





### Semester V

S.No	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	
BBI047A	Core 1 (Proteomics and Genomics)	4	-	2	4	2	6
BBI049A	Core 2 (Animal Tissue Culture & Biostatistics)	4	-	2	4	2	6
BBI051A	Core 3 (Environmental Biotechnology, IPR & Bioethics)	4	-	2	4	2	6
BMC113A	Communication skills	3	-	-	3		3
BMC109A	Value Education Human rights and Legislative Procedures						3
BBI053A	Seminar-V	3	-	-			3
BBI054A	Basic Techniques of Instrumentation	6					6
							33

### Semester VI

S.No	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	
BBI055A	Project	44	-	-			44
BBI056A	Seminar						2
							46

### Total Credits

Credits	I Sem	II Sem	III Sem	IV Sem	V Sem	VI Sem	Total
	27	27	27	28	33	46	188

**Unit-1**

**Cell:** Shapes, Morphology, Structure, Function, Relationship including organelles and their Biogenesis (e.g., Endoplasmic reticulum, Golgi body, nucleus, lysosomes, vacuoles); Cell theory; Membrane structure, cell wall.

**Unit-2**

**Cell divisions:** Cell cycles, Amitosis, Mitosis phases, structure and functions of spindle apparatus; anaphasic chromosome movement; Meiosis: phases, synaptonemal complex formation of chiasmata. Significance of mitosis and meiosis

**Unit-3**

**Transport across membrane:** Active, Passive, Facilitated; Protein synthesis and folding in the cytoplasm; Degradation of cellular components.

Chromosome organization: eukaryotic and prokaryotic, Chromosomes morphology: Centromere, Telomere; Specialized types of chromosomes: Sex chromosomes, Lampbrush chromosome, Polytene chromosomes.

**Unit-4**

Structure of cilia and flagella, microtubule and microfilament microtubule assembly, functions of filament and microtubules. Structure of Plastids and the light reaction and dark reaction

**Unit-5**

Centrioles and basal bodies: structure, chemical composition, duplication of centrioles, function of centrioles and basal bodies, Structure of Mitochondria.

**TEXT / REFERENCE BOOKS**

1. Strickberger "Genetics" (Macmillan)
2. Garrel Karp "cell biology"
3. C.B.Pawar "Cell biology"

**BBI020A: Practical of Cytology****Credit(S): 2**

1. To analyze prepared slides of mitosis
2. To perform and identify different stages of mitosis in onion root tip
3. To analyze prepared slides of meiosis
4. To perform and identify different stages of mitosis in onion flower bud
5. To prepare the slide of Giant chromosome
6. To analyze slides of different cell organelles
7. Introduction to microtomy and apparatus handling
8. To localize lipid Histochemically
9. To localize starch Histochemically
10. To localize proteins Histochemically
11. To perform paper chromatography for dyes
12. To perform chromosomal banding using dyes

**BBI021A: BIOLOGICAL MACROMOLECULES****Credit(s):4****Unit-1**

**Molecular interactions:** The concept of pH, dissociation and ionization of acids and bases, Lewis acid and base, electrophile and nucleophile, buffers and buffering mechanism, Henderson-Hasselbalch equation, biological buffer

**Vitamins:** Structure and biochemical properties of water soluble and fat soluble vitamins and their coenzyme activity.

## **Unit-2**

**Carbohydrates:** Introduction, biological importance. Definition, Classification, Monosaccharides other than glucose, glycosidic, bond, disaccharides, polysaccharides (starch, glycogen, peptidoglycan)

## **Unit-3**

**Lipids:** Introduction Structure, distribution and biological importance of fats and fatty acids; Chemical properties and characterization of Fats, Waxes, Cerebrosides, gangliosides, phospholipids and proteolipids; Steroids and Prostaglandins

## **Unit-4**

**Amino acids:** Definition, Classification, Structure and types; Proteins: Classification, structure and properties, biologically active peptides, classification and properties of proteins, structure of proteins-primary, secondary, tertiary and quaternary structure of proteins.

## **Unit-5**

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

### **TEXT / REFERENCE BOOKS**

1. Outlines of Biochemistry: Conn and Stumpf
2. Principles of Biochemistry: Jeffery Zubey
3. Biochemistry: Stryer

### **BBI022A: Qualitative estimation of biological molecules**

**Credit(s): 2**

1. To prepare the solutions of given normality and its standardization.
2. To Calibrate the pH meter by using different buffer solutions
3. To Prepare the buffer solutions
4. To determine the pKa value and hence the Dissociation constant of a given acid by using pH meter.
5. To prepare buffer solutions in the pH range of 2.2 to 8.0

6. To perform Qualitative estimation of carbohydrates
7. To perform Qualitative estimation of proteins
8. To perform Qualitative estimation of lipids
9. To perform the Titrimetric estimation of molar and mass concentration of sulfuric acid
10. To Determine the acid value of oil
11. To verify Lambert and beer law's
12. To calibrate spectrophotometer using  $K_2Cr_2O_7$  solution

## **BBI023A: MICROBIOLOGY**

**Credit(s): 4**

### **Unit-1**

Brief history of microbiology, Scope of Microbiology, Position of microorganisms in biological world, Whittaker's Five-kingdom and three-kingdom concept of living organisms ; General features of Eubacteria and Archaeobacteria (major difference within Eubacteria), Stains & Staining techniques: Definition of auxochrome; Chromophores; Acidic and Basic dyes; Classification of stains; Simple and differential staining: theories of staining, mordant and its function; Gram staining; acid fast staining; endospore staining; negative staining; capsule staining; flagella staining; mechanism of gram staining

### **Unit-2**

**Morphology and subcellular structures:** Bacterial morphology, Slime layer, Mycelial morphology: Actinomycetes, Capsule, Cell wall, Ribosome, Cytoplasmic membrane (Fluid mosaic model); Cytoplasmic inclusion bodies - (inorganic, organic); Exospores & Cysts: types & structure; Endospore, Flagella, Pilus, Fimbriae (structure, composition and functions). Plasmids and episomes, nuclear material, Bacterial Chromosome (Fundamental differences with eukaryotic chromosome); Bacterial cell wall biosynthesis and structure

### **Unit-3**

**Microbial Nutrition:** Nutritional types (definition and example) - Photoautotrophs, Photoorganotrophs, Chemolithotrophs (ammonia, nitrite, sulfur, hydrogen, iron oxidizing bacteria); Chemoorganotrophs, Effect of oxygen on growth - classification on the basis of oxygen requirement and tolerance

### **Unit-4**

**Bacterial Growth:** Growth phases - Generation time. Kinetics of growth, Types of culture: Batch, Continuous and Synchronous. Physical factors influencing growth like temperature, pH, osmotic pressure, salt concentration; Microbial Reproduction: Different modes and mechanism of microbial DNA replication – rolling circle model & Theta structure Bidirectional replication; Sexuality and bacterial recombination –Rarity in Bacteria, Male and female nessin bacteria (F<sup>+</sup>, F<sup>'</sup> and Hfr), Plasmids and pilus mediated transfer of genes in the conjugation process in *E.coli*,

### **Unit-5**

**Control of growth of Microbes:** Sterilization, disinfection, antiseptic, sanitizer, germicide, antimicrobial agent (definition, application & examples); physical method of disinfection and sterilization - dry heat, moist heat, filtration, radiation (mode of action, applications); Chemical control – dye solutions, alcohol, acid, alkali, halogen, heavy metal, phenol, phenol derivatives, formaldehyde, ethylene oxide, detergents (mode of action, applications). Assessment of chemical disinfectant; phenol coefficient-definition and method of determination

### **TEXT / REFERENCE BOOKS**

1. Stanier, RY., et al., General Microbiology, 5th ed., 2000, Tata-McGraw Hill
2. Atlas, RM., Principles of Microbiology, 2nd ed., 1997, McGraw-Hill

### **BBI024A: Practicals of Microbiology**

**Credit(s): 2**

1. To perform the Simple staining
2. To perform the Gram staining



3. To perform the Endospore staining
4. To perform the Acid fast staining
5. To prepare the different types of media
6. To Prepare Nutrient Agar media for bacterial culture
7. To Prepare the Potato Dextrose Agar media for fungal culture
8. To Prepare Nutrient and SDA Broth for fungal culture
9. To isolate microflora from soil
10. To isolate microflora from air
11. To isolate identify bacteria on the basis of their shapes
12. To Culture microflora from water by spreading and serial dilution method

**BBI025A: Seminar-I**

**Credit(s): 3**

## SEMESTER-II

Subject Code	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	
BBI026A	Core 1 (Metabolic Pathways)	4	-	2	4	2	6
BBI028A	Core 2 (Genetics)	4	-	2	4	2	6
BBI030A	Core 3 (Analytical Techniques)	4	-	2	4	2	6
BMC104A	General Studies	3	-	-	3		3
BMC003A BMC004A	Computer Applications	3	-				3
BMC102A	Communication Skills	3	-	-	3		3
BBI0032A	Seminar-II	3	-		3		3
							<b>30</b>

### BBI026A: METABOLIC PATHWAYS

**Credit(s): 4**

#### Unit-1

**Bioenergetics; General concepts of Thermodynamics:** Laws of Thermodynamics, Enthalpy, Entropy, Free energy & Chemical Equilibria, High Energy Bonds & Compounds, ATP-ADP Cycle, Oxidation-reduction Reactions and Redox potential, chemosmotic theory for ATP Production, Metabolism: Introduction (Anabolism & catabolism),

#### Unit-2

**Carbohydrate metabolism:** Glycolysis, Fermentation, Citric acid cycle, Oxidative Phosphorylation and ETS, Gluconeogenesis, Glycogenesis and Glycogenolysis, HMP shunt, Glyoxylate pathway.

#### Unit-3

**Lipid metabolism:** Fatty acid degradation (beta, alpha, and omega degradation), degradation of odd chain fatty acids, Fatty acid synthesis, Regulation of fatty acid metabolism.

#### **Unit-4**

**Amino acid metabolism:** Transamination, deamination, oxidative deamination, Amino acid degradation & Biosynthesis, Urea cycle and its regulation.

#### **Unit-5**

**Nucleotide metabolism:** Synthesis of purines & pyrimidines nucleotides, salvage pathway, nucleotide degradation, associated metabolic disorders.

#### **TEXT / REFERENCE BOOKS**

1. Outlines of Biochemistry: Conn & Stumpf
2. Principles of Biochemistry: Voet & Voet
3. Principles of Biochemistry: Jeffery Zubey
4. Clinical Biochemistry: D.C Deb
5. Biochemistry: Stryer
6. Lehninger's Principles of Biochemistry: Nelson & Cox

#### **BBI027A: Quantitative estimation of Biological molecules**

**Credit(s): 2**

1. To perform Quantitative estimation of carbohydrates by anthrone method
2. To perform acid value for given oil
3. To perform Quantitative estimation of RNA using Orcinol method
4. To perform Quantitative estimation of DNA using DPA method
5. To perform the Chlorophyll estimation Arnon' method
6. To Separate the dyes using radial paper chromatography
7. To separate Amino acid using paper chromatography
8. To separate Amino acid using thin layer chromatography
9. To Determine saponification value of oil
10. To perform Quantitative estimation of Protein by Biuret method
11. To perform Quantitative estimation of Protein by Barford method
12. To perform Quantitative estimation of reducing sugar
13. To perform Quantitative estimation of glycogen

**BBI028A: GENETICS****Credit(s): 4**

1. To perform Quantitative estimation of Protein by Lowry's method

**Unit-1**

**Mendelian principles:** Principle of segregation, monohybrid crosses, dominance, codominance, lethal genes. Principle of independent assortment: dihybrid gene interactions, epistasis, multiple alleles.

**Unit-2**

**Sex determination, linkage and crossing over, Sex linked inheritance-** Mechanism of sex determination: Simple mechanisms, One or a few genes, identification of sex chromosomes, XX-XY mechanism, Y chromosome and sex determination in mammals, Balanced concept of sex determination in Drosophila, plant, Environmental factors in sex determination, Sex linked inheritance.

**Unit-3**

**Principles of linkage:** Crossing over, cytological basis of crossing over, chromosome mapping by two factor crosses, interference, ISH, FISH, and GISH, Molecular concept of the gene and gene mapping.

**Unit-4**

**Mutations:** induced mutations in plants, animal and microbes for economic benefit of man spontaneous and induced, Frame shift mutation, Chromosomal Aberration, Duplication, deletion, translocation, inversion, polyploidy, auto and auto allopolyploidy, origin of wheat. Extra-chromosomal inheritance: Cytoplasmic inheritance, mitochondrial and chloroplast genetic systems.

**Unit-5**

**Population Genetics:** Behavioral genetics, Hardy-Weinberg frequencies, inbreeding, calculating F from pedigrees. Human Genetics: chromosomal banding, Turner syndrome, Klinefelter syndrome, Down syndrome, Patau syndrome, Edward syndrome, cat cry syndrome, Barr body.

## **TEXT / REFERENCE BOOKS**

1. Strickberger “Genetics” (Macmillan)
2. Freifelder “Genetics”

## **BBI029A: Practicals of Genetics**

**Credit(s): 2**

1. To study the Mendel’s law of inheritance
2. To analyze various chromosomal abnormalities
3. To perform the Karyotyping of normal human cells
4. To perform the Karyotyping of abnormal human cells
5. To perform the Pedigree analysis
6. To determine the Problems related to pedigree analysis (2)
7. To study the Linkage in Drosophila.
8. To determine the Problems related to linkage
9. To analyze Barr body using methylene blue
10. To analyze different stages of Mitosis and Meiosis
11. Differential staining of WBC

## **BBI030A: ANALYTICAL TECHNIQUES**

**Credit(s): 4**

### **Unit-1**

**Instruments, basic principle and usage:** pH meter, Measurement of pH: Principles of glass and reference electrodes, types of electrodes, calibration of pH meter, Handerson equation, biological buffer.

### **Unit-2**

**Microscopy:** Simple microscopy, Phase contrast microscopy and electron microscopy (TEM and SEM). Sedimentation- Sedimentation velocity, preparative and analytical ultracentrifugation techniques

### **Unit-3**

**Basic principles of electrophoresis:** AGE and SDS-PAGE and their importance, Radioisotopic Techniques: Types of radioisotopes used in Biochemistry, units of radioactivity measurements, isotopes commonly used in biochemical studies –  $^{32}\text{P}$ ,  $^{35}\text{S}$ ,  $^{14}\text{C}$  and  $^3\text{H}$ ), application of isotopes, Autoradiography: Biological hazards of radiation and safety measures in handling radioisotopes; Biological applications

#### **Unit-4**

**Chromatography:** General principles and applications of – Adsorption chromatography, Ion-exchange chromatography, Thin-layer chromatography, Hydrophobic chromatography, Gas-liquid chromatography, HPLC, Affinity chromatography, Paper chromatography.

#### **Unit-5**

**Spectroscopic Techniques:** Beer-Lambert law, light absorption and its transmittance, determination and application of extinction coefficient, application of visible and UV spectroscopic, and its application, IR spectroscopy and their applications

#### **TEXT / REFERENCE BOOKS**

1. Textbook of optics and atomic physics – P.P. Khandelwal (Himalaya Publishing House)
2. Nuclear physics an introduction – S.B. Patel (New Age International) Biophysics – Pattabhi and Gautham (Narosa Publishing House)
3. Instrumentation measurements and analysis – Nakara, Choudhari (Tata Mc Graw Hill)
4. Handbook of analytical instruments – R.S. Khandpur (Tata Mc Graw Hill)
5. Perspectives of modern physics – Arthur Beiser (Mc Graw Hill)
6. Introduction to atomic spectra – H.E. White (Mc Graw Hill)
7. Molecular cell biology – Ladish, Berk, Matsudara, Kaiser, Krieger, Zipursky, Darnell (W.H. Freeman and Co.)
8. Biophysics - Cotrell (Eastern Economy Edition)
9. Clinical Biophysics –Principles and Techniques- P. Narayanan (Bhalani Pub., Mumbai)

1. To Calibrate the spectrophotometer
2. To perform Verification of Beer-Lambert Law
3. To calibrate pH meter without buffer solution
4. To prepare a solution of different Normality, molarity
5. To prepare primary and secondary standard solution
6. To convert secondary standard solution into primary standard solution
7. To determine the  $\lambda_{\text{max}}$  for DNA
8. To separate various molecule on the basis of their sedimentation coefficient
9. To separate Amino acid using paper chromatography
10. To separate Amino acid using thin layer chromatography
11. To separate the aliphatic and aromatic fraction of oil by column chromatography
12. To separate the DNA using agarose gel electrophoresis

**BBI032A: Seminar-II**

**Credit(s): 3**

### SEMESTER-III

S.No	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	
BBI033A	Core 1 (Introductory Immunology)	4	-	2	4	2	6
BBI035A	Core 2 (r-DNA Technology)	4	-	2	4	2	6
BBI037A	Core 3 (Medical Biotechnology)	4	-	2	4	2	6
BMC107A	General Studies	3	-	-	3		3
BMC005A BMC006A	Computer Applications	3	-				3
BMC104A	Communication skills	3	-	-	3		3
BBI039A	Seminar-III						3
							30

#### BBI033A: INTRODUCTORY IMMUNOLOGY

Credit(s): 4

##### Unit-1

**Overviews of immune system:** Historical perspectives. Types of immunity: Innate and acquired. Features of immune response: Memory, Specificity and recognition of self and non-self, Clonal nature of immune response; Hematopoiesis and differentiation; Cells and organs of the immune system

##### Unit-2

**Antigen:** Immunogenicity v/s antigenicity, factors affecting immunogenicity, nature of immunogen, biological system, epitopes, haptens and antigenicity; Immunoglobulins: Structure of antibody, antibody mediated effector functions, antibody classes and biological activities; Monoclonal antibodies: Production and applications

##### Unit-3



**Antigen-Antibody interactions:** types: precipitation and agglutination reaction, radioimmunoassay, ELISA, chemiluminescence, ELISPOT assay, western blot, immune precipitation, immune fluorescence, flow cytometry and fluorescence.

#### **Unit-4**

**Major histocompatibility complex:** General organization, MHC molecules: structure & genes, their mode of antigen presentation and interaction, cellular distribution of MHC, regulation of MHC expression and disease susceptibility. Complement system: Function, components, activation, regulation and deficiencies of complement. Immune response to infectious diseases: Bacteria, viruses and intracellular parasites.

#### **Unit-5**

**Vaccines:** Active and Passive Immunization Types of Vaccines – Inactivate Attenuated, Purified macromolecules and Recombinant-vector, DNA, Multivalent subunit Vaccines.

#### **TEXT / REFERENCE BOOKS**

1. Roitt I.M, Brostoff, J., Male D.K. (2001). Immunology (Illustrated Publisher, Mosby)
2. T. J. Kindt, R.A. G. B. A. Osborne, J. Kuby (2006). Immunology (W.H. Freeman and Company, New York)
3. Austyn, J.M., Wood, K.J. (1993). Principles of cellular and molecular immunology (Oxford University Press Inc. New York)
4. Paul, W.E. (2008). Fundamental immunology (Lippincott Williams & Wilkins).
5. Birch J.R., Lennox E.S. (1995). Monoclonal antibodies: Principles and applications (Wiley-Liss).
6. T.G. Parslow, D.P. Stites, A.I. Terr (1997). Medical immunology (Lange Medical Books/McGraw-Hill)
7. Ian Freshncy (4th Edition) Buttler.
9. Elements of Biotechnology –P.K. Gupta (1st Edition-200) Rastogi Publications.

#### **BBI034A: Practicals of Immunological Techniques**

**Credit(s): 2**

1. To perform the Differential leucocytes count
2. To perform total counting of leucocytes

3. To perform the Total RBC count
4. To perform Haemagglutination assay
5. To separate the serum from blood
6. To perform Double immunodiffusion test using specific antibody and antigen.
7. To perform Dot ELISA.
8. To determine the Blood group
9. To perform Ouchterlony Double diffusion (ODD)
10. To perform Rocket Immuno-electrophoresis
11. To perform sandwich ELISA
12. To perform RID
13. To perform IEP

## **BBI035A: r-DNA TECHNOLOGY**

**Credit(s): 4**

### **Unit-1**

**Expression of genes in prokaryotic and eukaryotic systems:** Gene structure in prokaryotic and eukaryotic cells. Gene expression – concept of operon and related elements in the unit, regulatory and structural gene, post translational processing of mRNA, extra chromosomal DNA and its functions. Restriction endonuclease, Ribonucleases, taq DNA, SI nuclease, Alkaline phosphates, klenow enzyme, methyl transferase, restriction modification system

### **Unit-2**

Preparation of desired gene by genomic DNA, from reverse transcriptase and by gene machine; Vectors: bacteriophages, cosmids, Triplasmids, yeast artificial chromosome, shuttle and binary vectors, DNA labeling radioactive and non-radioactive methods

### **Unit-3**

DNA sequencing, Southern and Northern blotting in situ, DNA fingerprinting, Ligation method for gene transfer, Gene transfer technology cDNA and genomic DNA library, gene isolation and cloning,

### **Unit-4**

Polymerase chain reaction and site directed mutagenesis- Expression of cloned gene in recombinant cells, production of biochemicals with examples.

### **Unit-5**

Application of rDNA technology Antisense and ribozyme technology, Human genome project and its application, Gene therapy prospect and future, DNA vaccine, Transgenic plants, Current production of rDNA products, Bio-safety measures and regulations for rDNA work.

### **TEXT / REFERENCE BOOKS**

1. D.M. Glover, Genetic Engineering, Cloning DNA, Chapman and Hall, New York, 1980
- 2.S. Mahesh and A.B. Vedamurthy, Biotechnology-4 (rDNA Technology, Environmental biotechnology, Animal cell culture), New Age publisher.
3. T. A. Brown
4. Primrose

### **BBI036A: Practicals of Genetic Engineering**

**Credit(s): 2**

1. To Isolate the genomic DNA from bacteria
2. To perform Isolation of plasmid from bacteria
3. To perform Agarose gel electrophoresis for DNA separation
4. To perform Restriction Digestion DNA/plasmid
5. To perform DNA isolation from plant by CTAB method
6. To perform Ligation
7. To estimate DNA by DPA method
8. To determine the molecular weight of DNA
9. To estimate the amount of RNA by Orcinol method
10. To isolate DNA from Onion cell

## **BBI037A: MEDICAL BIOTECHNOLOGY**

**Credit(s): 4**

### **Unit-1**

Gene therapy- background, types of gene therapy (*ex vivo* & *in vivo*), choosing targets for gene therapy, vectors in gene therapy, retroviruses, adenoviruses, adeno-associated viruses, types of gene delivery, Weismann barrier (soma-to-germ line barrier), epigenetic inheritance, problems & ethics. Gene Delivery methods-Viral delivery (through Retroviral vectors, through Adenoviral vectors), Non-viral delivery,

### **Unit-2**

Stem cell culture technology- introduction to stem cell types of stem cells, application of stem cells in modern medical science. Tissue Engineering – Skin, Liver, Pancreas, therapeutic Ribozymes, synthetic drugs.

### **Unit-3**

Xenotransplantation – terminology, technology behind it, organ donors, social & ethical issues; Production of artificial tissues or organs; Cell Adhesion-based therapy- integrins, inflammation, cancer & metastasis;

Drug designing, Drug delivery and targeting: conventional & new approaches to drug delivery.

### **Unit-4**

Use of genetic engineering- in production of human insulin, growth hormones, factor VIII, plasminogen active protein, interferon, vaccine production, modification of monoclonal antibody in cancer treatment.

### **Unit-5**

Disease diagnosis technique; ELISA, RIA, RIEP, ODD, RID, FISH, GISH, IMMUNO FLUORESCENCE

## **TEXT / REFERENCE BOOKS**

1. Text Box of Microbiology R. Ananthanarayanan and C. K. Jayaram Paniker, Orient Longman, 1997.
2. Medical Microbiology, Vol 1; Microbial infection : Mackie and MaCartny, Churchill Livingstone, 1996
3. Bailey and Scott's Diagnostic Microbiology: Baron EJ, Peterson LR and Finegold SM Mosby, 1990.
4. Essential immunology (1995) - Roitt, I. M. Blackwell Scientific Publications Oxford.
5. Fundamental immunology: W.E. Paul 1984, Raven Press, New York.
6. Fundamentals of immunology: R.M. Coleman, M.F. Lombord and R.E. Sicarc (1992), 2nd ed, C. Brown publishers.
7. Immunology: D.M. Weir and J Steward, 7thEd, (1993).
8. Broude A.I. (1981): Medical " Microbiology" ; and Infectious Diseases, W.B. Saunders & Co. Philadelphia.
9. An Introduction to Immunology: Ian R. Tizzard.

**BBI038A: Practicals of Medical Biotechnology**

**Credit(s): 2**

1. To determine Differential leucocytes count.
2. To analyze Total leucocytes.
3. To determine Total RBC count.
4. To Separate serum from blood.
5. To perform Direct and indirect ELISA.
6. To determine Blood groups
7. To determine Oucترلouny Double diffusion (ODD)
8. To perform Rocket Immuno-electrophoresis

**BBI039A: Seminar-III**

**Credit(s): 3**

## SEMESTER-IV

S.No	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	
BBI040A	Core 1 (Molecular Biology)	4	-	2	4	2	6
BBI042A	Core 2 (Plant Biotechnology)	4	-	2	4	2	6
BBI044A	Core 3 (Bioprocess Engineering and Technology)	4	-	2	4	2	6
BMC108A	General Studies	3	-	-	3		3
BMC007A BMC008A	Computer Applications	4	-				4
BMC111A	Communication skill	3	-	-	3		3
BBI046A	Seminar-IV	3				3	3
							31

### BBI040A: MOLECULAR BIOLOGY

Credit(s): 4

#### Unit-1

**Nucleic Acids:** as the genetic material, structure and aggregation of DNA and RNA, DNA double helix, different conformations of double helix, DNA super coiling, Denaturation and renaturation of DNA, C-value paradox, Cot value, chemical complexity; DNA replication: Mechanism, Enzymes and accessory proteins involved, DNA damage, DNA mutagenesis and DNA repair (SOS and excision repair); Homologous recombination, site specific recombination and transposons.

#### Unit-2

Transcription in prokaryotes and eukaryotes: General and specific transcription factors, Regulatory elements and mechanism of transcription regulation, Modifications of RNA; Genetic code: deciphering the genetic code, nature of the code.

### **Unit-3**

Translation in prokaryotes and eukaryotes: machinery- tRNA, Ribosomes, mRNA, aminoacyl-tRNA synthases and aminoacylation of tRNA; Mechanisms of initiation, elongation and termination, Regulation of translation, post translational modifications of proteins, protein localization, protein degradation.

### **Unit-4**

Regulation of gene expression in prokaryotes: lac, arabinose and trp operons - induction, repression and attenuation mechanism.

### **Unit-5**

**Mutation:** Induced mutation, spontaneous mutation, frame shift mutation, point mutation, non sense mutations, site directed mutagenesis

### **TEXT / REFERENCE BOOKS**

1. Glick, B.T and Pasternak J.J (1998) Molecular Biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM press.
2. Howe.C. (1995) Gene Cloning and Manipulations, Cambridge University Press, USA
3. Lewin, B., Gene VI New York, Oxford University Press.
4. Rigby, P.W.J. (1987) Genetic Engineering, Academic Press Inc. Florida, USA.
5. Sambrook et al (2000) Molecular Cloning Volumes I, II, & III Cold spring Harbor Laboratory Press, New York, USA
6. Walker J.M. and Gingold, E.B. (1983) Molecular Biology and Biotechnology (Indian Edition) Royal Society of Chemistry U.K
7. Karp.G (2002) Cell and Molecular Biology, 3rd Edition, John Wiley and Sons; INC
8. Cell and Molecular Biology- P.K. Gupta, Rastogi Publishers, Meerut.
9. Bruce alberts et al (2008) Molecular Biology of the Cell, Fifth ed, , Garland Science, Taylor and Francis group
10. Voet and Voet , Biochemistry (2004) John Willey and Sons Inc.
11. Benjamin Lewin Genes IX, (2007) John Willy & Sons.

12. Molecular Biology of the Genes (2007) James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, Inglis CSHLP (2007), Benjamin Cummings

13. Molecular Cell Biology (2007) Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, HiddePloegh, Paul Matsudaira, Freeman & Co.

### **BBI041A: Practicals of Molecular Biology**

**Credit(s): 2**

1. To Isolate genomic DNA
2. To perform Gel electrophoresis
3. To perform SDS-PAGE
4. To perform Quantification of RNA
5. To perform Quantification of DNA
6. To perform transformation
7. To perform phage titration
8. To perform conjugation

### **BBI042A: PLANT BIOTECHNOLOGY**

**Credit(s): 4**

#### **Unit-1**

**History:** Milestones in the history of plant tissue culture, Cellular totipotency: ‘Explant’ for plant tissue culture: Laboratory Requirements for plant tissue culture laboratory different work areas, equipments & instruments required, techniques, other requirements.

**Aseptic techniques:** Washing & preparation of glassware, packing & sterilization, media sterilization, surface sterilization, aseptic work station, precautions to maintain aseptic conditions;

#### **Unit-2**



**Tissue Culture Media:** Introduction, nutritional requirements of the explants, PGR's and their *in vitro* roles, media constituents, media selection, media preparation; Callus culture technique

**Cell and Suspension Culture:** Introduction, principle, isolation of single cells, suspension cultures, culture of single cells, types, growth & growth measurement, synchronization,

### **Unit-3**

**Protoplast Technology:** Protoplast isolation, culture and regeneration of cell wall, Somatic hybridization – Protoplast fusion techniques, selection of hybrids, production of symmetric & asymmetric hybrids & cybrid production. Application of protoplast culture

### **Unit-4**

Genetic transformations –*Agrobacterium* mediated transformations, direct DNA transfer methods – electroporation, microprojectile bombardment, and microinjection, use of marker genes, integration & expression of foreign DNA

Somatic embryogenesis, organogenesis, Haploid Plant Production: Anther, pollen, ovule and ovary culture, artificial seed, types, uses and advantages

### **Unit-5**

Somaclonal variation and micropropagation Embryo rescue, embryo culture, Transgenic plant- Herbicide resistance plant, insect resistant plants, improving the quality of oils and fats, biodegradable plastic, Edible vaccine, Stress tolerance plants. Germplasm

**Conservation:** Introduction, long-term storages, short or medium term storage, cryopreservation, Gene Bank

### **TEXT / REFERENCE BOOKS**

1. Experiments in Plant Tissue Culture by John H. Dodds & Lorin W. Robert.
2. Plant tissue Culture: Theory and Practice by S.S. Bhojwani and M.K. Razdan (1996) Elsevier,

Amsterdam.

3. An Introduction to Plant Biotechnology by H C Chawla Oxford and IBH 2002

**BBI043A: Practicals of Plant Tissue Culture**

**Credit(s): 2**

1. To Prepare stock solution for M.S. media
2. To prepare and inoculate node and inter node
3. To culture callus
4. To perform suspension culture
5. To prepare media and inoculate shoot tip
6. To prepare media and inoculate root tip
7. To prepare media and inoculate anther
8. To Prepare the synthetic seeds
9. To perform Bergmann's cell plating technique for single cell culture
10. To determine the Composition of various plant tissue culture media
11. To Prepare stock solution for various growth hormones
12. To Prepare M.S. media for seed inoculation
13. To Inoculate seed in M.S. media for micro-propagation

**BBI044A: Bioprocess Engineering and Technology**

**Credit(s): 4**

**Unit-1**

Introduction, Objectives and Scope; Characteristic and comparison of bioprocessing with chemical processing

Microbial production of plant growth Hormones – definition types of IAA in plants, Biosynthesis of IAA, Production of IAA, selection source organisms, formulation of medium, culture of Microorganisms, extraction of IAA, Cytokinins, types.

**Unit-2**

Biosynthesis, production, selection of Microorganisms, extraction, Gibberellic acid, production, extraction, Metabolic basis for product formation; Production of secondary metabolites-penicillin, tetracycline etc; Process technology for the production of Ethanol, amino acid production, single cell protein, Production of Commercial Products: Baker's Yeast, Amino Acids, Xanthan Gum), Vitamins B12, Pigments (Shikonin)

### **Unit-3**

Fermentation technology- definition, stages of fermentation, designing of bioreactors, formulation of medium, sterilization of medium, isolation and selection of microorganisms, production of stock culture, culture of microorganisms in bioreactor,

### **Unit-4**

Batch culture and continuous culture, downstream processes, fermentation products, amino acids, alcohols, organic acids, polysaccharides, Biofuels

### **Unit-5**

Enzyme technology- enzyme versus catalyst, microbial production of enzyme, mechanisms of enzyme action, extraction and purification of enzymes, storage of enzyme, immobilization of enzyme, industrial application of microbial enzyme and production of industrial enzymes-glucose Isomerase, cellulase and lipases

### **TEXT / REFERENCE BOOKS:**

1. Comprehensive Biotechnology Vol. 1- 4: M.Y. Young (Eds.), Pergamon Press.
2. Biotechnology: A Text Book of Industrial Microbiology: T.D. Brock, Smaeur Associates, 1990.
3. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd., 1989.
4. Industrial Microbiology: Prescott & Dunn, CBS Publishers, 1987.
5. Bioprocess Technology- fundamentals and applications, S O Enfors & L Hagstrom (1992), RIT, Stockholm.
6. Biotechnology, Economic & Social Aspects: E.J. Dasilva, C Rutledge & A Sasson, Cambridge Univ. Press, Cambridge.

7. Biotechnology - a handbook of industrial microbiology: W. Crueger and A. Crueger.
8. Microbial Biotechnology: Channarayaappa, University press, Hyderabad, 2003
9. Protein: Biochemistry and Biotechnology by Gary Walsh (2002 John Wiley & Sons Ltd.)
10. Process Biotechnology Fundamentals by S.N. Mukhopadhyay (2001). Viva Books Private Limited.

**BBI045A: Practical of Fermentation Technology**

**Credit(s): 2**

1. To perform Sauerkraut Production
2. To Prepare ginger wine
3. To Prepare grape wine
4. To prepare apple wine
5. To perform the Production of citric acid
6. To estimate the Production of citric acid by *Aspergilles niger*
7. To perform MBRT test
8. Primary screening for amylase, protease and caiseinase producing potent microbial strain
9. To perform various biochemical tests (MRVP, Catalase, Oxidase, etc.)
10. Determination of bacterial growth by turbid metric method

**BBI046A: Seminar-IV**

**Credit(s): 3**

### SEMESTER-V

S.No	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	
BBI047A	Core 1 (Proteomics and Genomics)	4	-	2	4	2	6
BBI049A	Core 2 (Animal Tissue Culture & Biostatistics)	4	-	2	4	2	6
BBI051A	Core 3 (Environmental Biotechnology, IPR & Bioethics)	4	-	2	4	2	6
BMC110A	General Studies	3	-	-	3		3
BMC113A	Communication skills	3	-	-	3		3
BMC109A	Value Education Human rights and Legislative Procedures						
BBI053A	Seminar-V	3	-	-			3
BBI054A	Basic Techniques of Instrumentation	6					6
							36

#### **BBI047A: PROTEOMICS AND GENOMICS**

**Credit(s): 4**

#### **Unit-1**

#### **Introduction to Genomic data and Data Organization: Sequence Data Banks:**

Introduction to sequence data banks-protein sequence data bank. NBRF-PIR, SWISSPROT, Signal peptide data bank, Nucleic acid sequence data bank-Gene Bank, EMBL nucleotide sequence data bank.

## **Unit-2**

**Introduction to MSDN (Microbial Strain Data Network):** Numerical Coding Systems of Microbes, Hybridoma Data Bank Structure, Virus Information System Cell line information system.

## **Unit-3**

BLAST, FASTA algorithms to analyze sequence data: Sequence patterns motifs and profiles.

## **Unit-4**

Secondary Structure predictions; prediction algorithms; Tertiary Structure predictions

## **Unit 5**

Important Data banks in the area of Biotechnology/life sciences/biodiversity; Sequence analysis: Analysis Tools for Sequence Data Banks.

## **TEXT / REFERENCE BOOKS**

1. Lesk, Introduction to Bio Informatics, OUP
2. Developing Bioinformatics Computer Skills, Cynthia Gibas and Per Jambeck, 2001 SPD
3. Introduction to Bioinformatics, Atwood, Pearson Education
4. Beginning Perl for Bio-informatics, Tisdall, SPD
5. Biocomputing: Informatics and Genome Project, Smith, D.W., 1994, Academic Press, NY
6. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Baxevanis, A.D., Quелlette, B.F.F., John Wiley & Sons.
7. Biostatistics. S.P. Gupta

## **BBI048A: Practical Exercises of Bioinformatics**

**Credit(s): 2**

1. To retrieve the sequence of the Human keratin protein from GenBank database and to interpret the results.

2. To retrieve the structure of a protein and viewing it in RASMOL viewer.
3. To find the similarity between sequences using BLAST
4. To find the similarity between sequences using FASTA
5. To align more than two sequences and find out the similarity between those sequences
6. To perform Sequence analysis by using EMBOSS
7. To perform different Exercises of biostatistics (measure of central tendency, correlation regression, karl pearson coffecient, standard deviation and meadn deviation, t Test, r Test))

## **BBI049A: ANIMAL TISSUE CULTURE**

**Credit(s): 4**

### **Unit-I**

History of development of cell cultures, the natural surroundings of animal cells, stimulating natural conditions for animal cells, metabolic capabilities of animal cells  
Sterilization techniques: Aseptic techniques in animal tissue culture; sterilization of culture media, glassware and tissue culture laboratory, detection of contamination, safety considerations in ATC laboratory. Animal Cell Culture Techniques: primary cultures, secondary cultures, established/continuous cell lines; measurement tissue culture media: Components their importance. Serum free media

### **Unit-II**

Cell fusion and production of monoclonal antibodies; Genetic Engineering in animal cells: Transformation of animal cells, vectors and expression vectors, Genetic Engineering in production or regulatory proteins, blood products, vaccines and hormones, Transgenic animals and production of useful products in transgenic animals.

### **Unit-III**

Preliminary concept Definition of statistics, Data & types, Frequency distribution Graphical representation (Histogram, frequency polygon, frequency curve). Diagrammatic representation (simple Bar, Subdivided bar, pie chart) Importance and applications Tabulation and Classification of data, Frequency distribution and Graphical distribution of data

#### **Unit -IV**

Central Tendency: Concepts, definition, formulas of ungrouped and grouped data examples of Mean, Median, Mode and Quartiles. Relation between mean mode and median. Measures of Variation: Concept, Definition, formula, examples of Range, Standard Deviation and Mean deviation. Definition, examples of Variance and Coefficient of Variation

#### **Unit-5**

Correlation & linear regression, Test of significance: Z test, t- test, Chi-Square test, Hypothesis Testing Student T-test. Probability and Distribution Concepts and problems on probability, Binomial, Poisson, Normal Distribution and their Applications, Different Models of data presentation with special reference to biological samples

#### **Reference Books**

1. Mammalian Cell Biotechnology – A Practical Approach- Butler, M.
2. Culture of Animal Cells- Freshney, R. T.
3. Human Cell Culture Protocols- Gareth, E.J.
4. The Animal Cell Culture and Technology- Butler, M.
5. Cell Biology-A Laboratory hand books- Julio, E., Celis
6. Gene Therapeutics- Wolff, J.E.D.
7. Genes in Medicine- Rasko, I., and Downes, C.S.
8. Molecular Biotechnology Therapeutic Application and Strategies- Maulik S. and Patel, S.D.
9. Mammalian Cell Biotechnology. A practical approach- Butler, M.C.



10. Culture of Animal Cells- Freshney, R.T.
11. Fundamental of Biostatistics – P. Hanamantrao
12. Introduction to Biostatistics Dr. Pranabkumar Banerjee
13. Biostatistics – Khan and Khanam

**BBI050A: Practical of Animal Biotechnology**

**Credit(s): 2**

1. To study Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. To study Sources of contamination and decontamination measures.
3. To Prepare Hanks Balanced salt solution
4. To Prepare Minimal Essential Growth medium
5. To Isolate lymphocytes for culturing
6. To Isolate rat macrophages from peritoneum for culturing
7. To analyze Primary Lymphoid culture
8. To perform DNA isolation from animal tissue
9. To perform window making in egg
10. To analyze different stages of chick embryo
9. To perform Quantification of isolated DNA
10. To determine Resolving DNA on Agarose Gel
11. To study Calculation oriented statistical techniques
12. To analyze Problem based on test of significance
13. To analyze Problem based on correlation and coefficient
14. To analyze Problem based on standard deviation

**BBI051A: Environmental Biotechnology, IPR & Bioethics**

**Credit(s): 4**

**Unit-1**

**Ecology & Biodiversity:** Introductory concepts, The biological world and Ecology: Ecological balance and consequences of change, Biological world and eco-systems; Air Pollution Primary and secondary air pollutants, Acid rain and ozone depletion

### **Unit-2**

**Waste water Treatment-** Sources and classification of pollutants, BOD, COD, DO, TDS. Biological waste water treatment, sewage treatment, primary treatment, secondary treatment, anaerobic digestion, tertiary treatment reuse of sewage, conversion of waste into biogas

### **Unit-3**

**Biological monitoring of hazardous wastes:** degradation of Xenobiotic compounds, degrading agents, superbug, construction of superbug, bioremediation, phytoremediation, Anaerobic and aerobic composting, Vermiculture

### **Unit-4**

Biomining definition bioleaching, microorganisms involve in bioleaching, in situ bioleaching, removal of metal from water, microbial enhancement of oil recovery, advantages of Biomining, **Biosensors and Biochips:** Definition, biosensors, types of biosensors, application of biosensors, Biochips

### **Unit 5**

**IPR and bioethics:** Regulation in biotechnology, Biosafety, Possible dangerous of GEOs, Biohazards of rDNA technology Biosafety guidelines, implementation of Biosafety guideline, Intellectual property rights, legislation covering IPR in India, Administration of IPR in India, Patenting of Biotechnological products, Copyright, Designs and trademark. biosafety regulation and national and international guidelines, Patenting in Biotechnology, economic, ethical and depository considerations. Patenting in India, subject matter and legal aspects of transfer of Biotechnology in India. Writing a patent specification. Information sources in Patent Literature search.

### **TEXT / REFERENCE BOOKS**

1. Odum, E.P., Fundamentals of Ecology
2. Metcalf & Eddy, Wastewater Engineering – Treatment, Disposal and Reuse, 3rd ed., Tata McGrawhill
3. Rao, C.S., Environmental Pollution Control Engineering, New Age International, 1999
4. Arceiwala, S.J., Wastewater treatment for pollution control, 2nd Ed. TMH  
How to Write & Present Technical Information, 3rd Edition, Charles H. Sides, Cambridge University Press. 1999.
5. Garffey, Mary Ellen Business Communication, Cincinnati: South-Western College Publishing, 2000
6. Parley E Stevens and Daniel G Riardaw. Technical Report Writing Today N Delhi AITBS, 1998.

**BBI052A: Practicals of Environmental Biotechnology**

**Credit(s): 2**

1. To determine Temporary Hardness,
2. To determine permanent hardness,
3. To determine Total hardness
4. To determine Alkanity and Acidity of water
5. To determine BOD in different water samples
6. To determine COD in different water samples
7. To determine DO of different water samples
8. To determine Total Salts and Total Dissolve Salts of water
9. To Estimate chloride in water
10. To perform IMVIC Test
11. To perform MPN test

**BBI053A: Seminar V**

**Credit(s): 3**

**BI054A: Basic Techniques of Instrumentation**

**Credit(s): 6**

**SEMESTER VI**

S.No	Subject	Lecture (Hr.)	Tutorials (Hr.)	Practical (Hr.)	Credits		Total Credits
					L	P	
<b>BBI055A</b>	<b>Project</b>	<b>44</b>	<b>-</b>	<b>-</b>			<b>44</b>
<b>BBI056A</b>	<b>Seminar</b>						<b>2</b>
							<b>46</b>

**BBI055A: PROJECT**

**Credit(s): 44**

JECRC University on any topic related to the subject after one Educational tour at any place in India. The duration of tour should be at least one week at the spot. The work and tour should be documented and also student has to present his/her in front of an external.

**BBI056A: Seminar**

**Credit(s): 2**