

**MEENAKSHI COLLEGE FOR WOMEN  
(AUTONOMOUS)  
KODAMBAKKAM, CHENNAI-24**

**DEPARTMENT OF BIOCHEMISTRY**  
**syllabus**

**MEENAKSHI COLLEGE FOR WOMEN**  
**(AUTONOMOUS)**  
**Degree of Master of Science**  
**M.Sc. Biochemistry – Course Regulations**

**Conditions for Admission :**

A candidate who has passed B.Sc Degree Examinations in Biochemistry  
(Or)

B.Sc chemistry/ Botany/ Zoology/ Microbiology/ Biotechnology/  
Nutrition and Dietetics of University of Madras

(Or)

An examination of some other University accepted by syndicate as equivalent there to shall be permitted to undergo the course and to appear and qualify for the M.Sc Degree examination of this college after a course of two academic years.

**Duration of the Course:**

The course of Degree of Master of Science shall consist of two Academic years with four semesters.

**Examination:**

- There will be an Examination for theory papers at the end of each semester.
- Practical Examination will be conducted at the end of 2<sup>nd</sup> and 4<sup>th</sup> semester.
- A candidate who does not pass the Examination in any subject/ subjects of concern of any semester will be permitted to appear in such failed subject/ subjects in the month of June and December of an academic year.
- A short term project work had to be carried out during their 2<sup>nd</sup> year of the course and dissertation will have to be prepared and submitted for valuation which includes viva at the end of their 4<sup>th</sup> semester.

**Scheme of Examination**

The duration for theory papers is 3 hours and for the practical is 6 hours. The maximum marks for both theory and practical will be 100 of which 25 will be internal marks and 75 will be external marks.

Of the 25 marks which is allotted for internals

25% is of attendance

10% for assignment

10% for involvement in Department and college

30% for mid semester and model exam marks

25% for three best marks of the 5 tests given

**Passing Minimum:**

A candidate will be declared to have passed the exam if she secures a minimum of 50% each in her internal and external with an aggregate of the two equivalents to 55% in each paper/

practical/ project. Candidates interested in improving the marks in theory paper can take up the examination in the month of June of the two academic years.

**Classification of Successful Candidate:**

Candidate should acquire 135 credits to get the M.Sc degree. Candidates who obtain 75% marks shall be declared to have passed in first class with distinction provided they pass the examination prescribed for the course at first appearance. Candidates securing marks between 60% and less than 75% will be awarded first class and those securing between 55% and less than 60% will be awarded second class.

**MEENAKSHI COLLEGE FOR WOMEN (AUTONOMOUS)  
CHENNAI-24**

**Degree of Master of Science  
M.Sc. Biochemistry - Course of Study**

<b>PAPER</b>	<b>NAME OF THE PAPER</b>	<b>CODE</b>	<b>CREDITS</b>
<b><u>I YEAR - I SEMESTER</u></b>			
I	CELL BIOLOGY	1BC01a	5
II	PHYSIOLOGY	1BC02	5
III	ENZYMOLGY	1BC03a	5
IV	INTERMEDIARY METABOLISM I	1BC04	5
V	BIOMACROMOLECULES	1BC05a	5
<b><u>SEMESTER II</u></b>			
VI	ECOLOGY AND EVOLUTION	2BC06a	5
VII	BASIC MICROBIOLOGY	2BC07b	5
VIII	INTERMEDIARY METABOLISM II	2BC08	5
IX	NUTRITIONAL BIOCHEMISTRY	2BC09	5
X	ANALYTICAL TECHNIQUES I	2BC10a	5
	PRACTICAL I	2BCP1	5
	PRACTICAL II	2BCP2	5
<b><u>II YEAR – SEMESTER III</u></b>			
XI	ANALYTICAL TECHNIQUES II	3BC11a	5
XII	IMMUNOLOGY I	3BC12	5
XIII	CLINICAL BIOCHEMISTRY I	3BC13	5
XIV	ENDOCRINE SIGNALING	3BC14a	5
XV	MOLECULAR BIOLOGY	3BC15	5
<b><u>SEMESTER IV</u></b>			
XVI	IMMUNOLOGY II	4BC16	5
XVII	CLINICAL BIOCHEMISTRY II	4BC17	5
XVIII	ENDOCRINOLOGY	4BC18	5
XIX	BIOTECHNOLOGY	4BC19a	5
XX	GENETICS	4BC20	5
	PRACTICAL III	4BCP3	5
	PROJECT	4BCPR	10
	PROJECT VIVA	4BCPV	10

**Unit I:-**

Prokaryotes and Eukaryotic cells plant and animal cells. Types, structures and functions of tissues. Epithelium, microvilli, basement membrane, muscle and nervous tissues, functional and biochemical maturation of tissues

**Unit II:-**

Structure and function of sub-cellular organelles. Morphology and functions of nucleus, mitochondria, RER, SER, Golgi complex, lysosomes, peroxisomes and glyoxisomes.

**Unit III:-**

Cell-Cell interaction, cell adhesion proteins, tight junction, neurotransmitters, peptide hormones – insulin and growth factors.

**Unit IV:-**

Cell cycle, mitotic cell cycle-nuclear and cytoplasmic division events of prophase, metaphase, anaphase and telophase, cytokinesis, meiotic cell cycle regulation.

**Unit V:-**

Gametogenesis – spermatogenesis and regulation, oogenesis, and its regulation. Fertilization – mechanism of fertilization, organogenesis.

**Reference Books:-**

1. Cell and molecular biology – Lodish Berk and Baltimore
2. Molecular and cellular Biology – Wolfe S L
3. Human Physiology – Vande Arthur
4. Human Physiology – Chakrabarti
5. Cell and Molecular Biology – DeRobertis

**UNIT I:**

Composition and function of blood, differences between plasma and serum, development and function of RBC, WBC and platelets; regulation of blood cell production. Hemostasis - formation of platelet plug, coagulation of blood, mechanism, factors opposing coagulation, role of liver, vitamin K and role of blood vessels.

Heart-outline structure of heart, cardiac cycle, its mechanical events, cardiac output-definition, measurement of cardiac output by Fick's method, Dye method and thermo dilution method, factors influencing cardiac output, with a short note on electrocardiography, blood pressure –definition, measurement by sphygmomanometer, neural, chemical and hormonal control of cardiovascular system. Physiological, pathological, drug induced conditions affecting blood pressure, normal ECG pattern

**UNIT II**

Outline structure of stomach, liver, pancreas and intestine. Digestion in mouth-composition functions of saliva. Digestion in stomach- composition and function of gastric juice, pancreatic juice. Composition of liver, bile, gall bladder, functions gall bladder and bile, enterohepatic circulation. Digestive and absorptive function of small intestine and functions of large intestine.

**UNIT III**

Gross anatomy of respiratory tract- carriage, of oxygen and carbon dioxide by blood and their exchange at tissue level, oxygen and carbon dioxide dissociation curve. Bohr's effect, myoglobin, chloride shift. Cross section of kidney, basic structure of nephron, mechanism of urine formation, rennin angiotensin system.

**UNIT IV**

Structure of neuron, medullated nerve fibregrade and action potential, propagation of action potential [transmission of nerve impulse]

Synapse –Definition, three varieties, functional anatomy, synaptic transmission. Neuro transmitters- acetylcholine, catecholamine, serotonin, histamine, opioid peptides, gut brain peptides, GABA substance P Muscle- skeletal muscle –structure, mechanism of muscle contraction. Neuromuscular junction-functional anatomy, neuromuscular transmission, EPP, energy requirement for muscular activity.

**UNIT V**

Outline structure of reproductive organs, menstrual cycle – phases and events, hormonal control. Pregnancy – implantation, formation of placenta, estrogen, progesterone, common changes in pregnancy, parturition, lactation.

**REFERENCE BOOKS:**

1. Human physiology- C.Chatterjee.
2. Concise medical physiology- Chaudhuri, Sujith.K.
3. Human physiology-Vander Arthur.J.
4. Wrights applied physiology-Keele Sampson.
5. Text book of medical physiology- Arthur C.Guyton and John.E.Hall.
6. Essentials of medical physiology- Sembulingam.
7. Text book of human physiology-Saradha Subramaniam.

**UNIT I:**

Enzymes-Nomenclature and classification of enzymes, enzyme specificity, active site of enzymes, mapping of active site, enzyme activity. Intracellular localization of enzymes. Isolation and purification of enzymes. Isoenzymes and their separation. Enzyme turn over number.

**UNIT II**

Enzyme kinetics- reaction rate, order of reaction, energy of activation. Factors influencing velocity of enzyme reaction, effect of enzyme concentration, effect of substrate, pH, temperature, Michaelis Menten equation, Briggs Haldane modification, single and double reciprocal plots, determination of  $K_m$  and  $A_{max}$ , Kinetics of bisubstrate reactions (Alberty's equation). Single and double displacement reactions. Diagnostic plots for bisubstrate reactions. Enzyme inhibition – Types of inhibition, kinetics of competitive, non competitive and un competitive inhibition. Diagnostic plot for inhibitors. Determination of  $K_i$  and  $K_m$ . Allosteric enzymes with aspartate transcarbamoylase as example, sigmoidal kinetics, Hills plot, feedback inhibition.

**UNIT III**

Coenzymes and Multi enzymes systems.

Coenzymes cofactors, Structure and function of Coenzymes, reaction involving CoA, TPP, PLP, NAD/NADP, FMN/FAD, Biotin, folic acid Coenzymes. Multi enzymes systems – occurrence, isolation and properties, mechanism of action and regulation of Multi enzymes.

**UNIT IV**

Mechanism of enzyme activity – covalent catalysis, proximity, and orientation effects, acidbase catalysis, electrostatic catalysis, metal ion catalysis. Structure and mechanism of action of enzymes of chymotrypsin, lysozyme and ribonuclease.

**UNIT V**

Enzyme technology – industrial uses of enzymes – food and pharmaceutical industries. Designer enzymes, abzymes, ribozymes, immobilized enzymes – methods of immobilization and applications.

**Reference:**

1. Enzymes – Dixon and web
2. Principles of Biochemistry – Lehninger
3. biochemistry – Stryer
4. biochemistry – Zubay
5. Enzymes – Trevor Palmer

## **PAPER-IV INTERMEDIARY METABOLISM I CODE:1BC04**

### **UNIT I**

Glycolysis – energetics and regulation of glycolysis, gluconeogenesis – energetics and regulation, TCA cycle – amphibolic nature of TCA cycle, regulation of TCA cycle, uronic acid pathway. Pentose phosphate pathway, glyoxalate cycle, glycogenesis, glycogenolysis, hormonal regulation of glycogen metabolism.

### **UNIT II**

Chloroplast structure and function – CO<sub>2</sub> fixation by C<sub>3</sub> and C<sub>4</sub> plants, Hills reaction, photo respiration, photo phosphorylation

### **UNIT III**

Electron transport chain and production of ATP, components of Electron transport system, redox potential, chemiosmotic theory of oxidative phosphorylation, inhibitors of phosphorylation, uncouplers

### **UNIT IV**

Biosynthesis and degradation of heme, activation of sulphate ions, PAPS, APS, sulpho transferases

### **UNIT V**

Detoxification and xenobiotic metabolism. Mode of entry of xenobiotics into the body, phase I & phase II reactions, conjugation, reduction, hydrolysis and oxidative metabolism of xenobiotics.

### **Reference:**

1. Biochemistry – Voet
2. Biochemistry – Lubert stryer
3. Biochemistry – Albert Lehninger
4. Outlines of Biochemistry – Conn and Stumpf
5. Harper's Biochemistry – Murray and Robert
6. Lippincotts illustrated reviews – Champe, P.C.Harvey



**PAPER-V BIOMACROMOLECULES CODE: 1BC05a**

**UNIT I:**

Occurrence, chemical properties, classification, stereo and optical isomers, structure of monosaccharide, mutarotation, amino and deoxy sugars, structure and characterization of oligosaccharides, homopolysaccharides, heteropolysaccharides, starch, glycogen, cellulose, dextran, inulin, agar, pectin and mucopolysaccharides, lipopolysaccharides.

**UNIT II:**

Classification of amino acids, peptide bonds, Determination of amino acid sequence, methods of peptide synthesis, primary, secondary and tertiary structure of proteins, structural characteristics of hemoglobin, insulin, actin, myosin, collagen, elastin, denaturation of proteins.

**UNIT III:**

Structural properties of nucleic acids, nucleotides, nucleosides, phosphodiester linkage, methods of nucleotide sequencing. Denaturation and strand separation.

Fractionation, isolation and purification of DNA, messenger, ribosomal and transfer RNA, renaturation, cot value, hyper and hypo chromicity.

**UNIT IV:**

Classification of lipids, structure of phospholipids, TG, sterols, bile acids, prostaglandins, leukotrienes, thromboxanes, ceramides.

**UNIT V:**

Structure and assembly of biological membranes and membrane lipids. Integral and peripheral membrane proteins. Transport process – active, passive, ionophores, RBC membrane as role model, liposomes.

**Reference:**

1. Principles of Biochemistry – Lehninger
2. Biochemistry – Lubert Stryer
3. Biochemistry – Albert Lehninger
4. Harper's Biochemistry
5. Biochemistry – Voet

## **PAPER-VI ECOLOGY AND EVOLUTION      CODE: 2BC06a**

### **UNIT I:**

Evolution – Origin of life (including aspects of prebiotic environment and molecular evolution). Concepts of evolution, theories of organic evolution. Mechanism of speciation. Hardy Weinberg genetic equilibrium, genetic polymorphism and selection.

### **UNIT II:**

Biotic components of ecosystem – definition and types, sizes and structure of biotic community, ecological niche, community stability, correlation of environmental gradients and community gradients.

### **UNIT III:**

Dynamics of ecosystem - concepts and Dynamics of ecosystem. Components – food chain and food web, web flow, trophical levels. Types of ecosystem, ecological pyramids, ecological efficiencies.

### **UNIT IV:**

Aquatic ecosystem – fresh water ecosystem, subdivisions of Aquatic ecosystem. Physiochemical nature of fresh water lentic ecosystem: lakes and ponds, Physiochemical properties of lakes and ponds. Lotic ecosystem: characteristics of lotic environment, rapidly flowing water, slowly flowing water.

### **UNIT V:**

Marine communities – Marine ecosystems: Physiochemical aspects of marine environment, Marine communities, biotic communities of oceanic region and coral reef.  
Conservation of land and water

### **Reference:**

1. Ecology and evolutionary biology – Purohit and Agarwal
2. Environmental chemistry – P.K.Sharma
3. Environmental Biology – Varma

**UNIT I:**

Prokaryotes and Eukaryotes – the major groups of micro organisms. Structure of bacteria – cell wall, cell membrane, internal and external structure, structure of fungi and yeast. Bacterial photosynthesis – photosynthetic apparatus, CO<sub>2</sub> fixation and photophosphorylation. Micro organisms and biochemical cycles – N, C and S cycles, symbiotic and non symbiotic nitrogen fixation. Biological control of insect pests – Microbial insecticides and their application. Biosensors

**UNIT II:**

Bacterial growth curve, measurement of microbial growth, factors affecting growth, control of microbial growth – physical and chemical method. Types of culture, continuous culture, isolation and maintenance of pure culture.

**UNIT III:**

DNA organization, transfer of genetic information – transformation, transduction, conjugation, Virus – Bacteriophage, structure – lysogeny and lytic cycle, animal virus – DNA Virus, RNA Virus, SV 40, Retro Virus. Distribution and occurrence of normal flora in skin, respiratory tract, GI tract and genitourinary tract.

**UNIT IV:**

Food preservation – aseptic handling, high temperature, low temperature, dehydration, osmotic pressure, chemicals and radiation. Dairy Microbiology – fermented dairy products, microbial flora of milk, pasteurization and sterilization of dairy milk products.

**UNIT V:**

Microbial technology- Fermentors – Types, techniques, design and operation of fermentors, types and constituents of fermentative culture medium, antifoaming agents, ion methods employed in fermentation techniques, recovery and estimation of products. Production of ethanol, citric acid, glycerol, vit B<sub>12</sub>, streptomycin, Production of biofertilizers, soil inoculants

**Reference:**

1. Microbiology – Concepts and applications – Pelczar et al, Mcgraw Hill
2. Industrial Microbiology – Cassida, Prescott and Dunn
3. Text book of Microbiology – Panicker
4. General Microbiology – Hans G. Schelgel
5. General Microbiology – Power and Dagainawala
6. Microbiology – Tortora and Funke Case

## **PAPER-VIII INTERMEDIARY METABOLISM II CODE: 2BC08**

### **UNIT I:**

Fatty acid synthase complex, Biosynthesis of saturated and unsaturated Fatty acid, mitochondrial and microsomal chain elongation, regulation of Fatty acid biosynthesis.  $\alpha$ ,  $\beta$  and  $\omega$  oxidation of Fatty acid. Biosynthesis and degradation of ketone bodies.

### **UNIT II:**

Biosynthesis of phospholipids – phosphatidyl ethanol amine, phosphatidyl choline, phosphatidyl serine, phosphatidyl inositol, phosphatidyl glycerol and cardiolipin. Degradation of phospholipids, phospholipases – types and functions. Biosynthesis of plasmalogen. Biosynthesis and Degradation of sphingolipid. Phosphatidyl inositol cycle.

### **UNIT III:**

Biosynthesis of Tri acyl glycerol. Biosynthesis of cholesterol, primary and secondary bile acids. Regulation of Biosynthesis of cholesterol. Metabolism and transport of lipoproteins.

Definition and mechanism of lipid peroxidation, initiation, propagation and termination of lipid peroxidation, cellular targets and consequences of free radical damage, antioxidant and antioxidant defenses.

### **UNIT IV:**

Metabolism of nucleotides – denovo synthesis of purine nucleotides, salvage pathway, degradation of purine nucleotides. denovo synthesis of pyrimidine nucleotides, salvage pathway, degradation of pyrimidine nucleotides, Regulation of purine & pyrimidine nucleotide biosynthesis, inhibitors.

### **UNIT V:**

Biosynthesis and Degradation of tyrosine, phenyl alanine, histidine, tryptophan. Amino acid oxidases, transamination, deamination, decarboxylation reactions, inter conversion of amino acids. Urea cycle.

### **Reference:**

1. Biochemistry – Voet
2. Biochemistry – Lubert stryer
3. Biochemistry – Albert Lehninger
4. Outlines of Biochemistry – Conn and Stumpf
5. Harper's Biochemistry – Murray and Robert
6. Lippincotts illustrated reviews – Champe, P.C.Harvey
7. Lipid Biochemistry – Gurr

## **PAPER-IX      NUTRITIONAL BIOCHEMISTRY      CODE: 2BC09**

### **UNIT I:**

Dietary requirements, RDA for infants, children, pregnant and lactating women, old people. Dietary specifications in diseased conditions like diabetes, hypolipidemia, kidney damage & obesity. Body composition of adult man, determination of body fat and water. Calorific value of foods, respiratory quotient, BMR – Determination of BMR, factors controlling BMR and significance of BMR.

### **UNIT II:**

Specific dynamic action (SDA) of food, measurement of energy expenditure by direct and indirect calorimetry. Functions of Carbohydrates, lipids and proteins – Biological value of protein – PEM, over nutrition – obesity. Effects of cooking on diets.

### **UNIT III:**

Vitamins – dietary source, requirements, structure, absorption and storage, function disorders of water soluble and fat soluble vitamins and its antioxidation property

### **UNIT IV:**

Source, dietary requirements, absorption, function, clinical condition of sodium, potassium, calcium, phosphorus, iron, copper, magnesium, zinc, manganese, iodine, sulfur, chlorine, cobalt, molybdenum, selenium, fluorine.

### **UNIT V:**

Distribution of body water – normal channels of water gain and loss distribution of electrolytes - normal channels of electrolyte gain and loss. Abnormalities – depletion and excess states of sodium, potassium and pure water. Acid – Base balance- importance of pH, concept of pH and buffers, threats to blood pH, mechanism to tackle changes in pH (a) buffer systems (b) role in lungs and kidneys – acidosis and alkalosis.

### **Reference:**

1. Food science - M.S.Swaminathan
2. Human nutrition and Dietetics – Davidson and Passmore
3. Human nutrition – Garrow
4. Nutritional Science – Srilakshmi

## **PAPER-X ANALYTICAL TECHNIQUES I CODE: 2BC10a**

### **Unit I:**

General approaches to biochemical investigation. Organ and tissue slice technique, cell distribution and homogenization techniques, cell sorting and cell counting of various tissue culture collections. Cryopreservation, microscopy and manometric techniques.

### **Unit II:**

Distribution coefficient, types of chromatography, column chromatography, adsorption chromatography, hydroxyapatite chromatography, paper chromatography, thin layer chromatography, chromatofocussing, reverse phase liquid chromatography, ion paired reverse phase liquid chromatography, chiral chromatography, counter current chromatography.

### **Unit III:**

Gel filtration chromatography, ion exchange chromatography, affinity chromatography, gas liquid chromatography, high performance liquid chromatography, low pressure liquid chromatography.

### **Unit IV:**

Basic concepts of probability, mean, median, mode, standard deviation, law of chance, Hardy Weinberg's law, students 't' test, analysis of variance and correlation coefficients. Definition of population and sampling. Types of sampling – merits and demerits of sampling.

### **Unit V:**

General principles of electrophoresis, factors affecting electrophoresis, principle, instrumentation, application of high and low voltage thin sheet electrophoresis, paper, cellulose acetate thin layer electrophoresis, gel electrophoresis – starch, polyacrylamide, agarose, capillary electrophoresis. SDS – PAGE, iso electric focussing, isotacophoresis, 2D poly acrylamide gel electrophoresis, cellulose acetate electrophoresis, western blotting. Electrophoresis of nucleic acids, agarose gel electrophoresis, DNA sequencing gels, pulse field gel electrophoresis, electrophoresis of RNA.

### **Reference:**

1. Practical Biochemistry – Keith Wilson and John Walker
2. A biologist's guide to principles and techniques to Practical Biochemistry - Wilson and Kenneth Goulding
3. Chromatography – Kamlesh Bansal
4. Fundamentals of Biostatistics – Bernard Rosner
5. Introduction to Biostatistics and Research methods- P.S.S. Sundar Rao, J.Richard

## **PAPER-XI ANALYTICAL TECHNIQUES-II CODE:BC11a**

**Unit I:**

Electromagnetic spectrum, basic laws of light absorption, general instrumentation for spectroscopy. Types of spectrophotometer –  $\gamma$  – ray spectroscopy and resonance spectroscopy, X-ray spectroscopy, UV and visible light spectroscopy, IR and Raman spectroscopy, ESR, NMR, spectrofluorimetry, circular dichroism spectroscopy and atomic spectroscopy.

**Unit II:**

Principle, instrumentation and applications of UV – visible, IR, Raman, NMR, ESR, circular dichroism (ORD), atomic absorption and mass spectrometry, X-ray spectroscopy,  $\gamma$  – ray spectroscopy and spectrofluorimetry and luminometry and polarimetry.

**Unit III:**

Electro chemical techniques: Principles, Redox reactions – Principle and applications of redox couples, pH electrode – Principle, operation of the pH electrode/meter. Clark oxygen electrode - Principle, operation of the rank oxygen electrode and its applications. Biosensors and its applications, Biosensors – Introduction, Principle, instrumentation.

**Unit IV:**

Basic principles of sedimentation – centrifugal field, angular velocity, RCF, sedimentation rate or velocity, Svedberg unit, preparative and analytical ultra centrifuges. Techniques involved in differential centrifugation, application of analytical ultra centrifuge. Determination of relative molecular mass, estimation of purity of macro molecules, Determination of conformational changes in macro molecules.

**Unit V:**

Types and rate of radioactive decay, units of radioactivity – curie, count, Becquerel. Detection and measurement of radioactivity – Geiger Muller, scintillation counting, instrumentation and application of autoradiography. Applications of radioisotopes in biological sciences, radiation hazards and safety aspects.

**Reference:**

1. Practical biochemistry: Principles and techniques –Keith Wilson and John Walker
2. Biologist's guide to Principles and techniques to Practical biochemistry - Keith Wilson and Kenneth Goulding.
3. A textbook of spectroscopy – O.D.Tyagi, M.Yaddy

**Unit I:-**

Types of immunity – innate and acquired, mechanism of innate immunity, active and passive immunity. Vaccines – preparation of vaccines, example for bacterial, viral and parasite vaccines. Adjuvants

**Unit II:-**

Cells of immune system – granulocytes, monocytes, dendritic cells, lymphocytes and natural killer cells. Organs of immune system – primary and secondary lymphoid organs. Lymphocyte traffic. Development and maturation of T cells and B cells. Subsets of T cells and their functions. T cell receptors. B cell surface markers. Cytokines – interferons, interleukins, tumor necrosis and other cytokines. Phagocytosis and disorders of phagocytosis.

**Unit III:-**

Antigen specificity, antigenicity, immunogenicity, epitope, hapten. Antibody idiotope, structure of immunoglobulins, classes and properties of immunoglobulins, antibody diversity, class switching, affinity maturation, abnormal immunoglobulins. Cross reactivity. Antigen antibody interactions, general features, strength of antigen antibody reactions, antibody affinity and antibody avidity with example. Precipitation reactions – mechanism and application, Precipitation in free solutions and in gels, single and double immunodiffusion reactions. Agglutination reactions.

**Unit IV :-**

Complement system nomenclature, components of Complement system, Complement receptors, classical and alternate pathways, formation of membrane attack complex, regulation of Complement pathways. Biological consequences of Complement activation – opsonisation, cell lysis, inflammatory response, solubilisation of immune complexes. Complement deficiencies.

**Unit V :-**

Organisation of major histocompatibility complex in mouse and human. Location and function of MHC regions. Structure of class I and class II MHC molecules. Antigen processing and presentation – cytosolic pathway, endocytic pathway, presentation of non protein antigens. Transplantation immunology – classification of transplants. Mixed lymphocyte reaction. Graft versus host reaction, host versus graft reaction, mechanism of graft rejection. Immunosuppressants.

**Reference books:-**

1. Kuby Immunology – Richard Thomas, J.A.Goldsby
2. Immunology – Ivan Roitt, Brostoff, Male
3. Medical Immunology – Daniel P.Stites
4. Basic and Clinical Immunology - Peakmann
5. Immunology as an introduction - Tizard
6. Immunology – Immune system in Health and Disease
7. Immunology – Richard.M.Hyde
8. Antibody techniques – Mallik S. Vedapal
9. Immunology – D.M. Weir
10. Textbook of Clinical Biochemistry and Immunology – Ramakrishnan and Raji Swamy
11. Medical Immunology – Parslow
12. A Handbook of practical and clinical Immunology – Talwar



**Unit I:**

Collection and preparations of biological specimens such as blood, urine, CSF, bile, saliva and faeces. Basic principles and methodology in analysis of glucose, cholesterol, urea, protein and enzymes. Immunochemical methods and radioimmunoassay

**Unit II:**

Thyroid function tests – Classification, test based on primary function of Thyroid, blood level of Thyroid hormones, metabolic effects of Thyroid hormones, immunological tests for Thyroid functions, Thyroid scanning. CSF – Chemistry and clinical significance.

**Unit III:**

Renal function test, osmolarity, acute and chronic renal failure, glomerulonephritis, Nephrotic syndrome, renal hypertension, uremia, urinary calculi – its analysis, hemodialysis.

Disorders of blood – blood dyscrasias, agranulocytosis, thrombocytopenia, aplastic hemolytic anemia, methemoglobin, hematuria, hemoglobinopathies, hemostasis, blood clotting disorders, porphyria and porphyruria.

**Unit IV:**

Gastric function, stimulation of Gastric secretion, Gastric function test – examination of resting contents, fractional Gastric analysis, stimulation test, tubeless gastric analysis. Gastric diseases – Peptic Ulcer disease, Zollinger – Ellison syndrome, Gastritis, Gastric cancer

**Unit V:**

Liver function tests, fatty liver, cirrhosis, hepatitis – acute and chronic, cholestasis, jaundice, hepatic coma, tumor and inherited abnormalities of bilirubin, Gilbert syndrome, Criggler – Najjar syndrome, Dubin Johnson syndrome, Rotor syndrome, Gall stones – classification and treatment.

**Reference:**

1. Clinical chemistry in diagnosis and treatment – Philip.D.Mayne
2. Biochemistry and clinical pathology – Pillai K.K and Qudry J.S
3. Clinical chemistry – Calbreath.D
4. Practical Clinical Biochemistry – Gowenlock
5. Practical Clinical Biochemistry – Varley, Harold
6. Textbook of Clinical Biochemistry(Tietz) – Carl.A. Burtis E.R.Ashwood
7. Clinical chemistry in diagnosis and treatment – Zilva

**Unit I :-**

Hormones – chemical nature, functions, synthesis, storage, release and transport, feedback regulation with suitable examples. Hormone – receptor interactions, biochemistry of receptor activation, receptor desensitization.

**Unit II :-**

G proteins as signal transducers – composition and types of G proteins. Activation of G proteins, bacterial toxins and G protein functions, ras protein. G protein and disease – cholera, whooping cough, ras oncogenes.

**Unit III :-**

CAMP as a second messenger, the adenylate cyclase reaction, phosphodiesterases regulation of adenylate cyclase, the role of guanine nucleotides, inhibitors of adenylate cyclase by hormones, mechanism of action of CAMP, specificity of CAMP dependent protein kinase, structure and mechanism of action of protein kinase with a suitable example.

Guanylate cyclases and cGMP. Role of cGMP in visual transduction.

**Unit IV :-**

Phosphoinositide turnover in receptor activation phospholipase C, regulation of phospholipase activity, inositol – triphosphate as second messenger. DAG as second messenger

( with suitable examples). Effects of hormones on the metabolism of inositol phospholipids.

**Unit V :-**

Control of cellular calcium levels, calcium transport, calcium cycling modulation of cytoplasmic calcium by hormones, calcium as a second messenger on liver metabolism, calcium dependent regulator proteins, calmodulin interactions of calcium, calmodulin complexes with target proteins, troponin C.

**Reference Books :-**

1. Mammalian Biochemistry – Principles of Biochemistry – Smith and White Handler
2. Harper's Biochemistry – R.K.Murray, Granner
3. Textbook of medical Biochemistry – Chatterjee and Shinde
4. Basic and clinical endocrinology – Greenspan Gardener

**Unit I :-**

DNA as the genetic material ( classical experiments), Replication machinery. Prokaryotic Replication mechanism, the cellular response, eukaryotic DNA Replication, the roles of topoisomerases and telomerase, regulation of Replication – cell cycle regulation.

**Unit II :-**

Mutation, spontaneous and induced Mutation, molecular mechanisms of Mutation. DNA repair mechanisms – Direct repair, excision repair, mismatch repair, recombination repair, SOS response, eukaryotic repair system. Recombination and mobile genetic elements – the Holiday model, the general Recombination in E.Coli, site specific Recombinations, transposons and retroposons

**Unit III :-**

Transcription – subunits of RNA polymerase, eukaryotic RNA polymerases, E.Coli and eukaryotic promoters and enhancers. Transcription factors, p- dependent and p- independent termination and Transcription. Post Transcriptional modifications – mRNA 5' capping and 3' polyadenylation, splice. Spliceosomes assembly, alternative splicing, processing of tRNA and rRNA, SELF splicing, ribozymes, regulation of mRNA processing.

**Unit IV :-**

The lac operon, identification of operator and regulator sequences by mutations, induction and repression, foot printing and gel – shift assays for identification of Protein – DNA interactions. Catabolite repression. Trp operon – attenuation, arabinose operon. Regulation of eukaryotic transcription – response elements. DNA – binding motifs, association of methylation with gene expression, molecular mechanism of eukaryotic transcription control. Lysogeny and Lytic cycle bacteriophage  $\lambda$ .

**Unit V :-**

Genetic code, nature of genetic code, Wobble hypothesis, activation, initiation, elongation, termination of translation in prokaryotes, inhibitors of protein synthesis. Protein synthesis in eukaryotes and its regulation. Post translational modification. Protein sorting – signal peptides, targeting of mitochondria, secretory and lysosomal proteins.

**Reference Books –**

1. Genes V – Benjamin Lewin
2. Genes VI - Benjamin Lewin
3. Biochemistry – Donal Voet and Judith Voet
4. Molecular Biology – David Freifielder
5. Biochemistry and Molecular Biology – Eliot and Eliot
6. Molecular cell biology – Baltimore
7. Molecular and cellular biology – Wolfe.S.L

**UNIT I:**

Immune response – primary and secondary. Cell mediated Immune response – T<sub>H</sub> cell activation, T<sub>C</sub> cell activation, generation of effector and memory T cells. Apoptosis. Humoral Immune response – B cell activation, thymus dependent and thymus independent antigens, generation of plasma cells and memory B cells. Antibody response. Theories of Immune response.

**UNIT II:**

Hypersensitivity type I – mechanism, mediators and the consequences. Type II transfusion reactions, hemolytic disease of newborn and drug induced hemolytic anemia. Type III – localized and generalized reactions. Hypersensitivity type IV. Autoimmunity – mechanism, autoimmune disorders – rheumatoid arthritis, SLE, Hashimoto's thyroiditis, grave's disease, Addison's disease and multiple sclerosis.

**UNIT III:**

Structure and life cycle of HIV, modes and transmission risk of HIV, immuno pathogenesis of HIV infection, lab abnormalities, management and treatment of AIDS, vaccines to prevent AIDS.

**UNIT IV:**

Major and minor blood groups, blood group antigens and antibodies involved in transfusion reactions. Intravascular and extra vascular hemolysis. Types of transfusion reactions – hemolytic and non hemolytic. Mechanism of hemolytic transfusion reactions. Causes, symptoms and treatment of non hemolytic reactions. Blood component therapy.

**UNIT V:**

Detection of immune complexes – Immuno diffusion, Immuno electrophoresis, radio Immuno assay, ELISA, Fluoro Immuno assay, Western Blotting, Coomb's test, Complement fixation test. Fluorescence activated cell sorter. Production and application of monoclonal antibodies.

**Reference:**

1. Kuby Immunology – Richard Thomas, J.A.Goldsby
2. Immunology – Ivan Roitt, Brostoff, Male
3. Medical Immunology – Daniel P.Stites
4. Basic and Clinical Immunology - Peakmann
5. Immunology as an introduction - Tizard
6. Immunology – Immune system in Health and Disease
7. Immunology – Richard.M.Hyde
8. Antibody techniques – Mallik S. Vedapal
9. Immunology – D.M. Weir
10. Textbook of Clinical Biochemistry and Immunology – Ramakrishnan and Raji Swamy

**Unit I:**

Disorders of carbohydrate metabolism – blood sugar level, diabetes mellitus – IDDM, NIDDM, metabolic changes, metabolic complication, glucose tolerance test, assay of insulin, glycogen storage diseases – galactosemia, fructosuria, pentosuria and mucopolysaccharidiosis.

**Unit II:**

Plasma lipids, lipoproteins – abnormalities, hyper and hypo cholesterolemia, sphingolipidosis. Diagnostic tests of apolipoproteins, HDL – cholesterol, LDL – cholesterol and triglycerides. Cardiovascular disease – ischemia, arteriosclerosis, steatorrhea.

**Unit III:**

Inborn errors of metabolism – nature of genetic defect, alkaptonuria, phenyl ketonuria, Hartnup's disease, tyrosinosis, albinism, Niemann – Pick's disease, Tay Sachs's disease, maple syrup urine disease, gene therapy.

Clinically important enzymes in diagnosis – ALP, ACP, SGOT, SGPT, CK, LDH, Lipases, amylase, cholin esterase. Disorders of nucleic acid metabolism – Gout, hypo and hyper uricemia.

**Unit IV:**

Fetoplacental function, amniotic fluid – its analysis, amniocentesis, ectopic and abnormal pregnancy, trophoblastic disease, maternal serum scanning for fetal defects.

**Unit V:**

Definition, sources of free radicals, mechanism of lipid peroxidation, initiation, propagation, termination, lipid peroxidation, products and their deflection, oxidative stress, cellular targets and consequences of free radical damage. Health implications of free radical damage. Antioxidant, Antioxidant defenses, essential nutrients with Antioxidant function.

Quality management – fundamental concepts, principles, control of pre analytical and analytical variables, control of analytical quality using stable control materials.

**Reference:**

1. Clinical chemistry in diagnosis and treatment – Philip.D.Mayne
2. A handbook on Diabetes Mellitus – Seshiah
3. Biochemistry and clinical pathology – Pillai K.K and Qudry J.S
4. Clinical chemistry – Calbreath.D
5. Practical Clinical Biochemistry – Gowenlock
6. Practical Clinical Biochemistry – Varley, Harold
7. Textbook of Clinical Biochemistry (Tietz) – Carl.A. Burtis E.R.Ashwood
8. Clinical chemistry in diagnosis and treatment – Zilva

## **PAPER-XVIII      ENDOCRINOLOGY**

**CODE: 4BC18**

### **UNIT I:**

Biosynthesis and Regulation of Thyroid hormones, thyroglobulin metabolism, iodine metabolism, functions and disorders associated with the above hormones – hypothyroidism and hyperthyroidism. Assay of Thyroid hormones.

### **UNIT II:**

Biochemical function, Regulation, mechanism of action, abnormalities and Assay of parathyroid, calcitonin, calcitriol.

Insulin, glucagons and somatostatin structure, function, Regulation and related disorders.

### **UNIT III:**

Adrenal medulla hormones.

Catecholamines – Biosynthesis, storage, release, metabolism, specific biological actions, catecholamine receptors, Regulation, Adrenal medullary hyper function – Adrenal cortex hormones – Biosynthesis, inhibitors of Biosynthesis, metabolism, transport, biological actions, mechanism of action of adrenal steroids, specific actions of the steroids, Regulation, measurement, adreno cortical hyper and hypo function and its diagnosis.

### **UNIT IV:**

Hypothalamic hormones – function, Regulation, mechanism of action and disorders.

Pituitary hormones - function, Regulation, mechanism of action and related disorders and assay.

### **UNIT V:**

Biosynthesis, metabolism and its metabolic products, and Regulation of testicular function and its mechanism of action. Biosynthesis, metabolism and its metabolic products, mechanism of action and regulation of ovarian function.

Abnormalities in biosynthesis and secretion of androgen and estrogen.

### **Reference:**

1. Mammalian Biochemistry – Principles of Biochemistry – Smith and White Handler
2. Harper's Biochemistry – R.K.Murray, Granner
3. Textbook of medical Biochemistry – Chatterjee and Shinde
4. Basic and clinical endocrinology – Greenspan Gardener
5. Endocrinology – Mac. E. Hadley

**Unit I:**

Recombinant DNA technology: DNA cloning – restriction endonucleases, cutting and joining DNA molecules, DNA ligase, Linkers, Adapters, homopolymers tailing, selection of recombinants, screening genetic methods, Immunochemical methods, synthesis of probes, radioactive and non radioactive labeling of probes, analyzing DNA sequences – Maxam and Gilbert and Sanger's methods.

Cloning vectors – Plasmids (pBR 322, pUC 18), Bacteriophage vectors, cosmids, expression vectors, shuttle vectors, yeast vectors – YAC

Genomic DNA libraries, chromosome walking, cDNA libraries, PCR, RFLP, R-loop mapping.

**Unit II:**

Industrial Biotechnology: Microbial food and feed Production, single cell proteins and algal proteins. Production of industrially important enzymes – protease and amylase.

Test for water purity, purification of water – sedimentation filtration and disinfection. Sewage treatment process – physical and biological treatment, septic tanks, imhoff tanks, aerobic processes, oxidation lagoons, activated sludge process. Methanogenesis and biogas Production.

**Unit III:**

Animal Biotechnology: Cell and organ culture, primary cell culture, cell line, serum & serum free media, transfer of genes into animal cells in culture – viral vectors: SV 40, Retroviruses and adenoviruses. In vitro fertilization and embryo transfer, development and applications of transgenic animals.

**Unit IV:**

Bioinformatics: Definition & applications of Bioinformatics, Biological databases-types & classification. NCBI, EMBL, DDBJ, GenBank, PIR, SWISS-PROT, PubChem, Pfam, KEGG, BRENDA, PubMed. Bioinformatic tools – BLAST, Clustal W, Procheck, RasMol. Active site prediction, Modeling & Docking.

**Unit V:**

Plant Biotechnology: Plant tissue culture techniques – preparation of explant sterilization, callus culture, significance of protoplast culture, protoplast fusion, somatic hybridization. Plant vectors - T<sub>i</sub> plasmids, gene transfer using agro bacterium. Gene manipulation of nitrogen fixation in plants.

**Reference:**

1. Plant Biotechnology – S. Ignacimuthu
2. Animal Biotechnology – M.M. Ranga
3. Textbook of Biotechnology – H.K. Das
4. Biotechnology – U. Satyanarayana
5. Industrial Microbiology – Casida
6. Biotechnology fundamental and applications – S.S. Purohit
7. Basic Bioinformatics – S. Ignacimuthu
8. Bioinformatics – Prakash S. Lohar

**UNIT I:****Mendelian Genetics:**

Laws of Mendel, genotype, phenotype. Monohybrid cross and test cross. Dihybrid cross, Trihybrid cross. Alleles – mutant and wild type, multiple alleles, dominance relations – Incomplete dominance, Co – dominance, over dominance. Gene interaction, epistasis, Essential genes and lethal alleles. Penetrance and expressivity.

**UNIT II:**

Chromosomal theory of inheritance – sex Chromosomes, non – disjunction of X – Chromosomes, sex linked inheritance. Variation in chromosome number – euploidy, aneuploidy, polyploidy. Variations in Chromosome structure – deletion, duplication, inversion, translocation and position effects.

**UNIT III:**

Linkage – Linkage groups, Complete Linkage, Incomplete Linkage and recombination. Crossing over at the tetrad stage of meiosis( Neurospora Crassa), Double Crossing over, coincidence and interference. Detection of Linkage and Linkage maps.

**UNIT IV:**

Tumour virus and oncogenes – transforming virus, retro virus, life cycle, activation of proto oncogenes by mutation, translocation, amplification, insertion. Oncoproteins and regulation of gene expression. Oncogenic variants of growth factors, receptors of component of signal transduction. Tumour suppressor genes.

**UNIT V:**

Population genetics – genotypic and allelic frequencies, genepool, conservation of gene frequencies. The Hardy Weinberg law – assumptions, predictions and derivation. Change in genetic structure of population – mutation, genetic drift, migration, natural selection, fitness and non random mating.

**Reference:**

1. Genetics – Peter J Russel
2. Principles of Genetics – Gardner
3. Genetics – Weaver J Robert and Hedrick W Philip
4. Molecular and Cellular Biology – Wolfe. S.L
5. Genes V – Benjamin Lewin
6. Genes VII – Benjamin Lewin
7. Genetics from genes to genome – Leland H Hartwell
8. Molecular Cell Biology – Lodish, Berk and Baltimore
9. Genetics – Strickberger
10. Microbial Genetics – Freifelder
11. Human Genetics – concepts and applications – Ricki Lewis
12. Concepts of Genetics – Klug and Cummings



# PRACTICAL SYLLABUS

## I – M.Sc BIOCHEMISTRY

PRACTICAL –I

CODE: 2BCP1

- 1) Isolation and estimation of DNA from animal tissues
- 2) Isolation and estimation of RNA from animal tissues
- 3) Separation of starch from plant source and assessment of its purity

### COLORIMETRIC ANALYSIS

- 1) Estimation of pyruvate
- 2) Estimation of lactate
- 3) Estimation of tryptophan
- 4) Estimation of protein by Lowry' s method
- 5) Estimation of starch
- 6) Estimation of inorganic phosphorous

### MICROBIAL STUDIES

- 1) General guidelines for every lab session
- 2) General guidelines for working with bacteria
- 3) Universal precautions
- 4) Culture transfer techniques
- 5) Preparation of media, inoculation method
- 6) Staining techniques
  - a) Simple staining
  - b) Negative staining
  - c) Gram staining
  - d) Acid fast staining
  - e) Differential staining for visualization of bacterial culture
- 7) Antibiotic sensitivity test

## I – M.Sc BIOCHEMISTRY

### PRACTICAL –II

CODE: 2BCP2

- 1) Isolation, purification and kinetic studies of alkaline phosphatase of plant and animal source
- 2) Assay of ATPase
- 3) Assay of Creatinine phospho kinase
- 4) Assay of LDH
- 5) Kinetic studies of amylase
- 6) Kinetic studies of acid phosphatase

### FOOD ANALYSIS

- 1) Analysis of food materials for proteins and carbohydrates
- 2) Ash content and moisture content of foods
- 3) Estimation of calcium and iron from ash
- 4) Estimation of vitamin C
- 5) Estimation of thiamine by fluorimetry
- 6) Estimation of riboflavin by fluorimetry

### SEPARATION PROCEDURES

- 1) Separation of lipids by TLC
- 2) Separation of amino acids and sugars by chromatography

### DEMONSTRATION TECHNIQUES

- 1) Separation of amino acids by gel electrophoresis
- 2) Separation of proteins by gel electrophoresis
- 3) Separation of LDH by gel electrophoresis

## II– M.Sc BIOCHEMISTRY

PRACTICAL –III

CODE: 4BCP3

### BLOOD AND URINE ANALYSIS

- 1) Collection and preservation of blood samples
- 2) Collection and preservation of urine samples
- 3) Electrolyte determination of serum sodium by flame photometer
- 4) Electrolyte determination of serum potassium by flame photometer
- 5) Estimation of inorganic phosphorous by colorimetric method
- 6) Estimation of copper by colorimetric method
- 7) Estimation of iron by colorimetric method
- 8) Estimation of blood glucose by orthotoludine method
- 9) Estimation of cholesterol by zak's method

### LIVER FUNCTION TESTS

- 1) Estimation of bilirubin – direct and indirect
- 2) Estimation of plasma proteins
- 3) A/G ratio
- 4) Assay of serum glutamate oxaloacetate transaminase
- 5) Assay of serum alkaline phosphatase

### RENAL FUNCTION TEST

- 1) Qualitative tests for normal and pathological components of urine
- 2) Estimation of blood and urine urea
- 3) Estimation of creatinine
- 4) Estimation of creatine
- 5) Estimation of uric acid

### HAEMATOLOGY

- 1) RBC and WBC count – total and differential count
- 2) Estimation of hemoglobin by Haemocytometer
- 3) Blood clotting time

### ANTIOXIDANT STATUS

- 1) Estimation of super oxide dismutase
- 2) Estimation of catalase
- 3) Estimation of glutathione peroxidase
- 4) Estimation of vitamin A
- 5) Estimation of vitamin E
- 6) Estimation of vitamin C

### IMMUNOLOGICAL EXPERIMENTS

- 1) Precipitin reaction –the ring test
- 2) Precipitin reaction – immunodiffusion
- 3) Agglutination reaction – the febrile antibody test

## MICROBIAL STUDIES

- 1) Antibiotic Sensitivity tests

## DEMONSTRATION EXPERIMENTS

- 1) Assay of insulin by ELISA
- 2) Isoenzyme separation of LDH by electrophoresis
- 3) Western blotting and southern blotting
- 4) Determination of antibody titre
- 5) Assay of IgG and IgM

## REFERENCE BOOKS

- 1) Practical Clinical biochemistry – Varley
- 2) Laboratory manual in biochemistry – Jayaraman
- 3) An introduction to practical biochemistry – David.T. Plummer
- 4) Laboratory manual in biochemistry – Pattabiramanan
- 5) Medical Laboratory technology volume I – K.L. Mukherjee
- 6) Medical Laboratory technology volume II – K.L. Mukherjee
- 7) Medical Laboratory technology volume III– K.L. Mukherjee
- 8) Practical Clinical biochemistry – Sheriff
- 9) Microbiology and biotechnology – A laboratory manual – P. T. Kalaichelvan
- 10) Microbiology a laboratory manual – Cappuccino, Sherman