Dr. Bhimrao Ambedkar University, Agra

A State University of Uttar Pradesh (Paliwal Park, Agra -282004)

www.dbrau.ac.in

A Documentary Support

for

Matric No. – 1.3.1

Institution integrates cross-cutting issues relevant to **Professional Ethics, Gender, Human Values, Environment & Sustainability and other value framework enshrined in Sustainable Development goals and National Education Policy – 2020** into the Curriculum

under the

Criteria – I

(Curriculum Design and Development)

Key Indicator - 1.3

in

Matric No. – 1.3.1

MSc (BioChemistry)

PROFESSIONAL ETHICS	ENVIRONMENT & SUSTAINABILITY	NATIONAL EDUCATION POLICY – 2020
HUMAN VALUES	GENDER	

Registrar
Dr. B.R.A. University, Agra

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

Appendix II

(12)

M.Sc. Biochemistry Syllabus
Under credit system at the Department of Biochemistry
Dr. Bhimrao. Ambedkar University, Agra

Semester	Papers	Marks		Total	Credit
Semester I Course Code		CIE	End Semester examination		
BC 101C	Plant Biochemistry	25	75	100	4
BC 102C	Cell Biology and Cell Signalling	25	75	100	4
BC 103C	Biomolecules and Bioinstrumentation	25	75	100	4
BC 104C	Biostatistics and Computer Applications	25	75	100	4
BC 105	Practical		100	100	4
	IndustrialTraining/Survey/Research Project				
Total				500	20
Semester	**Papers**	**Marks**		**Total**	**Credit**
Semester II Course Code		CIE	End Semester examination		
BC 201C	Essential of Molecular Biology	25	75	100	4
BC 202C	Immunology	25	75	100	4
BC 203C	Advanced Enzymology	25	75	100	4
BC 204C	Intermediary Metabolism	25	75	100	4
BC 205	Practical		100	100	
	Industrial Training/ Survey/Research Project		200	200	8
	Minor	25	75	100	4
	Total		800	32	
Semester	**Papers**	**Marks**		**Total**	**Credit**
Semester III Course Code		CIE	End Semester examination		
BC 301C	Microbial Physiology and Biochemistry	25	75	100	4
BC 302C	Nutritional Biochemistry	25	75	100	4
BC 303C	Clinical Biochemistry and Biosafety	25	75	100	4
BC 304E	Genetic Engineering	25	75	100	4
BC 305E	Pharmaceutical biochemistry				
BC 305	Practical		100	100	4
	Industrial Training/ Survey/Research Project				
Total			500	20	
Semester	**Papers**	**Marks**		**Total**	**Credit**
Semester IV Course Code		CIE	End Semester examination		
BC 401C	Applied Biotechnology	25	75	100	4
BC 402C	Human Physiology	25	75	100	4
BC 403E	Environmental Biochemistry	25	75	100	4
BC 404E	Genomics and Proteomics				
BC 405E	Gene Expression and Regulation	25	75	100	4
BC 406E	Medical Biochemistry				
BC 407	Practical		100	100	4
	Industrial Training/ Survey/Research Project		200	200	8
Total		700	28		

Note:

1. Total number of credits in M.Sc. (Biochemistry) I year/ B.Sc. research is 52 credits.
2. Total number of credits in M.Sc. (Biochemistry) II year48 credits.
3. Total credis required for M.Sc. (Biochemistry) will be 52=48 = 100

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M.Sc. BIOCHEMISTRY
SEMESTER – FIRST
BC-101C(Core Course)
PLANT BIOCHEMISTRY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs

Credit 04

UNIT-I **15hrs**

Structure and function of plant cell,cell wall, plasmodesmata, vacuoles, peroxisomes. Isolation of cell organelles, mechanism of the transport of water, inorganic and organic substances.

Seed dormancy, growth and development.

UNIT – II **15hrs**

Photosynthesis: structure of organelles involved in photosynthesis in plants and bacteria, photosystem I, II and their location, mechanism of quantum captures and energy transfers between photosystem, reduction of CO_2, C_3, C_4 and CAM metabolism regulation of photosynthesis.

Photorespiration and its significance.

UNIT – III **15hrs**

Biological nitrogen fixation: mechanism of nitrate uptake and reduction ammonia assimilation, sulphate uptake and transport.

Mineral nutrition: micronutrients, macronutrients and their biological role in plants.

UNIT – IV **15hrs**

Secondary plant metabolites:biosynthesis of tannins, alkaloids (pyrrolidine,piperidine, coniine, quinolinate), flavonoidsnd surface waxes and their functions.

Antioxidative defense system in plants.

Plant hormones: Mode of action of auxins, gibberellins, cytokinins, ethylene, abscissic acid.

Reference Books

Plant Biochemistry, Goodwin Mercer

Plant Phsiology, Salisbury Ross

Biochemistry and Molecular Biology of Plants, by Buchanan

Plant Biochemistry and Molecular Biology, by Lea and Leegood Plant Biochemistry, by Dey and Harborne

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M.Sc. BIOCHEMISTRY
SEMESTER – FIRST
BC-102C (Core Course)
CELL BIOLOGY AND CELL SIGNALLING
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT – I **15hrs**

Cell Membrane: Physicochemical Properties, Molecular Organization – asymmetrical organization of lipids, proteins and carbohydrates and functions.

Transport across membranes: Types of transport (simple diffusion, passive-facilitated diffusion), active transport – primary and secondary group translocation, transport ATPases (V type, F type, P type, ABC type).

UNIT – II **15hrs**

Cell classification, cell variability (size, shape, complexity, and function).Structural organization of prokaryotic and eukaryotic cell.

The ultrastructure of nucleus, mitochondria, endoplasmic reticulum(rough and smooth), Golgi apparatus, lysosomes and their function.

The cytoskeleton: microtubules and microfilaments.

The extra cellular matrix:collagen.

UNIT – III **15hrs**

Cell–cycle: phases of cell cycle, cell cycle check points, CdK, cyclins, MPF, p53, wait signal, Apoptosis.

Cell division by mitosis and meiosis.

Biochemistry of cancer: characteristics of cancer cell, carcinogenesis,carcinogens, oncogenes and tumor suppressor genes.

UNIT – IV **15hrs**

Cell signaling:Forms of intracellular signaling, hormone and their receptors (steroid and plant hormones)

Pathways of intracellular signal transduction: c-AMP pathway, c-GMP pathway, phospholipids and Ca^{++}

Ras, Raf and MAP kinase pathway

JAK/STAT pathway

Reference Books

Molecular Biology of the Cell, Alberts, *et al*
Molecular Cell Biology, Lodish, et al
Cell and Molecular Biology: Concepts and Experiments, Gerald Karp
The Cell: A Molecular Approach, G.M. Cooper
The Word of the Cell, Becker *et al*
Cell Proliferation and Apoptosis, Hughes and Mehnet
Essential Cell Biology, Alberts*et al*
Biochemistry and Molecular Biology of Plants, Buchanan *et al*
Harpers Biochemistry Murray *et al*

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M.Sc. BIOCHEMISTRY
SEMESTER – FIRST
BC-103C(Core Course)
BIOMOLECULES AND BIOINSTRUMENTATION
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT–I **15hrs**

Carbohydrates: Classification, structure of carbohydrates (monosaccharides, disaccharides polysaccharides- homo- and hetero-polysaccharides).
Lipids:Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrosides, steroids, bile acids, prostaglandins and lipoproteins.

UNIT–II **15hrs**

Amino acids: Structure, classification, abbreviation, properties and functions of amino acids.
Proteins:Classification, structure and functions of proteins, Ramachandran plot, Protein Sequencing.
Nucleic acids:Structure and function of nucleotides. Primary, secondary and tertiary structure of nucleic acids. DNA forms (single stranded DNA, A, B and Z DNA) syn and anti conformations. Types of RNA (m RNA, t RNA, rRNA, hn RNA, micro RNA).

UNIT–III **15hrs**

Spectroscopy: Concept of spectroscopy, Laws of Photometry, Beer-Lambert's Law. Instrumentation and application of UV, Visible, and IR, Raman spectroscopy.
Radioisotope Techniques: Units and measurement of radioactivity. Use of radioisotopes in Biomedicine and research.
Electron Microscopy:Transmission and scanning, freeze fracture techniques.

UNIT– IV **15hrs**

Electrophoresis: Moving boundary zonal electrophoresis, paper and gel electrophoresis, isoelectric focusing.
Chromatography: Paper Chromatography, Thin Layer Chromatography (TLC), Ion exchange, gel filtration and affinity chromatography, High Pressure Liquid Chromatography (HPLC) – Normal & reverse phase.
Centrifugation techniques and their application.subcellular fractionation.

Reference Books

Principles of Biochemistry by Nelson, Cox and Lehninger
Biochemistry by G.Zubay
Biochemistry, DVoet and JG.Voet , J Wiley and Sons.
Physical Biochemistry: Applications to Biochemistry and Molecular Biology, D Freifilder, W.H. Freeman & Company.
Practical Biochemistry, Wilson &Walker.

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M.Sc. BIOCHEMISTRY
SEMESTER –FIRST
BC-104C(Core Course)
BIOSTATISTICS AND COMPUTER APPLICATIONS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT- I **15hrs**

Measures of central tendency. (arithmetic mean, mode, median), measure of dispersion, standard deviation, coefficient of variance, group data and graphic methods, frequency & distribution.

Probability: Definition of probability, multiplication, law of probability, addition, law of probability, random variable permutation &combination.binomial, normal &poisson distribution.

UNIT -II **15hrs**

Tests of significance hypothesis and errors, Student statistics- Population mean equal a specified value.Equality of two independent means, Equality of two means. Non-parametric test Chi square statistics, test of goodness of fit.

Regression and correlation coefficient, partial & multiple correlation, Relationship between regression and correlation. Analysis of variance:- One way analysis.

UNIT- III **15hrs**

Computers: Basics of common application software packages for word processing (MS Word), spreadsheets (MS Excel) and presentation (MS Powerpoint). Introduction of Internet- LAN, MAN, WAN.

UNIT- IV

Introduction to Bioinformatics: Concepts of Bioinformatics, Accessing and retrieving sequence information from genome sequence databases, use of genome data, overview of comparative and functions genomics, application of computers in Biochemistry.

Reference Books

Biostatistical analysis, Zar, Pearson
Biostatistics,Daniel, Wiley
Biostatistics, Norman, Decker
Fundamentals of Bioinformatics, Irfan Ali Khan, Ukanz
Fundamentals of Biostatistics, Irfan A. Khan and Khanum, Ukaz Publication
Fundamentals of Computers, V. Rajaraman, Prentice-Hall India
A Handbook of Agricultural Statistics, S.R.S. Chandel, LalPrakshan

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M.Sc. BIOCHEMISTRY
SEMESTER –SECOND
BC-201C(Core Course)
ESSENTIALS OF MOLECULAR BIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT –I **15hrs**

Organization of Genetic materials in prokaryotes and Eukaryotes: Genetic material, Genome type, Size, Genome Organization - Structural Maintenance of Chromosomes (SMC) Protein, Eukaryotic Nucleosomes, Histones, Chromatin, Concept of Gene, mono-cistronic and poly-cistronic genes, Gene Structure with various functional units - replicon, muton, recon, C-value and C-value paradox; Unique sequences and Cot value, reassociation kinetics, Split genes: Exons and Introns.

UNIT- II **15hrs**

Replication: Modes of replication: Details of Meselson and Stahl experiment; Prokaryotic DNA replication:Origin and Initiation, elongation and termination; Roles, properties and mechanism of action of DnaA, Helicase, Primase, DNA gyrase,Topoisomerases,DNA Polymerases, DNA ligase, Leading and lagging strands; Okazaki fragments; RNA primers;Regulation of replication; Fidelity of replication; Viral replication, σ or Rolling circle replication in ϕX174**DNA** damage and DNA repair**:** Types of DNA damages,TypesofDNARepair systems, Photoreactivation.

UNIT- III **15hrs**

Eukaryotic DNA replication: Initiation, elongation and termination; Multiple replicons/initiation sites; Autonomously replicating sequence; Mechanism and significance of Origin recognition complex, Mini-chromosome maintenance proteins, DNA dependent DNA polymerases α, δ, ε, Nucleases, DNA ligase and Telomeres in eukaryotic nuclear DNA replication; Regulation of eukaryotic DNA replication; Mitochondrial and Chloroplast DNA replication.

UNIT- IV **15hrs**

Transcription in prokaryotes: Initiation, elongation and termination; Prokaryotic promoter; weak and strong promoters, DNA dependent RNA polymerase: Physical properties, Templet strand, non-template strand, coding strand, Subunits, σ factor, its types and function; Recognition of promoter; Transcription bubble, Direction of Transcription; Abortive initiations; Promoter clearance; Elongation factor Gre and its role, Rho dependent and Rho independent termination of transcription; Sigma cycle; RNA - dependent DNA polymerase and Reverse transcription.

Reference Books

Genes XI , by Benjamin Lewin
Biochemistry – J. David Rawn – Neil Patterson publication, NC.
Cell and Molecular Biology: Concepts and Experiments, by Gerald Karp
Transcriptional Regulation in Eukaryotes, by Carey and Smale
Translational control of gene Expression, by Sonenberg*et al*
Chromatin and Gene Regulation, by Turner
An Introduction to Genetic Analysis, by Griffiths *et al*
Genome, by T. A. Brown

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M.Sc. BIOCHEMISTRY
SEMESTER –SECOND
BC-202C(Core Course)
IMMUNOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT- I **15hrs**

Introduction to Immune System
Memory, specificity, diversity, innate and acquired immunity, self Vs non-self discrimination.
Structure and functions of primary and secondary lymphoid organs.
Cells Involved in Immune Responses
Structure and Functions: Mononuclear cells (phagocytic cells and their killing mechanisms), granulocytic cells (neutrophils, eosinophils and basophils), mast cells and dendritic cell.
Lymphoid cells (B-lymphocytes, T-lymphocytes and Natural killer cells).

UNIT-II **15hrs**

Nature of Antigen and Antibody
Antigen VsImmunogen, Haptens
Structure and functions of immunoglobulins
Istopic, allotypic and idiotypic variations.
Generation of Diversity in Immune System
Clonal selection theory-concept of antigen specific receptor.
Organization and expression of immunoglobulin gens: generation of antibody diversity.
Immunization
Active immunization (immunoprophylaxis)
Passive immunization (Immunotherapy)
Role of vaccines in the prevention of diseases.

UNIT- III **15hrs**

Humoral and Cell-mediated Immune Responses
Kinetics of primary and secondary immune responses.
Complement activation and its biological consequences.
Antigen processing and presentation.
Cytokines and co stimulatory molecules: Role in immune responses.
T and B cell interactions.
Major Histocompatability Complexes (MHC) Genes and Products
Polymorphism of MHC genes.
Role of MHC antigens in immune responses.
MHC antigens in transplantation.

UNIT- IV **15hrs**

Measurement of Antigen- Antibody Interaction
Agglutination and precipitation techniques.
Radio Immunoassay
ELISA and ELISPOT
Immune fluorescence assays: Fluorescence activated cell sorter (FACS) technique.
Hypersensitivity
Immediate (Type I)
Cytotoxic (Type II)

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Immune complex-mediated (Type III)
Delayed hypersensitivity (Type IV)
Immune Responses in Diseases
Immune responses to infectious diseases: viral (HIV), bacterial (tuberculosis) and protozoal (malaria) infections
Immunodeficiency disorders: congenital (SCID, Leuckocyte adhesion deficiency, Chronic granulomatous disease) and acquired (AIDS) immunodeficiencies.
Autoimmunity

Reference Books

Kubey, Immunology, R.A. Goldsby, Thomas J. Kindt, Barbara, A. Osbarne. (Freeman).
Immunology-Ashort Course, -Eli Benjamini, Richard Coico, Geoffrey Sunshine.
Immunology by Tizzard
Fundamentals of immunology by William Paul.
Immunology by Roitt*et al*
Immunology by Abbas

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M.Sc. BIOCHEMISTRY
SEMESTER – SECOND
BC-203C(Core Course)
ADVANCED ENZYMOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT- I **15hrs**

Properties & classification of enzymes.

Kinetics of order of reactions, energy of activation, concept of ES complex, active site, derivation of Michaelis-Menten and Briggs-Haldane equations for uni- substrate reactions. Different plots for the determination of Km &Vmax (LB plot, Hanes plot, EadieHofstee plot, Eisenthal Cornish Bowden plot). Importance of Kcat/Km. Factors affecting the rates of enzymes catalyzed reactions- pH and temperature.

Reversible and irreversible inhibition-competitive, non-competitive, uncompetitive inhibitor.

UNIT – II **15hrs**

Enzyme purification techniques: objectives and strategy, methods of homogenization, method of isolation and purification

Mechanism of enzymes action: Chymotrypsin, Triose phosphate isomerase, aldoase, lysozyme – Methods to determine active site.

Metalloenzymes.

UNIT – III **15hrs**

Proteins – ligand binding concept & measurement.

Allosteric enzymes: Sigmoidal kinetics & their physiological signification. Hill and Scatchard Plots Symmetric and sequential modes of action of allosteric enzymes and their significance.

Enzyme regulation: General mechanism of enzyme regulation. Feed back inhibition and substrate inhibition. Reversible and irreversible covalent modifications of enzymes.

UNIT – IV **15hrs**

Immobilized enzymes and their industrial applications.Effect of partition of kinetics and performance with particular emphasis on changes in pH and hydrophobicity.

Multienzyme system: Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complexes. Immobilized multienzyme system and their applications.

Enzymes in medical diagnosis (aspartate aminotransferase, alanine aminotransferase, creatine kinase, lactate dehydrogenase) and enzyme therapy.

Reference Books

The Nature of Enzymology by R.L. Foster
Enzymes by Dixon and Webb
Fundamentals of Enzymology by Price and Stevens
Enzyme Catalysis and Regulation by Hammes
Enzyme Reaction Mechanisms by Walsch
The Enzymes vol I and II by Boyer
Enzyme Structure and Mechanism by Alan Fersht
Enzyme Assays: A Practical Approach by Eisenthal and Danson
Enzyme Biotechnology by G. Tripathi
Practical Biochemistry by Plummer.
Practical Biochemistry by Sawhney and R. Singh
Enzymes – Dixon & Webb – Academic press

M.Sc. BIOCHEMISTRY
SEMESTER – SECOND
BC-204C(Core course)
INTERMEDIARY METABOLISM
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT – I **15hrs**

Carbohydrates metabolism: Glycolysis, citric acid cycle and pentose phosphate pathway.
Gluconeogenesis
Glycogenesis &Glycogenolysis
Regulation of blood glucose homeostasis by hormones.

UNIT- II **15hrs**

Lipids Metabolism: Biosynthesis- Triacyglycerols, phospholipids, cholesterol, fatty acids, prostaglandins and ketone bodies.
Fatty acid oxidation: β- oxidation of saturated and unsaturated fatty acid.
Metabolism of circulating lipids: chylomicrons, LDL, HDL, and VLDL, free fatty acids.

UNIT- III **15hrs**

Bioenergetics: Energy transformation, Laws of Thermodynamics, Biological oxidations, Gibb's energy, Free energy changes.
Mitochondrial respiratory chain: ETC carriers (iron sulphur proteins, ubiquinone, universal carriers and cytochromes). ETC complexes I,II, III (Q cycle) & IV, the stochiometry of proton extrusion uptake, shuttle system.
Oxidative phosphorylation (OP): Coupling of ETC and OP, uncouplers, ATP syntahse, proton motive force, chemiosmotic theory, : P/O and H/P ratios. Mechanism of ATP formation.Respiratory controls and inhibitors of oxidative phosphorylation.

UNIT – IV **15hrs**

Amino Acids
Catabolism of tyrosine, phenylalanine, tryptophan, branched chain amino acids.
Urea cycle and its regulation.
Nucleic Acids
Biosynthesis of Purines and Pyrimidines nucleotides.
Degradation of Purines and Pyrimidines nucleotides.
Regulation of Purine and Pyrimidine biosynthesis.

References Books

Harper's Biochemistry – Murray, Granner, Mayes, and Rodwell – Prentice Hall International Inc.
Biochemistry – Lehninger – CBS Publishers.
Biochemistry – Stryer – W. H. Freeman & Co. – New York.
Text Book of Biochemistry – West, Todd, Mason, Bruggen.– Amerind Publishing Co. Pvt., Ltd.

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M.Sc. BIOCHEMISTRY
SEMESTER –THIRD
BC-301 C (Core Course)
MICROBIAL PHYSIOLOGY & BIOCHEMISTRY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT – I **15hrs**

Types of microorganisms, general characteristics of main groups of microorganisms, Nutrition and growth of microbial cells with different growth curve- lag, log, stationary and decline phases.
Synchronous growth, pure culture techniques and preservation methods

UNIT – II **15hrs**

Morphology and fine structure of eubacteria and archaebacteria cell wall, cytoplasmic membrane and other organelles.
Staining methods: Gram staining, acid-fast, endospore and fungal staining
Gram positive and gram negative organisms. Structure & function of peptidoglycan in gram positive and gram negative organisms. Functions of polymeric components in outer membrane and acidic polymers in gram negative organisms.Biosynthesis of bacterial cell wall and use of different inhibitors.

UNIT – III **15hrs**

Food spoilage, fermentation, food-borne infection (Staphylococcal, Clostridial, Salmonellosis, Shigellosis).
Role of microorganisms in domestic and industrial sewage.
Methods of sterilization in brief.
Metabolism: EDP pathway, Xylose-5-phosphoketolase pathway

UNIT – IV **15hrs**

Virus structure, virus proteins, virus classification and methods of assay.
Structure of bacteriophage, lytic and lysogenic life cycle
Replication of RNA viruses–negative strand (VSV), positive strand (Polio), retrovirus (to include all events in the infectious cycle).Replication of DNA viruses (Adenovirus & SV 40).
Virus–host interaction and prevention polio/AIDS, Hepatits.

Reference Books

Microbiology, Pelczar, M.J., Chan , E.C.S. and Kreig, N.R., Tata McGraw Hill.
Microbial Genetics, Maloy , S.R., Cronan, J.E.Jr and Freifelder, D. Jones, Bartlett Publishers.
General Microbiology – Stanier, Adelberg, Ingraham – The Macmillan Press – London.
Fundamental Principals of Bacteriology – Salle – TMH Pub. Co. Ltd. – New Delhi.
Microbiology-An Introduction – Tortora, Funke, Case, Benjamin – Cummings Publ. Co.

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M.SC. BIOCHEMISTRY
SEMESTER –THIRD
BC-302 C(Core Course)
NUTRITIONAL BIOCHEMISTRY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT – I **15hrs**

Basic concepts – Function of nutrients. Measurement of the fuel values of foods. Direct and indirect calorimetry. Basal metabolic rate: factors affecting BMR, measurement and calculation of BMR. Measurement of energy requirements.

UNIT – II **15hrs**

Elements of nutrition – Dietary requirement of carbohydrates, lipids and proteins.Biological value of proteins.Concept of protein quality.Essential amino acids, essential fatty acids and their physiological functions.

UNIT – III **15hrs**

Minerals – Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper. Vitamins – Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins.

UNIT – IV **15hrs**

Malnutrition – Prevention of malnutrition, improvement of diets. Recommended dietary allowances, nutritive value of common foods.Protein-calorie malnutrition.Requirement of proteins and calories under different physiological states- infancy, childhood, adolescence, pregnancy, lactation and ageing. Obesity: Definition, Genetic and environmental factors leading to obesity.

Reference Books

Tietz Fundamentals of Clinical Chemistry, BurtisAshwood, Saunders
Clinical Chemistry, Kaplan
Clinical Chemistry (Organ Function Test), M.N Chatterjee, Jaypee
Normal and Therapeutic Nutrition,Robinson, Garwick, Macmillan
Nutrition, Paul Insel, Don Ross, Jones and Bartlett
Nutrition and Diet Therapy, Lutz, F. A. Davis
Nutrition And Dietetics, Joshi,Tata McGraw Hill
Practical Clinical Biochemistry, Varley, CBS Publisher's latest Edition

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M.Sc. BIOCHEMISTRY
SEMESTER –THIRD
BC-303C(Core Course)
CLINICAL BIOCHEMISTRY AND BIOSAFETY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT – I **15hrs**

Disorders of Carbohydrates Metabolism: Diabetes mellitus, glycatedhemoglobins, hypoglycemias, various types of glucose tolerance tests, glycogen storage diseases, galactosemia.

Disorders of Lipid Metabolism: Tay-Sach's, Gaucher's and Niemann-Pick diseases, atherosclerosis and diagnosis tests.

Disorders of Amino Acid Metabolism:phenylketonuria, alkaptonuria, tyrosinosis, albinism, maple syrup urine disease.

Disorders of Nucleic Acid Metabolism: Lesch-Nyhan syndrome, gout oroticaciduria.

UNIT – II **15hrs**

Clinical and biochemical aspects of atherosclerosis, jaundice, diabetes, hepatitis, glomerular nephritis, gall stones, Addison's disease, Conn's syndrome, Cushing's syndrome, hypo & hyperthyroidism, Parkinson's disease and Alzheimer's disease

UNIT – III **15hrs**

Disorders of Erythrocyte: thalassemias and sickle cell anemia.

Diseases and organ function test: liver diseases (jaundice, hepatitis, hemochromatosis, Reye's syndrome) and liver function tests, renal diseases (glomerulonephritis, nephrotic syndrome, urinary tract infection, urinary tract obstruction, renal failure) and renal function tests.

UNIT – IV **15hrs**

Biosafety: Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety guidelines - Government of India; Definition of GMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication. Bioethics: Introduction, necessity and limitation

Reference Books

Tietz Fundamentals of Clinical Chemistry, BurtisAshwood, Saunders
Clinical Chemistry, Kaplan
Clinical Chemistry (Organ Function Test), M.N Chatterjee, Jaypee
Normal and Therapeutic Nutrition,Robinson, Garwick, Macmillan
Nutrition, Paul Insel, Don Ross, Jones and Bartlett
Nutrition and Diet Therapy, Lutz, F. A. Davis
Nutrition And Dietetics, Joshi,Tata McGraw Hill
Practical Clinical Biochemistry, Varley, CBS Publisher's latest Edition

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M.SC. BIOCHEMISTRY
SEMESTER –THIRD
BC-304E (optional /elective)
GENETIC ENGINEERING
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT – I **15hrs**

Enzymes used in rDNA Technology: Outline of cloning procedure, Host controlled restriction and modification: Restriction endonucleases and cognate methylases, Class I, II & III restriction enzymes, Variants of Type II Restriction enzyme, Restriction digestion, Star activity, Restriction mapping, Formation of chimeric DNA, Homopolymer tailing, Synthetic Linkers, Adaptors and DNA ligase; Filling in and Trimming back; Significance of T4 DNA polymerase &Klenow Fragment, Alkaline phosphatase, Reverse transcriptase in cloning.

UNIT – II **15hrs**

Plasmids: Plasmid classification on basis of phenotypic traits: Relaxed and stringent control of copy number; Plasmid incompatibility; Plasmid host range, Mobilizable plasmids and Triparental mating; Plasmid as cloning vector (recombinant plasmids): Properties of ideal plasmid cloning vectors, pBR322, pUC& pGEM3Z series, Transcriptional and translational fusion vectors; Fusion proteins; Selectable markers; Reporter genes.

UNIT – III **15hrs**

Phage as a cloning vector: Advantage of using phage lambda vector, Genome map of phage lambda, In vitro packaging, Insertional and replacement vectors: Cosmid vectors; M13 phage and its role in single stranded DNA production, M13 series of vectors; Phagemids; Yeast as cloning vector: Basic principles of development of yeast vectors, 2μ plasmid, YEP, YRP YCP, YIP; Artificial chromosomes: YACs, BACs and PACs.

UNIT – IV **15hrs**

Screening and selection of recombinants: Functional (genetic) complementation (Blue-white screening, Red-white screening), Nutritional complementation, Gain of function, Colony hybridization, Plaque hybridization, Southern blotting and hybridization, Dot blot, Zoo blot, Plus-Minus screening, Northern blotting, Immunological screening, Western blotting, South-Western blotting, North-Western blotting, HART, HAT

Reference Books

1. SmitaRastogi and NeelamPathak (2009), Genetic Engineering, Oxford University Press.
2. Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell publishing (Oxford, Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S.B., and Twyman, R. M., Blackwell publishing (Oxford, UK)
3. Old & Primrose
4. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC),
5. Molecular Cloning: A laboratory manual (2014),4nd ed., Michael R Green and J. SambrookCold spring Harbor laboratory press (3vol.), ISBN: 978-1-936113-42-2

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M.SC. BIOCHEMISTRY
SEMESTER – SECOND
BC-305E(optional\elective)
PHARMACEUTICAL BIOCHEMISTRY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT – I **15hrs**

Monoclonal antibodies: applications, generation, recombinant antibodies, production methods, Pharmaceutical, regulatory and commercial aspects.

UNIT –II **15hrs**

Formulation of proteins and peptides: making small protein particles, precipitation of proteins, quality control issues, multi-phase drug delivery system; Preparation of collagen, gelatin particles, albumin microparticles

UNIT – III **15hrs**

Proteins and phospholipids: structural properties of phospholipids, injectable lipid emulsions, liposomes, cochleal phospholipids structures; Polymeric systems for oral protein and peptide delivery.

UNIT – IV **15hrs**

Pulmonary drug delivery systems for biomacromolecules; Lipid based pulmonary delivery; Solid colloidal particles; Polycyanoacrylates; Poly (ether-anhydrides); Diketopiperazine derivatives; Poly ethylene glycol conjugates; Factors affecting pulmonary dosing. Aerosols, propellents, containers types, preparation and evaluation, intra nasal route delivery systems: Types, preparation and evaluation.

References Books

Groves MJ 'Pharmaceutical Biotechnology', Taylor and Francis Group.

Crommelin DJA, Robert D, Sindelar 'Pharmaceutical Biotechnology'.

Kayser O, Muller R 'Pharmaceutical Biotechnology'.

Banga AK 'Therapeutic peptides and proteins'.

Molecular Cell Biology- by Lodish H., Berk A., Matsudiaira P., Kaiser C.A., Krieger M. and Scott M.P., W. H. Freeman and Company, New York.

Vyas S.P. and Kohli D.V., Pharmaceutical Biochemistry, 1st Edition, CBS Publishers & Distributors, New Delhi

Principles and Techniques of Biochemistry and Molecular Biology by Wilson K. and Walker J. , Cambridge University Press

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M.SC. BIOCHEMISTRY
SEMESTER – THIRD
BC-401C (Core Course)
APPLIED BIOTECHNOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

UNIT – I **15hrs**

Principle & applications of PCR; RACE, Degenerate PCR, Realtime PCR, Site Directed Mutagenesis: oligonucleotide directed, PCR based Mutagenesis, Antisense RNA technique, ribozymes, Microarray techniques for DNA.

UNIT – II **15hrs**

Rapid DNA and RNA sequencing techniques: Sanger method, Maxam and Gilbert procedure, automated DNA sequencing, pyrosequencing; High throughput SequencingHuman Genome sequencing, and comparative genomics.Molecular Markers: RFLP, RAPD, AFLP,DNase I foot printing.Genome editing.

UNIT – III **15hrs**

Application of recombinant microorganism: Production of recombinant pharmaceuticals, therapeutic proteins, Production of Restriction Enzyme,Production of Antibiotics,Production of Biopolymer,Combating Human Diseases,Biopesticides, Bioremediation.

UNIT – IV **15hrs**

Plant Biotechnology:Ti plasmid, Binary and Cointegrate vectors derived from Ti plasmid of Agrobacterium, plant virus vectors, Transgenic plants and their applications Protein Engineering: Concept of designing of new protein molecule, Application of protein engineering.Basics of nanobiotechnology.

Reference Books

Gene Cloning,T. A. Brown,Blakwell
Gene engineering, Joshi, Daya Publication
Gene Isolation and Mapping Protocol,,JacquelineBoultwood,Humana Press
Molecular Biology and Biotechnology, C A Smith; Edward J Wood, Chapman & Hall
Molecular Biology and Biotechnology, Walker and Repley, Royal Society of Chemistry
Molecular biology and genomics, Cornel Mülhardt, Elsevier Academic Press
Molecular Biotechnology,,Bernard, Glick, ASM Press
Molecular Biotechnology, Primrose,Panima

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M.Sc. BIOCHEMISTRY
SEMESTER –THIRD
BC-402C(Core Course)
HUMAN PHYSIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs

Credit 04

UNIT – I **15hrs**

Blood: Composition and functions of plasma, erythrocytes including Hb, leucocytes and thrombocytes, plasma proteins in health ad diseases. Blood coagulation mechanism and regulation, Fibrinolysis. Transfer of gases – oxygen and carbon dioxide. Bohr effect and chloride shift.

UNIT – II **15hrs**

Digestive system: Composition, function and regulation of saliva, gastric, pancreatic, intestinal and bile secretions–digestion and absorption of carbohydrates, lipids and proteins.

UNIT – III **15hrs**

Excretory system: Structure of nephron, formation of urine, glomerular filtration, tubular reabsorption of glucose, water and electrolytes, tubular secretion. Regulation of an electrolytes balance and regulation of kidney function by hormones.

UNIT –IV **15hrs**

Nerve: structure of neuron, membrane potential, action potential, voltage gated channels, role of ions during action potential, transmission of action potential, synapse, synaptic transmission.

Muscles: Structure of skeletal, smooth & cardiac muscles. Neuromuscular junction and transmission, excitation and contraction coupling.

References

Human Physiology, Vol. I & II, - C. C. Chatterjee – Medical Allied Agency – Calcutta.

Concise Medical Physiology – Choudhary – New Central Book Agency – Calcutta.

TextBook of Medical Physiology – Guyton – Prism Books Pvt. Ltd. – Bangalore.

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M.Sc. BIOCHEMISTRY
SEMESTER- FOURTH
BC-403E(optional elective)
ENVIRONMENTAL BIOCHEMISTRY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

Unit-I **15hrs**

Environment: Basic Concept & Issues.
Environmental pollution: Types of pollution.
Air pollution & its control through biotechnology.
Water pollution & its Control: Water as a natural resource, need for water management, measurement of water pollution, source of water pollution.

Unit-II **15hrs**

Toxic effect: Basis for general classification & nature. Dose-Response relationship.Synergism & Antagonism.Determination of ED-50 & LD-50.Acute & chronic exposures. Factors influencing toxicity,.
Xenobiotics metabolism: Phase-I reactions: Oxidation, reduction, hydrolysis & hydration. Phase-II reactions\conjugation: Methylation, glutathione & amino acid conjuctions, detoxifications.

Unit-III **15hrs**

Pesticide toxicity: Insecticides- Organochlorines, Anti-cholinesterase- Organophosphates and Carbamates. Fungicides, Herbicides.Environmental consequences of pesticide toxicity.Biopesticides.
Metal toxicity: Toxicology of Arsenic, Lead and Cadmium in target organs.
Metabolism of CCl_4&Paracetamol& their effect in liver & kidney.

Unit-IV **15hrs**

Microbiology of degradation of xenobiotics in environment: Ecology considerations, decay behaviour and degradative plasmid.
Hydrocarbons, substituted hydrocarbons, oil pollution surfactants.
Global Environment problems: Ozone depletion, Green house effect and acid rain.

Reference Books

Environmental Biology and Toxicology, P. D. Sharma, Rastogi
Textbook of Toxicology, BalramPani, IK
Casarett&Doull's Essentials of Toxicology, Klaassen, MGH
Toxicology: Principles and Applications, Niesink, CRC
Clinical Toxicology, FACMT, Saunders
Environmental Pollution and Toxicology, Johi, APH

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M.Sc. BIOCHEMISTRY
SEMESTER- FOURTH
BC-404 E (Optional Elective)
GENOMICS AND PROTEOMICS
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

Unit-I **15hrs**

Introduction Structural organization of genome in Prokaryotes and Eukaryotes;
Organelle D NA-mitochondria l, chloroplast;
DNA sequencing-principles and translation to large scale projects;
Recognition of coding and non-coding sequences and gene annotation;
Tools for genome analysis-RFLP, DNA fingerprinting, RAPD, PCR, Linkage and pedigree analysis physical and genetic mapping.

Unit-II **15hrs**

Genome sequencing projects Microbes, plants and animals;
Accessing and retrieving genome project information from web;
Comparative genomics.
Identification and classification using molecular markers-16s rRNA typing/sequencing, ESTS and SNPS.

Unit-III **15hrs**

Microarray chips: Types of DNA chips and their production.
Gene Therapy for Human Diseases.
Protein Crystallization; Theory and methods: API Electrospray and MALDI-TOF.
SNP's and GMS (Genome mismatch Signals)

Unit-IV **15hrs**

L. Proteomics Protein analysis (includes measurement of concentration, amino-acid composition, N terminal sequencing); 2-D electrophoresis of proteins;
Microscale solution isoelectricfocusing; Peptide fingerprinting;
LC/MS-MS for identification of proteins and modified proteins; MALDI-TOF; SAGE and Differential display proteomics,
Protein-protein interactions, Yeast two hybrid systems.
Functional Proteomics: Significance of Proteome research

Reference Books

Genomics, Proteomics and Bioinformatics, 2nd Edition. Campbell AM &Heyer LJ, Benjamin Cummings 2007; CSH Press, NY. ISBN-10: 8131715590
Principles of Proteomics. R.M Twyman (2004). (BIOS Scientific publishers). ISBN-10: 1859962734
Principles of Gene Manipulation and Genomics- Primrose S &Twyman R, 7th Edition, Blackwell, 2006. ISBN-10: 1405135441
Principles of Genome Analysis and Genomics. Primrose SB &Twyman RM. 2007. Blackwell. ISBN-10: 1405101202
Introduction to Genomics. A.M Lesk, Oxford University press, 2007. ISBN-10: 0199557489
A Primer of Genome Science.Greg Gibson and Spencer V. Muse.2nd ed. 2004. SINAUER Associates Inc. ISBN-10: 0878932364
Genome III – T.A. Brown Garland Science Publ. June 08, 2006. ISBN-10: 0815341385

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M.Sc. BIOCHEMISTRY
SEMESTER- FOURTH
BC-405 E (Optional Elective)
GENE EXPRESSION AND REGULATION
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 04

Unit-I **15hrs**

Transcription in eukaryotes: Synthesis of pre-mRNA: Outline of process - Initiation, elongation and termination, RNA Pol II, promoter, Enhancer elements, Subunit structure of RNA Pol II, Roles of RNA polymerase II, Transcription factors, Nucleosome modifiers, Mediator complexes, Chromatin remodelers, Elongation factors in transcription; Synthesis & processing of pre-rRNA and pre-tRNA: Outline of process, RNA Pol I and III, promoters sequences..

Unit-II **15hrs**

Co-transcriptional processing: Addition of 5` cap and 3' Poly A tail in mRNA; **Post transcriptional processing**: RNA splicing – Type 1 and Type 2 Intron splicing, Spliceosome mediated splicing and maturation of precursors of rRNA, mRNA, tRNA): Role of different ribonucleases in splicing, Covalent modifications, RNA editing, Alternative splicing, Histone mRNA processing

Unit-III **15hrs**

Translation in prokaryotes and eukaryotes: Outline of the process - Initiation, elongation and termination; Adapter role of tRNA, Genetic code, Evidences for a triplet codon; Properties of Genetic code; Codon family and Codon pairs; Nonsense and Sense codons; Degeneracy: Significance of IsoacceptortRNAs and Wobble hypothesis; Codon bias; Amino acyl tRNAsynthetase: Classification, Specificity, Reaction catalyzed; A, P and E sites of ribosome; Start and stop codons, Ribosome binding site; Formation of initiation complex; Transpeptidation and Translocation; Ribosome cycle; Roles of Initiation factors, Elongation factors, Release factors, Ribosome recycling, AminoacyltRNAsynthetases, catalytic role of GTP, Peptidyltransferase site and Factor binding site of ribosomes in translation. Proofreading activity of ribosomes and Fidelity of Translation

Unit-IV **15hrs**

Regulation of prokaryotic gene expression; Concept of operon: Lac, Trp and Ara operons, Significance of repressor, Attenuation; Inhibitors of transcription and translation.

Reference Books

Lehninger,Albert,Cox,MichaelM.Nelson,DavidL.(2017)Lehninger principles of biochemistry/NewYork:W.H.Freeman.

Lewin "Genes"

Freifelder, DM "Molecular Biology"
Brown, TA "Genomes"
Watson, JD "Molecular Biology of the cell"
Twyman, R.M.Advanced Molecular Biology"
Brown, TA"Gene cloning: An introduction"
Old & Primrose "Principles of Gene Manipulation"
Primrose, SB "Molecular Biotechnology"
Jose B. Cibelli, Robert P. Lanza, Keith Campbell, Michasel D. West "Principles of Cloning"

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M.Sc. BIOCHEMISTRY
SEMESTER- FOURTH
BC-406 E (optional elective)
MEDICAL BIOCHEMISTRY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs

Credit 04

UNIT – I **15hrs**

Disorders of Carbohydrates Metabolism

Diabetes mellitus, Glycatedhemoglobins, Hypoglycemias.

Various types of glucose tolerance tests.

Disorders of Thyroid

Hyperthyroidism, Hypothyroidism.

Thyroid function Tests: T3, T4, TSH, TRH

UNIT – II **15hrs**

Disorders of Lipids

Hypoliproteinemia, Hyperlipoproteinemia, Atherosclerosis

Diagnostic tests for apolipoproteins, HDL – cholesterol, LDL – cholesterol and triglycerides.

Diagnostic Tests for Proteins

Total protein, albumin, globulin and fibrinogen

UNIT – III **15hrs**

Liver Function Tests

Van den Bergh test for bilirubin, urine and fecal urobilinogen

Determination of galactose, epinephrine test

Detoxification and excretion tests

Prothrombin Time

Determination of blood ammonia

KidneyFunction Tests

Urea clearance test, Creatinine clearance test

Renal plasma flow

Concentration and dilution test

UNIT-IV **15hrs**

Biochemical Aspects of Hematology

Complete blood count (CBC)- red blood cell, white blood cell, platelet counts, percent hemoglobin

Bleeding time, clotting time

Serum Aspartate aminotransferase, alanine aminotransferase, creatine kinase, gamma glutamyltranspeptidase, alkaline phosphatase

Reference Books

Tietz Fundamentals of Clinical Chemistry, BurtisAshwood, Saunders

Clinical Chemistry (Organ Function Test), M.N Chatterjee, Jaypee

Biochemistry, A.C. Deb,Central

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M.Sc. BIOCHEMISTRY
SEMESTER- SECOND
M.Sc. BIOCHEMISTRY
SEMESTER –SECOND
Minor
ESSENTIALS OF MOLECULAR BIOLOGY
(TOTAL CREDIT -04, END SEMESTER MARKS -75, CIE-25)

Total 60hrs
Credit 0415hrs

UNIT – I

Organization of Genetic materials in prokaryotes and Eukaryotes: Genetic material, Genome type, Size, Genome Organization - Structural Maintenance of Chromosomes (SMC) Protein, Eukaryotic Nucleosomes, Histones, Chromatin, Concept of Gene, mono-cistronic and poly-cistronic genes, Gene Structure with various functional units - replicon, muton, recon, C-value and C-value paradox; Unique sequences and Cot value, reassociation kinetics, Split genes: Exons and Introns.

UNIT- II 15hrs

Replication: Modes of replication: Details of Meselson and Stahl experiment; Prokaryotic DNA replication:Origin and Initiation, elongation and termination; Roles, properties and mechanism of action of DnaA, Helicase, Primase, DNA gyrase,Topoisomerases,DNA Polymerases, DNA ligase, Leading and lagging strands; Okazaki fragments; RNA primers;Regulation of replication; Fidelity of replication; Viral replication, σ or Rolling circle replication in ϕX174**DNA** damage and DNA repair**:** Types of DNA damages,TypesofDNARepair systems, Photoreactivation.

UNIT- III15hrs

Eukaryotic DNA replication: Initiation, elongation and termination; Multiple replicons/initiation sites; Autonomously replicating sequence; Mechanism and significance of Origin recognition complex, Mini-chromosome maintenance proteins, DNA dependent DNA polymerases α, δ, ε, Nucleases, DNA ligase and Telomeres in eukaryotic nuclear DNA replication; Regulation of eukaryotic DNA replication; Mitochondrial and Chloroplast DNA replication.

UNIT- IV 15hrs

Transcription in prokaryotes: Initiation, elongation and termination; Prokaryotic promoter; weak and strong promoters, DNA dependent RNA polymerase: Physical properties, Templet strand, non-template strand, coding strand, Subunits, σ factor, its types and function; Recognition of promoter; Transcription bubble, Direction of Transcription; Abortive initiations; Promoter clearance; Elongation factor Gre and its role, Rho dependent and Rho independent termination of transcription; Sigma cycle; RNA - dependent DNA polymerase.

Reference Books

Genes XI , by Benjamin Lewin
Biochemistry – J. David Rawn – Neil Patterson publication, NC.
Cell and Molecular Biology: Concepts and Experiments, by Gerald Karp
Transcriptional Regulation in Eukaryotes, by Carey and Smale
Translational control of gene Expression, by Sonenberg*et al*
Chromatin and Gene Regulation, by Turner
An Introduction to Genetic Analysis, by Griffiths *et al*