

M.Sc. Biochemistry
(CBCS Pattern as per UGC)
Effective from the Session 2018-19

Semester- I

Course Code	Title of Paper	Credit	Max. Marks		Total
			End-Sem.	Mid-Sem.	
CC-101	Organic and Biophysical Chemistry	04	80	20	100
CC-102	Cell Biology and Physiology	04	80	20	100
CC-103	Biomolecules	04	80	20	100
CC-104	Bioinstrumentation	04	80	20	100
CC-105	Practical	06	100	-	100
	Total	22	420	80	500

Semester- II

Course Code	Title of Paper	Credit	Max. Marks		Total
			End-Sem.	Mid-Sem.	
CC-201	Enzymes and Enzyme Technology	04	80	20	100
CC-202	Molecular Biology	04	80	20	100
CC-203	Cellular and Molecular Immunology	04	80	20	100
CC-204	Advance Molecular Biology	04	80	20	100
CC-205	Practical	06	100	-	100
	Total	22	420	80	500

Semester- III

Course Code	Title of Paper	Credit	Max. Marks		Total
			End-Sem.	Mid-Sem.	
CC-301	Intermediary Metabolism	04	80	20	100
CC-302	Genetic Engineering and IPR	04	80	20	100
CC-303	Practical	06	100	-	100
CC-304	Research Methodology	04	100	20	100
OEC-305	Biomolecules and Bioinstrumentation	06	100	-	100
	Total	22	420	60	500

Semester- IV

Course Code	Title of Paper	Credit	Max. Marks		Total
			End-Sem.	Mid-Sem.	
DEC-401 A or B	A= Nutritional Biochemistry or B= Microbiology and Clinical Biochemistry	04	80	20	100
DEC-402 A or B	A= Biochemical and Environmental Toxicology or B= Biostatistics and Bioinformatics	04	80	20	100
DEC-403	Practical	06	100	-	100
DC- 404	Dissertation Course/ Project and Presentation	08	200		200
	Total	22	420	80	500
	Grand Total:	88			2000

- i. CC-compulsory Core Course for all students of the subject concerned.
- ii. DEC-Discipline-specific Elective Course (Special paper)
- iii. OEC-Open Elective Course to be offered to students of other Departments
- iv. DC- Dissertation Course.

DEC 401 and DEC 402: A student has to choose any one from each paper (DEC 401 A= Nutritional Biochemistry or B= Microbiology and Clinical Biochemistry and DEC 402 A= Biochemical and Environmental Toxicology or Biostatistics and Bioinformatics)

CC – 101: Organic and Biophysical Chemistry

Marks – 80 + 20

Credits: 4

Unit - I

The Foundations of Biochemistry: Scope of biochemistry and its application in the field of Medicine, Agriculture, Industries. Electronic theory of valency, dipole moments. Electronic displacements in a molecule: Inductive effect, electronic effect, resonance. Types of organic reactions- Substitution, addition, elimination, rearrangement, condensation and polymerization;

Unit - II

Properties of water: Physical and chemical properties of water, ionization and ionic product of water, structure of liquid water and ice. Unusual properties of water. Hydrophilic, hydrophobic and amphipathic molecules in aqueous solution. Effect of solutes on colligative properties of water. Importance of water in biological systems with special reference to the maintenance of native structure of biological molecules. Biological relevance of pH and pKa, determination of pKa of weak acid. Buffers, buffer action, and buffer capacity. Henderson–Hasselbalch equation, preparation of buffers. Importance of buffers in biological systems (cytosol and blood).

Unit - III

Thermodynamics: First law of thermodynamics, basic concepts of entropy and second law of thermodynamics, free energy changes, standard free energy change and its relation to equilibrium constant. Oxidation – reduction reactions in biological systems. **Stereochemistry:** Optical isomerism, chirality, symmetry elements, enantiomers, diastereoisomers, D L and R S notations, racemization, stereoisomerism and geometrical isomerism, cis – trans and E – Z conventions.

Unit - IV

Free radicals: Introduction, formation – photolysis, thermolysis, redox reactions, radical reactions with biomolecules. **Heterocyclic systems:** Occurrence in biological systems, structure and properties of furon, pyrrole, Indole, thiazole, imidazole, pyridine, pyrimidine, purine, quinone, pteridine and isoalloxazine containing biomolecules.

Books Recommended

1. Physical Biochemistry, Kansal Edward Van Halde, Prentice Hall.
2. Physical Biology of the Cell, 2nd Edn. Rob Phillips, Jane Kondev, Julie Theriot, Hernan Garcia, Garland Publishers (2012).
3. Bioinorganic Chemistry; Ei-Ichiro Ochiai, Elsevier (2008).
4. Physical Biochemistry, David Frifielder, 2nd Edn. W.G.Freeman and Co
5. Organic Chemistry, Vol. I. Fundamental Principles, I. L. Finar, 6th Edn. ELBS
6. Inorganic Biochemistry, G.L. Eicharn, Elsevier.
7. Organic Mechanisms, Peter Sykes, Longman, (1977).
8. Biochemical Calculations, Irwin H. Segel (1976) 2nd Ed. John Wiley and Sons.
9. Introduction to Biophysical Chemistry, Bruce Martin
10. Organic Chemistry, R.T. Morrison and R.N.Boyd, 6th Edn, Prentice Hall, India.
11. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox (Eds), 6th Edn. Macmillan Publications (2012).

CC- 102: Cell Biology and Physiology

Credits: 4

Marks – 80 + 20

Unit - I

Cell Organization: Prokaryotic and Eukaryotic cells. Ultrastructure of cell wall, nucleus, mitochondria, Golgi apparatus, endoplasmic reticulum, lysosomes, peroxisomes, chloroplasts. Structure and functions of cytoskeleton and its role in motility.

Unit - II

Membrane Biology, Cell Signaling and Communications: Structure and functions of Cell Membranes. Transport across cell membranes, mechanisms of sorting and regulation of intracellular transport, gap junctions, extracellular matrix, cell adhesions molecules, membrane receptors (hormonal and cell surface receptors).

Unit - III

Cell Cycle, Cell Division and Cancer Biology: Phases of cell cycle, Molecular control mechanisms of cell cycle (CdKs and Cyclins, Checkpoints), Mitosis and Meiosis, Tumour suppressor genes, Cellular oncogenes and viral oncogenes.

Unit - IV

Coordinating System: Composition and functions of blood, Circulation in man, Mechanism of respiration, Physiology of digestion, Physiology of excretion, Endocrine system; Classification of hormones, Types of hormone and their function, Regulation of their secretion, Mechanism of Hormone action.

Books recommended:

1. Molecular and Cell Biology – Baltimore
2. Molecular Cell Biology – Darnell *et al.*
3. Biochemistry – Lehninger, Cox, Nelson
4. Biochemistry – Cohn and Stump;
5. Biochemistry - D.Voet & J.G.Voet (John Willey)
6. Cell biology – Bruce Alberts

CC-103: Biomolecules

Credits: 4

Marks – 80 + 20

Unit - I

Carbohydrates: Classification, structure, general properties and functions of polysaccharides and complex carbohydrates; amino sugars, proteoglycans and glycoproteins

Unit - II

Lipids: Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids, cerebrocides, steroids, bile acids, prostaglandins, lipoamino acids, lipoproteins, proteolipids, phosphatidopeptides, lipopolysaccharides.

Unit - III

Nucleic Acids: Structure and functions of nucleotides, Primary and secondary structures of nucleic acids (DNA, t-RNA, hnRNA, micro-RNA) isolation and purification of DNA, mRNA, rRNA and tRNA, Cot value curve, DNA-protein interactions.

Unit - IV

Proteins: Introduction to Amino acids and their classification, Overview of protein structure (primary, secondary, tertiary, quaternary), Ramchandran plot, protein classification (on basis of biological functions, shape and solubility), Proteins modifications, stability and folding. Protein sorting. Methods of isolation, characterization and purification of proteins.

Books Recommended:

1. Principles of Biochemistry - L. Stryer (W.H. Freeman & Co.)
2. Principles of Biochemistry - A.L. Lehninger, D.W. Nelson & M.M. Cox (Macmillan)
3. Biochemistry - D. Voet & J.G. Voet (John Willey)
4. Harper's Illustrated Biochemistry - R.K. Murray et al. (McGraw Hill)
5. Outline of Biochemistry - Conn & Stump (John Willey & Sons)

CC-104: Bioinstrumentation

Credits: 4

Marks – 80 + 20

Unit – I

Spectroscopy: Principles, instrumentations and applications of UV-Visible Spectrophotometer, Circular dichorism, ESR (Electron spin resonance), NMR (Nuclear magnetic resonance), Mass Spectroscopy and X-Ray diffraction.

Unit - II

Centrifugation and Radioisotope Techniques: Basic principles of sedimentation, Centrifuges and their uses, Density gradient centrifugation, Ultracentrifugation (Principles and applications). Analysis of subcellular fractions (Sedimentation velocity and sedimentation equilibrium) Detection and measurement and applications of isotopes used in biology. Safety guidelines in the use of radioisotopes.

Unit - III

Microscopic Techniques and Chromatographic techniques: Principles, types and applications of different types of light microscopes, electron microscope, scanning microscopes and transmission microscopes. Different staining and fixation methods for EM. Freeze –etch and freeze fracture methods for EM. General principles of partition and adsorption chromatography. Thin layer, column, ion - exchange, paper chromatography, affinity chromatography, gel exclusion, GLC and HPLC.]

Unit - IV

Electrophoretic Techniques and PCR: Gel electrophoresis of proteins -SDS - PAGE, isoelectric focusing, 2D electrophoresis. Western blotting. Electrophoresis of nucleic acids - agarose gel electrophoresis, DNA sequencing gels, pulsed field gel electrophoresis, Southern blotting. Principles of Polymerase chain reaction, types and application of PCR, DNA fingerprinting and foot printing.

Books recommended:

1. Introduction to Electron Microscopy - S. Wischnitzer.
2. Electron Microscopy in Biology - J.R.Harris (ed.).
4. Biophysics - V. Pattabhi & N. Gautham (Narosa, New Delhi).
5. Fundamentals of Molecular Spectroscopy - C.N. Banwell, (Tata-McGraw Hill)
6. Physical Biochemistry - D. Freifelder (W.H. Freeman & Co.)
7. Biophysical Chemistry, Vol.II - C.R. Cantor & P.R. Schimmel, (W.H. Freeman &Co.)
8. Modern Experimental Biochemistry - R. Boyer (Pearson Education)
9. Practical Biochemistry - K. Wilson & J. Walker (Cambridge Univ. Press)

CC –105 (Practical)**Credits: 6****Time: 6 hours****Marks – 100**

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|---|-----------------|
| 1. Major Practical | 30 |
| a) Identification of unknown carbohydrates in given solutions | |
| b) Estimation of total protein in given solution by Lowry's method | |
| c) Enumeration of WBC by haemocytometer. | |
| d) Enumeration of RBC by haemocytometer. | |
| e) Validate Beer – Lambert's Law | |
| f) Prepare a stage of chromosome of the supplied material and discuss its feature. | |
| 2. Minor Practical | 20 |
| a) Estimation of haemoglobin by Sahali's haemometer. | |
| b) To find out absorption maxima of the given sample. | |
| c) Action of salivary amylase | |
| d) Colour test of functional groups in protein solutions | |
| 3. Problems related to solution preparation | 7.5 |
| 4. Demonstration | 7.5 |
| (Simple and Compound Microscope, pH meter, Centrifuge, Spectrophotometer) | |
| 5. Spotting (Spot 1 - 5) | 5X3 = 15 |
| a) Endocrinology Slides (T.S. of Adrenal gland, Thyroid gland, Pituitary, Pancreas) | |
| b) Slides of different stages of mitosis and meiosis | |
| 6. Viva – Voce and Record | 20 |

CC-201: Enzymes and Enzyme Technology

Credits: 4

Marks – 80 + 20

Unit-I

Introduction to Enzymology: Enzyme classification, chemical nature and properties of enzymes. Factor affecting enzyme activity (enzyme concentration, substrate concentration, temperature, pH, product concentration, role of activators, time). Monomeric and Oligomeric Enzymes. The Active site (identification of binding and catalytic site, 3D Structure). Isoenzyme.

Unit-II

Enzyme Kinetics- I: Bioenergetics and the living cell, Factor Affecting the rate of chemical reaction (the collision theory, activation and transition theory, catalysis). Kinetics of uncatalyzed and enzyme catalyzed reaction. Methods used for investigation the kinetics of enzymes catalyzed reaction.

Unit-III

Enzyme kinetics-II: Kinetics of single substrate enzyme catalytic reaction (The Henri and Michaelis-Mentes equation, the Briggs-Haldane Modification, Lineweaver Burkplot, The Haldane relationship for reversible reaction). Kinetics of multi-substrate enzyme catalyzed reaction (Ping-Pong bi-bi mechanism, Random order mechanism, Compulsory order mechanism). Enzyme Inhibition (Reversible and its types, Allosteric, Irreversible)

Unit-IV

Enzyme Catalysis, Purification, Extraction and Application: Mechanism and principle of enzyme catalysis, Mechanism of reaction catalyzed by enzyme without co-factor (lysozyme). Metal activated enzyme and metallo enzymes, co-enzyme in enzyme catalyzed reaction (NAD, FMN, FAD, ATP, ADP and AMP). Extraction and purification of Enzyme. Principle of enzymatic analysis, Instrumentation techniques available for use in enzymatic analysis, Application of enzyme medicine and biotechnological field.

Books recommended:

1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry-Trevor Palmer
2. Principles of Biochemistry- Lehninger, David L. Nelson and Michael M. Cox
3. Enzymes- Malcolm Dixon and Edwin Webb
4. Harper's Biochemistry- Harper
5. Biochemistry- Western and Todd
6. Cell and Molecular Biology-Gerald Karp
7. Fundamentals of Biochemistry-Donald Voet, Judith G. Voet and Charlotte W. Bratt

CC-202: Molecular Biology

Credits: 4

Marks – 80 + 20

Unit I

Organization of genes and chromosomes and Control of gene expression: (Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons) Gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).

Unit II

DNA Replication – Mechanism of replication in prokaryotes and eukaryotes, extra chromosomal replicons, DNA damage and repair mechanisms (Mismatch, Photo reactivation, mechanisms of BER and NER), homologous and site-specific recombination.

Unit III *SP*

Mechanisms of Transcription – Prokaryotic transcription; promoters, properties of bacterial RNA polymerase, steps: initiation, elongation and termination. Eukaryotic transcription, promoters, enhancers factors and properties of RNA polymerase I, II and III. Reverse transcription. Inhibitors of transcription. Maturation of rRNA, mRNA and tRNA; RNA splicing, introns and exons, consensus sequence function. Poly A tail, 5' capping, structure and function of different types of RNA, RNA transport.

Unit IV *SP*

Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl-tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins).

Books Recommended

1. Cell and Molecular biology Lodish et.al .
2. Molecular and Cell Biology – Baltimore
3. Molecular Cell Biology – Darnell *et al.*
4. Biochemistry – Lehninger, Cox, Nelson
5. Biochemistry – Cohn and Stump;
6. Biochemistry - D.Voet&J.G.Voet (John Willey)
7. Cell biology – Bruce Alberts
8. Recombinant DNA technology – Watson and Crik
9. Human Genetics - Read and Strachan

CC-203: Cellular and Molecular Immunology

Credits: 4

Marks – 80 + 20

Unit-I

Introduction to Immunology: General properties of immune responses. Natural and acquired immunity, types, features and phases of immune responses. Cell and tissues of immune system. Development and activation of T and B lymphocytes, macrophages, granulocytes. Primary and secondary lymphoid tissues and organs.

Unit-II

Antigen and antibodies Interaction: Antigens, Antibody (structure and function), Immunoglobulin's (structure, function and classes). Monoclonal and Polyclonal antibodies (production and uses). Antigen-antibody interactions (principle and applications). Major Histocompatibility complex.

Unit-III

Complement System, Hypersensitivity and Immunodiagnostics: Complement cascade, Complement system pathway (classical, alternate), Biological significance of complement system. Hypersensitivity (Type I, Type II, Type III, Type IV, and Type V). ELISA, RIA technique and their application

Unit-IV

Immune system in health and disease, auto-immunity, Vaccines and interferon's: Recognition and entry processes of different pathogens like bacteria (tuberculosis), Viruses (HIV), Parasites (Malaria). Congenital and acquired immune deficiencies. Auto-immunity and Auto-immune disease (Myasthenia gravis, Rheumatoid arthritis). Vaccines (classification, type), recombinant vector vaccines, edible vaccines, synthetic peptide vaccine. Interferon (characteristics, type, production using rDNA technology and uses)

Book Recommended

1. Cellular and Molecular Immunology- 5th Edition, Abul K. Abbas, Andrew Litchman
2. Immunology-5th Edition, Richard A Goldsby, Thomas J. Kindt, Barbara A Osborne, Janis Kuby
3. Immunology- 6th Edition, Ivan Roitt, Jonathan Brostoff, David Male

CC-204: Advanced Molecular Biology

Credits: 4

Marks – 80 + 20

Unit I: Animal cell culture techniques

Animal cell Culture: Cell culture (adherent and suspension), basic equipments and techniques (flow cytometry, mechanical and enzymatic techniques of tissue disaggregation; cell culture media-Components, sterility, buffering capacity, growth requirements, supplementation of serum, antibiotic and antimycotic agents of Primary cell culture, serum free media, role of carbon dioxide) cell lines, clonal cell lines, sub-culturing, methods for quantization of cells and cell viability assays of cells, cytotoxicity assay and its applications, cell line characterization, An introduction to organ culture and tissue engineering.

Unit II: Engineering Animals:

Embryonic and adult stem cell & its applications. In vitro fertilization Development of transgenic animals-retroviral, microinjection and embryonic stem cell methods. Knockouts and Knock in technology in mice, Gene Therapy: Ex Vivo & In Vivo, Viral & non-viral gene delivery systems.

Unit III: Plant Tissue Culture and Applications

Plant cell and tissue culture- culture media and cell culture. Tissue culture, micropropagation and somaclonal variation. Protoplast culture- isolation and purification of protoplasts, protoplast fusion, genetic modification of protoplasts. Methods of gene transfer in plants- Agrobacterium mediated transformation, viral vectors and particle gun method. Transgenic plant technology- genetic engineering of plants for pest resistance, stress tolerance and delay of fruit ripening. Cryopreservation.

Unit IV. Fermentation Technology and Industrial Microbial technology:

Batch – fed batch – continuous fermentation, Bioreactors, Larger-scale fermentation system. Harvesting and disrupting microbial cells, Down-stream processing. Industrially important microbial strains, Industrial production of primary metabolites (amino acids, vitamins, organic acids etc.) and secondary metabolites (antibiotics, steroids.).

Books recommended:

1. Fermentation Biotechnology O.P. Ward. 1989 Prentice Hall.
2. Biotechnology J.E. Smith Cambridge University Press 1996.
3. Introduction to Biotechnology Brown, Campbell and Priest Blackwell Science 1987.
4. A Textbook on Biotechnology H.D. Kumar 2nd edition East West Press 1998.
5. Molecular Biotechnology Glick and Pasternak, Panima Publ.
6. From Genes to clones Winnaecker VCH Publication.
7. Elements of Biotechnology P.K. Gupta, Rastogi Publication, 1998.

CC-205 (Practical)

Credits: 6

Time: 6 hours

Marks – 100

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| 1. Major Practical | 30 |
| a) Enzyme kinetics study (catalase/ phosphatase) ✓ | |
| b) Experiment related to antigen antibody reaction ✓ | |
| c) Animal cell culture of fish/ chick | |
| a) Plant callus culture | |
| b) Demonstration of dot Elisa ✓ | |
| c) To find out the blood group and RH factor. ✓ | |
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| 2. Minor Practical | 20 |
| a) Agarose gel electrophoresis ✓ | |
| b) Subculturing | |
| c) Synthetic seed preparation | |
| d) Effect of temperature on enzyme activity ✓ | |
| e) Effect of pH on enzyme activity ✓ | |
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| 3. Seminar | 30 ✓ |
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| 4. Viva – Voce and Record | 20 |

CC-301: Intermediary Metabolism

Credits: 4

Marks – 80 + 20

Unit- I

Carbohydrate metabolisms: Glycolysis, citric acid cycle, pentose phosphate pathways, glycogenesis and glycogenolysis and their regulation, glyoxylate pathway, uronic acid pathway, Gluconeogenesis, Regulation of blood glucose homeostasis. Hormonal regulation of carbohydrate metabolism.

Unit- II

Lipids: Lipid biosynthesis- biosynthesis of Triglycerides, phosphoglycerides and sphingolipids. Fatty acid synthesis, desaturase and elongase. Fatty acid oxidation and lipid peroxidation. Ketone bodies- formation and utilization.

Unit- III

Amino acids: Catabolic fate of α -amino acids and their regulation, urea cycle and its regulation. Amino acid biosynthesis (arginine, leucine, isoleucine, tryptophan, glycine, serine, proline)

Unit- IV

Nucleotides and Integrated Metabolism: Biosynthesis of purines and pyrimidines- De novo and salvage pathways and their regulation. Catabolism of purines and pyrimidines. Structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides and deoxyribonucleotides. Integration of different metabolic pathways. Organ specialization. Metabolism under different stress conditions.

Books recommended:

1. Principles of Biochemistry - L. Stryer (W.H. Freeman & Co.)
2. Principles of Biochemistry - A.L.Lehninger, D.W.Nelson & M.M.Cox (Macmillan)
3. Biochemistry - D.Voet&J.G.Voet (John Willey)
- 4 Harper's Illustrated Biochemistry -R.K.Murray et al. (McGraw Hill)

AB **CC-302: Genetic Engineering and IPR**

Credits: 4

Marks – 80 + 20

Unit 1: Basics of Genetic Engineering

Basic principles. Use of restriction enzymes for production of DNA fragments. Cloning and expression vectors: Plasmids – bacteriophages (M13 and λ), YAC, BAC, Human artificial chromosomes, Ti plasmid, Ri plasmid, Shuttle vectors, SV40, baculoviruses, and retroviruses. End modification methods (blunt and cohesive end) with homopolymers, linkers and adaptors. Gene transfer methods– calcium phosphate co-precipitation, electroporation, lipofection, microinjection. Choice of host organisms for cloning. Recombinant selection (screening by nucleic acid hybridization, immunoscreening). Cloning of insulin in *E. coli*. Application of recombinant DNA technology in medicine, agriculture industry and environmental sciences.

Unit 2 Genomics

Genomics: an overview. Genome projects: HGP Genome sequencing approaches; Structural genomics; Genetic mapping (examples SNPs, VNTRs, microsatellites), Restriction Mapping (example RFLP) Physical mapping (Positional cloning). Functional genomics– study of gene interactions; Chromosome mappings; DNA Library (Genomic and cDNA library)

Unit III: RNA techniques and Protein Engineering

mRNA Isolation, hybridization and Northern Blotting, *in vitro* labeling with radioisotopes and chemical markers, Mapping of transcripts: si RNA technology/ gene silencing techniques, its applications, micro arrays, ribozyme technology. Proteomics: In vitro mutagenesis (introduction to gene correction), Production of proteins from cloned genes (expression vectors, problems in *E. coli*, GST-MBP-His tagging for protein purification), Polypeptide Sequencing.

Unit IV: Bioethics and Patenting

Ethics in animal experimentation. CPCSEA guidelines - Animal care. Ethical issues in human gene therapy and human cloning. IPR- its concepts and conditions. Patenting - definition of patent, Product and process patents, patenting of genes, cells and life forms, evaluation of life patenting.

Books Recommended

1. Molecular Biology: Robert Weaver 1st Edition, WCB McGraw-Hill
2. Principles of Biochemistry: Lehninger WH Freeman
3. Biochemistry of Signal Transduction and Regulation - Gerhard Krauss Wiley VCH 3rd Revised
4. Molecular Cell Biology: Lodish 6th Edition, WH Freeman & Company
5. The cell: Cooper 2nd Edition ASM Press
6. Gene IX: Benjamin Lewin Published by Pearson Prentice Hall
7. Cell and Molecular Biology: Gerald Karp

CC-303 (Practical)**Credits: 6****Marks – 100****Time: 6 Hours****1. Major Practical****30**

- a) Isolation of plasmid DNA and analysis using agarose gel electrophoresis
- b) Isolation of genomic DNA and analysis using agarose gel electrophoresis
- c) Preparation of SDS – PAGE
- d) Study of southern blot hybridization
- e) Estimation of proteins from serum by biuret and Lowry methods
- f) Determination of albumin and A/G ratio in serum
- g) Estimation of cholesterol in serum
- h) Estimation of lipoproteins in serum

2. Minor Practical**20**

- a) Construction of restriction digestion maps from given data
- b) Analysis of DNA fingerprinting (Dry lab)
- c) Separation and identification of amino acids by paper chromatography

3. Seminar**30****5. Viva – Voce and Record****20**

CC- 304: Research Methodology

Credits: 4

Marks: 100

Unit I: Basic Concepts of Research

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Problem Identification & Formulation – Research Question, Investigation Question, Measurement Issues, Hypothesis – Qualities of a good Hypothesis – Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance

Unit II: Research Design

Research Design: Concept and Importance in Research – Features of a good research design, Categories of research design (experimental, retrospective and cross-sectional), Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches, Measurement: Concept of measurement– what is measured? Problems of measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.] PP

Unit III: Research Methods

Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample. Survey: types of survey, methodology and design, Case study, Naturalistic observation, Experiments, Topical Method of research

Unit IV: Data Analysis and Interpretation and Paper Writing

Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association. Interpretation of Data and Paper/Thesis Writing – Layout of a Research Paper, planning of thesis, thesis or Assignment writing, writing review of Literature, Writing a Research report. Ethical issues related to publishing, Plagiarism and Self-Plagiarism, Software for detection of Plagiarism?

Books recommended:

1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. Research and Writing- P. Ramadass, A. Wilson Aruni

OEC- 305: Biomolecules and Bioinstrumentation

Credits: 4

Marks – 100

Unit - I

Carbohydrates and lipids: Classification, structure, general properties and functions of polysaccharides and complex carbohydrates. Classification, structure, properties and functions of fatty acids, essential fatty acids, fats, phospholipids, sphingolipids.

Unit - II

Nucleic Acids and proteins: Structure and functions of nucleotides, Primary and secondary structures of nucleic acids (DNA, t-RNA). Introduction to Amino acids and their classification, overview of protein structure (primary, secondary, tertiary, quaternary)

Unit - III

Vitamins and Enzymes: Vitamins: Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins. Enzyme classification, chemical nature and properties of enzymes.

Unit- IV

Bioinstrumentation: Principles and applications of UV-Visible Spectrophotometer, Density gradient centrifugation, Ultracentrifugation, Light microscope and Electron microscope, Chromatography.

Books Recommended:

1. Principles of Biochemistry - L. Stryer (W.H. Freeman & Co.)
2. Principles of Biochemistry - A.L.Lehninger, D.W.Nelson & M.M.Cox (Macmillan)
3. Biochemistry - D.Voet & J.G.Voet (John Willey)
4. Harper's Illustrated Biochemistry - R.K.Murray et al. (McGraw Hill)
5. Outline of Biochemistry - Conn & Stump (John Willey & Sons)
6. Introduction to Electron Microscopy - S. Wischnitzer.
7. Electron Microscopy in Biology - J.R.Harris (ed.).
8. Biophysics - V. Pattabhi & N. Gautham (Narosa, New Delhi).
9. Fundamentals of Molecular Spectroscopy - C.N. Banwell, (Tata-McGraw Hill)
10. Physical Biochemistry - D. Freifelder (W.H. Freeman & Co.)
11. Biophysical Chemistry, Vol.II - C.R. Cantor & P.R. Schimmel, (W.H. Freeman &Co.)
12. Modern Experimental Biochemistry - R. Boyer (Pearson Education)
13. Practical Biochemistry - K. Wilson & J. Walker (Cambridge Univ. Press)

DEC-401A: Nutritional Biochemistry

Credits: 4

Marks – 80 + 20

Unit- I

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 (Diet Chart) for normal and diseases persons (diabetes and hypertension). Specific dynamic action of proteins. **Starvation** – Techniques for the study of starvation.

Unit- II

Elements of nutrition: Dietary requirement of carbohydrates, lipids and proteins. Biological value of proteins. Concept of protein quality. Protein sparing action of carbohydrates and fats. Essential amino acids, essential fatty acids and their physiological functions. **Obesity** – Definition, Genetic and environmental factors leading to obesity.

Unit- III

Minerals and Vitamins: 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

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.

Books recommended

1. Text book of Biochemistry & Human Biology – G.P .Talwar
2. Text book of Human Nutrition – M.S.Banerji, N.Pralhad Rao & V.Reddy.
3. Nutritional Biochemistry & Metabolism – Linten.
4. Human Nutrition & Dietics- Davidson & Passmore(ELBS)
5. Modern Nutrition in Health & Diseases – Maurice E Skills & V R Yong.
6. Food & Nutrition – M.S.Swaminathan
7. The Cell – By Cooper.
8. Cell and Molecular Biology – de Robertis & de Robertis.
9. Molecular Biology of the Cell: Alberts 5th Edition 2007 NCBI Publication

✓ DEC-401B: Microbiology and Clinical Biochemistry

Credits: 4

Marks – 80 + 20

Unit-I

General Microbiology: Classical microbes and their distinctive characters; Criteria used in classification of microbes, microbial techniques (Current methods in microbial identification, Ribotyping). Pure culture techniques, theory and practice of sterilization and culture media preparation. Common parasites and pathogens of humans, domestic animals and crops. Recognition and entry processes of different pathogens (bacteria and viruses only) into animal and plant host cells.

Unit-II

Bacteria and Viruses: Bacterial nutrition, Gram positive and gram negative bacteria, Growth kinetics- growth curves and phases of growth. Bacteria reproduction- Methods of genetic transfers (transformation, conjugation, transduction, sex-detection), mapping genes by interrupted mating, endospore formation. Viral particles, capsids, envelop, other virus components. Multiplication of bacteriophages- infection to maturation and release. Gene of viruses.

Unit-III

In born error in metabolism: Metabolic disorder of carbohydrate (galactosemia, glycogen storage disease, deficiency of glucose 6-phosphate, hypoglecaemia, diabetis mellitus). Metabolic disorder of lipids (Tay-Sachs disease, Nieman pick disease), Metabolic disorder of amino acids (phenylketonuria, alkaptonuria), Metabolic disorder of nucleic acids (gouts, Lesch- Nyhan syndrome).

Unit-IV

Evaluation of organ function test: Evaluation of liver (Jaundice, Hepatitis, LFT). Pancreatic, gastric and intestinal function, test of myocardial infraction

Book Recommended

1. Cellular and Molecular Immunology- 5th Edition, Abul K. Abbas, Andrew Litchman
2. Immunology-5th Edition, Richard A Goldsby, Thomas J. Kindt, Barbara A Osborne, Janis Kuby
3. Immunology- 6th Edition, Ivan Roitt, Jonathan Brostoff, David Male

DEC- 402A: Biochemical and Environmental Toxicology

Credits: 4

Marks – 80 + 20

Unit I: Introduction to Environmental studies

Ecosystem- Structure and function of ecosystem. Concept of Sustainability and sustainable development. Natural sources: Renewable and non- renewable. Environmental pollution: Types, causes, effect and control of Air, Water, Soil pollution. Solid waste management, control measures for urban and industrial waste. Climate change, global warming, ozone layer depletion and Acid rain.

Unit III: General principle of Toxicology

Introduction to Xenobiotics and Environmental Toxicology, Classification of Xenobiotics (Agriculture, Industrial). Basic principle of Toxicology: Quintals theory of Dose response and influence factor of toxicity.

Unit IV: Biotransformation of Toxicants

General biotransformation process, Phase-I and phase-II reaction. Biotransformation of pesticides (organophosphate, carbamate, organochlorine). Toxicity of metals: factor affecting in manifestations of metal toxicity, Lead toxicity.

Unit IV: Non-organ and organ directed Toxicity

Chemical carcinogenesis: Definition, Mechanism. Genetic toxicology: Definition, health impact and Mechanism of induction of genetic alternation. Developmental toxicology: Definition, principle, mechanism and pathogenesis. Introduction to toxic response of Skin, Liver, Respiratory organ

Books recommended:

- 1.Environmental Toxicology-S.Bhattacharya
- 2.Fundamental of Ecology-O.P. ODUM
- 3.Developmental toxicology –Hood RD
- 4.Selective TOXICOLOGY –Albert A.

DEC 402B: Biostatistics and Bioinformatics

Credits: 4

Marks – 80 + 20

Unit I: Biostatistics

Collection, Tabulation and Serration of data, Frequency distribution and graphical representation, Measurement of central tendency (Mean, Median, Mode), Mean and standard deviation, Standard errors and test of significance (t-test and F-test), correlation and regression.

Unit II: Introduction to Computer

Introduction to Digital computer, Introduction to computer network, topology and design. Basic computer operating system (Windows and Linux). Excel, word, power point presentation, World Wide Web.

Unit III: Introduction to Bioinformatics

Introduction to Bioinformatics, Application of Bioinformatics, Bioinformatics resources. Biological Data Base: Over view of biological data base: Nucleotide data base (GenBank). Proteins sequence data bases (Uniport, Swiss port). Proteins structure data bases (PDB, SCOP, CATH)

Unit IV: Application of Bioinformatics

Sequence analysis: Sequence similarity search, BLAST, FASTA, CLUSTAL. Genomics: Introduction to Genomics, comparative genomics data bases, objects of genome comparison. Over view of Proteomics: Experimental technique in proteomics. Application of bioinformatics in drugs designing

Suggested reference:

- 1.Introduction to Biosatistics-Dr.p.k. Banerjee.S.Chand pub.
- 2.Text book Biotechnology –H.K. DAS. WILLY pub.
- 3.Stastical methods,Medhij,Wily Eastern Limited,
- 4.Bioinformatics: Apractical guide to the analysis of gene and protein.Baxevanis A.D and OvelleteB.F.F.,Wiley –Inter science.

DEC- 403 (Practical)
(Covering DEC 401 and DEC 402)

Credits: 6

Time: 6 Hours

Marks – 100

1. Major and minor Practical

401A

80

- Food chart preparation (normal male, normal female, child, diabetes patient, hypertension)
- Estimation of reducing sugars (lactose in milk) by DNS method.
- Estimation of sugars by Phenol – Sulfuric acid / Anthrone method.
- Estimation of sugars by Nelson's method.
- Estimation of protein by Lowry's method.
- Submission of Charts / Models related to disorders and diseases related to nutritional problems (vitamin deficiency, mineral deficiency, malnutrition, under nutrition)

401B

- Practicals related to clinical biochemistry
- Sterilization and media preparation for bacterial culture
- Isolation of bacteria from soil/water sample
- Antibiotic sensitivity
- Gram staining

402A

- Study the different physico-chemical parameters of water sample
- Study the different physico-chemical parameters of soil sample
- Calculate the DO content of the given samples
- Calculate COD content of the given samples.

402 B

- Find the central tendency of the given samples
- Application of bioinformatics tools
- Find the correlation and regression of the given data set
- ANOVA of a test
- Construction of tables and graphs (histogram, pie chart) on computers
- Demonstration of finding central tendency using computers

5. Viva – Voce and Record

20

DC-404: Dissertation Course/ Project

Credits: 8

Marks: 200

Dissertation Course/ Project and Thesis

150

Presentation and Viva-Voce

50