POSTGRADUATE MSc IN MEDICAL SCIENCES

Goal:
The Goal of Postgraduate MSc in Medical Sciences is to produce
1. Competent medical and paramedical professionals with a sound knowledge in basic sciences.
2. Individuals with research attitude
3. Skilled laboratory experts
4. Industry technical experts

General Objectives
At the end of the postgraduate training in the discipline concerned the student should be able to:
1. Demonstrate competence in basic concepts of research methodology and be able to critically analyze relevant published research literature
2. Develop skills in using educational methods and techniques as applicable to the teaching of medical/nursing students and paramedical health workers.
3. Demonstrate competence in developing diagnostic and analytical tools

Components of the course curriculum:
The major components of the Postgraduate curriculum shall be:
- Theoretical knowledge
- Practical skills
- Research skills.
- Diagnostic and analytical skills
- Attitudes including communication skills.
- Training in research methodology.

Regulations

1. Branch of the study
   Post graduate degree course

2. Courses offered in M.Sc medical Sciences:
   a. M.Sc in Anatomy
   b. M.Sc in Biochemistry
   c. M.Sc in Microbiology
   d. M.Sc in Pharmacology
   e. M.Sc in Physiology

3. Eligibility for Admission
   A candidate seeking admission to M.Sc medical science course must have passed B.Sc with at least one subject of biological Sciences or BAMS or MBBS or BHMS or BPT or B.Pharm or any other professional graduates from a recognized Deemed to be University

4. Duration of the course
   The duration of the course shall be a period of 3 years

5. Medium of instructions
   The medium of instruction & examination shall be in English
6. **Method of Training**
Training should include involvement in laboratory and experimental work and research studies.

7. **Attendance**
Candidates should have attended at least 80% of the total number of classes conducted in an academic year, from the date of commencement of the term to the last working day, as notified by the Deemed to be University, in each of the subjects prescribed for that year, separately in theory and practical, to be eligible to appear for the Deemed to be University examinations.

8. **Monitoring Progress of Studies:**

A) **FORMATIVE ASSESSMENT**
Formative assessment will be done continuously to assess medical knowledge, procedural & academic skills, interpersonal skills, professionalism, self directed learning and ability to practice in the system. Periodic Internal Assessment will be conducted frequently covering all domains of learning and feedback will be provided for improvement of the student.

B) **SUMMATIVE ASSESSMENT**

**Dissertation Work**
During the course of study every candidate has to prepare a dissertation individually on selected topic under the direct guidance and supervision of a recognised post graduate teacher. The suggested time schedule for dissertation work is:
- Identification and selection of topic for dissertation - in first 4 weeks.
- Preparatory work for dissertation /synopsis and submission of the synopsis to the Ethical clearance within first 6 months from the beginning of Second year as per the dates notified by the Ethics committee.
- Data collection for dissertation. Writing the dissertation in the following 1 year.

**Submission of dissertation**
The dissertation shall be submitted to the controller examination of the JSSAHER three months before final examination or as per the dates notified.

I. **Maintenance of Log book and Practical record**
A diary showing each day’s work has to be maintained by the candidate, which shall be scrutinized by the Head of the Department every month. A list of the seminars and journal reviews that have been attended and presented by the student has to be maintained which should be scrutinized by the Head of the Department.
A practical record has to be maintained by every candidate and duly scrutinized and certified by the Head of the Department and to be submitted to the external examiner during the final examination.

II. **Periodic tests:** The concerned Departments conduct tests, from first year to third year. In first year three tests will be conducted for 50 marks in each subject. 1st Internal assessment test at the end of 3rd month, 2nd internal assessment at the end of 6 month, 3rd internal assessment at the end of completing 1st year of the course. Average of best two is taken for final internal assessment marks. A candidate should get minimum 35% IA marks to take the JSSAHER examinations. The tests in second and final year may include written papers, practicals and viva voce. Records and marks obtained in such tests will be maintained by the Head of the Department and sent to the JSSAHER when called for. A mock exam will be
held one month before the final exam to see if students are eligible to attend the final exams. The candidates who have failed in final examination shall be given an internal assessment improvement test and the best marks shall be submitted to JSSAHER when called for.

9. A. Subjects and hours of teaching for theory and practicals in first-year

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Subjects</th>
<th>Theory hours</th>
<th>Practicals hours</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Anatomy</td>
<td>120</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>Physiology</td>
<td>120</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>Biochemistry</td>
<td>120</td>
<td>40</td>
</tr>
</tbody>
</table>

B. Second and Final year- Three course specific papers

C. Seminars & Journal clubs: Students are expected to actively participate in the departmental seminars and journal clubs. A record should be maintained for each student and the list of seminars and paper presented in journal club by each student should be presented at the time of Deemed to be University examination. Post graduate students should participate in undergraduate teaching, in theory, practical and tutorials

10. Dissertation

Every candidate pursuing M.Sc Degree course is required to carry out work on a selected research project under the guidance of a recognized post graduate teacher in their respective subjects in second and final year. The results of such work shall be submitted in the form of a dissertation.

Introduction to research methodology and bio statistics. Every postgraduate student should be given an introductory course in research methodology and research techniques. He / she will be taught as to how a research project can be planned and implemented. He / she must also acquire a basic knowledge in the statistical methods and their applications.

The project is aimed to train a post graduate student in research methods and techniques. It includes identification of a problem, formulation of a hypothesis, search and review of literature, getting acquainted with recent advances, designing of a research study, collection of data, critical analysis, and comparison of results and drawing conclusions.

Every candidate shall submit a synopsis in the prescribed format containing particulars of proposed project work within six months from the date of commencement of the 2nd year course and on or before the dates notified by the JSS Academy of Higher Education & Research. The synopsis shall be sent through the proper channel. Such synopsis will be reviewed and the project topic will be registered by the JSS Academy of Higher Education & Research. No change in the Dissertation topic or guide shall be made without prior approval of the JSSAHER.

The candidates shall report the progress of the Dissertation work to the concerned guide periodically and obtain clearance for the continuation of the project work. The Dissertation should be written under the following headings:
Four copies of Dissertation thus prepared shall be submitted three months before final examination on or before the dates notified by the JSS Academy of Higher Education & Research.

The Dissertation shall be valued by examiners appointed by the JSS Academy of Higher Education & Research. Approval of project work is an essential precondition for a candidate to appear for the final examination.

A co-guide may be included provided the work requires substantial contribution from a sister department or from another institution recognized for teaching/training by JSS Academy of Higher Education & Research.

11. Schedule of Examination
The JSSAHER examination for M.Sc courses shall be held at the end of first year for Anatomy, Physiology and Biochemistry. At the end of third academic year individual papers for each course will be held separately.

12. First year JSSAHER examination
Theory – 3 hours paper, 100 marks each in Anatomy, Physiology and Biochemistry.

<table>
<thead>
<tr>
<th>Pattern of theory question paper</th>
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<tbody>
<tr>
<td><strong>Theory</strong></td>
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<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td><strong>Type of Questions</strong></td>
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<tr>
<td>Long Essay</td>
</tr>
<tr>
<td>Short Essay</td>
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<tr>
<td>Short Answer</td>
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<tr>
<td><strong>Total Marks</strong></td>
</tr>
</tbody>
</table>

No practical examination for I year M.Sc (Medical) students.
Practical examination for final year will be for 200 marks and 100 marks for pedagogy and dissertation discussion. Total marks for Practicals are 300 for each course.

13. Appointment of examiners:
There shall be at least two examiners in theory and practical examination. Out of them one shall be external examiner and one shall be internal examiner. Postgraduate teacher with MD/MS/PhD degree with 5 years of experience shall be appointed as examiners.
14. **Criteria for declaring as pass in final examination for 1st year:**
A candidate should get 50% marks in each subject (Theory including IA marks). A candidate securing less than 50% of marks as described above shall be declared to have failed in the examination. Failed candidate may appear in subsequent examination upon payment of examination fee to the JSSAHER. A successful candidate is awarded pass class irrespective of percentage, as these marks will be considered while awarding the class at the end of final year.

**Final Examination:** A candidate should get 50% marks in (1) Theory, (2) Practical and viva-voce examination separately. A candidate securing less than 50% of marks as described above shall be declared to have failed in the examination. Failed candidate may appear in any subsequent examination upon payment of fresh fee. Those candidates who fail in one or more subjects shall have to appear only in the subject so failed, in the subsequent examinations. A candidate shall score 50% marks in Practicals including Viva voce to be declared Pass. A candidate if failed in Practicals including Viva voce and passed in theory, candidate needs to repeat only Practicals including Viva voce.

15. **Declaration of Class:**
- **Distinction:** A successful candidate passing the JSSAHER examination in first attempt will be declared to have passed the examination with distinction, if the grand total aggregate mark is **75% and above.**
- **First class:** if the grand total aggregate marks is **65% and 74%.**
- **Pass class:** if the grand total aggregate marks is **50% and 64%**

Distinction and 1st class will not be awarded for candidates passing the examination in more than one attempt.

16. **Carry over system:**
A candidate who has failed in one or more subject in the I year Deemed to be University examination can be permitted to enter II year, the candidate should clear all the I year subjects 6 months before taking the final year JSSAHER exams.

17. **Award of Degree:**
A candidate who has passed all the subjects of first year and final year shall be eligible for award of Degree.

18. **Duration for completion of the course of study**
The duration for the completion of the course shall be fixed as double the actual duration of the course and the students have to pass within the said period, otherwise they have to get fresh Registration.

19. **Revaluation I Retotalling of answer papers**
There is no provision for revaluation of the answer papers of failed candidates in any examination. However, the failed candidates can apply for retotalling.

20. **Re-admission after break of study**
Candidate who seeks re-admission to the course after break of study has to get the approval from the JSSAHER by paying a condonation fee. No condonation is allowed for the candidate who has more than 2 years of break up period and he/she has to rejoin the course by paying the required fees.
Syllabus for 1 year Medical M.Sc

Anatomy

Theory

I. General Anatomy: General anatomy includes introduction to anatomy, Skeleton system with classification, types of bone, features of long bone, ossification, blood supply, Joints – classification with examples, structure of typical synovial joints, Myology – classification with examples, types of skeletal muscles, tendon, aponeurosis, Nervous system – subdivisions, types of cells in CNS, neuron - structure, types, ganglia and plexuses.

II. Gross Anatomy: Head and Neck: Scalp, Muscles of Facial expression, Anterior Triangle of the Neck, Posterior Triangle of the Neck, Parotid Gland, Dural venous sinuses and Pituitary gland, Thyroid and parathyroid gland, Orbit and extra ocular muscles, Oral Cavity and Tongue, Nose and nasal cavity, Paranasal air sinuses, Pharynx, Larynx and Osteology of skull bone

Thorax:
Thoracic Wall, Mediastinum, Pleura, Lungs and bronchopulmonary segments, Pericardium, Heart, Blood and Nerve supply of Heart, Diaphragm, Oesophagus and Thoracic duct and Osteology of ribs, Sternum and thoracic vertebrae

Abdomen and pelvis: Anterior abdominal wall, Posterior Abdominal Wall, Peritoneal cavity and Peritoneum, Inguinal Region, Stomach, Duodenum, Jejunum and Ilium, Cecum and Appendix, Rectum and Anal canal
Spleen, Kidney, Pancreas, Liver, Extra hepatic biliary apparatus, Portal venous system, Kidney
Supra renal gland, Urinary bladder, Pelvic diaphragm and Urogenital diaphragm, Perineum, Male and female reproductive system and Osteology of pelvis and lumbar vertebrae

III. Histology: Microscopy, basic tissues, blood vessels, lymphoid tissue, salivary glands, tongue, oesophagus, stomach, small intestine, large intestine, pancreas, liver, gall bladder, trachea, lung, kidney, ureter, urinary bladder, testis, epididymis, vas deferens, prostate, ovary, uterus, fallopian tube, placenta, pituitary gland, thyroid and parathyroid glands, suprarenal gland, and skin.

IV. Genetics: Introduction, Chromosomes, Inheritance, Karyotyping & Chromosomal abnormalities.

V. Embryology: General embryology includes Introduction, gametogenesis, structure of sperm, growth of ovarian follicles, uterine cycle, fertilization, implantation, bilaminar germ disc, notochord formation, trilaminar germ disc, embryonic folds, fetal membranes, placenta, umbilical cord, amniotic cavity. Systemic embryology includes CVS, digestive system, urogenital system, pharyngeal arches and pouches, development of face and palate, respiratory system along with congenital anomalies

VII. Practical Syllabus: Gross Anatomy: Demonstration of dissected specimens region wise - Thorax, Abdomen and pelvis, Head and Neck and Brain including osteolog.
Histology: Demonstration of general and systemic histology slides. A practical record of work done in histology has to be maintained by the candidate and duly scrutinized by the faculty incharge and certified by head of the department.

RECOMMENDED TEXT BOOKS

Gross Anatomy:

Histology:
2. Text book of histology Inderbir Singh VI edition

Genetics:
1. Medical genetics by SD GANGANE III edition

Embryology:
1. Human Embryology by INDERBIR SINGH 10th edition

Neuroanatomy:

JSSAHER EXAMINATION:
THEORY : 100 Marks
Distribution of chapters for Anatomy paper with weightage of marks

<table>
<thead>
<tr>
<th>Topics</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>Head &amp; Neck</td>
<td>20</td>
</tr>
<tr>
<td>Brain, Spinal cord</td>
<td>10</td>
</tr>
<tr>
<td>Thorax including diaphragm</td>
<td>15</td>
</tr>
<tr>
<td>General Anatomy</td>
<td>05</td>
</tr>
<tr>
<td>Embryology</td>
<td>10</td>
</tr>
<tr>
<td>Histology</td>
<td>10</td>
</tr>
<tr>
<td>Abdomen</td>
<td>10</td>
</tr>
<tr>
<td>Pelvis</td>
<td>10</td>
</tr>
<tr>
<td>Perineum</td>
<td>05</td>
</tr>
<tr>
<td>Genetics</td>
<td>05</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Syllabus for I year Medical M.Sc

Physiology

THEORY

I  GENERAL PHYSIOLOGY
  1. Organization of the cell, Cell membrane & its function, cell organelles
  2. Intercellular communications
  3. Transport across cell membrane
  4. Membrane potentials – RMP & Action potential
  5. Body fluid compartments
  6. Homeostasis, concepts of physiological norms, range and variations.

II  BLOOD
  1. Composition and functions of blood, Plasma Proteins
  2. Red Blood cells – Erythropoiesis, Morphology of RBC, Functions, Normal values, Variations, PCV and ESR
  3. Haemoglobin - Structure ,Functions, Types, Derivatives.
  4. Life span and destruction of RBC & Haemoglobin, Jaundice, Types.
  5. Leucocytes – Leucopoiesis Morphology of different types of leucocytes, functions, Variations, Immunity,
  6. Platelets – thromopoiesis, morphology, functions, normal values & Variation.
  7. Hemostasis and blood coagulation – definition, clotting factors. Mechanism of clotting, Bleeding disorders, Tests for clotting & anticoagulants,
  8. Blood groups –ABO system and Rh factor. Blood transfusion

III  NERVE AND MUSCLE
  3. Neuromuscular junction and transmission across it
  4. Mechanism of muscle contraction and its molecular basis. Types of contraction- isotonic and isometric contractions.
  5. Types of skeletal muscle fibres
  7. Smooth muscle – Structure & Mechanism of contraction

IV  GASTROINTESTINAL SYSTEM
  1. Introduction – Anatomy of G.I. tract, composition, functions and regulation of secretion of saliva
  2. Mastication & Deglutition
  3. Stomach – Compositions, functions and regulation of secretion of gastric juice, Mechanism of secretion of HCL, Gastric Motility
  4. Exocrine pancreas – Compositions, functions and regulation of secretion of Pancreatic juice.
  5. Liver and gall bladder – Function of liver, Composition and functions of bile. Function of gall bladder, filling and emptying , Regulation
  6. Small intestine – Composition and functions of succus entericus , Small intestine movements.
  7. Large intestine – Functions and motility
9. Digestion & Absorption of Carbohydrates, Proteins & fats

V KIDNEY, SKIN AND TEMPERATURE REGULATION
2. G.F.R- Definition, Mechanism of filtration and its regulation.
3. Tubular function – Glucose, Water, Sodium and Chloride Reabsorption, concentration mechanism of urine, acidification of urine
4. Micturition and Cystometrogram, Renal function tests.
5. Skin & its functions and temperature.

VI RESPIRATION
1. Introduction – Functional anatomy of respiratory tract,
3. Alveolar ventilation, dead space ventilation, Ventilation Perfusion ratio
5. Oxygen transport – O2 –Hb dissociation curve and CO2 transport
6. Regulation of respiration – Neural & Chemical
7. Hypoxia -types, Effects, voluntary Hyperventilation, Periodic breathing.
9. Respiratory adjustments during muscular exercise.

VII CARDIO VASCULAR SYSTEM
1. Functional anatomy of heart, Properties of cardiac muscle, Innervation of the heart
2. Conducting system of Heart, Origin & Spread of cardiac impulse, ECG
3. Cardiac cycle.
4. Heart rate and regulation of heart rate.
5. Cardiac output definitions, variations, Regulation.
7. Blood pressure – Normal values, measurement, factors affecting and regulation
8. Regional circulation – coronary
9. Shock, Cardiopulmonary resuscitation
10. Cardio vascular changes during muscular exercises.

VIII ENDOCRINES
1. Introduction to endocrinology, classification, General properties and mechanism of action of hormones.
2. Pituitary gland:
   a) Anterior pituitary hormones, their actions, Regulation of secretion and disorders,
   b) Posterior pituitary hormones - Actions, Control and disorders
3. Thyroid hormones - Synthesis, actions, Regulation of secretion and disorders
4. Parathyroid hormones - Actions, Regulation of secretion and disorders
5. Calcium homeostasis
7. Adrenal gland:
   a) Adrenal cortical hormones – Actions, Regulation and Disorders.
   b) Adrenal medullary hormones – actions

IX REPRODUCTION
1. Introduction.
2. Male reproductive system
   a) Physiological anatomy, spermatogenesis and its regulation
   b) Testosterone, composition of semen.
3. Female reproductive system
   c) Oogenesis, Oestrogen & Progesterone
   d) Menstrual cycle
   e) Pregnancy and parturition
   f) Lactation and family planning

X CENTRAL NERVOUS SYSTEM
1. Organization of central nervous system
2. Synapse: Transmission and properties, neurotransmitters
3. Receptors and properties
4. Sensory system: Primary sensations: ascending tracts and sensory cortex
5. Pain sensation and thalamus
7. Pyramidal and extra pyramidal tracts
8. Functions of Basal ganglia, Cerebellum and Vestibular apparatus.
9. Hypothalamus, ANS, Limbic system
10. Sleep and EEG, Learning and memory, Language and speech
11. CSF and blood brain barrier (BBB)

XI SPECIAL SENSES
Vision:
1. Functional anatomy, Aqueous humor & IOP
2. Image forming mechanism, Errors of refractions
4. Visual activity, Visual pathway and its lesion, visual cortex
5. Accommodation, Dark adaptation, Pupillary reflexes,
6. Colour vision
7. Eyeball movements

Hearing:
1. Functional anatomy, Physics of sound.
2. Role of tympanic membrane, middle ear and cochlea in hearing.
3. Auditory pathway and auditory cortex.
4. Tests for hearing and deafness.

Taste and smell: Modalities, receptors, pathways, cortical and limbic areas associated with taste and smell.

XII. PRACTICALS:
1. Study of the microscope and Effect of different concentrations of Saline on RBC.
2. Hemoglobin estimation
3. Enumeration of Red Cell Count
4. Demonstration of Packed cell volume, ESR and Blood Indices
5. Total Leucocyte count
6. Differential leucocyte count
7. Absolute Eosinophil count
8. Bleeding time, clotting time
9. Demonstration of Human experiments

RECOMMENDED TEXT BOOKS:

JSSAHER EXAMINATION:
THEORY : 100 Marks
Distribution of chapters for Physiology paper with weightage of marks

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Marks</th>
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<tbody>
<tr>
<td>General Physiology</td>
<td>03</td>
</tr>
<tr>
<td>Blood</td>
<td>10</td>
</tr>
<tr>
<td>Nerve - Muscle</td>
<td>08</td>
</tr>
<tr>
<td>Gastrointestinal system</td>
<td>09</td>
</tr>
<tr>
<td>Renal system</td>
<td>06</td>
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<tr>
<td>Respiratory system</td>
<td>10</td>
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<tr>
<td>Cardiovascular system</td>
<td>12</td>
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<tr>
<td>Endocrines</td>
<td>10</td>
</tr>
<tr>
<td>Reproduction</td>
<td>06</td>
</tr>
<tr>
<td>Central Nerves system</td>
<td>14</td>
</tr>
<tr>
<td>Special senses</td>
<td>09</td>
</tr>
<tr>
<td>Skin and Body Temperature</td>
<td>03</td>
</tr>
</tbody>
</table>
Syllabus for I year Medical M.Sc

Biochemistry

THEORY
I. Introduction
Importance and scope of medical biochemistry in prevention, diagnosis and therapeutics of diseases
   a. Cell Biology
   b. Cell membrane – structure and composition
   c. Functions of cellular structures
   d. Transport across the cell membrane
      i. Facilitated diffusion
      ii. Passive transport
      iii. Active transport
      iv. Receptor mediation
      v. Endocytosis and exocytosis

II. Chemistry of Carbohydrates
   a. Definition, classification and their biological importance
   b. Monosaccharides – structure, classification and properties (along with important derivates of monosaccharides and reactions of carbohydrates)
   c. Isomerism and stereoisomerism
   d. Disaccharides & oligosaccharides-structure, properties & importance
   e. Polysaccharides – homo and heteropolysaccharides – structure, distribution and functions
   f. Dietary fibres

III. Chemistry of amino acids, peptides and proteins
   a. Amino acids – Structure, types, various classifications and properties
   b. Peptides – structure and functions of biologically important peptides e.g. Glutathione, oxytocin and vasopressin, ANP and BNP
   c. Proteins – definition, classifications, functions, properties (physical and chemical), structural organization, structure-function relationship with reference to hemoglobin
   d. Separation techniques – electrophoresis and chromatography

IV. Chemistry of lipids
   a. Definition, classification, properties and biological importance
   b. Simple lipids – Structure, distribution and functions
   c. Compound lipids – phospholipids, sphingolipids, glycolipids – composition, distribution and functions
   d. Derived lipids – fatty acids, steroids, eicosanoids – chemistry, distribution, classification and functions

V. Chemistry of nucleic acids
   a. Purines and pyrimidines – structure, structural analogues and their clinical applications
   b. Nucleoside, nucleotide and other biologically important nucleotides
   c. Nucleic acids – definition, types
   d. DNA – structure, types of DNA and functions
   e. RNA – structure, types and functions
VI. **Enzymology**
   a. Definition, classification, properties
   b. Coenzymes and cofactors (apoenzyme, holoenzyme, cofactors and activators)
   c. Mechanism of enzyme action
   d. Factors affecting enzyme activity and Km, its significance (derivation not required)
   e. Enzyme inhibition – types with Lineweaver-Burk plots and clinical importance
   f. Enzyme regulation – modes, mechanism and importance
   g. Isoenzymes – definition, chemistry, separation and clinical importance
   h. Diagnostic and therapeutic importance of enzymes
   i. Proenzymes, multienzyme complex and metalloenzymes
   j. RIA and ELISA

VII. **Vitamins**
   a. Definition and classification
   b. Chemistry, sources, absorption and transport, biochemical role, RDA, and deficiency, antivitamins and hypervitaminosis of fat and water soluble vitamins

VIII. **Minerals**
   a. Classification, sources, absorption, transport, fate, metabolism, biochemical functions, excretion, regulation, RDA, deficiency manifestations of the following: calcium, phosphorous, iron, copper, iodine, zinc, fluoride, magnesium, manganese, selenium, sodium, potassium and chloride.

IX. **Bioenergetics and Biological Oxidation**
   a. Redox potential, concept of bioenergetics in relation to thermodynamics
   b. High energy compounds
   c. Enzymes involved with special reference to oxygenases
   d. Shuttle mechanisms
   e. Components and organization of respiratory chain in mitochondria
   f. Oxidative phosphorylation
   g. Formation of ATP and its regulation
   h. Inhibitors and uncouplers (Brown adipose tissue and thermogenesis)

X. **Digestion and absorption**
   a. Carbohydrate
   b. Lipids
   c. Proteins
   d. Malabsorption syndromes and other related disorders

XI. **Metabolism of carbohydrates**
   a. Glucose transporters
   b. Glycolysis
   c. Oxidation of pyruvate
   d. TCA cycle
   e. Gluconeogenesis, Cori’s cycle
   f. Metabolism of glycogen (glycogenesis, glycogenolysis, storage disorders)
   g. HMP shunt pathway
h. Metabolism of fructose, galactose, uronic acid pathway, inborn errors associated with them
i. Blood glucose regulation
j. Diabetes Mellitus – etiology, metabolism in Diabetes Mellitus, biochemical basis of acute and chronic complications, laboratory diagnosis and monitoring (Glycated Hb, Fructosamine)
k. Glucose tolerance test and glucose challenge test

XII. **Metabolism of amino acids and proteins**
a. Dynamic state of body proteins, protein turnover, nitrogen balance
b. Cellular reactions of amino acids
c. Formation, transport and disposal of ammonia (urea cycle)
d. Metabolism of amino acids – glycine, serine, aromatic amino acids, sulphur containing amino acids, histidine, arginine, glutamic acid, branched chain amino acids (first three steps) and metabolic disorders associated with them along with laboratory diagnosis.
e. Specialized products obtained from amino acid metabolism and their importance (Polyamines, creatine, nitric oxide)*

XIII. **Metabolism of lipids**
a. Oxidation of fatty acids – alpha, beta, omega – beta oxidation of odd chain and even chain fatty acids along with disorders
b. Formation and utilization of ketone bodies and ketosis
c. De novo synthesis of fatty acids, elongation and desaturation
d. Phospholipids (lecithin and cephalin only) and triglycerides – formation and breakdown
e. Lipid storage disorders
f. Synthesis of cholesterol (only crucial intermediates), Fate of cholesterol and other compounds derived from cholesterol
g. Lipoproteins – classification, metabolism, functions and disorders
h. Atherosclerosis and role of PUFA in preventing atherosclerosis
i. Eicosanoids
j. Metabolism in adipose tissue, fatty liver and lipotrophic factors

XIV. **Metabolism of nucleic acids**
a. Biosynthesis and breakdown of purine and pyrimidine nucleotides
b. Salvage pathways and disorders

XV. **Intermediary metabolism**
a. Integration of carbohydrate, protein and lipid metabolism
b. Regulation by hormones in starvation, well fed state and diabetes mellitus
c. Methods of study of intermediary metabolism

XVI. **Hemoglobin metabolism**
a. Biosynthesis of heme, regulation and porphyrias
b. Degradation of hemoglobin
c. Biochemical basis of jaundice and distinguishing features of different types of jaundice
d. Hemoglobin variants and Hb derivatives
e. Abnormal hemoglobins, hemoglobinopathies and thalassemia
XVII. Genetics and Molecular Biology
   a. DNA replication
   b. Transcription, post transcriptional modifications, reverse transcriptase
   c. Genetic code, translation, post translational modifications
   d. Regulation of gene expression, mutation, Polymerase Chain Reaction, recombinant DNA technology, gene therapy, blotting techniques, Restriction Fragment Length Polymorphism, DNA fingerprinting

XVIII. Nutrition
   a. Nutrients, Calorific value of food, BMR, SDA, respiratory quotient and its applications
   b. Balanced diet based on age, sex and activity, biological value of proteins, nitrogen balance
   c. Protein energy malnutrition – kwashiorkor and marasmus
   d. Biochemistry of starvation and obesity
   e. Dietetics, Total parenteral nutrition, dietary fibres
   f. Acid base balance
   g. Basic concepts of acids, bases, buffers, pH, H ion concentration, derivation of Henderson – Hasselbach equation with its applications
   h. pH of blood and its regulation
   i. Anion gap and its importance
   j. Acidosis, alkalosis, assessment of acid-base status

XIX. Water and electrolyte balance
   a. Body water compartments, Donnan membrane equilibrium, osmolality, electrolytes concentration in body fluid compartments, water balance, regulation of water balance
   b. Electrolyte balance, regulation and its disorders

XX. Function tests
   a. Liver function tests
   b. Renal function tests
   c. Thyroid function tests

XXI. Plasma proteins
   a. Classification, site of synthesis, functions, electrophoretogram in health and disease
   b. Acute phase proteins
   c. Immunoglobulins – structure, types, functions and associated disorders

XXII. Metabolism of Xenobiotics & Detoxification

XXIII. Biochemistry of cancer
   a. Carcinogens
   b. Oncogenes
   c. Growth factors
   d. Tumor markers

XXIV. Free radical and antioxidants

XXV. Quality control

XXVI. Biomedical waste management
PRACTICALS

I. Introduction
II. Reactions of carbohydrates
III. Precipitation reactions of Proteins
IV. Colour reactions of albumin & casein
V. Reactions of NPN substances
VI. Analysis of normal urine
VII. Analysis of abnormal urine
VIII. Principles of colorimetry
IX. Estimation of blood glucose and interpretation
X. Estimation of blood urea and interpretation
XI. Estimation of urinary creatinine and calculation of creatinine clearance and interpretation
XII. Estimation of serum total protein, albumin and A/G ratio and interpretation
XIII. Paper chromatography
XIV. Electrophoresis
XV. GTT and OGCT

RECOMMENDED TEXT BOOKS AND REFERENCE BOOKS

Text Books
1. Murray (Robert.K.M), Harpers Illustrated Biochemistry. Published by Lange Medicals
3. Champe, Harvey & Ferrier. Lippincott’s illustrated reviews of Biochemistry. Published by Lippincott, Williams and Wilkins
5. Debajyoti Das Biochemistry. Published by Academic publishers.

Reference Books
1. CHATTERJEA & SHINDE. Textbook of Medical Biochemistry. Published by Jaypee Medical Publishers, New Delhi
3. STRYER (Lubert), Biochemistry Published by Freeman & Co.
5. BURTIS (Carl.A) & ASHWOOD (Edward.R) and Bruns (David E.). Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. Published by Saunders.

JSSAHER EXAMINATION:
THEORY : 100 Marks
Distribution of chapters for Biochemistry paper with weightage of marks

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Topic</th>
<th>Weightage of Marks</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Cell structure and function, sub cellular organdies, cell membranes, transport across the membranes</td>
<td>5</td>
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<tr>
<td>2</td>
<td>Chemistry, digestion, absorption and metabolism of Carbohydrates</td>
<td>10</td>
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<tr>
<td></td>
<td>Amino acids and protein chemistry, general reactions of amino acids, digestion and absorption, urea cycle and metabolism of amino acids</td>
<td>10</td>
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<tr>
<td>4</td>
<td>Chemistry, digestion, absorption and metabolism of lipids, Free radicals and antioxidants</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Enzymes , Biological oxidation, integration of metabolism and regulation of metabolism</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Nucleotides and nucleic acid chemistry &amp; metabolism, Liver function tests Kidney function tests, Thyroid Function tests</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Protein Biosynthesis, Molecular genetics, regulation of gene expression, recombinant DNA technology, PCR, Human Genome Project &amp; gene therapy, Biochemistry of cancer, oncogenes and tumour markers</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Vitamins &amp; Minerals</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>Water and Electrolyte balance, Acid - base balance, Nutrition and energy metabolism</td>
<td>10</td>
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<tr>
<td>10</td>
<td>Heme metabolism, normal and abnormal hemoglobins, Plasma proteins and immunoglobulins</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Detoxification and Xenobiotics , Clinical chemistry, SI Units, quality control, interpretation and reference values and analysis, Bio-medical Waste</td>
<td>5</td>
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</tbody>
</table>
Final year MSc Curriculum

Anatomy

**Goal:** The goal of postgraduate M.Sc in Medical Anatomy is to produce competent teachers who have acquired the skills in teaching medical and paramedical professionals and orient to the principles of research methodology.

**Objectives:**
At the end of the three years’ training in Anatomy the student should be able to:
1. Acquire in depth knowledge of structure of human body from the gross to the microscopic anatomy level, and correlate it with the functions.
2. Comprehend the principles underlying the structural organization of body and provide anatomical explanations for altered functions.
3. Acquire knowledge of basic principles of normal growth and differentiation. Understand the process of human growth and development of all the organ systems of body. Analyze the congenital malformations and etiological factors including genetic mechanisms involved in abnormal development.
4. Identify, locate and demonstrate surface marking of clinically important structures in the cadaver and correlate it with living anatomy
5. Competently Procure, Embalm and Preserve the human cadavers
6. Acquire mastery in tissue preparation, staining and museum specimens preparation
7. Develop an attitude of scientific enquiry and learn prevailing research methodologies.
8. Conduct research in bio-medical sciences

**Course Outcomes:**
After completing the course the postgraduate should:
1. Have acquired the competencies pertaining to the subject of Anatomy.
2. Competently carryout the Body Donation Program, Prepare histology slides and maintain the museum
3. Be oriented to the principles of research methodology
4. Have acquired skills in educating medical and paramedical professionals.
5. Have acquired skills in effectively communicating with the students and colleagues from various medical and paramedical fields.
6. Have acquired qualities of a good teacher capable of innovations in teaching & learning methodology

**Syllabus**
**Theory:**
**I. General anatomy:**
Introduction, subdivisions of anatomy, anatomical position, anatomical planes, anatomical terms, Cell, cell division, Basic tissues, Skin, Superficial fascia and deep fascia, modifications of deep fascia, Skeleton system with classification, types of bone, features of long bone, ossification, blood supply, Joints – classification with examples, structure of typical synovial joints, Myology – classification with examples, types of skeletal muscles, tendon, aponeurosis, Nervous system – subdivisions, types of cells in CNS, neuron - structure, types, ganglia and nuclei, plexuses, Cardiovascular system – blood vessels, anatomosis, types of circulation, lymphatic system – components of the lymphatic system.
II. Gross Anatomy:
Upper limb: Introduction, bones of the upper limb, pectoral region, muscles, mammary gland, applied anatomy, Axilla – Boundaries and contents, Brachial plexus, applied anatomy, Back and scapular region - muscles, intermuscular spaces, anastomosis around the scapula, Arm – compartments, muscles, nerves and vessels, Cubital fossa, Forearm – compartments, muscles, nerves and vessels, flexor retinaculum, Hand - palmar aponeurosis, spaces of the palm, muscles, nerves and vessels of the palm, joints of the upper limb with osteology, surface marking and radiology.
Lower limb: Introduction, bones of the lower limb, front of thigh – femoral triangle, Adductor canal, applied anatomy, Gluteal region - muscles, nerves and vessels, Back of the thigh – Hamstrings, Popliteal fossa, Leg - compartments, muscles, nerves and vessels, Dorsum of foot, Sole - plantar aponeurosis, muscles, nerves and vessels of the sole, joints of the lower limb with osteology, surface marking and radiology.
Neuroanatomy: Introduction, Parts of brain, Spinal cord, Forebrain – Cerebral hemispheres, Diencephalon, Midbrain, Hind brain – Pons, Medulla oblongata, cerebellum, Ventricles of brain and CSF – formation and circulation, white matter of cerebrum – corpus callosum and internal capsule in detail, Basal nuclei, corpus striatum, with clinical correlations, radiology, surface marking and applied anatomy.

III. Genetics: Introduction, chromosomes, inheritance, karyotyping, chromosomal abnormalities, inborn errors of metabolism and genetic counselling.

IV. Embryology:
General Embryology: Introduction, gametogenesis, structure of sperm, growth of ovarian follicles, uterine cycle, fertilization, implantation, First week of development, Second week of development, bilaminar germ disc, notochord formation, trilaminar germ disc, embryonic folds, fetal membranes, placenta, umbilical cord, amniotic cavity, twinning, teratology and prenatal diagnosis.
Systemic embryology: includes musculoskeletal system, body cavities. Development of CVS – formation of heart tube, cardiac loop, interatrial septum and interventricular septum, vascular development, clinical correlates, circulation

V Histology:
Histological technique: Microscopy, microtome, tissue collection, embedding and paraffin blocks preparation, serial section cutting, staining techniques, mounting the sections.  
Museum and embalming techniques.
Histology of basic tissues: Blood vessels, lymphoid tissue, salivary glands, tongue, oesophagus, stomach, small intestine, large intestine, pancreas, liver, gall bladder, trachea, lung, kidney, ureter, urinary bladder, testis, epididymis, vas deferens, prostate, seminal vesicle, penis, ovary, uterus, fallopian tube, mammary gland, placenta, umbilical cord, pituitary gland, thyroid and parathyroid glands, suprarenal gland, cerebrum, cerebellum, spinal cord, retina, cornea and skin.

Practical schedule:
1. Gross Anatomy: Dissect and demonstrate the entire human cadaver
2. Embalm and maintain the record of embalming work done.
3. Histology section:
   - Collection of tissues, fixing, block making, section cutting; use of different types of microtomes and preparation of general and systemic slides.
   - Haematoxylin & Eosin - (i) Preparation of stains. (ii) Staining techniques.
   - Knowledge of light microscope and electron microscope.
   - Detailed microscopic study of all the tissues (General and Systemic slides).

Recommended Books
Gross Anatomy:

**Histology:**
7. E.C. Clayden. Practical of section cutting and staining.

**Genetics:**
1. Medical genetics by SD GANGANE III edition

**Embryology:**
4. Larsen’s Human embryology Schoenwolf, Bleyl, Brauer, Francis-West 7th edition
5. AK Datta Essentials of Human embryology 7th edition

**Neuroanatomy:**

**Radiology:**

**Surface anatomy:**
1. A. Halim. and A.C. Das. Surface Anatomy Lucknow. ASI, KGMC.
JSSAHER EXAMINATION:

Theory:
The written examination consists of three papers, with maximum marks of 100 for each paper. Each paper will be of three hours duration.
Paper I: General Anatomy, Gross Anatomy and applied Anatomy
Paper II: Embryology with terotology, Histology, Comparative anatomy and Anthropology
Paper III: Neuroanatomy, Histological technique, Museum and embalming techniques including Medicolegal aspects and Human Genetics.

Distribution of chapters for with weightage of marks

Paper I. General Anatomy including gross and Applied anatomy

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<td>Thorax</td>
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<td>Abdomen</td>
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<td>Pelvis with perineum</td>
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<tr>
<td>7</td>
<td>Head and Neck</td>
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<td>8</td>
<td>Applied Anatomy</td>
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Paper II. Embryology with Teratology, Histology, Comparative Anatomy and Anthropology

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<td>Systemic embryology</td>
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<tr>
<td>3</td>
<td>General Histology</td>
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<td>4</td>
<td>Systemic histology</td>
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<td>5</td>
<td>Comparative anatomy</td>
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<td>6</td>
<td>Anthropology</td>
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Paper III. Genetics, Neuroanatomy including Histological, museum and embalming techniques with Medico legal aspects

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<td>Histological technique</td>
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<td>3</td>
<td>Museum and embalming techniques including Medico legal aspects</td>
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<tr>
<td>4</td>
<td>Human Genetics</td>
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JSSAHER EXAMINATION:
Practicals: 200 marks (Gross Anatomy - 100 marks, Histology - 100 marks) and Viva –Voce & Pedagogy: 100 marks
**A. Gross Anatomy:**
Dissection of the topic allotted on a human cadaver and display for discussion. Time allotted will be 03 hrs.

Distribution of Marks:

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<th>Topics</th>
<th>Marks</th>
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<td>3</td>
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<td><strong>Total</strong></td>
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Final year MSc Curriculum

PHYSIOLOGY

OBJECTIVES:
At the end of the course a post graduate student in Physiology should be able to:--
1. Demonstrate comprehensive knowledge and understanding of general and systemic physiology.
2. Comprehend the physiological basis of health and disease affecting various organ systems.
3. Analyze the research work, publish scientific articles in peer reviewed journals and critically evaluate published journal literature.
4. Demonstrate and perform appropriate experiments in physiology
5. Effectively teach UG students the basic physiological mechanisms using appropriate teaching techniques and resources.
6. Acquire skills in conducting collaborative research in the field of physiology & allied sciences.

COURSE OUTCOME:
After completing the course the postgraduate should:
1. Have mastered most of the competencies, with awareness of the contemporary advances and developments in physiology.
2. Be a competent teacher in physiology, who shall have acquired the basic skills in teaching of the medical and paramedical professionals.
3. Be a researcher who shall have acquired a spirit of scientific inquiry and is oriented to the principles of research methodology.
4. Be able to interact with allied departments and render services in advanced laboratory investigations.

Syllabus
THEORY :
I. General physiology
   1. History of Medicine with special reference to physiology
   2. Cell physiology – Cell cycle, organization and physical structure of cell, apoptosis
   3. Homeostasis: Internal environment, Control systems of body
   4. Body fluids compartments and measurements, oedema and dehydration
   5. Transport across cell membrane
   6. Membrane potentials and its measurements
   7. Genetics: Genetic code, its expression and regulation of gene expression
   8. Biophysical principles

II. Blood
   2. Plasma proteins: types, properties and functions
   3. RBC’s: formation, functions
   4. Hemoglobin – structure, synthesis, types – normal & abnormal,
   5. Fate of RBC’s and hemoglobin, jaundice, Anemia’s and Polycythemia
   6. WBC’s: Types, formation, structure and functions of each type
   7. Leukocytosis, leucopenia and leukemia
   8. Immunity: Reticuloendothelial system, Cell mediated, Humoral immunity and immune reactions
   9. Platelet’s: structure, formation, functions
10. Haemostasis: Definition and Steps, coagulation, fibrinolytic system, anticoagulants and coagulation tests
11. Blood groups: Major and minor blood group systems
12. Blood transfusion and its hazards
13. Lymph: formation and functions

III. Nerve Muscle physiology
1. Neuron, Neuroglia and Nerve fibres – Classification & properties
2. Degeneration and regeneration of nerve fibres, nerve growth factors
3. Neuromuscular transmission and its disorder, Drugs acting at Neuromuscular junction.
4. Skeletal muscle: Structure, Excitation and contraction coupling, molecular basis of contraction, Types of contraction Muscle types and properties and energy sources
5. EMG and Muscle disorders
7. Cardiac muscle: Structure, properties, molecular basis of contraction

IV. Gastrointestinal physiology
1. General overview of GI system - Organization of Gastrointestinal wall, Innervation of GIT
3. Physiology of deglutition: Definition, stages, neural control and applied aspects.
5. Gastric motility – characteristics and control, gastric emptying and antral pumpmechanism, peptic ulcer.
6. Pancreatic secretions: Composition, mechanism, functions and regulation.
7. Liver: Functions, Bile formation, secretion and regulation, Entero hepatic circulation,
8. Gall bladder: Functions, Mechanism and regulation of gall bladder contraction
9. Jaundice, Physiological basis of liver function tests
10. Small intestine: Secretion, movement and control.
11. Large intestine: Functions, secretions, movements.
12. Defaecation: Mechanism and control.
13. Physiology of vomiting, diarrhoea, constipation.
14. Gastrointestinal hormones
15. Digestion and absorption.

V. Renal system
3. Regulation of acid base balance.
4. Renal mechanisms for regulation of ECF volume, blood pressure and ionic composition.
5. Innervations of bladder, micturition and abnormalities of micturition.
6. Renal Function tests
7. Renal failure, Artificial kidney, dialysis and renal transplantation. Diuretics,
8. Integumentary system; Structure of Skin and its functions, sweat glands
and thermoregulation

VI. Respiratory system
1. Functional anatomy of respiratory system
2. Mechanics of breathing: Movements of thoracic cage during respiration, in-
trapleural and pulmonary pressure and volume changes, pressure-volume
inter-relationships, lung compliance, surfactant, airway resistance, work of
breathing.
3. Spirometry, lung volumes & capacities: Definitions, normal values and its
significance
4. Alveolar ventilation, Dead space ventilation, Ventilation perfusion ratio and
its Importance in respiratory diseases.
5. Diffusion of gases: Alveolar-capillary membranes, diffusion capacities, par-
tial Pressure gradients and factors influencing diffusion of gases.
6. Gas Transport: Oxygen transport – oxygen dissociation curve- factors af-
fecting its shift and Bohr’s effect.
7. Carbon dioxide transport – tissue uptake, carriage in blood and release at
the lungs importance of red blood cell, chloride shift, Haldane effect.
8. Regulation of respiration : Neural and chemical regulation, integrated responses.
9. Abnormal breathing : Apnoea, hyperpnoea, tachypnoea, dyspnoea, Chyne-
stokes breathing and Biot's breathing- definition, features and physiologi-
cal basis.
10. Hypoxia, cyanosis, asphyxia
11. Role of respiratory system in acid base balance
12. Pulmonary function tests
13. Artificial respiration: types, principles, indications, advantages and disad-
vantages.

VII. Cardiovascular physiology
1. Functional anatomy and innervations of heart
2. Properties of cardiac muscle
3. Electrical activity of the Heart – origin and spread of cardiac impulse.
   Electrocardiogram: Definition, waves and their explanations.ECG recording
   Techniques Cardiac arrhythmias and their ECG interpretation
4. Heart rate and its regulation
5. Cardiac cycle – Phases, pressure and volume changes, Heart sounds, JVP,
   Arterial pulse
6. Cardiac output: Definition, normal values and variations, major determi-
nants of cardiac output and regulation, Heart-lung preparation, measure-
ment of cardiac output.
7. Haemodynamics: General principles of circulation Blood flow - Laminar and
turbulent flow, factors affecting blood flow and resistance, critical closing
pressure. Regulation of blood flow
8. Arterial Blood Pressure : Definition, normal value, variations, measure-
ment, mean arterial pressure (MAP) and its determinants. Regulation of
blood pressure.
9. Regional circulation : Coronary, cerebral, cutaneous, capillary,splanchnic,
skeletal muscle and foetal. Normal values, special features and regulation.
10. Cardiovascular changes during exercise.
11. Cardiac failure, circulatory shock.
VIII. Endocrinology
1. General principles of endocrinology; Classification and mechanism of action of hormones Functional anatomy, mechanism and actions of hormones and applied aspects of
2. Pituitary gland
3. Thyroid Gland
4. Parathyroid gland - Physiology of bone, Hormonal Control of Calcium Metabolism
5. Endocrine Pancreas & Regulation of blood glucose level
6. The Adrenal Medulla & Adrenal Cortex
7. Pineal gland, Local hormones
8. Energy Balance, Metabolism & Nutrition

IX. Reproductive system
1. Sex determination and differentiation, Chromosomal disorders
2. Male reproductive system:
   - Primary and accessory organs and their functions
   - Puberty in males
   - Spermatogenesis and its regulation
   - Testosterone- secretion, transport, metabolism, mechanism and physiological Actions. Control of testicular function
3. Female reproductive system:
   - Functional anatomy
   - Puberty in females
   - Ovarian hormones – Estrogen and progesterone, Mechanism and physiological actions, Control of ovarian function
   - Physiology of menstrual cycle: Ovarian cycle, Uterine cycle, vaginal and cervical Cycle. Physiology of ovulation and its detection
   - Menopause and menstrual abnormalities.
   - Physiology of fertilization and implantation.
   - Physiology of pregnancy: Endocrine changes, foeto-placental unit, changes in Mother during pregnancy, tests for pregnancy
   - Physiology of parturition and lactation
   - Contraception
   - Infertility and assisted reproduction

X. Central nervous system
1. Introduction: Organization of the nervous system
2. Synapse - electrical activities & properties
3. Sensory system – Receptors, ascending tracts, sensory cortex
4. Pain and other sensations
5. Motor system – Spinal cord, Reflexes, Motor cortex and descending tracts
6. Spinal cord lesions
7. Basal ganglia, Cerebellum and Vestibular apparatus
8. Control of voluntary and involuntary movements
9. Control of Posture and equilibrium
10. Thalamus, Hypothalamus and Autonomic nervous system
11. Cerebral cortex, Prefrontal lobe and Limbic system – Behavioral physiology
12. Cerebrospinal fluid and blood brain barrier
13. Reticular formation, Sleep & EEG
14. Higher cortical functions: Speech, learning and memory
XI. Special senses
1. Vision: Functional anatomy, aqueous humor, IOP,
   - Optics of vision, errors of refraction
   - Photochemistry of vision, Light and dark adaptation
   - Neurophysiology of vision: Visual pathway and visual cortex
   - Color vision and applied aspects
   - Movements of eyeball and squint
2. Hearing: Functional anatomy, Auditory pathway and auditory cortex
   - Mechanism of hearing
   - Deafness, Test for hearing, Audiometry
3. Olfaction: Physiology of olfaction and its disorders
4. Gustation: Physiology of gustation and its disorders

XII. PRACTICALS:
1. Haematology:
   a. Study of Haemocytometer
   b. Determination of RBC count
   c. Estimation of Haemoglobin
   d. Reticulocyte count
   e. ESR and PCV
   f. Osmotic fragility of Red blood cells
   g. Specific gravity of blood
   h. Total leucocyte count
   i. Differential count of WBC and Arneth count
   j. Absolute eosinophil count.
   k. Platelet count
   l. Determination of bleeding time and clotting time
   m. Determination of Blood groups

2. Clinical Physiology:
   A. Elementary principles of clinical examination
   B. General examination
      a. Cardiovascular system
         i. Examination of arterial pulses and measurements of blood pressure.
         ii. Examination of heart
      b. Respiratory System
         i. Examination of respiratory system
      c. Gastro-intestinal system
         i. Examination of abdomen.
      d. Nervous System
         i. Examination of higher mental functions.
         ii. Sensory system
         iii. Motor functions
         iv. Examination of cranial nerves.
         v. Cerebellar function tests

3. Human Experiments:
   1. Measurement of arterial blood pressure and effect of posture & exercise on BP.
   2. Electrocardiography — ECG & its interpretation.
   3. Recording of lung function tests by computerized or electronic spirometer
   4. Stethography
   5. Ergography
4. Animal Experiments
Since animal experiments have been banned by the CPCSEA the practical will be held by way of interpretation of the pre-recorded graphs both for mammalian intact and isolated preparations and amphibian experiments listed in the respective sections. This section of the experiments will include asking questions as part of bench viva in the following areas:

i. Animals commonly used: dogs rabbits, guinea pigs and rats
ii. Anesthesia: types of drugs used, advantages and Disadvantages, route of administration
iii. Equipment used for the experiments, their identification and uses.
iv. Dissection procedure
v. Composition and preparation of various mammalian fluids.

a. Amphibian experiments (Simulated experiments)
   i. Preload and after load
   ii. Effect of continuous repeated stimulation (study of phenomena of fatigue)
   iii. Length tension diagram.
   iv. Properties of cardiac muscle: long refractory period, all or none law.
   v. Extrasystole and compensatory pause, beneficial effect
   vi. Regulation of heart, dissection of vagus nerve and effect of vagal stimulation.
   vii. Actions of acetylcholine, adrenaline and nicotine on heart (Langley's)
   viii. Perfusion of isolated frogs heart — role of Na+ K+, Ca+
   ix. Decerebrate and spinal frog.

b. Mammalian: (Simulated experiments)
   General management of mammalian experiments
   i. Rat/guinea pig ileum : intestinal movement recording
   ii. Isolated rabbit heart perfusion

Recommended Text, Reference books and Journals (latest edition)
5. JB West, Best & Taylor, Physiological basis of Medical Practice, 12th edition (1990), Williams & Wilkins publications.

Journals:
1. Indian Journal of Physiology and Pharmacology, by APPI.
2. Physiological Reviews, By American Physiological Society
3. Annual review of Physiology, By American Physiological Society
JSSAHER EXAMINATION:

A. Theory: The written examination consists of three papers of 100 marks each. Each paper will be of three hours duration.

Paper–I: General physiology including nerve, muscle and cardiovascular physiology and blood and applied aspects

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<td>Nerve and muscle physiology,</td>
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<td>Blood and applied aspects</td>
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<td>cardiovascular physiology</td>
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Paper–II: Physiology of Respiratory, renal and gastrointestinal and skin and body temperature

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<td>Renal Physiology</td>
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<tr>
<td>Gastrointestinal physiology</td>
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<td>Skin and body Temperature</td>
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Paper –III: Physiology of Endocrine, reproductive, central nervous system and special senses

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<td>central nervous system</td>
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Practical Examination-200 marks and Viva- voce and Pedagogy– 100 marks

A. Practicals:-200 marks

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<td>Mammalian experiments</td>
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</table>

B. Viva- voce – 100 marks

1. The Viva-Voce would be on all components of syllabus including discussion on dissertation - 80 marks
2. Pedagogy - 20 marks
Final year MSc Curriculum

BIOCHEMISTRY

Objectives
MSc post-graduate in Biochemistry should understand the theory and practical aspects of:
1. The chemical and three dimensional structures of the various classes of biomolecules such as carbohydrates, proteins, lipids and nucleic acids as a prelude to understand the correlation between structure and function.
2. The metabolic pathways of the major classes of biomolecules, regulatory mechanisms, interactions, significance and alterations in disease states.
3. The Mechanism of energy release, conservation, utilization and derangements thereof.
4. The Role of micro and macro nutrients such as vitamins and minerals in health and the pathophysiology of nutritional disorders.
5. The Mechanism involved in the storage, transmission and expression of genetic information.
6. The physiological and pathological process affecting biochemical investigations.
7. LIS (Lab information system) and understand pre-analytical, analytical and post analytical procedures.
8. Various research methodologies, analyse the data obtained.

Course outcomes:
After completing the three years of MSc in Medical Biochemistry, the post graduate should be able to:
1. Emerge as qualified technologists, medical teachers and pursue PhD
2. Carry out clinical lab investigations & instrument maintenance
3. Perform Quality control procedures in the lab

SYLLABUS
THEORY:
PAPER – I CHEMISTRY & TECHNIQUES
1. Chromatography: Principle, experimental procedure and applications of paper, thin layer, ion exchange, affinity, gel filtration, gas-liquid, HPLC.
2. Electrophoresis: Principle, experimental procedure and applications of paper, polyacrylamide gel, agarose gel and cellulose acetate.
3. Ultracentrifugation and ultrafiltration.
7. Monoclonal antibodies, hybridoma technology, immunodiffusion, immuno-electrophoresis, radio immuno assay (RIA), enzyme linked immunosorbent assay (ELISA), fluorescent in situ hybridization (FISH) techniques. Immunohistochemistry, Immunocytochemistry, Immunoflorescence and Fluroscence assisted cell sorting.
9. DNA sequence determination. Recombinant DNA technique, cloning pro-
10. Stem cell technology—Isolation and characterization of stem cells, Maintenance AND DIFFERENTIATION OF STEM CELLS. Preparation of Induced pleuripotent stem cells(IPSS). Role of stem cells in disease management.
13. Chemistry of lipids: Classification, fatty acids, compound lipids, steroids.
15. Immunoglobulins: Classification, structure and functions of immunoglobulins.
16. Bioenergetics and biological oxidation: Concept of free energy change, high energy compounds, ATP generation, redox potential, electron transport chain, oxidative phosphorylation, inhibitors, uncouplers, ionophores.
18. Bioinformatics & Biostatistics, Medical ethics
19. Preclinical pharmacology—Types of animals, maintenance, methods of drug administration, pharmacodynamics and pharmacokinetics and animal ethics.

**PAPER II – INTERMEDIARY METABOLISM**

5. Purine and pyrimidine metabolism: Synthesis and degradation of nitrogen
bases and nucleotides. Metabolic disorders associated with purine and pyrimidine metabolism.

6. Deregulation of metabolic pathways in disease condition (Diabetes, cancer, Neurodegenerative diseases)

7. Replication: Replication, DNA damage and repair, mutations, amplification of genes, telomeres, inhibitors of replication.

8. Transcription: Transcription, post transcriptional modifications, inhibitors of transcription.


10. Muscle contraction.

11. Metabolism of Xenobiotics

**PAPER III – CLINICAL CHEMISTRY & NUTRITION**

1. Vitamins: Fat soluble and water soluble Vitamins – chemistry, absorption, transport, active forms, biochemical function, RDA, deficiency manifestations, toxicity.


4. Biological Membranes: Chemical composition, structure, biological properties, functions, membrane transport systems, ion channels, endocytosis, exocytosis, defects.

5. Endocrinology: Mechanism of action of hormones, hormone receptors, signal transduction, G-proteins, second messengers, cyclic AMP, cyclic GMP, calcium, inositol triphosphate, diacyl glycerol. Biosynthesis of adrenal and thyroid hormones, thyroid and adrenal function tests and disorders.


7. Composition of plasma in health and disease.


10. Reactive oxygen species and defence mechanisms, antioxidants and enzyme systems.

11. Diagnostic enzymology

12. Acute phase proteins: Alpha 1 anti trypsin, alpha 2 macroglobulin, haptoglobin, ceruloplasmin etc.,

13. Laboratory management: Accuracy, precision, specificity, sensitivity, percentage error, quality control, precautions in handling hazardous materials.

14. Radioisotopes and applications in Medicine
PRACTICAL SYLLABUS

General Biochemistry Practicals:

1. Estimation of amino acids by ninhydrin method
2. Estimation of protein by Lowry's method
3. Estimation of protein by Folin's method, includes preparation of Folin's reagent
4. Estimation of protein by dye binding method
5. Titration of amino acid, formal titration and pK values
6. Paper chromatography of amino acids
7. Thin layer chromatography of amino acids
8. Paper chromatography of carbohydrates
9. Thin layer chromatography of amino acids
10. Poly acrylamide gel-electrophoresis, molecular weight determination
11. Absorption spectra of phenylalanine, tyrosine and tryptophan
12. Absorption spectra of purines and pyrimidines
14. Estimation of ketohexose – fructorse by resorcinol method
15. Estimation of aldohexose – glucose by iodometric method
16. Periodate oxidation of sugars
17. Estimation of amino sugars
18. Saponification number of oil
19. Iodine number of oil
20. Estimation of Vitamin C, titration method and colorimetric method
21. Amylase, effect of substrate, pH and chloride
22. Effect of pH, temperature on trypsin or chymotrypsin by caseinolytic method and determination of Km value
23. Sephadex gel chromatography of proteins, molecular weight determination
24. Affinity chromatography, blue sepharose and albumin
25. Purification of enzyme: amylase or urease

Clinical Biochemistry Practicals:

1. Estimation of glucose by glucose oxidase method
2. Estimation of glucose by ortho toluidine method
3. Estimation of glucose by Nelson-Somogyi method
4. Estimation of blood glucose by di-nitrosalicylate method
5. Estimation of blood urea
6. Estimation of serum creatinine
7. Estimation of total cholesterol and HDL cholesterol
8. Estimation of serum proteins by BCA method
9. Estimation of total protein, albumin, A/G ratio
10. Estimation of serum calcium
11. Estimation of serum electrolytes by ISE
12. Estimation of serum bilirubin
13. Estimation of serum alkaline phosphatase
14. Estimation of serum aspartate amino transferase
15. Estimation of serum alanine amino transferase
16. Electrophoretic separation of LDH and its isoenzymes
17. Estimation of serum amylase, by Somogyi method
18. Estimation of serum iron and iron binding capacity
19. Separation of proteins by agarose gel electrophoresis
20. Separation of lipoproteins by electrophoresis
21. Estimation of serum triglycerides
22. Calculation of creatinine clearance
23. Estimation of serum cortisol by fluorimetry
24. Calculation of urea clearance
25. Arterial blood Gas analysis
26. Estimation of protein, sugar and chloride in CSF
27. Electrophoresis of normal and abnormal hemoglobins
28. Estimation of glycated haemoglobin by affinity chromatography
29. Estimation of protein in urine
30. Estimation of GGT in serum
31. Estimation of serum lipase
32. Estimation of serum inorganic phosphate
33. Estimation of nucleic acid content by UV-Visible spectrophotometry and determination of purity of the nucleic acids by spectral scanning
34. Estimation of antioxidant activity using (a) FRAP – Ferric reducing antioxidant power and (b) DPPH – 2,2-diphenyl-1-picrylhydrazyl method
35. Isolation of DNA from mammalian tissues using phenol-chloroform method and kit method (Promega/Invitrogen)
36. Design of primers using manual procedures as well as primers3 software
37. DNA amplification using PCR.

**Clinical biochemistry laboratory posting:**
Student should be trained in collection of samples, carrying out investigations, interpretation, maintenance of records of investigations and quality assurance, including quality control.

**RECOMMENDED TEXT BOOKS AND REFERENCE BOOKS**

**Text Books**

1. MURRAY (Robert.K.M), Harpers Illustrated Biochemistry. Published by Lange Medicals
3. CHAMPE, HARVEY & FERRIER. Lippincott’s illustrated reviews of Biochemistry. Published by Lippincott, Williams and Wilkins
5. DEBAJYOTI DAS Biochemistry. Published by Academic publishers.

**Reference Books**

1. CHATTERJEA & SHINDE. Textbook of Medical Biochemistry. Published by Jaypee Medical Publishers, New Delhi
3. STRYER (Lubert), Biochemistry Published by Freeman & Co.
5. BURTIS (Carl.A) & ASHWOOD (Edward.R) and Bruns (David E.). Tietz Textbook of Clinical Chemistry and Molecular Diagnostics. Published by Saunders.
JSSAHER EXAMINATION:

A. Theory: The written examination consists of three papers of 100 marks each. Each paper will be of three hours duration.

Theory consists of 3 papers each of 100 marks : 300 Marks

PAPER – I Chemistry & Techniques
PAPER II – Intermediary metabolism
PAPER III – Clinical Chemistry & Nutrition

Weightage for topics in theory examination:

PAPER – I Chemistry & Techniques

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<td>Ultracentrifugation and ultrafiltration, Photometry, Cell fractionation, marker enzymes</td>
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<td>3</td>
<td>Isotopes, Ph and buffers</td>
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<td>Monoclonal antibodies, hybridoma technology, immunodiffusion, immuno-electrophoresis, radio immuno assay(RIA), enzyme linked immunosorbent assay (ELISA), fluorescent in situ hybridization (FISH) techniques. Immunohistochemistry, Immunocytochemistry, Immunoflorescence and Fluorescence assisted cell sorting</td>
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<td>5</td>
<td>DNA sequence determination. Recombinant DNA technique, cloning procedures, vectors, plasmids, phages, cosmids and restriction map and PCR techniques. Southern, Northern, Western blotting procedures. Restriction fragment polymorphism. In-situ hybridization. Genomic library and cDNA library. Transgenic animals and microinjection technique. Gene therapy. Next generation sequencing methodologies. Stem cell technology-Isolation and characterization of stem cells, Maintainance and differentiation of stem cells. Preperation of Induced pleuripotent stem cells(IPSS). Role of stem cells in disease management</td>
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<td>Chemistry of amino acids and proteins, carbohydrates</td>
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<td>Chemistry of lipids and Nucleic acids</td>
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### Paper II – Intermediary metabolism

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<td>Integration of metabolism</td>
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<td>Purine and pyrimidine metabolism</td>
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<td>Deregulation of metabolic pathways in disease condition (Diabetes, cancer, Neurodegenerative diseases)</td>
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<td>Genetics-Replication, Transcription, Translation</td>
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### Paper III – Clinical Chemistry & Nutrition

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<td>Erythrocytes</td>
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<td>Composition of plasma in health and disease, Diagnostic enzymology, Acute phase proteins</td>
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<tr>
<td>8</td>
<td>Biochemical investigations of liver, kidney and gastric functions, malabsorption disorder, inherited metabolic disorders, abnormal constituents of urine</td>
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<tr>
<td>9</td>
<td>Cell and cancer biology</td>
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<tr>
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<td>Reactive oxygen species and defence mechanisms</td>
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Practicals Examination: 200 Marks practicals and Viva-voce and pedagogy – 100 marks

**A. Practicals-200 marks**

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<td>Qualitative analysis of urine</td>
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<td>Quantitative estimation (single standard)</td>
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<td>Biochemical techniques</td>
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</table>
B.Viva-voce – 100 marks
1. The Viva-Voce would be on all components of syllabus including discussion on dissertation - 80 marks
2. Pedagogy - 20 marks

Final year MSc Curriculum

Pharmacology

Objectives
1. Recognize the importance of Pharmacology as a key branch in health sciences and train them to acquire knowledge of general pharmacological principles, systemic pharmacology and clinical pharmacology.
2. Students are motivated to find interest in respective areas of research from start of Second year M.Sc. onwards to carry out
   - Screening of drugs for pharmacological and toxicological profile
   - Drug related literature search, formulate a research project and undertake the same.
   - Apply appropriate statistical methods for summarizing and analyzing data,

Course Outcome:
- To gain opportunity as a Medical Researcher involved in drug discovery and pre-clinical screening.
- Possible outcome of research work - publications, thesis or dissertation.
- Provide a platform for their placement at Pharmaceutical Industry in R & D dept. and also in Drug marketing.
- Teaching for Medical and allied health disciplines.

Theory:
I. General principles of pharmacology
   - Principles of pharmacokinetics and pharmacodynamics.
   - Principles of toxicology and treatment of poisoning.
   - Gene based therapy.

II. Systemic pharmacology including recent advances of drugs affecting:
1. Autonomic nervous system
   - Neurohumoral transmission
   - Agonists and antagonist of cholinergic and adrenergic systems.

2. Cardiovascular system
   - Cardiac electrophysiology
   - Drugs used in Ischemic heart diseases, Hypertension, C.C.F, Arrhythmias and Hyperlipidemia

3. Renal function
   - Physiology of urine formation.
   - Diuretics and anti diuretics.

4. Central nervous system
   - Neurotransmission in the central nervous system
   - General anaesthetics
• Local anaesthetics
• Sedatives and hypnotics
• Antiepileptics
• Analgesics-opioids &Non-opioids (NSAIDs)
• Psychopharmacological agents
• Drugs for CNS degenerative disorders and migraine.

5. **Gastro intestinal system.**
   • Drugs for peptic ulcer
   • Cathartics (Purgatives)
   • Antidiarrhoeal agents
   • Emetics and antiemetics.

6. **Blood**
   • Drugs affecting haemopoietic system
   • Haematinics, coagulants, anticoagulants, fibrinolytics, antiplatelets

7. **Autocoids**
   • Histamine and antihistamines
   • 5-HT and its antagonists
   • Eicosanoides

8. **Respiratory system**
   • Drugs used for bronchial asthma and cough

9. **Drugs acting on uterus**
   • Oxytocics (Ecbolics) and Tocolytics

10. **Heavy metals and chelating agents**
    • Lead, mercury, iron, copper and arsenic

11. **Drugs used for immunomodulation**
    • Immunostimulants
    • Immunosuppressants.

12. **Hormones and hormone antagonists**
    • Hypothalamic and pituitary hormones
    • Thyroids hormones and antithyroid drugs
    • Sex hormones and their antagonists
    • Adrenocorticosteroids and their antagonists
    • Antidiabetic drug (Insulin and oral Hypoglycemic agents)
    • Drugs affecting Calcium balance

13. **Chemotherapy of microbial diseases**
    a. Antimicrobial agents – General considerations
    b. Antimicrobial agents – *Sulphonamides, Cotrimoxazole
       • Quinolones
       • β-lactam antibiotics
       • Aminoglycosides
       • Tetracyclines, chloramphenicol
       • Macrolide antibiotics
       • Miscellaneous antibiotics
c. Antimycobacterial agents (Anti tubercular & Antileprotic drugs)
d. Antifungal agents
e. Antiviral agents
f. Antimalarial agents
g. Antiamoebic agents
h. Antiprotozoal agents
i. Drugs for helminthiasis

14. **Chemotherapy of Neoplastic diseases**

15. **Miscellaneous topics**
   a. Basic knowledge about ethics of animal experimentation
   b. Preclinical screening for the following:
      - Antihypertensives
      - Analgesics
      - Antiepileptics
      - Antiulcer drugs
      - Antiinflammatory drugs
      - Analgesics, Antipyretics
      - Antidepressants,
      - Antianxiety
      - Antipsychotics,
      - Sedatives-hypnotics,
      - Muscle relaxants,
      - Prokinetic agents/ Antiemetics
      - Antitussives, /Anti-asthma agents
      - Local Anaesthetics
      - Oxytocics, Antifertility agents
      - Antidiabetics
      - Behavioral pharmacology models and evaluation of drugs affecting learning and memory
   c. Toxicity studies in animals
   d. Clinical trials – phase I, II, III & IV
   e. Bioassay: principles and methods.
   f. Principles and application of biostatistics
   g. Essential drug concepts
   h. Drug addiction and drug abuse
   i. Important interactions and their mechanisms

**PRACTICAL SYLLABUS FOR M.Sc. PHARMACOLOGY**

- Chemical test for
  - Alkaloids- Atropine, Physostigmine, Pilocarpine,
  - Acids- Salicylic acid (Aspirin)
  - Glycosides- Digoxin

- Bioassay for(recorded graph discussion):
  - Acetyl choline
  - Histamine
  - Oxytocin
  - 5-HT
• Screening methods for:
  - Antiepileptic agents
  - Anti inflammatory agents
  - Motor co-ordination.

• Estimation of antioxidant activity
  (a) FRAP – Ferric reducing antioxidant power method
  (b) DPPH – 2,2-diphenyl-1-picrylhydrazyl method

**BOOKS RECOMMENDED:**

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<th>Sl.no</th>
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<td>Goodman &amp; Gillman’s The pharmacological basis</td>
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<td>Annual Review of Pharmacology Toxicology</td>
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<td>Selected topics in Experimental Pharmacology</td>
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<td>U.K. Seth N.K. Dadkar Usha G. Kamat</td>
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**JSSAHER EXAMINATION:**

**Theory:**
The written examination consists of three papers, with maximum marks of 100 for each paper. Each paper will be of three hours duration.

**Paper I** : General and clinical pharmacology including Basic research.

**Paper II** : Systemic Pharmacology I

**Paper III** : Systemic Pharmacology II

**Distribution of chapters for with weightage of marks**

**Paper I General and clinical pharmacology including Basic research**

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**Paper II- Systemic Pharmacology I**

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Paper III- Systemic Pharmacology II

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<tbody>
<tr>
<td>Endocrine system</td>
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<td>Antimicrobial agents</td>
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<tr>
<td>Cancer Chemotherapy</td>
<td>20</td>
</tr>
<tr>
<td>Immunotherapy</td>
<td>10</td>
</tr>
</tbody>
</table>

Practicals: 200 marks and Viva-voce and pedagogy 100 marks

A. Practicals-200 marks

<table>
<thead>
<tr>
<th>PRACTICAL EXERCISE- EXPERIMENTAL PHARMACOLOGY :</th>
<th>MARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1). Bioassay</td>
<td>20</td>
</tr>
<tr>
<td>2). Graphs- Interpret the given graph</td>
<td>20</td>
</tr>
<tr>
<td>3). Techniques demonstration and short procedure</td>
<td>20</td>
</tr>
<tr>
<td>4). Demonstration of instrument</td>
<td>20</td>
</tr>
<tr>
<td>5). Chemical testing</td>
<td>20</td>
</tr>
<tr>
<td>6). PK Problems</td>
<td>20</td>
</tr>
<tr>
<td>7). Journal Criticism</td>
<td>20</td>
</tr>
<tr>
<td>8). Drug stations</td>
<td>20</td>
</tr>
<tr>
<td>9). Screening methods</td>
<td>20</td>
</tr>
<tr>
<td>10). Dosage forms of drugs</td>
<td>20</td>
</tr>
</tbody>
</table>

B. Viva-voce and pedagogy 100 marks

1. The Viva-Voce would be on all components of syllabus including discussion on dissertation - 80 marks
2. Pedagogy - 20 marks
Final year MSc Curriculum

MICROBIOLOGY

GOALS
The main goal of this course is to train M.Sc students in the field of medical microbiology. Theoretical and practical training is given in the subspecialties viz bacteriology, virology, parasitology, immunology and mycology. They are introduced to basic research methodology, so that they can conduct fundamental and applied research. They are also trained in teaching methods which may enable them to take up teaching assignment for B.Sc courses.

OBJECTIVES
At the end of the course the students will be able to:
1. Establish a good laboratory medicine practice in hospitals and community in the field of bacteriology, virology, parasitology, immunology and mycology.
2. Undertake teaching assignment of Microbiology for the students of Microbiology
3. Undergo special training in any of the above sub-specialties.
4. Carry out applied and fundamental research in various branches of Microbiology.

OUTCOME
After completing the course, M.Sc postgraduate should:
1. Acquire competency pertaining to the subject of Medical Microbiology
2. Be oriented to principles of research Methodology
3. Acquire skills in laboratory techniques

Theory
I. GENERAL MICROBIOLOGY
1. History and Pioneers in Microbiology
5. Growth and nutrition of bacteria.
7. Sterilization and disinfection.
8. Bacterial toxins.
10. Bacterial genetics and molecular techniques in microbiology
12. Antibacterial substances used in the treatment of infections
13. Phenotypic and Genotypic Drug resistance mechanisms
15. Host parasite relationship.
16. Hospital waste management: Organization for health care waste management (biomedical waste), techniques for treatment and disposal of biomedical waste and regulations on biomedical waste management, 2016
II. IMMUNOLOGY
1. Normal immune system- Structure, function and cells of immune system
2. Innate immunity.
3. Antigens.
4. Immunoglobulins
5. Complement.
6. Antigen-Antibody reactions.
7. Immune response (Cell mediated immunity, Humoral mediated immunity)
8. Hypersensitivity
9. Immunodeficiency
10. Auto-immunity
11. Immune tolerance
12. Immunology of transplantation.
13. Tumour immunity.

III. SYSTEMIC BACTERIOLOGY
1. Isolation, description and identification of bacteria.
2. Staphylococcus and Micrococcus: The anaerobic gram positive cocci.
3. Streptococcus and Lactobacillus
4. Neisseria, Branhamella & Moraxella
5. Corynecbacterium and other coryniform organisms
7. Clostridium: The Anaerobic spore bearing bacilli
8. Enterobacteriaceae
9. Vibrios, Aeromonas, Plesiomonas Campylobacter and spirillum
10. Haemophilus and Bordetella
11. Pasteurella and Francisella
12. Brucella
13. Mycobacteria
14. Actinomycyes, Nocardia, and Actinobacillus
15. Pseudomonas
16. Spirochaetes
17. Chlamydiae
18. Rickettsiae
19. The bacteriodaceae: Bacteriodes, Fusobacterium and leptotrichia
20. Mycoplasmatales: Mycoplasma, Ureaplasma, Acholeplasma
21. Erysipelothrix and listeria
22. Chromobacterium, Flavobacterium, Acinetobacter and Alkaligens
23. Miscellaneous bacteria

IV. VIROLOGY
1. Nature of viruses
2. Classification of viruses
3. Morphology, virus structure
4. Viral replication
5. The genetics of viruses
6. Pathogenicity of viruses
7. Epidemiology of viral infections
8. Vaccines and Anti viral drugs
9. Bacteriophages
10. Pox viruses
11. Herpes viruses
12. Vesicular viruses
13. Toga viridae
14. Flaviviridae
15. Arena viridae
16. Marburg and Ebola viruses
17. Rubella
18. Arbo viruses
19. Influenza viruses
20. Respiratory diseases: Rhinoviruses, Adenoviruses and Corona viruses
21. Paramyxiviridae
22. Enteroviruses: Polio & other enteric viruses
23. Hepatitis viruses
24. Rabies virus
25. Slow viruses, Prions
26. Human immunodeficiency viruses
27. Oncogenic viruses
28. Tetatogenic viruses and Vaccine preventable neoplasia
29. Viruses of gastroenteritis
30. Hanta virus, Zika virus, SARS

V. PARASITOLOGY
1. Protozoan parasites of medical importance:
   Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium,
   Toxoplasma, Sarcocystis, Cryptosporidium, Babesia, Balantidium etc.
2. Helminths: All those medically important heminths belonging to Cestodes,
   Trematode and Nematode.
   Cestode: Diphyllobothrium, Taenia, Echinococcus, Hymenolepis,
   Dipylidium, Multiceps etc
   Trematode: Schistosoma, Fasciola, Gastrodiscoides, Paragonimus, Clonorchis,
   Opisthorchis, etc.,
   Nematodes: Trichuris, Trichinella, Strongyloides, Ancylostoma, Ascaris,
   Enterobius, Filarial worms, Dracunculus, etc.,
   Ectoparasites: common arthropods and other vectors (Lice, Ticks, Mites etc)

VI. MYCOLOGY
1. The morphology and reproduction in fungi and antimycotic agents,
2. Classification of fungi,
3. Contaminant and opportunistic fungi
4. Superficial mycotic infections.
5. Fungi causing subcutaneous mycoses.
6. Fungi causing systemic infections.
7. Antifungal susceptibility testing methods
8. Mycotoxins

VII. BACTERIOLOGY:
1. Preparation and pouring of media – Nutrient agar, Blood agar, Mac Conkey
   agar, Sugars, Kligler iron agar, Robertson’s cooked meat, Lowenstein
   Jensens, Sabouraud’s, Biochemical media
2. Operation and maintenance of Autoclave, Hot air oven, distillation plant,
   filters like Seitz and Membrane sterility tests.
3. Washing and sterilization of glassware.
4. Preparation of reagents – oxidase, kovac, etc.,
5. Disposal of contaminated materials.
7. Quality control of media, reagents etc.,
8. Aseptic practises in lab and safety precautions.
9. Care and maintenance of common laboratory equipments.
10. Preparation of antibiotics discs, performance of Kirby Bauer, Stokes etc.,
    Estimation of minimal inhibitory/bactericidal concentrations by tube/plate
    dilution methods.
11. Tests for Beta lactamases & detection of Drug resistance in Bacteria (ESBL,
    Carbapenemase, AmpC etc.)
12. Collection of specimens for microbiological investigations.
14. Identification of bacteria of medical importance up to species level (except
    Anaerobes which could be up to generic level.
15. Preparation of stains viz, Grams, Alberts, Capsules, Spores, Ziehl-Neelsens etc.,
    and performing for staining.
16. Care and operation of microscopes viz., Light microscope, Dark ground,
    Phase contrast and Fluorescent microscope, (Electron microscope).
17. Handling and uses of laboratory animals
18. Stock culture maintenance and laboratory inventory
19. Sero grouping to Streptococci.
20. Antibiotic susceptibility testing for Mycobacteria.

VIII. IMMUNOLOGY
2. Preparation of antigens.
3. Performance of common serological tests.
4. Immunoelectrophoresis
5. Immunodiffusion and CIEP.
6. ELISA
7. CD4, CD8 counts.
8. CLIA

IX. MYCOLOGY
1. Collection and processing of clinical specimens for fungi.
2. Special techniques like Woods lamp examination, hair baiting techniques,
   slide cultures.
3. Stock culture maintenance.
4. Antifungal susceptibility testing

X. PARASITOLOGY
1. Examination of faeces for ova and cysts: Direct and concentration methods.
2. Egg counting techniques.
3. Examination of peripheral blood, urine, CSF, and other fluids for parasites.
4. Examination and identification of histopathology slides for parasitic infection.
5. Serological test for parasitic diseases.
7. Permanent staining techniques for parasites.
XI VIROLOGY
1. Serological tests for viral infections
2. Laboratory diagnosis for AIDS
3. Laboratory diagnosis of Hepatitis.
4. Prevention and laboratory safety measures.

XII. Molecular Methods
1. PCR
2. Gel electrophoresis and documentation
3. RFLP

PRACTICALS
Duration of examination: 2 days (as per the scheme given below) Marks: 200
1. Exercise in clinical bacteriology.
2. Isolation and identification of bacteria from various clinical samples.
3. Exercise in bacteriological techniques.
4. Isolation and identification of bacteria from a pure culture.
5. Identification of various fungi, and slide culture.
6. Exercise in virology techniques.
7. Exercise in Parasitology.
8. Serology exercise in Bacteriology and Virology
9. Applied bacteriological techniques-Staining or Serology exercise
10. Immunology exercise

METHODS OF TRAINING
Training is given under the following heading:
1. Seminars.
2. Journal clubs.
3. Culture seminars.
4. Symposia.
5. Slide seminars.
6. Serological tests.
7. Dissertation
9. Guest lectures/Conferences/Workshops/CME.

Each candidate is posted to different sections in the department on rotation. They will be acquainted with the basic microbiology for first three months.

RECOMMENDED BOOKS: (LATEST EDITIONS)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Title</th>
<th>Author</th>
<th>Publishers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Medical Microbiology</td>
<td>Samuel Baron</td>
<td>Churchill Livingstone Inc</td>
</tr>
<tr>
<td>2.</td>
<td>Laboratory Diagnosis of Viral Infections</td>
<td>Edmin H Lennette</td>
<td>Newyork Marcel Dekker, Inc</td>
</tr>
<tr>
<td>3.</td>
<td>Manson’s Tropical Diseases</td>
<td>Gordon Cook</td>
<td>London, ELBS</td>
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<tr>
<td>4.</td>
<td>Bergey’s Manual of Determinative Bacteriology</td>
<td>John G Holt et al</td>
<td>Williams &amp; Wilkins</td>
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<td>Author</td>
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<tr>
<td>5</td>
<td>Manual of Clinical Microbiology</td>
<td>Albert Balwows</td>
<td>American Society for Microbiology</td>
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<td>6</td>
<td>Bailey &amp; Scott’s Diagnostic Microbiology</td>
<td>Ellen Jo Baron et al</td>
<td>Missouri, Mosby</td>
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<tr>
<td>7</td>
<td>Clinical Virology</td>
<td>Douglas D.Richman</td>
<td>Churchill Livingstone</td>
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<tr>
<td>8</td>
<td>Burrows Textbook of Microbiology</td>
<td>Bob A Freeman</td>
<td>W.B.Saunders</td>
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<tr>
<td>9</td>
<td>Anaerobes in Human Disease</td>
<td>Brian I Duerden &amp;B.S.Drasar</td>
<td>Edward Arnold</td>
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<td>10</td>
<td>Introduction to Diagnostic Microbiology</td>
<td>Elmer W Koneman el al</td>
<td>Lippincott Company</td>
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<tr>
<td>11</td>
<td>Field’s Virology Vol.1</td>
<td>Bernards N Fields et al</td>
<td>Lippincott-Ramen</td>
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<td>12</td>
<td>Field’s Virology Vol. 2</td>
<td>Bernards N Fields et al</td>
<td>Lippincott-Ramen</td>
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<tr>
<td>13</td>
<td>Medical Microbiology, A guide to Microbial Infections, Pathogenesis, Immunity, Laboratory Diagnosis and control</td>
<td>Danial London, Chruchill, Greenwood et al</td>
<td>Livingstone</td>
</tr>
<tr>
<td>14</td>
<td>Mackie &amp; McCartney Practical Medical Microbiology</td>
<td>J.G.College et al</td>
<td>London, Chruchill Livingstone</td>
</tr>
<tr>
<td>15</td>
<td>Hospital Infections</td>
<td>John V Bennett &amp; Philip S Brachman</td>
<td>Little Brown</td>
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<tr>
<td>16</td>
<td>Manual of Clinical Laboratory Immunology</td>
<td>Noel R Rose et al</td>
<td>Washington D.C, American Society for Microbiology</td>
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<td>17</td>
<td>Fundamental Immunology</td>
<td>William E Paul</td>
<td>Newyork, Raven Press</td>
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</table>
JSSAHER EXAMINATION:

**A. Theory**: The written examination consists of three papers of 100 marks each. Each paper will be of three hours duration.

PAPER I - General microbiology and Immunology.
PAPER II - Systemic Bacteriology and Parasitology.
PAPER III - Mycology and Virology

**Distribution of chapters for with weightage of marks**

<table>
<thead>
<tr>
<th>General microbiology (Topics)</th>
<th>50%</th>
<th>Immunology (Topics)</th>
<th>50%</th>
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<tbody>
<tr>
<td>1. History and pioneers in microbiology.</td>
<td>50%</td>
<td>1. Anatomy of the human immune system.</td>
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<tr>
<td>3. Morphology of bacteria and other microorganisms.</td>
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<td>3. Immunity and types of immunity including vaccination.</td>
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<tr>
<td>5. Growth and nutrition of bacteria.</td>
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<td>5. Immunoglobulins</td>
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<td>6. Bacterial metabolism</td>
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<tr>
<td>7. Sterilisation, disinfection and applied aspects in health care industry</td>
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<tr>
<td>8. Bacterial cultivation, study of different culture media and methods.</td>
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<tr>
<td>11. Bacteriology of hospital environment, air, water and milk.</td>
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<tr>
<td>12. Host parasite relationship</td>
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<tr>
<td>13. Antimicrobial susceptibility, resistance and detection of different resistance mechanisms.</td>
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<tr>
<td>15. Organization of clinical microbiology laboratory and quality control / quality assurance.</td>
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<td>17. Accreditation procedures</td>
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</tbody>
</table>
6. Immune response-theories of antibody formation and mechanisms of CMI.
7. Complement.
8. Antigen-antibody reactions

9. Hypersensitivity.
10. Immunodeficiency.
11. Auto-immunity

12. Immune tolerance.
13. Immunology of transplantation.
14. Tumour immunology

15. Prophylaxis and immunotherapy.
17. Immunogenetics

**PAPER II Systematic Bacteriology & Parasitology**

<table>
<thead>
<tr>
<th>Systematic Bacteriology (Topics)</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>1. Isolation, description and identification of bacteria.</td>
<td>10%</td>
</tr>
<tr>
<td>2. Gram positive cocci: Staphylococcus, micrococcus, streptococcus and anaerobic gram positive cocci.</td>
<td>10%</td>
</tr>
<tr>
<td>3. Neisseria, branhamella &amp; moraxella</td>
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<tr>
<td>4. Corynebacterium and other coryniform organisms</td>
<td>10%</td>
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<tr>
<td>5. Bacillus: the spore bearing bacilli</td>
<td>10%</td>
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<tr>
<td>6. Non sporing anaerobic bacteria - bacteroides, fusobacterium, leptotricha and lactobacillus.</td>
<td>10%</td>
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<tr>
<td>7. Clostridium: The spore bearing anaerobic bacilli.</td>
<td>10%</td>
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<tr>
<td>8. Mycobacteria: M tuberculosis, atypical mycobacteria and M leprae.</td>
<td>10%</td>
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<tr>
<td>9. Enterobacteriaceae.</td>
<td>10%</td>
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<tr>
<td>10. Vibrios, aeromonas, plesiomonas, campylobacter and spirillum.</td>
<td>10%</td>
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<tr>
<td>11. Spirochaetes.</td>
<td>8%</td>
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<tr>
<td>12. Actinomyces, nocardia, and actinobacillus.</td>
<td>8%</td>
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<tr>
<td>13. Chlamydiae.</td>
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<td>14. Rickettsiae</td>
<td>7%</td>
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<tr>
<td>15. Haemophilus and bordetella. Pasteurella and francisella</td>
<td>3%</td>
</tr>
<tr>
<td>16. Brucella</td>
<td>3%</td>
</tr>
<tr>
<td>17. Mycoplasmatales: Mycoplasma, ureaplasma, acholeplasma</td>
<td>3%</td>
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<tr>
<td>18. Erysipelothrix and listeria.</td>
<td>3%</td>
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<tr>
<td>19. Pseudomonas.</td>
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<tr>
<td>20. Chromobacterium, flavobacterium, acinetobacter, alkalisgens and other nonfermenters.</td>
<td>2%</td>
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<tr>
<td>21. Miscellaneous bacteria.</td>
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</table>
### Parasitology (Topics) 50%

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1. General characters of parasites, hosts, sources of parasitic diseases, route of entry etc.
2. Lab diagnostic procedures in parasitology

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3. Protozoan parasites of medical importance: entamoeba, giardia, trichomonas, leishmania, trypanosoma, plasmodium, toxoplasma, sarcocystis, cryptosporidium, babesia, balantidium etc.

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4. Nematodes: Trichuria, trichinella, strongyloides, ancylostoma, ascaris, enterobius, filarial worms, dracunculus, etc.

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5. Cestode: Diphyllobothrium, taenia, echinococcus, hymeonolepis, dipylidium, multiceps, etc.

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6. Trematode: Schistosoma, fasciola, gastrodiscoides, paragonimus, clonorchis, opisthorchis, etc.

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7. Ectoparasites: Common arthropods and other vectors

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### Virology and mycology

#### Virology (Topics) 50%

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1. The nature of viruses.
2. Classification of viruses.
3. Morphology, virus structure.
4. Viral replication.
5. The genetics of viruses.
7. Epidemiology of viral infections.
8. Laboratory diagnosis of viral infections.
9. Vaccines and anti viral drugs.

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11. DNA viruses: Pox viruses, herpes viruses, adeno virus, papova viruses, parvo viruses and hepdna viruses.

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<tbody>
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<td>20</td>
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</table>

12. RNA viruses: Myxo viruses, picorna viruses, rhabdo viruses, toga viruses, flavi viruses, bunya viruses, retro viruses, hepatitis viruses, slow viruses, oncogenic viruses, teratogenic viruses.

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<th>Percentage</th>
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</table>

13. Clinical virology
   a. Viruses affecting CNS.
   b. Viruses affecting the eyes.
   c. Viruses affecting the respiratory tract.
   d. Viruses causing skin lesions and fever.
   e. Viruses causing gastroenteritis.
   f. Viruses transmitted sexually.
   g. Viruses transmitted congenitally.
   h. Viruses causing haemorrhagic fevers.
   i. Vector borne viral diseases.
Mycology (Topics)  50%

1. The morphology and reproduction in fungi and anti-mycotic agents,
   2. Classification of fungi.
   3. Lab diagnosis of fungal infections, antifungal susceptibility testing.

   10

4. Superficial mycotic infections.

5. Fungi causing subcutaneous mycoses

6. Fungi causing systemic infections.

7. Contaminant and opportunistic fungi.

   10

Note - Recent advances and applied aspects in Microbiology can be incorporated in ALL THE PAPERS

Practical EXAMINATION: 200 Marks and Viva voce & pedagogy 100 marks

A. Practical examination: 200 marks

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Practicals</th>
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<tr>
<td>1</td>
<td>Pure Culture</td>
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<tr>
<td>2</td>
<td>Mixed Culture</td>
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<tr>
<td>3</td>
<td>Mycology techniques</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Virology techniques</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Parasitology techniques</td>
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<td>Bact/Viral serology</td>
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<tr>
<td>7</td>
<td>Media Preparation</td>
<td>10</td>
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<tr>
<td>8</td>
<td>Immunology</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>Slides</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>Dissertation Review</td>
<td>20</td>
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</table>

B. VIVA-VOCE Marks: 100
The Viva-Voce examination consists of question on Bacteriology, Mycology, Virology, Immunology, and Parasitology topics, it will also include recent advances, history and scope of Microbiology.

1. Viva-Voce Examination: 80 Marks
2. Pedagogy: 20 marks
Students will be examined by all the examiners together about comprehension, analytical approach, expression and interpretation of data.