THE TAMIL NADU Dr. M.G.R MEDICAL UNIVERSITY, CHENNAI

I MBBS - SYLLABUS

ANATOMY

GENERAL ANATOMY:

Sub divisions of anatomy

Anatomical position and planes

Structure and classification of bones and skeleton

Classification of joints, muscles

Classification of vascular system

Classification of nervous system

UPPER LIMB:

Gross features ,concerned radiology and surface markings and bones of upper limb.

Pectoral region

Gross and applied anatomy of breast

Actions of pectoralis major,minor and serratus anterior

Brachial plexus

Axilla : Boundaries and contents – axillary group of lymph nodes in detail

Back: Muscles of the back

Shoulder: Muscles and movements of shoulder joint

Free upper limb:

Muscles of arm, forearm, hand and their actions.

Cubital fossa- boundaries and contents

Course and branches and applied anatomy of ulnar, median, radial, musculocutaneous and axillary nerve.

Flexor and extensor retinaculum

Applied anatomy of fascial spaces

Joints, Blood vessels of upper limbs and their applied anatomy

Lymphatic drainage of upper limbs

LOWER LIMB:

Gross anatomy ,concerned radiology,and surface marking and bones of lower limb.

Fascia lata

Vascular and lymphatic drainage of Lowerlimb

Boundaries and contents of femoral triangle

Femoral, Obturator, Sciatic , Tibial and common Peroneal nerves- course and branches & their applied anatomy.

Course & branches of femoral artery & profunda femoris artery.

Muscles of gluteal region, thigh, leg and foot.

Adductor canal.

Popliteal fossa-boundaries and contents.

Movements of hip,knee,ankle and subtalar joints.

Arches of the foot.

THORAX:

Osteology-Sternum,Ribs and Vertebrae

Boundaries of thoracic inlet,cavity,and outlet.

Muscles of thoracic wall

Thoracic spinal nerves – typical & atypical

Anterior and Posterior intercostal arteries.

Internal thoracic artery.

Pleural cavity: pleura,lungs,trachea,bronchi,phrenic nerve.

Mediastinum: Boundaries and contents.

Pericardium,heart,and coronary arteries.

Venous drainage and nerve supply of heart.

Thymus

Aorta, pulmonary trunk,superior venacava

Oesophagus,sympathetic chain,thoracic duct and azygos system of veins.

Joints of thorax.

ABDOMEN AND PELVIS:

Abdominal wall-Muscles,bloodvessels,nerves.

Rectus sheath,Inguinal canal,

Testis-coverings and content

Penis –parts

Thoracolumbar fascia,Lumbar plexus.

Peritoneal cavity,Lesser sac,Greater sac,Mesentery.

Rectovesical,Rectouterine,Uterovesical pouches,

Viscera:

Liver&Extra hepatic biliary apparatus,,Spleen,Stomach,Pancreas.

Smallintestine,Caecum,Appendix,Colon,Rectum,Anal canal &their clinical significance.

Kidney,Ureter,Urinary bladder,Urethra,Suprarenals.

Portalvein,Inferior venacava,Renalvein.

Abdominal aorta,Coeliac artery,Superior,inferior mesenteric arteries.

Comman,External,Internal iliac arteries.

Diaphragm: Attachments,Opennings,Nervesupply and action.

Pelvic muscles and their actions.

Prostate,Seminal vesicle,Vasdeferens,Ejaculatoryduct.

Ovary,Uterine tube,Uterus,Vagina.

Sacral plexus,Superficial,Deep perineal pouches.Ischiorectal fossa.

HEAD AND NECK:

Skull and individual skull bones, foetal skull

Layers of scalp and its clinical importance.

Muscles of facial expression

Facial artery, vein, nerve &surgical importance of deep facial vein.

Boundaries and contents of posterior triangle.

Suboccipital triangle.

Cranial cavities and their foramina

Pituitary gland

Meninges & Dural venous sinuses.

Extraoccular muscles and their actions.

Boundaries and contents of Anterior triangle.(carotid,digastric,muscular and submental)

Parotid gland, submandibular gland & sublingual gland and their ducts.

Boundaries and content of temporal and infra temporal fossa.

Temperomandibular joint.

Thyroid and para thyroid,tonsil and adenoid.

Common carotid, external and internal carotid arteries

Subclavian artery, vagus, spinal accessary nerves.

External, Internal & Anterior jugular veins

Deep cervical fascia & Muscles of soft palate and pharynx

Nasal septum, cavity, lateral wall, paranasal sinuses.

Cartilages and ligaments of larynx.

Intrinsic and Extrinsic muscles of tongue & Larynx

External, middle, internal ear, mastoid antrum, auditory tube.

Parts and layers of eye ball.

Pre vertebral muscles.

Atlanto occipital,Atlanto axial joints and their movements.

Lymphatic drainage of Head and Neck

NERVOUS SYSTEM:

Surfaces,Borders,sulci and gyri of cerebrum

White matters of Cerebrum

Lateral, Third, Fourth ventricles of brain.

Circulation of Cerebro spinal fluid, Blood brain barrier

Basal nuclei and its components.

Brain stem.

Cerebellum.

Cranial nerves.

Vertebral canal & its contents

Coverings and blood supply of brain and spinal cord.

Thalamus, Hypothalamus, Limbic system and Pineal gland

GENETICS:

Chromosomes-Denvers classification

Karyotyping

Chromosomal aberrations.

Prenatal diagnosis and Genetic counselling.

Histology – General & Systemic histology

Embryology – General & Systemic embryology

Text Book to be followed: Dr. T. S. Ranganathan.

Histology – General & Systemic histology
Embryology – General & Systemic embryology

Should not be asked as question in the theory paper. Only spotters can be kept.

Physiology Curriculum

The goal of learning Physiology is to enable an undergraduate student to have a comprehensive knowledge of the normal functions of the organ systems, which facilitates an understanding of the physiological basis of health and disease.

HUMAN PHYSIOLOGY

COMPETENCIES:

At the end of the I MBBS Physiology course, the student must:

- Have an understanding of the functioning of the different organ systems of the human body and their interactions towards maintenance of homeostasis or a constant internal environment.

- Be able to apply the knowledge of physiological processes to comprehend mechanisms of disease and basis of treatment.

- Be able to perform some basic laboratory tests and interpret their results

- Be able to perform clinical examination to assess various organ systems.

ii) OBJECTIVES

a) KNOWLEDGE
At the end of the course the student should be able to:

(1) Explain the normal functioning of all the organ systems and their interactions for maintenance of a constant internal environment.

(2) Describe physiological responses and adaptations to changes in internal and external environment.

(3) Describe the physiological principles underlying pathogenesis and treatment of disease.

(4) List normal values and acceptable ranges for relevant physiological parameters

(5) Identify variations from normal in the following laboratory tests:
(i) serum electrolytes, pH, osmolarity and blood gases
(ii) pulmonary function tests
(iii) renal function tests
(iv) cardiac function tests

(6) Diagnose conditions from symptoms and signs and investigative data provided in case scenarios dealing with common disorders of:
hematological, musculoskeletal, alimentary, endocrine, reproductive, renal, cardiovascular, respiratory, and neurological systems.

b) SKILLS

At the end of the course the student should have developed skills in/to:

(1) Basic hematological techniques:

(i) use and maintenance of a compound microscope

(ii) collection of blood by the finger prick method using aseptic techniques

(iii) performance of ESR, Differential count, Arneth count, PCV, Bleeding and clotting time, blood grouping. **To remove total WBC count and Hemoglobin estimation provided it is not there in the MCI curriculum. This be replaced with observation of latest techniques involved in hematological tests.**

(iv) Calculation of hematological indices and explain its physiological significances

(2) Distinguish between normal and abnormal data derived from the tests mentioned above.

(3) Perform the following tests and clinical examinations in a normal subject with an understanding of the physiological basis of the examination and the clinical need to do so. The student should be able to:

(i) Measure blood pressure, record ECG and perform clinical examination of the cardiovascular system.

(ii) perform tests of ventilatory function using spirometer and peak flow meter and perform clinical examination of the respiratory system

(iii) do experiments towards understanding the effect of posture and various grades of exercise on cardiorespiratory function.

(iv) perform clinical examination of the abdomen- Students to be assessed through OSCE (Objective Structured Clinical Examination)

(v) perform clinical examination of the nervous system including special senses

c) ATTITUDE:

The student must

(i) develop a scientific approach in the practice of clinical medicine

(ii) correlate disease manifestation with derangements of physiological mechanisms and understand rationale of treatment

INTEGRATION

The teaching-learning program should be integrated horizontally and vertically, as much as possible, to enable students to understand the physiological processes in health, derangements in disease and rationale of treatment.

Number of hours:

Lectures + Tutorials	: 275
Practicals + OSPE	: 160
ECE	: 45

	480

Syllabus

The syllabus is framed as specific learning objectives for a student.

The I MBBS student must be able to fulfill the specific learning objectives listed under each heading.

General Physiology and Body fluids

(Lectures + Tutorials 20 hours; Practicals + OSPE 5 hours; ECE: 3 hours**)**

Homeostasis; Feedback systems:

Describe the concept of maintenance of internal environment
Recognize that negative feedback is the most common type of physiological control
State and describe examples of negative feedback
State and describe instances of positive feedback in human physiology

Body fluids:

List the different body fluid compartments and state the volume, osmolarity and electrolyte
composition of each of the following compartments:
Total body water, extracellular, intracellular, plasma, intravascular
Describe the term transcellular fluid
Define'Anion gap' and explain its physiological significance
Describe the difference between tonicity and osmolarity
Describe the Starling's forces that govern fluid exchange across the membranes separating the various compartments
Describe edema and its causes in terms of Starling's forces

Cell membrane:

Describe with a diagram, the Fluid Mosaic model of the cell membrane.
State the Composition of the cell membrane in terms of Lipids and proteins and describe
how these are organized.

Membrane transport:

Classify transport mechanisms as passive and active and differentiate between them.
List and describe the following passive transport processes with examples:
o Simple diffusion of respiratory gases through lipid film
o Diffusion of ions through ion channels
☐ Sodium, potassium, calcium and chloride channels
☐ Non-gated channels, voltage-gated channels, ligand-gated channels and mechanogated channels

o Facilitated diffusion - Glucose transporters (GluTs)
o Osmosis
Describe the differences between channel and carrier-mediated transport processes
State Fick's law of diffusion
Describe the following active transport processes:
o Primary active transport:
☐ sodium-potassium pump,
☐ calcium pumps - plasma membrane calcium pumps (PMCA) and
Sarco/endoplasmic reticulum calcium pumps (SERCA)
☐ Proton pumps - V-type H ATPase, H/K ATPase
o Secondary active transport: sodium-glucose co-transport (SGLT), sodiumaminoacid co-transport, sodium-hydrogen exchangers (NHE), sodium-calcium exchangers (NCX), Na/2Cl/K symport (NKCC)
Describe the following transport processes by formation of membrane vesicles
o Endocytosis
o Exocytosis

Membrane potential:
Describe the mechanisms involved in genesis of the resting membrane potential (RMP) in a prototype cell
Recognize that the RMP in a nerve or a cardiac cell is the Nernst or equilibrium potential for potassium, because of the dominance of K conductance over other conductances in a resting cell
Describe what 'Equilibrium potential' means
Describe Action potentials in neuron, skeletal muscle cell, Sino atrial node and cardiac ventricular cell.

Blood

(Lectures + Tutorials 30 hours; Practicals + OSPE 40 hours; ECE: 6 hours)

Describe the normal composition of blood.
Describe the composition of plasma; State the electrolyte concentrations in plasma. State the difference between plasma and serum.

Plasma proteins:
Give the normal concentrations of plasma proteins.
Describe production and functions of albumin
Explain what is plasma oncotic pressure
Discuss causes for decrease in serum Albumin levels with specific examples of disease conditions
Discuss the production, various types and role of Globulins (alpha, beta and gamma globulins)
Discuss the significance of albumin/globulin ratio

Explain the cause for oedema in Kwashiorkor, Liver failure, glomerulonephritis and filariasis

Acute phase reaction and Erythrocyte Sedimentation Rate (ESR):

State what is 'acute phase reaction'.
Describe Erythrocyte Sedimentation Rate (ESR) and its significance as a measure of acute phase reaction.
State normal values for ESR in men and women
Describe the factors influencing ESR (fibrinogen particularly)
Discuss the prognostic significance of ESR in disease states
Estimate ESR by Westergren's method of a provided sample of blood and interpret the result

Red Blood Cells and Erythropoiesis:

State the normal red cell count. Describe the physiological variations of the normal RBC count
Define erythropoiesis. Describe the factors regulating/affecting erythropoiesis, List the changes in sites of erythropoiesis with age. Briefly state the major changes that take place during the stages of erythropoiesis.
Discuss the normal life span and destruction of RBCs.
Describe the physical characteristics of red blood cells
Explain the functions of RBCs
Define Packed Cell Volume (PCV)/Hematocrit and state normal range for men and women
State the physiological variations in PCV.

Hemoglobin (Hb):

State the components of Hb, the various types of Hb and normal range of Hb in men and women
Briefly discuss the synthesis of hemoglobin
Describe the role of Hb in gas transport
Illustrate and describe the Oxygen‑Hb dissociation curve
State the oxygen carrying capacity of blood
State what is reduced hemoglobin.
Define and describe cyanosis.
Describe abnormal hemoglobins and list diseases associated with abnormal Hemoglobins
Discuss the types of jaundice
Estimate and interpret Hb content by Sahli's Acid Hematin method- Estimation of Hb to be included only if it is part of MCI curriculum
Describe sickle cell anemia & Thalassemia
Describe physiological jaundice of new born
Discuss carbon monoxide poisoning and treatment
Discuss Iron metabolism and iron overload
State the role of phototherapy in treating infants with jaundice due to hemolysis

Anemia:
Define anemia
Classify anemia based on etiology and morphology
Discuss the principles of treating anemias
State the normal reticulocyte count and its significance
Define reticulocyte response
Calculate and interpret red cell indices
Recognize major symptoms, signs and effects of anemia

Polycythemia:
Define what is Polycythemia
Explain what is Polycythemia rubra vera
Discuss causes for secondary polycythemia
Explain what is relative polycythemia
Discuss the effects of polycythemia

Platelets:
Describe the formation, structure, life span & removal of platelets
State the normal platelet count
Describe the functions of platelets.
Discuss the causes and effects of thrombocytopenia

Hemostasis:
Describe the processes involved in hemostasis:
o vasoconstriction
o Platelet plug formation
o Clotting or coagulation pathways
o Clot retraction
Describe anticlotting and fibrinolytic mechanisms in the body
List anticoagulants (therapeutic and laboratory) and their mechanism of action
Explain various causes for abnormal hemostasis
Perform and interpret simple tests of hemostasis like bleeding time by Duke's method and clotting time by capillary method of Wright on oneself.
Explain Lee and White's method for determining clotting time.
Explain and Interpret tests of hemostasis such as platelet count, Prothrombin Time, Activated Partial Thromboplastin Time and clotting factor assays.

Blood groups & Blood banking:
Describe the importance of blood groups
Explain the genetic determination of blood groups
Describe the ABO system of blood grouping
State the frequency of different blood groups
Describe the Rh system of blood grouping
Explain the mechanism and consequence of ABO and Rh incompatibility

Explain the condition Erythroblastosis Fetalis, state preventive measure and treatment for the same.
Discuss the minor blood group systems.
Perform and interpret blood grouping/typing.
Explain the cause and effects of transfusion reaction

White blood cells:
Classify types of WBC as granulocytes, agranulocytes.
Describe the morphology and functions of neutrophils, eosinophils, basophils, mast cells; Lymphocytes ,
monocytes
State the normal Total and Differential count;
Perform and interpret total leucocyte count total Leucocyte count to be performed only if recommended by MCI.
Make a peripheral blood smear, perform and interpret the differential leucocyte count.
List Conditions in which total leucocyte counts is increased or decreased.
List conditions in which counts of each type of WBC are increased or decreased
Describe the various cells that constitute the monocyte‐ macrophage system and state their function

Leucopoiesis:
Outline the process of maturation of white blood cells

Immunity:
Classify immunity and state the differences between innate and acquired immunity
Discuss the cells and mechanisms involved in innate immunity
Name the lymphoid organs in the body and outline the development of T and B cells
Classify acquired immunity and mention the cells involved in acquired immunity
Describe the cells and mechanisms involved in cell mediated immunity
Describe the cells and mechanisms involved in humoral immunity
Classify immunoglobulins and state their functions
Explain primary and secondary immune response
Illustrate the role of Complement system in immunity
Name important cytokines. State their source and functions

Lymph
Describe the formation and composition of lymph. Illustrate the lymphatic circulation.
Discuss functions of lymph.
Discuss the pathophysiology of lymphedema.

Gastrointestinal system

(Lectures + Tutorials 15 hours; Practicals + OSPE 12 hours; ECE: 3 hours**)**

Salivary glands:
List the salivary glands, describe the functions of saliva.
Describe the regulation of salivary secretion

Mouth and oesophagus:
Define mastication
Outline the process of Deglutition.
State the importance of lower oesophageal sphincter
Explain Gastro-esophageal reflux disease (GERD)
State what is Achalasia

Gastric secretion:
Describe the composition and functions of gastric secretion
Describe the mechanism of gastric acid secretion
State the role of chief cells and parietal cells
Describe the different phases of gastric secretion
Discuss the regulation of gastric secretion
Explain the importance of mucus-bicarbonate barrier
Define acid peptic disease
Explain the physiological basis for the use of proton pump blockers and histamine receptor blockers for peptic ulcers
State an example of proton pump inhibitor and histamine receptor blocker
Recognize the role of *H. pylori* in peptic ulcers.
Define pernicious anemia and give the reason for the same.

Gastric Motility:
Explain the process of mixing of food in the stomach
Explain the factors influencing gastric motility and gastric emptying
Describe the mechanism of vomiting
-
State the role of enterokinase
State the reason for the alkaline pH of pancreatic secretion and its importance
Explain the regulation of pancreatic secretion
State what is pancreatitis

Small intestine:
Describe the functional anatomy of the small intestine
Describe the secretions of small intestine and their functions
Describe the regulation of small intestinal secretion

Movements of small intestine:
Describe peristalsis; state the stimuli and factors which influence peristalsis
Describe ‘segmentation contractions’ and ‘mixing contractions’ and their fuctions
Define paralytic ileus
State what is basic electrical rhythm of the gastrointestinal tract and it’s role
Explain what is Migrating Motor Complex

Movements and function of large intestine:
State the segmentation and mixing contractions of large intestine
Describe the functions of large intestine and formation of faeces
State the importance of dietary fibre
State the role of mass action contraction
Describe the Defecation reflex
State what is Gastrocolic reflex

Liver and gall bladder:
Explain the Portal system
Describe the functions of liver with regard to
o Synthesis of proteins like albumin, fibrinogen, alpha globulins, clotting factors II, VII, IX, X (vitamin K dependent), angiotensinogen, transport and storage proteins
Describe the composition and functions of Bile
State the factors regulating bile secretionn
Explain the function of Gall Bladder
Explain the process of Entero-hepatic circulation

Gastro intestinal hormones:
State the source; describe the functions and regulation of secretion of Gastrin, Cholecystokinin and Secretin

Enteric nervous system:
State the location and components of the enteric nervous system.
Explain the functions of the Myenteric plexus and Meissner's plexus
Explain the effect of the autonomic nervous system on the enteric nervous system
Explain the physiological basis of megacolon

Muscle

(Lectures + Tutorials 15 hours; Practicals + OSPE 5 hours; ECE: 3 hours)

Morphology
Describe and draw the structure of sarcomere marking actin filament, myosin filament, I band, A band, H band, Z line and sarcomere
Describe the functions of contractile and regulatory proteins involved in muscle contraction
Draw and describe the structure of the sarco-tubular system

Neuromuscular junction
Draw and describe the structure of the neuromuscular junction
Describe the events involved in neuromuscular transmission
Describe the pathophysiology of diseases affecting the neuromuscular junction like myasthenia gravis and organophosphorus poisoning.

Excitation-contraction coupling
Describe the events involved in excitation contraction coupling.
Describe calcium transporters in muscle cells.

Contraction
Describe the sliding filament theory of muscle contraction

Relaxation
Describe the role of ATP and calcium pumps (SERCA) in the mechanism of relaxation of the muscle
Describe Rigor mortis

Types of contraction
Describe the difference between isotonic and isometric muscle contractions

Factors affecting force of contraction
List the factors affecting force of contraction: pre‑load, after load, beneficial effect.
Describe the physiological basis of the length-tension relationship.

Motor unit
Define a motor unit

EMG :
Define EMG.

Denervation
Describe the physiological basis of denervation hypersensitivity

Smooth muscle and cardiac muscle:

Compare structural differences and similarities between skeletal, cardiac and smooth muscle

List the differences between unitary and multi-unit smooth muscle

Compare the similarities and differences in the mechanism of contraction of skeletal, cardiac and smooth muscle

List the various factors that modulate smooth muscle contraction like stretch, sympathetic nervous system, parasympathetic nervous system, circulating substances etc.

Describe special properties of smooth muscle like latch-bridge mechanism and plasticity

Endocrine system

(Lectures + Tutorials 30 hours; Practicals + OSPE 15 hours; ECE: 3 hours)

Introduction to Endocrinology:

Define a hormone

Classify and list the hormones based on chemical nature

Mention the target organs for each hormone

Describe the general mechanism of negative and positive feedback regulation of hormone release

Describe the general mechanism of action of hormones including their receptors and second messengers

Hypothalamus:

Describe the relationship between hypothalamus and pituitary including the hypothalamohypophyseal tract and the hypothalamohypophyseal portal circulation

List the various releasing and inhibiting hormones released by the hypothalamus

Pituitary Gland

List the various hormones secreted by the anterior and posterior pituitary.

Growth hormone:

List the important actions of growth hormone, its effects on growth and metabolism

Recognize that insulinlike growth factor (IGF) or Somatomedin is the mediator for the actions of growth hormone

Describe the regulation of growth hormone secretion

List the important stimuli that can increase or decrease growth hormone secretion

Abnormalities of growth hormone secretion: Describe the physiological basis and important features of conditions resulting from abnormal secretion of growth hormone, like gigantism, acromegaly and pituitary dwarfism

Prolactin:
Describe the actions of prolactin and regulation of prolactin secretion
List the features of excess Prolactin secretion

Antidiuretic hormone (ADH)
List the important actions of ADH and describe Facultative water reabsorption
List the physiological stimuli that regulate ADH secretion
List the important factors that increase or decrease ADH secretion
List the causes and describe features of Diabetes Insipidus
List the causes and describe features of panhypopituitarism and syndrome of inappropriate hypersecretion of antidiuretic hormone (SIADH)

Oxytocin
List the important actions of oxytocin
List the stimuli for its secretion and describe regulation of secretion of Oxytocin

Thyroid Gland
List the important steps involved in the synthesis of thyroid hormones
Mention the transport of thyroid hormones
Describe the mechanism of action of thyroid hormones
Describe the important actions of thyroid hormones
Describe the regulation of thyroid hormone secretion
List the causes for and describe the features of Hyposecretion and hypersecretion of thyroid hormones
Describe the physiological basis for Simple Goitre
List the differences between dwarfism and cretinism
Describe the important thyroid function tests and its clinical use

Calcitonin
Mention the gland and cells secreting Calcitonin
List the actions of calcitonin on calcium metabolism

Parathyroid Gland
Mention the target cells of parathyroid hormone
List the major actions of parathyroid hormone
Describe the regulation of secretion of parathyroid hormone
List the causes of and features of hypoparathyroidism/tetany
Differentiate between Tetanus and Tetany
List the features of primary hyperparathyroidism
List the causes for secondary hyperparathyroidism

Vitamin D

Mention the sources of Vitamin D.

Describe the important actions of vitamin D. Recognize its emerging role as an immunomodulator.

Describe the regulation of vitamin D synthesis.

List the features of vitamin D deficiency in children and in adults – Rickets and Osteomalacia

Calcium Homeostasis

Mention the normal level of serum calcium

Mention the role of bones and its cells in calcium homeostasis

Mention the organs and hormones involved in Calcium homeostasis and their roles

Adrenal Gland

Adrenal Cortex:

List the hormones secreted by the different layers of the adrenal cortex

Glucocorticoids:

List the important glucocorticoids

Describe the mechanism of action of glucocorticoids

List the major actions of glucocorticoids

Describe the regulation of glucocorticoid secretion

List the causes of and describe the features of excess Glucocorticoid secretion

Minearalocorticoids:

List the important mineralocorticoids

Describe the mechanism of action of mineralocorticoids on its target cells

Describe the important actions of mineralocorticoids

List the physiological stimuli that regulate mineralocorticoid secretion

Describe the regulation of mineralocorticoid secretion

List the features of primary hyperaldosteronism or Conn's syndrome

Adrenal insufficiency: List the causes of and describe features of Addison's disease

Adrenal medulla:

List the physiological effects of epinephrine and nor-epinephrine on various systems of the body

List the factors that regulate the secretion of adrenal medullary hormones

List the features of Phaeochromocytoma

Endocrine Pancreas
List the cells of the Islets of Langerhans and mention the hormone secreted by each

Insulin:
Mention the steps in biosynthesis of Insulin and the origin of the C-peptide (Connecting peptide)
Mention the physiological stimulus for Insulin secretion
Describe the activation of islets by its physiological stimulus resulting in Insulin secretion
List the target cells of Insulin and the cells that do not require insulin action for glucose uptake
Mention the mechanism of action of Insulin on its receptor
List the important actions of insulin
List the various factors that regulate insulin secretion
Describe the features of hypersecretion of Insulin and Hypoglycemia

Diabetes Mellitus:
Mention the underlying cause for Diabetes mellitus – Insulin deficiency leading to high blood sugar level
Describe the pathophysiological effects of high blood sugar and insulin deficiency
Mention the clinical feature of Diabetes Mellitus
Compare and contrast Type I and Type II Diabetes Mellitus and their complications

Hypoglycemia
List the feature of hypoglycemia and the counter regulatory hormones
List the hormones that raise blood sugar level

Glucagon
List the important actions of glucagon

Reninangiotensin system
List the important actions of angiotensin II

Atrial natriuretic peptide (ANP)
List the important actions of ANP
List the physiological stimuli for ANP secretion

Pineal gland
Mention the role of hypothalamus and melatonin on circadian rhythm

Reproductive Physiology

(Lectures + Tutorials 20 hours; Practicals + OSPE 5 hours; ECE: 3 hours)

Sex determination:

Differentiate between Genetic sex, Gonadal sex and phenotypic sex.
Describe the role of SRY gene and testis determining factor in development of gonads
Describe the role of testosterone and Mullerian inhibiting substance in the development of male and female internal genitalia
Discuss the role of dihydrotestosterone in the development of external genitalia
Describe the cause and features of abnormalities of sex differentiation
(Klinefelter's syndrome
Turner's syndrome
XXX superfemale
Female pseudohermaphroiditism
Male pseudohermaphroiditism – androgen resistance)

Pituitary gonadotropins and prolactin:

Describe the mechanism of action, functions and regulation of secretion of pituitary gonadotropins and prolactin.

Puberty and menopause:

Explain the changes that occur during puberty and describe the mechanism of onset of puberty
Define menopause and describe the physiological changes during menopause.

Male reproductive physiology:

Describe the functional anatomy of the male reproductive tract (Testis seminiferous tubules, Sertoli cells,
Leydig cells, Blood Testis barrier, Epididymis, Vas deferens, Seminal vesicle, Prostate gland).
Describe the blood testis barrier and its function
Discuss factors that regulate Spermatogenesis
Describe the structure of spermatozoa
Describe the source, mechanism of action and functions of testosterone and dihydrotestosterone
State the source and functions of inhibin
Discuss the hypothalamic and pituitary control on testicular function and Feed back control of testicular hormones on hypothalamus and pituitary
Describe the role of prostate, seminal vesicles in reproductive function
Describe the mechanisms that cause erection and ejaculation
State what is capacitation and discuss the changes that occur during capacitation
Outline the steps involved in spermatogenesis
State the composition of semen and recognize use of semen analysis as a test to evaluate infertility

Female reproductive system:

Describe the Functional anatomy of the female reproductive system
Outline the stages of Oogenesis
State differences between oogenesis and spermatogenesis
Describe the development of ovarian follicles **(**Stages of follicle development , ovulation, luteinisation, luteal regression)
Describe the control of follicular development, ovulation and luteinization (role of FSH, estrogen and LH)
Describe the process of follicle attrition
List the hormones produced by the ovary
Illustrate the synergistic role of thecal and granulosa cells in steroidogenesis
Discuss the mechanism of action and functions of estrogen and progesterone
Discuss the physiological basis of use of synthetic estrogens and progestins as oral contraceptives
Describe the feedback regulation of ovarian function
Describe the physiological changes occurring in ovaries, uterus, cervix , vagina and breast during a menstrual cycle
Discuss and illustrate the hormonal changes during the menstrual cycle (changes in FSH, LH, estrogen and progesterone)
Describe the mechanism of ovulation
State the importance of detecting ovulation and the time of ovulation
State the tests for ovulation and their physiological basis
Identify common causes of anovulatory cycles (physiological, PCOD)
Name the protein hormones produced by the ovary and state their source and functions
Define:

- Menorrhagia,
- Dysmenorrhea,
- Amenorrhea, and
- Premenstrual syndrome

Contraception:

Classify contraceptive methods
Describe the physiological basis of the various methods of contraception

Pregnancy and parturition:

Outline the process of fertilization, implantation and placenta formation
Discuss the importance of corpus luteum of pregnancy
Discuss the functions of placenta.
Discuss the secretion and function of hCG from the placenta.
State the physiological basis of immunological tests for pregnancy based on hCG*.

Describe the role of hormonal and mechanical factors influencing labor
Describe the changes that occur in the various organ systems in the mother during pregnancy
List the hormones secreted by the placenta
State the source and functions of relaxin
Describe the fetoplacental unit

*(Biological tests of pregnancy are only of historical interest and are not to be taught (e.g. Ascheim Zondek,Galli Mainini etc)

Lactation:
Describe the role of estrogen and progesterone in breast development
Describe the mechanism that causes initiation of lactation after delivery
Describe the role of prolactin and prolactin inhibitory factor (Dopamine) in lactation
Describe the Milk ejection reflex
Discuss the effect of lactation on menstrual cycle

Excretory system
(Lectures + Tutorials 25 hours; Practicals + OSPE 10 hours; ECE: 3 hours)

Structure of the Nephron
Describe the structure of the juxtaglomerular apparatus
Describe the structure of the cortical and Juxtamedullary nephrons
Describe the salient features of Renal circulation

Glomerular filtration and renal blood flow
Describe the following factors affecting glomerular filtration:
• Surface area of Glomerular Capillaries
• Starling's forces: [GFR = Kf X (PG – PB – πG + πB)]
• Molecular weight of the substances
• Electrical charge of the substance
List and describe the factors determining and regulating renal blood flow
Describe the mechanisms of autoregulation of renal blood flow and Glomerular filtration rate.
Describe the role of the Juxtaglomerular apparatus in the autoregulation of GFR and RBF (TG feedback) and the regulation of blood pressure via the Renin-AT-Aldosterone axis.
Discuss the concept of renal clearance
Discuss the usage of Inulin clearance to measure GFR and PAH clearance to measure Renal blood flow
Explain the role of creatinine clearance to assess GFR
Explain the role of serum creatinine as renal function test

Functioning of the Proximal Convoluted Tubule:

Describe the reabsorption of sodium, chloride and water in the proximal tubule

Describe the important sodium transporters in PCT – sodium-glucose cotransporter (SGLT), sodiumaminoacid co-transporter and sodium‑hydrogen exchanger (NHE) in the luminal border, sodium-potassium pump in the basolateral border.

Describe the mechanism of glomerulotubular balance

Discuss the renal handling of glucose, bicarbonate and amino acids in the PCT

Recognize the almost complete reabsorption of glucose, bicarbonate and amino acids in the PCT

Describe the role of Carbonic anhydrase, the sodium‑hydrogen exchanger in luminal border, and the bicarbonate transporter in basolateral border in bicarbonate reabsorption in the PCT

Describe the concept of the transport maximum for glucose, renal threshold, types of glycosuria (diabetes mellitus, renal, alimentary)

Describe the action of parathormone on PCT.

Functioning of the Loop of Henle (LOH)

Distinguish between permeability characteristics of the two limbs of loop of Henle.

Describe the role of the Na/2Cl/K transporter and the sodium potassium pump in the thick ascending limb (TAL)

Recognize the mechanism of action of Loop diuretics (Furosemide) as due to blockade of Na/2Cl/K transporter

Describe the function of the Function of LOH in the creation of hyperosmolar medullary interstitium (MI) by the following two mechanisms:

i. Active transport of salt in TAL segment

ii. Counter current multiplication of the active transport

Describe the role of the vasa recta in maintaining the hyperosmolarity of the medullary interstitium by counter-current exchange

Functioning of the Distal Convoluted tubules (DCT):

Describe the regulated reabsorption of sodium (aldosterone-dependent) via Epithelial sodium channels (ENaC) and Na/Cl symporter in luminal border

Recognize the mechanism of diuretic action of thiazide and amiloride

Describe the regulated secretion of potassium (aldosterone-dependent) via potassium channels in Luminal border

Describe the generation of bicarbonate in the distal tubule, discussing the roles of:

Proton pumps in luminal border

Luminal electronegativity due to sodium absorption via the ENaC

Phosphate and ammonia as urinary buffers

Discuss the features of hyperaldosteronism and the occurrence of metabolic alkalosis in the same.

Describe the action of Atrial Natriuretic peptide.

Discuss ‘aldosterone escape’.

Functioning of the Collecting duct (CD):
Describe the role of aquaporins in water absorption in the collecing duct.
Describe the role of ADH in regulated water absorption.
Describe the role of the hyperosmolarity of the medullary interstitium (created by the Loop of Henle) in producing a gradient for water reabsorption in the collecting duct.
Describe the role of ADH in urea absorption from the collecing duct, enhancing the hyperosmolarity of Medullary Interstitium.

Micturition reflex: .
Describe the reflex pathway of micturition
Explain the use of a cystometrogram **In the context of plasticity of smooth muscles**

Kidney Function Tests
Recognize the normal urinary volume
Discuss the significance of the presence of albumin in urine
Discuss the role of creatinine clearance in the measurement of renal function.
Discuss the role of serum creatinine in the measurement of renal function
Discuss the importance of measuring inulin and PAH clearances. Are these done routinely?
Define and explain the concept of filtration fraction.
Discuss the normal findings in microscopic examination of urine.

Regulation of osmolarity, Na+ and K+ levels:
Describe the role of osmoreceptors in sensing body fluid osmolarity.
Describe the mechanism of sensing thirst.
Describe the role of ADH, Aldosterone, Angiotensin II and ANP in sodium and water balance.
Discuss the relationship between K+ concentrations and the pH of blood.
Discuss the effect of aldosterone in the renal handling of K+ at DCT

Regulation of Acid base balance:
Describe the different buffer systems in the body
Explain the respiratory regulation of acid base balance
Describe the role of the kidney in regulation of acid base balance
Explain the concept of Anion gap

Respiratory system
(Lectures + Tutorials 25 hours; Practicals + OSPE 20 hours; ECE: 6 hours)

Functional anatomy

List the parts of the respiratory tract
State the functions of nose and para-nasal sinuses
Differentiate between conducting zone and respiratory zone
Describe the structure of alveolus & alveolo-capillary membrane

Pulmonary Ventilation

State the normal respiratory rate and define inspiration & expiration
List the muscles of inspiration, expiration & accessory muscles of respiration
Describe the movements of chest wall and the changes in chest wall dimensions produced by respiratory muscles
Recognize the difference between quiet-breathing and forced respiration
Discuss the factors affecting airflow between the atmosphere and alveoli
Discuss recoil of Lungs and chest wall
State the values of intra alveolar pressure, Intra pleural pressure
Discuss the changes in alveolar and intra pleural pressures during respiration
Define lung compliance and relate it to clinical conditions in which it is altered
Identify the sites of air way resistance. Recognize that airway resistance is increased in obstructive lung diseases.
Explain the action of autonomic nervous system on bronchial tone.
State clinical conditions in which work of breathing is increased.
Discuss the role of histamine as a bronchoconstrictor.

Lung volumes and capacities:

Define the lung volumes and capacities; state the normal values and discuss their physiological variations
Explain the recording of the Spirogram with a diagram and recognize the volumes and capacities which cannot be measured by spirometry
Record the lung volumes and capacities of a normal subject using a spirometer
Discuss the physiological significance of the Residual volume & functional residual capacity
Describe the forced expiratory spirogram and describe FEV1, FVC and the FEV1/FVC ratio and its variations in obstructive and restrictive lung diseases.
Define peak expiratory flow & state its normal value
Record peak expiratory flow in a normal subject
Interpret altered values of absolute lung volumes, peak expiratory flow and FEV1/FVC ratio in restrictive and obstructive lung diseases
Define minute ventilation, anatomical dead space, physiological dead space & alveolar ventilation

Alveolar Ventilation

Discuss the effect of changes in respiratory rate and tidal volume on alveolar ventilation

Pulmonary circulation and Ventilation/ Perfusion ratio

State the normal rate of pulmonary blood flow & normal range of pulmonary blood pressures

Discuss the special features of pulmonary circulation, pulmonary veins, pulmonary vascular resistance, its response to hypoxia (hypoxic vasoconstriction in pulmonary circulation)

Explain the regional differences in perfusion, ventilation & V/Q ratio in the lungs

State normal values of V/Q ratio and recognize that physiological dead space is associated with high V/Q and 'physiological shunt' is associated with low V/Q.

Gas Exchange

Discuss normal composition of atmospheric, tracheal and alveolar air.

Discuss the normal partial pressures of gases in blood entering and leaving lung

Explain oxygen uptake and carbon‑dioxide elimination by lungs and state the normal rates of the same.

Define respiratory exchange ratio and state its normal value.

Recognize that oxygen diffusion can be affected in cases of respiratory membrane thickening, but not necessarily carbon dioxide diffusion.

State the physiological causes for normal alveolar-arterial oxygen difference.

Discuss gas exchange during exercise.

Transport of oxygen

Explain the forms of oxygen transport in blood

Discuss hemoglobin's affinity for oxygen

Explain & illustrate oxygen-hemoglobin dissociation curve and discuss the factors affecting it and the physiological advantages of the curve

Explain Bohr effect

Discuss oxygen carrying capacity of blood

Differentiate between oxygen content of blood & % oxygen saturation of hemoglobin

Define hypoxemia and hypoxia; explain the physiological basis of types of hypoxia with examples

Define cyanosis and differentiate between conditions in which it occurs and may not occur

State the physiological basis of oxygen therapy as treatment for the different types of hypoxias

Transport of Carbon dioxide:

Explain the forms of carbon dioxide transport in blood

Explain the role of chloride shift and Haldane effect

Control of Respiration

Express the concept of the sensors, central controller in brain & effectors in the respiratory control system

Describe the location and functions of the respiratory centres in brain; describe the current explanation for the basic rhythm of respiration
Describe the effects of neural inputs on respiration in terms of the voluntary cortical control, motor cortical input, limbic input, peripheral afferent inputs (Hering breuer reflexes, J receptor input, proprioceptor input, and other peripheral inputs)
Describe chemical control of respiration; explain the role of peripheral and central chemoreceptors; explain the feedback control of ventilation to regulate gas exchange & maintain normal levels of arterial blood gases and pH.
Describe Cheyne-stokes breathing, state its causes. Demonstrate the effect of apnoea & hyperventilation on respiration using a stethograph or respiration belt transducer; demonstrate the effect of breathing through a tube (increased anatomical dead space) and the effect of speech & cough on respiration.
Define hypercapnoea and hypocapnoea
Define asphyxia

Exercise
Describe the effects of exercise on the respiratory system and explain the physiological basis of these effects; explain the physiological need for these changes
Define VO2 max and oxygen debt

Physiological adaptations in special environments
State the physiological effects of zero gravity
Describe the physiological basis of Caisson's disease & Nitrogen narcosis
Explain the physiological adaptations occurring at high altitude

Miscellaneous
List the Non-Respiratory functions of lung
State the physiological mechanism of cough, sneeze and gag reflexes

Clinical examination of respiratory system
Demonstrate the methods of Clinical examination of the respiratory system
Recognize normal Clinical findings of respiratory system examination
State the abnormal findings that may be present in a patient and list the common clinical conditions in which these abnormalities occur and the physiological explanations for these abnormalities if any.

Cardiovascular system
(Lectures + Tutorials 35 hours; Practicals + OSPE 20 hours; ECE: 6 hours)

Functional anatomy of heart:
Describe the functional anatomy of the heart, with respect to its chambers, valves, input and output vessels, AV ring and electrical discontinuity, Conducting system, Coronary supply

SA node:
Describe the following:
Contour of SA node action potential with a diagram, depicting the various phases (4, 0 and 3)
Prepotential (phase 4 depolarization)
Currents responsible for generation of SA node action potential: The funny current (If), T-type calcium current (ICaT), L-type calcium current (ICaL)
Recognize the role of INCX (Current through sodium‑calcium exchanger) as a rhythm-generating mechanism

State the intrinsic rate of the SA node and influence of autonomic nervous system, hormones and temperature.
Define Sinus arrhythmia, sinus bradycardia, sinus tachycardia

Ventricular cell:
Describe the contour of the ventricular action potential with the aid of a diagram
Describe the ionic currents responsible for phases 0,1,2,3,4 of the ventricular action potential
State the differences between the SA node action potential (slow AP) and the ventricular cell action potential (fast AP).
Describe how the action potential leads to an increase in cytosolic calcium concentration
Describe excitation-contraction coupling
State the basic concepts of the sliding filament theory of contraction

Atrial cell:
Recognize that AP in atrial cell is similar to ventricular cell (fast AP)

Cells of conducting pathway:
Recognize that :
the AV node AP is similar to SA nodal cell (slow AP)
His Bundle cell: fast AP
Purkinje fibres: fast AP

ECG:
Describe the electrocardiogram as a surface recording of electrical changes occurring on the external surface of the heart during the passage of an action potential.
Describe the 12 Leads in which ECG is recorded.
State the rationale of recording from multiple leads.
Identify the lead which is commonly used to monitor patients continuously.
Describe the P, QRS, T and U waves of an ECG in lead II configuration and describe the electrical events responsible for these waves
Describe PR and QT intervals and state what they represent
Describe the significance of ST segment being on the isoelectric line in a normal ECG

Record an ECG in a human subject in all 12 leads
Calculate rate from a normal ECG tracing
List the ECG changes in the following conditions:
Myocardial ischemia
Myocardial infarction
Hyperkalemia
State the causes for PR prolongation

Properties of cardiac muscle:

Automaticity:

Describe the function of the sinoatrial node as the pace‑maker of the heart
Describe the ionic currents responsible for rhythm-generation in the SA node
Describe the determinants of heart rate and the neural and chemical regulation of heart rate

Excitability and Refractoriness:

Define refractory period, describe its relation to the duration of the ventricular action potential, and state its physiological significance.

Conductivity:

Describe the normal mode of conduction of the cardiac impulse

Contractility:

Describe the determinants of force of contraction of the ventricle in terms of

- **Preload (Starling's law)**
- **Afterload**
- **Inotropic status (contractility)**
- **Frequency** (or heart rate), (Bowditch phenomenon or Force-frequency relation)

Discuss the clinically measurable parameters reflecting:

Preload (Left-ventricular end-diastolic volume (LVEDV) or Left-ventricular end diastolic pressure (LVEDP) or Right atrial pressure (RAP) or central venous pressure (CVP),

force of contraction of the heart (stroke volume or cardiac output, ejection fraction).

Cardiac cycle:

Describe with a diagram, the chronological relationship of the following events shown on the same time axis:
ECG
Valvular events
Heart sounds
Pressure curves: Left ventricular pressure, Atrial pressure and aortic pressure
Volume curve: Ventricular volume curve

Stroke volume:
Discuss the determinants of stroke volume

Cardiac output:
Discuss the determinants of cardiac output
Describe the regulation of cardiac output
Discuss high output and low output states

Vascular Physiology:
Describe the function of Aorta and large Arteries as elastic, windkessel vessels
Describe what would happen to pulse pressure in case of thickening and loss of elasticity of aorta
Describe the role of arterioles as resistance vessels
Describe the term Total Peripheral resistance (TPR)
Discuss the determinants of TPR and the relationship of TPR to blood pressure and cardiac output.
Discuss the role of arteriolar resistance as a determinant of blood flow to a specific organ
Discuss the determinants of arteriolar resistance in terms of Poiseulle's equation
Identify that the arteriolar diameter is the major determinant of arteriolar resistance
Discuss the global and local factors affecting arteriolar diameter and therefore the TPR, blood pressure and blood flow – vasodilator and vasoconstrictor mechanisms
Discuss the physiological/pathophysiological role of the following vasoactive substances: Histamine, bradykinin, serotonin, thromboxane A2, prostacyclin, Endothelin
Discuss the physiological role of endothelium‑derived relaxing factor (EDRF) or Nitric oxide (NO)
Discuss the role of capillaries as exchange vessels
Describe the Starling's forces determining fluid movement across the capillary membrane
Describe the function of Veins as capacitance vessels
Define the term Venous return (VR) and discuss its role as preload
Describe the determinants of VR
Discuss the significance of assessing jugular venous pulse
Discuss the interactions between Right atrial pressure, VR and Cardiac output (CO)

Blood pressure:
Define the following terms:
Mean arterial blood pressure, Systolic pressure, Diastolic pressure, pulse pressure
Describe the determinants of blood pressure in terms of cardiac output and TPR
Discuss the short-term (neural and hormonal) and long term (renal) mechanisms regulating blood pressure (with special reference to shock and exercise).
Demonstrate the method of measurement of blood pressure using a sphygmomanometer.
Describe the principle of measuring blood pressure by sphygmomanometry

Discuss other methods of measuring blood pressure

Cardiovascular autonomic reflexes:
Describe the physiological role of the following reflexes, their receptors, specific stimuli, afferent and efferent neural pathways, and the responses.
Baroreceptor reflexes
Chemoreceptor reflexes
Vasovagal syncope
Cushing's reflex
Bainbridge reflex
Bezold Jarisch reflex
Define Diving reflex

Regional circulations:
Discuss the features and regulation of the following circulations:
Coronary
Cerebral
Renal circulation - auto-regulatory mechanisms (myogenic factors and Tubuloglomerular feedback)
Pulmonary (its pressures, hypoxic vasoconstriction)
Splanchnic
Cutaneous circulation and temperature regulation
Skeletal muscle
Recognize the importance of sympathetic regulation versus local metabolic factors in the regulation of the regional circulations mentioned above.
Discuss the physiology of Fetal circulation before and after birth

Effects of exercise on cardiovascular system:
Discuss the effects of exercise on the cardiovascular system
Demonstrate the effects of mild to moderate and high intensity exercise on the blood pressure and heart rate in a normal subject

Hypertension:
State the normal ranges for systolic and diastolic blood pressures in the various age groups
Define hypertension

Hypotension or Shock:
Define the term ‘Shock’ or Cardiovascular shock
State the different types of shock
Discuss the pathophysiology of the following types of shock (in terms of factors affecting blood pressure):
Hypovolemic, cardiogenic, Distributive (septic, anaphylactic, neurogenic) Obstructive

Myocardial infarction or heart attack:
Define the following terms: Angina, Ischemia, Myocardial infarction or heart attack
Discuss the major ECG changes in: Myocardial ischemia; Myocardial infarction

Central nervous system

(Lectures + Tutorials 45 hours; Practicals + OSPE 22 hours; ECE: 6 hours)

Organization of the nervous system:
Describe the classification of nervous system and the components of the following divisions:
CNS
PNS
Somatic NS
Autonomic NS
Enteric NS
State the cell types present in the nervous system
Describe the morphology of different types of neurons and neuroglia
Describe the process of myelination and its significance
Differentiate between white matter and grey matter.
Define the terms 'nuclei' and 'ganglia'.

Peripheral nerve fibres:
Define the term 'Peripheral nerve'.
State the types of fibres in a mixed peripheral nerve.
Describe Ehrlanger & Gasser's classification of peripheral nerve fibres
Describe nerve injury, degeneration and regeneration of injured fibres

Electrical properties of the nerve cell membrane :
Describe the ionic basis of Resting membrane potential (RMP) of a nerve cell.
Describe the term electrotonic potentials with reference to:
• 'receptor or generator potential' in a sensory receptor
• 'excitatory or inhibitory post-synaptic potentials (EPSP and IPSP)' in a post-synaptic neuron
• 'end-plate potential' at the neuromuscular junction
Define the term 'Action potential' and describe the currents responsible for the different phases of the action potential in the neuron.
Describe the process of transmission of action potential in unmyelinated and myelinated neurons.
Describe the phenomenon of saltatory conduction in a myelinated neuron.
List the factors affecting conduction velocity in a nerve.

Neurotransmitters:
List the important small molecule neurotransmitters in the CNS and their receptors:
o Glutamate and its ionotropic receptors:
NMDA, and non-NMDA

o GABA
o Glycine
o Dopamine
o Serotonin or 5-HT
o Acetylcholine
o Noradrenalin
State whether the action of each of the above neurotransmitters on the various receptors is
excitatory or inhibitory.
State the major excitatory neurotransmitter in the CNS
State the inhibitory neurotransmitters of the CNS. State the mechanism of inhibition.

Synapses:
Define the terms electrical & chemical synapse
Describe the morphological features of a chemical synapse – pre and post synaptic neurons
List the morphological types of chemical synapse – axosomatic, axodendritic and axoaxonic
Describe the process of synaptic transmission.
List the events in the pre-synaptic neuron, culminating in release of neurotransmitter.
Describe the events in the post-synaptic neuron – Excitatory and inhibitory post-synaptic potentials,
Summation (spatial and temporal) of synaptic inputs at the axon hillock, formation of action potential.
Define the following properties of synapse:
One-way conduction
Synaptic delay
Convergence and Divergence of synapses
Spatial summation
Temporal summation
Define the term synaptic plasticity
Describe the differences between Pre-synaptic and post-synaptic inhibition.
Define the term Pre-synaptic facilitation.

Sensations:
Classify the types of sensations (sensory modalities)

Sensory receptors:
Differentiate between usage of the term ‘Receptors’ i.e., sensory receptors versus neurotransmitter or ligand receptors.
List the sensory receptor for each modality of sensation
• Touch receptors
• Receptors for proprioception
• Pain and temperature receptors
Define rapidly adapting and slowly adapting receptors

Describe the mechanism of sensory transduction taking a particular receptor as example (e.g., pacinian corpuscle)
Define the term ‘generator potential’ or ‘receptor potential’.

Ascending sensory pathways:
State the common features of ascending sensory pathways.
List the ascending sensory pathways and list the sensations carried in each pathway.
Define the term ‘Proprioception’.
Describe the ways in which proprioceptive input terminates after entering the spinal cord, with special reference to the muscle spindle (Posterior column pathway, spinocerebellar tracts, spinal reflex arcs)
Describe the pathways (receptors, sensory neurons, synapses in the pathway, cortical termination) for fine-touch and proprioception.
Describe the role of posterior columns or dorsal columns.
Describe the role of anterior spinothalamic tract.
Define the term sensory homunculus.
Describe the ‘phantom limb’ phenomenon.
Demonstrate the clinical examination of the sensory system.

Physiology of pain:
Briefly describe receptors for pain.
Describe the pathway for transmission of pain from receptors to the cortex.
Define the following terms: Substantia gelatinosa, Lissauer’s tract, fast pain, slow pain.
State the type of peripheral nerve fibres carrying fast pain and slow pain respectively.
Describe the gate control theory of pain
Discuss the principle of using pain balms and Acupuncture for pain relief.
Describe the following phenomena:
• Referred pain•
• Phantom limb pain
Describe descending pain control pathways: from Periaqueductal grey, Locus ceruleus and Nucleus Raphae magnus
List the endogenous opioids and the types of Opiate receptors.
Describe the role of endogenous opioids in pain transmission

Motor system:
Describe the features of organization of the motor system.
Define UMN & LMN
List the descending tracts involved in motor control.
Describe origin, course, termination and functional role of the Pyramidal tracts. State why the pyramidal tracts are called so.
List the extrapyramidal descending tracts.
State the physiological role of the following extrapyramidal tracts:
• Rubrospinal
• Pontine reticulospinal
• Medullary reticulospinal

• Lateral vestibulospinal
Describe the influence of the extrapyramidal tracts on spinal motor neurons & spinal reflexes
Describe the effects of lesion of the pyramidal and extrapyramidal tracts respectively on spinal motor neurons, spinal reflexes & muscle tone
Describe the physiological basis and the clinical significance of
• Decerebrate posture
• Decorticate rigidity
Demonstrate clinical examination of the motor system.
Define the term 'Motor homunculus'.

Reflexes:
Define the term 'reflex'.
Describe the components of a reflex arc with a diagram.
Classify reflexes:
• based on the location of receptors (deep and superficial)
• Based on number of synapses in the reflex arc (mono, di or polysynaptic)
Describe in detail, the stretch reflex and its physiological significance.
List the other terms which are commonly used to refer to the stretch reflex.
Identify that the clinically tested deep reflexes (or tendon jerks) are stretch reflexes.
Differentiate between alpha and gamma motor neurons.
Name the receptor for the stretch reflex and describe its basic structure with a diagram. State the functional role of gamma motor neurons.
State the effects of supraspinal influences on the stretch reflex.
Describe the effects of UMN lesions.
Describe the effects of LMN lesions.
Describe the inverse stretch reflex arc. State the stimulus and response for the inverse stretch reflex.
Describe the functional role of Golgi tendon organ.
Describe the physiological basis of "Clasp-knife" rigidity.
Describe the flexion withdrawal reflex. State its functional role.
Describe the afferent, efferent pathways and the centre of integration for the following superficial reflexes: Corneal, conjunctival, Abdominal, cremasteric.
State the rationale in assessing superficial reflexes, while examining the nervous system.
Describe flexor and extensor plantar reflexes.
Recognize the importance of using a painless stimulus to elicit plantar response.
Describe Babinski's sign and state its clinical significance.
List the physiological conditions, where plantar response is extensor.
Demonstrate how to elicit the clinically significant superficial and deep reflexes in normal subject.
State the physiological basis for Jendrassik's maneuver
Describe the Crossed extensor reflex.

Describe the mass reflex & its use in spinal cord injury patients
Demonstrate elicitation of the following deep reflexes in a normal subject:
Biceps jerk
Triceps jerk
Brachioradialis jerk
Knee jerk
Ankle jerk
Demonstrate the following superficial reflexes in a normal subject:
Conjunctival
Abdominal
Plantar
State the rationale for testing the above reflexes in a patient.

UMN and LMN Lesions:
Describe the features and Physiological basis of Upper motor neuron & lower motor neuron lesion.
Describe the features of:
Hemisection of spinal cord at a given level (e.g. T8, L3 etc)
Brown Sequard syndrome
Complete transaction of spinal cord at a given level.
Define the following terms: Hemiplegia, quadriplegia, paraplegia
Hemiparesis, quadriparesis & paraparesis
Describe the stages of spinal shock.

Cerebellum:
Describe the structure of cerebellum, its somatotopic organization, deep cerebellar nuclei, afferent pathways, internal connections, efferent pathways.
Name the afferent and efferent fibres of cerebellum
Describe the functions of cerebellum.
Describe the features of cerebellar lesions
Describe cerebellar function tests.
Demonstrate how to perform cerebellar function tests.

Cranial Nerves
Examine the integrity of the cranial nerves I-XII in a normal subject

Basal ganglia:
Define the term basal ganglia.
List the nuclei forming the basal ganglia.
o Input nuclei – which receive afferents from cortex
o Output nuclei – which send output to thalamus and spinal cord
Describe the internal connections between input and output nuclei – what are direct

and indirect pathways.
Describe the origin and termination of the nigro-striatal pathway. State the neurotransmitter in this pathway.
Describe the physiological role and clinical significance of the nigrostriatal pathway.
Describe the features of Parkinson's disease. Describe the pathophysiological basis of Parkinson's disease.
Define the terms chorea, athetosis, hemiballism

Reticular formation:
Describe the organization of the reticular formation and its physiological role.
Describe the ascending Reticular Activation System

Thalamus:
List the groups of thalamic nuclei
Give an outline of connections of thalamus
List the functions of thalamus.

Hypothalamus :
List the major regions and functions of hypothalamus.
Describe the functions of the hypothalamus

Limbic system:
State the components of Limbic system
Describe the physiological role of the limbic system. Recognize the importance of Papez's contributions
Recognize the central role of amygdala.

Cortex:
Identify the major somatic and special sensory, motor & association areas in the cortex.
Recognize the somatotopy of the motor and somatic sensory areas (homunculi)
Recognize the phenomena of hemispheric specialization (dominance), handedness.
Define the role of corpus callosum – inter-hemispheric transfer of information.

EEG:
State the physiological basis of EEG, types of EEG waves, Uses of EEG

Sleep:
Define the various stages of a sleep cycle.
Distinguish between NREM and REM sleep.

Language & speech:
Define the role of Wernicke's & Broca's areas in language & speech
Define aphasia and state the site of lesion in motor and sensory aphasia

Learning and memory:
Describe the classification of learning and memory
Describe the following phenomena of implicit or Non-declarative learning:
o Non-associative – Habituation
Sensitization
o Associative – Classical conditioning
Operant conditioning
Define Explicit or declarative memory.
Define the term synaptic plasticity.
Describe the synaptic phenomenon associated with Short term memory.
Describe the phenomenon leading to long-term memory.
Describe the role of hippocampus in memory formation.
Describe the role of cerebellum in motor learning.

Special Senses
(Lectures + Tutorials 20 hours; Practicals + OSPE 6 hours; ECE: 3 hours

Vision

List the structures within the eyeball.
Name the extraocular muscles and describe their functions.
Describe the functions of Iris, Ciliary body, Intra-ocular muscles, Lens, Aqueous humor, Vitreous body and Optic nerve.
Describe the formation and drainage of aqueous humor.
State the normal range of intraocular pressure

Optics of eye:
List the structures through which light passes before falling on the retina
State the important refracting surfaces of the eye and the extent of contribution of each to image formation.
State that the image formed on the retina is inverted and diminished in size.
Describe the role of crystalline lens in focusing the light rays and describe the changes that happen while focusing a near object – accommodation reflex
List the common refractive errors – Myopia, hypermetropia, presbyopia and astigmatism
Describe the cause for the refractive errors and explain their correction

Retina:
List the retinal cells contributing to the visual pathway. (photoreceptors, bipolar cells and ganglion cells)
Describe optic disc, macula lutea and fovea as important structural features in the retina
Classify photoreceptors – Rods and cones

List major structural and functional differences between rods and cones
Demonstrate visual acuity on a subject using Snellen's chart
Describe the distribution of rods and cones in the retina.

Light & Dark adaptation
Describe the changes that happen during dark and light adaptation.

Colour vision:
Name the types of photoreceptors responsible for colour vision
Classify cones based on their spectral sensitivity
List the types of colour blindness
Describe theories of colour vision
Demonstrate the use of Ishihara's chart to check for colour blindness

Optic pathway:
Draw and describe the optic pathway from the photoreceptors to the visual cortex
Describe the visual field defects produced by lesions at various levels of the pathway

Pupillary reflexes:
Describe the pupillary light reflex pathway
Differentiate between direct and consensual pupillary light reflexes
Demonstrate direct and consensual light reflexes on a subject provided
Describe the accommodation reflex pathway
List the features of Horner's syndrome
Explain Argyll-Robertson pupil

Eye movements:
List the extraocular muscles and describe their actions
Name the cranial nerves innervating the extraocular muscles
Demonstrate assessment of normal eye-movements on a given subject

Hearing

Functional anatomy of the ear:
List different parts of the ear.
Mention functions of outer ear
Describe the role of middle ear in impedance matching
List structures within the inner ear and specify their functions
Describe the importance of attenuation reflex

Function of cochlea:
Draw the cross-section of cochlea with all 3 three scalae.
Describe the 'travelling wave theory' of hearing
Describe the function of basilar membrane in frequency discrimination - 'Place principle' of hearing

Processing of auditory signals:
Describe the auditory pathway

Assessment of hearing:
Define an audiogram
Identify a normal air-conduction and bone-conduction tracing- To be assessed as an Objective Structured Practical Examination
Identify conductive hearing loss and sensory neural hearing loss using audiogram- To be assessed as an Objective Structured Practical Examination
Distinguish between conductive hearing loss and sensory neural hearing loss based on audiogram and simple clinical examinations like Rinne's and Weber's test
Describe the principle of Rinne's and Weber's test
Demonstrate the technique of performing Rinne's and Weber's test on a subject

Equilibrium

Functional anatomy of vestibular apparatus:
List the structures which make up vestibular apparatus and their functions

Mechanism of stimulation vestibular hair cells:
Describe the mechanism of stimulation of otolith organs - deflection of hair cells using gravitational force/inertial force of otolith membrane
Describe the mechanism of stimulation of semicircular canals - deflection of hair cells using inertial force of endolymph

Vestibular pathway:
Describe the connections of vestibular nucleus to the cortex and cerebellum
Describe the projections through vestibulospinal tracts
Describe the functions of Vestibular system - Maintenance of balance, equilibrium and posture

Smell
Describe the arrangement of olfactory sensory neuron within the olfactory epithelium
List the types of cells within the olfactory bulb
Describe the connections of olfactory sensory neurons with cells in the olfactory bulb
Describe the olfactory pathway from the olfactory sensory neurons to the cortex
Assess the olfactory nerve of a subject

Taste
Describe the arrangement of taste cells within taste buds and organization of taste buds within papillae.
List the four basic qualities of taste sensation
Demonstrate how to test for the four basic qualities of taste sensation

Draw and describe the taste pathway from the anterior two-third and posterior one-third of the tongue to the gustatory cortex

Book recommended by the University
Dr. Sharada Subramanian.

BIOCHEMISTRY THEORY SYLLABUS

PAPER I

1. CELL

Cell and cellular organelles

Basics of structure of eukaryotic cells

Overview of cellular organelles (mitochondria, nucleus, ribosomes, proteasomes, lysosomes, endoplasmic reticulum, peroxisomes and golgi apparatus) and their functions

Membrane structure (fluid mosaic model)

Liposomes

Transport across membranes

2. ENZYMES

Nomenclature and IUBMB classification of enzymes

General properties and mechanism of action of enzymes

Specificity of enzymes

Concept of active site

Cofactors

Factors that affect the activity of enzymes

Zymogens and their activation

Enzyme inhibition

Enzyme regulation: covalent modifications of enzymes, allosteric and feedback regulation;

concept of rate-limiting enzymes; constitutive and inducible enzymes

Importance of enzymes in diagnosis and treatment of diseases; isoenzymes

3. VITAMINS

Fat- and water-soluble vitamins: dietary sources, absorption, active forms, recommended dietary
allowances and deficiency manifestations

Hypervitaminosis

4. BIOENERGETICS

Biologic oxidation, electron transport chain and oxidative phosphorylation

5. CARBOHYDRATES

Classification of carbohydrates with physiologically important examples and functions of each type

Digestion and absorption of carbohydrates

Examples of common dietary carbohydrates and the foods that they are present in

Enzymes involved in digestion of carbohydrates: sources, sites of action and effects

End products of digestion and their absorption

Lactose intolerance

Importance of dietary fibre

Glucose transporters

Types, functions, tissue specificity and importance of each

Pathways of carbohydrate metabolism

Glycolysis; Rapaport- Leubering shunt (2, 3-bisphosphoglycerate shunt)

Pentose phosphate pathway and related disorders

Citric acid cycle/ Krebs' cycle/ tricarboxylic acid cycle

Glycogenesis, glycogenolysis and glycogen storage disorders (only names and associated enzyme deficiencies are required for the disorders)

Gluconeogenesis; Cori's cycle and glucose-alanine cycle

Uronic acid pathway

Metabolism of galactose; galactosemia

Metabolism of fructose and related disorders

Polyol pathway and its importance in complications of diabetes mellitus

Regulation of blood glucose levels

Diabetes mellitus

Investigations in patients with diabetes mellitus - plasma glucose estimations (fasting and postprandial), glycated haemoglobin (HbA1c), urine analysis for detection of glucose, ketone bodies and proteins in urine, microalbuminuria, glucose tolerance test (GTT).

6. LIPIDS

Definition, classification and functions of lipids

Classification of fatty acids

Importance of cholesterol, phospholipids, gangliosides, triacylglycerols and eicosanoids in the body

Lipoproteins: types and functions

Digestion and absorption of lipids

Dietary lipids, sources, sites and action of enzymes involved in digestion of lipids

Absorption of lipids, steatorrhoea, importance of chylomicrons

Pathways of lipid metabolism

Fatty acid oxidation: types of oxidation; beta-oxidation of saturated fatty acids and energetics of the pathway; related disorders.

Concept that fatty acids can be synthesized in the body from acetyl CoA from various sources (pathway not required)

Metabolism in adipose tissue

Metabolism of ketone bodies; regulation and clinical significance of the processes

Metabolism of cholesterol: outline of biosynthesis only with emphasis on regulatory step;

regulation of synthesis of cholesterol and bile acids; cholesterol-lowering agents; enterohepatic circulation.

Metabolism of lipoproteins; dyslipidemias; lipoprotein (a); risk factors for atherosclerosis and coronary artery disease; definition of metabolic syndrome

Eicosanoids and their significance

Phospholipids and their significance; lecithin-sphingomyelin ratio in amniotic fluid

Lipid storage disorders (names of conditions and associated enzyme defect only)

Role of liver in lipid metabolism; fatty liver and lipotrophic factors

7. INTEGRATED METABOLISM

Overview of metabolism in the fed and fasting states

Overview of metabolism in liver, brain and muscle

8. MINERALS

Metabolism of macro minerals and trace elements and related disorders

9. NUTRITION

Importance of the various macro- and micronutrients in the diet

Calorific value of various macronutrients; glycemic index of food; importance of dietary fibre

Balanced diet; specific dynamic action; basal metabolic rate; respiratory quotient

Parenteral nutrition

Protein energy malnutrition

Body mass index (BMI); obesity

PAPER II

10. PROTEINS

Classification of amino acids

Separation of amino acids by paper chromatography

Classification of proteins.

Structural organization of proteins

Structure and functions of myoglobin, hemoglobin and collagen and associated disorders

Plasma proteins and their functions

Separation of serum proteins by paper and gel electrophoresis

Patterns of serum protein electrophoresis (normal pattern and patterns in multiple myeloma, cirrhosis and nephrotic syndrome)

Digestion and absorption of proteins

Digestion of proteins

Overview of amino acid absorption

Amino acid transporters in the intestine

Meister's cycle

Disorders associated with amino acid absorption

General pathways of amino acid catabolism

Overview and biochemical importance of the processes of transamination and oxidative deamination

Urea cycle and related disorders

Metabolism of individual amino acids

Overview of biosynthesis of non-essential amino acids

Functions of individual amino acids

Physiologically important products derived from amino acids, with overview of the pathways involved.

Catabolism of amino acids

Disorders of amino acid metabolism

11. NUCLEOTIDES

Types and functions of nucleotides and nucleic acids

Synthetic oligonucleotide analogues

Metabolism of nucleotides

Outline of synthesis of purine and pyrimidine nucleotides, with reference to precursors and endproducts only

Salvage pathways and associated disorders
Degradation of purine and pyrimidine nucleotides and related disorders

12. HOMEOSTATIC MECHANISMS IN THE BODY

Acid base balance: hydrogen ion homeostasis and related disorders; blood gas parameters and clinical applications

Fluid and electrolyte balance; regulation of osmolality and maintenance of fluids in the various body compartments and related disorders

13. HEME METABOLISM

Heme synthesis, regulation and porphyrias

Heme degradation and related disorders

14. FUNCTION TESTS

Renal, liver and thyroid function tests

15. MOLECULAR BIOLOGY

Overview of cell cycle

Structure of DNA and RNA

Outline of DNA synthesis, with relevant enzymes

Types of DNA damage and mention of repair mechanisms of clinical relevance

Outline of RNA synthesis, with relevant enzymes; post-transcriptional processing in eukaryotes

Genetic code and outline of protein synthesis in eukaryotes; post-translational modifications

Mutations

Basic concepts of gene expression in eukaryotes

Recombinant DNA technology; principles and applications of various techniques (polymerase chain reaction, blotting techniques, restriction fragment length polymorphism)

Transgenic animals

Human genome project

Gene therapy

16. MISCELLANEOUS TOPICS

Metabolism of xenobiotics

Oxidative stress: mechanisms of generation of reactive oxygen species (ROS) in cells and the role of antioxidants

BIOCHEMISTRY PRACTICAL SYLLABUS FOR FIRST YEAR MBBS

1. Normal constituents of urine
2. Abnormal constituents of urine
3. Estimations of levels of glucose, urea, creatinine, uric acid and total protein in blood
4. Demonstration of protein electrophoresis and paper chromatography
5. Demonstration of use of instruments: centrifuge, colorimeter, flame photometer, electrophoretic apparatus, chromatography chamber and urinometer.
6. Electrophoretic patterns (normal pattern and patterns in multiple myeloma, cirrhosis and nephrotic syndrome)
7. Chromatographic patterns seen in inborn errors of metabolism (eg, phenylketonuria)
8. Charts: Clinical cases for interpretation and discussion of results of biochemical tests
9. OSPE
10. Record maintenance.

Textbook to be followed: Vasudevan and Sreekumari

- Students should **NOT** be questioned on structure and chemistry of biomolecules **(EXCEPT for nucleic acids)** in theory papers.

- Students should **NOT** be asked to write the steps or describe the reactions of the following pathways: in theory exams.

  a. Uronic acid pathway
  b. Pentose phosphate pathway
  c. Cholesterol biosynthesis.
  d. Fatty acid synthesis
  e. Synthesis of phospholipids, prostaglandins and the related molecules.
  f. Purine and pyrimidine synthesis.
  g. Glycogen metabolism and its regulation.
  h. Pathways of synthesis and catabolism of amino acids other than aromatic and **sulphur-containing amino acids**