
6	Project		-	-			8
							32

Total Credits

Credits	I Sem	II Sem	III Sem	IV Sem	V Sem	VI Sem	Total
	30	30	30	31	32	32	185

Biotechnology

Semester –I		
Course Code	Title	Credits
BBI001A	Microbes in our lives	4
BBI002A	Microbiological Laboratory Exercises	2
	Total	6
Semester –II		
BBI004A	Instrumentation and Virology	4
BBI005A	Biotechniques Laboratory Exercises	2
	Total	6
Semester –III		
BBI007A	Principles of Immunology	4
BBI008A	Immunological techniques Laboratory Exercises	2
	Total	6
Semester –IV		
BBI010A	Industrial Biotechnology	4
BBI011A	Fermentation Laboratory Exercises	2
	Total	6
Semester –V		
BBI013A	Genetic Engineering	4
BBI014A	Genetic engineering Laboratory Exercises	2
	Total	6
Semester –VI		
BBI016A	Plant and Animal Tissue Culture	4
BBI017A	Plant and Animal Culture Laboratory Exercises	2
	Total	6

SEMESTER-I

BBI001A: Microbes in our lives

Credit(s): 4

UNIT-1

Brief history of microbiology. Scope of Microbiology Bacterial Morphology and sub cellular structures: Morphology of bacteria, Slime layer, Capsule, Cell wall, Ribosome, Cytoplasmic membrane (Fluid mosaic model of Singer-Nicholson); Cytoplasmic inclusion bodies (inorganic, organic); Spores, Flagella, Pilus, Fimbriae. Plasmids and episomes, Bacterial Chromosome.

UNIT-2

Microbial Reproduction: Different modes of microbial DNA replication, Mechanism of DNA replication– rolling circle model. Sexuality and bacterial recombination-Conjugation, Transformation and Transduction

UNIT-3

Bacterial Growth: Growth phases- Generation time. Kinetics of growth, Batch culture, Continuous culture, Synchronous culture (definition and brief description). Physical factors influencing growth, temperature, pH, osmotic pressure, salt concentration

Microbial Nutrition: Nutritional types (definition and example)

Control of growth of Microbes: Sterilization, disinfection, antimicrobial agent (definition, application & examples); physical method of disinfection and sterilization; Chemical control. Assessment of chemical disinfectant; phenol coefficient-definition and method of determination

UNIT-4

Carbohydrates: Introduction, biological importance. Definition, Classification, {glyceraldehydes, Simple Aldose, Simple Ketose, D-glucose, Conformation of D glucose, Monosaccharides other than glucose, glycosidic, bond, disaccharides, polysaccharides, starch, glycogen, peptidoglycan, proteoglycan matrix

Lipids: Chemical properties and characterization of fats. Waxes, cerebrosides, gangliosides, phospholipids, Steroids and bile salts Prostaglandins

UNIT-5

Proteins: Classification, structure and properties of amino acids, biologically active peptides, classification and properties of proteins, conformation and structure of proteins-primary, secondary, tertiary and quaternary structure of proteins.

Nucleic acids: Structure of purines, pyrimidines, nucleosides and nucleotides. Structure, types and biological role of RNA and DNA

Suggested Books

1. Outlines of Biochemistry: Conn and Stumpf
2. Principles of Biochemistry: Jeffery Zubey
3. Biochemistry: Stryer
4. Stanier, RY., et al., General Microbiology, 5th ed., 2000, Tata-McGraw Hill
5. Atlas, RM., Principles of Microbiology, 2nd ed., 1997, McGraw-Hill

BBI002A: Microbiological Laboratory Exercises

Credit(s): 2

1. To study the Instrumentation techniques (Autoclave, LAF, pH meter, Incubator, Oven, Weighing balance)
2. To perform Qualitative estimation of sugars
3. To perform Qualitative estimation of lipids
4. To perform Qualitative estimation of proteins
5. To perform Qualitative estimation of starch
6. To perform Gram staining
7. To perform Spore staining
8. To Prepare nutrient agar for bacteria isolation from soil, water and air.
9. To Prepare potato dextrose agar for fungi isolation from soil, water and air.
10. To Isolate fungi from soil, water and air.
11. To Isolate bacteria from soil, water and air.
12. To perform Serial dilution

Semester II

BBI004A: Instrumentation and Virology

Credit(s): 4

UNIT-1

Separation and Identification of Materials - Concept of Chromatography (Partition Chromatography, Paper Chromatography, Column Chromatography, Adsorption Chromatography, TLC, GLC, HPLC)

UNIT-2

Spectroscopy: Simple theory of the absorption of light by molecules, Beer-Lambert law, Instrumentation for measuring the absorbance of visible light, Auxochrome, K bands, R bands, E bands, Bathochromic shift, Application of UV visible spectroscopy, Infra red region, Theory and principle of IR, Different vibration in molecule, Factors affecting the absorption.

UNIT-3

Electrophoresis: Gel electrophoresis, paper electrophoresis, southern, northern and Western blotting, PCR, SDS PAGE, ELISA

Centrifugation – Basic Principle of Centrifugation, Instrumentation of Ultracentrifuge (Preparative, Analytical)

UNIT-4

History and principles of virology, Occurrence, Nature of virus, Size, Structure of viruses, Polyhydral virus, helical symmetry, the envelope, nucleic acid, protein, classification, Plant virus, TMV, Rhabdovirus, CaMV, Animal Virus, Adenovirus, Retrovirus

UNIT-5

Bacteriophage, T4, lambda phage, lysogenic and lytic cycle, vegetative multiplication, Interferon, Virioid and Prions, plasmid as a vector, cosmids

BBI005A: Biotechniques Laboratory Exercises

Credit(s): 2

1. To prepare solution of different normality and molarity
2. To standardize secondary standard solution from primary standard solution
3. To calibrate colorimeter using $K_2Cr_2O_7$
4. To calibrate pH meter
5. To verify Lambert and beer law
6. To separate the mixture according to their sedimentation coefficient
7. To estimation protein by Lowry method
8. To separate amino acids using Paper Chromatography
9. To perform Estimation of RNA by Orcinol method
10. To perform Estimation of DNA by biphenyl amine method
11. To perform Gel electrophoresis

12. To Separate protein using SDS PAGE

Suggested Books

1. Perspectives of modern physics – Arthur Beiser (Mc Graw Hill)
2. Nuclear physics an introduction – S.B. Patel (New Age International)
3. Introduction to atomic spectra – H.E. White (Mc Graw Hill)
4. Textbook of optics and atomic physics – P.P. Khandelwal (Himalaya Publishing House).
5. Instrumentation measurements and analysis – Nakara, Choudhari (Tata Mc Graw Hill)
6. Handbook of analytical instruments – R.S. Khandpur (Tata Mc Graw Hill)
7. Biophysical Chemistry- Upadhyay, Upadhyay and Nath – (Himalaya Pub.

Semester III

BBI007A: Principles of Immunology

Credit(s): 4

UNIT-1

Immune Response - An overview, components of mammalian immune system, molecular structure of Immunoglobulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

UNIT-2

Regulation of immunoglobulin gene expression – Clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity, alternate pathways of transcript splicing, variable joining sites & somatic mutation, role of antibody (alone, in complement activation & with effector cells), monoclonal antibodies.

UNIT-3

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition, inactivation of host-immune effector mechanisms. Immuno-techniques - Blood grouping, Antigen-Antibody reactions: agglutination, precipitation, immuno-electrophoresis, Coomb's test, ELISA, RIA.

UNIT-4

Vaccines & Vaccination – Adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, tumor vaccines, principles

of vaccination, passive & active immunization, immunization programs & role of WHO in immunization programs.

UNIT-5

Auto-immune diseases – autoimmunity & auto-immune diseases, factors contributing development of auto-immune diseases, mechanism of development, breakdown of self-tolerance, rejection of transplants, molecular mimicry, diagnosis & treatment of auto-immune diseases, replacement therapy, suppression of auto-immune processes, nature of auto-antigens, immunodeficiency, AIDS

BBI008A: Immunological techniques Laboratory Exercises **Credit(s): 1**

1. To perform Antigen-Antibody reactions – Agglutination (Blood grouping testing)
2. To perform Antibody titration (Ouchterlony Double Diffusion).
3. To perform Antigen-Antibody reactions – Immuno-electrophoresis
4. To perform Rocket immunoelectrophoresis
5. To perform Antigen-Antibody reactions –Sandwich ELISA
6. To perform WBC counting
7. To perform RBC counting
8. To perform Hemoglobin estimation
9. To perform DOT ELISA
10. To perform differential staining of WBC
11. To separate serum from blood
12. To examine barr body in human

Suggested Books

1. Abbas AK & AH Lichtman (2006): Basic Immunology: Functions and Disorders of the Immune System. With Student Consult Online Access. Edn. 3. WB Saunders Co.
2. Delves PJ, SJ Martin, DR Burton & IM Roitt (2006): Roitt's Essential Immunology. Edn. 11. Blackwell Publishing.
3. Kindt TJ, RA Goldsby & BA Osborne (2007): Kuby Immunology. Edn. 6. WH Freeman & Co.
4. Mak TW, M Saunders & W Tamminen (2008): Primer to the Immune Response. Elsevier.
5. Male D, J Brostoff, D Roth & I Roitt (2007): Immunology: With Veterinary Consult Access. Edn. 7. CV Mosby & Co.
6. Roitt I, J Brostoff, D Male & D Roth (2006): Immunology. With Student Consult Online Access. Edn. 7. CVMosby & Co.
7. Sompayrac L (2008): How the Immune System Works. Wiley- Blackwell.
8. Wood P (2006): Understanding Immunology. Edn. 2. Prentice Hall/ Pearson Education, Harlow, England.

Semester IV

BBI010A: Industrial Biotechnology

Credit(s): 4

UNIT-1

Bioreactor / Fermenter – types & operation of Bioreactors, physico-chemical standards used in bioreactors, limitations of bioreactors, stages of fermentation processes, Media design for fermentation processes, Solid substrate fermentation, Fermentors (Stirred tank, bubble columns, airlift. Bioreactors, Static, Submerged and agitated fermentation), advantages & disadvantages of solid substrate & liquid fermentations

UNIT-2

Technology of Microbial cell maintenance – steps to maintain microbial culture in an aseptic & sterile environment (how to inoculate, preserve & maintain), Strain preservation, maintenance and strain improvement by mutation of gene transfer processes

UNIT-3

Products from Microorganisms – Metabolites, Enzymes, Single-cell Protein. Bioremediation – Petroleum prospecting and formation of oil spills, Wastewater treatment. Vermiculture. Downstream processing: extraction, separation, concentration, recovery & purification, operations (Insulin, Vitamins, and Metabolites), Industrial production of Ethyl alcohol, Acetic Acid (Vinegar), Citric acid, lactic acid

UNIT-4

Enzyme technology – nature of enzymes, application of enzymes, limitations of microbial cells used as catalysts in fermentation, multi-enzyme reactors, technology of enzyme production, use of immobilized cells and enzymes (Ca-alginate beads, polyacrylamide), industrial applications of immobilized enzymes.

UNIT-5

Biological fuel generation –Sources of biomass, ethanol from biomass, methane from biomass, hydrogen, microbial recovery of petroleum. Biotechnology in specific medical & industrial applications

BBI011A: Fermentation Laboratory Exercises

Credit(s): 2

1. To Prepare Antibiotics from Fungi
2. To perform antibacterial activity of antibiotic
3. To Perform anti fungal activity
4. To Produce of citric acid from *A.niger*
5. To estimation of citric acid
6. To perform Sauerkraut production

7. To perform Wine production from ginger
8. To perform Wine production from grapes
9. To produce Apple wine
10. To estimate of alcohol in produced wine
11. To culture bacteria on liquid medium (Broth culture)

Suggested Books

1. Microbiology – Pelzar
2. General Microbiology – Stanier
3. Food Microbiology –Frazier
4. Principles of Fermentation Technology - Whitaker, A. 2 edition

Semester V

BBI013A: Genetic Engineering

Credit(s): 4

UNIT-1

How to clone a gene - What is clone, Overview of the procedure, Gene library, Hybridization. Purification and Separation of nucleic acids – Extraction and Purification of nucleic acids, Cutting and Joining DNA – Restriction Endonucleases, Ligation, Alkaline Phosphate, Double Digest, Modification of Restriction Fragments ends, Other Ways of joining DNA Molecules.

UNIT-2

Vectors – Plasmid vectors, Vectors based on the lambda Bacteriophage, Cosmids, M13 vectors, Expression vectors, Vectors for cloning and expression in Eukaryotic cells, Super vectors: YACs and BACs.

UNIT-3

Amplifying DNA : PCR and Cell based DNA Cloning – The importance of DNA Cloning, PCR: basic features and application, Principles of Cell-based DNA Cloning.

UNIT-4

Nucleic Acid Hybridization: Principle and application - Preparation of nucleic probes, Principle of Nucleic acid hybridization, nucleic acid hybridization assays, and microarrays.

DNA Typing: DNA polymorphisms: the basis of DNA typing, Minisatellite analysis, Polymerase chain reaction based analysis, Short tandem repeat analysis, Mitochondrial DNA analysis, Y chromosome analysis, randomly amplified polymorphic DNA (RAPD) analysis.

UNIT-5

High-throughput analysis of gene function- DNA microarrays, Protein arrays, Mass spectrometry Single Nucleotide Polymorphisms- The nucleolar proteome, Mapping disease-associated SNPs: Alzheimer's disease.

BBI014A: Genetic engineering Laboratory Exercises

Credit(s): 2

1. To perform Isolation of plasmid DNA & Gel electrophoresis
2. To perform Genomic DNA- Isolation
3. To perform Quantitation of isolated genome
4. To perform DNA Ligation
5. To Prepare Component Cells
6. To analyze Transformation of E. coil and selection of recombinants.
7. To study Colony PCR of recombinant and analysis
8. To perform Restriction mapping of recombinant DNA
9. To study Southern blotting techniques
10. To study Searching for gene and protein sequences and accessing information from web, and databases Information from genomes, BLAST, FASTA
11. To digest genomic DNA using restriction endonuclease
12. To estimate the amount of DNA by DPA method

Suggested Books

1. Molecular Biology of the Gene: Waston J. D.
2. Molecular Biotechnology: Glick
3. Milestones in Biotechnology : Classic papers in Genetic Engineering: J. A. Davis, W. S. Resnikoff
4. DNA Cloning – A Practical approach: D. M. Glover and B. D. Hames
5. Principles of Gene Manipulation & Genomics – Primrose and Twyman (2006, 7th Edition)
6. Molecular cloning – a laboratory manual – Sambrook and Russell (Vol. 1-3)

Semester VI

BBI016A: Plant and Animal Tissue Culture

Credit(s): 4

UNIT-1

Plant Tissue Culture: Introductory History – Concepts of Cell theory & Cellular totipotency, Milestones in plant tissue culture. Infrastructure & Organization of plant tissue culture laboratory – General & aseptic laboratory, different work areas, equipments & instruments required, other requirements. Aseptic techniques – Washing & preparation of glassware, packing & sterilization, media sterilization, surface sterilization, aseptic work station, precautions to maintain aseptic conditions. Culture Medium – Nutritional requirements of the explants, PGR's & there in vitro roles, media preparation.

UNIT-2

‘Explant’ for plant tissue culture – histological and/or cellular characteristics Response of explants in vitro– Dedifferentiation and redifferentiation: a) callus formation, b) organogenesis (direct and indirect), c) embryogenesis (direct and indirect) Callus culture technique– Introduction, principle, protocol, factors affecting, Morphology & internal structure, genetic variation Suspension culture technique – Introduction, principle, protocol, types, growth & growth measurement, synchronization

UNIT-3

Organ culture technique – Introduction, principle, protocol factors affecting w.r.t. root tip culture, leaf culture, shoot tip & meristem culture, Anther & pollen culture technique – Introduction, principle, protocol, factors affecting, ovary, ovule, embryo and endosperm culture. Protoplast – Protoplast isolation, protoplast culture. Somatic hybridization – Protoplast fusion techniques, selection of hybrids, production of symmetric & asymmetric hybrids & cybrid production

UNIT-4

Genetic transformations – Agrobacterium mediated transformations, direct DNA transfer methods electroporation, microprojectile bombardment, microinjection, use of marker genes, integration & expression of foreign DNA. Production of artificial seeds – techniques

UNIT-5

Animal Tissue Culture: Animal Tissue culture – Principles & practice, cleanliness, precautions, care to be taken. Nutrition & Physiology media components – Serum, balanced salt solutions, washing, packing, sterilization practices, and instruments. Primary cell culture, establishing & maintenance of lymphocyte culture Cell lines – Insects & Animals cells, subculture. Karyotyping, biochemical & genetic characterization of cell lines Application of Animal cell cultures

BBI017A: Plant and Animal Culture Laboratory Exercises

Credit(s): 2

1. To study PTC Laboratory organization of facility and equipment
2. To perform Aseptic manipulation – washing, capping, packing & sterilization, laminar flow operation & general precautions

3. To prepare Stock solutions & media
4. To prepare stock solution for plant growth hormones
5. To perform Callus culture technique – Initiation of culture, callus morphology & internal structure
6. To Perform Suspension culture technique – Initiation of culture, sub culture and growth measurement
7. To study Effect of plant growth regulators on in vitro response of anther culture
8. To perform Initiation of shoot tip & axillary bud culture and sub culture.
9. To perform Ovary / ovule / anther / embryo culture
10. To prepare Animal cell culture media, sterilization, washing, packing
11. To prepare artificial seed
12. To perform shoot tip culture

Suggested Books

1. Animal Tissue culture: J. Paul
2. Introduction to Plant Tissue culture: M.K. Razdan
3. Plant Tissue Culture: Theory & Practice : S. S. Bhojwani & M. K. Razdan
4. Micropropagation: Debergh & Zimmermann
5. Plant tissue culture: Kalyan Kumar Dey