



SRI BALAJI VIDYAPEETH

(Deemed to be University)

Accredited by NAAC with A Grade Pillaiyarkuppam, Puducherry-607402

M.Sc. MEDICAL BIOCHEMISTRY

(FACULTY OF MEDICINE)

REVISED SYLLABUS

(From 2020 batch onwards)

Department of Biochemistry

Mahatma Gandhi Medical College and Research Institute

I. SHORT TITLE AND COMMENCEMENT

- These regulations shall be called “THE REGULATIONS FOR THE **MASTER OF SCIENCE IN FACULTY OF MEDICINE (M.Sc. Medical Biochemistry)** OF SRI BALAJI VIDYAPEETH, Puducherry.
- They shall come into force from the academic year 2021 onwards.
- The regulations and syllabus are subject to modifications by the standing Post Graduate Board of Studies for paramedical courses from time to time.

II. REGULATIONS

1. ELIGIBILITY FOR ADMISSION:

A degree in Bachelor of Science (B.Sc) from any University in India with Chemistry/ Biochemistry / Medical Lab Technology / Allied Health Sciences with a minimum of 50% marks.

2. MODE OF SELECTION:

Based on the merit list of candidates drawn from the common entrance test conducted by Sri Balaji Vidyapeeth.

3. DURATION OF THE COURSE AND COURSE OF STUDY:

M. Sc Medical Biochemistry (Faculty of medicine) is a 3 years full time course.

First year subjects (M. Sc Preliminary)

Human Anatomy, Human Physiology and Medical Biochemistry. These are common to the present courses Viz. M.Sc Medical Biochemistry, M.Sc Medical Microbiology as well as future courses like M. Sc. Human Anatomy, M.Sc Human Physiology and M. Sc Pharmacology.

Second and third year subjects (M. Sc Final)

Medical Biochemistry

4. *MINIMUM WORKING DAYS IN AN ACADEMIC YEAR:*

Each academic year shall consist of not less than 180 working days

5. *ATTENDANCE REQUIRED FOR APPEARING EXAMINATION:*

- a) Examination will be conducted in both theory and practical as prescribed. Candidates will be permitted to appear for the University Examinations in the subject, only if they secure not less than 80% of attendance in each subject in the respective year.
- b) A student who does not meet the minimum attendance requirement in a year must repeat the course along with the next batch of students.

6. *CONDONATION OF SHORTAGE OF ATTENDANCE:*

Condonation of shortage of attendance in aggregate up to 10% (between 70% and 80%) in each year may be granted by the College Academic Committee and as per the regulations of University.

7. *INTERNAL ASSESSMENT:*

Internal assessment will be done in each subject of study and the marks will be awarded to the candidates as detailed in the scheme of examinations. The marks awarded will be on the basis of the candidate's performance in the assignments, class tests, laboratory work, preparation and presentation of seminars as assessed by the teachers.

8. *EXAMINATIONS:*

- a) The examinations in the above three subjects in first year (M.Sc. Preliminary) will be at the end of first year July/ August. For each subject, there will be one Internal and one External Examiners for valuing Theory papers and conducting Viva voce. Supplementary examination for failed candidates shall be conducted not more than 6 months after the regular exams. Any student failing in any subjects shall repeat the respective subjects. There is a provision to carry over the failed subjects. The students can continue their studies in the second and third year, but should clear the arrears in M. Sc Preliminary subjects before appearing for the M.Sc Final examination, which will be conducted at the end of third year June/ July.

- b) The final year M. Sc. Medical Biochemistry, Practical Examinations & Viva – Voce shall be jointly conducted by two internal and two external examiners duly appointed by the University, separately for Medical Biochemistry

9. MAXIMUM DURATION FOR THE AWARD OF THE DEGREE:

- a) The maximum period to complete the course successfully should not exceed a period of six years from the date of joining first year.

10. QUALIFYING MARKS FOR A PASS - (FINAL YEAR)

50% of marks in aggregate in University Theory, Internal assessment (Theory), Viva-voce examination taken together. The students must also obtain a minimum of 40% in each theory paper. 50% of marks in aggregate in the University Practical examination, Internal assessment (Practical) and Record and dissertation marks, if any, taken together.

11. DECLARATION OF CLASS:

- A successful candidate obtaining 75% and more marks in the grand total aggregate in the first attempt shall be declared to have passed with **Distinction**.
- A successful candidate obtaining 60% and more but less than 75% of marks in the grand total aggregate shall be declared to have passed with **First Class**.
- A successful candidate obtaining 50% and more but less than 60% of marks in the grand total aggregate shall be declared to have passed with **Second Class**.
- Ranks shall be declared on the basis of the aggregate marks obtained by a candidate in the M.Sc Biochemistry (Final year) / M.Sc. Medical Microbiology University Examination. Only those candidates who have passed in the first attempt shall be eligible for the award of **Rank**.

SCHEME OF EXAMINATION
M.Sc. MEDICAL BIO-CHEMISTRY
FIRST YEAR (M.Sc. PRELIMINARY)

Subject	Theory	Oral-50 + Internal assessment-50 (theory 25+practical-25)	Grand total
HUMAN ANATOMY	40/100	100 (No Minimum)	100/200
HUMAN PHYSIOLOGY	40/100	100 (No Minimum)	100/200
MEDICAL BIOCHEMISTRY	40/100	100 (No Minimum)	100/200

FINAL EXAMINATION (II & III YEAR)

Subject	Theory	Theory+ Viva voce+IA (300+50+50)	Practical	Practical +IA+Record + Dissertation (200+50+20+30)	Grand total
PAPER-I	40/100				
PAPER-II	40/100				
PAPER-III	40/100				
TOTAL	150/300	200/400	100/200	150/300	350/700

Final year theory papers:

PAPER- I: Analytical Biochemistry & Biophysics, Vitamins, Minerals, Nutrition and Biostatistics

PAPER- I: Chemistry and metabolism of Biomolecules, Enzymology, Bioenergetics, Immunology, Metabolism of xenobiotics and Environmental Biochemistry,

PAPER-III: Cell and Molecular biology, Cancer biology, Endocrinology and Clinical Biochemistry,

Syllabus

M. Sc. (MEDICAL BIOCHEMISTRY) FIRST YEAR (M.Sc. PRELIMINARY)

PAPER I- HUMAN ANATOMY

A) DEPARTMENTAL OBJECTIVES

The students of M.Sc. Medical Biochemistry & Medical Microbiology at the end of learning Anatomy during the First year of their course should be able to:

1. Point out and state the names and gross anatomical features of the various systems of the human body.
2. Recognize and state the histological features of the various tissues and organs of the human body.
3. State the basic principles of the embryology of organs of the various systems of the human body interpret the same in models and recognize the congenital anomalies in life and models.
4. State the basic principles of Medical Genetics and recognize the karyotyping of human chromosomes in normal and abnormal states.
5. Continue to learn the anatomical aspects of the human body and apply the same in health care programmes.

B. COURSE CONTENT

The duration of the course: 1 year

Total Teaching Hours : 500 hours (14 hrs / week)

THEORY:

- a) General Anatomy – Basic Principles
- b) General Histology – basic Principles
- c) Systemic Histology
- d) General Embryology – Basic Principles
- e) Systemic Embryology

f) Systemic Anatomy:

A brief account of gross Anatomy of various organs of the following systems:

- i. Skeletal System**
 - Bones- types, structure, Axial & Appendicular skeleton.
 - Bone formation and growth.

- ii. Respiratory system**
 - Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, diaphragm and pleura.

- iii. Circulatory system**
 - Circulatory system – structure of the Heart, Structure of Blood vessels – arterial and venous system.
 - Lymphatic system.

- iv. Digestive system**
 - Parts and Structure of Tongue, Salivary glands, Pharynx, Esophagus, stomach, Intestines, Liver, Pancreas.

- v. Excretory system**
 - Parts, Structure of Kidney, Ureters, Urinary bladder and Urethra.

- vi. Nervous system**
 - Structure of Neuroglia and neurons.
 - Parts and classification:
 - a) CNS – Structure of Brain and spinal cord and their functions.
 - b) PNS – Cranial nerves & Spinal nerves.
 - c) ANS – Sympathetic and parasympathetic systems.

- vii. Special sensory organs**
 - Structure of Skin, Eye, Nose, Tongue, Auditory and Olfactory apparatus.

- viii. Reproductive System**
 - Parts and Gross structure of both male and female reproductive organs.

ix. Endocrine glands

- Gross Structure of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal glands.

g) Medical Genetics – Basic Principles.

PRACTICAL:

- Demonstration of Dissected human specimens of various systems.
- Identification of the histological features of various tissues and organs using Histology slides stained with haematoxylin and eosin.
- Identification of the embryology specimens and models.
- Identification of the chromosomes using human karyotyping.

III TECHING LEARNING ACTIVITIES

The course in Anatomy will be covered by:

- Lecture classes : One hr. per day for 4 days / week.
- Practical Classes : Two hrs. per day for 2 days / week.
- Tutorial / Demonstration classes : Two hrs per day for 3 days / week.

IV. EVALUATION

It shall comprise of	: Marks	Duration	Minimum Marks to pass
1. Written Examination	: 100 marks	3 hrs	40 Marks
2. Oral examination	: 50 marks		No Minimum
3. Internal assessment	} 50 Marks		No Minimum
Theory (25),			
Practical (25)			
Total	: 200 marks		100 Marks

(a) INTERNAL ASSESSMENT

i.	Theory By notified tests + Viva-voce	25 marks
ii.	Practical + Record Note Book	25 marks
	Total	: 50 marks

(b) Annual / summative Examination

- **Written** (3 hours duration) : 100 marks
Paper shall have two sections A & B, each carry questions of 50 marks.

Section A

- Systemic Anatomy ABOVE Diaphragm and related Histology & related Embryology.
- General Anatomy

Section B

- Systemic Anatomy BELOW Diaphragm and related Histology & related Embryology.
- Medical Genetics.

Paper shall consist of:

Systemic Anatomy	: 50 marks
General Anatomy	: 10 marks
Embryology	: 15 marks
Histology	: 15 marks
Medical Genetics	: 10 marks.

Section A:

Long answer question	- 1×15 = 15 marks
Short answer question	- 4×5 = 20 marks
Brief notes question	- 3×5 = 15 marks

50 Marks

Section B:

Long answer question	-1×15 = 15 marks
Short answer question	- 4×5 = 20 marks
Brief notes question	-3×5 = 15 marks

Viva-Voce

50 Marks

a) Spotters:

Identification of histology slides & Discussion: (10×2= 20 marks)

Examiner I

General Anatomy and Systemic Anatomy : 15 marks
(Models & Specimens)

Examiner II

Histology, Embryology & Medical genetics : 15 marks
(Models)

Total : 50 marks

MODEL QUESTION PAPER

M.Sc. PRELIMINARY - HUMAN ANATOMY

Time: 3 hours

Maximum Marks: 100

Answers are to be illustrated with suitable diagrams.

Section I and II are to be answered in separate answer books.

SECTION A

1. Describe the Internal features of the chambers of the Heart. (15 marks)
2. Write Short notes on the following: (4×5=20 marks)
 - a) Development of Tongue.
 - b) Microscopic features of Submandibular gland.
 - c) Histology of Elastic artery (Aorta)
 - d) Formation of Circle of Willis.
3. Write brief account on: (3×5=15 marks)
 - a) Bronchopulmonary segments.
 - b) Circulation and functions of CSF.
 - c) Functions of Piacents.

SECTION B

4. Describe the Gross features and blood supply of Kidney. Write a note on the development and name the two congenital anomalies of Kidney. (15 marks)
5. Write short notes on: (4×5=20 marks)
 - a. Testis
 - b. Ossification
 - c. Synovial joints
 - d. Pancreas.
6. Give a brief account of: (3×5=15 marks)
 - a. Down's syndrome.
 - b. Karyotyping of human chromosomes
 - c. Function of Liver

LIST OF BOOKS RECOMMENDED
(ANATOMY)

- A. GENERAL ANATOMY:
Handbook on General Anatomy: By Chaurasia, Central Book agency
- B. SYSTEMIC ANATOMY:
Clinical Anatomy for Students: By Neeta Kulkarni, Jaypee
- C. HISTOLOGY:
Textbook of Histology: By J.P.Gunasegaran, Elsevier
- D. EMBRYOLOGY:
Human Embryology: By Inderbir Singh, MacMillan India Ltd.
- E. GENETICS IN MEDICINE:
Human Genetics: By Gangane, Elsevier.DISSECTION:
- F. PRACTICAL ANATOMY
Cunningham's manual of Practical Anatomy: Vol. I, II & III

PAPER II-HUMAN PHYSIOLOGY

A) DEPARTMENTAL OBJECTIVES

The students of M.Sc. (Medical Biochemistry) & (M.Sc. Medical Microbiology) at the end of learning Physiology, during the First Year of their course should be able to: -

- i) State the functions organs and systems of the body.
- ii) Describe in brief the mechanisms of function of various systems in the body.
- iii) Apply basic principles of physiology to simple clinical conditions.
- iv) Know and utilize the knowledge of Physiology in organizing simple experiments for biochemical work.
- v) Continue to learn the physiological aspects of human body.

B) COURSE CONTENT:

THEORY:

1. Introductory Principles: Structure of cell and cell membrane, composition of intracellular and extracellular fluid, transport of substances across cell membrane, resting membrane potential.
2. Body fluid and blood:
Body fluid – Body fluid compartments, composition, size, capillary – structure and filtration across capillary wall, pH and buffer system and principle of homeostasis.
Blood – Composition of blood, plasma proteins, bone marrow, erythrocytes – formation and fate, anaemia, jaundice, white blood cell, immune mechanism, platelets, haemostasis, blood types and blood transfusion
3. Nerve and muscle: Nerve – Structure of neuron, excitability, action potential, conduction of nerve impulse, nerve fiber type, skeletal muscle – structure, cross bridge theory, types of muscle contraction – neuromuscular transmission – heart muscle – structure, electrophysiology, properties of cardiac muscle. Smooth muscle – structure, types – electrophysiology.
4. Renal Physiology: Cross and ultrastructure of nephrons, glomerular filtration, tubular reabsorption and secretion, clearance, water excretion – counter current multiplier and exchanger, renal role in acid base balance, renal failure, mechanism and regulation of micturition.

5. Endocrine and Reproductive Physiology:
- a. Endocrine pancreas : Functional anatomy of islets, actions of insulin and insulin deficiency, regulation of insulin secretion, glucagon.
 - b. Physiology of bone: Vitamin D and Parathyroid, Calcium metabolism, Physiology of bone formation and destruction. Vitamin D, parathyroid hormone – actions and effects of deficiency.
 - c. Neuroendocrinology: Hypothalamo–hypophyseal unit. Pituitary and pituitary hormones – Growth actions of growth hormone, effects of excess and deficiency of growth hormone, regulation of growth hormone secretion. Prolactin, post pituitary hormone – oxytocin and vasopressin.
 - d. Adrenal Gland: Adrenal corticoids – actions, effects of excess and deficiency of cortisol aldosterone. Regulation of secretion of aldosterone. Adrenal medulla – Catecholamines – actions, regulation of secretion.
 - e. Thyroid: Functional anatomy: Synthesis, storage and release of thyroid hormones, acting of thyroid hormones, regulation of thyroid hormone secretion, thyroid dysfunction.
 - f. Reproductive Physiology: Sex differentiation and development, puberty. Male reproduction system – functional anatomy; spermatogenesis, testosterone – actions, regulation of testosterone secretion. Female reproductive system – Menstrual cycle, ovarian hormones, control of ovarian functions, pregnancy, fetoplacental unit – lactation – physiology of contraception.
6. Cardiovascular system: Functional anatomy of heart, genesis and spread of cardiac impulse, basic E.C.G., cardiac cycle, heart sound, cardiac output, nervous control of heart rate and cardiac output, heart lung preparation – Sterling’s law, ventricular function. Principles of haemodynamics, systemic arteries, veins and capillaries, blood pressure; regulation of blood pressure – cardiac and cardiovascular reflexes. Regional circulation – coronary, pulmonary cerebral and skeletal muscle circulation.
7. Respiratory system: Functional anatomy of air- passages and lung, respiratory muscles, mechanics of respiration – intrapleural and airway pressures, compliance and surfactant; lung volumes and capacities dead space, alveolar ventilation transport of gasses – O₂ dissociation and CO₂ dissociation curves. Gas exchange – diffusion and gases across alveolo – capillary membrane, ventilation – perfusion ratio, control of breathing – neural and chemical, hypoxia, cyanosis.

8. G.I. system
 - Mastication and swallowing, salivary secretion and its regulation.
 - Regulation of gastric secretion and motility.
 - Biomechanism of secretion, function and regulation of bile secretion.
 - Intestinal secretion and motility – regulation (including defecation)

9. Nervous system: General role of nervous system is causing appropriate response environmental stimuli, concept of reflex and voluntary action. Sensory system; Receptors, afferent pathways, cortical sensory areas for somesthetic sensation. E.E.G. consciousness and sleep. Motor system: Reflexes – stretch reflexes, withdrawal reflex and other reflexes.
Corticospinal and extra pyramidal system – neuroanatomy function and dysfunction; regulation of posture and locomotion (spinal shock, decerebrate rigidity, postural reflexes); cerebellum and basal ganglia. Visceral control – Neuroanatomy of autonomic nervous system – regulation of visceral activity from spinal and supraspinal (medullary and hypothalamic) centres, regulation of body temperatures. Emotion + behaviour - Neuro – anatomy of limbic system; feeding behaviour; drinking behaviour; sexual behaviour; emotional behavior (fear, anxiety, rage, etc.). Higher cortical functions – Learning and memory; speech.
10. Special senses: Physiology in brief of vision – structure of eye, errors of refraction – Functions of refractory media, retina – optic pathway. Auditory sense; structure and functions of external, middle and internal ear. Role of basilar membrane in hearing – auditory pathway. Taste and olfaction – Receptors, pathway.

PRACTICALS

Practical Course shall comprise of:

- a) Simple experiments in muscles and heart – simple muscle twitch, isotonic and isometric contractions. Free and after loading, fatigue, intestinal movements, frog's cardiogram, Mosso's ergography.
- b) Simple experience in haematology – e.g. haemoglobin, estimation, differential leucocyte count, bleeding and clotting time.
- c) Simple experiments in human physiology. Demonstration of B.M.R., E.C.G., Spirometry, B.P. Recordings, Reflexes.

TEACHING AND LEARNING ACTIVITIES:

The course in Physiology will be covered by:

- a) Lectures – 150 hours..
 - b) Demonstrations & Practicals – 60 hours
 - c) Group Discussions / Tutorials / Assignment / Tests - 90 hours
- Total 300 Hours.

EVALUATION

It shall comprise of	: Marks	Duration	Minimum Marks to pass		
1. Written Examination	: 100 marks	3 hrs	40 Marks		
2. Oral examination	: 50 marks		No Minimum		
3. Internal assessment	}				
Theory (25),				50 Marks	No Minimum
Practical (25)					
Total	: 200 marks		100 Marks		

(a) INTERNAL ASSESSMENT

iii. Theory by notified tests + Viva-voce	25 marks
iv. Practical + Record Note Book	25 marks
Total	: 50 marks

Section – A: Essay type – 1 Question x 15 = 15 marks
Short notes – 7 Questions x 5 = 35 marks

(Body fluids. Blood and skeletal muscle, smooth muscle, gastrointestinal tract, renal physiology, Endocrinology & Reproductive system)

Section – B: Essay types – 1 Questions x 15 = 15 marks
Short notes – 7 Questions x (7x5) = 35 marks

(Cardiovascular system, Respiratory system, Nerve, Central nerve system and special senses).

TEXT BOOKS AND REFERENCE BOOKS RECOMMENDED:

1. Human physiology: A.J. Vander, J.H. Sherman, D.S. Luciano, Tata Megraw Hill Publishing Co., New Delhi.
2. Concise Medical Physiology: S.K. Chaudhuri, New central Book Agency, 8/1, Chintamani Daslane, Culcutta – 9.
3. BDS Text book of Physiology and Biochemistry; G.H. Bell, D. Emsilie – Smith, C.R. Peterson Churchill Livingstone.
4. Review of medical Physiology – W.E. Ganong, Prentice Hall international Inc.

MODEL QUESTION PAPER

M.Sc. Preliminary – HUMAN PHYSIOLOGY

Time: 3 Hours

Marks: 100

Each section should be written on separate answer books. Draw neat diagrams wherever necessary.

Section - A

1. Describe calcium homeostasis in the human body. (15 marks)
2. Write short notes on: (7x 5 = 35 marks)
 - a) Functions of stomach
 - b) Excitation – contraction coupling in skeletal muscle
 - c) B.M.R.
 - d) Hormones of ovulation
 - e) Pheochromocytoma.
 - f) H.C.G.
 - g) Safe period.

Section – B

1. What are the ascending tracts of spinal cord? Trace any one of them from the receptor to its termination. (15 marks)
2. Write short notes on: (7x5=35 Marks)
 - a. Surfactant
 - b. Cardiac output
 - c. Myopia
 - d. Chloride shift
 - e. Lung Volumes
 - f. Cardiac cycle.
 - g. Cerebrospinal fluid

ORAL EXAMINATION
MODEL QUESTION PAPER

Examiner – I : Cardiovascular system, Respiratory system, Nerve, Central nerve system and special senses
(25 marks)

Examiner – II: Body fluids, Blood and skeletal muscle, smooth muscle, gastrointestinal tract, Renal physiology, Endocrinology & Reproductive system.
(25 marks)

PAPER III- MEDICAL BIOCHEMISTRY

1. A. GOAL

The subject in Biochemistry for I year M. Sc Medical Biochemistry will cover the following areas in Biochemistry. The student is familiarized with the basic concepts in Biochemistry as applicable to the human body so that he can be able to undertake the study of Biochemistry at advanced level in the next two years of this course.

B. COURSE CONTENT

THEORY

1. Introduction to Biochemistry: Role of Biochemistry in Medicine – Biochemical functions of cell organelles – Biophysical phenomena – Membrane transport.
2. Overview of Chemistry of Biomolecules: Carbohydrates, lipids, proteins and aminoacids, nucleic acids, nucleoproteins and hemoglobin. Plasma proteins – Immunoglobulins.
3. Enzymes: Classification with important examples - coenzymes, specificity of enzymes, mechanism of enzyme action, Factors influencing enzyme activity, enzyme inhibition, enzyme units – Regulation of enzymes – Clinical importance of enzymes and isoenzymes.
4. Vitamins: Classification, sources, chemical nature, daily requirements, functions, deficiency manifestations of all fat soluble and water soluble vitamins. Antivitamins - hypervitaminosis.
5. General aspects of metabolism: Anabolism, catabolism and amphibolic pathway.

6. Overview of biological oxidation – electron transport chain and high energy compounds.
7. Digestion and absorption of nutrients from GI tract
8. Metabolism of carbohydrates: Overview of glycolysis, citric acid cycle, glycogenesis and glycogenolysis, gluconeogenesis– HMP shunt, uronic acid pathway, Metabolism of fructose and galactose, sorbitol pathway, Regulation of blood sugar- Disorders of carbohydrate metabolism, Diabetes mellitus- Glucose tolerance test and importance of glycated hemoglobin.
9. Metabolism of lipids: Overview of fatty acid oxidation and synthesis: Ketone bodies. Synthesis and disposal of cholesterol - lipoprotein metabolism, Brief description on fatty liver, atherosclerosis and obesity.
10. Metabolism of proteins: General pathways of aminoacid catabolism – sources of ammonia and disposal – urea cycle – special products formed from aminoacids and their biomedical importance: Disorders associated with aminoacid metabolism
11. Integration of metabolism: Metabolism in starvation and well-fed state, metabolic syndrome.
12. Outlines of synthesis and degradation of purine and pyrimidine nucleotides – associated disorders.
13. Synthesis of heme and its associated disorders – porphyrias –Breakdown of hemoglobin – formation and disposal of Bilirubin – Jaundice – causes, types and lab diagnosis.

14. Overview of metabolism of minerals – Sources, daily requirements, functions, deficiency manifestations and toxicity symptoms.
15. Hormones – Classification – mechanism of action, Biochemical / metabolic functions of all hormones.
16. Body fluids – water and electrolyte balance – Acid base balance – disturbances and compensation.
17. Food and Nutrition: Caloric value of foods – Respiratory Quotient, SDA, BMR, energy requirements and expenditure – Nutritional significance of dietary constituents. Balanced diet – Nutritional disorders
18. Organ function tests: Basic concept of liver function tests, renal function tests, gastric function tests, pancreatic function tests, thyroid function tests
19. Molecular Biology: Basic knowledge of DNA organization and replication – Mutations – transcription - Genetic code – Translation; Recombinant DNA technology – Gene therapy.
20. Detoxication – various mechanisms available in the body – examples.
21. Principles and applications of techniques - chromatography, electrophoresis, colorimeter and centrifugation.

PRACTICALS:

Qualitative:

1. Reactions of carbohydrates, proteins
2. Reactions of hemoglobin and its derivatives
3. Reactions of non protein nitrogenous substances
4. Analysis of unknown substance of biochemical importance
5. Analysis of normal urine
6. Analysis of abnormal urine

Quantitative:

1. Principles of colorimetry
2. Estimation of the following constituents in the blood
 - (a). Glucose
 - (b) Urea
 - (c) Cholesterol

Demonstration:

1. Detection of hemoglobin derivatives by spectroscope
2. Chromatography for separation of sugars and aminoacids
3. Electrophoresis of serum proteins
4. Centrifuge
5. Incubator
6. Hot air oven

Text books recommended (Latest Editions)

1. Harper's Illustrated Biochemistry - Robert K. Murray et al.
2. Textbook of Biochemistry for Medical students – Vasudevan and Sree Kumari
3. Biochemistry – Satyanarayna
4. Textbook of biochemistry by Dinesh puri

Practical books recommended

1. Practical manual in Biochemistry for Medical students , Department of Biochemistry, MGMC&RI, Sri Balaji Vidyapeeth, Puducherry.

Teaching and learning Methods

1. Lectures	-	100 hours
2. Practicals / Demonstrations	-	60 hours
3. Tutorials / small group Discussions	-	40 hours
4. Assignments / Tests	}	

TOTAL

200 HOURS

Examination Pattern:

		Maximum	Minimum for Pass
Theory examination	3 hrs	100 marks	40 marks
Viva voce examination	----	50 marks	No minimum
Internal assessment (Theory)	----	25 marks	No minimum
Internal Assessment (Practical)	--	25 marks	No minimum
		-----	-----
	Total	200 marks	100 marks
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(a) Model Question paper pattern

Theory examination in Biochemistry shall have two sections A and B each carrying questions of 50 marks each.

Each section will have

1 long answer question = 15 marks

7 short answer questions (7 x 5) = 35 marks

(b) Viva examination should be conducted by two examiners: 1 Internal, (25 marks)

- External (25 Marks)

MODEL QUESTION PAPER

M. SC. PRELIMINARY - MEDICAL BIOCHEMISTRY

Time: 3hrs

Max Marks: 100

Each section should be answered in separate answer sheets

Answer all the questions

Section – A

I. Long answer question:

1 x 15 = 15 marks

1. Narrate the dietary sources, chemical nature, daily requirements, biochemical functions and deficiency manifestations of vitamin Niacin.

1 x 15 = 15 marks

II) Write short notes on

7 x 5 = 35 marks

2. Isoenzymes
3. Electrophoresis of serum proteins
4. Balanced diet
5. Genetic code
6. Glycogen storage diseases
7. Functions of zinc
8. LDL metabolism

Section – B

Long answer question:

1 x 15 = 15 marks

9. Describe the Krebs - Hensleit cycle. Add a note on ammonia detoxication.

Write short notes on

7 x 5 = 35 marks

10. Detoxification mechanism.
11. How are triglycerides digested and absorbed?
12. Describe Liver function tests.
13. Explain calcium homeostasis.
14. Discuss the regulation of pH of blood by renal mechanism.
15. Maple syrup urine disease
16. Tumor markers

FACULTY OF MEDICINE

M. Sc. Medical Biochemistry (II & III Year Main)

Departmental objectives:

At the end of training for 3 years in Biochemistry, the postgraduate student shall be able to:

1. Explain the normal functions, physiochemical basis and regulatory mechanisms of the various organs and systems of the human body
2. Apply the principles of biochemical processes in understanding health and disease
3. Impart the basic knowledge and skills in biochemistry to students through various teaching and learning programmes
4. Apply the principles and methods of evaluation in judging the performance of the students.

5. Use, maintain and undertake basic repairwork of equipments, used in a biochemical laboratory
6. Perform various biochemical investigations on biofluids to assess health and disease conditions.
7. Organize and run efficiently a Clinical Biochemistry laboratory for investigative purposes.
8. Collect relevant information regarding the existing knowledge of biochemistry in his field of interest, design and execute appropriate experiments to investigate it.
9. Utilize appropriate biostatistical knowledge and methods to evaluate the results of investigations
10. Present the research findings in systematic scientific format in appropriate scientific forum or in conferences.

II & III YEAR SYLLABUS

Paper – I: Analytical biochemistry & Biophysics, Vitamins, Minerals, Nutrition and Biostatistics

UNIT I : Biophysics

Acids, bases, buffers and its importance in biological systems, pH – Determination of pH- Henderson Hassalbalch equation, indicators, pH meter - water as universal biological solvent – Filtration-Osmosis and osmotic pressure, osmometry - dialysis, ultrafiltration – Diffusion, absorption, viscosity, surface tension mechanisms – factors affecting-their application to biological systems- precipitation- colloidal systems - Donnan membrane equilibrium.

UNIT II: Analytical biochemistry

- **Centrifugation techniques-** Principles, differential centrifugation – Density gradient centrifugation – Ultra Centrifugation and its application in biological systems.
- **Chromatographic techniques:** Principles, types of chromatographic techniques like column, thin layer, paper, adsorption, partition, gas liquid ion exchange, affinity, high. Performance and their application in biological systems.
- **Electrophoresis:** Principles, types and procedures, applications in biological systems.
- **Principles and techniques of photometry and Colorimetry** - Laws of light absorption – visible and UV Spectrophotometry - Spectrofluorimetry - Flame photometry- atomic absorption spectrometry- mass spectrometry.
- Principles, Instrumentation, techniques and application of Nuclear magnetic resonance (NMR) spectroscopy and Electron spin resonance spectroscopy (ESR)
- **Radiation biology-** Principles of radio activity- nature, types, unit of radio activity, detection and measurement of radio activity - radiation hazards and prevention; application of radio activity and radio active isotopes in biological systems and medicine. Radioimmunoassay (RIA), Non-isotopic immuno assays : ELISA, chemiluminescence - Immunoelctrophoresis. and applications

UNIT III: Vitamins- Classification of vitamins with examples, Sources, chemical nature, RDA, biological functions, deficiency manifestations of fat soluble and water soluble vitamins. Hypervitaminosis, antivitamins, Detection of vitamin deficiencies and Vitamin like compounds.

UNIT IV: Mineral metabolism- Macrominerals and microminerals – Sources, daily requirements, metabolism, biochemical functions, deficiencies, toxicity symptoms and disorders associated with them.

UNIT V: Nutrition- Energy metabolism - Calorific value of foods, Direct and indirect Calorimetry, Respirations quotient, specific dynamic action foods, energy requirement of the body, basal metabolic rate (BMR), calculation of total caloric requirement of an individual; Food groups, requirements for normal health nutritional significance of dietary fiber, biological value of proteins, nitrogen balance, , food adulteration, food toxins.

Balanced diet, recommended dietary allowance (RDA). Nutrification of food. Disorders of nutrition - undernutrition, overnutrition - protein calorie (energy) malnutrition, obesity - Biochemical assessment of nutritional status - Diet formulation of therapeutic diets with reference to various diseases.

UNIT VI: Research methodology & Biostatistics

Basic concepts of probability, mean, mode, median, standard deviation, Binomial expression, t-test, chisquare analysis of variance, coefficient of correlation, evaluation of new analytical procedure and diagnostic procedure, Regression analysis and Research methodology.

Paper – II: Chemistry and metabolism of Biomolecules , Enzymology, Bioenergetics, Immunology, Metabolism of Xenobiotics and Environmental Biochemistry

UNIT I: Chemistry and metabolism of biomolecules:

a. Chemistry and metabolism of Carbohydrates

Chemistry of carbohydrate - Classification, structure, properties and functions of Monosaccharides, Disaccharides, Oligosaccharides, and Polysaccharides, Glycoprotein and Proteoglycan. **Carbohydrate metabolism-** Digestion, absorption and transport of carbohydrates, Glycolysis, gluconeogenesis, citric acid cycle, HMP shunt, uronic acid pathway, glycogen metabolism and regulation of blood glucose; Metabolism of fructose and galactose, lactose metabolism, Hormonal control of carbohydrate metabolism, disorders associated with carbohydrate metabolism.

b. Chemistry of lipids: Classification, properties, structure and functions of simple, compound and derived lipids, essential fatty acids, prostaglandins. **Lipid metabolism-** Digestion, absorption and transport of lipids, Oxidation of fatty acids, formation and utilization of ketone bodies – biosynthesis of fatty acids. Metabolism of triacylglycerols, phospholipids, glycolipids, cholesterol, lipoproteins. Eicosanoids. Role of adipose tissue and liver in lipid metabolism. Fatty liver, lipotropic factors, obesity, atherosclerosis. Inborn errors associated with lipid metabolism

c. Chemistry of proteins and aminoacids-Classification, properties, structural organization and denaturation of proteins, biologically important peptides, classification and properties of amino acids, functions of plasma proteins. **Protein metabolism**- Digestion, absorption and transport of amino acids, General pathways of catabolism of amino acids. Ammonia production and disposal. Urea cycle and its disorders, Ammonia intoxication; Metabolism of individual amino acids. Essential and non essential amino acids, Glucogenic, ketogenic and glucogenic – ketogenic amino acids. conversion of aminoacids to specialised products. Creatinine, biogenic amines, polyamines, neurotransmitters etc. Inborn errors associated with protein metabolism - aminoaciduria.

d. Integration of metabolism

Definition, significance of integration of metabolism, integration of metabolism at cellular level, integration of metabolism at tissue or organ level, metabolism in starvation.

e) Hemoglobin metabolism:

Biosynthesis of heme and the disorders associated with it – Porphyrrias. Degradation of heme, metabolism of Bilirubin, Jaundice – Types causes and laboratory diagnosis.

UNIT II: Enzymology- Enzymes as biocatalysts; Classification, and nomenclature of enzymes as per IUB enzyme classification system with specific examples. Cofactors, Intracellular localization of enzymes- isolation and purification of enzymes - enzyme specificity, Mechanism of enzyme action, Lock and key model and induced fit model, Enzyme substrate complex (ES), active sites, allosteric sites, Michaelis- Menten equation. Factors influencing enzyme catalysed reactions Km value, Enzyme regulation, enzyme inhibition, Multienzyme complexes, Clinically important enzymes and isoenzymes.

UNIT III: Bioenergetics: Law of thermodynamics and their applications in biological system, Free energy change, entropy and enthalpy, high energy and low energy compounds, Redox potential, Enzymes involved in biological oxidation - Organization of the electron transport chain (Respiratory chain), Oxidative phosphorylation – mechanisms, uncouplers, Inhibitors

UNIT IV: Immunology

1. Introduction to the cells and organs of immunity-memory, specificity, diversity, self vs, non-self, discrimination, structure and functions of primary and secondary – lymphoid organs - cell mediated versus humoral immunity - T and B lymphocytes.

2. The host response - Natural defense of the body, species, racial, communal, regional and individual variation - mechanism of natural resistance - the skin, mucus membrane, lysozyme, phagocytes, defences In blood, lymph and components of Reticulo endothelial system.

3. Nature of antigen and antibody: antigen vs immunogen - structure of antibody - constant and variable and hypervariable regions, Fab and Fc, isotype, allotype and idiotype - functions of antibody molecules, classification.

4. Antigen presentation, MHC, complements system, antibody diversity, clonal selection, cytokines,

5. Measurement of antigen-antibody interactions: Direct binding assays, agglutination, precipitation, immunodiffusion, immunoelectrophoresis, Elisa, RIA, fluorescence analysis, hybridoma technique.

6. Hypersensitivity, autoimmunity, vaccines and immunodeficiency disorders,

UNIT V: Metabolism of xenobiotics

Detoxification, mechanisms in the body. Biological implications

UNIT VI: Environmental Biochemistry

Biochemical aspects of environmental hazards, occupational hazards

**Paper – III – Cell and molecular biology, Cancer biology, Endocrinology and Clinical
biochemistry,**

UNIT I: Cell and molecular biology

i) Cell biology-General structure of prokaryotic and eukaryotic cells. Methods of studying cells and subcellular organelles; marker enzymes of cell organelles structure and functions of cell organelles. biomembrane structure and transport mechanism.

ii)Molecular biology-Nucleic acids as genetic information carriers, DNA organization Nucleosomes,. DNA replication different types, semiconservative mechanism of DNA replication in prokaryotic and eukaryotic organisms, Meselson and Stahl experiments, DNA polymerases, DNA repair mechanisms - mutations. Transcription process in prokaryotic and eukaryotic organisms – posttranscriptional modifications; reverse transcription. Genetic code - characteristics of the genetic code - wobble hypothesis - Direction of protein synthesis. Translation mechanism in prokaryotic and eukaryotic organisms posttranslational modifications and inhibitors and regulation of gene expression.

Molecular biological techniques: DNA sequencing techniques, synthesis of oligonucleotides, recombinant DNA technology and its applications, polymerase chain reaction (PCR) blotting techniques, restriction fragment length polymorphism. Gene therapy, cloning, transgenic animals and Human genome project.

UNIT II: Cancer biology: cell cycle and its regulation, Molecular basis of carcinogenesis, Oncogenes and antioncogenes – Inborn errors of metabolism - causes and effects – Tumour markers.

Unit III: Endocrinology- Classification of hormones with examples - Mechanism of action of peptide hormones and steroid hormones – Second messengers – structure, biosynthesis, secretion, transport, regulation, metabolic effects of the hormones of pituitary, hypothalamus, thyroid, parathyroid, pancreas, adrenals, gonads, gastrointestinal tract – Menstrual cycle fetoplacental unit, synthetic hypoglycemic agents, antithyroid agents. Hormonal regulation of metabolism; Endocrine disorders- biochemical basis and diagnosis.

UNIT IV: Clinical biochemistry

- Collection of samples and preservation, anticoagulants, pre-analytical errors in clinical biochemistry. Use of pooled serum; Acquisition of standards for laboratory estimation, reference values, selection of methods for estimation of common analytes. Automation in clinical Biochemistry. Use of computers in clinical Biochemistry. Statistical methods of analysis of results. Quality Control in Clinical Biochemistry.

- Role of Biochemistry in diagnosis of disease
- Gastro intestinal disorders; Digestive diseases and malabsorption syndromes- Lab diagnosis.
- Disorders of carbohydrate metabolism: hyperglycemia, hypoglycemia. Renal glycosuria,. Glucose tolerance tests. Diabetes mellitus- types, complications, lab diagnosis, galactosemia, fructosuria - glycogen storage diseases.
- Disorders of lipid metabolism: Changes in cholesterol, triacylglycerol and lipoproteins levels in blood in normal state and in diseases – Hyper and hypolipoproteinemia, Ketosis, fatty liver, atherosclerosis and obesity.
- Disorders of protein metabolism - Excretion of nitrogenous waste products: Ammonia urea, uric acid; creatinine. Abnormalities of nitrogen metabolism including ammonia intoxication, aminoaciduria
- Blood and coagulation- coagulation and prothrombin time - determination, Hemoglobin - anemia - abnormal hemoglobins and their identification – porphyrias and Jaundice.
- Clinical enzymology- serum enzymes and their diagnostic and therapeutic applications and their interpretation. Isoenzymes – separation and their diagnostic importance.
- Fluid and electrolyte balance
 - a. Fluid components of the body and regulation; Disturbances of fluid and electrolyte balance. Laboratory parameters in the diagnosis and management of fluid and electrolyte disorders; oral dehydration therapy
 - b. Fluid in health and diseases: CSF, pleural fluid, peritoneal fluid, Amniotic fluid in normal and disease, laboratory findings
- Acid base balance-Regulation of blood pH, disturbances in acid base balance – acidosis and alkalosis, lab diagnosis – Blood gas analysis

- Endocrine disorders-Laboratory diagnosis and investigation related to disorders of thyroid, pituitary, adrenals, gonads. Plasma and urinary assay of hormones related to various endocrine disorders.
- Inborn errors of metabolism-Biochemical changes and symptoms and diagnosis of glycogen and Lipid storage disorders, Phenyl ketonuria, Alkaptonuria, Albinism, Gout, Lesch Nyhan syndrome, Detection and diagnosis of Inborn errors of metabolism.
- Function Tests-Investigative tests for liver function, renal function, adrenal function - Interpretation,

PRACTICALS

Part –I : General Biochemistry

1. Lab safety precautions and good laboratory practice
2. Units of measurements
3. Calculation of Normality, molarity, molality in laboratory
4. General reactions of carbohydrates and proteins
5. Reactions of non protein nitrogenous substances
6. Identification of unknown substance of biochemical importance
7. Reactions of hemoglobin derivatives, detection by spectroscope
8. Analysis of normal urine
9. Analysis of abnormal urine
10. Preparation of buffers and determination of pH using pH meter
11. Separation of (a) Sugar (b) Aminoacids by chromatography
12. Separation of proteins by electrophoresis
14. Estimation of vitamin C

Part –II: Clinical Biochemistry

1. Estimation of blood sugar
2. Glucose tolerance test
3. Estimation of glycosylated hemoglobin
4. Estimation of a. Urea b. Creatinine c. Uric acid in blood
5. Estimation of a. Total cholesterol b. Triacylglycerol c. HDL d. LDL e. VLDL

6. Estimation of a. Protein b. Albumin c. A.G. ratio in serum
7. Estimation of a. Calcium b. Phosphorus in blood
8. Estimation of a. Total Bilirubin b. Direct Bilirubin c. Indirect Bilirubin in serum
9. Estimation of enzymes in serum (a) Amylase (b) ALT (c) AST (d) LDH (e) CPK (g) Acid phosphatase (h) Alkaline phosphatase (i) Lipase
10. Measurement of electrolytes (Sodium, potassium, chloride) in blood and urine using (a) Flame photometer (b) Ion selective electrodes
11. Blood gas analysis (ABG); pO₂ pCO₂, pH and other calculated parameters
12. Estimation of elements a. Iron b. Copper c. Magnesium d. Lithium
13. Analysis of biofluids a. CSF b. Plural fluids c. Peritoneal d. Amniotic fluid.
14. Separation of serum Proteins by polyacrylamide gel electrophoresis and Densitometry scanning of electrophoresis pattern
15. Estimation of urine proteins
16. Detection of Bence Jones protein in urine
17. Separation of lipoproteins by electrophoresis
18. Separation of normal and abnormal hemoglobins by electrophoresis
19. Estimation of cortisol by fluorimeter
20. Analysis of renal and biliary calculi
21. Estimation of a. 17 keto steroids b. 5HIAA c. VMA in urine
22. Estimation of estriol in urine
23. Function tests related to liver function, renal function, gastric function, thyroid function and adrenocortical function.
24. Effect of pH, temperature on enzyme activity(trypsin)

Part – III : Demonstration

1. Tissue culture techniques.
2. HPLC
3. DNA isolation, and quantification
4. PCR, RT-PCR
5. Blotting techniques
6. Immunochemical techniques (ELISA, RIA)
7. Chemiluminescence

8. Blood gas analyzers
9. Electrolyte analyzer (Ion selective electrodes)
10. Autoanalyzers
12. Ultracentrifuge
13. flowcytometry
14. mass spectrophotometry

Teaching – Learning methods

1. Participation in UG teaching programmes
2. Participation in PG seminars, Symposia, Journal clubs, Case discussion etc.
3. Teaching some selective topics in Biochemistry for UG classes
4. Supervision of practical classes of UG students
5. Carrying out PG practical classes for PG course work
6. Performing experiments for PG dissertation and research work
7. Participation in laboratory and investigative procedures related to Biochemistry in clinical services
8. Participation in Biochemistry and Clinical chemistry conferences
9. May be posted (optional) for 15-20 days for learning advanced techniques in Biochemistry / Molecular Biology in other Institutions (JIPMER, CMC Vellore, SRM Institute of science and technology, Sri Ramachandra institute of Higher education and Research etc.,)

Textbooks recommended (Latest editions):

1. Lehninger's Principles of Biochemistry –Nelson and Cox.
2. Text book of Biochemistry with clinical correlations - Thomas M. Devlin
3. Biochemistry - Lubert Stryer.
4. Harper's Illustrated Biochemistry - Robert K. Murray et al.
5. Textbook of Clinical Chemistry and molecular diagnostics- Tietz
6. Biochemistry - Voet & Voet
7. Lippincott's Illustrated Reviews: Biochemistry - Pamela C. Champe and Richard A. Harvey
8. Clinical Chemistry in Diagnosis & Treatment - Philip D. Mayne.

9. Clinical chemistry – Marshall
10. Textbook of Biochemistry for Medical students - Chatterjee & Shinde
11. Textbook of Biochemistry – Dinesh Puri
12. Molecular Biology of the Cell - Bruce Alberts.
13. Cell and Molecular Biology - . De Robertis, De Robertis Jr.
14. Genes VIII - Benjamin Lewin.
15. Immunology – Roiter
16. Davidson’s Human Nutrition – Geissler.
17. Textbook of Biochemistry – West & Todd
18. William’s Textbook of Endocrinology

Practical Books Recommended:

1. Varley’s Practical Clinical Biochemistry
2. Clinical Chemistry -Principles, procedures, correlations - Michael L. Bishop
3. Clinical Chemistry – Principles and Techniques - Henry
4. Introduction to Practical Biochemistry - Plumner
5. Standard methods in Clinical chemistry – series - Academic Press
6. Methods in enzymology - Academic Press
7. Rodney Boyer -Modern Experimental Biochemistry
8. Practical Biochemistry and Molecular Biology – Wilson & Walker Oxford University Press
9. Medical laboratory Technology –Sood
10. Clinical diagnosis and management by laboratory methods – Todd and Stanford

List of Journals:

1. Clinical chemistry
2. Clinical Biochemistry
3. Clinica Chimica Acta
4. Biochemical Journal
5. British journal of Nutrition
6. Journal of Molecular Biology
7. Indian Journal of Biochemistry and Biophysics

8. Indian Journal of Clinical Biochemistry
9. Indian Journal of Medical Research
10. Indian Journal of Experimental Biology
11. Journal of Endocrinology
12. Journal of Laboratory investigations
13. Trends in Biochemical Sciences
14. Science
15. Nature
16. Annual review of Biochemistry

M.Sc. MEDICAL BIOCHEMISTRY
FINAL Examination (at the end of III Year)

There are three papers each consisting of 2 Essay Questions (2 x 20 = 40) and six Short Notes (6 x 10 = 60). Total 100 Marks each.

<u>Theory</u>		<u>Duration</u>	<u>Maximum</u>	<u>Minimum</u>
<u>for Pass</u>			<u>Marks</u>	<u>Marks</u>
Paper- I	Analytical biochemistry & Biophysics, Vitamins, Minerals, Nutrition and Biostatistics	3 hrs	100	40
Paper- II	Chemistry and Metabolism of Biomolecules , Enzymology, Bioenergetics, Immunology, Metabolism of Xenobiotics and Environmental Biochemistry	3 hr	100	40
Paper – III	Cell and molecular biology, Cancer biology, Endocrinology, And Clinical biochemistry	3 hrs	100	40
	Total (Theory)		300	150
	Viva voce		50	---
	Internal Assessment (Theory)		50	---
	Total (Theory + Viva voce + Internal Assessment)		400	200

Practicals:

Practical - I – (A) Analysis of unknown sugar / amino acid and confirmation by chromatography	50	---
(B) Basic experiment / Charts	50	---
Practical – II – (A) Estimation of one analyte in blood / urine with standard graph	50	---
(B) Electrophoresis of serum proteins of a sample with diagnosis and interpretation	50	---
Total	200	100
(Duration of Practical examination shall be 2 days)		
Internal assessment (Practical)	50	---
Records	20	---
Dissertation	30	---

Total	300	150

Grand Total (Theory & Practical)	700	350

MODEL QUESTION PAPERS
M.Sc. (Medical Biochemistry) - III YEAR

PAPER – I : Analytical Biochemistry, Biophysics, Vitamins, Minerals, Nutrition and Biostatistics

Time: 3 hrs

Max.Marks: 100

Long Essay

(2X20=40 marks)

1. Discuss the principles, operating procedure and applications of an ultracentrifuge **(20)**

2. Describe the Vitamin A under following headings: sources, RDA, biochemical functions and deficiency manifestations. **(2+2+8 + 8) = 20**

Write short notes on:

6x 10 = 60 marks

3. BMR
 4. Donnan membrane equilibrium
 5. Regulation of blood calcium levels
 6. Affinity chromatography
 7. Statistical evaluation between a control group and an experimental group
 8. Biochemical functions of Vitamin B12
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PAPER – II: Chemistry And metabolism of Biomolecules , Enzymology, Bioenergetics, , Immunology, Metabolism of Xenobiotics and Environmental Biochemistry

Time: 3 hrs

Max.Marks: 100

Long Essay

(2X20=40 marks)

1. How is ammonia formed and detoxified in the body? (20)
2. Describe the types of enzyme inhibition with suitable illustrations. (20)

Write short notes on:

6x 10 = 60 marks

3. Reverse cholesterol transport
 4. Regulation of glycogen metabolism
 5. Conjugation reactions of Detoxification
 6. Chemiosmotic theory for oxidative phosphorylation
 7. Monoclonal antibodies
 8. Lead Poisoning
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PAPER – III : Cell and Molecular biology, Cancer biology, Endocrinology and Clinical biochemistry,

Time: 3 hrs

Max.Marks: 100

Long Essay

(2X20=40 marks)

1. Describe the laboratory tests performed to investigate different types of Jaundice
2. Describe the process of translation with suitable illustration and add a note on post translational modification.

Write short notes on:

6x 10 = 60 marks

3. Chemiluminescence
 4. Quality control in a Clinical Biochemistry laboratory
 5. Tumor markers
 6. Mechanism of action of insulin
 7. Laboratory diagnosis of Cushing`s and Addison`s disease
 8. Biochemical analysis of CSF.
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