

**BHARATHIAR UNIVERSITY, COIMBATORE.**  
**M. Sc., BIOCHEMISTRY DEGREE COURSE**  
**(AFFILIATED COLLEGES)**  
(Effective from the academic Year 2014-2015)  
**SCHEME OF EXAMINATIONS – CBCS PATTERN**

SEM	Subject and Paper	Inst. Hrs/ week	Examinations				Credit
			Dur.H	CIA	Marks	Total Marks	
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
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
IV	Practical-II Core Biochemistry Practical-II	5	6	40	60	100	4
	Project Work	20	6	100	150	250*	10
	Elective – Practical/ Project	5	6	40	60	100*	4
	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.

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

Paper / Sem	GROUP A Elective - Cell Culture and Molecular Techniques	GROUP B Elective - Computational Molecular Biology	GROUP C 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 :

1. The syllabus for the above papers (except **Paper II - Analytical Biochemistry and Bioinformatics, Core Biochemistry Practical – I & II, Paper VII –Immunology, Paper X - Biostatistics and Research Methodology, Paper XIV – Pharmaceutical Chemistry and Neurochemistry**) be the same as prescribed for the academic year 2011-12.
2. The syllabus for the Paper II - Analytical Biochemistry and Bioinformatics, Core Biochemistry Practical – I & II, Paper VII –Immunology, Paper X - Biostatistics and Research Methodology, Paper XIV – Pharmaceutical Chemistry and Neurochemistry are furnished below.

## Semester-I Paper-II

**Subject Title : ANALYTICAL BIOCHEMISTRY AND BIOINFORMATICS**

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

**Subject Description :** This course focuses on instrumental techniques including spectrometry, electrophoresis, centrifugation, x-rays, radioactivity and also in bioinformatics database design, principles of programming languages, structure and sequence analysis.

**Goals:** Students will have the ability to critically understand many instrumental principle and analysis. They can use computer databases to store, retrieve and assist in understanding biological information and also get knowledge about use of the most commonly used online tools and resources

### **Objectives:**

At the end of this course students will be able

To have a basic understanding of the theoretical principles involved in Bioinstrumentation

To have the practical skills and techniques required in biochemical analysis

To become competent in the basic experimental techniques of biochemistry

To gain knowledge in using software techniques and internet resources to handle and compare sequence and structure information, search databases and Interpret protein structure.

### **UNIT-I**

Spectroscopic technique: Basic principles, instrumentation and applications of UV, visible and IR spectrophotometers. Electron spin resonance, Nuclear Magnetic Resonance, Mass Spectrometry, Flame Photometry – principles and applications. Centrifugation techniques: Principle and technique of preparative and analytical centrifugation, differential centrifugation, density gradient centrifugation, ultracentrifuge and its application.

### **UNIT-II**

Chromatographic techniques: Principle, technique and applications of paper, TLC, ion-exchange, molecular sieve and adsorption chromatography. Principle, components, limitations and applications of GLC and HPLC.

Electrophoresis techniques: Principle and technique of paper, gels – Agarose gel electrophoresis, SDS-PAGE. Isoelectric focusing.

### **UNIT-III**

X-rays, X-ray diffraction, crystals and detectors – quantitative analysis and applications. ORD and circular dichroism – principles and applications.

Nature and units of radioactivity. Radiochemical methods: basic concepts, counting methods and applications, autoradiography.

#### **UNIT-IV**

Introduction: objectives and scope of bioinformatics, internet and world wide web. Useful search engines. Scripting languages – perl and its applications to bioinformatics. Biological databases – sequence and structure. Data retrieval. Database search – FASTA and BLAST. CLUSTAL and PHYLIP. Protein databases – sequence and structure data, Expasy, Swiss-port/PDB bases.

#### **UNIT-V**

Secondary and tertiary structure prediction of proteins. Introduction to proteomics. Fold recognition. Application of proteomics. Mining proteomes, protein expression profiling, identifying protein-protein interactions and protein complex. Mapping protein modification.

#### **References:**

1. Analytical biochemistry – D.J. Homie and H. Peck. Longman group – Rastogic CBS publishers, 1<sup>st</sup> edition, 2003.
2. Modern experimental biochemistry 3<sup>rd</sup> edition – R. Boyer, Addison Wesley Longman Publishers, 2000
3. A biologist's guide to principles and techniques of practical biochemistry 5<sup>th</sup> edition – Wilson and Walker, Cambridge University Press, 2000
4. Bioinformatics – concepts, skills and applications 1<sup>st</sup> edition. S.C. Rastogi *et al.*, CBS publishers, 2003
5. Introduction to bioinformatics 1<sup>st</sup> edition – S. Sundararajan, R. Balaji, Himalya publishing house, 1<sup>st</sup> edition, 2002
6. Bioinformatics for beginners. 1<sup>st</sup> edition – K. Mani, N. Vijayara, Kalaikathir Achagam, Coimbatore, 2002
7. Discovering genomics, proteomics and bioinformatics – Campbell, Heyer, Cold Spring Harbor Laboratory Press, 2002
8. Introduction to bioinformatics – A. M. Lesk, Oxford University Press, 2002
9. Introduction to proteomics – D. C. Liebler, Humana press, 2002

#### **Web sites:**

- <http://www.ensembl.org>
- <http://www.ncbi.nlm.nih.gov/genbank>
- <http://www.123genomics.com>
- <http://www.expasy.ch>

### **SEMESTER I AND II** **CORE BIOCHEMISTRY PRACTICALS – I**

#### **Clinical biochemistry:**

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) Creatine kinase    g) Superoxide dismutase    h) glutathione peroxidase
2. Determination of the following from urine/serum:  
a) Chloride    b) Calcium    c) Magnesium

3. Estimation of albumin
4. Estimation of thiobarbituric acid reactive substances (TBARS) in serum
5. Estimation of glucose and protein in Serum

**Genetic engineering and molecular biology:**

6. Agarose gel electrophoresis of DNA
7. Preparation of competent *E. coli* – Transformation (demonstration)
8. Plasmid DNA isolation from *E. coli*

**Immunology:**

9. Immunodiffusion – single radial and double diffusion
10. Immunoelectrophoresis
11. Rocket immunoelectrophoresis
12. Agglutination antibodies - Identifying blood group and Rh typing

**Separation techniques:**

13. Separation of amino acids by paper chromatography – circular, ascending and descending
14. Separation of amino acids/lipids/sugars by TLC
15. Separation of plant pigments by column chromatography

**Bioinformatics**

16. Sequence and Structural Database
17. BLAST and Clustal W
18. Gene Prediction using GenMark and GenScan

**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  $\beta$ -carotene from carrot
5. Estimation of thiamine from cereals/fruits
6. Estimation of riboflavin
7. Estimation of lactose from milk
8. Estimation of RNA – UV and visible methods
9. Isolation and estimation of DNA from spleen/liver – UV and visible methods
10. Estimation of fructose in fruits

**Enzyme studies:**

11. 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:**

12. Isolation of pure culture – serial dilution, pour plate, spread plate, streak plate methods, and slab culture techniques for long term storage
13. Colony morphology – colony counting

14. Staining techniques – simple, differential, negative, acid fast, spore, capsule and fungal staining
15. Antibiotic sensitivity disc – Disc diffusion method
16. Growth curve of bacteria
17. Biochemical test – IMVIC test.

### Semester – II – Paper – VII

**Subject Title** : IMMUNOLOGY

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

**Subject Description** :

Immunology is a broad branch of [science](#) that covers the study of all aspects of the [immune system](#) in all [organisms](#). It deals with, among other things, the [physiological](#) functioning of the immune system in states of both health and disease; malfunctions of the immune system in immunological disorders ([autoimmune diseases](#), [hypersensitivities](#), [immune deficiency](#), [allograft rejection](#)); the physical, chemical and physiological characteristics of the components of the immune system [in vitro](#), [in situ](#), and [in vivo](#).

**Goals:** Students can attain knowledge about body's immune system ,its functions and disorders, identifying antibodies, investigating problems with the immune system such as autoimmune diseases, and immunodeficiency disorders. And determining organ compatibility for transplantation.

**Objectives:**

given students a key understanding of the molecular and cellular components that comprise the immune system, including their function and interaction.

Enable students to learn [diseases](#) caused by disorders of the immune system (failure, aberrant action, and malignant growth of the cellular elements of the system),

Given the students, the latest methods of detecting disease causing pathogens, its treatment using novel vaccines.

#### UNIT I

Experimental Animal Models: inbred strains, SCID mice, nude, knockout mice. hemolytic plaque assay. Cells of the immune system: haematopoiesis. haematopoietic growth factors. Regulation of haematopoiesis, clinical uses of stem cells. Lymphoid cells – Lymphoblasts CD antigens, T cell membrane molecules. T-cell receptors. Null cells, granulocytes adhesion molecules.

#### UNIT II

Antigens : B cell epitopes, T cell epitopes, Haptens : viral and bacterial antigens. factor influencing immunogenicity, adjuvant technology; Immunoglobins: domains classes and biological active antigenic determinants on Immunoglobins. Immunoglobulins superfamily, Monoclonal Antibodies. Antigen - antibody interactions invivo - cross reactivity Antigen - antibody interaction invivo -- precipitants, agglutinants, RIA, ELISA - techniques and applications. MHC: Organization, MHC molecules and genes, Cellular distribution, regulation of MHC and immune responsiveness. MHC and disease. Antigen processing and presentation.

### **UNIT III**

Complement Activation: Pathways regulation of complement system, Biological consequence of complement activation, complement deficiencies. Cytokines: IL, IFN, TNF, CSF, Cytokine, receptors, Cytokine antagonists, Cytokines related diseases. B&T cell maturation, activation, proliferation & differentiation

### **Unit IV**

Hypersensitivity reactions - Type I, II, III & IV. Hypersensitivity disease. Cell mediated immunity: CTL mediated cytotoxicity, NK cell mediated toxicity. delayed type hypersensitivity. Immunological tolerance. Vaccines: Active and passive immunization, whole organism vaccines, recombinant vector vaccines, DNA vaccines, Synthetic peptide vaccines, multivalent sub-units vaccines. Immunodeficiency diseases.

### **UNIT V**

Autoimmunity: Autoimmune disease in human, animal models, mechanism for induction of autoimmunity, Therapy. Transplantation immunology: clinical manifestation, therapy and bone-marrow transplants. organ-transplants. Cancer immunology: Tumor antigens, immune response to tumors, tumor evasion, Cancer immuno therapy. AIDS: Structure of HIV, destruction of T cells, immunological symptoms of AIDS. AIDS vaccine, gene therapy for treatment.

### **References:**

1. Kuby immunology 4<sup>th</sup> edition – Goldsby *et al.*, Freeman and Co. 2000
2. Immunology V-The immune system in health and disease. Janeway Jr.Paul Travels and Co., 2001
3. Immunology 3<sup>rd</sup> edition – Roitt *et al.*, Mosby publishers 1993
4. Immunology 4<sup>th</sup> edition - Zubay, W.M.C. Brown publishers, 1992
5. Cellular and molecular immunology 2<sup>nd</sup> edition Abbas *et al.*, W.S.saunders 1994
6. Immunology 3<sup>rd</sup> edition Kuby, W.H.Freeman and company
7. Introduction to Medical immunology 4<sup>th</sup> edition, Virella, Marcel Dekker Ltd., 1999

## **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.

### **UNIT II**

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

### **UNIT III**

Probability -- definition, concepts, theorems (proof of the theorems not necessary) and calculations of probability.

Theoretical, distributions.

Binomial - 'Poisson and normal distribution.

Normal -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, 4<sup>th</sup> Edition

### 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, dependence, 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, 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. 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; Alzheimer's disease.

Neurodegenerative disorders – amyotrophic, lateral sclerosis, senile dementia, Schizophrenia, Huntington's disease,

#### **References:**

1. The pharmacology, Volumes I and II – Goodman, Gilman
2. Basic and clinical pharmacology 7<sup>th</sup> edition – Katzung, Printice Hall, New Delhi
3. Pharmacology 3<sup>rd</sup> 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 2<sup>nd</sup> edition – Glick, Pasternak, Panima Publishers, 2002