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
M.Sc., CURRICULUM (2015 – 2016 Batch)
(Scheme of Examination for 2015- 2016 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										
15BCP101	Chemistry of Biopolymers	I	a	4	-	-	4	40	60	100
15BCP102	Enzymes and Microbial Technology	II	d	4	-	-	4	40	60	100
15BCP103	Bioinstrumentation	II	d, e	4	-	-	4	40	60	100
15BCP104	Cellular Biochemistry	III	a	4	-	-	4	40	60	100
15BCP105	Plant Biochemistry	III	a	4	-	-	4	40	60	100
15BCP111	Practical – I Quantitative Estimation and Separation Techniques	I,III	c, f	-	-	4	2	40	60	100
15BCP112	Practical – II Plant Biochemistry and Microbiology	I, III	d	-	-	4	2	40	60	100
	Seminar Presentation	I, II	a,e	2	-	-	-	-	-	-
Semester Total				**22**	**-**	**8**	**24**	**280**	**420**	**700**
SEMESTER – II										
15BCP201	Regulation of Metabolic Pathways	II	a	4	-	-	5	40	60	100
15BCP202	Molecular Biology	II	a, b	4	-	-	5	40	60	100
15BCP203	Bioinformatics	II	a, b	4	-	-	4	40	60	100
15BCP204	Core Elective - I	III	d	4	-	-	4	40	60	100
15OEP201	Open elective			4			3	-	100	100
15BCP211	Practical – III Molecular Biology and Animal Biotechnology	II	d, g, h	-	-	4	3	40	60	100
15BCP212	Practical – IV Biological Databases and Analysis	III	d, g, i	-	-	4	3	40	60	100
	Journal paper analysis and Presentation	I-III	a, e	2	-	-	-	-	-	-
Semester Total				**22**	**-**	**8**	**27**	**240**	**460**	**700**
SEMESTER – III										
15BCP301	Immunology	I	a	4	-	-	4	40	60	100
15BCP302	Clinical Biochemistry and Endocrinology	I, III	a, d	4	-	-	4	40	60	100
15BCP303	Chemsitry of Natural Products	II	a, d	4	-	-	4	40	60	100
15BCP304	Drug Biochemistry and Neurochemistry	III	a, d, j	4	-	-	4	40	60	100
15BCP305	Core Elective – II	III	e,g	4			4	40	60	100
15BCP311	Practical – V Clinical Enzymes and	I, II	d, e	-	-	4	2	40	60	100

	Immunology									
15BCP312	Practical – VI Clinical Biochemistry and Animal Studies	I	d, e, i	-	-	4	2	40	60	100
	Seminar Presentation	I-III	d, e, h	2	-	-	-	-	-	-
	Journal paper analysis and Presentation	I-III	d, e	2	-	-	-	-	-	-
Semester Total				**22**	**-**	**8**	**24**	**280**	**420**	**700**
SEMESTER – IV										
15BCP491	Project and Viva Voce	I-III	a-j	05	-	25	15	80	120	200
Semester total				**05**	**-**	**25**	**15**	**80**	**120**	**200**
Program Total							**90**	**880**	**1420**	**2300**

Open Elective (Theory)	
15OEP401	Bioremediation

Core Elective – 1 (Theory)		**Core Elective – 2 (Theory)**	
15BCP204A	Recombinant DNA Technology	15BCP305A	Biostatistics and Research Methodolology
15BCP204B	Good Laboratory Management	15BCP305B	Clinical Research and IPR
15BCP204C	Fermentation Technology	15BCP305C	Biopharmacy
15BCP204D	Plant Tissue Culture	15BCP305D	Animal Tissue Culture
15BCP204E	Dietetic Management of Disease	15BCP305E	Genomics and Proteomics

Code	**Additional Course**	**Objectives an**		**Instruction hours /**			**Credit(s)**	**Maximum Marks**		
		PEOs	**POs**	**L**	T	P	**Total**	**CIA**	**ESE**	**Total**
								-	100	100
15BCP306	Clinical Data Management	III	b, i, j	-	-	-	04	-	100	100
15BCP401	Drug Desinging	III	b, i, h	-	-	-	04	-	100	100

Blue – Employability
Green – Entrepreneurship
Red – Skill Development
Code: 15BCP101

15	-Academic Year
BC	-Biochemistry
P	- Masters 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)

h. 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.

i. 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.

j. 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

15BCP101 **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: Occurrence, structure and biological functions of cellulose, chitin, starch and glycogen. Fructans, arabinans and galactans(brief account). 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: 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 organisation. Quarternary structure of proteins- Structure of haemoglobin. Models for haemoglobin allostery. Quintinary structure-basics only.

UNIT III

Lipids: Introduction- simple lipid, compound lipids-phospholipids, glycolipids and storage lipids. Properties of lipids-Micelles, bilayers and liposomes. Significance of lipid anchored protein-prenylated, fatty acylated and GPI anchored proteins. Lipoproteins – classification and composition. 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, sn RNA, siRNA, hn RNA – 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 – gel retardation assay, DNase I footprinting.

REFERENCES

1. Lehninger Principles of Biochemistry 4th edition Nelson and Cox, Freeman Publishers, 2005
2. Harper's Biochemistry 26th edition. McGraw Hill, 2003
3. Biochemistry 4th edition. Zubay, William C. Brown Publication, 1998
4. Biochemistry. Voet and Voet, John Wiley, 1995
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. David Rawn.J.(2004). Biochemistry, First Indian reprint, Panima Publishing Corporation, New Delhi.

Semester I

15BCP102 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

Proteins: Enzymes - Nomenclature and classification of Enzymes with examples; coenzymes and cofactors. Active site rule: catalytic triad; Mechanism of enzyme action - Lock and key model, Induced fit model. Factors affecting enzyme activity. Isolation, purification and characterization of enzymes.

UNIT II

Enzyme Kinetics : Derivation of MM equation, LB plot, Eadie Hofstee plot and Hanes plot. Enzyme inhibition-Types and differentiation of competitive, uncompetitive, Non-competitive inhibition, Allosteric inhibition, feed-back inhibition and regulation. Allosteric enzymes- cooperativity, Hills equation, Physiological significance of sigmoidal behaviour. R and T states and K and V series. Mechanism of action of enzymes - chymotrypsin and lysozyme.

UNIT III

Immobilization of enzymes: Methods of immobilization - adsorption, covalent binding, entrapment, membrane confinement. Effect of immobilization on enzyme. Use of enzymes in detergents, Leather Industry, Wool Industry, Food, Dairy, Juice and Beverage Industry, Sugar Industry. Uses in medicine. Enzyme engineering. Artificial enzymes and synzymes, Abzymes, ribozymes, enzymes in organic solvents.

UNIT IV

Microbial Growth: Balanced and Unbalanced microbial growth; Measurement of growth; Principles of microbial growth and culture systems-batch culture, fed batch 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*.,- Basics only).

TEXT BOOKS

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. M. R. Adams and M. O. Moss, 2004, Food Microbiology, New age publishers, New Delhi.
6. R. Singh and S.K.Ghosh, 2004, Industrial Microbiology, Global Vision publishers, New Delhi.

REFERENCES

1. Chapline M.F and C. Bucke, 1990, Protein Biotechnology. Cambridge University Press, London.
2. Gary Walsh, 2002, Proteins Biochemistry and Biotechnology, John Wiley & Sons Ltd, New York.
3. Glazer A.N, H.Nikaido,2007, Fundamentals of Applied Microbiology. W H. Freeman Company, New York.
4. Nicholas C.Price and Lewis Stevens, 2004, Fundamentals of Enzymology, 3rd Edition, Oxford Univ. Press, New York.
5. Stanbury P.F, A.Whitaker and S.J.Hall, 2005, Principles of Fermentation Technology, Elsevier Publishers.
6. Thomas. E and W.Creighton 2002, Proteins: Structure and Molecular properties, W.H Freeman and Company, New York.
7. Patel, 2003, Industrial Microbiology, Macmillan India limited, New Delhi.

Semester I

15BCP103 **BIOINSTRUMENTATION** **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
- To understand the applications of advanced spectrophotometric techniques
- To learn the basics, advanced techniques and applications of chromatography
- To learn the principle and applications of electrophoresis techniques
- To understand the principle and applications of radio isotopic techniques in biological sample analysis

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 spectrophotometry for sample analysis
4. Use chromatographic techniques for sample analysis
5. Detect radioisotopes and analyze samples
6. Use electrophoretic techniques for sample analysis

UNIT I

Colorimetry: Colour and absorption spectra, 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, Spectrofluorimetery, atomic spectroscopy, NMR spectroscopy and ICPMS, Applications.

UNIT II

Centrifugation: Principle, 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.

UNIT III

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), MALDI-TOF. Application of Chromatography.

UNIT IV

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.

UNIT V

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.

Flowcytometry: Principles and applications**.**

TEXT BOOKS

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

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

REFERENCES

1. Boyer, R. 2000. Modern Experimental Biochemistry. 3rd Edition. Addision Wesley Longman. New Delhi.

2. David Friedfelder, 2001. Physical Biochemistry. 5th Edition Oxford Publishers. New York.

3. Keith Wilson and John Walker, 2010. Principles and Techniques of Biochemistry and Molecular Biology, 7th Low Price Edition, Cambridge University Press, India.

15BCP104 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.

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 ATP ase; 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 and receptor mediated endocytosis.

UNIT III

Mitochondria – Reduction potential, 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 – Stuctures, Assembly, Myosin. Microtubules – Organisation and dynamics, kinesin and dynein. Cilia and flagella – Structure and functions, intermediary filaments.

UNIT IV

Cell – Matrix interaction: Cell – Cell interaction: Extra cellular matrix; Collagen, hyaluronan and proteoglycans, laminin, integrins and fibronectins.

Cell – Cell adhesion: Specialised junctions – Desmosomes, Gap junctions, Tight junctions. Adhesion molecules – Cadherins, Connexins.

Cell – Cell signaling – Signalling 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.

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 effect of chemicals and radiation. Apoptosis (Programmed cell death) – pathways, regulators and effectors on apoptosis.

TEXT BOOKS

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

2. Geoffrey M. Cooper and Robert E. Hausman 2013.Cell-A Molecular Approach, 6th Edition. Sinauer Associates. USA.

3. Gerald Karp 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.

REFERENCES

1. Harvey Lodish, Arnold Berk, Chris A. Kaiser and Monty Krieger. 2012. Molecular Cell Biology, 7th edition. W.H. Freeman & Company, London.

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

3. Bruce Alberts, Alexander Johnson, Julian Lewis and Martin Raff. 2007. Molecular Biology of the Cell, 5th edition. Garland Publishing Co.New York.

Semester I

15BCP105A **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 applications of plant tissue culture techniques

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. Understand the application of tissue culture in mass production

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.

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. Senescence: biochemical changes, regulation.

UNIT V

Plant secondary metabolites: Alkaloids, flavonoids, terpenoids, phenols-Occurrence, distribution & functions, Production of secondary metabolites in plants, stages of secondary metabolite production, PTC- Totipotency, meristematic and nodal cultures-Callus induction. Somatic embryogenesis. Metabolic engineering for increased production of secondary metabolites.

TEXT BOOKS

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

2. John.W.Anderson and John Beardall.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. James Bonner and Joseph F Varner, Plant Biochemistry. 3rd edition. Academic Press, New York.

REFERENCES

1. Bob Buchannan ,2002. Biochemistry and Molecular Biology of Plants, IK. International, New York.

2. Hans-Valter Heldt ,2005. Plant Biochemistry and Molecular Biology, Oxford University Press, England.

3. Michael Wink, 2010. Functions and Biotechnology of Plant Secondary Metabolites, Second edition, Blackwell Publishing Ltd, London.

4. Hans-Walter Heldt, Birgit Piechulla, Fiona Heldt, 2011. Plant Biochemistry, Fourth Edition, Academic Press Publication, London, UK.

Semester I

15BCP111 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)

Fluorimetry

7. Estimation of thiamine from cereals or fruits
8. Estimation of riboflavin

Titrimetry

9. Estimation of lactose in milk
10. Estimation of calcium in milk

Separation techniques

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

Descending.

12. Separation of plant pigments by TLC.
13. Separation of plant pigments by column chromatography.
14. 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

REFERENCES

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

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

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

Semester I

15BCP112 **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

Experiments

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.

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.

REFERENCES

1. Jayaraman J , 2011. Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi.

2. Kannan.N , 2003. Laboratory Manual in Microbiology, Panima Publishing Corporation, Bangalore.

3. Sadasivam S and A. Manickam , 2009. Biochemical Methods, New Age International Publishers, New Delhi.

4. Singh S.P, 2009. Practical Manual of Biochemistry, CBS Publishers, New Delhi.

5. Talib V.H , 2007. A Handbook of Medical Laboratory Technology, CBS publishers,2nd edition. New Delhi.

6. Varley H, 2003. Practical Clinical Biochemistry, CBS Publishers, New Delhi.

Semester II

15BCP201 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

- 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. 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. Hormonal regulation of fuel metabolism; Metabolic disorders-Diabetes mellitus.

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, phosphotidyl ethanolamine and sphingomyelin and their regulation. Synthesis and degradation of cholesterol and its regulation. Obesity and regulation of body mass. Metabolic disorders- Atherosclerosis, Hyper and hypo lipoproteinemia.

UNIT IV

Amino acid metabolism: Regulation of synthesis of aspartate and aromatic family of aminoacids. Key role of glutamate dehydrogenase and glutamine synthetase in nitrogen metabolism and their allosteric regulations. Amino acid degradation- deamination, decarboxylation and transamination. Regulation of urea cycle. Biosynthesis of heme (porphyrin) and its regulations. Molecules derived from aminoacids. 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. Tissue specific metabolism- Metabolic profile of major organs- Brain, Muscle, Liver and Adipose tissue. Intergration of metabolism. Metabolic disorders- Gout, SCID.

TEXT BOOKS

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

2. Robert K. Murray, David A. Bender, Kathleen M. Botham and Peter J. Kennelly 2012.Harper's illustrated Biochemistry, 29th Edition.. McGraw-Hill Medical. London.

REFERENCES

1. Donald Voet and Judith Voet ,2004. Biochemistry, John Wiley and Sons,. 2nd Eedition.New York

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

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

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

5. Robert K. Murray, David A. Bender, Kathleen M. Botham and Peter J. Kennelly 2012.Harper's illustrated Biochemistry, 29th edition.. McGraw-Hill Medical. London.

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

7. Geoffrey Zubay,2009. Biochemistry, Wm.C Brown Publishers, Saunders and Company, Philadelphia.

Semester II

15BCP202 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.

TEXT BOOKS

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. Benjamin Lewin (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.

REFERENCES

1. Harvey Lodish, Arnold Berk, Chris A. Kaiser and Monty Krieger. 2012. Molecular Cell Biology, 7th edition. W.H. Freeman & Company,

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

3. Arther Kornberg, A. Baker , 2005. DNA replication, W.H. Freeman and Co, USA.

4. Geoffrey M. Cooper and Robert E. Hausman 2013.Cell-A Molecular Approach, 6th Edition.. Sinauer Associates. USA

Semester II

15BCP203 **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.
6. Knowledge on applications of bioinformatics

UNIT I

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

Introduction to sequence Alignment: Pairwise and multiple sequence alignment, substitution matrices, Similarity searching programs, BLAST, FASTA, Multiple sequence alignment – CLUSTAL, 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, protein folding and visualization of molecules – Visualization tools-RasMol, Deep View.

UNIT IV

Gene Identification and Prediction: Gene Mark, Gene Scan, Pattern Recognition, Global gene expression studies-DNA Micro array.

UNIT V

Applications of Bioinformatics-Molecular medicine, biotechnology, agricultral, Computer Aided Drug Designing- Lead molecules, properties, ADME profiles, QSAR. receptors, docking.

REFERENCES

1. Arthur M. Lesk, 2014. Introduction to Bioinformatics, 4th edition. Oxford University Press, Oxford.

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

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

4. David W. Mount, 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, Namitha Mendiratta and Parag Rastogi, 2004. Bioinformatics – Concepts, Skills, Applications. CBS Publishers & Distributiors, New Delhi.

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

9. Sundararajan. S and R.Balaji, 2003. Introduction to Bioinformatics, Himalaya Publishing House, Mumbai.

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Semester II

15BCP204A **CORE ELECTIVE –I** **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.

REFERENCES

1. Bernard R. Glick, Jack J. Pasternak and Cheryl L. Patten, 2009. Molecular Biotechnology, 4th edition, Panima Publishing Corporation, Delhi.

2. James D.Watson,Michael Gilamn,Jan Witkowski and Mark Zotler 2006 . Recombinant DNA, 3rd Edition. W.H. Freeman Company, New York.

3. Kingsman S .M and A. J. Kingsman , 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, E.F.Fritch and T.Maniate, 2001. Molecular Cloning, A Laboratory Manual, Cold Spring Harbor Laboratory Press, New York.

7. Tom Strachan and Andrew, P. Read , 2003. Human Molecular Genetics, 3rd edition. John Wiley and Sons,Toronto. Canada.

15BCP204B **CORE ELECTIVE –I** **4H-4C**

GOOD LABORATORY MANAGEMENT

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 basic quality control procedures in the laboratory
- To ensure safety in laboratory
- To understand the good laboratory procedures
- To acquaint with standard operating procedures
- To understand the importance of quality audit procedures
- To learn the laboratory safety and regulations

Course Outcomes (COs):
After completion of this course the student will be able to

1. understand the basic quality control procedures in the laboratory
2. Follow safety procedures in laboratory
3. Follow good laboratory procedures
4. Acquaint with standard operating procedures
5. Do quality audits
6. Maintain laboratory safety and regulations

UNIT I

Basic Concepts: Quality concepts, Quality Assurance, Good Manufacturing Practices, Responsibilities, Ensuring safety in laboratories: Introduction, principles-engineering controls, work practices and administrative control, personal protective equipment. General safety-biological safety, chemical safety and fire safety.

UNIT II

Quality Control: Quality control laboratory: Responsibilities, routine controls, instruments, protocols, non-clinical testing, controls on animal house, data generation and storage, quality control documents, retention samples, records, audits of quality control facilities.

UNIT III

Good Laboratory Practice (GLP): GLP – an overview and basic information, Scope. Principles of GLP: Test Facility Organization and Personnel, Quality Assurance

Programme, Facilities, Apparatus, Material, and Reagents, 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

UNIT IV

Inspections, Quality Audit and Quality System Reviews: Inspections of pharmaceutical manufacturers, role of quality audit, role of inspectors, methods of inspection- routine, concise, follow-up and special inspections, frequency and duration of inspections, preparations for inspections, conduct, report and regulatory actions. Loan License Auditing – Concepts, Auditing, role of quality circle in quality assurance.

UNIT V

Laboratory Regulations and Safety: List of Regulations to be followed**.** Laboratory safety procedure- glass ware, equipment safety, hands protection, precaution to be undertaken to prevent accident and contamination.

TEXT BOOKS

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

REFERENCES

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

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

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Semester II

15BCP204C **CORE ELECTIVE –I** **4H-4C**

FERMENTATION 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 understand the basics of fermentation technology
- To gain knowledge on preservation and maintenance of industrially important microorganisms
- To learn the effective bioreactor system for effective fermentation technology
- To gain knowledge on fermentation kinetics
- To understand downstream processing
- To learn the application of fermentation technology in food, pharmaceutical and therapeutic industry

Course Outcomes (COs):

After completion of this course the student will be able to

1. Understand the basics of fermentation technology
2. Preserve and maintain industrially important microorganisms
3. Use effective bioreactor system for effective fermentation technology
4. Gain knowledge on fermentation kinetics
5. To carryout downstream processing
6. Apply fermentation technology in food, pharmaceutical and therapeutic industry

Unit I:

Introduction of fermentation technology: History of fermentation. Fermentation process. Microbial culture, Screening and selection for fermentation processes. Preservation and improvement of industrially important microorganisms. Inoculum production for bacterial and fungal processes. Strain improvement

Unit II:

Bioreactor Design: Fermentor functions, construction and maintenance of aseptic conditions. Control of various parameters: temperature control; Aeration and agitation system (Non-Newdonian fermentations), baffles; types of fermentors, computer applications in fermentation technology. Sterilization of fermentor, aseptic inoculation

and sampling methods, Specialized bioreactors: tubular bioreactors, membrane bioreactors, tower bioreactors, fluidized bed bioreactors, Immobilized system and packed bed reactors and Photobioreactor.

Unit III:

Fermentation kinetics: Fermentation growth kinetics. Simple unstructured kinetic model for microbial growth of bacterial, fungal, animal and plant systems. Kinetic of substrate utilization, biomass growth and product formation in continuous system, batch and fed batch cultures, total cell retention cultivation, inhibition on cell growth and product formation.

Unit IV:

Downstream process: Basic concepts of bio-separation technology, separation characteristics of proteins and enzymes –size, stability properties;purification methodologies characteristics of bio enzymes products; Flocculation and conditioning of broth,over view of reaction processes involved in separation. Centrifugation as a tool for downstream processing.

Unit V:

Bioreactor Products: Production of fermented dairy products, Fermented foods and beverages; Types of fermentation processes and their advantages and disadvantages; production of penicillin, recombinant insulin. Propagation of animal and plant cell using bioreactors for production of pharmaceuticals, therapeutic proteins and monoclonal antibodies.

TEXT BOOKS

1. Stanier, R.Y. 1996. "General Microbiology", Vth Edition, MacMillan, publisher,London
2. Lehninger, 2008."Principles of Biochemistry. 5thEdition, David Nelson & Michael Cox,
3. W.H. Freeman and company, NY.
4. Kalia M. and Sangita, S. 1996. Food Preservation and Processing, First edition, KalyaniPublishers, New Delhi.
5. Microbiology; Pelczar, Chan and Krieg; Tata McGraw Hill, New Delhi
6. E.M.T.El. Mansi, C.F.A. Bryce, .A.L.Demain, A.R. Allman. 2006."Fermentation microbiology and biotechnology", 2nd Edition, Taylor & Francis, Florida.

REFERENCES

1. James M. and Jay. 2000. “Modern Food Microbiology”, 5th Edition, CBS Publishers, New Delhi

2. Stanier, R.Y. 1996. “General Microbiology”, Vth Edition, MacMillan, publisher, London

3. Toledo R.T. 2000. “Fundamentals of Food Process Engineering; 2nded, CBS Publishers, New Delhi.

4. Precott, Harley.2004. Microbiology (Sixth edition) McGraw-Hill Science, NewYork.

5. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton. 2001. “Industrial Microbiology: An Introduction”, Blackwell Science, UK

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Semester II

15BCP204D **CORE ELECTIVE –I** **4H-4C**

PLANT 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 understand the role of nutrients and hormones in plant growth and development
- To gain knowledge on media composition for plant tissue culture
- To maintain aseptic condition in laboratory
- To gain knowledge on setting up of plant tissue culture laboratory
- To understand plant transformation techniques
- To understand the applications of plant tissue culture

Course Outcomes (COs):

After completion of this course the student will be able to

1. Understand the role of nutrients and hormones in plant growth and development
2. Design media composition for plant tissue culture
3. Maintain aseptic condition in laboratory
4. set up a plant tissue culture laboratory
5. Carryout plant transformation techniques
6. Apply plant tissue culture for mass production of significant products.

UNIT I

Growth and Development:

Role of Plant Hormones in growth & development. Plant Nutrition - Effect of soil pH on mineral availability, uptake & assimilation of minerals and their physiological role.
Impact of macro, micro, vitamins in plant growth development.

UNIT II

Introduction to plant tissue culture: Totipotency, Tissue culture Media (Composition and preparation). Nutritional components of tissue culture media. Plant Hormones- Types, structures, biosynthesis & metabolism. Basic concepts of aseptic cultures and its uses Different areas and applications of plant tissue culture.

UNIT III

Basic techniques in tissue culture: Design & lab setup of Tissue Culture laboratory. Types of culture, Initiation of callus and suspension cultures, Micro propagation (Organogenesis, Somatic Embryogenesis, Shoot tip culture, Rapid clonal propagation, Embryo Culture and Pollen culture).Production of haploids and their application, Storage of plant genetic resources and Cryopreservation.

UNIT IV

Plant transformation technology: Ti &Ri Plasmid and thier transfer mechanisms, Use of Ti &Ri as vectors, Binary vectors, Use of 35s & other promoters genetic markers- methods of nuclear transformation, viral vectors & their applications, Use of reporter gene, Particle bombardment ,electroporation, Microinjection, Chloroplast transformation- transplastomics, Transformation of monocots, Transgene stability & gene silencing in Plant transformation.

UNIT V

Plant tissue culture and its applications: Transgenic plants - for– biotic (weeds, insects, viruses, fungi and bacteria) and abiotic (drought, salt, temperature, poor soil quality and oxidative) stress tolerance. Production of secondary metabolites. Molecular farming(improvement in protein, lipids, carbohydrates). Plant antibodies, vaccines, therapeutic proteins and active principles. Biofortification of important crops (rice and banana).

TEXT BOOKS

1. Davies K. 2004. "Plant pigments and their manipulation" – Annual plant revies, vol 14 Blackwell Publication, UK

2. Slater A, Scott NW, Fowler MR. 2008 "Plant Biotechnology: the genetic manipulation of plants" Oxford Press, UK

3. Altman A, Hasegawa PM . 2012 "Plant Biotechnology and agriculture. Prospect for the 21st century" Academic press,USA.

REFERENCES

1. Brown T. A.. 2010. "Gene Cloning and DNA Analysis: an introduction", 6th edition, Wiley-Blackwell Publisher, UK.

2. Chawla H.C. 2009 " Introduction to plant biotechnology 3rd Edition", Oxford & IBH publication Pvt .Ltd, New Delhi.

3. Primrose S.B and R.M.Twyman. 2003. "Principles of Genome Analysis".Blackwell Publishing, Oxford.

4. Winnacker E.. 2003. "From Gene to Clones ; Introduction to gene technology", 4th edition, (2003), Panima Publisher, India

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Semester II

15BCP204E **CORE ELECTIVE –I** **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 bone disease- osteoporosis.

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

Blood –Nutrition deficiency affecting hematopoiesis.

REFERENCES

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

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

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

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Semester II

15OEP201 **OPEN ELECTIVE**

3C

BIOREMEDIATION

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

- Environmental pollution and its impact on living beings
- Bioremediation process
- Bioremediation techniques
- Bioremediation of contaminants
- Recent approaches in bioremediation
- Waste water management

Course outcomes (CO's)

After successful completion, the students will be able to

1. Understand impact of environmental pollution on living beings
2. Do bioremediation process
3. Understand bioremediation techniques
4. Carryout bioremediation of contaminants
5. Understand recent approaches in bioremediation
6. Manage waste water treatment

UNIT I

Environmental pollution: Definitions, Parts of environment, Environmental contamination versus pollution.Nature of contaminants: Recalcitrant compounds, pollutants. Physico - chemical properties of contaminants. General classification of contaminants.Effect of contaminants on environment.Environmental segments – structure and composition of atmosphere - Pollution –Air, water, soil , thermal and radiation – Effects – acid rain, ozone layer depletion and greenhouse effect. Sources of heavy metal pollution

UNIT II

Bioremediation: Introduction of Bioremediation, general perspectives, constraints and priorities of bioremediation, Advantages, limitations and applications. Factors affecting process of biodegradation. Contaminant availability for biodegradation. Microbial

interactions with inorganic pollutants, Microbial metal resistance, Microbial transformation, accumulation and concentration of heavy metals.

UNIT III

Bioremediation Techniques: *In situ* and *ex situ* bioremediation. Characterization of essential factors for bioremediation. Strategies for improvement of bioremediation techniques. Bioremediation monitoring (physical, chemical, biological). Molecular techniques in the analysis of contaminated sites.

UNIT IV

Bioremediation of contaminants: Nature of organic compound and wastes, Decomposition of organic matter, microbes involved in decomposition. Aerobic and anaerobic decomposition of organic waste, Waste water treatment (Primary, Secondary and Tertiary), Bioreactor for waste water treatment, microbes for waste water treatment. Environment impact of fertilizers.

UNIT V

Recent approaches in bioremediation: Organic and vermicomposting (Elementary concepts only). Recent biotechnological trends in bio augmentation and bio stimulation. Role of plasmids in bioremediation. Evolution barriers for new microbes. Enhancement of novel microbial degradative abilities. Genetics and gene manipulation of bioremediation. Role of environmental biotechnology in management of resources. Reclamation of wasteland, biomass production, biogas and biofuel production. Development of environmentally friendly processes such as integrated waste management.

TEXT BOOKS

1. Rajendran. P & Gunasekaran. P. 2006. "Microbial Bioremediation", MJP publishers, New Delhi.

2. Kamaraj. P & Arthanareeswari. M. 2010. "Environmental Science – Challenges and Changes", 4 th Edition, Sudhandhira Publications.

3. Sharma. B. K. and Kaur. 1994. "Environmental Chemistry", Goel Publishing House, Meerut.

REFERENCES

1. De. A.K., "Environnemental Chemistry". 1996. New Age International, New Delhi.
2. Helen P and Kavitha. 2008. "Principles of Environmental Science", Sci tech Publications, 2nd Edition. Chennai.

3. Foster C.F., John Ware D.A. 1987. "Environmental Biotechnology", Ellis Horwood Ltd. London.

4. John. T. cookson, Jr. 1995. "Bioremediation engineering; design and application". McGraw Hill, Inc. New York

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Semester II

15BCP211 **PRACTICAL – III** **5H-3C**

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.

REFERENCES

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 A. Manickam, 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.

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Semester II

15BCP212 **PRACTICAL – IV** **5H-3C**

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.

Experiments:

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.

REFERENCES:

1. Arthur M. Lesk, 2014. Introduction to Bioinformatics, Oxford University Press, Oxford.

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

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

4. David W. Mount, 2013. Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbour Laboratory Press, New York.

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Semester III

15BCP301 **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

- Specialized immune cells and their function
- Mechanisms of humoral immunity
- Mechanisms of cell mediated immunity
- Hyperactivation of immune cell and associated pathogenesis
- Basis behind immunodeficiency diseases
- 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 of the immune system: Haematopoiesis. Overview of Immune stem cells-Lymphoid cells, mononuclear, granulocytes, mast cells and dentritic cells. Lymphoid classes B, T and NK – B & T Cell maturation, activation and differentiation; Lymphocyte surface markers, CD nomenclature. Cell-mediated and humoral 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.

UNIT III

Hyper sensitivity: Type I, II, III, IV, V and VI. Complement-definition, classical and alternate pathway, MHC: organization, MHC molecules and genes, MHC and immune responsiveness, Transplantation and rejection.

UNIT IV

Immunity to infection: Definition and types of immunity, Primary and secondary immunodeficiency diseases. Auto-immune diseases, Tumor immunology Vaccines: Active and passive immunization, Types of vaccines with example. Monoclonal Antibodies- Production and Applications.

UNIT V

Immuno Techniques: Antigen-Antibody interactions- precipitation reaction, agglutination tests- haemagglutination; Complement fixation test. Direct and indirect immunofluorescence, RIA, ELISA, CLIA, ECLIA, Immunoblotting, effector cell assay, Heamolytic plaque assay and Elispot assay.

TEXT BOOK

1. Roitt I., 2006. Essential Immunology. Blackwell Science, Oxford, UK 11th edition.

REFERENCES

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

3. Charles. A. Janeway and Jr. Paul Traverse, 2004. Immunobiology, 6th edition, Blackwell Scientific Publishers, Oxford university, London.

4. Geoffrey Zubay, 2009. Immunology, W.B. Saunders and company, Philadelphia, United States.

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

6. Ivan Riott and Janathar Brotoff, 2006. Immunology, Mosby Publishers,Sydney. 7th Edition.

7. Janis Kuby, 2006. Immunology,. W.H. Freeman and Company, New York. 6th Edition.

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Semester III

15BCP302 CLINICAL BIOCHEMISTRY AND 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:

- 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, seperation of haemoglobin, Thalassemia, Hemoglobinopathies. Disorder of erythrocyte metabolic pathways, erythrocyte enzyme disorders. Porphyrins and

disorder: porphyrias.

UNIT III

Clinical Parameters: Myocardial infarctions, hepatobiliary disease. General principles of hormone assay and clinical significance of steroid, protein and thyroid hormone (experimental details are not required). Oncology- oncogenes and cell cycle, Cancer Markers; Free radical induced lipid peroxidation. Free radical scavengers. Antioxidants in disease prevention.

UNIT IV

Overview of important endocrine glands and their hormones: Chemistry, synthesis, control, physiological role and pathophysiology of hypothalamus, pituitary, thyroid and parathyroid hormones.

UNIT V

Chemistry, synthesis, control, physiological role and pathophysiology of pancreas, adrenal medulla, adrenal cortex, male and female reproductive hormones.
Endocrinology of pregnancy, parturition and lactation.

REFERENCES

1. Carl, A. Burtis, Edward R. Ashwood and William Heinmann Teitz, 1999. Textbook of Clinical Biochemistry, W.B. Saunders Company, London.

2. Emil. Smith, Philip Handler and Abraham White, 2004. Principles of Biochemistry, Mcgraw Hill International Book Company, London.

3. Harold Varley, 2003. Practical Clinical Biochemistry, volume 1 and 2, CBS Publishers, New Delhi.

4. Mac. E. Hadley, 2004. Endocrinology, Prentice Hall International Inc, London.

5. Philip D. Mayne, 1994. Clinical Chemistry in Diagnosis and Treatment, ELBS Publications, New York.

Semester III

15BCP303 CHEMISTRY OF NATURAL PRODUCTS 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 learn and understand the methods of plant analysis
- To gain knowledge on natural products from plant sources
- To extract the natural products from plant sources
- To gain knowledge on natural products from plant sources
- To learn extraction of secondary metabolites from marine organisms
- To extract drugs from natural sources

Course outcomes (CO's)

After successful completion, the students will

1. Learn and understand the methods of plant analysis
2. Gain knowledge on natural products from plant sources
3. Extract the natural products from plant sources
4. Gain knowledge on natural products from plant sources
5. Learn extraction of secondary metabolites from marine organisms
6. Extract drugs from natural sources

UNIT I

Methods of plant analysis-Extraction- sequential and percolation techniques. Separation techniques-Column chromatography, TLC, GLC and HPLC. Methods of identification-UV, IR, NMR and MS; Analysis of results- Qualitative and quantitative methods.

UNIT II

Natural products from plant sources: Chemistry, distribution and techniques for anthocyanins, phenolics, flavonol and flavones, tannin and quinines (General discussion only).

UNIT III

Natural products from plant sources: Chemistry, distribution and techniques for triterpenoids, essential oils, steroids, carotenoids and alkaloids (General discussion only).

UNIT IV

Natural products from microbes: Sample collection; Screening tests- antiviral, antibacterial, anticancer, antihypercholesterolemic. Commercial production of microbial enzymes - Invertase and beta galactosidase.

UNIT V

Marine organism and animals: Secondary metabolite from marine algae, bacteria, fungi and vertebrates. Separation and isolation techniques- Desalting, ion exchange and reverse

phase column chromatography; Bio assay directed fractionation. Isolation of simple peptides. Drugs from animal sources – hormones, carbohydrate and proteins.

TEXT BOOKS

1. HarborneJ.P 2008.Phytochemical methods- A Guide to modern techniques of plant analysis. Fourth Indian reprint-3rd Edition, Springer (India) Pvt Ltd, New Delhi.

2. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton 2001. Industrial Microbiology: An Introduction", Blackwell Science, Replica press Pvt Ltd, New Delhi.

REFERENCES

1. Sujatha VB, B.A.Nagasampagi, S. Meenakshi (2014) Natural Products-Chemistry and applications. Second reprint. NK Mehra for Narosa Publishing House Pvt Ltd, New Delhi.

2. E.M.T.El.Mansi, C.F.A. Bryce, .A.L.Demain, A.R. Allman (2006).Fermentation microbiology and biotechnology", 2nd Edition, Taylor & Francis, Florida.

3. Arnold L. Demain, Julian E. Davies, Ronald M. Atlas(1999).Manual of industrial microbiology and biotechnology, 2nd Edition, ASM Press, Washington.

Semester III

15BCP304 DRUG BIOCHEMISTRY AND NEUROCHEMISTRY 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

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.

UNIT II

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

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 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

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.

TEXTBOOKS

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

2. Graham Patrick, 2002. Medicinal Chemistry Instant notes, Viva books private limited, New Delhi.

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

REFERENCES

1. Bernard R. Glick, Jack J. Pasternak and Cheryl L. Patten, 2009. Molecular Biotechnology, 4th edition, Panima Publishing Corporation, Delhi.

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

3. William O.Foye,Thomas L.Lemke,David A.Williams, 2012. Principles of Medicinal Chemistry, 7th edition, B.I. Wanerly Pvt. Ltd, New Delhi.

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

Semester III

15BCP305A CORE ELECTIVE –I I 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

Definitions-Scope of Biostatistics- Variables in biology, collection, classification and tabulation of data- Graphical and diagrammatic representation.

Measures of central tendency – Arithmetic mean, median and mode. Measures of dispersion- Range, standard deviation, Coefficient of variation.

UNIT II

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

Test of significance: Tests based on Means only-Both Large sample and Small sample tests – Student's t test, Chi square test - goodness of fit. Analysis of variance – one way and two way classification. CRD, RBD Designs.

UNIT IV

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.

UNIT V

Sampling Design : Meaning – Concepts – Steps in sampling – Criteria for good sample design. Scaling measurements – Techniques – Types of scale.

REFERENCES

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 J.Richard., 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

15BCP305B CORE ELECTIVE –II 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)
- Questionnaire 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. Questionnaire 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.

TEXT BOOK

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

REFERENCES

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

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

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

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

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

Semester III

15BCP305C CORE ELECTIVE –I I 4H-4C

BIOPHARMACY

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 palnts,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

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 – 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.

REFERENCES

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

Trease GE, Evans MC, 1979. Textbook of Pharmacognosy, 12th edition. Balliere-Tindal, London.

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

Semester III

15BCP305D CORE ELECTIVE –I I 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, 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, 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

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: 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: 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

TEXT BOOKS

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

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

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

REFERENCES

1. Epithelial Cell Culture, Ann Harris, 1996. Cambridge University Press, London.

2. Methods in Cell Biology, Volume 57, Jennie P.Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press.

15BCP305E **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 Sequencing: 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- 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: Gene structure and pseudo genes. 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, Mass Spectrometry – ESI MS and MALDI techniques and applications. Characterization of protein complexes – protein-protein interactions, yeast two-hybrid system and protein micro arrays.

UNIT V

Experimental Proteomics: 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.

TEXT BOOKS

1. Brown TA., 2002 . Genomes. John Wiley & Sons. Singapore.

2. Pennington S. and M.J. Dunn, 2001. Proteomics: From Sequence to Function. Bios Scientific Pub.Ltd. Oxford.

3. Primrose S.B and R.M.Twyman, 2003. Principles of Genome Analysis. Blackwell Publishing, Oxford.

4. Richard P. Simpson, 2004. Proteins and Proteomics. A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York.

REFERENCES

5. Charles R. Cantor, and Cassandra L. Smith, 1999. Genomics: The Science and Technology behind the Human Genome Project, John Wiley & Sons Pvt. Ltd. Singapore.

6. Dov Stekal, 2003. Microarray Bioinformatics, Cambridge University Press, Cambridge.

7. Greg Gibson and Spencer V. Muse., 2003. A Primer of Genome Science. Sinauer Associates Inc. Publishers, Sunderlands, New York.

8. Liebler, 2001. Introduction to Proteomics, Tools for the New Biology. Humana Press, New Jersey. USA

9. Reiner Westermeier and Tom Naven., 2002. Proteomics in Practice. Wiley – VCH, Weinheim,Germany.

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Semester III

15BCP311 **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

Case study-Report

7. Serum enzyme in liver disease
8. Serum enzyme in cardiac disease
9. Serum enzyme in cancer disease
10. Glucose Tolerance Test

REFERENCES

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

2. Sadasivam S and A. Manickam, 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.

Semester III

15BCP312 **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 and liver function through the analysis of urea and uric acid and bilirubin in serum
4. Determine A/G ratio and interpret its relevance
5. Handle the small experimental animals and
6. 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 chloride in the urine and serum
5. Estimation of calcium in the urine and serum
6. Estimation of magnesium in the urine and serum
7. Analysis of urinary calculi

8. Estimation of Bilirubin in serum(Kit method)
9. Estimation of triglyceride in serum (Kit method)
10. Estimation of HDL in serum (Kit method)

ANIMAL STUDIES (Group experiment)

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

REFERENCES

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

2. Sadasivam S and A. Manickam, 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.

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		Semester IV
15BCP491	PROJECT AND VIVA VOCE	15C

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

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		Semester II
15BCP306	CLINICAL DATA MANAGEMENT	4C

SCOPE

To understand structural features of clinical data management.

OBJECTIVE

Since the emerging trends are numerous the goals of the course is to introduce the student to the current trends in database management for clinical research.

UNIT I

Drug Development Process

Review FDA approved process for development and approval of a drug, role of key player in drug development. Key events in history that have impacted human subject rights, review informed consent process and describe regulatory requirements.

UNIT II

GCP Regulation and Guidelines

Key concept in regulatory application such as GCP, regulation guidance and ICH guide lines. Review mandatory regulations of FDA that apply to sponsor investigator and IRB. Review the regulatory documents which must be collected and maintained, discuss the role of these regulatory documents, and identify strategies to ensure their accurate completion, review management of study files.

UNIT III

Database Management Systems (DBMS) for Clinical Research

The concept of a multi-table relational database and data normalization. Rows as entities, columns as attributes. Primary and foreign keys. One-to-One, One-to-Many and Many-to-Many relationships. The basic tables in a clinical research study: subjects, measurements, and examiners.

Creating a table in design or "data dictionary" view. Field names, types, and descriptions; validation rules, primary and foreign keys, lookup tables, and relationships between tables. Creating data entry forms/subforms.

UNIT IV

Queries and Reports, Importing Data

Filtering by form. Writing select queries and reports for monitoring study progress. Importing data and appending and updating records.

UNIT V

Queries and Exporting Data

More sophisticated queries, including totals ("group by") queries. Exporting data for statistical analysis. SAS Programming

TEXT BOOKS

1. Martin D.Hynes, 1998. Preparing for FDA pre-approval inspections, Informa Health Care Publication.

2. Raghu Ramakrishnan, Johannes Wendy Bohaychuk and Graham Ball, 1999. Conducting GCP-compliant clinical research, John Wiley Son's publication.

3. Richard K. Rondel and Sheila A.Varley, 2000. Clinical Data Management, John Wiley and Sons.

REFERENCES

1. Abraham Silberchatz Henry K.Forth, Sudharshan ,2005. "Database System Concepts" 5th Edition Tata McGraw Hill, New Delhi.

2. Date C.J, 2003. An Introduction to Database Systems, 8th Edition Addison Wesley

3. Gehrke, 2003. Database Management SystemsMcGraw-Hill Professional, New Delhi

4. Jack Shostak, 2005. SAS Programming in the Pharmaceutical Industry, SAS Publication.

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Semester III

15BCP401 **DRUG DESIGNING** **4C**

SCOPE

This paper encodes information on drug designing, drug discovery and drug metabolism.

OBJECTIVE

To aasist the students to know the actual path of drug mechanism of action and drug discovery.

UNIT I

Introduction to drugs, classification of drugs, passage of drugs across biological membrane; absorption and distribution of drugs; Drug metabolism and elimination- methods of study of drug metabolism, microsomal drug metabolism, binding of drugs to plasma proteins, Introduction and receptor concept-. Types of receptors, receptor theories, isolation of receptors. consequences of drug receptor interaction

UNIT II

Monte Carlo Simulation Methods, Conformational analysis, *Ab initio*, dft and semi empirical methods, Use of molecular modeling to discover and design new molecules. Techniques of molecular dynamics, Molecular Dynamics Simulation Methods - molecular dynamics using simple models, molecular dynamics with continuous potential-setting up and running a molecular dynamic simulation, constraint dynamics.

UNIT III

Recent advances in drug design methodologies- Biomolecular structure, Structure activity relationship, Pharmacokinetics, Pharmacophoric pattern, ADME Properties, quantitative structure activity relationship, Use of genetic algorithms and principle component analysis in the QSAR equations.

UNIT IV

Ion channels- Structure, function and Pharmacology, Enzymes and enzyme inhibitors, - Enzyme Inhibition strategies.- Enzyme inhibition as a tool for drug development – Examples. Finding new drug targets to treat disease- strategies for target identification and

lead design- Use of Genomics and Proteomics for understanding diseases at molecular level-- new targets for anti-cancer drugs, Lipinski's rule.

UNIT V

Principles and methods of docking, docking problem, structure based drug design, induced fit docking. 3D database search approaches. Screening technology and Informatics for natural products drug discovery. The drug development process, the practice and limitations of Computer assisted drug discovery process, Commercial analysis of docking software's.

TEXT BOOKS

1. Andrew R.Leach., 2001. Molecular Modeling; Principles and Applications, Prentice Hall
2. Kothekar.V, 2005. Essential of Drug Designing 2nd Edition, Academic Press, New York.
3. Penelope W Codding, 1998. Structure-Based Drug Design, Springer Publishers, Berlin Publications, New Delhi.
4. Satoskar, R.S.Bhandarkar, S.D and S.S. Ainapure, 14th edition, 1995. Pharmcology and pharamacotherapeutics. Popular Prakashnan Bombay.

REFERENCE BOOKS

1. Alan L. Harvey, 1998. Advances in Drug Discovery Techniques, John Wiley & Sons, New York.
2. Arup K Ghose,2001. Combinatorial Library Design and Evaluation, Marcel Dekker Publishers, New York.
3. Patrick.L.Graham (1995), An introduction to medicinal chemistry, Oxford University Press.
4. Povl Krogsgaard-Larsen, 2002.Textbook of Drug Design and Discovery, Taylor & Francis Publishers, New York.
5. Richard B Silverman, 2004. The Organic Chemistry of Drug Design and Drug Action, Elsevier Publishers, Ireland.
6. William Foye (1986), 3rd edition, Principles of medicinal chemistry.