M.Sc., - BIOCHEMISTRY

PREAMBLE

- Biochemistry is the study of chemistry and relating to biological organisms.
- Biochemistry is sometimes viewed as a hybrid branch of organic chemistry which specializes in the chemical processes and chemical transformations that take place inside of living organisms.
- Biochemistry incorporates everything in size between a molecule and a cell and all the interactions between them.
- Biochemistry essentially remains the study of the structure and function of cellular components (such as enzymes and cellular organelles) and the processes carried out both on and by organic macromolecules - especially proteins, but also carbohydrates, lipids, nucleic acids and other biomolecules.
- All life forms alive today are generally believed to have descended from a single proto-biotic ancestor, which could explain why all known living things naturally have similar biochemistries.
- Biochemistry is most simply put the chemistry of life.

KARPAGAM ACADEMY OF HIGHER EDUCATION
Coimbatore – 641 021
DEPARTMENT OF BIOCHEMISTRY
FACULTY OF ARTS ,SCIENCE AND HUMANITIES
PG PROGRAM (CBCS)- M.Sc., Biochemistry
(2018–2019 and onwards)

Course code	Name of the course	Objectives and out comes		Instruction hours / week			Credit(s)	Maximum Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
								40	60	100
SEMESTER - I										
18BCP101	Chemistry of Biopolymers	I	a	4	-	-	4	40	60	100
18BCP102	Enzymes and Microbial Technology	II	d	4	-	-	4	40	60	100
18BCP103	Bioinstrumentation and Good Laboratory Practices	II	d, e	4	-	-	4	40	60	100
18BCP104	Cellular Biochemistry	III	a	4	-	-	4	40	60	100
18BCP105A	Plant Biochemistry	III	a	4	-	-	4	40	60	100
18BCP105B	Ecology and Evolutionary biology	I	c, f							
18BCP105C	Biopharmaceutics	I	d							
18BCP111	Practical – I Quantitative Estimation and Separation Techniques	II	a	-	-	4	2	40	60	100
18BCP112	Practical – II Plant Biochemistry and Microbiology	I, III	a, e	-	-	4	2	40	60	100
	Journal paper analysis and Presentation	I- III	a, e	2	-	-	-	-	-	-
Semester Total				**22**	**-**	**8**	**24**	**280**	**420**	**700**
SEMESTER – II										
18BCP201	Regulation of Metabolic Pathways	II	a	4	-	-	4	40	60	100
18BCP202	Molecular Biology	II	a, b	4	-	-	4	40	60	100
18BCP203	Developmental Genetics	II	a, b	4	-	-	4	40	60	100
18BCP204	Bioinformatics	III	d	4	-	-	4	40	60	100
18BCP205A	Recombinant DNA Technology	I	d	4	-	-	4	40	60	100
18BCP205B	Animal Tissue Culture	III	d, e							
18BCP205C	Genomics and Proteomics	III	d							
18BCP211	Practical – III Molecular Biology and Animal Biotechnology	II	d, g	-	-	4	2	40	60	100
18BCP212	Practical – IV Biological Databases and Analysis	III	d, g	-	-	4	2	40	60	100
	Journal paper analysis and Presentation	I-III	a, e	2	-	-	-	-	-	-
Semester Total				**22**	**-**	**8**	**24**	**280**	**420**	**700**
SEMESTER – III										
18BCP301	Immunology	I	a	4	-	-	4	40	60	100
18BCP302	Clinical Biochemistry	I, III	a, d	4	-	-	4	40	60	100
18BCP303	Endocrinology	II	a, d	4	-	-	4	40	60	100
18BCP304	Drug Biochemistry	III	a, d	4	-	-	4	40	60	100
18BCP305A	Biostatistics and Research Methodolology	III	e, g	4	-	-	4	40	60	100
18BCP305B	Clinical Research and IPR	III	d, e							
18BCP305C	Dietetic Management of Disease	I	d							
18BCP311	Practical – V Clinical Enzymes And Immunology	I, II	d, e	-	-	4	2	40	60	100
18BCP312	Practical – VI Clinical Biochemistry and	I	d, e	-	-	4	2	40	60	100

	Animal Studies									
	Journal paper analysis and Presentation	I-III	d, e	2	-	-	-	-	-	-
Semester Total				**22**	**-**	**8**	**24**	**280**	**420**	**700**
SEMESTER – IV										
18BCP491	Project and *Viva Voce*	I-III	a-g	05	-	**25**	**15**	**80**	**120**	**200**
Semester total							**15**	**80**	**120**	**200**
Program Total							**87**	**920**	**1380**	**2300**

Blue – Employability
Green – Entrepreneurship
Red – Skill Development

Elective courses *

Elective – 1 (18BCP105)*		**Core Elective – 2 (18BCP205)***		**Core Elective – 3(18BCP305)***	
Course code	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**	**Course Code**	**Name of the course (Theory)**
18BCP105-A	Plant Biochemistry	18BCP205-A	Recombinant DNA Technology	18BCP305-A	Biostatistics and Research Methodolology
18BCP105-B	Ecology and Evolutionary biology	18BCP205-B	Animal Tissue Culture	18BCP305-B	Clinical Research and IPR
18BCP105-C	Biopharmaceutics	18BCP205-C	Genomics and Proteomics	18BCP305-C	Dietetic Management of Disease

* The candidate has to select any one elective course from three options in each semester

Code: 18BCP101

18 - Academic Year

BC - Biochemistry

P - Master's Degree

First Digit - Semester number (1, 2, 3 and)

Second digit - Theory (0); Practical (1); Project (9)

Last digit - Paper number in the concerned semester (1, 2…)

PROGRAMME OUTCOME(POs)

PG biochemistry graduate will be able to achieve

a. **Critical Thinking and Effective Communication:** The teaching is intended to kindle the critical thinking of the student to address problems (Problem based learning) and equip them to list out their understanding (Activity based learning). The syllabus also includes journal paper presentation and analysis on specific topics of all subjects which will be evaluated by faculty handling the subject.

b. **Future Career:** To prepare students for future careers in the various fields of biochemistry such as academic and research institution.

c. **Societal Contribution and Social Interaction:** The Biochemistry Programme will benefit the society on the whole by adding to the highly skilled scientific workforce, particularly for the biomedical research sectors, in the academic, industry as well as for research laboratories across the country and the globe. Inside the classrooms group discussion is encouraged on topics during the last five minutes of class to improve the understanding and to share the knowledge and view point. Outside the classroom, various outreach programme are conducted on various health initiatives.

d. **Identification and Differential Diagnosis:** To acquire **b**iochemist position in leading hospitals and scientist position in industries.

e. **Ethics:** Students learn about the significance of having right moral features to develop good interpersonal skills.

f. **Environment and Sustainability:** Understand the role of citizen to maintain sustainable environment and encourage Eco-friendly initiatives.

g. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of health and disease.

PROGRAMME SPECIFIC OUTCOME (PSOs)

i. To prepare students for future careers in various fields of biochemistry by enhancing analytical and critical-thinking skills in which a core understanding of the chemistry of biological processes is important for the understanding of human health and disease.

j. To equip highly skilled scientific workforce, particularly for the biomedical research sectors, in the academic, industry as well as for research laboratories across the country and the globe.

k. The skills acquired in the programme will help the students in acquiring scientific, academic and industrial positions such as Analyst, Research Scientist at Pharma (R&D) Industries, Academician, Project Associates (JRF, SRF), Doctoral Research positions abroad at India and abroad. Clinical biochemist at renowned hospitals, medical coding, Scientific writers.

PROGRAMME EDUCATIONAL OBJECTIVE (PEOs)

I. The course aims to impart advanced and in depth understanding on all the human physiological and pathological state. To understand the molecular process and their perturbation during disease.

II. The programme covers various aspects of Biomolecule estimation and regulation to ascertain health and disease state. metabolic pathways alterations along with their regulation at the replication, transcriptional, translational, and post-translational levels including by studying DNA, RNA and protein molecules, immunology, endocrinology, advancements in rDNA technologies to circumvent genetic disorders.

III. Further to enrich research understanding various genomic, proteomic and bioinformatics tools are added. Animal cell culture, IPR, Biostatistics, research methodology, clinical research and Plant tissue culture are offered as elective papers to get specialized in a specific area. The final semester is devoted exclusively to enrich the students to address specific research objective.

Mapping of PEOs and POs

POs	a	b	c	d	e	f	g	i	j	k
PEO I	X		X			X				
PEO II	X		X	X	X	X		X	X	X
PEO III	X	X	X	X	X		X		X	X

Semester I

18BCP101 **CHEMISTRY OF BIOPOLYMERS** **4H-4C**

Instruction hours/week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students:

- To understand the biological significance of polysaccharides in living systems
- To understand the structure of amino acids and proteins and their biological significance in living systems
- To know the structure, properties and biological significance of lipids in biological systems
- To understand lipid peroxidation and the importance of antioxidants in degenerative diseases
- To understand the structure and functional role of nucleic acid in living systems
- To understand the nucleic acid interaction with proteins and their molecular aspects.

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the structure and organization of storage and structural polysaccharides in living system
2. Recognize the structure and importance of proteins and amino acids in biological system.
3. Recall the role of lipids in bio membrane including signal transduction
4. Equip with the knowledge on antioxidants and their importance
5. Differentiate the structure, types, properties and functions of DNA and RNA
6. Recognize the nucleic acid interaction with proteins and gain knowledge in molecular techniques.

UNIT I: Polysaccharides

Brief review of carbohydrates, classification. Occurrence, structure and biological functions of cellulose, chitin, starch and glycogen. Fructans, arabinans and galactans (brief account). Dietary fibre. Occurrence, structure, and biological functions of bacterial cell wall polysaccharides and blood group antigens. Structure and significance of glycoconjucates -Glycosaminoglycans – structure and biological role of hyaluronic acid, chondroitin sulfate and heparin, sialic acid; glycoproteins and glycolipids.

UNIT II: Proteins

Review of structure and classification of amino acids. Orders of protein structure. Primary structure – determination of amino acid sequence of proteins. The peptide bond – The Ramachandran plot. Secondary structures – α-helix, β-sheet and β-turns. Fibrous proteins- Collagen triple helix-Structure and assembly. Globular proteins-forces involved, folding process and folding patterns. Tertiary structure –Myoglobin organization. Quaternary structure of proteins- Structure of haemoglobin. Models for

haemoglobin allostery. Quaternary structure-basics only. Protein function as enzymes, defensive and transport.

UNIT III: Lipids

Introduction, classification, structure and functions of simple lipid, compound lipids-phospholipids, glycolipids, storage lipids and cholesterol. Eicosanoids-prostaglandins, thromboxanes and leukotrienes. Properties of lipids-Micelles, bilayers and liposomes. Significance of lipid anchored protein-prenylated, fatty acylated and GPI anchored proteins. Lipoproteins – classification, composition and biological functions. Lipids as signals, cofactors and pigments (Brief account). Lipid peroxidation and antioxidants.

UNIT IV: Nucleic acids

DNA double helical structure – Watson and Crick model. A, B and Z forms of DNA. Tertiary and quadraplex structures of DNA. DNA supercoiling and linking number. Properties of DNA – DNA bending, buoyant density, viscosity, denaturation and renaturation – The cot curve – Chemical synthesis of DNA.

Major classes of RNA – mRNA, rRNA, tRNA, snRNA, siRNA, hnRNA – structure and biological functions. Secondary and tertiary structure of tRNA and rRNA.

UNIT V: Nucleic acid interaction with proteins

DNA binding motifs in proteins – the basic helix loop helix (bHLH) motif, zinc finger, the leucine zipper, helix-loop helix and homeo domain. RNA binding motifs in proteins. Molecular aspects of protein-nucleic acid binding – direct interactions. Techniques characterizing nucleic acid-protein complex – chromatin immunoprecipitation assay, DNase I footprinting.

SUGGESTED READINGS

1. Nelson, D., and Cox, M. W.H. (2012) Lehninger Principles of Biochemistry (4th Ed.) New York, Freeman and Company.
2. Murray, R.K., Bender, D.A., Botham, K.M., and Kennelly, P.J., (2012). Harper's illustrated Biochemistry, 29th Edition. McGraw-Hill Medical. London.
3. Zubay, G., (2009). Biochemistry, Wm.C Brown Publishers, Saunders and Company, Philadelphia.
4. Voet, D., Voet, J. G., & Pratt, C. W. (2008). Fundamentals of biochemistry: Life at the molecular level. Hoboken, NJ: Wiley.
5. Nucleic acid structure and recognition. Neidle, Oxford University Press, 2002
6. Nucleic acids in Chemistry and Biology. Blackburn and Gait, IRL Press, 1996
7. Rawn,. J.D., (2004). Biochemistry, First Indian reprint, Panima Publishing Corporation, New Delhi.

Semester I

18BCP102 ENZYMES AND MICROBIAL TECHNOLOGY 4H-4C

Instruction hours/week: L: 4 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students:

- To understand the structure of enzymes and their classifications.
- To analyse the active site of enzymes by various experimental approaches.
- To learn the kinetics of enzyme catalysed reactions.
- To learn the importance of enzyme immobilization and its wide applications in medicine and industries.
- To study various fermentor designs, culture systems and the application of fermentation process in industry.
- To learn the fermented products preparation, downstream processing and its industrial applications.

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the mechanism of action of enzymes and their classifications.
2. Recall the kinetics of enzyme catalyzed reactions
3. Understand the enzyme immobilization concept and apply the knowledge to produce more products out of it.
4. Gain knowledge in designing fermentor based on Industrial needs
5. Have clear understanding of microbe's implication to derive a product and the role of enzymes in downstream process.
6. Clear in concept of various culture techniques and apply the suitable one for a particular application.

UNIT I: Enzymes

Enzymes Nomenclature and classification of Enzymes with examples; Structure and functions of coenzymes and cofactors. Active site, the investigation of active site structure – The identification of binding sites, catalytic sites-trapping the E-S complex. Use of substrate analogs, enzyme modification by treatment with proteolytic enzymes, photo oxidation and chemical modification of amino acid side chains. Affinity labeling studies and super reactive amino acid chains. The 3-D structural features of active sites as revealed by X-ray crystallographic and chemical studies, site directed mutagenesis. catalytic triad. Lock and key model, Induced fit model. Factors affecting enzyme activity. Isolation, purification and characterization of enzymes. Mechanism of enzyme action –Acid base and covalent catalysis (Chymotrypsin, lysozyme), metal activated and metalloenzymes.

UNIT II: Enzyme Kinetics

Derivation of MM equation, LB plot, Eadie Hofstee plot and Hanes plot. Bisubstrate reactions-types of bi-bi reactions, differentiating bi substrate mechanisms-diagnostic

plots, isotope exchange. Enzyme inhibition-Types and differentiation of competitive, uncompetitive and non-competitive inhibition, Allosteric inhibition, feed-back inhibition and regulation. Reversible covalent modification (glycogen phosphorylase); proteolytic cleavage (Zymogen); multi enzyme complex as regulatory enzymes (PDH); isoenzymes (LDH). Mechanism based inhibitors-antibiotics as inhibitors. Mechanism of action of enzymes - chymotrypsin and lysozyme. Enzyme based diagnostic techniques.

UNIT III: Immobilization of enzymes

Methods of immobilization - adsorption, covalent binding, entrapment, membrane confinement. Effect of immobilization on enzyme. Use of enzymes in clinical diagnosis and industries. Enzyme engineering. Artificial enzymes and synzymes, Abzymes, ribozymes, enzymes in organic solvents.

Biosensors – glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors.

UNIT IV: Microbial Growth

Balanced and Unbalanced microbial growth; Measurement of growth; Principles of microbial growth and culture systems- culture, fed culture, semi-continuous culture and continuous culture. Isolation and screening of industrially important microbes. Important strains for better yield. Design of a fermenter. Types of bioreactor-Continuous stirred tank, Bubble column, Airlift, Fluidized bed, Packed bed and Photobioreactor.

Solid substrate fermentation and Media fermentation. Examples of bioprocess for the production of biomass. Microbial metabolic products-primary and secondary metabolites.

UNIT V: Production of fermented products and downstream processing

Production of alcohol and alcoholic beverages. Microbial production of Organic acids: Source, recovery and uses of Citric acid, Lactic acid, Acetic acid and L-ascorbic acid. Production of antibiotics: Penicillin and Tetracyclin. Bioinsecticides: Production of Bacterial and fungal polysaccharides, commercial production of Xanthan gum and pullulan. Production of edible mushroom and SCP.

Biofertilizers *Phosphobcterium* and *Rhizobium sp*.,; Biopesticides, leaching of ores by microbes, microbial treatment of wastewater – aerobic and anaerobic methods.

SUGGESTED READINGS

1. Jain, J.L, (2013). Fundamentals of Biochemistry, S. Chand & Co Ltd, New Delhi.
2. Sathya Narayana U, (2005). Biotechnology, Books and Allied Publishers, Kolkata.
3. Trevor and Palmer, 2004. Enzymes, East West Press Pvt Ltd, New Delhi.
4. Wolf Crueger and Annesie Cruger, 2004. Biotechnology: A Textbook of Industrial Microbiology, 2nd Edition, Panima Publishers, Bangalore.

5. Adams, M.R., and Moss, M. O. (2004). Food Microbiology, New age publishers, New Delhi.

6. Singh, R., and Ghosh, S.K., (2004). Industrial Microbiology, Global Vision publishers, New Delhi.

7. Dixon, M., and Webb, E.C. (1979). Enzymes, 3rd Edition, Longman and company Better World books Ltd. UK

8. Chapline, M.F., and Bucke, C. (1990). Protein Biotechnology. Cambridge University Press, London.

9. Walsh, G (2002), Proteins Biochemistry and Biotechnology, John Wiley & Sons Ltd, New York.

10. Glazer, A.N., Nikaido, H. (2007). Fundamentals of Applied Microbiology. W H. Freeman Company, New York.

11. Price, N.C., and Stevens, L (2012). Fundamentals of Enzymology, 3rd Edition, Oxford Univ. Press, New York.

12. Stanbury, P.F., Whitaker, A and Hall, S.J. (2005). Principles of Fermentation Technology, Elsevier Publishers.

13. Thomas, E., and Creighton, W., (2002). Proteins: Structure and Molecular properties, W.H Freeman and Company, New York.

14. Patel, (2003). Industrial Microbiology, Macmillan India limited, New Delhi.

18BCP103 BIOINSTRUMENTATION AND GOOD LABORATORY PRACTICE 4H-4C

Instruction hours/week: L: 4 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objective
Equip the students:

- To learn centrifugation techniques and their applications in biological system.
- To understand the principle of colorimetry and advanced spectrophotometric techniques
- To learn the basics, advanced techniques and applications of chromatography
- To learn the importance of calibration of analytical instruments.
- To learn the principle and applications of electrophoresis and radioisotopic techniques in biological sample analysis
- In good laboratory practices procedures.

Course outcomes (CO's)
After successful completion of the course, the student will:

1. Apply the centrifugation techniques in biological system
2. Use colorimetry and spectrophotometry for sample analysis
3. Use chromatographic techniques for sample analysis
4. Calibrate analytical instruments
5. Detect radioisotopes and analyze samples using electrophoretic techniques
6. Follow the good laboratory practices procedures.

UNIT I: Centrifugation
Types of centrifuges, Principles and applications of analytical and preparative centrifuges, density gradient and ultra centrifugation. Relative molecular mass determination and sedimentation coefficient. Sub cellular fractionation of cellular components. Applications. Separation of cells on the basis of density.
Colorimetry: Beer's law and Lambert's law. Principle of photoelectric colorimeter
Spectroscopy: Properties of electromagnetic radiations, Instrumentation and applications of UV Visible and mass spectroscopy, FTIR, NIR, reverse spectroscopy. Spectrofluorimetery, atomic spectroscopy, NMR spectroscopy. Advantages and disadvantages and advancements of spectroscopic methods.

UNIT II: Chromatography
Principles, Types – paper chromatography, thin layer chromatography and HPTLC, Column chromatography - Ion exchange chromatography, affinity chromatography, gel filtration chromatography, Low pressure liquid chromatography (LPLC) and High-Performance Liquid Chromatography (HPLC)- Normal and Reverse Phase Gas -liquid chromatography Mass spectroscopy (GC – MS), LC-MS, MALDI-TOF, ICPMS, Application of Chromatography. Separation of phytoconstituents using TLC.

UNIT III: Electrophoresis

Principle, instrumentation and applications of agarose gel electrophoresis, sodium dodecyl sulphate – polyacrylamide gel electrophoresis (SDS-PAGE), native PAGE, isoelectric focusing, immunoelectrophoresis, 2D gel electrophoresis. Pulse field gel electrophoresis, capillary electrophoresis, gel documentation – Applications. Blotting techniques.

UNIT IV: Radioisotopic techniques

Introduction, nature of radio activity, types and rate of radioactive decay, units of radio activity, detection and measurement of radioactivity-Geiger-Muller counter, solid and liquid scintillation counter. Autoradiography, X-ray diffraction and circular dichorism. Non-radioactive, fluorescent methods. Applications of radioisotopes in biological sample analysis.

Flowcytometry: Principles and applications**.**

Microscopic Imaging techniques: Atomic Force Microscopy, Confocal fluorescent microscopy, SEM and TEM

UNIT V: Good Laboratory Practices

Quality concepts, personal protective equipment. General safety-biological safety, chemical safety and fire safety. data generation and storage, quality control documents, retention samples, records, audits of quality control facilities. List of Regulations to be followed**.** Laboratory safety procedure- glass ware, equipment safety, hands protection, precaution to be undertaken to prevent accident and contamination. GLP – an overview and basic information, Scope. Principles of GLP: Test Facility Organization and Personnel, Test Systems, Test and Reference Items, Standard Operating Procedures, Performance of the Study, Reporting of Study Result, Storage and Retention of Records and Materials. Responsibilities in GLP. Implementing of GLP in non GLP analytical laboratory.

SUGGESTED READINGS

1. Weinberg, S., (1995). Good Laboratory Practice Regulations, 3rd edition, CRC Press, U.S.A.

2. Harburn, K., (1990). Quality Control of Packing Materials in Pharmaceutical Industry, CRC Press, U.S.A.

3. Chatwal, G.R., and Anand, S.K., (2003). Instrumental Methods of Chemical Analysis. 5th Edition, Himalaya Publishing House, Mumbai.

4. Sharma, B.K., (2004). Instrumental Methods of Chemical Analysis, 24th Edition, Goel Publishing House, Meerut.

5. Richard, A.G., Richard, G., (2009). New Drug Approval Process Drugs and the Pharmaceutical Sciences), 5th edition CRC Press, U.S.A.

6. Wenclawiak, B.W., Koch, M., Hadjicostas, E. (2004). Quality Assurance in Analytical Chemistry: Training and Teaching. 1st edition, springer. U.S.A.

7. Wilson, K., and Walker, J., (2010). Principles and Techniques of Biochemistry and

Molecular Biology, 7th Low Price Edition, Cambridge University Press, India.

18BCP104 **CELLULAR BIOCHEMISTRY** **4H-4C**

Instruction hours per week: L: 4 T: 0 P:0 Marks: Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

Equip the students

- To recall the knowledge in organization and dynamics of mitochondria.
- To understand the molecules within the cell and interaction between cells that allows construction of multicellular organisms.
- To understand cytoskeleton network and extracellular matrix.
- To learn cell signaling mechanisms and pathways
- To understand cell cycle, cell division and cell death process.
- To recognize cancer and mutational changes at gene level.

Course outcomes (CO's)

Upon successful completion of this course, participants will be able to:

1. Recognize the organization and dynamics of mitochondria.
2. Recognize cell cell interaction and their mechanism.
3. Maintain cytoskeleton structure and functions of micro, macro and intermediary filaments.
4. Recognize the cell signaling mechanisms and pathways.
5. Enumerate the phases of cell cycle, events in cell division and mechanism of cell death
6. Relate properties of cancerous cells to mutational changes in gene function.

UNIT I: Membrane

Membrane bilayer- models, Membrane lipids- fluidity, asymmetry, phase transition, Liposomes. Langmuir trough, Metamorphic mosaic model, Techniques for determination of membrane protein topology

Membrane proteins – Types, Orientation, Mobility – Experiments, flippases, proteins of RBC membrane, RBC ghosts, Bacteriorhodopsin, Porins – aquaporin.

solubilisation of proteins, lipid anchored proteins, Carbohydrates – cell surface carbohydrates – Lectins and selectins.

UNIT II: Membrane transport

Passive diffusion, facilitated diffusion in erythrocytes, Carriers and ion channels, Ion concentration gradients.

Uniporter Catalyzed transport, active transport systems. Transport process driven by ATP-Ion pumps: Calcium ATPase; Na^+ K^+ ATPase; Mechanism, Gastric H^+ K^+ ATPase, ABC superfamily – ATPases that transport peptides and drugs (MDR proteins).

Co-transport by Symporters and antiporters, Group translocation.

Osmosis, receptor mediated endocytosis and its significance.

UNIT III: Mitochondria

Mitochondria – Reduction potential, Free energy and entropy**,** electron transport chain – Complexes, Q-cycle, Cyt C oxidase complex, Translocation of protons and the

establishment of a proton motive force, machinery for ATP formation and chemi-osmotic mechanism, ATP synthase – Experiments, inhibitors and uncouplers of oxidative phosphorylation.
Microfilaments – Actin – Structures, Assembly, Myosin. Microtubules – Organization and dynamics, kinesin and dynein. Cilia and flagella – Structure and functions, intermediary filaments.
Mitochondrial transport system: ATP/ADP exchange, malate-glycero phosphate shuttle

UNIT IV: Cell – Matrix interaction
Cell – Cell interaction: Extra cellular matrix; Collagen, hyaluronan and proteoglycans, laminin, integrins, Fibrillin, elastin and fibronectins.
Cell – Cell adhesion: Specialized junctions – Desmosomes, Gap junctions, Tight junctions. Adhesion molecules – Cadherins (E and N), Connexins.

Cell – Cell signaling – Role of Signaling molecules and their receptors; functions of cell surface receptors, pathways of intracellular signal transduction, second messengers, G-protein coupled receptors, receptor tyrosine kinases, Ras, MAP kinases in cellular growth and functions.

UNIT V: Cell cycle and cancer
Cell cycle and its control, Cell cycle control in mammalian cells, checkpoints in cell cycle regulation.
Cancer: Properties of tumour cells and genetic basis and onset of cancer.
Tumour viruses – DNA & RNA Viruses as transforming agents – mechanism.
Tumour suppressor genes and functions of their products. Carcinogenic and anticarcinogenic effect of chemicals and radiation. Apoptosis (Programmed cell death) – pathways, regulators and effectors on apoptosis and necrosis.

SUGGESTED READINGS

1. Paul, A., (2009). Text Book of Cell and Molecular Biology,1st edition. Books and Allied (P) Ltd, Kolkata.

2. Cooper, G.M., and Hausman, R.E., (2013). Cell-A Molecular Approach, 6th Edition. Sinauer Associates. USA.

3. Gerald, K., 2013. Cell and Molecular Biology, 7th edition. John Wiley and Sons, Inc, Hoboken, United States.

4. Nelson, D.L., and Cox, M.M., (2012). Lehninger's Principles of Biochemistry, 6th edition. W.H.Freeman and company, New York.

5. Lodish, H., Berk, A., Kaiser, C.A., and Krieger, M., (2012). Molecular Cell Biology, 7th edition. W.H. Freeman & Company, London.

6. Garrette & Grisham, (2004). Principles of biochemistry, 4th edition. Saunders college publisher, Philadelphia,United States.

7. Alberts, B., Johnson, A., Lewis, J., and Raff, M., (2007). Molecular Biology of the Cell, 5th edition. Garland Publishing Co.New York.

Semester I

18BCP105A **CORE ELECTIVE -I** **4H-4C**

PLANT BIOCHEMISTRY

Instruction hours/week: L: 4 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students

- To recollect the knowledge in plant cell organelles and their functions
- To understand the functions and regulations of major biosynthetic pathways of plants,
- To learn and understand the role of plant growth substances in various stages of plant growth
- Obtaining knowledge on tissue culture techniques
- To learn metabolic engineering to increase the production of plant secondary metabolites
- To become familiar with the transformation process and its applications

Course outcomes (CO's)

Upon successful completion of this course, participants will be able to:

1. Recall the understanding of plant cell organelles and their functions
2. Recognize the source of food for other organisms and their synthesis in plants
3. Recall the role of plant growth substances in various stages of plant growth
4. Equip with tissue culture techniques
5. Understand the role of secondary metabolites and their production and importance
6. Equip with gene transfer techniques

UNIT I: Plant cell

Structure of plant cell – cell wall, vacuoles, plastids, mitochondria, peroxisomes and Golgi complex. Overview of photosynthesis: photosynthetic apparatus, reaction center, photosystems I and II, mechanism of photosynthesis-cyclic and non cyclic photophosphorylation; evidences in support of light and dark reactions.

Solute transport and photo assimilate translocation – Uptake, transport and translocation of water, ions, solutes and macromolecules from soil.

UNIT II: Assimilatory mechanisms in plants

Photorespiration and water consumption, CO_2 assimilation by C3 and C4 plants, CAM plants. Nitrogen assimilation; reduction of nitrate, nitrogen fixation in symbiotic and non-symbiotic plants, nitrogen cycle. Sulphate metabolism in leaf; sulfite reduction and sulphur cycle, glutathione synthesis. Carbon and phosphorus cycles.

UNIT III: Lipid metabolism in plants

Biosynthesis of fatty acids in plastids, synthesis of waxes, triacyl glycerols and glycolipids. Synthesis of chlorophyll. Carotenoid formation. Synthesis of nitrogenous compounds: caffiene synthesis, ureide synthesis in nodulated legumes. Secondary oxidative mechanisms: β- oxidation, ω- oxidation, glyoxylate pathway.

UNIT IV: Plant growth substances

Chemistry, biosynthesis, mode of action and physiological role of auxins, gibberellins, cytokinins, abscisic acid and ethylene. Factors influencing endogenous growth- Biotic and Abiotic factors. Phytochromes: molecule, biological display, functions as light sensor. Crytochromes and phototropins, stomatal movement, photoperiodism and biological clock. Senescence: biochemical changes, regulation.

UNIT V: Plant secondary metabolites

Synthesis of secondary metabolites- shikimate pathway. Alkaloids, flavonoids, terpenoids, phenols and glycosteroids-Occurrence, distribution & functions, Production of secondary metabolites in plants, stages of secondary metabolite production.

Plant Tissue Culture- Totipotency, meristematic and nodal cultures-Callus induction. Somatic embryogenesis. Metabolic engineering for increased production of secondary metabolites.

Plant Transformation Technology – Ti and Ri plasmid and their transfer mechanisms. Methods of transformation, chloroplast transformation. Agrobacterium mediated transformation.

SUGGESTED READINGS

1. Verma,S.K., and Verma, M., (2010). A Text Book of Plant Physiology, Biochemistry and Biotechnology. 7th edition.S.Chand and Co, New Delhi.

2. Anderson, J.W., and Beardall, J., Molecular Activities of Plant cells-An introduction to Plant Biochemistry. Blackwell Scientific Publications.

3. Goodwin,T.W., and Mercer, E.I., Introduction to Plant Biochemistry, 1st edition, Robert Maxwell.M.C Publisher, New York.

4. Bonner, J., and Varner, J.F., Plant Biochemistry. 3rd edition. Academic Press, New York.

5. Buchannan, B., (2002). Biochemistry and Molecular Biology of Plants, IK. International, New York.

6. Heldt, H.V., (2005). Plant Biochemistry and Molecular Biology, Oxford University Press, England.

7. Wink, M., (2010). Functions and Biotechnology of Plant Secondary Metabolites, Second edition, Blackwell Publishing Ltd, London.

8. Heldt, H.W., Piechulla, B., Heldt, F., (2011). Plant Biochemistry, Fourth Edition, Academic Press Publication, London, UK.

18BCP105B **CORE ELECTIVE –I** **4H-4C**

ECOLOGY AND EVOLUTIONARY BIOLOGY

Instruction hours/week: L: 4 T: 0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objective
Equip the students

- To gain an appreciation for the diversity of life
- To understand how organisms, interact with each other and their environment
- To gain a basic understanding of how populations function,
- To learn how communities are structured
- To understand behavioral ecology
- To be aware of the central role that evolution plays in biology

Course outcomes (CO's)
After completion of this course the student will

1. Appreciate the diversity of life
2. Interact with each other and their environment
3. Have practical understanding of species interaction
4. Built a structured community
5. Expertise in behavioral ecology
6. Recognize the central role of ecology and evolution in biology

UNIT I: Ecology
Population ecology; metapopulation dynamics; growth rates; density independent growth; density dependent growth; niche concept; Species interactions: Plant-animal interactions; mutualism, commensalism, competition and predation; trophic interactions; functional ecology; ecophysiology; behavioral ecology.

UNIT II: Community Ecology
Community assembly, organization and evolution; biodiversity: species richness, evenness and diversity indices; endemism; species-area relationships; Ecosystem structure, function and services; nutrient cycles; biomes; habitat ecology; primary and secondary productivity; invasive species; global and climate change; applied ecology.

UNIT III: Basics of Evolution
Origin, evolution and diversification of life; natural selection; levels of selection. Types of selection (stabilizing, directional etc.); sexual selection; genetic drift; gene flow; adaptation;

convergence; species concepts; Life history strategies; adaptive radiation; biogeography and evolutionary ecology.

UNIT IV: Origin of genetic variation

Mendelian genetics; polygenic traits, linkage and recombination; epistasis, gene-environment interaction; heritability; population genetics; Molecular evolution; molecular clocks; systems of classification: cladistics and phenetics; molecular systematics; gene expression and evolution.

UNIT V: Behavioral Ecology

Classical ethology; neuroethology; evolutionary ethology; chemical, acoustic and visual signaling; Mating systems; sexual dimorphism; mate choice; parenting behavior Competition; aggression; foraging behavior; predator–prey interactions; Sociobiology: kin selection, altruism, costs and benefits of group-living.

SUGGESTED READINGS

1. Bergstrom, Carl, T. and Lee Alan Dugatkin., (2016). Evolution. W.W. Norton & Company. ISBN 978-0-393-93793-0.

2. Charles J. Krebs, (2009) Ecology, Benjamin Cummings, 6thEdition, USA.

3. Hall, B.J, (2011) Evolution, Jones and Bartlett Publishers, 1st Edition, USA.

4. McMillan, Victoria E. (2012). Writing Papers in the Biological Sciences, 5th Edition. Bedford/St. Martin's Press, Boston. ISBN- 0-312-64971-1.

Semester I

17BCP105C **CORE ELECTIVE -I** **4H-4C**

BIOPHARMACEUTICS

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the student

- To explain the relationship among physicochemical and biological factors, dosage forms,
- To understand the routes of administration and therapeutic outcomes;
- To illustrate the principles of pharmaceutics and biopharmaceutics in dosage form design and development;
- To describe production procedures
- To learn quality control measurements and stability improvements for tablets and sterile products and different routes of drug administration in principles and applications
- To identify the needs and differences in drug use for various patient groups, and devise appropriate strategies from perspectives of dosage forms.

Course outcomes (CO's)

After completion of this course the student will

1. Explain biopharmaceutical, physiological, biochemical and cell biology-related aspects
2. Understand the transport and metabolism of drugs in the gastrointestinal tract and in the liver.
3. Explain mechanisms behind the transport of drug and metabolism and how drugs can interact with other drugs and food and methods to study these
4. Have developed its ability to plan, compile, analyse and report experiment that has importance for biopharmaceutical issues -
5. Recognize the regulatory requirements within the biopharmaceutical area
6. Describe the role of biopharmaceutics in drug development within the pharmaceutical industry

UNIT I: Phytochemistry

Authentication of medicinal plants, Biosynthesis of primary and secondary metabolites - alkaloids, terpenoids. Phenolic compounds and coumarins. Classification and sources of alkaloids. Major classes in phenolic compounds – carotenoids, flavonoids, tannins and phenolic acids. Classification of terpenoids.

UNIT II: Techniques in plants

General extraction and isolation techniques for compounds from plants. Techniques involved in extraction of phytochemicals – Perculation, Soxhlet extraction, Supercritical Fluid extraction, Pilot scale extraction, reflux and other methods. Factors affecting extraction.

UNIT III: Isolation and purification techniques

Isolation and purification techniques – Thin layer and Column chromatography. Chemical fingerprinting – HPLC, HPTLC, FTIR, NMR and GC-MS.

UNIT IV: Biotechnology of medicinal plants

Production of secondary metabolites from plant culture. Indian Standard Specifications (ISI) laid down for sampling and testing of various drugs in finished form by the Bureau of Indian Standards. Toxicity testing in drugs and Safety.

UNIT V: Bioactive studies

Anticancer, antidiabetic, anti-inflammatory, hepatoprotectives, antimicrobials from medicinal plants. Antioxidants of plant origin – Reactive Oxygen Species (ROS), antioxidant polyphenols.

SUGGESTED READINGS

1. Harborne, J.B., (1998). Phytochemical methods to modern techniques of plant analysis. Chapman & Hall, London.

2. Trease, G.E., Evans, M.C., (1979). Textbook of Pharmacognosy, 12th edition. Balliere-Tindal, London.

3. Khan, I.A., and Khanum, A., (Eds.). (2004). Role of Biotechnology in medicinal and Aromatic plants, Vols. I-X. Ukaaz Publications, Hyderabad.

Semester I

18BCP111 PRACTICAL- I 4H-2C

QUANTITATIVE ESTIMATION AND SEPARATION TECHNIQUES

Instruction hours / week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

- To provide hands on experience on preparation of buffers and determination of pH of solutions
- To estimate the macromolecules quantitatively thro colorimetric procedures
- To perform fluorometric experiments and titrimetry
- To separate the macromolecules using TLC and column chromatography.
- To perform the secondary metabolite quantification using HPLC.
- Gain hands on training in protein extraction and purification techniques.

Course outcomes (CO's)

After completion of this course the student will

1. Prepare buffers and reagents based on the needs of experiments
2. Estimate macromolecules quantitatively thro colorimetric procedures
3. Estimate vitamins and calcium using fluorimetry and titrimetry
4. Quantify secondary metabolites using HPLC
5. Separate the macro molecules using TLC and column chromatography
6. Extract and purify protein from various sources

Colorimetry

1. Isolation and estimation of starch from potato (Anthrone method)
2. Isolation and estimation of glycogen from liver (Anthrone method)
3. Estimation of Total carotenoids (Spectroscopic method)
4. Estimation of fructose in fruits (Resorcinol method)
5. Estimation of ascorbic acid (DNPH method)
6. Estimation of Vitamin E (Dipyrridyl method)
7. Estimation of methionine (Sodium nitroprusside method)
8. Determination of saponification and iodine number of fat or oil

Fluorimetry

9. Estimation of thiamine from cereals or fruits
10. Estimation of riboflavin

Titrimetry

11. Estimation of lactose in milk
12. Estimation of calcium in milk

Separation techniques

13. Separation of amino acids by paper chromatography- circular, ascending &

Descending.
14. Separation of plant pigments by TLC.
15. Separation of plant pigments by column chromatography.
16. Estimation of quercetin using HPLC (Demo).

Cell biology:
15. Preparation of standard buffer and determination of pH of buffers.
16. Subcellular fractionation by differential centrifugation and purity assessment with marker enzymes (Group Experiment).
17. Salting out of proteins using ammonium sulphate precipitation

SUGGESTED READINGS

1. Jayaraman, J., (2007). Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi.

2. Sadasivam, S.,and Manickam, A., (2009). Biochemical Methods, New Age, International Publishers, New Delhi.

3. Singh, S.P., (2009). Practical Manual of Biochemistry, CBS Publishers, New Delhi.

Semester I

18BCP112 PRACTICAL – II 4H-2C

PLANT BIOCHEMISTRY AND MICROBIOLOGY

Instruction hours/week: L:0 T:0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students

- To screen phytochemicals and estimate the amount of secondary metabolites
- To handle microbiological techniques
- To identify microbes in soil and water samples
- To isolate, characterize and purify microbial enzymes
- To perform antibacterial activity of active compounds
- To gain hands on experience in plant tissue culture

Course outcomes (CO's)

After completion of this course the student will perform

1. Phytochemical screening and secondary metabolite estimation
2. Microbiological techniques
3. Microbial identification in soil and water samples
4. Isolation, characterization and purification of microbial enzymes.
5. Antibacterial activity of active compounds
6. Callus induction and regeneration of plantlets

Plant Biochemistry

1. Phytochemical screening of any one selected medicinal plant
2. Estimation of Tannins
3. Estimation of Flavonoids
4. Estimation of Chlorophyll
5. Estimation of Phenols

MICROBIOLOGY

6. Isolation of pure culture – serial dilution, pour plate, spread plate, streak plate methods.
7. Colony morphology – colony counting.
8. Staining techniques- simple, differential, spore, and fungal staining.
9. Antibiotic resistance / sensitivity test (Disc method)
10. Estimation of bacteria- growth curve of bacteria and generation time.
11. Identification of microorganisms – biochemical tests (IMVIC test)(Group Experiment)
12. Microbiology of potable water
13. Isolation, characterization and purification of ANY one of the following microbial enzymes
    a) Amylase

b) Protease

14. Assay of Antibacterial of ANY ONE selected medicinal plant by Disc or Well diffusion and broth dilution method.
15. Assay of antifungal activity of ANY ONE selected medicinal plant by Disc or Well diffusion. TLC- Bioautography.

PLANT TISSUE CULTURE (Group experiment)

16. Preparation of tissue culture media
17. Surface sterilization
18. Induction of meristem culture
19. Callus induction.
20. Regeneration of shoot and root from callus culture.

SUGGESTED READINGS

1. Wagner, H., and Bladt, S., (1996). Plant drug analysis. Springer Science & Business media 2nd edition
2. Jayaraman, J., (2011). Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi.
3. Kannan, N., (2003). Laboratory Manual in Microbiology, Panima Publishing Corporation, Bangalore.
4. Sadasivam, S.,and Manickam, A., (2009). Biochemical Methods, New Age, International Publishers, New Delhi.
5. Singh, S.P., (2009). Practical Manual of Biochemistry, CBS Publishers, New Delhi.
6. Talib, V.H., (2007). A Handbook of Medical Laboratory Technology, CBS publishers,2nd edition. New Delhi.
7. Varley, H., (2003). Practical Clinical Biochemistry, CBS Publishers, New Delhi.

Semester II

18BCP201 REGULATION OF METABOLIC PATHWAYS 4H-4C

Instruction hours/week: L: 4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students

- To shed knowledge on generation and transformation of energy in metabolic pathways.
- To know the metabolic pathway of carbohydrate and their regulation with associated disorders.
- To learn fatty acid synthesis and degradation and their regulation
- To study the regulation of amino acid metabolism and its regulations with Metabolic disorders.
- To understand the inter relationship of carbohydrate, lipid, protein and nucleic acid metabolism and understand the importance of TCA cycle.
- To aware about the homeostasis of glucose metabolites by intrinsic and extrinsic control mechanism.

Course outcomes (CO's)

After completion of this course the student will perform

1. Gain knowledge on glucose anabolic and catabolic pathways that ultimately control the glucose homeostasis.
2. know the metabolic pathway of amino acid and their regulation with associated disorders.
3. learn fatty acid synthesis and degradation and their regulation
4. Able to explain the role of lipids, their metabolism and their stringent control by hormones and other factors.
5. Understand the anabolic and catabolic processes associated with amino acids and nucleic acids and their regulation.
6. Able to understand the energy homeostasis during starvation and energy excess

UNIT I: Introduction to control of enzyme activity

Allosteric interaction; Reversible covalent modification; proteolytic action; control of amount of enzyme; control of rates of enzyme degradation; feedback inhibition; feed forward stimulation. Role of compartmentation. Elucidation of Metabolic pathways- Single- and Multi-step pathways. Experimental approaches to study the metabolism- using metabolic inhibitors and isotopes.

UNIT II: Carbohydrate Metabolism

An overview of Glycolysis and Gluconeogenesis. Role of LDH. Regulation of Glycolysis and Gluconeogenesis-Reciprocal control of Glycolysis and Gluconeogenesis, TCA cycle-steps, regulation at branch points; Glycogen Metabolism: Overview of glycogenesis and

glycogenolysis. Reciprocal control of glycogenesis and glycogenolysis. Alternative pathways of metabolism-HMP shunt, Entner- doudoroff pathway, glucoronate and Glyoxalate pathway, cori cycle. Hormonal regulation of fuel metabolism; Metabolic disorders-Diabetes mellitus and insipidus.

UNIT III: Lipid metabolism

An overview of fatty acid synthesis and degradation, Regulation of fatty acid synthesis-control of acetyl CoA carboxylase and fatty acid synthetase complex; Reciprocal control of fatty acid synthesis and degradation. Biosynthesis of triacyl glycerol, phosphatidyl choline, phosphatidyl ethanolamine and sphingomyelin and their regulation. Synthesis and degradation of cholesterol and its regulation. Metabolism of prostaglandins-COX and LOX pathways. Metabolic fate of VLDL, LDL and HDL. Obesity and regulation of body mass. Metabolic disorders- Atherosclerosis, Hyper and hypo lipoproteinemia.

UNIT IV: Amino acid metabolism

Regulation of synthesis of pyruvate, serine, glutamate, aspartate, aromatic and histidine family of amino acids (Flow chart only) . Key role of glutamate dehydrogenase and glutamine synthetase in nitrogen metabolism and their allosteric regulations. Amino acid degradation- Oxidative deamination, Non oxidative deamination,decarboxylation and transamination. Ammonia formation and disposal- urea cycle and its regulation. Catabolism of carbon skeleton of amino acids. Biosynthesis of heme (porphyrin) and its regulations. Molecules derived from amino acids. Metabolic disorders- Alkaptonuria, phenyl ketonuria.

UNIT V: Nucleic acid metabolism

De novo synthesis of purine and its regulation – Role of PRPP amino transferase. De novo synthesis of pyrimidine and its regulation – Role of aspartate carbomyl transferase. Regulation of deoxy ribonucleotides by activators and inhibitors. Integration of metabolism. Metabolism during starvation. Tissue specific metabolism- Metabolic profile of major organs- Brain, Muscle, Liver and Adipose tissue. Metabolic disorders- Gout, SCID.

SUGGESTED READINGS

1. Lehninger, L., Nelson, D.L., and Cox, M.M., (2012). Principles of Biochemistry, 6th edition WH Freeman and Company, New York.

2. Murray, R.K., Bender, D.A., Botham, K.M., and Kennelly, P.J., (2012). Harper's illustrated Biochemistry, 29th Edition. McGraw-Hill Medical. London.

3. Donald Voet and Judith Voet ,2004. Biochemistry, John Wiley and Sons, 2ndEedition. New York

4. Leubert Stryer, 2009. Biochemistry, W.H. Freeman and Company. New York.

5. Pamila C. Champ and Richard A. Harvey ,2008. Biochemistry, Lipponcott Company, Philadelphia.

6. Smith. 2003. Principles of Biochemistry, McGraw– Hill International Book Company, London.

7. Zubay, G., (2009). Biochemistry, W.C Brown Publishers, Saunders and Company, Philadelphia.

Semester II

18BCP202 MOLECULAR BIOLOGY 4H-4C

Instruction hours/week: L: 4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students

- To acquire the knowledge on Organization of DNA in a genome and transposons
- To know the mechanism behind replication and repair.
- To enable the knowledge on transcription and translation.
- To understand the mechanism of Regulation of gene expression in prokaryotes
- To study the structure and remodeling of chromatin
- To learn the mechanism of Eukaryotic gene regulation

Course outcomes (CO's)

After completion of this course the student will

1. Acquire the knowledge on molecular structure of genes.
2. Understand the structure of nucleic acids and the DNA replication process
3. Learn about the process of transcription
4. Understand the mechanism of translation
5. Learn about gene regulation in prokaryotes
6. Learn about gene regulation in eukaryotes

UNIT I: Molecular structure of genes

Molecular definition of gene, chromosomal organization of genes and non-coding DNA, protein coding genes, tandomly repeated genes, single sequence DNA. Structural organization of eukaryotic chromosomes- histone proteins, chromatin, functional elements. Mobile DNA elements- bacterial IS elements, transposons, viral transposons and non- viral transposons. Mutation- types.

UNIT II: DNA replication and repair

General features of chromosomal replication. Enzymology of DNA replication, DNA replication machinery. Replication in prokaryotes and eukaryotes- Initiation, elongation and termination. DNA damage-types. Repair mechanism of DNA damage-all types.

UNIT III: Transcription

Prokaryotic gene transcription- Initiation, elongation and termination. Eukaryotic gene transcription- transcription unit, RNA polymerases- types, Transcription and processing of mRNA, tRNA and rRNA. Regulatory sequences in protein coding genes-TATA box, initiators, CpG island, promoter-proximal element, activators and repressors of transcription, Multiple transcription control elements. Regulation of transcription factor activity by lipid-soluble hormones.

UNIT IV: Translation

Deciphering genetic code, features. Wobble hypothesis. Initiation, elongation and

termination of prokaryotic and eukaryotic translation. Fidelity of translation. Post translational modifications-all types; Protein targeting-Targeting protein to nucleus, ER, Golgi complex. Protein degradation- ubiquitin mediated degradation.

UNIT V: Prokaryotic gene regulation

Operon model, Lac, trp and ara operons. Regulatory proteins-DNA binding domain, protein-protein interaction domain. Recombination- holiday model, Rec BCD enzymes, Rec A protein, Messelson Radding model, site- specific recombination. Antisense RNA technology.

Eukaryotic gene regulation: Transcriptionally active chromatin, chromatin remodeling, DNA binding transactivators and coactivators. Regulation of gene expression by intracellular and intercellular signal, RNAi.

SUGGESTED READINGS

1. Watson, J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A., and Weiner, A. M., (2005) Molecular biology of the gene, The Benjamin/Cummings publishing companies, Inc, California.

2. Lewin, B., (2008) Genes IX, Oxford University Press, 9th Edition, Oxford, London,

3. Weaver, R. F., (2008) Molecular biology, WCB McGraw-Hill companies, 6th Edition.Inc, New York.

4. Lodish, H., Berk, A., Kaiser, C.A., and Krieger, M.,. (2012). Molecular Cell Biology, 7th edition. W.H. Freeman & Company,

5. Lehninger, L., Nelson, D.L., and Cox, M.M., (2012). Principles of Biochemistry, WH Freeman and Company, 6th Edition, New York.

6. Kornberg, A., Baker, A., (2005). DNA replication, W.H. Freeman and Co, USA.

7. Cooper, G.M., and Hausman, R.E., (2013). Cell-A Molecular Approach, 6th Edition.. Sinauer Associates. USA

Semester II

18BCP203 **DEVELOPMENTAL GENETICS** **4H-4C**

Instruction hours/week: L: 4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objective

Equip the students

- To interpret the Mendelian Principle and experiments
- To infer the environmental effects and human intelligence
- To acquire the knowledge on diagnosis of infectious disease and molecular probes used in diagnosis, gametogenesis and fertilization
- To gain knowledge on chemical changes in cell division and cleavage
- To understand and discuss ramifications of inherence, gene structure and function, gene mutation, and research related to genetics and its applications.
- To comprehend cellular mechanisms of developmental stages.

Course outcomes (CO's)

After completion of this course the student will perform

1. Comprehensive, detailed understanding of the chemical basis of heredity
2. Comprehensive and detailed understanding of genetic methodology
3. Quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms.
4. Comprehensive detailed understanding of cellular mechanisms of developmental stages.
5. ramifications of inherence, gene structure and function, gene mutation, and research related to genetics and its applications.
6. knowledge on chemical changes in cell division and cleavage

UNIT-I: Mendelian Principle and experiments

Mendelian inheritance-principles; Mendel"s experiments-monohybrid, dihybrid trihybrid and multihybrid crosses. Interaction of genes: incomplete dominance, codominance, epistasis, complementary genes, duplicate genes, polymeric genes, modifying genes; lethal genes. Environmental influence of gene expression: penetrance and expressivity; temperature, light, phenocopies. Environmental effects and twin studies; human intelligence. Quantitative or polygenic inheritance: Inheritance of kernel color in wheat; corolla length in tobacco skin color inheritance in man, transgressive and regressive variation. Multiple alleles; Sex determination; Extra chromosomal inheritance. Genetic abnormalities

UNIT-II: Prenatal Screening

Amniocentesis; Prenatal diagnosis of genetic diseases, XX and XY karyotyping, DNA/RNA probes. DNA probes in the diagnosis of infectious diseases; Mycobacterial, plasmodial, HIV and HPV infections during development. Molecular probes in diagnosis of genetic diseases: Down syndrome, Cystic fibrosis, Sickle cell anemia, Alkaptonuria, Phenylketonuria, Kleinfelter syndrome and Cancer (breast cancer,Leukaemia, Burkets lymphoma).

UNIT-III: Developmental Stage I

Gametogenesis – Origin of germ cells – Significance of different stages of gametogenesis Oogenesis – Types of eggs–growth, development and maturation of oocyte, Egg envelopes, Polarity and symmetry, Spermatogenesis–Sperm Structure, Types of sperm, Fertilization – Approach of spermatozoon–Reaction of egg, essence of activation – Changes in egg cytoplasm during fertilization.

UNIT-IV: Developmental Stage II

Cell division in cleavage – Chemical changes–Patterns of embryonic cleavage – Morula and Blastula – Role of egg cortex – Morphogenetic gradients – Fate map – Gastrulation – Primary organ, Rudimental organs, Organizer – Morphogenetic movements- invagination, extension, ingression movements and locomotion.

UNIT-V: Developmental Stage III

Organogenesis: Induction and differentiation of Brain, eye, ear, limb, Heart, kidney, Development of Immune system, Genetic basis of differentiation – selective action of genes–gene action in development – Nuclear transplantation–apoptosis during development– aging–Teratogens and Teratogenesis.

SUGGESTED READINGS

1. Berrill, N.J., (1980). Developmental Biology, McGraw-Hill Inc.,US.
2. Diwan, A.P., Dhakad. N.K., (1996). Animal Regeneration, Anmol Publication Pvt. Ltd, New Delhi.
3. Browder. L.W., Erickson C.A., and Jeffery. W.R., (1991). Developmental Biology, Saunder College Publishing House, Philadelphia.
4. Strickberger, M.W., (2015). Genetics, 3rd edition, Pearson Education India.
5. Benjamin Lewin, (2004). Genes VIII, Oxford University Press.
6. Singh, B. D., (2009). Genetics, Kalyani Publishers, New Delhi.
7. Gupta, P.K., (2009). Genetics, Rastogi Publications, Meerut, India.

Semester II

18BCP204 BIOINFORMATICS 4H-4C

Instruction hours / week: L: 4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives
Equip the students

- To make students understand the essential features of the interdisciplinary field of science for better understanding the biological data.
- To retrieve the sequence analysis of Nucleic acid and protein
- To create opportunity to interact with algorithms, tools and data in current scenario.
- To make the students look at a biological problem from a computational point of view.
- To find out the methods for analyzing the expression, structure and function of proteins,
- To understand the relationships between species.

Course outcomes (CO's)
After completion of this course the student will perform

1. Acquire the knowledge on biological data, submission and retrieval from databases.
2. Able to make experiment pair wise and multiple sequence alignment
3. Analyze the secondary and tertiary structures of protein sequences.
4. Understand the data structure (databases) used in bioinformatics and interpret the information (especially: find genes; determine their functions),
5. Understand and be aware of current research and problems relating to this area.

UNIT I: Concepts of Bioinformatics

Definition, concepts of Bioinformatics: Objectives, History of Bioinformatics, Milestones, Genome sequencing projects, Human Genome Project- Science, applications and ELSI.
Introduction to Biological databases: Types of databases, sequence databases-nucleic acid sequence databases, GenBank, protein sequence database, Swiss-Prot, PIR, motif database-PROSITE, structural databases, bibliographic databases and organism specific databases-GMOD- Searching and retrieval of data-Entrez and SRS.

UNIT II: Sequence Alignment

Introduction to sequence Alignment: Pairwise and multiple sequence alignment, substitution matrices, Dynamic programming algorithms-Needleman and Wunsch and Smith-Waterman, Similarity searching programs, BLAST, FASTA, Multiple sequence alignment – CLUSTAL, Introduction and application to phylogenetic trees, basic terminologies, Phylogenetic analysis-PHYLIP theory of phylogeny, tree building methods.

UNIT III: Protein prediction strategies and programs

Protein Secondary Structure Prediction, three-dimensional structure prediction-Comparative modeling, threading, Concepts of Molecular modeling, Model refinement, evaluation of the

model, protein folding and visualization of molecules – Visualization tools-RasMol, Deep View.

UNIT IV: Gene Identification and Prediction

Genome sequencing, Genome database-SWISS-2D PAGE database, Gene Mark, Gene Scan, Pattern Recognition, Global gene expression studies-DNA Micro array.

UNIT V: Applications of Bioinformatics

Applications of Bioinformatics-Molecular medicine, biotechnology, agricultural, Computer Aided Drug Designing-structure and ligand-based drug designing, ADME profiles, QSAR. receptors, docking, Introduction to molecular dynamics simulation.

SUGGESTED READINGS

1. Lesk, A.M., (2014). Introduction to Bioinformatics, 4th edition. Oxford University Press, Oxford.

2. Attwood, K., and Parry-Smith, J., (2003). Introduction to Bioinformatics, Pearson Education, Singapore.

3. Baxevanis, A.D., and Quellette, B.F.F., (2001). Practical Guide to the Analysis of Genes and Proteins, John Wiley & Sons, New York.

4. Mount, D.W., 2013. Bioinformatics: Sequence and Genome Analysis. 2nd edition, Cold Spring Harbour Laboratory Press, New York.

5. Ignacimuthu, S., (2013). Basic Bioinformatics, 2nd edition Alpha Science Intl Ltd Chennai.

6. Rastogi, S.C., Mendiratta, N and Rastogi, P., (2004). Bioinformatics – Concepts, Skills, Applications. CBS Publishers & Distributiors, New Delhi.

7. Rastogi S.C and Mendiratta, N., (2006). Bionformatics Methods and applications Genomics, Proteomics and Drug Discovery 2nd Edition, Parag Rastogi Publication, India.

8. Sundararajan, S., and Balaji, R., (2003). Introduction to Bioinformatics, Himalaya Publishing House, Mumbai.

Semester II

18BCP205A CORE ELECTIVE –II 4H-4C

RECOMBINANT DNA TECHNOLOGY

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students

- To make the student to understand the concept of gene manipulation and gene transfer technologies.
- To understand the concept of recombinant DNA technology or genetic engineering
- To interpret the characterization of recombinant protein
- To infer the knowledge on cDNA
- To expose students to application of recombinant DNA technology in biotechnological research.
- To train students in strategizing research methodologies employing genetic engineering techniques.

Course outcomes (CO's)

After completion of this course the student will

1. Understand the application of genetic engineering techniques in basic and applied experimental biology
2. Learn the concept of recombinant DNA technology or genetic engineering
3. Understand the expression of gene cloning vectors
4. Explore the knowledge on genomic library
5. Proficiency in designing and conducting experiments involving genetic manipulation.
6. Describe DNA fingerprinting, and restriction fragment length polymorphism (RFLP) analysis and their applications.

UNIT I: Introduction to gene manipulation

Basic techniques- Isolation and purification of nucleic Acids, Agarose gel Electrophoresis. Hybridization of nucleic acids-probes and types. Hybridization techniques-Southern, Northern, Western blotting. DNA and RNA markers.

UNIT II: Gene cloning vectors

Plasmids, bacteriophages, phagemids, cosmids, Artificial chromosomes- BAC, YAC, HAC. Restriction mapping of DNA fragments, Map construction, Cloning in *E. coli*- Vector engineering and codon optimization. Gene expression in *E.coli.* Expression vector- PET vector. Genomic library.

UNIT III: Isolation and characterization of gene transcripts

Introduction, Converting mRNA transcripts into cDNA, Screening representative cDNA libraries, Functional sequencing of cDNA expression libraries. Expressed cDNAs compared

with computer databases. Characterization of recombinant proteins- Processing, purification and refolding and stabilization-Insulin, hGH, tpA.

UNIT IV: Mutagenesis

Site-directed mutagenesis, *In vitro* mutagenesis-Linkers, synthetic oligonucleotides and transposons, Role of Tagging in gene analysis, Identification and isolation of genes through T-DNA or transposons.

Gene therapy- Different strategies for gene therapy, therapeutics based on targeted exhibition of gene expression and mutation correction *in vivo*, Gene therapy for inherited diseases, ADA, FH, Cystic fibrosis.

UNIT V: Transgenics

Gene transfer techniques- Microinjection, biolistic methods, vector based transfer.

Transgenic plants: Agrobacterium & Ti plasmids. Methods of engineering herbicide resistance plants, Stress resistance plants and modification of plant nutritional content (amino acids, β- carotene) Plants as bioreactors: edible vaccines.
Transgenic animals: Method of Engineering transgenic mice, transgenic cattle- applications Biosafety- regularities and concerns. Societal impact of genetically modified food.

SUGGESTED READINGS

1. Glick, B.R., Pasternak, J.J., and Patten, C.L., (2009). Molecular Biotechnology, 4th edition, Panima Publishing Corporation, Delhi.

2. Watson, J.D., Gilamn, M., Witkowski, J., and Zotler, M., (2006). Recombinant DNA, 3rd Edition. W.H. Freeman Company, New York.

3. Kingsman, S .M., and Kingsman, A.J., (2001). Genetic Engineering: An Introduction to Gene Analysis and Exploitation in Eukaryotes, 6th Edition. Blackwell Scientific Publication, Oxford.

4. Kreuzer, H., and Massay, A., (2008). Molecular Biology and Biotechnology, 3rd Edition Aim Press, Washington,DC.

5. Primrose, S. B., (2003). Molecular Biotech, 2nd edition, Panima Publications, New Delhi.

6. Sambrook, J., Fritch, E.F., and Maniate, T., (2001). Molecular Cloning, A Laboratory Manual, Cold Spring Harbor Laboratory Press, New York.

7. Strachan, T., and Read, A.P., (2003). Human Molecular Genetics, 3rd edition. John Wiley and Sons,Toronto. Canada.

Semester III

17BCP205B CORE ELECTIVE –II 4H-4C

ANIMAL TISSUE CULTURE

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students

- To impart the knowledge on basic tissue culture techniques and limitations in products
- To study about tissue culture laboratory and safety – biohazards
- To extrapolate the different types of culture media
- To understand the various types of cultures
- To learn synchronization of cell cultures and cell division
- To know the importance of stem cell research and its applications.

Course outcomes (CO's)

After completion of this course the student will be able to

1. Demonstrate foundational knowledge of Cell culture techniques and competence in laboratory techniques.
2. Set up a tissue culture lab to carry out research based on cell lines.
3. Extrapolate the different types of culture media
4. Understand the various types of cultures
5. Learn synchronization of cell cultures and cell division
6. Know the importance of stem cell research and its applications.

UNIT I: Introduction to cell culture

Introduction, importance, history of cell culture development, different tissue culture techniques including primary and secondary culture, continuous cell lines, suspension culture, organ culture, advantages and limitations medical/pharmaceutical products of animal cell culture-genetic engineering of animal cells and their applications. Risks in a tissue culture laboratory and safety - biohazards.

UNIT II: Different types of cell culture media

Different types of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application. Facilities for animal cell culture-infrastructure, equipment, culture vessels. Biology and characterization of cultured cells-cell adhesion, proliferation, differentiation, morphology of cells and identification.

UNIT III: Types of cell culture techniques

Primary cell culture techniques - mechanical disaggregation, enzymatic disaggregation, separation of viable and non-viable cells. Mass culture of cells - manipulation of cell line selection - types of cell lines -maintenance of cell lines - immobilization of cells and its

application - synchronization of cell cultures and cell division - production of secondary metabolites - biotransformation - Induction of cell line mutants and mutations - cryopreservation – germplasm conservation and establishment of gene banks.

UNIT IV: Animal cell culture scale up

Animal cell culture scale up: Scale up in suspension - stirrer culture, continuous flow culture, air-lift fermentor culture; Scale up in monolayer - Roller bottle culture, multi surface culture, multi array disks, spirals and tubes - monitoring of cell growth. Organ culture - whole embryo culture - specialized culture techniques - measurement of cell death.

UNIT V: Tissue engineering

Tissue engineering: Design and engineering of tissues - tissue modeling. Embryonic stem cell engineering - ES cell culture to produce differential cells - Human embryonic stem cell research. Transgenic animals-transgenic animals in xenotransplantation

SUGGESTED READINGS

1. Darling, D.C., and Morgan, S.J., (1994). Animal Cells Culture and Media, BIOS Scientific Publishers Limited.

2. Ranga, M.M., (2000). Animal Biotechnology,. Agrobios, India.

3. Satyanarayana, U., (2006). Biotechnology, Books and Allied (P) Ltd. India.

4. Harris, A., (1996). Epithelial Cell Culture, Cambridge University Press, London.

5. Mathur, J.P., and David Barnes, D., (1998). Methods in Cell Biology, Volume 57, Animal Cell Culture Methods Academic Press.

Semester III

18BCP205C **CORE ELECTIVE –II** **4H-4C**

GENOMICS AND PROTEOMICS

Instruction hours/week: L: 4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students

- To provide a comprehensive theoretical knowledge on genomics and proteomics
- To learn the fundamentals, current techniques and applications.
- To update and strengthen basic concepts in proteomics and genomics
- To address the modern biological issues.
- To use the different methodologies, techniques and tools commonly used in genome sequencing, assembly and annotation.
- To understand the Characterization of protein complexes

Course outcomes (CO's)

After completion of this course the student will be able to

1. Identify and describe the different components in prokaryotic and eukaryotic genomes and proteomes.
2. Identify molecular mechanisms responsible for diseases.
3. Use the different methodologies, techniques and tools commonly used in genome sequencing, assembly and annotation.
4. Use the different methodologies, techniques and tools commonly used in proteomics.
5. Address the modern biological issues.
6. Characterize the protein complexes

UNIT I: Genome Analysis

Introduction to Genes, Genome organization –prokaryotes and eukaryotes, Genetic markers- RFLP, Mini and Micro satellite, STS, EST, SSCP, RAPD, RFLP, SNP and SSR. Human Genome and Genomic analysis: Size, features, composition and characteristics of human genome – Sequence repeats, transposable elements, gene structure and pseudogenes.

UNIT II: Sequencing Genomes

Sequencing Genomes- methodology, chain termination method, chemical degradation method, shotgun sequencing and assembly of contiguous DNA sequence. cDNA and genomic library construction. Genomic Mapping: Different types of Genome maps and their uses, Genetic and Physical mapping techniques. Map resources. Practical uses of genome maps, NGS

UNIT III: Gene Expressions and Microarrays

Concepts of microarrays, spotter analysis, Normalization –total intensity, using regression techniques, ratio statistics. Clustering Gene expression profiles-hierarchical, single-linkage, complete linkage, and average linkage. Tools for microarray analysis- MADAM, spot finder, SAGE Applications of Microarrays- Bioinformatics challenges in micro array design and analysis.

UNIT IV: Analytical Proteomics

RP-HPLC, Proteome analysis- 2D gel electrophoresis: general strategy, immobilized pH gradients, sample preparation, isoelectric focusing, second dimension PAGE, staining, transfer of proteins from 2D gels, image acquisition and analysis of 2D gels. 2DE databases. Mass Spectrometry – ESI MS and MALDI techniques and applications.

UNIT V: Experimental Proteomics

Characterization of protein complexes – protein-protein interactions, yeast two-hybrid system and protein micro arrays. Proteomics in drug discovery.

SUGGESTED READINGS

1. Brown, TA., (2002). Genomes. John Wiley & Sons. Singapore.
2. Pennington, S., and Dunn, M.J.,(2001). Proteomics: From Sequence to Function. Bios Scientific Pub.Ltd. Oxford.
3. Primrose, S.B., and Twyman, R.M., (2003). Principles of Genome Analysis. Blackwell Publishing, Oxford.
4. Simpson, R.P., (2004). Proteins and Proteomics. A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York.
5. Cantor, C.R., and Smith, CL., (1999). Genomics: The Science and Technology behind the Human Genome Project, John Wiley & Sons Pvt. Ltd. Singapore.
6. Stekal, D., (2003). Microarray Bioinformatics, Cambridge University Press, Cambridge. Greg Gibson and Spencer V. Muse., A Primer of Genome Science. Sinauer Associates Inc. Publishers, Sunderlands, New York.
7. Liebler, (2001). Introduction to Proteomics, Tools for the New Biology. Humana Press, New Jersey. USA
8. Westermeier, R., and Naven, T., (2002). Proteomics in Practice. Wiley – VCH, Weinheim,Germany.

Semester II

18BCP211 **PRACTICAL – III** **4H-2C**

MOLECULAR BIOLOGY AND ANIMAL BIOTECHNOLOGY

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students

- To understand the Molecular structure, functions of cells, molecules such as DNA, RNA, proteins.
- To understand the principles of animal cell culture and its application.
- To learn the knowledge on quantity of DNA by Diphenylamine method
- To infer the Estimation of RNA by Orcinol method
- To know the Preparation of competent *E coli*- transformation
- To explore the knowledge on Ligation of DNA

Course outcomes (CO's)

After completion of this course the student will perform

1. To demonstrate knowledge and understanding of the molecular machinery of living cells, cell and tissue culture to manipulate.
2. To explore the genomes of animals for ways to improve the livestock for food production and biomedical purpose as well as and to analyse, interpret, and participate in reporting to their peers on the results of their laboratory experiments.
3. Identification of DNA by Agarose gel electrophoresis
4. Estimation of RNA by Orcinol method
5. Preparation of competent *E coli*- transformation
6. Ligation of DNA

MOLECULAR BIOLOGY

1. Isolation of DNA and RNA from liver
2. Estimation of DNA and RNA - UV method
3. Estimation of DNA by Diphenylamine method
4. Estimation of RNA by Orcinol method
5. Estimation of Protein by Lowry's method
6. Culturing and Isolation of Plasmid DNA
7. Agarose gel electrophoresis of DNA
8. Restriction digestion analysis of DNA (Demonstration)
9. Preparation of competent *E coli*- transformation (demonstration)
10. Determination of Molecular weight of polypeptides by SDS PAGE (group)
11. Polymerase Chain Reaction for amplification of DNA (demonstration)
12. Ligation of DNA
13. Southern Blot Analysis (Demonstration)
14. Western Blotting (Demonstration)

ANIMAL TISSUE CULTURE (Demonstration)

15. Preparation and Sterilization of media

16. Cell lines and maintenance -Trypsinisation, Passaging, Staging
17. Cell counting and cell staining
18. Cell viability determination – Tryphan blue exclusion.

SUGGESTED READINGS

1. Freshney, R. I., (2010). Culture of Animal Cells - A Manual of Basic Techniques, 6th edition, John Wiley and Sons,Inc, Publication,NewYork.

2. Jayaraman, J., (2007). Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi.

3. Kannan, N., (2003). Laboratory Manual in Microbiology, Panima Publishing Corporation, Bangalore.

4. Sadasivam, S., and Manickam, A., (2009). Biochemical Methods, New Age International Publishers, New Delhi.

5. Singh, S.P., (2009). Practical Manual of Biochemistry, CBS Publishers, New Delhi.

6. Talib, V.H., (2003). A Handbook of Medical Laboratory Technology, CBS Publishers, New Delhi.

Semester II

18BCP212 **PRACTICAL – IV** **4H-2C**

BIOLOGICAL DATABASES AND ANALYSIS

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

To make the students

- To provide hands on experience on various biological databases
- To learn the retrieval of data from the biological databases
- To make them learn about pair wise and multiple sequence analysis.
- To learn and apply the statistical approaches
- To study the models for phylogenetic analysis and tree reconstruction.
- To teach them protein prediction methods and its validation.

Course outcomes (CO's)

The students shall be able to

1. The course will enable students to use various biological databases
2. The importance functions in the biological system.
3. The use computational approaches for pair wise, multiple and phylogenetic analysis.
4. Aware to predict the physio-chemical properties, protein structure and validation using computer-based labs.
5. Solve the biological problems using various computational tools and techniques.
6. Visualization of Protein structure by RASMOL.

1. Biological Databanks Sequence databases, Structure Databases, Specialized databases
2. Data base file formats.
3. Data retrieval tools and methods (PUBMED, ENTREZ, SRS)
4. Sequence Similarity searching (NCBI- BLAST, FASTA)
5. Protein sequence analysis (ExPASY proteomics tools)
6. Multiple sequence alignment (Clustal-W)
7. Gene structure and function prediction (Using ORF Finder, Genscan, GeneMark)
8. Molecular Phylogeny (PHYLIP)
9. Sequence Analysis using EMBOSS
10. Protein structure visualization – RASMOL (Menu function and Command line entries), Deep View.

SUGGESTED READINGS

1. Lesk, A.M., (2014). Introduction to Bioinformatics, Oxford University Press, Oxford.
2. Attwood, K., and Parry-Smith, J., (2003). Introduction to Bioinformatics, Pearson Education, Singapore.
3. Baxevanis., A.D., and Quellette, B.F.F., (2001). Practical Guide to the Analysis of Genes and Proteins, 3rd edition, John Wiley & Sons, New York.
4. Mount, D.W., (2013). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbour Laboratory Press, New York.

Semester III

18BCP301 **IMMUNOLOGY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives
Equip the students with

1. Specialized immune cells and their function
2. Mechanisms of humoral immunity
3. Mechanisms of cell mediated immunity
4. Hyperactivation of immune cell and associated pathogenesis
5. Basis behind immunodeficiency diseases
6. Utility of immune based principles in diagnostic field

Course outcomes (CO's)
After successful completion, the students will understand:

1. The structure and functions of specialized immune cells
2. Basis of humoral immunity
3. Basis of cell mediated immunity
4. Hypersensitivity reactions (I-V)
5. Hereditary and acquired immunodeficiency diseases
6. Utility of immune based principles in diagnostic field

UNIT I: Cells and Organs of the Immune System
Primary and secondary lymphoid organs, Overview of immune stem cells - Lymphoid cells, mononuclear, granulocytes, mast cells and dendritic cells. Lymphoid classes B, T and NK – B & T Cell maturation, activation and differentiation; Lymphocyte surface markers, CD nomenclature. Innate immune responses: Physical, chemical, biological barrier immunity. Cell-mediated and humoral response, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity cell adhesion molecules, complements (classical and alternate pathways), chemokines, leukocyte extravasation, localized and systemic response.

UNIT II: Antigen
Epitope, B cell and T cell epitope, haptens, viral and bacterial antigens; factors influencing adjuvant technology. Immunoglobulins-domains, B cell receptors, antigenic determinants on immunoglobulins, Immunoglobulin super family. Immunoglobulin genes: multigene family; Immunoglobulin rearrangement- antibody diversity - Burnet's clonal selection theory. Cell-mediated immunity – MHC: organization, MHC molecules and genes, MHC class-I/II and non-MHC antigen presentations.

UNIT III: Hypersensitivity and Autoimmunity
Coombs & Gell classification, IgE mediated (Type I), antibody mediated cytotoxic (Type II), immune- complex mediated (type III) and cell-mediated (Type IV) hypersensitivity, Principles of autoimmunity and autoimmune diseases, MHC and immune responsiveness,

transplantation and rejection, tumor immunology, primary and secondary immunodeficiency disorders.

UNIT IV: Immunity to infection

Definition and types of immunity, Vaccines: active and passive immunization, types of vaccines with examples. Immune responses against bacterial, viral, fungal and parasitic agents. Evasion of infectious agents from immune system, Monoclonal antibodies - Production and applications.

UNIT V: Immunodiagnostics

Antigen-antibody interactions - precipitation reaction, agglutination tests - haemagglutination; complement fixation test, direct and indirect immunofluorescence, immunoprecipitation, RIA, ELISA, CMIA, ECLIA, Immunoblotting, effector cell assay, hemadsorption, hemolytic plaque and ELISPOT assays.

SUGGESTED READINGS

1. Kuby, J., (2006). Immunology, W.H. Freeman and Company, New York. 6th Edition.

2. Abbas, L., and Pober, (2000). Cellular and Molecular Immunology, W.B. Saunders and company, Philadelphia, United States.

3. Janeway, C.A., and Traverse, P., (Jr) (2004). Immunobiology, 6th edition, Blackwell Scientific Publishers, Oxford university, London.

4. Zubay, G., (2009). Immunology, W.B. Saunders and company, Philadelphia, United States.

5. Tizard, I.R., (2009). Immunology- An Introduction,.Saunders College Publishers, Sydney, 8th Edition.

6. Riott, I., and Brotoff, J., (2006). Immunology, Mosby Publishers,Sydney. 7th Edition. Roitt, I., (2006). Essential Immunology. Blackwell Science, Oxford, UK 11th edition.

Semester III

18BCP302 CLINICAL BIOCHEMISTRY 4H-4C

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- Biological fluid collection and analysis
- Blood cell counting
- Assessment of inflammatory markers
- Estimation of clinically relevant enzymes
- Diagnosis of cancer
- Assessment of endocrine pathophysiology

Course outcomes (CO's)

After successful completion, the students will:

1. Collect and analyze biological fluid
2. Count the total RBC and different WBC using hemocytometer
3. Learn the assessment of CRP, RA and ESR
4. Perform estimation of clinically relevant enzymes
5. Understand the cancer marker assessment
6. Understand the endocrine pathophysiology

UNIT I: Clinical Samples

Blood collection, processing and transfusion process. Normal blood profile. Cerebrospinal fluid: Composition, clinical investigation of CSF in meningitis. Amniotic fluid: Origin, composition and analysis of amniotic fluid. Collection of urine Urine preservatives. Test for urine compounds. Clinical significance of urinary components.

UNIT II: Serology and Hematology

C- reactive protein test, immunological test for pregnancy. Rheumatoid arthritis (RA) test, ESR. Coagulation test, prothrombin test. Haemoglobin Normal and abnormal Hb, separation of haemoglobin, Thalassemia, Hemoglobinopathies. Disorder of erythrocyte metabolic pathways, erythrocyte enzyme disorders. Porphyrins and disorder: porphyrias.

UNIT III: Clinical Pathology

Myocardial infarctions, hepatobiliary disease. - Enzyme tests in determination of myocardial infarction. Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine aminotransferase, creatine kinase, aldolase and lactate dehydrogenase. Enzymes of pancreatic origin and biliary tract. Clinical significance of electrolytes. AIDS- Clinical diagnosis. Diagnosis of genetic diseases by molecular biology techniques (cystic fibrosis, Hemachromatosis, thalassemias, sickle cell diseases).

UNIT IV: Oncology

Oncogenes and cell cycle, Etiology-Free radical induced cancer. Free radical scavengers. Antioxidants in disease prevention. Benign and malignant types- Different stages of cancer progression- Cancer Markers. Therapy-Chemotherapy, radiotherapy, hormonal therapy and phytotherapy. Diagnosis of various cancers.

UNIT V: Pathophysiology

Pathophysiology of hypothalamus and pituitary (dwarfism, Klienfelter syndrome, adenoma, galactorrhea, amenorrhea). Pathophysiology of thyroid cretinism, myxodema, hashimoto's (autoimmune thyroid disorder), hypo- and hyperparathyroidism, bone (osteopenia and osteoporosis), adrenal (Cushing syndrome and Addison's disease) Pancreas (IDDM and NIDDM) and gonads (cystic ovaries, endometriosis, hypogonadism, cryptorchidis and testicular carcinoma).

SUGGESTED READINGS

1. Murray, R.K., Bender, D.A., Botham, K.M., and Kennelly, P.J., (2012). Harper's illustrated Biochemistry, 29th Edition. McGraw-Hill Medical. London.
2. Chatterjea, M.N., (2011). Text book of medical biochemistry, 8th edition, JB publisher.
3. Burtis, C.A., Ashwood, E.R., and Teitz, W.H., (1999). Textbook of Clinical Biochemistry, W.B. Saunders Company, London.
4. Smith, E., Handler, P., and White, A., (2004). Principles of Biochemistry, Mcgraw Hill International Book Company, London.
5. Varley, H., (2003). Practical Clinical Biochemistry, volume 1 and 2, CBS Publishers, New Delhi.
6. Wards, MJC and Bouchier, I., (1995), Davidson's Principles and Practice of Micine, English Language Book Society.
7. Murray, R.K., Granner, D.K., Mayes, P.A., Rodwell, V.W.,(2012). Harper's illustrated Biochemistry, Appleton and Lange Publishers, London, 29th edition

Semester III

18BCP303 **ENDOCRINOLOGY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with:

1. Hypothalamo - Hypophyseal axis
2. Classification of hormones
3. Mechansim of action of peptide and steroid hormones
4. Endocrine pathologies
5. Endocrinology of pregnancy
6. Investigative techniques in endocrinology

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Course outcomes (CO's)

After successful completion, the students will understand:

1. Hypothalamo - Hypophyseal axis
2. Different classification of hormones
3. Functioning of peptide and steroid hormones
4. The molecular and cellular basis of endocrine pathologies
5. Role of hormones in different stages of gestation
6. The techniques involved in the assessment of endocrine functions

Unit I: General Introduction

General Introduction, Hypothalamo-hypophyseal axis, Chemical signaling – endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. Chemical classification of hormones, transport of hormones in the circulation and their half-lives. Hormone receptors – extracellular, transmembrane and intracellular. Receptor – hormone binding, Scatchard analysis, recycling and degradation of receptors. Releasing/release-inhibiting hormones (TRH, GnRH, CRH, GHRH, somatostatin, dopamine), their structure, secretion and regulation.

Unit II: Protein/Peptide hormones

Protein/Peptide hormones, Steroid and Thyroid hormones, GH, prolactin, ACTH, insulin, glucagon, PTH and calcitonin, and glycoprotein hormones (TSH, FSH, LH and hCG) – Structure, synthesis, secretion, regulation, transport and metabolism.

Unit III: Hormones and gonads

Physiological action of hormones in the regulation of spermatogenesis, sperm maturation, oogenesis and menstrual/estrus cycles. Gonadal and adrenal steroidogenesis. Cell-cell communication – Two cell concept. Hormonal control of implantation, gestation, parturition and lactation; hormonal contraception. Semen analysis.

Unit IV: Hormone action

Protein and steroid hormone receptors and their signaling cascades; non-genomic actions; Ras-Raf-MAPK signaling - PI3K signaling. Genomic actions of hormones - thyroid hormone nuclear receptor superfamily. Renin-angiotensin system, atrial natriuretic hormones. Vasopressin and water retention.

Unit V: Investigative techniques in endocrinology

Hormone assays, RIA, IRMA, ELISA, Radio receptor assay, extraction, purification, and quantification of hormone receptors (cell surface, cytosolic and nuclear receptors). Radiolabeling techniques – Radioiodination of peptides, autoradiography. Properties of different types of radioisotopes commonly used in biology, radioactivity, detection and measurement of radioactivity, safely guidelines and disposal procedures.

SUGGESTED READINGS

1. Burtis, C.A., and Edward R. Tietz, E.R., (1999) Textbook of Clinical Chemistry 3rd Edition, WB Saunders Harcourt Brace & Company Asia PTE Ltd., USA.

2. Lehninger, L., Nelson, D.L., and Cox, M.M., (2012). Principles of Biochemistry, WH Freeman and Company, 6th Edition, New York.

3. Hadley, M.C., and Levine, J.E., (2007) Endocrinology 6th ed.,. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.

4. Cooper, G.M., and Hausman, R.E., (2009) The Cell: A Molecular Approach 5th Ed.. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300-6.

5. Widmaier, E.P., Raff, H. and Strang, K.T. Vander's Human Physiology (2008) 11th ed., McGraw Hill International Publications, ISBN: 978-0-07-128366-3.

Semester III

18BCP304 **DRUG BIOCHEMISTRY** **4H-4C**

Instruction hours / week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with

- Pharmacokinectics
- Pharmacodynamics
- Drug tolerance and dependence
- Genetically engineered drugs
- Mechansim of action of drugs
- Undesired effects of drugs

Course outcomes (CO's)

After successful completion, the students will understand

1. What the body does to a drug
2. What a drug does to a body
3. Drug dependence
4. The principles and procedure for genetically engineered drugs
5. How the drugs elicit the desired effect
6. Undesired effects of drugs

UNIT I: Basic concepts of Drugs

Drugs – Introduction, sources and routes of administration, Structural features and pharmacological activity, prodrug concept, Adsorption – factors modifying drug absorption. Distribution, metabolism - phase I, II reactions, action of cytochrome P450 and excretion of drugs.

Drug receptors – Localization, types and subtypes, models and theories. G-protein coupled receptor and ion-channel linked receptors. Examples of drug-receptor interactions. Agonists and antagonists. Bioavailability of drug

UNIT II: Assay of Drug

Drug tolerance and drug dependence. Principles of basic pharmacokinetics. Adversse response to drugs, drug intolerance, pharmacogenetics, drug allergy, tachyphylaxis, drug abuse, vaccination against infection, factors modifying drug action and effect. Assay of drug potency: chemical, bioassay and immunoassay.

UNIT III: Engineered Protein

Genetically engineered protein and peptide agents as drugs, Novel drug delivery systems, anti-AIDS drug development, oncogenes as targets for drugs, multidrug resistance phenotypes, production of secondary metabolites by plant tissue culture. Genome based medicine.

UNIT IV: Mechanism of action of drugs used in therapy

Mechanism of action of drugs used in therapy of Respiratory system – cough, bronchial asthma, pulmonary tuberculosis. Antimicrobial drugs – sulphonamides, trimethoprim,

penicillins, aminoglycosides and bacterial resistance, Cancer chemotherapy. Thyroid and antithyroid drugs, insulin and oral antidiabetic drugs, antifertility and ovulation inducing drugs. Pharmacotherapy of gout and rheumatoid arthritis, Immuno therapy – Immunosuppressants and immunostimulants, Enzymes in therapy.

UNIT V: Neurotransmitter Drugs

Brain – Neurotransmitters, encephalins and endorphins; general function of autonomic and somatic nervous system; cholinergic transmission and receptors; adrenergic transmission and receptors; muscarinic receptors. Non steroidal and anti inflammatory drugs; adrenergic blocking drugs; cholinergic blocking drugs; muscatrinic blocking drugs; parkinson's disease; Alzhiemier's disease. Neurodegenerative disorders – Amylotropic, lateral sclerosis, senile dementia, schizophrenia, Huntington's disease.

SUGGESTED READINGS

1. Satoskar, R.S., Bhandarkar, S.D., and Ainapare, S.S., (2003). Pharmacology and Pharmacotherapeutics, Popular Prakasham, Mumbai.

2. Patrick, G., (2002). Medicinal Chemistry Instant notes, Viva books private limited, New Delhi.

3. Chauduri, S.K., (2001). Quintessence of Medical Pharmacology, New central book agency limited, Calcutta.

4. Glick, B.R., Pasternak, J.J., and Patten, C.L., (2009). Molecular Biotechnology, 4th edition, Panima Publishing Corporation, Delhi.

5. Grahame-Smith, D.G., and Aronson, J. K., (2002). Oxford textbook of Clinical Pharmacology and Drug Therapy: 3rd edition. Oxford University Press.

6. Foye, W.O., Lemke, T.L., Williams, D.A., (2012). Principles of Medicinal Chemistry, 7th edition, B.I. Wanerly Pvt. Ltd, New Delhi.

7. Wolf, E.,(1995). Burgers Medicinal Chemistry and Drug Discovery. Principles and Practice, John Wiley and Sons, Manfred.

Semester III

18BCP305A CORE ELECTIVE – III 4H-4C

BIOSTATISTICS AND RESEARCH METHODOLOGY

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- Definition and representation styles of data
- Analysis of data using correlation to understand the interdependence
- Analysis of data using regression to understand the interdependence
- To learn various measures of central values and standard deviation.
- To understand the relationship between two variables.
- To test the significance of a particular data by various parameters.

Course outcomes (CO's)

After successful completion, the students will:

1. Use appropriate representation styles to present the data
2. Perform correlation analysis
3. Perform regression analysis
4. Calculate mean, median, mode and standard deviation.
5. Calculate the relationship between two variables.
6. Test the significance of a particular data by various parameters.

UNIT I: Introduction to Biostatistics

Definition and scope of Biostatistics- Statistical survey-organizing , planning and executing the survey; Sources of data-primary and secondary data, Collection of data-Methods of data collection; Classification and tabulation of data- Graphical and diagrammatic representation. Measures of central tendency – Arithmetic mean, median, mode, quartiles, deciles and percentiles. Measures of dispersion- Range, quartile deviation, mean deviation and standard deviation, Coefficient of variation.

UNIT II: Correlation and Regression

Correlation: Meaning and definition - Scatter diagram –Karl Pearson's correlation coefficient. Rank correlation.

Regression: Regression in two variables – Regression coefficient problems – uses of regression.

UNIT III: Probability

Probability- Definition, concepts, theorems (proofs of the theorems not necessary) and calculations of probability-simple problems, theoretical distributions-Binomial, Poisson and Normal distribution – simple problems

UNIT IV: Sampling distribution and test of significance

Sampling distribution and test of significance – concepts of sampling, testing of hypothesis, errors in hypothesis testing, standard errors and sampling distribution– Student's t test, F-

test, Chi square test - goodness of fit. Analysis of variance – one way and two way classification. CRD, RBD Designs. Duncan's multiple range tests.

UNIT V: Introduction to Research

Research: Scope and significance – Types of Research – Research Process – Characteristics of good research – Problems in Research – Identifying research problems. Research Designs – Features of good designs.

Sources of information: Journals, eJournals, books, biological abstracts, preparation of index cards, review writing, article writing – structure of article, selection of journals for publication – Impact factor – citation index and H index. Proposal writing for funding. IPR and patenting. Concepts and types.

SUGGESTED READINGS

1. Gupta, S.P., (2007). Statistical Methods, Sultan Chand & Co, New Delhi.

2. Kothari, C.R., (2009). Research Methodology – Methods and Techniques, 3rd edition, New Age International Pvt. Ltd, New Delhi.

3. Sundar Rao, P.S.S., and Richard, J., (2006). Introduction to Biostatistics and ResearchMethods, PHI Publication, New Delhi.

4. Sandhu, T., (1990). Research Techniques in Biological Sciences, Anmol Publishers, New Delhi.

Semester III

18BCP305B **CORE ELECTIVE –III** **4H-4C**

CLINICAL RESEARCH AND IPR

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- The process of drug discovery
- Pre-clinical studies
- Components of clinical research (Phases)
- Questionaire preparation
- Fundamentals of IPR
- Patents laws

Course outcomes (CO's)

After successful completion, the student will understand:

1. Steps involved in drug discovery
2. Using small experimental animals
3. Phase 2 and Phase 3 trials
4. Questionaire preparation
5. Intellectual property rights
6. Patents laws

UNIT I: Drug discovery and Development

Introduction to Pharmaceutical Industry, New drug discovery-Target Identification- Target Prioritization/ validation, Lead identification, Lead optimization; Preclinical studies - Preclinical technology, Chemistry manufacturing and controls / Pharmaceutics Pharmacology/Toxicology

UNIT II: Basics of Clinical Research

Definition of clinical research and development, History of randomized trial Literature - Finding and Evaluation databases of Scientific Literature; Critiquing of Research Projects, Time management and resource implications

UNIT III: Epidemiology

Experimental Procedures - Controlled Experiments, Sampling Techniques, Questioner Design, Validity and reliability of observations, Primary variables, Acquisition and using secondary data, Randomization and Blinding: Theory and practice

UNIT IV: IPR

Introduction to Copyright - Conceptual Basis, International Protection of Copyright and Related rights- An Overview (International Convention/Treaties on Copyright). Indian Copyright Law -The Copyright Act, 1957 with its amendments, Ownership, transfer and duration of Copyright, Renewal and Termination of Copyright.

UNIT V: Patent

Introduction to Patent Law - Paris Convention, Patent Cooperation Treaty, WTO- TRIPS, Harmonisation of CBD and TRIPs. Indian Patent Law- The Patents Act, 1970, Amendments to the Patents Act, Patentable Subject Matter, Patentability Criteria, Procedure for Filing Patent Applications, Patent Granting Procedure.

SUGGESTED READINGS

1. Weinberg, S., and Sandy, W., (2009). Guidebook for Drug Regulatory Submissions, 1st edition, Wiley-Blackwell, U.S.A.

2. Richard, A.G., Richard, G., (2009). New Drug Approval Process Drugs and the Pharmaceutical Sciences), 5th edition CRC Press, U.S.A.

3. Duolao, W., Bakhai. A., (2005). Clinical Trials: A Practical Guide to Design, Analysis and Reporting, Remedica, London.

4. Weinberg, S., (1995). Good Laboratory Practice Regulations, 3rd edition, CRC Press, U.S.A.

5. Harburn, K., (1990). Quality Control of Packing Materials in Pharmaceutical Industry, CRC Press, U.S.A.

6. Prichard, E., (1995). Quality in the Analytical Chemistry Laboratory, 1st edition, Wiley, U.S.A.

Semester III

18BCP305C **CORE ELECTIVE –III** **4H-4C**

DIETETIC MANAGEMENT OF DISEASE

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with

- Nutrition as a drug
- Dietary management of diabetes
- Dietary management of obesity
- Dietary management of cardiovascular diseases
- Nutrition deficiency affecting hematopoiesis and diet for individual with cancer
- Dietary management of musculoskeletal diseases

Course outcomes (CO's)

After successful completion, the students will understand:

1. Nutrition as a drug
2. Dietary management of diabetes
3. Dietary management of obesity
4. Dietary management of cardiovascular diseases
5. Nutrition deficiency affecting hematopoiesis and diet for individual with cancer
6. Dietary management of musculoskeletal diseases

UNIT-1: Nutrition

Foods for normal nutrition. Diets in gastrointestinal diseases-Acute gastrointestinal conditions, chronic and non-acute disorders of the upper gastrointestinal tract, lower gastrointestinal conditions, pancreatitis, liver diseases, gall stones, appendicitis, cholelithiasis. Diet for hepatitis

Nutrition for critically ill- Burns, Enteral nutrition, Enteral feeding vs parenteral feeding, Indications of enteral nutrition, Types of enteral feed formula, Complications of enteral feeding. Parenteral nutrition- Techniques of infusion, Complications of parenteral feeding.

UNIT II: Diet for diabetes mellitus

Nutrition recommendations for patient with diabetes, Meal planning, Exchange list of different food groups, Diabetic diets based on exchange list, Diabetic diets menu wise.

Diets in Renal disease-Acute renal failure, Proteinuria, Indoor diet charts for renal patients.

UNIT III: Diet for Cardiovascular Diseases

Risk Factors, Hypertension, Atherosclerosis, Stroke and other peripheral diseases, Cardiomyopathy and cardiac failure, Rheumatic heart disease, dietary management, general guidelines for coronary heart disease, Dietary recommendations of WHO.Diet for Acute cardiac diseases

Obesity- Body fat distribution, Health risks of obesity, Weight reduction, Factors contributing to obesity.

UNIT IV: Cancer and diet therapy

Influence of diet on carcinogenesis, Dietary risk factors and cancers at various sites in the human body, diet therapy, eating well during cancer treatment, managing eating problems during treatment

Diet for inborn errors of metabolism- phenylketonuria, Galactosaemia, Celiac disease.

UNIT V: Nutrition related disease

Nutrition related bone disease- osteoporosis.

Dietary factors in dental disease- Starch & dental cavities, protective factor in food

Blood –Nutrition deficiency affecting hematopoiesis.

SUGGESTED READINGS

1. Sharma, R (2004). Diet Management,3rd Edition,Reed Elsevier India Private Limited, Chennai.

2. Garrow, J.S., and James, W.P.T., (2000). Human Nutrition & Dietetics,Longman Group, UK.

3. Srilakshmi, (2006). Dietetics, 5th Edition.New Age International.Pvt Ltd, New Delhi.

Semester III

18BCP311 PRACTICAL – V 4H-2C

CLINICAL ENZYMES AND IMMUNOLOGY

Instruction hours/week: L:0 T:0 P: 4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

To impart hands-on training in:

- Assays of clinically relevant enzymes
- Diagnostic utility of enzyme assays
- Radial immunodiffusion
- Double immunodiffusion
- Immunoelectrophoresis
- Glucose tolerance test

Course outcomes (CO's)

After successful completion, the students will understand:

1. Various methods of assaying clinically relevant enzymes
2. The diagnostic significance of enzyme assays
3. Working knowledge principle of Radial immunodiffusion
4. Working knowledge principle of Double immunodiffusion
5. Working knowledge principle of Immunoelectrophoresis
6. Working knowledge principle of Glucose tolerance test

ENZYMOLOGY

1. Determination of the activity of the following serum enzymes:
   a. LDH
   b. Acid phosphatase
   c. Alkaline phosphatase
   d. Aspartate amino transferase
   e. Alanine amino transferase
   f. 5' nucleotidase
   g. Sodium potassium ATPase
   h. Ceruloplasmin

IMMUNOLOGY (DEMONSTRATION)

2. Raising of antibodies- single soluble and particulate antigen
3. Immunodiffusion- single radial and double diffusion.
4. Immunoelectrophoresis.
5. Rocket immunoelectrophoresis
6. ELISA
7. Bacterial Agglutination: WIDAL
8. Antibody titration – ELISA

Case study-Report

9. Serum enzyme in liver disease

10. Serum enzyme in cardiac disease
11. Serum enzyme in cancer disease
12. Glucose Tolerance Test

SUGGESTED READINGS

1. Jayaraman, J., (2007). Laboratory Manual in Biochemistry, New Age International Publishers New Delhi.

2. Sadasivam, S., and Manickam, A., (2009). Biochemical Methods, New Age International Publishers, New Delhi.

3. Singh, S.P., (2009). Practical Manual of Biochemistry, CBS Publishers, New Delhi.

4. Talib, V. H., (2003). A Handbook of Medical Laboratory Technology, CBS Publishers, New Delhi.

5. David Wild, (2013). Elsevier; Immuno Assay Hand Book

Semester III

18BCP312 PRACTICAL – VI 4H-2C

CLINICAL BIOCHEMISTRY AND ANIMAL STUDIES

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

To impart hands-on training in:

- The estimation of biomolecules such as glucose and cholesterol
- Assessment of renal function through the analysis of urea and uric acid in serum
- Assessment of liver function through the estimation of bilirubin
- The determination and significance of A/G ratio
- Handling experimental animals
- Various routes of injections

Course outcomes (CO's)

Upon successful completion of this course, students will be able to:

1. Explain the physiopathological bases and the biochemical markers of the most prevalent diseases in our population
2. Perform the estimation of biomolecules such as glucose and cholesterol
3. Assess renal function through the analysis of urea and uric acid in serum
4. Assess liver function through the estimation of bilirubin
5. Determine A/G ratio and interpret its relevance
6. Handle the small experimental animals
7. Understand the differences and significance of routes of injections

Clinical analysis

1. Estimation of glucose in serum
2. Estimation of cholesterol in serum
3. Estimation of urea in the urine and serum
4. Estimation of uric acid in the urine and serum
5. Estimation of chloride in the urine and serum
6. Estimation of calcium in the urine and serum
7. Estimation of magnesium in the urine and serum
8. Analysis of urinary calculi
9. Estimation of Bilirubin in serum(Kit method)
10. Determination of A/G ratio
11. Estimation of triglyceride in serum (Kit method)
12. Estimation of HDL in serum (Kit method)

ANIMAL STUDIES (Group experiment)

13. Handling of animals
14. Methods of injection
15. Induction of liver toxicity
16. Assay of lipid peroxidation in rat liver.

SUGGESTED READINGS

1. Jayaraman, J., (2007). Laboratory Manual in Biochemistry, New Age International Publishers New Delhi.

2. Sadasivam, S., and Manickam, A., (2009). Biochemical Methods, New Age International Publishers, New Delhi.

3. Singh, S.P., (2009). Practical Manual of Biochemistry, CBS Publishers, New Delhi.

4. Talib, V. H., (2003). A Handbook of Medical Laboratory Technology, CBS Publishers, New Delhi.

M.Sc., Biochemistry		2018-2020
		Semester IV
18BCP491	PROJECT AND *VIVA VOCE*	15C

Hours / week: L:5 T:0 P:25 **Marks:** Internal: **80** External:**120** Total: **200**