

# **CURRICULUM**

**M.Sc. (MEDICAL BIOCHEMISTRY) Course**

***2008-09***



**JAWAHARLAL INSTITUTE OF POSTGRADUATE MEDICAL EDUCATION &  
RESEARCH (JIPMER),**

**PUDUCHERRY-605 006**

**Academic Affairs  
Concerned Officials**

<b>Dr. K.S.V.K. Subba Rao</b>	...	<b>Director</b>
<b>Dr. K.S. Reddy</b>	...	<b>Dean</b>
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**Jawaharlal Institute of Postgraduate Medical Education & Research (JIPMER),  
Puducherry-605 006.**

### **SYLLABUS COMMITTEE**

- |   |     |                  |
|---|-----|------------------|
| 1. Dr. K.S.V.K. Subba Rao, Director       | ... | Chairperson      |
| 2. Dr. K.S. Reddy, Dean                   | ... | Member           |
| 3. Head of the Department of Anatomy      | ... | Member           |
| 4. Head of the Department of Biochemistry | ... | Member           |
| 5. Head of the Department of Physiology   | ... | Member           |
| 6. Professor (Examinations)               | ... | Member           |
| 7. Professor (Academics)                  | ... | Member-Secretary |

# M.Sc. (MEDICAL BIOCHEMISTRY)

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## REGULATIONS AND SYLLABI FOR M.Sc. (MEDICAL BIOCHEMISTRY) COURSE

This regulation is effective for the students admitted from August 1996 Session.

### Qualification for Admission

A candidate for admission to M.Sc. (Medical Biochemistry) Course should have passed B.Sc. Chemistry or B.Sc. (MLT) or B.Sc. Biochemistry degree in any University recognized

### Method of Selection

Candidates for the M.Sc. (Medical Biochemistry) course will be selected on the basis of merit in the common All India Entrance Examination conducted by the Institute. The syllabus for the entrance examination will be of B.Sc. standard.

### Registration

All candidates admitted to M.Sc. (Medical Biochemistry) course shall register with JIPMER at the commencement of the course, usually, the 1<sup>st</sup> August every year.

### Duration of the course

The M.Sc. (Medical Biochemistry) course is of 3 years duration.

### Scheme of Examination

At present, the examination pattern followed is as follows:

Preliminary Examination (At the end of the First Year)

	Subject		Max. Marks	Min. Marks
Paper I	Anatomy	Written	100	--
		Viva-voce	50	--
		Internal Assessment	20	--
		<b>Total</b>	<b>170</b>	<b>85</b>
Paper II	Physiology	Written	60	--
	Biochemistry	Written	40	--
	Physiology	Viva-voce	30	--
	Physiology	Internal Assessment	15	--
	Biochemistry	Viva-voce	20	--
	Biochemistry	Internal Assessment	15	--
		<b>Total</b>	<b>180</b>	<b>90</b>
		<b>Grand Total</b>	<b>350</b>	<b>175</b>

Final / Summative Examination (At the end of the Third Year)

	<b>Subject</b>	<b>Max. Marks</b>	<b>Min. Marks</b>
Paper I	Physical and organic aspects of Biochemistry	100	--
Paper II	Enzymes, Intermediary Metabolism and Nutrition	100	--
Paper III	Clinical Biochemistry	100	--
	Viva-voce	50	--
	<b>Total</b>	<b>350</b>	<b>175</b>
	Practical - I	100	
	Practical – II	100	
	Records	50	
	<b>Total</b>	<b>250</b>	<b>125</b>
	<b>Grand Total</b>	<b>600</b>	<b>300</b>

The above is modified as follows from August 1996 Batch.

- i) Written Examination
- ii) Practical Examination
- iii) Oral Examination
- iv) Dissertation

### Theory Papers

At the end of the first year, the candidate has to write 3 theory papers, each of 3 hours duration and the maximum marks for each theory paper is 80. At the end of the second year, the candidate has to write 4 theory papers, each of 3 hours duration and the maximum marks for each theory paper is 100. At the end of the third year, the candidate has to appear for 4 theory papers of 3 hours duration each carry a maximum marks of 100.

### Practical Examination

At the end of the first year, the candidate has to undergo for practical examination in Anatomy, Physiology and Biochemistry, each of 2 hours duration and carrying a maximum marks of 40.

### First year

<b>Subject</b>	<b>Written (Max.)</b>	<b>Oral (Max.)</b>	<b>Total</b>	<b>Minimum</b>	<b>Practical (Max.)</b>	<b>I.A. (Max.)</b>	<b>Grand Total</b>	<b>Minimum</b>
1. Anatomy	80	40	120	60	40	40	200	100
2. Physiology	80	40	120	60	40	40	200	100
3. Biochemistry	80	40	120	60	40	40	200	100
<b>Total</b>							<b>600</b>	<b>300</b>

At the end of the second year, the candidate has to undergo 2 practical examinations each of 6 hours duration and each will carry 100 marks.

### Second year

Written	Duration	Maximum Marks	Minimum Marks
1. Paper I	3 hours	100	40
2. Paper II	3 hours	100	40
3. Paper III	3 hours	100	40
4. Paper IV	3 hours	100	40
<b>Total</b>		<b>400</b>	<b>200</b>
1. Practical I	6 hours	100	50
2. Practical II	6 hours	100	50
<b>Total</b>		<b>200</b>	<b>100</b>
1. Record		100	--
2. Oral		100	--
3. Internal Assessment		100	--
<b>Total</b>		<b>300</b>	<b>150</b>
<b>Grand Total</b>		<b>900</b>	<b>450</b>

At the end of the third year, the candidate has to undergo 2 practical examinations of each 6 hours duration and each will carry 100 marks.

### Third year

Written	Duration	Maximum Marks	Minimum Marks
1. Paper I	3 hours	100	40
2. Paper II	3 hours	100	40
3. Paper III	3 hours	100	40
4. Paper IV	3 hours	100	40
<b>Total</b>		<b>400</b>	<b>200</b>
1. Practical I	6 hours	100	50
2. Practical II	6 hours	100	50
<b>Total</b>		<b>200</b>	<b>100</b>
1. Record		100	50
2. Oral		100	50
3. Internal Assessment		100	50
4. Project Work (75+25)		100	50
<b>Total</b>		<b>400</b>	<b>200</b>
<b>Grand Total</b>		<b>1000</b>	<b>500</b>

1. First Year Total Marks	600
2. Second Year Total Marks	900
3. Third Year Total Marks	1000
<b>Grand Total</b>	<b>2500</b>

### **Oral Examination**

At the end of the first year, the candidate has to undergo oral examination in Anatomy, Physiology and Biochemistry which will carry a maximum of 40 marks in each subject. At the end of the second year, the candidate has to undergo oral examination, which will carry a maximum of 100 marks. At the end of the third year, the candidate has to undergo oral examination, which will carry a maximum of 100 marks.

### **Dissertation**

The topics for the dissertation shall be selected by the candidates within 6 months of starting second year course and shall be submitted 3 months before the final examination in the third year for approval. The project work is mainly to orient the candidate towards research methodology. The practical work shall be carried out by the candidate under the guidance of a postgraduate teacher in the department. Collaboration works with other departments are encouraged. The dissertation will be valued by 2 examiners (1 internal and 1 external) and the project work will carry 75 marks. A viva will be conducted on the project during the oral examination and the viva on the project will have 25 marks.

### **Passing Minimum**

#### First Year:

A candidate has to get 50% of minimum marks in written and oral examinations in each paper put together and 50% aggregate in written, oral, practical and internal assessment.

#### Second and Third Year:

A candidate has to get 40% minimum in each theory paper and 50% in all the 4 theory papers. In case of failure, the candidate has to appear for all the 4 theory papers. Further, a candidate has to get 50% minimum marks in the second / third year subjects as a whole.

### **Practicals**

A candidate has to get 50% of marks in the practical examinations of each year.

Further, a candidate has to get 50% of marks in aggregate of records, oral and internal assessment in second year and 50% of marks in aggregate of records, oral, internal assessment and project.

The candidate is allowed to continue his course in the second year, if he / she has passed any two of the three subjects in first year, but he / she will not be permitted to appear for the examinations of the 2<sup>nd</sup> year, unless he / she passes all the three subjects of first year, within 6 months of joining the second year.

The candidate is permitted to join the third year of the degree course, if he / she has not passed all the examinations of second year, but will not be permitted to appear for the examinations of third year, unless he / she passes all the subjects of second year, within 6 months of joining the third year.

**Grace Marks**

Grace marks of 5 if candidate fails in only one subject / paper out of all the subjects / papers he had appeared. Applicable to I / II / III year provided they pass the subject with the marks provided.

## **CURRICULUM IN ANATOMY FOR FIRST YEAR M. Sc. (MEDICAL BIOCHEMISTRY)**

### **I. DEPARTMENTAL OBJECTIVES**

The students of M.Sc. Medical Biochemistry 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. Recognise 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 recognized 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. Do staining of the tissue or the organ in paraffin section with haematoxylin and Eosin and identify the tissue or the organ.
6. Continue to learn the anatomical aspects of the human body and apply the same in health care programmes.

### **II. COURSE CONTENT**

The course will start on or before 1<sup>st</sup> August (Duration: August to April) and the Annual / Summative Examination will be in the 3<sup>rd</sup> week of the following April. The following areas in the subject of Anatomy shall be covered:

#### **ANATOMY**

##### **Theory**

- a) General Anatomy – Basic Principles
- b) General Histology – Basic Principles
- c) Systemic Histology
- d) General Embryology – Basic Principles
- e) Systemic Embryology
- f) A brief account of gross Anatomy of various organs of the following systems:
  - i) Respiratory system
  - ii) Circulatory system
  - iii) Alimentary system
  - iv) Excretory system
  - v) Nervous system
  - vi) Special sensory organs
  - vii) Endocrine glands
- g) Medical Genetics – Basic Principles

## **Practical**

- a) Dissection of the human cadaver to learn the anatomy of the organs of various systems listed above.
- b) Identification of the histological features of various tissues and organs using Histology slides stained with haematoxyline and eosin.
- c) Staining of the tissues and organs in paraffin sections with haematoxlin and eosin.
- d) Identification of the chromosomes using human karyotyping.
- e) Identification of the embryology specimens and models

### **III. BOOKS RECOMMENDED**

#### A. GENERAL ANATOMY:

Grant's Method of Anatomy: Scientific Book Agency, Calcutta/

#### B. SYSTEMIC ANATOMY:

Human Anatomy: By Inderbir Singh, Vol.I, II and III, MacMillan India Ltd., Madras

#### C. HISTOLOGY:

Histology by Arrey: Kothari Publications, Bombay

#### D. EMBRYOLOGY:

Hunan Embryology: By Inderbir Singh, Macmillan India Ltd., New Delhi

#### E. GENETICS IN MEDICINE:

Thompson J.S., Thompson M.W., Saunders, Philadelphia.

#### F. DISSECTION:

Cunningham's Manual of Practical Anatomy. Vol. I, II & III

### **IV. TEACHING LEARNING ACTIVITIES**

- |                                      |   |                                      |
|--------------------------------------|---|--------------------------------------|
| 1. Lecture Classes                   | : | One per day of one hour duration.    |
| 2. Practical Classes                 | : | Three per week of two hours duration |
| 3. Tutorial / Demonsstration Classes | : | Three per week of two hours duration |

### **V. EVALUATION**

- |                          |   |           |
|--------------------------|---|-----------|
| 1. Written Examination   | : | 80 marks  |
| 2. Oral Examination      | : | 40 marks  |
| 3. Practical Examination | : | 40 marks  |
| 4. Internal Assessment   | : | 40 marks  |
| Total                    | : | 200 marks |

#### **(a) Internal Assessment**

- |  |   |          |
|--|---|----------|
| i) Record Notebooks<br>(History – 5 marks; Systemic Anatomy – 5 marks) | : | 10 marks |
| ii) By notified tests  | : | 30 marks |
| Total  | : | 40 marks |

**(b) Annual / Summative Examination**

i) Written (3 hours duration) : 80 marks

**Examiner I**

Section A/I Systemic Anatomy : 20 marks

Histology : 20 marks

Total : 40 marks

**Examiner II**

Section B/II Embryology and Medical Genetics : 20 marks

General and Systemic Anatomy : 20 marks

Total : 40 marks

Model Question Paper is provided.

ii) Practical (2 hours duration) : 40 marks

a) Spotters: Identification of various organs : 10 marks

Identification of histology slides : 10 marks

Identification of embryology specimens and models (2x5=10) : 10 marks

b) Staining a paraffin section with H/E and identification : 10 marks

Total : 40 marks

iii) Oral Examination

**Examiner I**

General Anatomy and Systemic Anatomy : 20 marks

**Examiner II**

Histology, Embryology & Medical Genetics : 20 marks

Total : 40 marks

## MODEL QUESTION PAPER

### M. Sc. (Medical Biochemistry) Part I – Anatomy

Time: 3 Hours

Maximum Marks: 80

Answers are to be illustrated with suitable diagrams.

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

#### **SECTION I**

1. Describe the internal features of the chambers of the heart. (10 marks)
2. Describe the histology of the following organs: (5x4=10 marks)
  - a) Stomach
  - b) Liver
  - c) Kidney
  - d) Thyroid gland
3. Write short notes on: (5x2=10 marks)
  - a) Pituitary gland
  - b) Testis

#### **SECTION II**

4. Describe the development of the urinary system. Write the list of the congenital anomalies of the organs of the urinary systems and the embryo genesis of each. (6+2+2=10 marks)
5. Give a brief account of: (5x2=10 marks)
  - a) Down's syndrome
  - b) Karyotyping of human chromosomes
6. Write short notes on: (5x4=20 marks)
  - a) Limbic system
  - b) Ossification
  - c) Synovial joints
  - d) Pancreas

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## **CURRICULUM IN PHYSIOLOGY FOR FIRST YEAR M. Sc. (MEDICAL BIOCHEMISTRY)**

### **I. DEPARTMENTAL OBJECTIVES**

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

- i) state the functions of various 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

### **SYLLABUS FOR PHYSIOLOGY FOR M.Sc. (MEDICAL BIOCHEMISTRY)**

#### **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, principle of homeostasis.

**Body** – 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 fibre 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 nephron, 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**: Vit. D and Parathyroid, Calcium metabolism, Physiology of bone formation and destruction. Vit. 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 – O<sub>2</sub> dissociation and CO<sub>2</sub> 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
- i) Mastication and swallowing, salivary secretion and its regulation.
  - ii) Regulation of gastric secretion and motility.
  - iii) Biomechanism of secretion, function and regulation of bile secretion.
  - iv) Intestinal secretion and motility – regulation (including defecation).
9. Nervous system  
 General role of nervous system is causing appropriate response to environmental stimuli, concept of reflex and voluntary action. Sensory system: Receptors, afferent pathways, cortical sensory areas for somaesthetic 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 behaviour (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**

1. The course in Physiology will be covered by:
  - i) Lectures - 4 hours per week (100 hours approximately)
  - ii) Group Discussions / Tutorials – 1 hour per week (20 hours approximately)
  - iii) Demonstrations & Practicals – 2 hours per week (50 hours approximately)

**TEXT BOOKS AND REFERENCE BOOKS RECOMMENDED:**

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

## EVALUATION

1. Written examination	-	80 marks
2. Oral examination	-	40 marks
3. Practical examination	-	40 marks
4. Internal assessment	-	40 marks
		-----
Total		200 marks
		-----

### **(A) Internal Assessment:**

i) Record Note books	-	10 marks
ii) By notified tests	-	30 marks
		-----
Total		40 marks
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### **(B) Annual / Summative Examination:**

i) Written (3 hours duration)	-	80 marks
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#### Examiner I

<u>Section – A:</u> Essay types – 2 Questions x 10 =	20 marks
Short notes – 4 Questions x (4x5) =	20 marks

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

#### Examiner II

<u>Section B:</u> Essay types – 2 Questions x 10 =	20 marks
Short notes – 4 Questions x (4x5) =	20 marks

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

Model question paper is provided.

ii) Practical (2 hours duration)	-	40 marks
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#### Human Practicals (one hour)

a) Electrocardiogram		
b) Pulmonary function tests		
c) Basal Metabolic rate		
d) Blood pressure		
e) Perimetry		
f) Moso's Ergography	-	20 marks

Haematology Practicals (45 minutes) - 10 marks)  
(R.B.C. Count, W.B.C. Count, Differential counts, Hb, E.S.R, PCV, Blood indices)

Cards – 2 (Problems) (15 minutes)	-	10 marks
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**MODEL QUESTION PAPER**  
**PRACTICAL**

Human Practical:

- I. a) Record B.P. of the given subject in the supine position and after mild exercises and tabulate your results. (20 marks)

Haematology Practical:

- b) Perform the different leucocytes counts of your own blood (10 marks)  
c) Comment on the given problems (10 marks)

**ORAL EXAMINATION**

Examiner – I: Cardiovascular system, Respiratory system, Nerve, Central nerve system and special senses (20 marks)

Examiner – II: Body fluids. Blood and skeletal muscle, smooth muscle, gastrointestinal tract, Renal physiology, Endocrinology & Reproductive system. (20 marks)

**MODEL QUESTION PAPER**

**M. Sc (Biochemistry) Medical Faculty – PHYSIOLOGY**

**Time: 3 Hours**

**Marks 100**

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

**Section – A**

1. List the stages in erythropoiesis and describe regulations of erythropoiesis. (10 marks)
2. Describe the mechanism of glomerular filtration and explain how (a) glucose (b) water are reabsorbed in the kidney tubules. (10 marks)
3. Write short notes on: (5x4=20 marks)
  - a) Functions of stomach
  - b) Excitation-contraction coupling in skeletal muscle
  - c) B.M.R.
  - d) Hormones of ovulation

**Section – B**

1. Describe the events in cardiac cycle. (10 marks)
2. What are the ascending tracts of spinal cord? Trace any one of them from the receptor to its termination. (10 marks)
3. Write short notes on:
  - a) Vital capacity
  - b) Cardiac output
  - c) Myopia
  - (d) Chloride shift

## **DEPARTMENTAL OBJECTIVES FOR POSTGRADUATE STUDENTS IN BIOCHEMISTRY**

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

1. Describe the normal functions, physiochemical basis and regulatory mechanisms of the various organs and systems of the human body.
2. Apply the principles of biochemical process in understanding health and disease processes.
3. Impart the basic knowledge and skill in biochemistry to students through various teaching learning activities.
4. Use, maintain and undertake ordinary repair work of equipments commonly used in a biochemistry laboratory.
5. Perform various biochemical investigations in various bio fluids in assessment of health and disease conditions.
6. Collect relevant information regarding the existing knowledge of biochemistry, in general, and in his field of interest in particular by utilizing salibrary and other sources of information.
7. Identify the lacunae in the existing knowledge of biochemistry and design and execute appropriate experiments to investigate a relevant problem.
8. Analyse the results of investigation and draw valid conclusions therefrom.
9. Utilise appropriate bio-statistical knowledge and methods to evaluate the results of investigations.
10. Present the research findings in proper and scientific format in writing or in appropriate scientific forums.
11. Organise and run efficiently a biochemistry laboratory for investigative purposes.
12. Demonstrate his understanding of the students attitudes, feel concern for them and guide them properly.
13. Apply the principles and methods of evaluation in judging the performance of self and students.
14. Improve his knowledge, attitude and skill by self learning on completion of formal training.
15. Demonstrate understanding of principles of personal management for smooth working with other members in the department.

## **COURSE CONTENT IN M. Sc. (Medical Biochemistry) I YEAR**

The course will start on or before 1st August and the Annual examination will be in the 3rd week of following April.

The following areas in the subject of Biochemistry shall be the course content in the year I Year. The general idea is that candidate is familiarised and sensitized to the basic concepts of biochemistry as applicable to the human body so as to enable him to undertake the study of biochemistry in the next two years of this course.

### **THEORY:**

1. Introduction to Biochemistry
2. Overview of the Chemistry of carbohydrates, lipids, proteins constituent amino acids, nucleic acids and nucleoproteins.
3. Enzymes, coenzymes, specificity of enzymes, factors influencing enzyme activity, mechanisms and regulation of enzyme action, classification of enzymes, clinical enzymology.
4. Vitamin - definition, classification, sources, daily requirements, functions, deficiency manifestations and hypervitaminoses.
5. Overview of Biological oxidation - respiratory chain - energy capture.
6. Digestion and absorption from GI tract.
7. General aspects of metabolism.
8. Intermediary metabolism of carbohydrates - overview of glycolysis, glycogenesis, glycogenolysis, HMP shunt, gluconeogenesis, common metabolic pathway, metabolism of individual sugars and disorders of carbohydrate metabolism.
9. Overview of lipid metabolism comprising of fatty acid oxidation, synthesis, lipoproteins, acyl glycerols, cholesterol synthesis and disposal, ketosis, fatty liver atherosclerosis and hyperlipoproteinemias, obesity.
10. Overview of protein and amino acid metabolism.  
Disposal of nitrogen - urea cycle - transamination and deamination, disposal of carbon skeletons of amino acids, formation of special products from amino acids and their biological significance.
11. Synthesis and breakdown of hemoglobin, jaundice, classification and importance, bile pigments and their significance porphyrins.
12. Degradation of purines and pyrimidines and associated disorders.

13. Overview of metabolism of minerals and trace elements, their sources, daily requirements, biochemical and physiological functions, deficiency manifestations and toxicities - water metabolism.
14. General concepts of hormones, their biochemical functions, mechanisms of action of hormones in general.
15. Body fluids, acid base balance, renal functions.
16. Energy metabolism and nutrition.
17. Basic concepts of hepatobiliary, thyroid, adrenocortical and medullary pancreatic function tests.
18. Elementary knowledge of molecular biology including DNA organisation and repair, replication, RNA processing, genetic code, mutations, recombinant DNA and its application in medicine and allied sciences.

#### **PRACTICALS:**

1. Reactions of carbohydrates, lipids, proteins, Vitamins A & C
2. Reactions and properties of hemoglobin.
3. Qualitative analysis of gastric juice and bile.
4. Qualitative analysis of milk and egg.
5. Qualitative analysis of normal and abnormal constituents of urine.
6. Principles of colorimetry.
7. Estimation of glucose, creatinine and urea in blood.
8. Determination of basal and maximal acid output in gastric juice:

#### **DEMONSTRATIONS:**

1. Electrophoretic and chromatographic techniques
2. Radio active tracer technique

Text Books recommended (as for MBBS students)

#### **TEXT BOOKS RECOMMENDED:**

1. Biochemistry by Ottaway and Apps - ELBS edition 1983 or latest edition.
2. Text book of Biochemistry by A.V.S.S. Rama Rao (1986) L.K. & S Publishers, Tanuku, Andhra Pradesh.
3. Text book of Biochemistry by Ranganatha Rao (1987) Prentice Hall India Limited.

#### **BOOKS FOR FURTHER READING:**

1. Harper's Review of Biochemistry by D.W. Hartin et al (1986 Latest - Lange Medical Publications.

2. Text book of Medical Biochemistry - by S. Ramakrishnan et al (1982) Latest - Orient Longman Limited.
3. Principles of Biochemistry by Lehninger A.L. (1982) Latest Worth N.Y.
4. Biochemistry - case oriented approach by Montgo18ory Latest C.V. Mosby.

**BOOKS FOR PRACTICAL EXPERIMENTS IN BIOCHEMISTRY:**

1. Laboratory Manual in Biochemistry by Pattabhiraman T.N. & Mr. U.S. Acharya - 1986 All India Traveler Book Seller Publishers a Distributors - Delhi 110 051.
2. Practical Biochemistry for Medical Students - by G. Rajagopal, S. Ramakrishnan - 1983 - Orient Longman Limited.
3. Practical Manual of Experiments in Biochemistry for the Medic students - Department of Biochemistry, JIPMER, Pondicherry 605 006.

**TEACHING/LEARNING EXPERIENCES:**

1. Lectures - 5 / week
2. Practicals/Demonstration - 2 hrs. /week
3. Small group discussion/Tutorials - 1 hr. /week
4. Individual assignments referral work in library - 3 hrs. /week
5. Maintenance of practical record book of work done by students in practical class.

**IV. EVALUATION:**

It will be conducted by JIPMER

It shall comprise of:

Written examination (3 hours)	-	80 marks
Oral examination	-	40 marks
Practical examination (2 hours)	-	40 marks
Internal assessment	-	40 marks
		-----
		200 marks
		-----

**1. Internal Assessment:**

Record notebooks	-	10 marks
Average of all notified tests conducted by the department	-	30 marks

**2. Written Examination:**

This will comprise of a written test of 3 hours duration and maximum marks of 80. The

paper shall have two sections A & B, each carrying questions of 40 marks.

Each section shall have

1 long answer question	-	10 marks
6 short answer question 5 marks each	-	30 marks
		-----
		40 marks
		-----

Model question paper is provided.

### 3. Practical examination:

It is of 2 hrs. duration carrying 40 marks and comprise of:

Qualitative exercise	-	15 marks
Quantitative exercise	-	15 marks
Spotters	-	5 marks
Interpretation of charts/graphs	-	5 marks

### 4. Oral examination: (40 marks)

#### **Note:**

The written, oral and practical examinations will be evaluated by 2 examiners, one internal and one external. Each examiner will value one section of written examination separately, while the practical and viva voce examination will be valued conjointly by both the examiners.

Students will be declared to have passed Biochemistry subject, in the first year, only if he obtains a minimum of 50% in written and oral examination put together and 50% in aggregate.

A student is declared to have passed the First year of M.Sc. degree course in Medical Biochemistry only, if he was passed the subjects of Anatomy, Physiology and Biochemistry individually.

The candidate is permitted to join the second year of M.Sc. Medical Biochemistry course, if he has cleared any two subjects of 1st year course. Candidates will not be permitted to appear for the 2<sup>nd</sup> year examination unless they have passed all three subjects of 1st year.

## MODEL QUESTION PAPER

M. Sc. DEGREE IN MEDICAL BIOCHEMISTRY -----19----

(Preliminary)

Subject: BIOCHEMISTRY

Time: 3 hours.

Marks: 100

Each Section should be answered in separate answer books.

All Sections carry equal marks.

Answers should be brief and to the point.

### SECTION A

1. Describe the urea cycle. Indicate how this cycle is interrelated to common metabolic pathway. (10 marks)
2. a) How is HMP shunt pathway metabolically significant?  
b) What is fatty liver? Enumerate 4 factors that can cause fatty liver. List lipotropic factors.  
c) Derive Henderson-Hasselbalch equation.  
d) Name the purine and pyrimidine bases. What are their biological importances?  
Name the products of their metabolism.  
e) What is oxidative phosphorylation? Mention the sites of ATP formation in the electron transport chain.  
f) Explain the factors influencing the absorption of calcium in the G.I. Tract. (6 x 5 = 30 marks)

### SECTION B

3. Give an account of the dietary sources. Deficiency manifestations and biochemical functions of ascorbic acid. Add a note on its daily requirements and toxicity. (10 marks)
4. a) What is Van Den Bergh's test? What is its significance? How is it used in the clinical laboratory?  
b) What is balanced diet? Construct a balanced diet for an adult male of 70 kg. requiring 2500 calories/day.  
c) Describe the formation of serotonin. What is its importance?  
d) How are serum lipoproteins classified by ultracentrifugation Give their functions.  
e) Name the proteolytic enzymes of G.I. Tract. How are they released and activated?  
Enumerate the substrates on which act.  
f) What is the principle of electrophoresis? What are its applications? (6 x 5 = 30 marks)

## II and III year

### PAPER I - Biophysical Chemistry and Techniques related to Biochemistry

1. Acids, Bases, Buffer system in living body - pH - Handerson Hasselbalch equation, effect of pH on biological processes - Buffer solutions for biological investigations - methods of pH determination working principles of a pH meter.
2. Osmosis and Osmotic pressure - Osmomolarity of body fluids
  - a) Distribution of fluids in body compartments.
  - b) Surface tension and viscosity - their application to human body in relation to normal life and disease processes.
  - c) Colloidal system - preparation - protective action emulsification - colloidal systems of biological importance - their application and role in human body.
  - d) Dialysis, semipermeable membrane, Gibbs-Donnan equilibrium.
  - e) Diffusion and absorption mechanisms - their application to biological systems.
3. Equilibria of biochemical reactions -  $\text{CO}_2$ ,  $\text{H}_2\text{CO}_3$  and  $\text{HCO}_3^-$  ion thermodynamics, acid dissociation constants and complex ion dissociation constants for ATP and related substances - thermodynamics of the hydrolysis of ATP - ... structures in polypeptides and proteins helix and random coil transition in polypeptides - binding of oxygen to hemoglobin and myoglobin - binding to multiple identical and independent sites.
4. Centrifugation techniques - Principles - differential centrifugation - Density gradient centrifugation - ultra centrifuge and its application in biological systems.
5. Chromatographic techniques - Principles types of chromatographic techniques like column, thin layer, paper, adsorption, partition, gas liquid ion exchange, affinity, high. performance - their applications in biological systems.
6. Principles and techniques of photometry and Colorimetry - Laws of light absorption - visible and u v Spectrophotometry - Spectrofluorimetry - Flame photometry atomic absorption spectrometry.
7. Principles, instrumentation, techniques and applications of electron spin resonance, Nuclear Magnetic resonance, crystallography Mass spectrometry.
8. Principles of radioactivity, nature and types - decay rate radioactive decay - units of radioactivity - detection and measurement, of radio activity - radiation hazards and its prevention applications of radio activity and radio isotopes in biological systems. .
9. Electrophoresis - Principles, types and their applications in biological systems.

## **PAPER II - Foods, Human Nutrition and Dietetics**

### **Foods:**

1. Introduction of food science - food groups providing nutritive requirements for normal health - basic four, basic five and basic seven food groups - preliminary preparation of food prior to cooking with special reference to conservation of nutrients and palatability - moist and dry heat methods of cooking foods - physical and chemical changes during cooking with special reference to nutritional components, color, texture, flavour and appearance of foods.
2. Study of foods - cereals and cereal products - pulses and nuts - vegetables and fruits - milk and milk products, flesh foods - eggs beverages - fats and oils - sugars - spices and flavours - their composition nutritive values storage - ripening and aging - preservation - changes occurring during food processing - food toxins.
3. Food fads - food fadism - effects of processing and preparation on the nutritive value of foods - food additives and contaminants - establishing the safety of food additives.
4. Nutrition of food - nutrient needs and allowances nutrition policy - criteria for food nutrition.

### **Human Nutrition and Dietetics:**

1. Emergence, scope and methodology of nutrition as science - Energy metabolism - Energy value of foods - direct and indirect calorimetry - respiratory quotient - Energy needs of the body - basal metabolism Calculation of total caloric requirements.
2. Concepts of adequate and balanced diet - recommended dietary allowances (RDA) protein efficiency ratio, biological value etc.
3. Food energy (carbohydrate, protein, fat) and individual nutrients (Vitamins and minerals) with special reference to
  - a) distribution in body and biochemical rate
  - b) amount in ordinary foods
  - c) digestion, absorption, transport, storage, disposal.
  - d) requirements and recommended allowances and their modifications under stress.
  - e) effects of their deficiency and excesses
  - f) incidence, etiology and prevention of diseases
  - g) inter relation with other nutrients
4. Assessment of nutritional status of an individual and community.
5. Nutritional and food requirements to meet the needs of infants, preschool, school children, adolescents, adults, geriatric group pregnancy, and lactation.

6. Formulation of balanced diets, nutritional adaptation.
7. Common disorders of nutrition – under-nutrition - over nutrition - protein malnutrition, obesity, food allergy.
8. Diet therapy or formulation of therapeutic diets - purpose and principles of therapeutic diets with special reference to diabetes mellitus, renal disorders, diseases of liver, diseases of heart and circulatory system, obesity and leanness, atherosclerosis, hypertension, anemia, vitamin deficiencies, peptic ulcer, use of exchange lists.

### **PAPER III**

#### **BIO-ORGANIC CHEMISTRY AND BIO-STATISTICS**

1. Carbohydrates: Occurrence, Chemical properties and Classification Stereo and optical isomerism.  
 Monosaccharides: Structure, mutarotation, general reactions derivatives.  
 Oligosaccharides: Structure and functions  
 Homoglycans: Starch, glycogen, cellulose, insulin, dextrin, structural properties.  
 Heteroglycans: Agar, pectins, aliginic acid - structure ant properties of mucopolysaccharides cell wall polysachharides - cell surface carbohydrates.
2. Lipids: Classification, physiochemical properties and structure of fatty acids, waxes, oils, triacylglycerols, phospholipids, glyco lipids, sterols, prostaglandins, thromboxanes, leukotuienes, bile acids - separation of lipids by various methods.
3. Heterocyclic systems, furans, pyran, thiazole, indole, imidzole, pyridine, pyrididine, purine, guinone, isoalloxasone, pteridine, corium compounds - porphyrins, classification, properties and structure - Heme, cytochromes.
4. Proteins: Classification, structure, physiochemical properties and reactions of amino acids, peptides, polypeptides membrane proteins, levels of organisation, synthesis of peptide bonds, peptide unit, denaturation, renaturation, coagulation, flocculation, precipitation methods of estimations, separation techniques, end group analysis-hemoglobins, cytochromes, collagen, immunoglobulins.
5. Nucleic acids and Nucleoproteins: Structure, isolation and functions of nucleosides, nucleotides, nucleoproteins, nucleic acids, DNA, RNA, Denaturation and hybridisation, biologically important nucleotides.

6. Structure and functions, properties of antibiotics: Penicillins, streptomycin, chloromycetin, tetracyclines, chemotherapeutic agents antagonists to vitamins.
7. Biostatistics: Basic concepts of probability, mean, mode, median, standard deviation, laws of chance, binomial expression, hard weinberg law, 't' test, chi square - analysis of variance - co-efficient of correlation, evaluation of a new diagnostic procedure.

## PAPER IV

### ENZYMES, VITAMINS AND BIOENERGETICS

#### **Enzymes:**

1. Reaction rates, collision and transition state theories - order of reaction, energy of activation, role of enzyme as a catalyst of biochemical reaction and factors influencing enzyme catalysed reactions.
2. Enzyme classification and nomenclature as per IUB enzyme classification of system (rationale, overview and specific examples).
3. Intracellular localisation of enzymes, homogenisation techniques, isolation and fractionation of enzymes, purification by precipitation gel filtration, chromatographic and ultra centrifugal techniques criteria of purity, specific activity of enzymes, procedures to purify enzymes by PAGE, SDS-PAGE immunoelectrophoresis.
4. Titrimetric, colorimetric, spectrophotometric, fluorometric and manometric methods of assay of enzyme activity, units of enzyme activity, fast reactions, stopped flow technique.
5. Determination of the active site of the enzymes and presence of serine, cystine, lysine, histidine, arginine, tryptophan and tyrosine at the active site.
6. Enzyme-substrate complex formation - concept of ES complex binding sites, active site, stereospecificity - Michaelis - Menten equation - form and derivation of Michaelis Henten equation - Significance of  $U_{max}$  and  $K_m$ -rate equation for bisubstrate reaction.
7. Mechanism of enzyme action - induced fit and lock and key mode mechanism of action of chymotrypsin, lysozyme, carboxypeptidase mechanism of bisubstrate reactions - random, ordered and ping pong mechanisms.
8. Graphical procedures in enzymology - advantages and disadvantages of alternative plotting procedures, Hill Scatchard, Ramachandra plots.
9. Enzyme inhibition - inhibitors - Kinetics of competitive, non competitive and uncompetitive inhibition, concepts of riversible irreversible and partially reversible reactions catalysed by enzyme.

10. Enzyme cofactors - structure and biological functions of a variety of cofactors of enzymes.
11. Immobilised enzymes - immobilised multienzyme systems - effects of charge, pH, ionic strength, hydrophobicity on reaction kinetics.
12. Isoenzymes - chemical modification of enzymes.
13. Enzyme regulation - allosteric, non co-operative, co-operative and cumulative regulation of enzyme activity ~ enzyme induction repression - covalent modifications.

**Vitamins:**

Occurrence, properties, structure, sources, daily requirements, biochemical role, deficiency manifestations and toxic effects of water soluble and lipid soluble vitamins - antivitamins, pseudovitamins

**Bioenergetics:**

Laws of thermodynamics and their application in biological systems - free energy change - entropies and enthalpy - thermodynamics of coupled reactions - high energy phosphates - their role in energy capture and transfer - redox potential enzymes involved in biological oxidation - components of respiratory chain - phosphorylation at the substrate level and respiratory chain level - inhibitors of biological oxidation - mechanism of energy capture - chemiosmotic theory - uncouplers of oxidative phosphorylation.

**PAPER V**

**INTERMEDIARY METABOLISM AND REGULATION**

1. Introduction to methods of studying intermediary metabolism whole organism studies - whole animal, plant studies - perfusion of isolated organ-organ and tissue slice techniques isolated and cultured tissue and cell technique.
2. Intermediary metabolism of carbohydrates - glycolysis, glycogenolysis, glycogenesis, HMP shunt, uronic acid, gluconeogenesis, common metabolic pathway, aminosugar, sialic acids, glycoproteins and proteoglycans, regulation of blood glucose, hormonal control of carbohydrate metabolism.
3. Lipid metabolism: Oxidation of fatty acids, degradation of complex lipids, biosynthesis of fatty acids, essential fatty acids, triacyl glycerols, steroids, phospholipids, prostaglandins, cholesterol, bile acids, lipoproteins, glycolipids - regulation of lipid metabolism.
4. Protein and amino acid metabolism: Degradation of amino acids oxidative and non-oxidative deamination, transamination, decarboxylation, detoxication of ammonia,

catabolism of carbon skeletons of amino acids - ketogenic and glucogenic amino acids - nitrogen balance conversion of amino acids to specialised products.

5. Nucleic acid metabolism - Biosynthesis and degradation of purines and pyrimidine ring nucleotides - regulation of biosynthesis and degradation conversion to doxynucleotides.
6. Metabolism of xenobiotics - detoxication mechanisms in the body biological implications of xenobiotic metabolism.
7. Mineral metabolism: macro, micro nutrients, daily requirements, sources, biochemical functions, regulation of intake, turnover and metabolism - disorders related to macro and micro mineral nutrients, calcium, phosphorus, iron, copper, zinc, magnesium, chromium, selenium, sodium and potassium.

## **PAPER VI**

### **CELL AND MOLECULAR BIOLOGY**

#### **Cell Biology:**

1. Introduction to cell biology - organization levels - cell theory - cell classification and variability.
2. General structure of prokaryotic and eukaryotic cells - mitosis - meiosis - method for studying cells and organelles - freeze fracture technique - specific staining of organelles/marker enzymes - sub cellular fractionation, ultracentrifugation, differential and density gradient centrifugation - cell cycle.
3. Cell and tissue culture techniques - contact inhibition, cancer, growth inhibitors, cell movement, communication between and within cells.
4. Cell differentiation - organogenesis, morphological functional and biochemical maturation of tissues, impact of environmental factors - structure and function of cell membrane and organelle membranes.
5. Structure, elements of cytoskeleton and its role in maintaining cell shape - erythrocyte and non erythrocyte cytoskeletons and their modes of interaction with membrane microvillar cytoskeleton - role of calcium - Behaviour of receptor coated vesicles - endocytosis.
6. Hydrophobic effect and organisation of lipids in micelles monolayers, bilayers, liposomes, motion of lipids and proteins in membranes - organisation of proteins in membranes, protein lipid interaction - assembly membrane flow cycling - targeting signals and adaptor proteins, membrane lipids - transport, different lipid components, flip-flop asymmetry of membranes, receptors - receptor mediated endocytosis.

## **Molecular Biology:**

1. Nucleic acids as genetic information carriers - experimental evidence e.g. action spectrum, genetic information, Hershey-chase experiment etc.
2. Modes of replication, details of Meselson and Stahl experiment, semi conservative replication.
3. Physical properties of DNA - 5' - 3' direction, size range location, isolation, shear, base composition, base equivalent, gel electrophoresis, secondary structure, base pairing, base stacking, helix~ coil transition, T<sub>m</sub> and relationship to GC content, Tertiary structures.
4. Genetic code - Evidence for a triplet code, properties of the code - sequential, ubiquitous, degenerative, wobble hypothesis, nonsense codon, adapter role of tRNA, amino acyl tRNA synthases, anticodon loop, direction of protein synthesis.
5. Mechanism of translation - A & P sites, N-blocked aaTRNAS - tmet RNA - initiator codon, shine - Dalgarno consensus sequence (AGGA) Formation of 70S initiation complex - role of initiation factors and GTP, Peptidyl transferase, translocation, role of EF-Tu, EF-Ts, EF-G and GTP - Nonsense codons, role of RF1, RF2 and GTP.
6. Mechanism of transcription-sigma cycle, recognition, binding and initiation sites – TATA / Pribnowbox, enhancer and other regulatory elements - Direction of chain growth - termination rho and palindromes - Regulation of transcription of promoters and repressors - concept of operon.
7. DNA replication - properties of DNA dependent DNA polymerases I, II, III and their role in DNA replication - Discontinuous/continuous synthesis - okazaki fragments - RNA primers, repairs of DNS polymerase and DNA lipase, role of DNA glyrase, unwinding enzyme, HD protein, polymerase chain reaction.
8. Rates of eukaryotic and prokaryotic protein synthesis, multiple invitation sites, bidirectional replication, bubbler, fidelity of replication excision - repair systems, recombinant repair system, chemical carcinogenesis.
9. DNA dependent RNA polymerase - in vitro assay-physical properties of the enzyme, subunit structure, proof of template directed synthesis.
10. Post transcriptional processing-maturation of rRNA and tRNA-RNA splicing introns and exons - consensus sequence of junction - mechanism of RNA splicing-Poly A tail -5' capping-Non coding sequences etc - Introns and Protein functional domains.

11. Post translational processing-signal hypothesis-Functions of pre and pro regions signalase - symogen activation.
12. Rapid DNA sequencing techniques - details of methodologies eg. plus and minus dideoxynucleotide, partial ribosubstitution, Maxam and Gilbert - use of thin gels, resolution etc. interpretation of DNA sequences.
13. Role of counterions, deep and grooves, SBS-DNA, A, B&Z DNA etc. chirality of the helix, syn/antiparallel complementary strands.
14. Physical properties of RNA-classes of RNA-structure, methods of isolation and fractionation of RNA-primary, secondary and tertiary structures - DNases, RNases, phosphodiesterases etc.
15. Rapid RNA sequencing techniques - plus and minus, dideoxynucleotide, Zimmern and Kaesberg, Paettie, Simonesites method et, interpretation of RNA sequences.
16. Classes of DNA sequences - zero order binding, highly repetitive, unique methods of distinguishing double stranded and single stranded DNA - Reassociation kinetics, cot values, use of Ag+ cesium sulfate.
17. Satellite DNA - possible functions - C value paradox-mechanical strength, gene library, suppressor mutation, centromeric DNA, split genes.
18. Recombinant DNA technology and its applications, plasmids, cosmids as vehicles, isolation and characterization of DNA and fragmentation with restriction enzymes, ligation to vehicles, introduction of gene by transduction and transfection, selection of clones, DNA cloning-social and moral implications - international guidelines.

## **PAPER VII**

### **ENDOCRINOLOGY AND IMMUNOLOGY**

#### **Endocrinology:**

1. Comparison of hormones and trace dietary substances, Endocrine and nerve integration - cell membrane and intracellular receptors for hormones-hormonal inter-relationships. Experimental approaches to endocrinology - Mechanism of hormone action - classification of hormones.
2. a) Hormones of the pituitary and hypothalamus - POMC peptide family.  
b) Hormones of the thyroid - iodine metabolism - biosynthesis of thyroid hormone structure, activity, metabolism - interaction with other endocrine systems - antithyroid drugs.  
c) Hormones regulating calcium metabolism – parathyromones, calcitriol, calcitonin,

synthesis, secretion, regulation

- d) Hormones of the adrenal cortex-Glucocorticoids, mineralo corticoids and androgens – their biosynthesis, secretion, transport and metabolism and their metabolic effects.
  - e) Hormones of adrenal medulla-catecholamines and their derivatives - biosynthesis, excretion, storage, regulation and metabolic effects - functional similarity between catecholamine receptor and visual response system.
  - f) Hormones of the gonads - androgens, estrogens and progestins - structure, biosynthesis secretion, regulation, metabolic effects - transport - menstrual cycle - regulation.
  - g) Hormones and endocrinology and pregnancy and lactation - fetoplacental unit.
  - h) Hormones of pancreas - chemistry, biosynthesis, regulation, secretion of insulin, glucagon, somatostatin-effects of insulin and glucagon on carbohydrate, lipid and protein metabolism-synthetic hypoglycemic agents.
  - i) Miscellaneous hormones: Hormones of GI tract, kidneys, prostaglandins and their derivatives, hormones of central nervous system, thymus and pineal gland.
- (3) Endocrine disorders - Biochemical basis of the disorders related to all the above endocrine system under (2).

### **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. Infection: Types, factors influencing infection and harmful microbial products such as exotoxins and endotoxins, leukocidins, hemolysins, fibrinolysins-proof of pathogenicity and course of infection - sources of infectious agents and their carriers - portals of entry.
3. 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.
4. 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.
5. Measurement of antigen-antibody interactions: Direct binding assays, agglutination, precipitation, immunodiffusion, immunoelectrophoresis, Elisa, RIA, fluorescence analysis, hybridoma technique.

6. Generation of diversity in the immune response - immune tolerance at birth, in adult and termination of tolerance - instructive, selective and clonal selection theories - concept of antigen specific receptors, genes encoding antigen - specific receptors on T & B lymphocytes - genetic rearrangement - class switch.
7. Antigenicity: Definition - flagellar, somatic, capsular, soluble, heterophilic and auto antigens - blood groups and blood group antigens - tissue antigenic determinations.
8. Central role of major histocompatibility complex (MHC) genes and products in immune response - associated MHC functions - allograft, autograft, graft vs host and mixed leukocyte response transplantation and immune response.
9. Complement - complements of classical and alternate pathways hypersensitivity Types I, II, III and IV responses - immune responses to parasites and tumors.
10. Immunodeficiency, auto immunity - Monoclonal cloning and related methodologies.

## **PAPER VIII**

### **CLINICAL BIOCHEMISTRY**

1. Role of biochemistry in diagnosis of diseases.
2. Gastrointestinal tract - Acidity curves, qualitative and quantitative analysis of gastric contents and duodenal contents Pancreatic disorders in relation to exocrine function - malabsorption syndromes - laboratory parameters useful in diagnosing diseases of GT Tract.
3. Hepatobiliary system - Hepatobiliary function tests - lab findings and differential diagnosis of jaundice - metabolism of bilirubin - cirrhosis, hepatic coma, hepatitis, gall stones, cholecystitis and tumors.
4. Excretory system - Renal function tests - Biochemical changes and laboratory findings in acute and chronic renal failure - clearance of tests - urinary calculi, renal hypertension - principles of peritoneal and hemodialysis - urinalysis for normal and abnormal constituents.
5. Disorders of carbohydrates metabolism - Glucose level in normal blood, renal threshold, hyper and hypoglycemia and glycosuria - qualitative tests for sugars in urine - intravenous and other types of glucose tolerance tests - fructose levels in blood lab diagnosis of early and latent diabetes mellitus - diabetic coma, secondary degenerative changes associated with diabetes mellitus - Glycogen storage disorders.

6. Disorders of nitrogen metabolism - Assimilation and excretion of nitrogen with reference to ammonia, urea, uric acid, creatine, creatinine - excretion of nitrogenous waste products - abnormalities of nitrogen metabolism including uremia, porphyrias, porphyrinurias, aminoaciduria - factors affecting nitrogen balance.
7. Disorders of lipid metabolism - Plasma lipoproteins, cholesterol triglycerides and phospholipids in health and diseases, ketosis, fatty liver.
8. Blood and coagulation - disturbances of blood clotting mechanisms - systematic analysis of hemorrhagic disorders - coagulation and prothrombin time, determination - hemoglobin-anemia - abnormal hemoglobins and their identification.
9. Mineral metabolism - Laboratory findings in disorders related to iron, copper, iodine, calcium, phosphorus, magnesium and zinc and their importance in health and disease. Cerebrospinal fluid - Composition in normal and diseases - laboratory findings of CSF constituents in health and disease.
10. Inherited disorders of metabolism: Changes occurring in phenyl ketonuria, alkaptonuria, tyrosinosis, albinism, Hartnup's disease, galactosemia. Tay-Sach's disease, Niemann Pick's disease, Hunter's and Hunter's syndrome, Lysh-Nyhan syndrome - detection of these anomalies.
11. Clinical Enzymology - Laboratory investigations on serum and urine for constituents (normal & abnormal) of diagnostic and prognostic importance. Plasma specific and non plasma specific enzymes of diagnostic prognostic importance and their interpretation of amylase, aminotransferase, phosphatases, creatinine kinase, cholinesterases, lactate dehydrogenase, phosphohexose isomerase, lipoprotein lipase.
12. Endocrine system: Laboratory diagnosis and investigations related to disorders of thyroid, pituitary, adrenal cortex, adrenal medulla, testes, ovaries - plasma and urinary assays of hormones related to various endocrinal disorders.
13. Acid base balance - regulation of blood pH within normal range disturbances in acid base balance - acidosis, alkalosis, mixed disturbances - laboratory parameters - blood gas analysis.
14. Fluid and electrolyte balance - regulation - disturbances of fluid and electrolyte balance - laboratory parameters in the diagnosis and management of fluid and electrolyte disorders - oral rehydration therapy.

## **Practicals:**

1. General reactions of carbohydrates, lipids, proteins and amino hemoglobin and its derivatives.
2. Chromatographic separation of sugars, amino acids, lipids and proteins.
3. Preparation and estimation of glycogen, cholesterol casein, hemoglobin and cystine from biological samples.
4. Estimation of glucose, fructose, pentose, lactose, Vit A, Vit C in biological samples.
5. Determination of nitrogen and phosphorus content of biological samples.
6. Analysis of common food stuffs.
7. Dialysis, determination of pH, surface tension, viscosity.
8. Warburg's techniques with tissue slices and homogenates.
9. Determination of enzyme activity and kinetic properties of phosphatases and any of the digestive enzymes.
10. Blood sugar and GTT estimation in serum/plasma.
11. Estimation, of cholesterol and triacylglycerol plasma.
12. Estimation of  $Ca^{++}$ , electrolytes, pH and blood gas analysis.
13. Estimation of urea, creatinine, uric acid and NPN reserve and clearance tests.
14. Estimation of bilirubins, and hepato biliary function tests.
15. Estimation of copper, ceruloplasmin activity, lithium, Iron, iron binding capacity, magnesium in plasma/serum.
16. Thyroid function tests like T3 T4 assays.
17. Urinalysis for normal and abnormal constituents.
18. Estimation of 17 ketosteroids and catecholamines in urine.
19. Analysis of Gastric juice.
20. Analysis of renal and biliary calculi.
21. Estimation of LDH, phosphatases, amino transferases, amylase and CPK in serum.
22. Estimation of phospholipids, free fatty acids in serum.
23. Estimation of serum phosphohexose isomerase activity.
24. Separation of serum LDH & isoenzymes by polyacrylamide disc gel electrophoresis.
25. Separation of serum alkaline phosphatase isoenzymes by p.a.g.e.
26. Estimation of serum and leucocyte ascorbic acid.
27. Estimation of ethylalcohol in urine and blood.
28. CSF analysis for biochemical parameters.

29. Analysis of any other biofluid.
30. Estimation and electrophoretic separation of plasma/serum proteins.
31. Estimation of glycated hemoglobin/any other proteins.

**TEXT BOOKS RECOMMENDED:**

1. Harper's Review of Biochemistry - Ed By David Martin et al Lange Medical Publications 1987/Latest.
2. Metabolic control and disease – Ed. Roxenburg and Philip K. Bondy W.B. Saunders - Latest.
3. Biochemistry - A case oriented approach by Montogommoiry - CV Moshy Vo. / Latest.
4. Biochemistry - A functional approach by Mc Gilvery - W.B. Saunders Co., Latest.
5. Principles of Biochemist Vol. I and II by White Handler Smith al - Latest Edition McGraw Hill Publication.
6. Text book of Clinical Chemistry by Norbert Tietc – 1986 W.B. Saunders Co., Latest.
7. Metabolic Basis of inherited diseases by Stanbury, Wyngarden et al, W.B. Saunders Co., Latest.

**PRACTICAL BOOKS RECOMMENDED:**

1. A manual of laboratory techniques by National Institute of Nutrition (ICMR) - Hyderabad.
2. Practical Clinical Chemistry by Varyley H.Vol. I and II. Latest.
3. Methods in Enzymology - Colowich and N.O. Kaplan Academic Press 11 volumes.
4. Clinical Chemistry - Principles and Techniques by R.J.Henry, Harper and Row Publishers.
5. Advances in Clinical Biochemistry - Series Edited by Bodansky, Academic Press. Vol. I - 15 or latest.
6. Standard Methods in Clinical Chemistry - Series Edited by Seliekson, Academic Press.
7. Clinical Biochemistry by E.J. King and IDP Woo Church Hill and Co.
8. Fundamentals of Clinical Chemistry - Edited by Norbert W. Tetz. Pub: W.B. Saunders Company. Latest.
9. Practical Clinical Biochemistry (5<sup>th</sup> Edition) or Vol. I and II Herold Varley et al. Publisher: Arnold - Heinemann/ Latest.
10. Todd Sanford Davidson's Clinical Diagnosis and Management by laboratory methods (17th Edn.) Edited by - John Bernard Henry, MD., Publisher - W. B. Saunders Company.

The list is not complete. The candidate is advised to refer to other books related to medicine and allied specialties as also journals related to the various discipline of medicine to keep himself informed of latest developments in theoretical and practical aspects of Biochemistry.

### **TEACHING LEARNING ACTIVITIES/EXPERIENCES:**

The various teaching and learning experiences described as under shall put the student in an active situation for better learning experiences:

- Participation in undergraduate teaching activities.
- Participation in PG Seminars, Symposia Case discussions Journal Clubs etc.
- Laboratory work - all exercises will be performed independently in various labs of the department.
- Supervision of lab work under guidance for teaching and research activities.
- Participation in laboratory and investigative procedures related to biochemistry in clinical and other disciplines.

As and when required, the students shall be posted for training for a period of 15 days to 1 month in some of the Institutions like Indian Institute of Science, Bangalore etc. to learn some advanced techniques and information related to clinical applications of biochemical principles, which are not available in the department.

### **EVALUATION**

This comprises of:

- a) Project work by the candidate to be evaluated by the guide and all examiners.
- b) Written examination in II and III years.
- c) Practical examination in II and III years.
- d) Oral examination in II and III years and
- e) Internal assessment in II and III years.

#### **a) Project work:**

This will be compulsory for all M.Sc. students in Medical Biochemistry. The topic for project work shall be selected by candidates within 6 months of starting the 2nd year of the course and shall be submitted 3 months before the final examination in the third year for approval. The project work is mainly to orient the candidates towards research methodology. The project work shall be carried out by the candidates under the guidance of a postgraduate teacher in the department. Collaborative work with other departments are encouraged.

**Examinations: At the end of II year.**

i) Written

	Duration	Max. Marks
Paper I: Biophysical Chemistry and Techniques related to Biochemistry	3 hrs.	100
Paper II: Foods, Human Nutrition and Dietetics	3 hrs.	100
Paper III Bioorganic Chemistry and Biostatistics	3 hrs.	100
Paper IV: Enzymes, Vitamins and Bioenergetics	3 hrs.	100

ii) Practicals:

I : Separation techniques, qualitative, analysis, volumetric and colorimetric analysis of biological materials.	} 2 days of 6 hrs. each	100
II : Enzymology		100
iii) <u>Oral examination/Viva voce</u>		100
iv) <u>Practical records</u>		100
v) <u>Internal Assessment</u>		100

**Examinations at the end of the III Year:**

i) Written:

Paper V - Intermediary metabolism and regulation	3 hrs.	100
Paper VI - Cell and molecular biology	3 hrs.	100
Paper VII- Endocrinology and Immunology	3 hrs.	100
Paper VIII-Clinical Biochemistry	3 hrs	100

ii) Practicals:

I. Clinical Biochemistry	} 2 days of 6 hrs. each	100
II. Clinical Biochemistry		100
iii) Oral Examination/Viva Voce:		100
iv) Practical records		100
v) Project work and viva on project		100
vi) Internal assessment		100
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		1000
		-----

Model Question Papers for written examination are enclosed.

**Eligibility for a pass:**

A candidate is declared to have passed only if he/she scores 50% marks minimum in written and practical examinations separately and 50% marks in aggregate in each year of examinations. .

**Examiners:**

The evaluation of written, practical and oral examinations shall be conducted by a set of 4 examiners in each year of 2nd and 3rd year of the degree course. Of the 4 examiners, 2 shall be internal and 2 shall be external. Among the internals, the head of the department shall be one of the examiners while the other internal shall be on a rotatory basis from amongst the eligible teachers by seniority.

The written examination shall be evaluated by the 4 examiners individually, i.e. each examiner shall evaluate one written paper, while the practical and oral examinations shall be evaluated conjointly.

The Head of the department shall be the Convener / Chairman of the Board of Examiners.

**MODEL QUESTION PAPER**  
**PAPER I - BIOPHYSICAL CHEMISTRY AND TECHNIQUES,**  
**RELATED TO BIOCHEMISTRY**

Time: 3 hours

Marks: 100

Answer any 4 questions from Sl.No.1 to 5.

Question Nos. 6 & 7 are compulsory.

1. How does a buffer resist the change in pH? Explain how you will choose a buffer for any work. (16 marks)
2. What is Donnan-Membrane equilibrium? How is that relevant in erythrocytes? (16 marks)
3. What is the ultracentrifuge? How is it useful in determining the molecular weight of macromolecule? (16 marks)
4. Discuss the working principle of a flame photometer. (16 marks)
5. Discuss the radiation hazards in a laboratory and the methods of preventing them. (16 marks)
6. Write short notes on the following: (18 marks)
  - (a) Gas liquid chromatography
  - (b) Nuclear magnetic resonance
  - (c) Hydrolysis of ATP
7. Briefly discuss the following: (18 marks)
  - (a) Protective colloids
  - (b) Oxygen uptake by hemoglobin
  - (c) Scintillation counter

**MODEL QUESTION PAPER**  
**PAPER II - FOODS, HUMAN NUTRITION AND DIETETICS**

Time: 3 hours

Marks: 100

Answer any 4 questions from Sl.No.1 to 5.

Question Nos. 6 & 7 are compulsory.

1. Discuss the influence of cooking on the palatability and digestibility of foods. (16 marks)
2. How do storage, addition to preservatives and food toxins affect the foods? (16 marks)
3. Discuss the criteria to be considered for constituting a balanced diet for a normal adult. (16 marks)
4. Discuss about obesity and its prevention. (16 marks)
5. Discuss the suitable diet for a patient of diabetes mellitus. (16 marks)
6. Write short notes on the following: (18 marks)
  - (a) Kwashiorkor
  - (b) RQ value of major nutrients
  - (c) Maillard reaction
7. Briefly discuss the following: (18 marks)
  - (a) Nutrification of common salt
  - (b) Diet during pregnancy
  - (c) Diet during hyperchylomiconemia

**MODEL QUESTION PAPER**  
**PAPER III - BIO ORGANIC CHEMISTRY AND BIostatISTICS**

Time: 3 hours

Marks: 100

Answer any 4 questions from Sl.No.1 to 5.

Question Nos. 6 & 7 are compulsory.

1. How will you evaluate statistically the difference between a control group and experimental groups? When the numbers involved are small in both? (16 marks)
2. Discuss the actions of acids and alkalis on glucose. (16 marks)
3. Discuss the physical properties of fatty acids and the factors influencing these properties. (16 marks)
4. Describe the structure and properties of heme. (16 marks)
5. How will you denature a protein? Explain the changes observed during denaturation. (16 marks)
6. Write short notes on the following: (18 marks)
  - (a) Structure of tRNA
  - (b) Antibiotics as antivitamin
  - (c) Amino acids as ampholytes
7. Briefly discuss the following: (18 marks)
  - (a) Structure and function of hyaluronic acid.
  - (b) Emulsifying action of bile salts.
  - (c) Structure of an immunoglobulins.

**MODEL QUESTION PAPER**  
**PAPER IV - ENZYMES, VITAMINS AND BIOENERGETICS**

Time: 3 hours.

Marks: 100

Answer any 4 questions from Sl.No. 1 to 4.

Question Nos. 6 & 7 are compulsory.

1. Discuss the different types of inhibitors of enzyme action. (16 marks)
2. Point out the mechanisms of action applicable to any enzyme. Elaborate the mechanisms with reference to any specific example. (16 marks)
3. Describe the structures of Vitamin A and its provitamins. Elaborate on the functions of Vitamin A. (16 marks)
4. Write about the structure and chemical properties of ascorbic acid. Correlate its functions with the manifestations of scurvy. (16 marks)
5. Discuss the chemiosmotic theory for oxidative phosphorylation. (16 marks)
6. Write short notes on the following: (18 marks)
  - (a) Transferases
  - (b) Specific activity of enzymes
  - (c) Poly affinity theory
7. Briefly discuss the following: (18 marks)
  - (a) Sources and daily requirements for thiamine
  - (b) Functions of Vitamin K
  - (c) Folate deficiency manifestations.

**MODEL QUESTION PAPER**  
**M.Sc. DEGREE EXAMINATION IN MEDICAL BIOCHEMISTRY**  
**PAPER V - INTERMEDIARY METABOLISM AND REGULATION**

Time: 3 hours

Marks: 100

Answer any 4 questions from Sl.No. 1 to 5.

Questions 6 & 7 are compulsory.

1. Discuss the HMP shunt pathway and its role in metabolism. (16 marks)
2. Outline the biosynthesis and functions of prostaglandins. (16 marks)
3. Describe the biosynthesis of cholesterol. Add a note on its transport in the body. (16 marks)
4. How is ammonia formed and detoxified in the body? (16 marks)
5. Discuss the metabolic changes in starvation. (16 marks)
6. Write short notes on any THREE. (18 marks)
  - (a) Sialic acids
  - (b) Nitrogen balance
  - (c) Zinc as a cofactor
  - (d) Regulation of pyrimidine biosynthesis
7. Write briefly on any THREE. (18 marks)
  - (a) Carnitine
  - (b) Structure and functions of heparin
  - (c) Anaerobic dehydrogenases
  - (d) Warburg's manometer

**MODEL QUESTION PAPER**  
**M.Sc. DEGREE EXAMINATION IN MEDICAL BIOCHEMISTRY**  
**PAPER VI - CELL AND MOLECULAR BIOLOGY**

Time: 3 hours

Marks: 100

Answer any 4 questions from Sl.No.1 to 5.

Questions 6 & 7 are compulsory.

1. Describe the structure of a typical cell membrane. Enumerate its functions. (16 marks)
2. Outline the process of transcription. (16 marks)
3. Describe the recombinant DNA technology and its applications. (16 marks)
4. Discuss the methods of DNA sequencing. (16 marks)
5. Discuss the different types of mutations. (16 marks)
6. Write short notes on any THREE. (18 marks)
  - (a) Cell cycle
  - (b) Polymerase chain
  - (c) DNA repair
  - (d) Class switching
7. Write briefly on any THREE (18 marks)
  - a) Cytoskeleton of RBC.
  - (b) Ion channels
  - (c) Z-DNA
  - (d) Post-translational modifications

**MODEL QUESTION PAPER**  
**M.Sc. DEGREE EXAMINATION IN MEDICAL BIOCHEMISTRY**  
**PAPER VII - ENDOCRINOLOGY AND IMMUNOLOGY**

Time: 3 hours

Marks: 100

Answer any 4 questions from SI.No.1 to 5.

Questions 6 & 7 are compulsory.

1. Discuss the second messenger systems in the body. (16 marks)
2. How is the calcium homeostasis maintained? Add a note on renal rickets. (16 marks)
3. Outline the biosynthesis of cortisol in the body. Add a note on Metyrapone test. (16 marks)
4. Describe the chemistry, biosynthesis and regulation of thyroxine in the body. (16 marks)
5. Describe the structure of a typical immunoglobulin molecule. What is the basis of its heterogeneity? (16 marks)
6. Write short notes on any THREE. (18 marks)
  - (a) Cell mediated immunity.
  - (b) Gut hormones
  - (c) Oral contraceptives
  - (d) Melatonin
7. Write briefly on any THREE. (18 marks)
  - (a) Complement system
  - (b) Monoclonal antibodies
  - (c) 17-OXO steroids
  - (d) Tests of Feto-placental functions.

**MODEL QUESTION PAPER**  
**M.Sc. DEGREE EXAMINATION IN MEDICAL BIOCHEMISTRY**  
**PAPER VIII - CLINICAL BIOCHEMISTRY**

Time: 3 hours

Marks: 100

Answer any 4 questions from Sl.No.1 to 5.

Questions 6 & 7 are compulsory.

1. Describe the laboratory tests which are useful in the diagnosis of hepatocellular disease. Add a note on HBs Ag. (16 marks)
2. How is the acid-base homeostasis maintained in the body? Add a note on non-respiratory acidosis. (16 marks)
3. Outline the causative factors of atherosclerosis. (16 marks)
4. Discuss the biochemical basis of fatty liver and its treatment. (16 marks)
5. Describe the tests done to investigate glomerular function. (16 marks)
6. Write short notes on any THREE: (18 marks)
  - (a) Lab findings in acute intermittent porphysis.
  - (b) Urinary calculi
  - (c) Galactosemia
  - (d) Thyroxine index
7. Write briefly on any THREE: (18 marks)
  - (a) Overflow aminoacidurias
  - (b) Tumour markers
  - (c) Anion gap
  - (d) Quality control in a biochemistry laboratory.