SEMESTER-I
CORE THEORY-I
CELL BIOLOGY AND GENETICS

Unit 1: Cell structure and Functions 1.1. Cell as basic unit of living organisms-	1hrs
bacterial, fungal, plant and animal cells 1.2. Ultrastructure of prokaryotic cell (cell membrane and plasmids, Nucleoid)	2hrs
1.3. Ultrastructure of eukaryotic cell (cell wall, cell membrane, nucleus, mitochondria, chloroplast,	2hrs
endoplasmic reticulum, Golgi apparatus, vacuoles)	2hrs
1.4. Fluid mosaic model, Sandwich model, Cell membrane permeability	2hrs
1.5. Structure of chromosome-morphology, components of chromosomes (histones and non-	2hrs
histones), specialized chromosomes (Polytene, Lampbrush)	2hrs
1.6. Chromosomal aberrations- structural and numerical	2hrs
Unit 2: Cell cycle 2.1 Bacterial cell division	2hrs
2.2 Eukaryotic cell cycle –phases	2hrs
2.3 Mitosis - Stages (spindle assembly)-	2hrs
significance	1hr
2.4 Meiosis- Stages (synaptonemal complex)- significance	2hrs
2.5 Senescence and necrosis	2hrs
2.6 Apoptosis	2hrs
2.6 Apoptosis	2hrs
Unit 3: Principles and mechanism of inheritance 3.1 Mendel's experiments- factors contributing to success of Mendel's experiments	1hrs
3.2 Law of segregation- Monohybrid Ratio;	1hrs
Law of independent assortment- dihybrids, trihybrids	2hrs
3.3 Deviation from Mendel's laws- partial or incomplete dominance	2hrs
(eg: Flower Color in Mirabilis jalapa), Co-dominance (eg: MN Blood groups),	1hrs
Non allelic interactions-types of epistasis, modification of dihybrid ratios	2hrs

3.4 Penetrance and Expressivity (eg: polydactyly, waardenburg syndrome), pleiotropism, phenocopy-microcephaly, cleft lip	1hr
3.5 Multiple alleleism (eg: Coat color in Rabbits, eye color in Drosophila and ABO Blood groups)	2hrs
3.6 X-Y chromosomes - Sex determination in Drosophila, Birds, Man, Bonellia,	1hr
X-linked inheritance - Hemophilia, Color blindness, X- inactivation, Y-linked inheritance- Holandric genes	2hr
Unit 4: Linkage, Recombination and Extension to Mendel's Laws	2hr
4.1 Linkage and recombination- Cytological proof of crossing over	2hr
phases of linkage, recombination frequency, gene mapping and map distance	2hr
4.2 Non-Mendelian Inheritance – Maternal effect (Shell coilng in snail), variegation in leaves of Mirabilis jalapa	2hr
4.3 Cytoplasmic male sterility in Maize and Paramecium,	2hr
4.4 Mitochondrial inheritance in human and poky in Neurospora crassa	2hr
4.5 Chloroplast inheritance in Chlamydomonas	2hr
4.6 Hardy-Weinberg Equilibrium, allelic and genotypic distribution	1hr

REFERENCE BOOKS

1. Cell & Molecular Biology. E.D.D De Robertis & E.M.F De Robertis, Waverly publication
2. An introduction to Genetic Analysis by Anthony, J.F. J.A. Miller, D.T. Suzuki, R.C. Richard Lewontin, W.M-Gilbert, W.H. Freeman publication
3. Principles of Genetics by E.J.Gardner and D.P. Snusted. John Wiley & Sons, New York
4. The science of Genetics, by A.G. Atherly J.R. Girton, J.F. Mcdonald, Saundern College publication
5. Principles of Genetics by R.H. Tamarin McGrawhill
6. Theory & problems in Genetics by Stansfield, Schaum out line series McGrawhill
7. Molecular Cell Biology Lodish, H., Baltimore, D; fesk, A., Zipursky S.L., Matsudaride, P. and Darnel. American Scientific Books. W.H. Freeman, New York
8. The cell: A molecular approach. Geoffrey M Cooper, Robert E Hausman, ASM press
9. Cell and Molecular Biology, Concepts and Experiments – Gerald Karp, John Wiley & Sons, Inc

SEMESTER II CORE THEORY II NUCLEIC ACIDS & BIOINFORMATICS

Unit 1: Nucleic Acids and Genome organization	
1.1 DNA as the genetic material- Griffiths experiments on transformation in Streptococcus pneumoniae,	2hrs
Hershey-Chase experiments with radio labeled T2 bacteriophage, Avery, MacLeod and McCarty's experiments	2hrs
1.2 RNA as genetic material- Tobacco Mosaic Virus	1hrs
1.3 Structure and forms of DNA (A, B and Z)	1hrs
1.4 Genome organization in prokaryotes	1hrs
1.5 Genome organization in eukaryotes, C-value and C-value paradox, Reassociation kinetics-cot curve,	1hrs
Denaturation, Reanturation, Tm curve	1hr
1.6 Kinetic classes of DNA- unique sequences, moderately repeated and highly repeated sequences;	2hrs
tandem repeats (satellite, minisatellite and micro satellites),	2hrs
interspersed repeats (SINES-eg: Alu repeats, LINES); palindromic sequences and transposable genetic elements	2hrs
Unit 2: DNA Replication, Recombination and Repair	
2.1 DNA replication- enzymes involved, semi conservative	2hrs
DNA replication-Messelson and Stahl experiment, Linear, Circular, Rolling circle, Theta, D loop	2hrs
2.2 Mutation- spontaneous, induced (frame shift, transition, transversion)	2hrs
2.3 Physical and chemical mutagens	2hrs
2.4 DNA damage- intrinsic and extrinsic factors	2hrs
2.5 DNA repair-Direct, Excision and methyl mediated mismatch, recombinational and SOS repair	2hrs
2.6 DNA recombination-homologous, site specific recombination	2hrs
NHEJ (Non-Homologous End Joining)	1hr
Unit 3: Concepts of Bioinformatics	
3.1 Bioinformatics – a historical perspective	2hrs
3.2 Internet and its role in bioinformatics	2hrs
3.3 Bioinformatics Data: Genomes, nucleic acids, proteins, protein structures	2hrs
3.4 Storage of databases in DNA (GenBank, EMBL, DDBJ)	2hrs
3.5 Protein data banks (PDB, SWISS-PROT)	2hrs

UNIPROT, PIR and their utilization	1hr
3.6 Data retrieval tools-BLAST,	2hrs
ENTREZ	2hrs
Unit 4: Applications of Bioinformatics	
4.1 Genome annotation: Gene identification tools	2hrs
4.2 Basics of sequence alignment	2hrs
Pairwise alignment (global and local)	2hrs
4.3 Multiple sequence alignment and phylogenetic analysis	2hrs
4.4 Structural classification of proteins and homology model building	2hrs
4.5 Applications of Bioinformatics- drug targets,	2hrs
overview of drug designing	1hr
4.6 Concepts of Phramacogenomics	2hrs

REFERENCE BOOKS

1. Genes VII. Benjamin Lewin, Oxford Univ. Press, Oxford
2. Molecular Biology by D, Freifelder Narosa Publishing house New York, Delhi
3. Molecular Cell Biology Lodish, H., Baltimore, D; fesk, A., Zipursky S.L., Matsudaride, P. and Darnel. American Scientific Books. W.H. Freeman, NewYork
4. Molecular Biology by Brown
5. Essentials of Molecular Biology. D. Freifelder, Panima Publishing Corporation.
6. Bioinformatics: Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press
7. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids by Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison, Cambridge University Press
8. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Andreas D. Baxevanis, B. F. Francis Ouellette, Wiley-Interscience
9. Bioinformatics tools and Resources – free online tools, downloadable free tools, software packages, internet, Bioinformatics books and Journals, Bioinformatics web-portals

SEMESTER III

CORE THEORY III	
BIOLOGICAL CHEMISTRY	
Unit 1: Biomolecules-Carbohydrates and Lipids	
1.1 Carbohydrates-Importance, classification, physical and chemical properties of carbohydrates	2hrs
1.2 Structure, configuration and biochemical importance of monosaccharides (Glucose and Fructose) Oxidation,	2hrs
Reduction; Vitamins- classification, sources, functions and applications	2hrs
1.3 Reducing and non-reducing sugars- structure, configuration and biochemical importance of disachharides and glycosidic bond (Sucrose, Lactose, Maltose, Isomaltose)	2hrs
1.4 Structure and functions of polysachharides (Starch, glycogen, chitin)	2hrs
1.5 Lipids, Fatty acids- importance, properties and	1hr
classification, simple lipids- tag, complex lipids, derived lipids,	2hrs
sterols, fatty acids: saturated and unsaturated fatty acids with examples	1hr
1.6 Acids, Bases, acid-base interactions, pH, buffers, functional groups	1hr
Unit 2: Biomolecules-Proteins	
2.1 Classification, structure, physical and chemical properties of amino acids	2hrs
2.2 Characteristic properties of peptide bond and formation	2hrs
2.3 Structure of proteins, primary, secondary, tertiary and quaternary	2hrs
2.4 Enzymes-classification and nomenclature	2hrs
2.5 Michaelis Menton equation-factors influencing the enzyme reactions and enzyme inhibition	2hrs
(competitive and non-competitive), role of co-enzymes.	2hrs
2.6 Peptide-hormones, mode of action, thyroid gland,	2hrs
pancreatic hormones	1hr
Unit 3: Metabolism and Cell Signaling	
3.1 Basic concepts of metabolism, anabolic and catbolic pathways with examples.	2hrs
3.2 Glycolysis, TCA Cycle,	2hrs
electron transport, Oxidative phosphorylation	2hrs
3.3 Gluconeogenesis and its significance	2hrs
3.4 β-oxidation of fatty acid,	2hrs
transamination and oxidative deamination reactions of amino	2hrs

acids	
3.5 Basic characteristics of cell signaling- paracrine, endocrine, autocrine	2hrs
3.6 Second messengers and their role in signal transduction	1hr
Unit 4: Bioanalytical techniques	
4.1 Colorimetry: Beer and Lambert's laws	2hrs
UV- Vis spectrophotometry	1hrs
4.2 Principle and applications of Chromatography (Paper, thin layer)	1hrs
Ion exchange and gel filtration, HPLC)	2hrs
4.3 Principle and applications of Electrophoresis- Native gels	2hrs
SDS-PAGE, Agarose	2hrs
4.4 Principle and applications of centrifugation (Preparative	2hrs
and Analytical)	1hr
4.5 Principle and applications of X-ray crystallography	1hr
4.6 Principle and applications of NMR	1hrs

REFERENCE BOOKS

1. Lehninger Principles of Biochemistry By: David L. Nelson and Cox
2. Biochemistry By: Rex Montgomery
3. Harper's Biochemistry By: Robert K. Myrray
4. Enzymes By:Trevor Palmer
5. Enzyme structure and mechanism By: AlanFersht
6. Principles of Biochemistry By: Donald J. Voet, Judith G.Voet, Charlotte W.Pratt
7. Analytical Biochemistry By Cooper
8. Principles and techniques of Biochemistry and Molecular Biology Edited By Keith Wilson and John Walker
9. Experimental Biochemistry: A Student Companion by Sashidhar Beedu et al
10. Practical Biochemistry By Plummer

SEMESTER IV CORE THEORY IV MICROBIOLOGY AND IMMUNOLGY

Unit 1: Fundamentals of Microbiology	
1.1 Historical development of Microbiology and contributors of microbiology	2hrs
1.2 Microscopy: Bright field microscopy, Dark field microscopy,	2hrs
Phase contrast microscopy, Flourescent microscopy,	2hrs
scanning and Transmission Electron microscopy	2hrs
1.3 Outlines of classification of Microorganisms	2hrs
1.4 Structure and general characteristics of Bacteria	2hrs

1.5 Structure and general characteristics of Virus	2hrs
1.6 Structure and general characteristics of Micro algae	1hr
and Fungi	1hr
Unit 2: Culture and Identification of Microorganisms	
2.1 Bacterial nutrition, Nutritional types of Bacteria,	2hrs
Essential macronutrients, micronutrients and growth factors	2hrs
2.2 Bacterial growth, factors influencing bacterial growth	2hrs
2.3 Typical growth curve-batch and continuous cultures,	2hrs
synchronous cultures	1hr
2.4 Measurement of bacterial growth- measurement of cell number and cell mass	2hrs
2.5 Culturing of anaerobic bacteria	2hrs
2.6 Culturing of viruses	2hrs
Unit 3: Basics of Immunology	
3.1 Types of immunity-innate and adaptive immunity	2hrs
3.2 Cells of the immune system: T-cells (helper and cytotoxic cells), B-cells, natural killer cells, macrophages,	2hrs
basophils and dendritic cells	1hr
3.3 Primary organs of immune system (thymus and bone marrow)	2hrs
3.4 Secondary organs of immune system (Spleen and lymph nodes)	2hrs
3.5 Complement system-functions and components of complement system	2hrs
3.6 Cell mediated immunity and cytokines	2hrs
Unit 4: Antigens and Antibodies	
4.1 Antigens-Immunogenicity vs Antigenicity,	1hr
factors affecting antigenicity, epitopes, haptens, adjuvants	1hr
4.2 Antibody structure, function and diversity, antigen-antibody reactions, complement activation	2hr
4.3 Antigen antibody interactions	1hr
principle and applications of precipitation and agglutination	1hr
4.4 Monoclonal antibodies, production and applications	2hrs
4.5 Basic concepts of cell mediated immunity,	2hrs
autoimmunity and hypersensitivity	2hrs
4.6 Major Histocompatibility Complex and	2hrs
its role in organ transplantation	1hr

REFERENCE BOOKS

1. Brock, T.D. and Madigan, M.T. Biology of Microorganisms
2. Prescott, L.M., Harley, J.P. Klein, D.A. Microbiology
3. Pelczar, M.J, Chan, E.C.S., Ereig, N.R. Microbiology
4. Benson Microbiological applications
5. Freifelder, D Physical biochemistry: application to biochemistry and molecular biology
6. Wilson & Walker Practical biochemistry
7. Upadhyay and Upadhyay Physical Biochemistry
8. Essential Immunology - By I. Roitt, Publ: Blackwell
9. Immunology - By G. Reever & I. Todd, Publ: Blackwell
10. Abbas AK, Lichtman AH, Pillai S. Cellular and Molecular Immunology. Saunders Publication, Philadelphia
11. Golds by RA, Kindt TJ, Osborne BA. Kuby's Immunology. W.H. Freeman and Company, New York

SEMESTER V

CORE THEORY V	
MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY	
Unit 1: Gene expression in prokaryotes and eukaryotes	
1.1 Organization of prokaryotic and eukaryotic genes,	2hrs
gene families-homogenous, heterogenous gene families, pseudogenes, split genes	2hrs
1.2 Transcription in prokaryotes: initiation,	2hrs
elongation, termination	1hr
1.3 Transcription in eukaryotes: initiation,	2hrs
elongation, termination	1hr
1.4 Processing and maturation of eukaryotic RNA (Splicing)	2hrs
1.5 Genetic code, properties of genetic code,	1hr
Wobble concept, aminoacylation	1hr
1.6 Translation in prokaryotes and eukaryotes	1hr
Unit 2: Regulation of Gene expression in Prokaryotes and Eukaryotes	
2.1 Regulation in prokaryotes: general aspects of regulation	2hrs
2.2 Transcription level regulation-positive,	2hrs
negative and coordinated regulation (inducible–lac operon and	2hrs
repressible operon concept – trp operon	1hr

2.3 Regulation in Eukaryotes: genome rearrangement for generation of functional protein sequences (immunoglobulin genes)	2hrs
2.4 Transcriptional control by cis (enhancers, silencers) and	2hrs
Trans (transcription factors) regulatory elements	1hr
2.5 Translational regulation in prokaryotes	2hrs
2.6 Translational regulation in eukaryotes	1hr
Unit 3: Introduction to Recombinant DNA Technology	
3.1 Enzymes useful in molecular cloning: Restiction endonuclease, DNA ligases, Polynucleotide kinase,	2hrs
Klenow enzyme, DNA Polymerase I, reverse transcriptase,	2hrs
Alkaline phosphatase, terminal nucleotidyltransferase	1hr
3.2 Plasmids as cloning vehicles-pBR322, pUC 18 and pET	2hrs
3.3 Cloning and expression of foreign genes in E.coli	2hrs
3.4 Labeling nucleic acids and blotting techniques	2hrs
3.5 Polymerase Chain Reaction and its applications	2hrs
3.6 Applications of recombinant DNA technologies	2hrs

REFERENCE BOOKS

1. Molecular Biology of the cell. Alberts, B; Bray, D, Lews, J., Raff, M., Roberts, K and Watson, J.D. Garland publishers, Oxford
2. Molecular Biology of the Gene - By Watson, Hopkins, Goberts, Steitz and Weiner (Pearson Education)
3. Text Book of Biotechnology - By H.K. Das (Wiley Publications)
4. Gene Structure & Expression - By J.D. Howkins, Publ: Cambridge
5. Test Book of Molecular Biology - By K.S. Sastry, G. Padmanabhan & C. Subramanyan, Publ: Macmillan India
6. Principles of Gene Manipulation - By R.W. Old & S.B. Primrose, Publ: Blackwell
7. Genes - By B. Lewin - Oxford Univ. Press
8. Molecular Biology &Biotechnol - By H.D. Kumar, Publ: Vikas
9. Methods for General & Molecular Bacteriology - By P. Gerhardf et al., Publ: ASM
10. Molecular Biotechnology - By G.R. Click and J.J. Pasternak, Publ: Panima
11. Genes and Genomes – By Maxine Singer and Paul Berg
12. Molecular Biology - By D. Freifelder, Publ: Narosa
13. Molecular biology. By;F.Weaver. WCB/McGraw Hill
14. Gene, Genomics and Genetic Engineering - By Irfan Ali Khan and AtiyaKhanum (Ukaaz Publications)

SEMESTER-VI CORE THEORY VI MICROBIAL TECHNOLOGY

Unit 1: Introduction to Microbial technology	
1.1. Introduction to industrial biotechnology,	2hrs
scope and applications	1hr
1.2. Principles and exploitation of microorganisms and their products	2hrs
1.3. Isolation and screening of microorganisms for industrial products	2hrs
1.4. Strategies for Strain improvement (mutation, selection, recombination)	2hrs
1.5. Preservation of industrial microorganisms	2hrs
1.6. Good manufacturing practices and	2hrs
Intellectual Property Rights and Patenting issues	2hrs
Unit 2: Microbial fermentation	
2.1 Principles of Fermentation technology	1hrs
2.2 Fermentation concept and	2hrs
Design	1hr
2.3 Types of Fermentation	2hrs
2.4 Formulation and	2hrs
Design of fermentation Media	2hrs
2.5 Substrates used as Carbon and Nitrogen	2hrs
Inoculum development.	1hr
2.6 Factors affecting fermentation process	2hrs
Unit 3: Microbial technology products and applications	
3.1 Microbial production of Organic acids (Lactic acid, citric acid)	2hrs
3.2 Microbial production of Amino acids (Glutamic acid ,Aspartic acid, Lysine)	2hrs
3.3 Fermentation by microbes for food additives: dairy products (Cheese, Yogurt, Bread, Vinegar, SCP), beverages	2hrs
(Beer, Wine) and antibiotics (Penicillin, Streptomycin, Erythromycin)	2hrs
3.4 Food quality and Control	2hrs
3.5 Therapeutic drugs: Recombinant vaccines, monoclonal antibodies,	2hrs
insulin, vitamins	1hr
3.6 Biofuel: Hydrogen, Alcohol, Methane	2hrs

REFERENCE BOOKS

1. Text Book of Biotechnology - By H.K. Das (Wiley Publications)
2. Biotechnology -By H.J. Rehm and G. Reed. VIH Publications, Germany
3. Biogas Technology - By b.T. Nijaguna
4. Biotechnology - By K. Trehan
5. Industrial Microbiology - By L.E. Casida
6. Food Microbiology - By M.R. Adams and M.O. Moss
7. Introduction to Biotechnology - By P.K. Gupta
8. Essentials of Biotechnology for Students - By Satya N. Das
9. Bioethics – Readings and Cases - By B.A. Brody and H. T. Engelhardt. Jr. (Pearson Education)
10. Biotechnology, IPRs and Biodiversity - By M.B. Rao and Manjula Guru (Pearson Education)
11. Bioprocess Engineering - By Shuler (Pearson Education)
12. Essentials of Biotechnology - By Irfan Ali Khan and AtiyaKhanum (Ukaaz Publications)
13. Gene, Genomics and Genetic Engineering - By Irfan Ali Khan and AtiyaKhanum (Ukaaz Publications)