HAMDARD INSTITUTE OF MEDICAL SCIENCES & RESEARCH

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M.Sc. (Medical Pharmacology) Syllabus and curriculum

M.Sc. Medical Pharmacology

GOALS

The future prospects for a medical pharmacologist may be in academics, pharmaceutical industry, research institutions and clinical research organizations or in regulatory agencies, as a scientist, advisor, scientific writer or a science manager / administrator. To fulfill these goals, a M.Sc. Medical pharmacology student should be comprehensively trained to meet the requirements of effective role plays in these positions.

OBJECTIVES

At the end of 3 years training in Pharmacology, the postgraduate student should be competent in medical pharmacology through following self-learning sessions;

1. **Post graduate lectures** in systemic pharmacology to update various aspects of basic pharmacology and applied therapeutics
2. **Journal club:** To familiarize research methodologies and application of statistics in experiments and analyze new drug development
3. **Therapeutic club (clinical case discussion)**: To critically analyze the day to day development in new drugs
4. **Seminars:** To update newer developments in pharmacology
5. **Group discussion:**
6. **Drug Information**: Acquire adequate knowledge of general pharmacological principles, drugs acting on systems and organs, rational use of drugs including critical evaluation of drugs for therapeutic potential and their place in therapy of concerned diseases
7. **Teaching and Training**: Plan and conduct lectures, tutorial classes and practical demonstrations for students of medical fraternity and allied disciplines.
8. **Research**: Carry out research and /or evaluate data on drugs and drug product development, conduct experimental studies in animals and trials involving patients and/or human healthy volunteers. Also critically review and comment on research proposals, data, reports and manuscripts
9. **Patient Services**: Monitor adverse drug reactions, drug interactions, therapeutic drug monitoring and able to provide relevant drug information service leading to effective Pharmacovigilance Services Practical exercises: Under the supervision of a faculty, with/without the help of animals, various principles/ mode of drug action/ screening of drugs/ drug analysis using various techniques should be performed to develop practical skills to conduct similar experiments in future.
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11. **Thesis:** Each student will carry out research work under the supervision of a faculty member. Thesis will be submitted to the university and will be analyzed by experts in that field. The acceptance of thesis by the institute will be a prerequisite for the candidate to be allowed to appear in the final examination.

This list is not exhaustive and can be expanded to include all those skills that may be deemed fit to meet the desired expectations from a medical/clinical pharmacologist.

Eligibility: Candidates with the degree in Bachelor of Science with pharmacology as one of the subject with minimum of 55% marks. MBBS and BDS students are eligible for M.Sc. pharmacology with lateral entry in second year.

Duration: Three-year full time (Annual System)

Course overview: The course will be divided into 2 + 4 semester. The first two semesters will include applied aspect of basic Anatomy, Biochemistry and Physiology. The next four semesters will focus on various sections of medical Pharmacology. The students will be involved in theory classes, practical classes, seminars, and journal club etc. at the end of each semester the students will take up the theory, Viva and Practical Exam.

Course Content (syllabus) for First Year:

ANATOMY- 1st Semester

THEORY: Total Theory Hours: 80

A. Introduction: Total lecture hours - 02

1. Significance of anatomy in medical science, subdivisions of the subject, Nomenclature & terminology
2. Skin & subcutaneous tissue

B. General Anatomy: Total lecture hours- 12

1. Introduction, cellular organelles, cell membrane
2. Connective tissue
3. Sclerous tissue with ossification
4. Joints
5. Muscle tissue with Ultrastructures
6. Nerve tissue including introduction to Autonomic nervous system
7. Blood vascular & lymphatic system

C. General Embryology: Total lecture hours- 16

1. Germ cells & their maturation
2. Changes in Reproductive organs at puberty & in pregnancy, Menstrual & Cycle, Contraception
3. Fertilisation, Implantation, Trophoblast, Yolk sac, Gastrulation, Extra-embryonic coelome, Notocord, Neuro-enteric canal, Intra-embryonic mesoderm
4. Decidua, chorion, yolk sac, connecting stalk
5. Placenta, umbilical cord, amniotic cavity & Foetal Circulation
6. 1Derivatives of, ectoderm, endoderm, mesoderm
7. Human genetics

D. General Histology: Total lecture hours- 10

1. Introduction to Histology: Simple epithelium, Cuboidal epithelium, Columnar epithelium, Stratified epithelium
2. Connective tissue: Cells of connective tissue, Loose areolar tissue, Fibrous tissue, Collagen fibres, Reticular fibres etc
3. Cartilages: Hyaline cartilage, Elastic cartilage, White fibro cartilage Bone: Cells of bone, Compact bone, Spongy bone
4. Nervous tissue: Neurons & types, Nerve fibres , Neuroglia: Microglia, Macroglia Muscle: Cardiac Muscle, Skeletal Muscle, Smooth Muscle
5. Vascular system: Large sized artery & vein, Medium sized artery & vein Lymphatic system: Thymus, lymph nodes, spleen
6. Skin & Appendages: Thick skin & thin skin, Hair, Nail, Sweat & sebacious glands
7. Excretory system: Kidney, Ureter, Urinary Bladder. Reproductive system: Males(Testis), Females (Ovary, uterus, fallopian tube)

8. Glandular tissue: Endocrine glands and exocrine glands

E. Head & Neck: total lecture hours- 40

1. Scalp Layers, nerve & blood supply & applied aspects.
2. Temporal & infra temporal region – Muscles of Mastication, Mandibular nerve, Maxillary artery, otic ganglion, Pterygo palatine ganglion, Temparo mandibular joint.
3. Triangles of Neck: Anterior Triangle Boundaries & contents, applied aspects of, Submental triangle, Diagastric triangle, Muscular triangle, Carotid triangle, Posterior Triangle of Neck: Boundaries, contents & applied aspects.
4. Cranial Cavity: Meningis: Dura mater, Arachnoid mater, Pia mater ,Dural venous Sinusus, Cranial Nerves
5. Orbit & its contents: Eyeball, Extra occular muscles, Occulomotor nerve, Abducent nerve, Trochlear nerve, Optic nerve, Lacrimal gland.
6. Deep dissection of Neck: Thyroid gland,Trachea, Oesophagus.
7. Submandibular region: Submandibular gland, Sub lingual gland, Suprahyoid muscles, Extrinsic group muscles of tongue, Submandibular ganglion.
8. Parotid region: Parotid gland, Extra cranial course of facial nerve.
9. Nasal cavity: Medial wall of nose,Lateral wall of nose, Paranasal air sinusus.
10. Larynx: Cartilages, Interior of larynx, Muscles of larynx, Blood and nerve supply, Applied aspects.
11. Pharynx: Naso pharynx, Oropharynx, Laryngo pharynx, Muscles of pharynx, Blood and nerve supply, Applied aspects.
12. Tongue: External features, Extrinsic Muscles, Intrinsic Muscles, Blood & nerve supply, Applied aspects.
13. Ear: External ear, Internal ear, Middle ear- Boundaries, contents, Blood & nerve supply, Applied aspects
14. Eye ball: External features, Different Layers, Blood & nerve supply, Applied aspects
15. Osteology: Norma frontalis, Norma lateralis, Norma basalis, Norma occipitalis, Norma verticalis.

ANATOMY- 2nd Semester

THEORY: Total Theory Hours: 70

F. Thorax: total lecture hours-20

1. Thoracic Wall: Typical intercostal space & its contents.
2. Mediastinum: Superior mediastinum, Middle mediastinum, Inferior mediastinum
3. Pleura: Viceral & parital layers, Pleural cavity
4. Lungs: External features, Nerve & blood supply, Broncho pulmonary segments & its applied aspects

5. Pericardium: Fibrous pericardium, Serous pericardium
6. Heart: External features of Heart in detail, Details of interior of rights atria & right ventricle, Blood supply of heart, Nerve supply & applied aspects
7. Great vessels: Arch of aorta, Pulmonary trunk, Inferior vena cava
8. Oesophagus: Parts, features, blood & nerve supply & applied aspects
9. Trachea: Parts, features, blood & nerve supply & applied aspects
10. Osteology: Typical & atypical thoracic vertebrae, Typical & atypical, Ribs Sternum

G. Abdomen & Pelvis: total lecture hours -30

1. Anterior abdominal wall: Muscles of Anterior abdominal wall, Rectus sheath boundaries, contents, formation & applied aspects.
2. External Genetalia: Males—Penis parts & features, blood & nerve supply,Females—Vagina, Clitorius.
3. Abdominal Cavity: Peritoneal cavity in general, Peritoneal folds, Ligaments, Omentum, Pouch of douglus, Hepatorenal pouch, Paracolic, gutters, Supra & infra colic compartments & applied aspects.
4. Abdominal Viscera: Stomach, Spleen, Live, Kidney & Ureter, Small intestine - Duodenum, Jejunum, Ileum, Large intestine—General Features, Appendix & ceacum , Blood supply of Gut, Applied aspects
5. Diaphragm: Attachments, Minor & major openings, Nerve & blood supply & applied aspects
6. Perineum: Superfecial perineal pouch, Deep perineal pouch, Male perineum, female perineum, Ischiorectal fossa & its boundaries, contents & applied aspects.
7. Vessels & nerves: Abdominal aorta & its branches, Common iliac artery & its branches in detail, Lumbar plexus.
8. Urinary system: Kidney, Ureter, Urinary bladder, Urethra.
9. Pelvis: Pelvic diaphragm, Uterus-- parts, features, position, supports, blood & nerve supply, Rectum in detail, Anal canal in detail with applied aspects.
10. Osteology: Typical & atypical lumbar vertebrae, Sacrum Male & Female pelvis.

H. Neuro anatomy: total lecture: 20

1. Surfaces,Borders,sulci and gyri of cerebrum
2. White matters of Cerebrum, Lateral, Third, Fourth ventricles of brain.
3. Circulation of Cerebro spinal fluid, Blood brain barrier.
4. Basal nuclei and its components.
5. Brain stem, Cerebellum.
6. Cranial nerves.
7. Vertebral canal & its contents.
8. Coverings and blood supply of brain and spinal cord.
9. Thalamus, Hypothalamus, Limbic system and Pineal gland

ANATOMY PRCTICALS:

2x2 Hours of dissection/demonstration classes per week(40 weeks/year)

Gross Anatomy

1. Thorax : Dissection: Chest wall, mediastinum, pleura, lungs, heart.
2. Abdomen: Dissection: Anterior abdominal wall and inguinal region, external genitalia. Viscera and Posterior Abdominal wall and nerve plexus.
3. Pelvis: Dissection : Pelvic viscera, blood vessels and nerves. Prosected Parts: Perineum including ischio-rectal fossa.
4. Head & Neck: Dissection: Superficial and deep dissection of face and neck, orbit and eye ball. Submandibular region temporal and infratemporal fossa, cranial cavity, naso and oropharyngeal regions. Ear,. Larynx and pharynx.

Neuro Anatomy

Gross specimen of full brain, meninges, spinal cord,prosected specimens to demonstrate visual system, auditory and vesibular pathways and major functional areas. Stained sections of brain and spinal cord at various levels to demonstrate cranial nerve nuclei, ascending and descending tracts, thalamic nuclei and important functional areas.

Demonstrations

1. Bones of skull and vertebral column
2. Brain and spinal cord
3. Cross-sectional anatomy

Microscopic Anatomy

1. Routine and special stained slides of all the tissues and organs of body.
2. Electronmicrographs to demonstrate filtration barrier of kidney, alveolar septum, tight junctions of capillaries and such relevant areas.

Developmental Anatomy

1. Models to demonstrate various stages of early foetus and different organ development.
2. Slides of ovary and testis to show follicles and stages of maturation of spermatozoa: early chick and pig embryos to understand the development of tissues and organs from conception till term.

Genetics

1. Demonstration of normal karyotype and common abnormal conditions including banding; Pedigree chart, syndromes and their clinical phenotype.
2. Demonstration of various new techniques such as FISH.

ANATOMY TUTORIALS: 2hours per week (40 weeks per year)

ANATOMY SEMINARS: 1 Hour per week

RECOMMEDED BOOKS:

1. Cunningham's Manual of Practical Anatomy By G.J. Romanes Vols. I,II & III Oxford University Press 15th Edition 1996

2. Clinical Anatomy for Medical Student By R.S. Snell 7th Edition 2003 Lippincott ,Williams & Wilkins
3. Grants Atlas of Anatomy By A. Agur, M. Lec 11th Edition 2004
4. Langman's- Medical Embryology T. Sadler with Simbryo Version 1CD-ROM Lippincott, Williams and Wilkins 9th Edition 2003
5. Gray's Anatomy By Susan Standring 39th Edition Churchill Livingstone
6. Essential Medical Genetics J.M. Connor 5th Edition 1997 M.A. Frguson Smith Blackwell Scientific Publication
7. Textbook Anatomy by Inderbir Singh.
8. Textbook Anatomy by B D Chaurasia 1, 2 & 3
9. Textbook of Histology by Inderbir Singh.
10. Functional Neuroanatomy ,Jefferey T Joseph David L Cordoz , Weley - LISS

PHYSIOLOGY-1ST SEMESTER

THEORY : Total Theory Hours: 84

A. General physiology: total lecture hours - 04 hrs.

1. Molecular structure of cell membrane and its functions. Types of transport across cell membrane.
2. Intercellular connections.
3. Resting membrane potential and Action potential.
4. Homoeostasis.

B. Blood and body fluids: total lecture hours - 18 hrs

1. Introduction – Fluid compartments. Composition of body fluids. Composition and functions of blood.
2. Plasma Proteins- Types, Normal Values, Functions.
3. Red blood cells- Morphology, functions. Normal values ,variations and life span.
4. Erythropoiesis- Stages, factors and regulation.
5. RBC indices PCV and ESR.- Normal values. Clinical significance.
6. Haemoglobin – Functions, concentration physiological variation, fate of Hb, Jaundice.
7. Anaemias- Defination types and features.
8. Leucocytes –Morphology of different types of leucocytes, functions, variations. Basic mechanism of immunity.
9. Platelets –Morphology, functions, normal values, variations.
10. Hemostasis and blood coagulation – definition, clotting factors, mechanism of clotting, anticoagulants
11. disorders & tests of bleeding and clotting.
12. Blood groups – ABO system and Rh factor, blood typing, significance.
13. Blood transfusion – indications, types, reactions. Lymph- origin, composition, circulation & functions of lymph.

C. Nerve muscle physiology: total lecture hours- 12 Hrs

1. Types of neurons & neuroglia.
2. Classification of nerve fibers.
3. Types of nerve injuries, wallerian degeneration, retrograde degeneration, chromatolysis. Regeneration of
4. nerve fiber, factors affecting regeneration.
5. Properties of nerve fiber, RMP monophasic action potential & its ionic basis
6. Mechanism of conduction of impulses in myelinated and non-myelinated nerve fibre.
7. Muscles- Types, structure of skeletal & smooth muscles, sarcomere, strength duration curve.
8. Excitation contraction coupling
9. Properties of skeletal muscle, isometric and isotonic contraction,
10. NMJ Structure (electron microscopic) & Transmission of impulse across the NMJ.

D. Respiration: total lecture hours-14 Hrs

1. Introduction - Functional anatomy of respiratory tract.
2. Mechanism of ventilation - Pressure & volume changes, compliance. Airway resistance
3. Surfactant – Source, chemical nature, functions, lung volumes and capacities, definition, determination, normal values, significance.
4. Dead space & Alveolar ventilation – Significance. Ventilation, perfusion ratio & its significance.
5. Pulmonary gas exchange – Structure of respiratory membrane. Diffusion of gases. Diffusion capacity. Factors affecting diffusion of gas.
6. Oxygen Transport – O2 Hb dissociation curve & factors affecting it.
7. CO2 transport – CO2 dissociation curve. Chloride Shift. Haldane effect.
8. Regulation of respiration – Organization of respiratory centres. Neural regulation & Chemical regulation.
9. Hypoxia : Types and effects. Acclimatization to high altitude. Voluntary hyperventilation. Periodic breathing. Dyspnoea, Asphyxia. Cyanosis. Decompression sickness. Artificial respiration. Pulmonary function tests. Respiratory adjustments during muscular exercise.

E. Cardiovascular system: total lecture hours- 22 Hrs

1. Functional anatomy of heart and blood vessels.
2. Properties of cardiac muscle.
3. Origin and spread of cardiac impulse, heart block, cardiac arrhythmias.
4. Cardiac cycle: Mechanical events, Pressure changes in atria, ventricles, aorta, pulmonary artery and jugular vein. End diastolic volume, End systolic volume, Ejection fraction.
5. Heart sounds: normal character, physiological basis of splitting, murmur.
6. Cardiac output: Definition, Determination, Factors regulating, Venous return.
7. ECG: leads, principles of normal recording, normal waves, & their interpretations, electrical axis of the heart including left and right axis deviation, clinical uses of ECG
8. Arterial pulse: normal & abnormal.
9. Physical principles governing flow of blood in heart & blood vessels, laminar flow, turbulent flow, Reynolds number, peripheral resistance, Poiseuille-Hagen formulae.
10. Arterial pressure: total pressure, lateral pressure, Bernoulli's principle, Importance of different pressure measurement, Factors controlling B.P, Effects of gravity, Posture and Exercise on B.P, Hypertension & hypotension

11. Regulation of CVS: local regulation including auto regulation of blood flow, vasoconstrictors, vasodilators, substances secreted by endothelium ,systemic regulation-humeral & neutral, innervations of heart and blood vessels, cardiovascular centres, cardiovascular reflexes, regulation of B.P & heart rate.
12. Regional circulation: coronary circulation, cutaneous circulation, pulmonary, cerebral, renal circulation will be taught in respective systems.
13. Cardio-vascular adjustments in health & disease: effects of exercise, haemorrhage & shock.

F. Gastrointestinal System: total lecture hours- 14 hrs.

1. Characteristics of G.I wall, Neural control of G.I function, G.I. hormones
2. Saliva: Composition, Functions, control of secretion.
3. Gastric juice: Composition, mechanism of secretion, functions, regulation of secretion, mucosal barrier, peptic ulcer, gastrectomy, Dumping Syndrome,
4. Pancreatic juice: Composition, function, and regulation-applied importance.
5. Liver and gall bladder: Compositions and functions of bile control of secretion, functions of gall bladder, gall stones, enterohepatic circulation, jaundice, functions of Liver and L.F.T.
6. Small intestine: Composition, regulation of secretion, and functions of intestinal juice. Large intestine: Functions
7. Gastro intestinal movements – Deglutition, Movements of small & large intestine, defecation & vomiting.
8. Gastro-intestinal hormones and their actions.
9. Digestion of carbohydrates, proteins and fats.
10. Absorption of carbohydrates, proteins, fats, vitamins, water and electrolytes.

PHYSIOLOGY-2ND SEMESTER

THEORY : Total Theory Hours: 76

G. Endocrines: total lecture hours- 17 Hrs

1. Introduction to Endocrinology. Classification, general properties and mechanism of action of hormones.
2. Pituitary gland: Anterior pituitary hormones, their actions, control and disorders . Actions, control and disorders of posterior pituitary hormones.
3. Thyroid gland: Synthesis, actions of iodine containing thyroid hormones, Control of secretion, thyroid function tests and disorders
4. Calcium : Functions. Control – parathormone, calcitonin and 1-25 (OH)2 D3 disorders
5. Endocrine pancreas – Insulin and glucagon - a) source b) actions c) regulation d) clinical disorders

6. Adrenal gland: a) Adrenal cortex – Nomenclature, actions, control, disorders. b) Adrenal medullay hormones - synthesis, actions and control.

H. Reproductive system: total lecture hours-10 hrs.

1. Sex differentiation and development of Reproductive system
2. Aberrant sexual differentiation, chromosomal abnormalities, developmental abnormalities
3. Puberty, precocious and delayed puberty, menopause.
4. Male reproductive system: Spermatogenesis, endocrine functions of testis, abnormalities of testicular function, cryptorchidism, male hypogonadism, and sterility.
5. Female reproductive system: ovary, oogenesis, ovulation, corpus luteum, ovarian hormones- estrogens, progesterone, relaxin, control of ovarian functions by hypothalamic and pituitary hormones.
6. Menstrual cycle: ovarian cycle, uterine cycle, hormonal basis, abnormalities of menstruation, infertility
7. Pregnancy: Fertilization, implantation, placental hormones, pregnancy tests, parturition.
8. Lactation, Contraception.

E. Excretory System: total lecture hours-12 hrs.

1. Functional anatomy of kidney, nephron-structure, parts, function, types.
2. Juxtaglomerular apparatus: autoregulation, peculiarities, measurements.
3. Renal circulation: Auto regulation, peculiarities, and measurement
4. Glomerular filtration: filtration barrier, forces governing filtration, measurement.
5. Tubular functions: re-absorption, secretion, Tm values
6. Regulation of ECF-volume, osmolality and electrolytes
7. Micturition
8. Renal function tests, renal clearance, abnormal constituents of urine
9. Excretory functions of skin.

J. Nervous system: total lecture hours-25 hrs.

1. Organization of nervous system, functional anatomy of brain and spinal cord, neuron, neuroglia
2. Cerebral circulation, CSF, blood-brain barrier.
3. Synapse- types, properties, synaptic transmission, neurotransmitters.Sensory receptors: classification, generator potential, properties,
4. Reflex action: definition, reflex arc, stretch reflex, inverse stretch reflex, withdrawal reflex.
5. Sensory system: touch, pain, temperature, vibration, proprioception, ascending tracts, sensory cortex
6. Pain: types, visceral pain, pain inhibiting mechanism, gating of pain, opioids, analgesia, hyperalgesia, thalamic syndrome
7. Motor system: motor cortex, descending tracts-pyramidal & extra pyramidal tracts, upper motor neurone lesion, lower motor neurone lesion, hemiplegia, paraplegia, monoplegia.
8. Injuries of spinal cord: complete transaction, hemi section,Tabes dorsalis, syringomyelia, section of anterior root & posterior root.
9. Cerebellum: structure, parts, connections, functions, features of cerebellar lesion.
10. Basal ganglia: components, connections, functions, applied.
11. Muscle tone, posture, equilibrium, regulation of muscle tone & posture, vestibular apparatus.

12. Autonomic nervous system: organizations and functions.
13. Hypothalamus: structure & functions, temperature regulation.
14. Physiology of thalamus, reticular formation, RAS.
15. EEG, sleep and wakefulness.
16. Physiology of limbic system.
17. Higher functions of the brain: learning & memory, speech.

K. Special senses: total lecture hours-12 Hrs

1. Smell: Receptors and olfactory pathway.
2. Taste: Structure of taste bud. Basic taste modalities Taste pathway.
3. Ear- Structure of the ear (external, middal and internal).Components and functions of middle ear, Structure of organ of corti, Physiology of hearing, auditory pathway, theories of hearing, deafness types & tuning fork tests, functions of vestibular apparatus.
4. 4. Eye- Physiological Anatomy of eye ball. Visual pathway, effects of lesion at different levels in visual pathway, light reflexes and accommodation reflexes, Common errors of refraction, dark and light adaptation, photo chemical changes, colour vision, color blindness.

PHYSIOLOGY PRCTICALS:

2x2 Hours of Physiology practical classes per week(40 weeks/year)

1) **Haematology:**

1. Compound microscope.
2. Preparation of blood film
3. Staining with Leishman's stain
4. Identification of blood cell
5. Differential count of WBC
6. Total count of WBC.
7. Total count of RBC.
8. Haemoglobin estimation.
9. Total count of platelets.
10. Blood grouping.
11. Bleeding time and clotting time.
12. Haemin crystal
13. Demonstration of: PCV, ESR, Osmotic fragility, Prothrombin time

2) Human Physiology Practicals:

1. Clinical examination of respiratory system: vocal fremitus, vocal resonance, breath sounds.
2. Clinical examination of CVS: Arterial pulse, apex beat, heart sounds, recording of blood pressure and effects of posture and exercise on Blood Pressure.
3. Clinical examination of nervous system:
4. 1) Examination of cranial nerves. 2) Examination of sensory system.
5. 3) Examination of motor system-examination of superficial and deep reflexes, examination of muscle tone and power.
6. Spirometry- Measurement of lung volumes and capacities.
7. Stethography- Effect of breath holding and deglutition on respiration.
8. Measurement of BMR.

9. Demonstration of ECG, EEG, EMG, Ophthalmoscope, bicycle ergometer and arterial blood gas analysis

PHYSIOLOGY TUTORIALS: 2hours per week (40 weeks per year)

PHYSIOLOGY SEMINARS: 1 Hour per week

RECOMMEDED BOOKS:

a) GUYTON (Arthur C), Text of Medical Physiology 11th Edition, 2008, Prism Publishers, Bangalore.
b) GANONG (William F), Review of Medical Physiology, 23rd Edition, Lange.
c) VANDER ct al. Human Physiology, 8thEdition, Mechanism of body function, Mc Graw Hill Publishers.
d) CHAUDHURI (Sujith K), 5th Edition Concise Medical Physiology New Central Books, Calcutta.
e) TORTORA (Gerald J), Principles of anatomy and physiology 11th Edition John Waley & Sons, Ref. college publication.
f) GABRIEL EZIELO – Text book of Physiology, 2002., Oxford University Press
g) A.K. Jain – Textbook of Medical Physiology, 4th Edition 2008.
h) BIJLANI (RL), Understanding medical physiology; text book for medical students, Jaypee Brothers, New Delhi

BIOCHEMISTRY-1ST SEMESTER

THEORY : Total Theory Hours: 66

A. Introduction **1 hour**

Importance, scope of medical biochemistry in prevention, diagnosis,therapeutics of diseases

B. Cell Biology **3 hours**

1. Cell membrane – structure and composition
2. Functions of cellular structures
3. Transport across the cell membrane: Facilitated diffusion, Passive transport, Active transport, Receptor mediation, Endocytosis and exocytosis

C. Chemistry of Carbohydrates **4 hours**

1. Definition, classification and their biological importance
2. Monosaccharides – structure, classification and properties (along with important derivates of monosaccharides and reactions of carbohydrates)
3. Isomerism and stereoisomerism
4. Disaccharides & oligosaccharides-structure, properties & importance

5. Polysaccharides – homo and heteropolysaccharides – structure, distribution and functions , Dietary fibres

D. Metabolism of carbohydrates 10 hours

1. Glucose transporters, Glycolysis
2. Oxidation of pyruvate, TCA cycle
3. Gluconeogenesis, Cori's cycle
4. Metabolism of glycogen (glycogenesis, glycogenolysis, storage disorders)
5. HMP shunt pathway
6. Metabolism of fructose, galactose, uronic acid pathway, associated inborn errors
7. Blood glucose regulation
8. Diabetes Mellitus – etiology, metabolism in Diabetes Mellitus, biochemical basis of acute and chronic complications, laboratory diagnosis and monitoring (Glycated Hb, Fructosamine)
9. Glucose tolerance test and glucose challenge test

E. Chemistry of amino acids, peptides and proteins 6 hours

1. Amino acids – Structure, types, various classifications and properties
2. Peptides – structure and functions of biologically important peptides
3. Proteins – definition, classifications, functions, properties (physical and chemical), structural organization, structure- function relationship with reference to hemoglobin.
4. Separation techniques – electrophoresis and chromatography

F. Metabolism of amino acids and proteins 10 hours

1. Dynamic state of body proteins, protein turnover, nitrogen balance
2. Cellular reactions of amino acids
3. Formation, transport and disposal of ammonia (urea cycle)
4. 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.
5. Specialized products obtained from amino acid metabolism and their importance (Polyamines, creatine, nitric oxide)

G. Chemistry of lipids 4 hours

1. Definition, classification, properties and biological importance
2. Simple lipids:Structure, distribution and functions
3. Compound lipids :phospholipids, sphingolipids, glycolipids –composition, distribution and functions
4. Derived lipids: fatty acids, steroids, eicosanoids (chemistry, distribution, classification and functions)

H. Metabolism of lipids 10 hours

1. oxidation of fatty acids – alpha, beta, omega – beta oxidation of odd chain and even chain fatty acids along with disorders

2. Formation and utilization of ketone bodies and ketosis
3. De novo synthesis of fatty acids, elongation and desaturation
4. Phospholipids (lecithin and cephalin only) and triglycerides – formation and breakdown
5. Lipid storage disorders
6. Synthesis of cholesterol (only crucial intermediates), Fate of cholesterol and other compounds derived from cholesterol
7. Lipoproteins – classification, metabolism, functions and disorders
8. Eicosanoids

I. Chemistry of nucleic acids 4 hours

1. Purines and pyrimidines – structure, structural analogues and their clinical applications
2. Nucleoside, nucleotide and other biologically important nucleotides
3. Nucleic acids – definition, types
4. DNA – structure, types of DNA and functions
5. RNA – structure, types and functions

J. Metabolism of nucleic acids 3 hours

1. Biosynthesis and breakdown of purine and pyrimidine nucleotides
2. Salvage pathways and disorders

K. Digestion and absorption 3 hours

1. Carbohydrate, Lipids, Proteins, Malabsorption syndromes and other related disorders

L. Enzymology 8 hours

1. Definition, classification, properties
2. Coenzymes and cofactors (apoenzyme, holoenzyme, cofactors and activators)
3. Mechanism of enzyme action
4. Enzyme inhibition: reversible and irreversible, competitive, other types and their clinical application
5. Enzyme regulation – modes, mechanism and importance
6. Isoenzymes – definition, chemistry, separation and clinical importance
7. Diagnostic and therapeutic importance of enzymes including enzyme immuno Assay.
8. Proenzymes, multienzyme complex and metalloenzymes
9. RIA and ELISA

BIOCHEMISTRY-2ST SEMESTER

THEORY : Total Theory Hours: 54

M. Vitamins 10 hours

1. Definition and classification

2. Chemistry, sources, absorption and transport, biochemical role, RDA, and deficiency, antivitamins and hypervitaminosis of fat and water soluble vitamins
3. A brief account of role of antioxidants and free radicals.

N. Minerals 4 hours

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.

O. Acid base balance 3 hours

1. Basic concepts of acids, bases, buffers, pH, H ion concentration, derivation of Henderson – Hasselbach equation with its applications
2. pH of blood and its regulation, Anion gap and its importance
3. Acidosis, alkalosis, assessment of acid-base status

P. Water and electrolyte balance 2 hours

1. Body water compartments, , osmolality, electrolytes concentration in body fluid compartments, water balance,regulation of water balance
2. Electrolyte balance, regulation and its disorders

Q. Bioenergitics and Biological Oxidation 4 hours

1. Redox potential, concept of bioenergetics in relation to thermodynamics, High energy compounds
2. Shuttle mechanisms
3. Components and organization of respiratory chain in mitochondria
4. Oxidative phosphorylation, Formation of ATP and its regulation
5. Inhibitors and uncouplers (Brown adipose tissue and thermogenesis)

R. Intermediary metabolism 2 hours

1. Integration of carbohydrate, protein and lipid metabolism
2. Regulation by hormones in starvation, well fed state and diabetes mellitus

S. Hemoglobin metabolism 3 hours

1. Biosynthesis of heme, regulation and porphyrias
2. Degradation of hemoglobin
3. Biochemical basis of jaundice and distinguishing features of different types of jaundice
4. Hemoglobin variants and Hb derivatives
5. Abnormal hemoglobins, hemoglobinopathies and thalassemia

T. Genetics and Molecular biology 10 hours

1. DNA replication, Transcription, post transcriptional modifications, reverse transcriptase
2. Genetic code, translation, post translational modifications
3. Regulation of gene expression, mutation, Polymerase Chain Reaction, recombinant DNA technology, gene therapy, blotting techniques, Restriction Fragment Length Polymorphism, DNA fingerprinting

U. Nutrition 5 hours

1. Nutrients, Calorific value of food, BMR, SDA, respiratory quotient and its applications
2. Balanced diet based on age, sex and activity, biological value of proteins, nitrogen balance
3. Protein energy malnutrition – kwashiorkor and marasmus
4. Biochemistry of starvation and obesity
5. Dietetics, Total parenteral nutrition

V. Function tests **4 hours**

1. Liver function tests , Renal function tests ,Thyroid function tests

W. Endocrinology **3 hours**

Classification of hormones, mechanism of hormone action, Mechanism of action of insulin, glucagon, epinephrine and steroid hormones

X. Plasma proteins **2 hours**

1. Classification, site of synthesis, functions, electrophoretogram in health and disease
2. Acute phase proteins
3. Immunoglobulins – structure, types, functions and associated disorders

Y. Biochemistry of cancer **2 hours**

Carcinogens, Oncogenes ,Growth factors, Tumor markers

Z. Small Topics **6 hours**

1. Metabolsim of Xenobiotics
2. Radioisotopes and their application in medicine
3. Myocardial Infarction :Causes, Cardiac marker, Lipid profile
4. Free radical and antioxidants
5. Quality control
6. Biomedical waste management

BIOCHEMISTRY PRCTICALS:

2x2 Hours of Physiology practical classes per week (40 weeks/year)

1. Tests for monosaccharides.
2. Tests for disaccharides.
3. Colour reactions of proteins.
4. Precipitation reactions of proteins.
5. Spectroscopic examination of Hb -derivatives (Oxy Hb; deoxy Hb; meth-Hb).
6. Estimation of blood sugar.
7. Estimation of blood urea.
8. Estimation of i) Serum creatinine, ii) Creatinine in urine..
9. Determination of serum total protein ,albumin and A/G ratio.
10. Estimation of total serum bilirubin.
11. Estimation of serum cholesterol.
12. Estimation of serum calcium.
13. Estimation of serum phosphorus (Inorganic)
14. Estimation of S.G.P.T(ALT).
15. Estimation of S.G.O.T (AST).
16. Estimation of serum alkaline phosphatase.

17.Estimation of serum amylase.
18.Urine ; Physical characteristics and normal constituents (organic)
19.Urine report; Physical characteristics and Abnormal constituents.
20.C.S.F.- Sugar & Protein.
21.Serum uric acid.

Demonstrations and hand on training :

1. pH- measurement,
2. Colorimetry.
3. Electrophoresis.
4. Chromatography.
5. Flame photometry
6. RFLP
7. SDS-PAGE

BIOCHEMISTRY TUTORIALS: 2hours per week (40 weeks per year)
BIOCHEMISTRY SEMINARS: 1 Hour per week

RECOMMEDED BOOKS:

1. HARPERS Illustrated Biochemistry, MURRAY (Robert.K.M),. Published by Lange Medicals
2. D.M.VASUDEVAN and SREEKUMARI.S Textbook of Biochemistry for Medical students, published by Jaypee Medical Publishers, New Delhi
3. U. SATYANARAYAN Textbook of Biochemistry published by Books and Allied (P) ltd.
4. DEBAJYOTI DAS Biochemistry. Published by Academic publishers.
5. LEHNINGER'S. Principles of Biochemistry. WH Freeman and Company, New York .
6. STRYER (Lubert), Biochemistry Published by Freeman & Co.
7. DEVLIN (Thomas M). Biochemistry with Clinical Correlations. Published by Wiley-Liss, New York.

1st YEAR ANNUAL EXAMINATION:

To be conducted by 2nd week of June every year

M.Sc. MEDICAL PHARMACOLOGY 1st YEAR			
S. No	PAPER TITLE	PAPER CODE	MARKS (EA+IA)
1.	Anatomy Theory	MMPHT101	75+25
2.	Anatomy Practical	MMPHP101	75+25
3.	Physiology Theory	MMPHT102	75+25
4.	Physiology Practical	MMPHP102	75+25
5.	Biochemistry Theory	MMPHT103	75+25
6.	Biochemistry Practical	MMPHP103	75+25
		TOTAL Marks	(600)

Course Content (syllabus) for Second Year

Teaching/Learning Method

The following self-learning sessions for M.Sc. Pharmacology students;
Lectures in systemic pharmacology to update various aspects basic pharmacology and applied therapeutics
Therapeutic club: once a week, to critically analyze the day to day development in new drugs
Journal club: once a week, to familiarize research methodologies and application of statistics in experiments
Seminars: once a week to update newer developments in pharmacology/emerging trends/ novel mechanisms of drug action etc.
Group discussions: once in a week.
Case presentations: once in a month.
Guest lectures: at regular interval by field experts.
Practical exercises: Once in a week, under the supervision of a faculty, with/without the help of animals (CAL lab), various principles/ mode of drug action/ screening of drugs/ drug analysis using various techniques should be performed to develop practical skills to conduct similar experiments in future.
Thesis: Each M.Sc. student will carry out research work under the supervision of a faculty member of the Pharmacology Department. The thesis will be submitted at specified time and will be analyzed by suitable experts in that field. The acceptance of the thesis by the institute will be a prerequisite for the candidate to be allowed to appear in the written/practical examination.

General principles of pharmacology

Course Contents

1. Drug nomenclature
2. Various sources of drug
3. Drug absorption, distribution, metabolism & excretion.
4. Mechanism of drug action
5. Pharmacovigilance & ADR reporting systems
6. Drug interactions
7. Various routes of drug administration
8. Drug formulations and drug delivery systems
9. Principles of prescription writing
10. Drug dose calculation.
11. Evidence based medicine

SYSTEMIC PHARMACOLOGY

Course Contents

1. Autonomic nervous system
2. Central nervous system
3. Autacoids
4. Drugs affecting kidney function and Cardiovascular system
5. Drugs affecting gastrointestinal and respiratory system
6. Drugs affecting uterine motility
7. Drugs acting on blood and blood forming organs
8. Hormones
9. Miscellaneous
10. Vitamins (water soluble and fat soluble vitamins).
11. Heavy metals and heavy metal antagonists.
12. Ocular and dermato-pharmacology.
13. Gene therapy. Therapeutic gases.
14. Free radical biology and antioxidants,
15. Pharmacology of bisphosphonates, melatonin-therapeutic potential.
16. Pharmacotherapy of migraine,
17. Drug therapy in Alzheimer's disease and male sexual dysfunction.
18. Hormone replacement therapy.
19. Ocular Pharmacology
20. Drugs affecting skin and mucus membrane.
21. Drugs uses in extremes of age, pregnancy and in organ dysfunction.

Chemotherapy and Therapeutic

1. Chemotherapy of microbial diseases
2. Chemotherapy of parasite infections
3. Treatment of tuberculosis, MDR and XDR Tuberculosis
4. Treatment of UTI/ STD and viral diseases including HIV
5. Antineoplastic agents
6. Immunomodulators
7. Management of organ transplant rejection

PHARMACOLOGY PRACTICAL-I

Course Contents

1. Effect of anti-inflammatory agents on caraagennian induced rat paw edema. Evaluation of analgesic activity of morphine using tail flick latency test. Demonstration of Dale's vasomotor reversal and nicotinic effect of acetylcholine on dog blood pressure.(through CAL-lab). Effect oautonomic drugs on rabbit intestine. Effect of sedatives & skeletal muscle relaxants on rodents (rotarod test).
2. Prescription writing for common diseases in the proper format.
3. Audit a given prescription.
4. Criticize & evaluate pharmaceutical company's literature.
5. Recognize signs and symptoms of common drug over dosage and poisons and how to treat them.
6. Calculate the cost- effectiveness of various drug regimens for common illness.
7. Interpret graphs & charts of Experimental and Clinical Pharmacology.
8. Perform causality assessment and report ADR as per Pharmacovigilance Programme of India (PvPI)

FUNDAMENTALS OF COMPUTER LAB

Course Contents

Unit – I: Basic computer organization functionality computer codes computer classification Boolean algebra, primary storage, secondary storage devices, input-output devices, computer software, computer languages, operating system, business data processing concepts, data communication and networks and advances

Unit – II: Planning the computer program, algorithm, flowcharts, and decision tables.

Unit – III: Writing simple programs in 'C', Numeric constants and variables. Arithmetic Expressions, Input & Output in 'C' Programs, conditional statements, implementing loops in programs, arrays, logical expressions, and control statements such as switch, break and continue functions, processing character strings, files in 'C'.

Unit – IV: MS Office (Word, Excel, PowerPoint), Basic Database concept and classification, operations performed on database, using MS-Access. Internet Features.

Unit – V: Computer applications in Pharmacology and clinical studies. Computer assisted learning (CAL) softwares and ability to use them efficiently to promote learning of pharmacology

Recommended Books

1. Sinha, R.K., *Computer Fundamentals*, BPB Publications.
2. Raja Raman, V, *Computer Programming in 'C'*, PHI Publication.
3. Hunt N & Shelley J., *Computers and Common Sense*, PHI Publication.

* Latest editions of all the suggested books are recommended.

2nd YEAR ANNUAL EXAMINATION:

To be conducted by 2nd week of June every year

M.Sc. MEDICAL PHARMACOLOGY 2nd YEAR			
S. No	PAPER TITLE	PAPER CODE	MARKS (EA+IA)
1.	General Pharmacological Principles and applied sciences	MMPH201	75+25
2.	Systemic pharmacology-1 (ANS, CNS, CVS & Renal system)	MMPH202	75+25
3.	Systemic pharmacology-2 (Endocrine, GIT, Autacoids & Respiratory system)	MMPH203	75+25
4.	Chemotherapy and Therapeutics	MMPH204	75+25
5.	Pharmacology Practical	MMPH205	75+25
		TOTAL MARKS	(500)

Course Content (syllabus) for Third Year:

Experimental pharmacology, Bioassay and Biostatistics

Course Contents

Experimental methodologies involved in the discovery of drugs (in vivo, in vitro, ex vivo). Animal handling and animal care. Methods of anaesthetising animals and methods of euthanasia. Restraining and blood collecting methods. Drug screening methods involved in the evaluation of anti-ulcer, antidepressant, antianginal, antihypertensive, antiarrhythmic, antidiabetic, anticataract, anti-platelet, anticancer, antiinflammatory, antidiarrhoeal, antiepileptic, analgesic, antithyroid, antip yretic, antiglaucoma, antihyperlipidemic antiasthmatics drugs and cough suppressants. Drug screening methods used in screening antifungal, anthelminthic, antibacterial, antiviral agents, drugs for heart failure, posterior pitutary, adrenal steroid (gluco & mineralo corticoids), testicular, parathyroid, ovarian, thyroid hormones, Methods involved in testing teratogenicity, carcinogenicity and organ toxicities in animals.

INSTRUMENTATION IN DRUG ANALYSIS

Qualitative testing, titrimetric analysis. Beer and Lambert's law. Basis and working principle of colorimeter, ultraviolet, atomic absorption spectrometers, Fluorescence spectroscop y, NMR and Mass Spectroscopy. Basics of Chromatography. Partition, adsorption and ionexchange chromatography. Column chromatography, thin layer chromatography, paper chromatography, immunoabsorbant chromatography, high performance thin layer Chromatography, high performance liquid chromatography (HPLC) and gas Chromatography. Radio immunoassay. Processing of biological materials for drug analysis. Calculations in drug analysis. Good laboratory practice. Validation of analytical procedure.

CLINICAL PHARMACOKINETICS

Course Contents

Basics of pharmacokinetics, calculation of pharmacokinetic estimates (C-max, Tmax, T1/2, AUC(0-n), AUC(0-µ), Vd, Ke, Ka etc.) Compartment models used in pharmacokinetics (oral and intravenous). Compartment fitting (one comp & two comp). Pharmacodynamic /pharmacokinetic (PD/PK) correlation. Therapeutic drug monitoring (TDM)

DRUG REGULATIONS

Drugs and Cosmetics Act, Drug Price Control order, Application for Investigational New Drug (IND), Application for New Drug Discovery (NDD) according to Indian Control Authority & USFDA guidelines. Conducting bio-equivalence studies. Ethical considerations in utilizing human subjects for drug discovery process. Helsinki's declaration. ICH-GCP Guidelines. Ethical guidelines in utilising animals for experimental purposes.

DRUG DEVELOPMENT PROCESS

Methods involved in the development of new drugs. Preclinical toxicological studies. Calculation of LD50 & ED50. Acute, subacute and chronic toxicity studies. Pre-clinilcal pharmacokinetic and dynamic studies. High throughput screening (invitro and invivo) for pre-clinical pharmacokinetic and pharmacodynamic studies.

THERAPEUTIC DRUG MONITORING

Basic principles of TDM. Therapeutic index. Trough level monitoring and dosage adjustments.

Drug delivery systems: sustained release, enteric coated formulations and liposome etc.

Four point assay of histamine and acetylcholine on guinea pig ileum. Identification of unknown by evaluating its action on dog haemodynamic parameters(through e-lab)

Fundamentals of Clinical Research

Course Contents:

Different types of clinical research.

Protocol writing for a clinical trial

Informed consent form and participant information sheet for research involving human participants

Ethics in biomedical research

Principles of Good clinical practice (GCP) and Good laboratory practice (GLP) guidelines

Interpretation of bioavailability parameters with the help of given pharmacokinetics data.

Writing research projects for funding agencies.

Analysis and evaluation of research paper

PHARMACOLOGY PRACTICAL II

Course Contents:

Spectrophotometric & flurimetric estimations of drugs in biological fluids
Calculation for statistical significance in the given data for Student paired and unpaired `t test.
Applying ANOVA to the given set of concentration vs time data of two drug formulations to comment about their bio-equivalence.
Draft an IND and NDD application for the approval of a numbered compound

**Practical exercise using animal experiments is subject to institutional animal ethical committee approval

THESIS

Guidelines

Each M.Sc. Medical student will carry out research work under the supervision of a faculty member (Guide) with post-M.D./ Ph.D. teaching experience of three years or more in the subject. However, a teacher with M.D./ Ph.D. degree in the subject or related subjects shall be qualified for being taken in as Co-guide.

The Guide will be allotted to each student at the commencement of second year. The student will prepare a Plan of Thesis under the supervision of the Guide, and submit it to the university within two months of commencement of second year. The university will convey approval/disapproval of the Plan within one month.

In case the Plan is disapproved, a fresh Plan must be submitted within one month. After approval of the Plan, the student will begin work on the thesis.

The progress of work will be monitored regularly by the Guide. The thesis not exceeding 100 pages typed on A4 paper on one side only in double spacing is to be submitted to the university through the Guide six months before the date of III year University examination.

It will be evaluated b y a panel of examiners (2 external & 1 internal at least) approved by the Vice Chancellor. The approval of the thesis by the panel will be a pre-requisite for the candidate to appear in the written/practical examination of III year. If the thesis is returned for revision, the suggested revision must be done and the revised thesis submitted for evaluation to the examiner(s) who has/ have suggested for the revision.

After approval of revised thesis, the candidate can appear in the next 3rd year examination provided the approval is received one month before the examination. If the thesis is disapproved, the entire process from submission of a new Plan to submission of Thesis is to be repeated. On approval of new thesis, the candidate can appear in the next 3rd year examination provided there is a one month gap between the receipt of approval and commencement of examination.

Note: A student is required to submit four hard copies of the thesis along with the soft copy in the prescribed format given by the college.

Recommended Books

1. Hardman JG, Limbird LE, (Ed,) *Goodman Gillman's The Pharmacological basis of Therapeutics.* (Eleventh Edition) McGraw Hill Press New York.
2. Katzung (Ed), *Basic & Clinical Pharmacology*,.
3. Gupta. S. K. *Drugs Screening Method*
4. Sharma KK & Sharma, *Principles of Pharmacology*, H.L.
5. Ed. Ghosh MN. *Fundamentals of Experimental Pharmacology*, Scientific Book Agency, Calcutta.
6. Vogel HG & Vogel WH(Ed). *Drug Discovery and Evaluation–Pharmacological Assays*, Springer-New York.
7. Indrayana, *Biostatistics for Undergraduates*
8. Mahajan BK, *Methods in Biostatistics*: latest Ed.
9. Jagdeesh, G (Ed), *Biomedical Research* (latest edition).

Journals to be referred

1. Trends in Pharmacological Sciences,
2. Annual Review of Pharmacology,
3. Pharmacological Reviews,
4. Indian Journal of pharmacology,
5. Indian Journal of Physiology and Pharmacology,
6. Pharmacology and Experimental Therapeutics,
7. Journal of Ethno pharmacology,
8. Nature,

9. Science,
10. European Journal of Clinical Pharmacology,
11. BJCP

3rd YEAR ANNUAL EXAMINATION:

To be conducted by 2nd week of June every year

M.Sc. MEDICAL PHARMACOLOGY 3rd YEAR			
S. No	PAPER TITLE	PAPER CODE	MARKS (EA+IA)
1.	Experimental pharmacology, Bioassay and Biostatistics.	MMPH301	75+25
2.	Clinical Pharmacokinetics	MMPH302	75+25
3.	Fundamentals of Clinical Research	MMPH303	75+25
4.	Clinical Pharmacology and Recent advances	MMPH304	75+25
5.	Pharmacology Practical	MMPH305	75+25
		TOTAL MARKS	(500)