**BHARATHIAR UNIVERSITY, COIMBATORE.**
**M. Sc., BIOCHEMISTRY DEGREE COURSE**
(Effective from the academic Year 2017-2018 onwards)
REVISED SCHEME OF EXAMINATIONS – CBCS PATTERN***(AFFILIATED COLLEGES)***

| SEM | Subject and Paper | Inst. Hrs/ week | Examinations | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Dur.Hr | CIA | Marks | Total Mark | |
| I | Paper-I Biopolymers | 5 | 3 | 25 | 75 | 100 | 4 |
| | Paper-II Analytical Biochemistry and Bioinformatics | 5 | 3 | 25 | 75 | 100 | 4 |
| | Paper-III Enzymes and Enzyme Technology | 4 | 3 | 25 | 75 | 100 | 4 |
| | Paper-IV Cellular Biochemistry | 4 | 3 | 25 | 75 | 100 | 4 |
| | Paper-V Plant Biochemistry and Biotechnology | 4 | 3 | 25 | 75 | 100 | 4 |
| | Practical-I Core Biochemistry Practical-I | 5 | - | - | - | - | - |
| | Elective – Paper I | 3 | 3 | 25 | 75 | 100 | 4 |
| II | Paper-VI Microbial Biochemistry | 5 | 3 | 25 | 75 | 100 | 4 |
| | Paper-VII Immunology | 5 | 3 | 25 | 75 | 100 | 4 |
| | Paper-VIII Advanced Clinical Biochemistry | 5 | 3 | 25 | 75 | 100 | 4 |
| | Paper-IX Molecular Biology | 5 | 3 | 25 | 75 | 100 | 4 |
| | Practical-I Core Biochemistry Practical-I | 5 | 6 | 40 | 60 | 100 | 4 |
| | Elective – Paper II | 5 | 3 | 25 | 75 | 100 | 4 |
| | Summer Training | - | - | - | - | - | - |
| III | Paper-X Biostatistics and Research Methodology | 5 | 3 | 25 | 75 | 100 | 4 |
| | Paper-XI Metabolism and Metabolic Regulation | 4 | 3 | 25 | 75 | 100 | 4 |
| | Paper-XII Genetic Engineering | 5 | 3 | 25 | 75 | 100 | 4 |
| | Paper-XIII Endocrinology | 4 | 3 | 25 | 75 | 100 | 4 |
| | Paper-XIV Pharmaceutical Chemistry and Neurochemistry | 5 | 3 | 25 | 75 | 100 | 4 |
| | Practical –II Core Biochemistry Practical-II | 4 | - | - | - | - | - |
| | Elective – Paper III | 3 | 3 | 25 | 75 | 100 | 4 |
| | Summer Training@ | - | - | 25 | - | 25 | 1 |
| IV | Practical-II Core Biochemistry Practical-II | 5 | 6 | 40 | 60 | 100 | 4 |
| | Project Work | 20 | 6 | 100 | 100 | 200* | 8 |
| | Elective – Practical/ Project | 5 | 6 | 40 | 60 | 100* | 4 |
| | Industrial visit@ | - | - | 25 | - | 25 | 1 |
| | Total | | | | | 2250 | 90 |

* For Project report - 80%; Viva-voce - 20% [ Assessment of Internal marks should be based on Monthly assessment and report by the concerned guide and HOD]

* Includes 25 / 40% continuous internal assessment marks for theory and practical papers respectively.

@ No University Examinations. Only Continuous Internal Assessment (CIA)

**List of Group Elective papers (Colleges can choose any one of the Group papers as electives)**

| Paper / Sem | GROUP A<br>Elective - Cell Culture and Molecular Techniques | GROUP B<br>Elective - Computational Molecular Biology | GROUP C<br>Elective – Nanoscience |
|---|---|---|---|
| I | Plant Tissue Culture | Computational Molecular Biology | Fundamentals of Nanoscale Science |
| II | Animal Tissue Culture | Genomics | Nanomaterials Synthesis |
| III | Methods in Molecular Biology | Proteomics | Characterization and Application of Nano Materials |
| IV | Elective Practical | Elective Practical | Elective Project work |

Note : **The syllabi for the following papers furnished below be followed and there is no change in the syllabi of remaining papers.**

**Semester I Paper IV – Cellular Biochemistry, Semester III Paper X - Biostatistics and Research Methodology and Paper XIV – Pharmaceutical Chemistry and Neurochemistry**

**Semester II- PAPER-VIII ADVANCED CLINICAL BIOCHEMISTRY**

**Sem.IV:CORE BIOCHEMISTRY PRACTICALS – II**
**and ELECTIVE GROUP A : PAPER I PLANT TISSUE CULTURE**

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**Semester- I-Paper-lV**

**Subject Title** : **CELLULAR BIOCHEMISTRY**

**Course Number** : **Number of Credit Hours: 4 (Fours)**

**Subject Description** :
This course is concerned with the structure and function of cells. "Structure" and "function" are two different ways of looking at the same thing; structures exist to accomplish certain functions and we account for biological function in this course.

**Goals:** This course of study aims:
To develop an understanding of the fundamentals of cell biology.
To gain an understanding of the structure and function of living organisms, their life processes and Biochemical basis of motility
To provide a strong basis for membrane and organelle biogenesis, cell-cell interaction, cell-cell signaling, Cancer and cell cycle.

**Objectives:** At the end of this Course of study students will be able to:
Demonstrate an understanding of the membrane models and membrane transport.
Demonstrate an understanding of the major types of living organisms and the characteristics of and fundamental differences in their body plans/organisation and functions.
Demonstrate an understanding of the various types of microfilaments and microtubules .
Demonstrate an understanding of the structures and functions of the major cell and tissue types of higher animals, particularly humans.
Demonstrate an understanding of the cell cycle, its control through apoptosis, and explosion of cancer and its mechanism

**UNIT-I**
Membrane bilayer - Models, Membrane lipids - fluidity, Asymmetry phase transition, Liposomes . Membrane proteins - Types, Orientation, Mobility - Experiments, flippases, proteins or RBC membrane, Bacteriorhodopsin, Porins-aquaporin. RBC ghosts, solubilisation of proteins, lipid anchored proteins Carbohydrates - cell surface carbohydrates – Lectins.

**UNIT II**
Membrane transport - Overview, Passive diffusion, Facilitated diffusion in erythrocytes, Carriers and Ion - Channels. Ion cone. gradients. Uniporter Catalyzed transport. Active transport systems. Transport process driven by ATP - Ion Pumps :-Calcium ATP ase; $Na^+K^+$ATP ase; Mechanism, Gastric $H^+K^+$ ATP ase, ATP ases that transport peptides and drugs.
ABC superfamily - Bacterial PM permeases, Mammalian MDR proteins: Transport process driven by light and ion gradients.
Co-transport by Symporters and antiporters, Group translocation Osmosis and Receptor mediated endocytosis.

**UNIT III**

Mitochondria - Reduction potentials, electron transport chain Overview, Complexes, Q-cycle, Cyt.C oxidase complex, Translocation of Protons and the establishment of a proton, motive force, Machinery for ATP formation. Chemi-osmotic mechanism, ATP Synthase - Experiments, Inhibitors and Uncouplers of oxidative phosphorylation.

Microfilaments - Actin – Structures, Assembly, Myosin.

Microtubules - Organisation and dynamics, Kinesin and dynein.

Striated muscle - structure, excitation - contraction.

**UNIT IV**

Cell - matrix adhesion, metallo proteinase types and its importance.

Cell-Cell, interaction:- ECM; Collagen, hyaluronan & proteolycans, laminin, integrins, adeponectin and fibronectins.

Cell-Cell adjunction: Specialised junctions -- Desmosomes, Gap junctions, - Cadherins - Connexins.

Cell-Cell signaling - Signaling molecules and their receptors: functions of cell surface receptors, pathways', of intracellular signal transduction, second messengers - G -protein coupled receptors, receptor tyrosine kinases, Ras, MAP kinases, PEP-CK.

**UNIT V**

Subcellular organelles – structure and biochemical functions of ER, Lysosomes, Chloroplast and Golgi apparatus

Cell Cycle: - Overview and its regulation. Cell cycle Control in mammalian cells,

**References:**

1. Molecular cell biology 5th edition- Locish, Berk *et al.*, Freeman and Co., 2004
2. Principles of biochemistry, Garrette, Grisham, Saunders College Publishing Co. 1994
3. Molecular Cell biology 3rd edition, Lodish *et a1.*, Scientific American Books. Freeman and Co.,1995
4. Molecular biology of the cell 4th edition – Alberts *et al.*, Garland Publishers, 2002
5. Harper's Biochemistry 26th edition – Murray *et al.*, McGraw Hill, 2003

**SEMESTER- III PAPER –X**

**Subject Title** : **BIOSTATISTICS AND RESEARCH METHODOLOGY**
**Course Number** : **Number of Credit Hours: 5 (Five)**

**Subject Description** :
The course emphasizes on various statistical methods and significance. In this paper the methods for which there are applications in life sciences are taught. The students are expected to understand the concepts and solve relevant problems pertaining to each topic. No derivations or proofs are expected of them. Emphasis is laid on learning to solve the problems

**Goals:**
To equip the students with basic statistical knowledge and its biological applications
**Objectives:**
To provide knowledge and skills sufficient to allow students to understand the role of statistics in research.
To develop skill in the basic methods of data gathering and analysis.
To provide sufficient background to be able to interpret statistical results in research papers.
To develop sufficient knowledge of probability and probability distributions to support further studies in statistics and operations research.

**UNIT I**
Organising a statistical survey - Planning and executing the survey. Source of data - Primary and secondary data, Collection -- observation; interview; enquiry forms, questionnaire schedule and check list. Classification and tabulation of data. Diagrammatic & graphic presentation of data.
Thesis writing, Publication in a scientific journal, Preparation of Abstract and manuscript. Research problem, research design, preparation for a research and funding agencies. Bioethics& Biosafety, IPR & Patenting

**UNIT II**
Measures of central tendency; arithmetic mean, median, mode, quartiles, deciles and percentiles.
Measures of variation: range, quartile and Quartile deviation, mean deviation, standard deviation.
Correlation analysis: Scatter diagram, Karl Peason's coefficient of correlation and Spearman's rank method. Regression analysis- Regression line, Regression equation.

**UNIT III**
Probability -- definition, concepts, Addition and Multiplication theorems (proof of the theorems not necessary) and calculations of probability.
Theoretical, distributions.
Binomial ,Poisson, Fit a Poisson distribution.
Normal distribution -importance, properties, conditions and constants of the distribution (proof not necessary).
Simple problems.

**UNIT IV**
Sampling distribution and test of significance:
Testing of hypothesis errors in hypothesis testing, standard error and sampling distribution. sampling of variables (large samples and small samples ).
Student's 't' distribution and its applications.
Chi - square test & goodness of fit.

**UNIT V**
Analysis of variance one way and two-way classification. Duncans Multiple Range Test.
Design of experiment - completely randomized block design randomized clock design

**References:**
1. Statistical methods S.P. Gupta
2. Biostatistics – A foundation for analysis in health science Danien.
3. Biostatistical analysis - Jerrold H.Zar. Pearson Education, 4th Edition
4. IPR, Biosafety and Bioethics – Deepa Goal and Shomini Parashar, Pearson Publications.
5. Research methodology – Kothari
6. Research methodology – R. Gurumani

## SEMESTER- III PAPER-XIV

**Subject Title** : **PHARMACEUTICAL CHEMISTRY AND NEUROCHEMISTRY**

**Course Number : Number of Credit Hours: 5 (Five)**
**Subject Description** :
This course. deals with the drug, drug metabolism, drug receptors,drug tolerance, dependance , resistance. It also contains the effect of drugs on neuro system
**Goals:**
To enable the students to learn about various drugs with its effects and metabolism. Therapeutic monitoring of drugs.
**Objectives:**
After the completion of this course the student would have understood
Various routes of Drugs administration, its distribution, metabolism and excretion.
Genetically engineered drugs for AIDS and cancer and novel drug delivery systems
Effect of drugs on central nervous system and associated diseases

**UNIT-I**
Drugs – sources, Classification, dosage forms and routes of administration. Drugs – structural features and pharmacological activity, prodrug concept. Absorption, factors modifying drug absorption. Distribution, metabolism and excretion of drugs – phase I, II reactions, action of cytochrome P450.

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, ADME properties of drugs. Adverse 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**

**Biotechnology and Pharmacy**

Genetically engineered protein and peptide agents. Drug delivery systems : Non-conventional routes of administration, anti-AIDS drug development, oncogenes as targets for drugs, multidrug resistance, production of secondary metabolites by plant culture.
Patenting of Drug, Marketing, Computer aided drug design.

**UNIT-IV**

Mechanism of action of drugs used in therapy of

a) Respiratory system – cough, bronchial, asthma, pulmonary tuberculosis.
b) Antimicrobial drugs – sulfonamides, trimethoprim, penicillins, aminoglycosides and bacterial resistance.
c) Cancer chemotherapy
d) Thyroid and antithyroid drugs, insulin and oral antidiabetic drugs, antifertility and ovulation inducing drugs.

**UNIT-V**

Neurotransmitters :- Cholinergic transmission and receptors; adrenergic transmission and receptors; muscarinic receptors.
Non-steroidal and anti-inflammatory drugs; adrenergic blocking drugs; cholinergic blocking drugs; muscarinic blocking drugs; Parkinson's disease; Alzhemier's disease.
Neurodegenerative disorders – amylotropic, lateral sclerosis, senile dementia, Schizophrenia,Huntington's disease, meningitis.

**References:**

1. The pharmacology, Volumes I and II – Goodman, Gilman
2. Basic and clinical pharmacology 7th edition – Katzung, Printice Hall, New Delhi
3. Pharmacology 3rd edition – Rang, Tale
4. Pharmacology and pharmacotherapeutics – Satoskar *et al.*, Popular Prakashar, Mumbai
5. Principles of medicinal chemistry – Foye, Waverks Pvt. Ltd. New Delhi
6. Burger's medicinal chemistry and drug discovery: principles and practice – Wolf, John Wiley
7. Molecular basis of inherited diseases – Davies, Read, IRL Press
8. Molecular biotechnology 2nd edition – Glick, Pasternak, Panima Publishers, 2002

**SEMESTER-II PAPER-VIII**

**Subject Title : ADVANCED CLINICAL BIOCHEMISTRY**

**Course Number : Number of Credit Hours: 5**

**Subject Description** :
Clinical biochemistry is the area of pathology that is generally concerned with analysis of bodily fluids. Clinical Biochemistry is that discipline which applies basic biochemistry and analytical chemistry to medical diagnosis, treatment and management. It provides a sound, objective basis on which to gauge the extent of a clinical disorder, the biochemical consequences of a particular disease process, and the response to therapy..

**Goals**:
To enable the students to learn serum chemistry, Principle, assay, and clinical significance of diagnostic enzymes .Diseases associated with liver, kidney and pancreas. Cancer, types and role of free radicals

**Objectives:**
Given information Common chemical pathology tests include: AST,ALT,GTT, Alkaline phosphatases , Bilirubin, CSF etc.
Course emphasized human metabolism , students developed knowledge of metabolic changes during the fed, fasting and starved state.
A substantial no of medical cases were included to demonstrate the relevance of biochemistry to health and disease.
Topics discussed include: Biochemical markers of disease and clinical significance of steroid, protein and thyroid hormones

**UNIT I**
Serology and hematology :- C- reactive protein test, immunological test for pregnancy. Rhumatoid arthritis (RA) test. ESR.,Coagulation test, prothrombin test. Hemoglobin: Normal and abnormal Hb, Seperation of hemoglobin. Thalasemia, Hemoglobinopathies. Erythrocyte metabolic pathways, Disorder of erythrocyte metabolic pathways,. Porphyrins and porphyrias.

**UNIT II**
Specimen collection and processing:-
Collection of blood vein puncture, collection with syringe, collection with evacuated tube, skin puncture, arterial puncture and anticoagulants.
Collection of urine:-
Timed urine specimens, urine preservatives. Test for urinary compounds. Clinical significance of urinary components with reference to sugars,proteins,ketone bodies, bilirubin and porhyrins.
CSF:- Composition and collection ,chemical examination and infections, spinal cord infections.
Amniotic fluid:- Origin, collection,composition and analysis of amniotic fluid.

**UNIT III**

Clinical enzymology and endocrinology:-

Principles of diagnostic enzymology - Factors affecting enzyme levels in blood.

Principle, assay, and clinical significance of transaminases, creatine kinase, lactate Dehydrogenase, phosphatases, isocitrate dehydrogenase, 5'nuclotidase, gamma –glutamyl transferase, amylase, lipase, trypsin, chymotrypsin, choline esterase, glutamate dehydrogenase, glucose -6-phosphate dehydrogenase and ceruloplasmin.

Enzyme pattern in diseases:- Myocardial infarction, hepatobiliary diseases. Overview of clinical significance of steroid, protein and thyroid hormones. (Experimental details not required).

**UNIT IV**

Liver function test and related disorders:-Jaundice ,cirrhosis, hepatitis, fatty liver and gall stones. Renal function test and related disorder:- Acute renal failure.glomerular disease,tubular diseases, analysis of urinary calculi. Gastric and pancreatic function test. Hyper and hypo lipoproteinemias and diagnostic test for lipoprotein disorders.

**UNIT V**

Oncology:-

Apoptosis (Programmed cell death) -- Pathways, regulators ,& effectors in apoptosis. Cancer markers for oral cancer. Prostate cancer,.Colorectal cancer.breast cancer and gastrointestinal tract cancer. Alpha fetoproteins,carcino embryonic antigens, leukemia.

Cancer: Properties of tumor cells & Genetic basis and onset of cancer.

Tumor suppressor genes and functions of their products. Carcinogenic effect of chemicals and radiation. Molecular diagnosis of cancer.

Free radicals in diseases:- Introduction , Types of free radicals. Free radical induced lipid peroxidation and antioxidants( Enzymic – SOD, Glutathione PEroxidase, Glutathione Reductase; Non Enzymic-Ascorbic acid, Tocopherol, Reduced Glutathione) .

**References:**

1. Fundamentals of clinical chemistry – Teitz, W.B.Saunders company, 1994
2. Clinical chemistry in diagnosis and treatment 6th edition – Mayne, ELBS Publications, 1994
3. Practical clinical biochemistry, volume I and II, 5th edition – Varley *et.al.*, CBS Publishers, 1980
4. Teitz text book of clinical biochemistry 3rd edition – Burtis *et al.*, William Heinmann medical books, Ltd., 1999
5. Clinical biochemistry – Metabolic and clinical aspects, Pearson Professional Ltd.1995
6. Clinical chemistry 5th edition – Mosby, Marshall, 2004
7. Harrison's Principles of internal medicine Vol. I and II. 14th edition, McGraw Hill
8. Clinical chemistry – princ

## SEMESTER – III and IV
## CORE BIOCHEMISTRY PRACTICALS – II

**Colorimetric experiments:**

1. Isolation and estimation of starch from potato
2. Isolation and estimation of glycogen from liver
3. Isolation and estimation of ascorbic acid from fruit
4. Estimation of β-carotene from carrot
5. Estimation of lactose from milk
6. Estimation of RNA – UV and visible methods
7. Isolation and estimation of DNA from spleen/liver – UV and visible methods
8. Estimation of fructose in fruits
9. Antioxidant assay- DPPH, FRAP and $H_2O_2$ scavenging assay.

**Enzyme studies:**

10 . Isolation , purification (precipitation methods, dialysis and chromatography), properties, kinetics and inhibitor studies of any one of the following enzymes:

a) peroxidase b) amylase c) cellulase d) protease

**Clinical microbiology:**

11. Isolation of pure culture – serial dilution, pour plate, spread plate, streak plate methods, and slab culture techniques for long term storage
12. Colony morphology – colony counting
13. Staining techniques – simple, differential, negative, acid fast, spore, capsule and fungal staining
14. Antibiotic sensitivity disc – phenol coefficient method
15. Estimation of bacteria – growth curve of bacteria and generation time
16. Biochemical test – IMVIC , Starch test and Catalase test.

## ELECTIVE GROUP A : PAPER I - PLANT TISSUE CULTURE

**Number of Credit Hours: 3 (Three)**

### UNIT -I

Genome organization in plants. Cell and Tissue culture in plants: Tissue culture media (composition and preparation)
Primary culture: cell line, cell clone, callus and suspension culture, Somoclonal variation, Micropropagation, Organogenesis.

### UNIT- II

Embryo culture and Embryo rescue, somatic embryogenesis, Haploidy, Protoplast fusion and somatic hybridization, Cybrids, Allopheny, Artificial seeds.

### UNIT -III

Anther, Pollen and ovary culture for production of haploid plants and homozygous lines. Cryopreservation, slow growth and DNA banking for germ plasm conservation.

### UNIT- IV

Application of Plant Transformation for productivity and performance: Herbicide resistance, Insect resistance, virus resistance, Nematode resistance, and Bt genes.

### UNIT- V

Plant secondary metabolites, Edible vaccines, and Biodegradable plastics.
Phytochemistry –Extraction methods and purification of alkaloids, flavonoids and terpenoids. Therapeutic importance of medicinal plants.