VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT.

F.Y. M.B.B.S.

SECTION - B

MUHS

CURRICULA I

1. PHASE-I

A) Introduction

As per the regulations on graduate medical education the M.B.B.S. course is divided in to phases – I, II, and III. During phase – I every student shall undergo a period of study of pre-clinical subjects for two semesters. These subjects are

1 – Human Anatomy
2 – Physiology including bio-physics
3 – Biochemistry
4 – Introduction to community medicine including Humanity.

At the end of second term there will be Ist professional university examination.

B) Time distribution :- The first two semesters (approximately 240 teaching days) shall be occupied in the phase I (pre-clinical) subjects and introduction to a broader understanding of the perspectives of medical education leading to delivery of health care.

Following minimum teaching hours are prescribed in various disciplines for two semester

Anatomy	650 hours
Physiology	480 hours
Biochemistry	240 hours
Community Medicine	060 hours
Total	1430 hours

Didactic lectures should not exceed 1/3 of the time schedule, 2/3 schedule should include practicals and group discussions/ seminars / tutorials. Learning processes should include living experiences and problem oriented approaches. Passing in phase –I is compulsory before proceeding to phase-II training.

C) Attendance:

75% of attendance in a subject for appearing in the examination is compulsory provided he/she has 80% attendance in non lecture teaching. I.e. seminars, group discussions, tutorials, demonstrations and practicals.

Internal assessment:

i) Pattern of Examination for formative evaluation (internal assessment)

first semester will have one (1) periodical short tests each carrying 25 marks each in Theory & practicals. There will be Terminal examination before the completion of 1 st Semester. The Terminal examination will include one theory paper of 60 marks & practical of 40 marks and viva 20 marks.

-Similarly second semester will have one (1) periodical short tests examination will be at the end of second Semester. It will have Theory 100 marks (2 papers of 50 marks each), Viva 20 marks & Practicals of 40 marks. Detail table is as follows..

ii) Internal Assessment- Total marks 40

(Theory 20 & practical 20)

In theory & practical. 10 marks each will be based on performance in – Terminal & Preliminary examination & the remaining 10 marks each will be based on the performance of 2 periodicals short tests in theory and practical as follows:

In periodical short tests, MCQs should be included.

The candidate should secure 50% marks in internal assessment in theory –and practical taken together .

Table showing method of calculation of internal Assessment marks

Examinations	**Theory**	**Practical**
	Theory Paper + Viva = Total	
1. Terminal Exam	60 + 20 = 80	40
2. Preliminary Exam	100 + 20 = 120	40
Total	**200**	**80**

Take 5% of it to calculate Marks out of 10=A

Take 12.5 % of it to calculate marks out of 10=C

Theory Practicals

Ist Term

1st Periodical Test 25 25

Ilnd Term

2nd Periodical Test 25 25

Total 50 50

Take 20% of it to calculate marks out of 10=B

Take 20% of it to calculate marks out of 10=D

ii) Internal Assessment marks to be sent to University

For Theory total 20 (A+B)

Practicals total 20 (C+D)

University examination:

There shall be one main university examination in a year at the end of second semester in the subjects of Anatomy, Physiology and Biochemistry.

Distribution of Marks: As per the following table

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Appendix - A

Sr. No.	Subject	Theory /Oral / Practical/ Internal Assessment		Maximum marks in each part of the subject	Minimum marks required to pass in each part of the subject	Minimum marks required to pass in each subject
1	ANATOMY	a) Theory - Paper I		50	50	100
		- Paper II		50		
		b) Oral		20	--	
		c) Theory +Oral		120	60	
		d) Practical		40	20	
		e)Internal Assessment	Theory	20	20	
			Practical	20		
2	PHYSIOLOGY	a) Theory - Paper I		50	50	100
		- Paper II		50		
		b) Oral		20	--	
		c) Theory +Oral		120	60	
		d) Practical		40	20	
		e)Internal Assessment	Theory	20	20	
			Practical	20		
3	BIOCHEMISTRY	a) Theory - Paper I		50	50	100
		- Paper II		50		
		b) Oral		20	--	
		c) Theory +Oral		120	60	
		d) Practical		40	20	
		e)Internal Assessment	Theory	20	20	
			Practical	20		

In each of the subjects a candidate must obtain 50% in aggregate with a minimum 50% in theory, 50% in Theory+orals, 50% in practicals and 50% in Internal Assessment.

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MODEL TIME TABLE

PHASE -.I

MODEL TIME- TABLE

(Subject to modification as per local situation)

First Semester :

Days Time	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4
Mon	Anat.	Anat.	Anat.	Anat.	L	Phys-	Phys-	Phys-
Tues	Anat.	Anat.	Anat	Anat.	U	Phys	Phys -	Phys-
Wed	Anat.	Anat.	Anat.	Anat.	N	Bioch	- Bioch	Bioch-
Thurs	Anat.	Anat.	Anat.	Phy.	C	Phys-	Phys-	Phys-
Fri	Anat.	Anat,	Anat.	Bioc.	H	Bioch.	Bioch-	Bioch-
Sat	Anat.	Anat.	Anat.	Phys-		Phys-	Phys	Phys

Second Semester;

Days Time	8-9	9-10	10-11	11-12	12-1	1-2	2-3	3-4
Mon	Phys.	Phys	Phys	Anat	L	Anat	Anat	Anat
Tues	Phys	Phys	Phys	Anat.	U	Anat.	Anat.	Anat.
Wed	Bioch	Bioch	Bioch	Bioch	N	Anat	Anat	Anat
Thurs	Phys	Phys	Phys	Phys	C-	Anat	Anat	Anat
Fri	Bioch	Bioch	Bioch	Anat	H	Anat	Anat	Anat
Sat	Phys	Phys	Phys	Phys		Anat	Anat	Anat

NOTE: Community Medicine lecture be arranged in consolation with other preclinical departments in the above things.

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HUMAN ANATOMY

(i) Goal:

The broad goal of the teaching of undergraduate students in Anatomy aims at providing comprehensive knowledge of the gross and microscopic structure and development of human body to provide a basis for understanding the clinical correlation of organs or structures involved and the anatomical basis for the disease presentations.

(ii) Objectives

A-Knowledge:

At the end of the course the student shall be able to

(a) Comprehend the normal disposition, clinically relevant interrelationships, functional and cross sectional anatomy of the various structures in the body

(b) Identify the microscopic structure and correlate elementary ultrastructure of various organs and tissues and correlate the structure with the functions as a pre requisite for understanding the altered state in various disease processes.

(c) Comprehend the basic structure and connections of the central nervous system to analyse the integrative and regulative functions of the organs and systems. He/she shall be able to locate the site of gross lesions according to the deficits encountered.

(d) Demonstrate knowledge of the basic principles and sequential development of the organs and systems, recognize the critical stages of development and the effects of common teratogens, genetic mutations and environmental hazards. He/she shall be able to explain the developmental basis of the major variations and abnormalities.

B-Skills

At the end of the course the student shall be able to;

(a) Identify and locate all the structures of the body and mark the topography of the living anatomy.

(b) Identify the organs and tissues under the microscope.

(c) Understand the principles of karyotyping and identify the gross congenital anomalies.

(d) Understand principles of newer imaging techniques and interpretation of CT scan, sonogram etc.
(e) Understand clinical basis of some common clinical procedures i.e. intramuscular and intravenous injection, lumbar puncture and kidney biopsy etc.

C-Integration

From the integrated teaching of other basic sciences, student shall be able to comprehend and regulation and integration of the functions of the organs and systems in the body and thus interpret the anatomical basis of disease process.

(iii) Detail syllabus of Human Anatomy is given under following heads.

A) General Anatomy

B) Regional Anatomy

I - Upper limb

II - Lower limb

IIII - Abdomen

IV - Thorax

V - Head Face Neck

VI - Spinal Cord & Brain

C) Micro-Anatomy I - General Histology

II - Systemic Histology

D) Developmental Anatomy I - General Embryology

II - Systemic Embryology

E) Genetics

F) Radiological Anatomy, USG, CT, MRI

G) Surface Anatomy, Living & Marking

H) University Exam pattern, Theory & Practical

I) Books recommended

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Detail syllabus of Human Anatomy

A) GENERAL ANATOMY

I) DESCRIPTIVE TERMS

Terms used for describing the position of the body, Anatomical planes, Commonly used terms in Gross Anatomy, Terms used in Embryology, Terms related to limbs, for hollow organs, for solid organs, to indicate the side, for describing muscle, for describing movements

II) General Osteology

Definition, Nutrition & Morphological Classification, Distribution and Functions of bone Appendicular, Axial.

Diaphysis, Metaphysis, Epiphysis, Types of epiphysis

Primary centres, Secondary centers, Law of ossification, Epiphyseal plate, Blood supply of long bone

CARTILAGE

Definition, Types, structure, Distribution, Nutrition

III) General Arthrology

Classification, Synarthrosis, Amphiarthrosis, Diarthrosis.
Cartilaginous. Primary, Secondary

Synovial - Axis of movement, Structure of typical synovial joints

Classification of synovial joints, according to the shape ,axes of movement and morphology

Simple, Compound ,Complex joints, Blood supply & nerve supply.

IV) General Myology

Definition, types: Origin, Insertion, Morphological classification
Actions of muscles, nerve supply
Functional classification, Prime movers, Fixators, Antagonists, Synergists
BURSA, Structure, Functions, types:
LIGAMENTS, Types & functions, Sprains
RETINACULA & APONEUROSES

V) INTEGUMENT

a) Skin - Introduction : Surface area
Types :Thin, Thick, hairy, Functions, innervation
Structure :
Epidermis, Dermis, Appendages

b) SUPERFICIAL FASCIA
Distribution of fat, functions

c) DEEP FASCIA
Features, Modifications, Functions

VI) General Angiology

Arteries: Muscular, Elastic; Arterioles; Capillaries: Sinusoids, Veins - Anastomosis: End arterial; Vasa vasorum, nerve supply of blood vessels
Lymphatic system
Lymph vessels, Central lymphoid tissue, Peripheral lymphoid organs, Circulating lymphocytes - T and B lymphocytes

VII) General Neurology

Structure of nervous tissue,
Neurons: Synapses :Structural – type, Functional types
Classification of neurons : According to polarity and According to relative lengths of axons and dendrites:
Neuroglia: Nerves :Cranial – Spinal, Structure of typical spinal nerve
Autonomic nervous system :Sympathetic :Sympathetic ganglia, postganglionic fibres
Parasympathetic :Cranial outflow, sacral outflow

Level 2: Mechanical properties of bones.
synthesis, histogenesis, growth of Cartilage,Factors limiting range of movement,
Kinesiologically: Sellar, Ovoid, Joint position: Loose-packed, Close-packed
Number and diameter of fibres, Range of contraction, Active insufficiency,Passive insufficiency, shunt, swing, spin
Adventitious bursae - Housemaid's knee, Clergyman's knee, Student's elbow, Weaver's bottom, Porter's shoulder
Clinical correlation, significance of Langer's lines, Tension lines, flexure lines Transplant Collateral circulation, Functional end arteries, Arteriosclerosis,

Level 3: Effect of hormones on bony growth, Wolff's law, Surface topology of articular surfaces, Spin, Swing, Cartilage Grafts, Kinesiology, Body liver system,Skin grafts,Ischaemia, Infarct,Bursitis

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B) Regional Anatomy

I) UPPER LIMB

REGIONS : Mammary gland, Axilla, Cubital fossa, Fascial spaces of the hand Relations and functional importance of individual structures, Dupuytren's contracture, Hand as a functional unit – grips, Nerve injury, carpal tunnel syndrome, Clavipectoral fascia; Salient features about carpals;

ARTHROLOGY

Shoulder girdle; Shoulder joint ; Elbow ; Radioulnar joints; Wrist; Carpometacarpal joint of thumb; Bones taking part Classification of joints, Movement with muscles causing movements, midcarpal joint, metacarpophalangeal joints, interphalangeal joints Fall on the outstretched hand

Level 2 Axilla: Collaterals Lymph nodes (breast) Axillary sheath cervico-axillary canal, Abscess drainage, Palm: comparative anatomy (thumb, palmaris brevis), position of rest and of function, collaterals, Fascial spaces: Surgical significance

OSTEOLOGY

Identification; Anatomical position; Parts; Joints formed; Development; identification of individual carpals in and articulated hand)
Clavicle: Line of force transmission, commonest site of fracture
Humerus: fractures - Colles' fracture, Smith's fracture
Carpals, Metacarpals, Phalanges: Carpal tunnel syndrome, fracture scaphoid Surgical approaches, Subluxation of head of radius, carrying angle

MYOLOGY:

Muscles of upper limb, attachment, Nerve supply, Actions Applied aspects: Volkmann's ischaemic contracture Quadrangular and triangular spaces, Triangle of auscultation

ANGIOLOGY: Axillary, Brachial, Radial, Ulnar Arteries, veins, lymphatics Commencement, Termination, Main area of distribution and drainage, Anastomosis – Applied aspects, Artery : Damage to vessels, Raynaud's disease, Veins: Thrombosis, Lymphatics: Lymphangitis (red streaks), lymphadenitis,

NEUROLOGY:

A. Nerves

Axillary, median, ulnar, musculocutaneous, radial, Origin, course, distribution, Root value

B. Plexus: Brachial

Applied aspects: Nerve injury at various sites - Tendon reflex - Winging of scapula, Erb's palsy, Klumpke's palsy, Crutch palsy, ulnar paradox

II) LOWER LIMB

REGION: boundaries, major contents**;** Gluteal, femoral triangle; Adductor canal, compartments of thigh, leg**;** Popliteal fossa, Adductor canal , Sole, Arches of foot,; Gluteal IM injections
Femoral hernia blood supply to head of femur**;** Fracture neck of femur, mechanics movement of joints; hip and knee, Trendelenburg test; Knee joint : derangement, injuries to cruciate ligaments, menisci; (tear - bucket handle type); Ankle : Sprain mechanism of venous return, varicose veins
Applied aspects of Adductor canal, popliteal aneurysms

OSTEOLOGY: Identification, region, anatomical position; parts, joints formed, For tarsals - identification of individual tarsals in an articulated foot.

Level 2

Applied aspects: Bony specialization for bipeds, walking and transmission of weight, Fracture, femoral torsion, neck shaft angle, bone grafts

ARTHROLOGY

Hip, knee, ankle, subtalar, Tibiofibular Hip joint : dislocation, congenital, traumatic, surgical approaches to joints (anatomical basis), traumatic effusion, bursitis

MYOLOGY

Attachments, nerve supply, actions of: Muscles of lower limb calf pump, antigravity muscles

ANGIOLOGY

Artery: Femoral, profunda femoris, popliteal, dorsalis pedis, Commencement, termination, main area of supply, course, relations & applied
Vein: Venous drainage of lower limb, long and short saphenous veins, Communication and valves. Varicose Lymphatics: Inguinal group of lymph nodes

Lever 2 :intermittent claudication, clinical significance of anastomosis: around knee, venous thrombosis

NEUROLOGY

a. Plexus: Lumbar and sacral, Location, Formation, Distribution

b. Nerves: Root value of sciatic, femoral, obturator, tibial, common peroneal nerves; Origin, course, distribution; sciatica, foot drop

Level 2 : Pes cavus, equinovarus, clawing of toes

III) ABDOMEN

i) ANTERIOR ABDOMINAL WALL

Rectus sheath, quadrants and regions, Testes, epididymis, spermatic cord, scrotum

Level 2: Surgical incisions of abdomen types of inguinal herniae
Peritoneum, Lesser Omentum, Omental Bursa, Epiploic Foramen, Testes
Morphology, blood supply, lymphatic drainage

25. SPERMATIC CORD

Definition, beginning, end, course and contents, coverings, vasectomy

ii) Abdominal organs :

Morphology relations blood supply, lymphatics nerve supply & applied Anatomy of following organs

STOMACH, SPLEEN, LIVER:,BILIARY APPARATUS, PANCREAS, SMALL INTESTINE,LARGE INTESTINE AND VERMIFORM APPENDIX,KIDNEYS, URETERS,SUPRARENAL GLANDS

Level 2: peptic ulcer ,Splenic circulation, splenic vascular segments,liver, biopsy, Support of liver,Gall stones **,**Duct system of pancreas **,**Surgical approach to kidney , stones (Renal), Ureter,Sites of constrictions, Hydronephrosis, pheochromocytoma

Level 3: Gastroscopy, Achlorhydria, Splenectomy, Liver transplant, Pancreatitis, diabetes, Renal transplant, Stones in ureter, Cushing's disease

iii) Pelvic Viscera :-

Morphology, relations, blood supply nerve supply & applied anatomy

URINARY BLADDER & URETHRA, UTERUS, OVARIES AND UTERINE TUBES, PROSTATE, RECTUM AND ANAL CANAL, UROGENITAL DIAPHRAGM (UGD)

Level 2: Supports and micturition, stones in bladder ,Ovarian cyst, enlargement complications, Fistula, Fissure, piles

Level 3: cystoscopy, Hysterectomy,cancer, Supports of rectum

iv) Perineum – Ischiorectal fossa, pudendal canal, perianal spaces Urogenital diaphragm, male urethra, penis – perineal pouches

Level 2: Ischiorectal hernia

v) MYOLOGY

Anterior abdominal wall, Rectus sheath, Psoas major, Quadratus lumborum, Thoracoabdominal diaphragm, pelvic diaphragm, Thoracolumbar fascia, perineal spaces & muscles

Level 3: Psoas abscess

vi) OSTEOLOGY

Level 2: Pelvis - types
(various diameters), lumbar vertebrae, anatomical basis of disc prolapse, nerve compression

Level 3: Sacralization, Lumbarization

ARTHROLOGY

Movements of lumbar vertebrae, lumbosacral, sacroiliac, sacrococcygeal joints

vii) ANGIOLOGY :-

Origin, course, termination, relations, branches & applied anatomy of

PORTAL VEIN

Level 2: portasystemic communications

Level 3: Portasystemic communications in detail**;** Development
INFERIOR VENA CAVA,ABDOMINAL AORTA,INTERNAL ILIAC ARTERY

viii) NEUROLOGY, LUMBAR PLEXUS, SACRAL PLEXUS

IV) THORAX

i) THORACIC WALL,THORACIC INLET

Boundaries and contents

THORACIC OUTLET, Boundaries and contents, major openings and levels, Typical intercostal space, Boundaries and contents, muscles Atypical intercostal space, Movements of respiration

Level 2: importance and minor openings in outlet, Accessory muscles of respiration

Level 3: Applied aspects: Barrel chest, pectus excavatum, rickety rosary

ii) MEDIASTINUM

Divisions and major contents

Level 2: Mediastinitis, mediastinoscopy

SUPERIOR AND POSTERIOR MEDIASTINA, LIST OF STRUCTURES

Boundaries and contents:

Level 2 : Superior mediastinal Syndrome, Course, relation and branches / area of drainage

Level 3: Coarctation of aorta, aneurysm, developmental anomalies

iii)PLEURA

Pleural reflections, recesses, innervation

Level 2: importance of recesses

Level 3: pleural effusion

LUNGS

Gross description including lobes, fissures and bronchopulmonary segments

Level 2: relations, blood supply, nerve supply

Level 3: Postural drainage, surgical importance, of bronchopulmonary segments, foreign body inhalation

iv)PERICARDIUM & HEART

Divisions of pericardium and sinuses

Level 2: referred pain

Level 3: Pericardial effusion

HEART

Anatomical position, location, surfaces and borders, interior of all chambers, conducting system of heart; vessels of heart

Level 2: Relations, nerve supply - foramen ovale, patent IV septum, over-riding aorta, referred pain, functional end arteries - coronaries

Level 3: PDA, Fallot's tetralogy, etc.

v)OSTEOLOGY

IDENTIFICATION and parts of VERTEBRAE , RIBS - and STERNUM

Level 2: Identification of T1, T9, T10, T11, T12, vertebrae and atypical ribs - 1, 2, 11, 12. relations, attachments, ossification

Level 3: Fracture ribs, flail chest, compression fracture of vertebra

V) HEAD-FACE NECK

i) REGIONS AND ORGANS, FASCIAE OF THE NECK TRIANGLES OF NECK

Level 2 Spaces and spread of infections, axillary sheath **,** Relations of contents, Damage to accessory nerve, sialogram, approach to gland, bidigital palpation of submandibular glan**d,**Dangerous area of face, squint

Level 3: surgical neck incisions, external jugular vein - air embolism, LN biopsy, JVP, pulse, Frey's syndrome

GLANDS

Thyroid, Parathyroid, Parotid, Submandibular, sublingual, Pituitary
Morphology, capsule, relations, nerve supply, blood supply

FACE

Muscles, nerve supply - blood supply

SCALP,PALATE,TONGUE,LARYNX, PHARYNX, ORBIT, EYEBALL,STYLOID APPARATUS,NASAL CAVITY, EAR,INTERNAL EAR,MIDDLE EAR,EXTERNAL EAR,MENINGES

ii) OSTEOLOGY

Identification, anatomical position, parts, foramina in the skull, structures passing through them, norma basalis, verticalis, frontalis, lateralis, occipitalis and interior of cranial cavity
Foetal skull; Mandible: Age changes
Level 2: Fontanelles, Dental formula
Level 3: Fractures of the skull, Age of dentition, cervical rib, disc herniation

iii) ARTHROLOGY

TM JOINT
Level 2: Dislocation

iv) MYOLOGY

Sternomastoid, Digastric, Mylohyoid, Hyoglossus, Muscles of facial expression, mastication, larynx, pharynx, tongue, palate and, Extra-ocular muscles
Level 2 Relations, development
Level 3 facial nerve palsy

v) ANGIOLOGY

ARTERIES

Origin, parts, course, relations, branches of:
Subclavian, Internal carotid, External carotid, Vertebral, Lingual, Facial, Maxillary

Level 2: Sub-branches, distributions

Level 3: Subclavian steal syndrome, Subclavian-axillary anastomosis

VEINS

External and internal Jugular veins, venous drainage of face

VENOUS SINUSES

Names, locations, drainage, classification
EMISSARY VEINS, CAVERNOUS SINUS, LYMPHATIC DRAINAGE OF HEAD FACE NECK

vi) NEUROLOGY

Cranial nerves,Nucleus, course, relations, branches, distribution, reflex pathways & applied anatomy, PLEXUS: Cervical, Brachial, PARASYMPATHETIC GANGLIA, CERVICAL SYMPATHETIC CHAIN

VI) NEUROANATOMY

i) SPINAL CORD

Gross features: Extent (child / adult), enlargements, conus medullaris, filum terminale, spinal meninges Tracts Ascending and Descending

Level 2: Spinal segments, vertebral correlation, significance of enlargements nuclei of grey matter at upper & lower cervical, mid-thoracic, Lumbar & sacral levels Clinical correlation of lesions

Level 3: anomalies,lamination, syringomyelia, PID, tumours, TB, trauma, dislocation, myelography

ii) MEDULLA OBLONGATA

Gross features: Motor decussation: Sensory decussation: Inferior olivary nucleus Cranial nerve nuclei

Level 2: Tuber cinereum, pontobulbar body, Order of neurons, Details of nuclei and organisation of white matter

Level 3: medullary syndromes-Bulbar palsy, increased ICT, Arnold-Chiari malformation,

iii) PONS

Cross sections at the level of:

- Facial colliculus, Trigeminal nucleus

General features: Peduncles, Floor of the fourth ventricle

Level 2: Relations

Level 3: Tumours, pontine haemorrhage

iv) CEREBELLUM

Gross features: Division, Lobes, relations, internal structure -

Level 2: connections of,cerebellar cortex and intracerebellar nuclei, white matter classification, Purkinje neuron,

Level 3: dysfunction,-dysequilibrium, ataxia, hypotonia

Nuclei: Names of nuclei and important connections

Peduncles : Important tracts in the peduncles

Functions : Of archicerebellum, paleocerebellum & neocerebellum

v) MIDBRAIN

General features :

relations, contents of interpeduncular cistern, connections of red nucleus

Level 2: Weber's syndrome, Benedikt's syndrome

Level 1 :T.S. at inferior colliculus, TS at superior colliculus

vi) CEREBRUM

CORTEX, WHITE MATTER, BASAL NUCLEI, LIMBIC LOBE

Surfaces, borders, major sulci, gyri, poles, lobes, major functional areas, interior - gray and white matter

Gray - cortex - granular / agranular, striate, Basal nuclei - names, White matter - classification with examples; Components of limbic lobe

Level 2: handedness, Connections of limbic lobe

vii) DIENCEPHALON

Dorsal thalamus Epithalamus Metathalamus Hypothalamus Subthalamus

Boundaries, parts, relations (gross), cavity, major nuclei, gross connections

viii) VENTRICULAR SYSTEM

Parts, boundaries, foramina, correlation with parts of brain

Level 2: Choroid fissure, recesses, Queckenstedt's test

Level 3: Hydrocephalus, VA shunt

ix) BLOOD SUPPLY OF BRAIN

Circle of Willis, subarachnoid space, arteries, veins

Level 2: blood brain barrier, Hemiplegia

Level3: End arteries, CSF formation

x) MENINGES

Cerebral and spinal meninges, folds of dura, contents of subarachnoid spaces, arachnoid villi and granulations, direction of flow of CSF, lumbar puncture **Cisterns,** Definition, terminology, cisterna magna

Level 2: cisternal puncture, Queckensted's test, vertebral venous plexus, choroid plexus
Extracerebral and intracerebral communication, CSF block,
Level 3: Epidural space

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C) MICROANATOMY

I) GENERAL HISTOLOGY

i) MICROSCOPE,

Light microscope: parts, magnification, resolution,Electron microscope,
Level 2 Micro techniques, H and E staining
Level 3: Polarizing microscope, phase contrast, scanning EM

ii) CYTOLOGY

Cell,Cytoplasm and nucleus,Cytomembranes,Unit membrane, **Cell organelles**
Mitochondrial DNA, mitochondrial myopathy

Level 2 Specialisations of cell surface, Sarcoplasmic reticulum of muscle, Primary and secondary lysosomes, residual bodies, Effect of colchicine and anticytotic drugs on spindles preventing mitosis, Endocytosis, exocytosis, movement of microvilli; Cell mitotic activity
Level 3 Lysosomal storage disease
NUCLEUS - Structure, nuclear envelope, chromatin, Barr body, nucleolus

iii) Epithelial

Definition, Classification, Structure of various types & subtypes of epithelia
Level 2: Nutrition, Renewal, Innervation,
Level 3: Metaplasia;
Surface modifications,Cilia; Microvilli; Stereocilia; Cell junction and junctional complexes;
Glands, Classification; Unicellular and Multicellular; Exocrine, Endocrine, Amphicrine. Exocrine: Simple, Compound; Apocrine, Merocrine, Holocrine; Tubular, alveolar, tubuloalveolar; Serous; Mucous ; Mixed

iv) Connective tissue, classification, structure, fibres, ground substance, loose areolar tissue, adipose tissue
Level 2 : Glycosaminoglycans
Level 3 : Scurvy, oedema, inflammation

v) Bone & Cartilage

Bone, Compact, Cancellous, Developing bone; ossification, Woven, lamellar bone

Cartilage, Classification, types, Perichondrium, functions
Level 2: Growth: Interstitial, Appositional; Bone callus, Osteomalacia , Osteoporosis , Osteoma
Level 3: Chondroma

vi) Muscle

Skeletal muscle Plain muscle Cardiac muscle Intercalated disc, syncitium; Sarcomere, I and A bands, myofibrils, myofilaments,; Sarcoplasmic reticulum,
Level 2: Innervation, Red fibres, white fibres
Level 3: Hypertrophy, Hyperplasia ,Rigor mortis , Myasthenia gravis

vii) Nervous

Neurons, types; Neuroglia, types; Myelinated nerve fibre *LS*; Non-myelinated nerve fibre; Peripheral nerve ; Nodes of Ranvier; Synapses;

viii) Vessels

Large sized artery Medium sized artery, Arteriole; Capillary, Sinusoid; Medium sized vein;
Level 2: Atherosclerosis, Aneurysm, Infarcts, clotting

Lymphoid tissue

T cells, B cells; Mucosa Associated Lymphoid Tissue; Humoral immunity, Cell mediated immunity; Lymph node *section*; Thymus, Spleen, Tonsil
Level 2: Blood-thymus barrier, Open and closed circulation in the spleen
Level 3: Organ transplantation, Graft rejection, Autoimmune disease

II) SYSTEMIC HISTOLOGY

Basic organization, salient features, Identification
Structure and function correlation, individual features

i) Integumentary system

Skin - Types; Epidermis and dermis; various cells, Appendages of skin
Level 2: Renewal of epidermis
Level 3: Albinism, melanoma, Acne

ii) Alimentary system

a) Oral tissues

Lip, Tongue, taste buds, Papillae; Tooth, Developing tooth, Salivary glands
Level 2: Striated duct, ion transport

b) GI Tract

Basic organization - 4 layers; Oesophagus with glands Stomach - Fundus, Chief cells, Parietal cells, intrinsic factor; Stomach -

Pylorus Duodenum Brunner's glands; Small intestine - with Peyer's patch, Appendix, Large intestine

Level 3: Pernicious anaemia, ulcer, gastritis, Hirschsprung's disease or megacolon

c) Glands

Pancreas: Exocrine, islets of Langerhans; Liver, Hepatic lobule, portal lobule,; portal acinus; Gall bladder

Level 2: Liver as an endocrine gland

Level 3: Diabetes mellitus, Cirrhosis of liver, liver regeneration, Chalones

iii) Respiratory system

Olfactory mucosa; Epiglottis; Trachea, Lung, Bronchus, bronchiole, alveolar duct, sac, alveoli, pulmonary type I and II cells

Level 2: Double spirally arranged bronchial smooth muscle

Level 3: Bronchial asthma, Hyaline membrane disease, Heart failure cells

iv) Urinary system

Basic organization; Nephron - Parts, podocytes, Collecting system; Kidney - Cortex, Medulla Ureter; Urinary bladder, Urethra

Level 2: Juxtaglomerular apparatus

v) Male reproductive system

Basic organization; Gonads, Tract, Accessory glands; Testis; Epididymis ; Vas deferens; Prostate ; Penis; Seminal vesicle

Level 2: Stages of spermatogenesis

Level 3: Immotile sperm

Female reproductive system

Basic organization; Gonads, Tracts, Accessory glands; ; Ovary - with corpus luteum; Fallopian tube; Uterus ; Cervix; Vagina, Mammary gland Active , Passive

Level 2: Stages of maturation of ovarian follicle , Phases of menstruation Colostrum, IgA, Placenta : Maternal unit, Foetal unit, Umbilical cord***:*** Wharton's jelly

vi) Endocrine system:

Pituitary; Adenohypophysis; Neurohypophysis; Thyroid ; Follicular, parafollicular cells; Parathyroid ; Chief cells, oxyphil cells; Adrenal; Pancreas; Testis ; Ovary

Level 2: Hypothalamo-pituitary Portal system

Level 3: Pheochromocytoma

vii) Nervous system

A. Central

Basic organization; Cerebrum; Cerebellum; Spinal cord; Cervical; Thoracic; Lumbar; Sacral;

B. Peripheral

Sensory ganglia; Autonomic ganglia (sympathetic ganglion); Peripheral nerve

Special senses

I. Visual: Eyeball

Cornea ; Sclerocorneal junction ; Canal of Schlemm; Lens ; Retina ; Optic nerve

Level 3: Kerattoplasty, eye donation, glaucoma, retinal detachment

2. Auditory:

Internal ear; Cochlea ; Semicircular canals; Vestibule;

3. Olfactory

Nasal cavity

4. Gustatory

Tongue with taste buds

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D) DEVELOPMENT ANATOMY

I) GENERAL EMBRYOLOGY

i) **Introduction:** Stages of human life phylogeny
Ontogeny, Trimester, Viability,
Terms of reference: e.g. Cranial, Rostral, Caudal, Dorsal, Ventral, Lateral, Medial, Median, Planes of section
Level 3: The law of recapitulation, "Critical period", malformations, USG, Amniocentesis Chorionic Villus Biopsy, Fetoscopy, etc Teratology History of Embryology

ii) **Gametogenesis:** Menstrual cycle other reproductive cycles, Germ cell Transport and Fertilisation, Sperm capacitation, Methods of contraception, Sex determination
Level 3: Teratogenic influences; Fertility and Sterility, Surrogate motherhood; Social significance of “Sex-ratio”,

iii) Cleavage, Blastocyst, Cytotrophoblast, Syncytiotrophoblast Implantation: Normal sites, Abnormal sites,; Placenta praevia, Extra-embryonic Mesoderm and Coelom; Bilaminar disc - Prochordal plate
Level 2: “abortion”; Decidual reaction, Chorionic Gonadotropins - Pregnancy test,

iv) Primitive streak Notochord, Neural tube and its fate Neural crest cells - their fate, Development of somites, Intra-embryonic coelom, Foetal membranes :Chorionic villi, Amnion, Yolk sac, Allantois
Level 2: Congenital malformations, Nucleus pulposus, Sacrococcygeal teratomas, Neural tube defects, Anencephaly
Level 3: Signs of pregnancy in the first trimester, Role of teratogens, Alpha-fetoprotein levels

v) **Folding of the embryo:** Derivatives of germ layers,
Pharyngeal arches
Level 2: Thalidomide tragedy, Estimation of Embryonic Age - Superfoetation & superfoecundation

vi) **Fetal membranes:** Formation Functions, fate of: Chorion ; Amnion; Yolk sac; Allantois; Decidua; Umbilical cord; Placenta - Physiological functions; Foetomaternal circulation, Placental barrier, Twinning: monozygotic, dizygotic

Level 2: Placental hormones, Uterine growth, Parturition, Estimation of fetal age,

Level 3: Types of cord attachments, Chorion villus biopsy and Amniocentesis; Uses of amniotic membranes, Trophoblastic tumours - Rh incompatibility, Haemolytic disease of newborn,

II) Systemic Embryology

i) Cardiovascular System - Venous System; Heart - Chambers - Septa - Truncus - Aortic arches - Fetal circulation - Changes at birth, ASDs, VSDs, PDA, Fallot's Tetralogy.
Level 2: Veins, abnormalities, Surgical corrections

ii) The Respiratory System: Development of Larynx, Trachea, Bronchi, Lungs; Tracheo-oesophageal Fistula
Level 2: malformations
Level 3: Respiratory Distress Syndrome; Premature births

iii) The Alimentary System: Foregut: Oesophagus, Stomach, (Lesser sac); Duodenum - Hepatobiliary apparatus, Pancreas, Spleen, Portal vein; Midgut : Rotation and Fixation, Caecum and Appendix, Meckel's diverticulum; Hindgut : Cloaca; Rectum and Anal Canal
Level 2: Malformation - Tracheo-oesophageal fistulae; Congenital Hypertrophic Pyloric Stenosis; Atresia; Omphalocele, Hernia; Malformations - Fistulae, Situs inversus; Nonrotation; Mixed rotation of gut

iv) The Urogenital System, Development of Kidneys and Ureters; Cloaca - Urinary Bladder and Urethra; Suprarenal gland; Genital System - Testis and Ovary; Ducts and associated glands; External genital organs, Mesonephric and paramesonephric ducts, Uterine tube, Uterus and vagina
Level 2: congenital malformations; Ambiguous genitalia and Hermaphroditism ; Remnants and Vestiges of Ducts and Tubules

v) Integument : Development of mammary gland, skin & appendages

vi) Pharyngeal arches, nerves, muscles, cartilage, development of face, palate

vii) Endocrine : Glands, Adrenal, Thyroid, Parathyroid, Pituitary

viii) The Nervous System: Neural Tube: Spinal Cord and Brain i.e., Forebrain, Midbrain and Hindbrain, Hypophysis cerebri; Neural Crest : Peripheral Nervous System,

Level 2: correlation Spina bifida; Anencephaly, Hydrocephalus, Retinal detachment; glaucoma; Coloboma iris,
Level 3: Myelination of tracts shortening of spinal cord, Neural Tube Defects
Organs of the special senses - Eye and Ear
Ear - Internal ear -; External and middle ear - anomalies of the Ear

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E) GENETICS

i) Introduction – Mendelism, Laws Genetic code
Level 2: Evolution, Eugenics and Polygenic inheritance, Radiation and mutation , Sex chromatin, Population genetics

ii) Cytogenetics
Structure and function of chromosomes, Cell cycle, Cell divisions, Spermatogenesis, Oogenesis

iii) Molecular genetics (Normal)
Gene, Genetic code, Structure and types of DNA, Structure of RNA

iv) Inheritance: Single gene inheritance, Multifactorial inheritance, Polygenic inheritance, Mitochondrial inheritance, Pedigree charts with symbols

Genetic basis of variation

Mutation, Polymorphism, Multiple allelism
Level 2: Types, Factors influencing mutational load

Developmental genetics
chromosomes; Lyon's hypothesis; Hermaphroditism and pseudohermaphroditism; teratogenesis

Gonadal dysgenesis, Adrenogenital syndrome Androgen insensitivity

Level 3: Counselling

Pedigree charting
Chromosomal basis of disease: Numerical, Structural abnormalities
Down's, *Cri-du-chat*, Turner's, Klinefelter's
Level 2: Dermatographics
Level 3: Counselling

Prenatal diagnosis
Maternal Serum Sampling; Fetal USG; Fetal Amniocentesis; Fetal Chorion Villus Sampling
Level 2: (cordocentesis); Foetoscopy
Level 3: Eugenics

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F) Radiological Anatomy

I) Introduction

Principles of plain radiograms and CT scan.

Identification of gross anatomical features in plain and contrast radiographs.

Identification of gross anatomical features in normal CT scan especially of the Abdomen and Head-Face-Neck-Brain regions.

Diagnostic procedures. Technical details (e.g. dye) are not necessary.

Level 2 : Estimation of age if epiphyseal line seen.

II) UPPER LIMB – X-Ray of

Shoulder region
Arm
Elbow region
Fore arm
Wrist and hand

III) LOWER LIMB

Hip region
Thigh
Knee region
Leg
Ankle region Foot

IV) ABDOMEN

Plain X-ray
Ba meal
Ba meal follow through
Ba enema
Oral cholecystogram
Intravenous urogram
Cystogram
Ascending pyelogram
Abdominal Aortogram
Hystero-salpingogram
Myelogram
CT abdomen

V) THORAX

Plain X-ray
Ba swallow
Bronchogram
CT mediastinum
High resolution CT lung

VI) **HEAD-FACE**

X-ray skull plain
Carotid angiogram
Vertebral arteriogram
CT Scan Brain

NECK

Plain X-ray cervical region

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G) SURFACE ANATOMY

I) SURFACE MARKING:

i) Upper Limb

NERVES: Radial nerve, Median nerve, Ulnar nerve, Axillary nerve, Musculocutaneous nerve

VESSELS: Axillary artery, Brachial artery, Radial artery, Ulnar artery, Superficial and deep palmar arches

ii) Lower Limb

NERVES: Femoral, Sciatic, Common peroneal nerves

VESSELS: Great saphenous & Small saphenous veins; Femoral, Popliteal & Dorsalis pedis arteries

iii) ABDOMEN

ORGANS: 9 regions and projection of organs in them; Stomach, Duodenum, Caecum, Appendix, Ascending,, transverse and descending colon, Pancreas, Liver, Gall bladder, Spleen, Kidneys (ventral and dorsal) Abdominal aorta

iv) **THORAX**

Heart and valves, Lungs, fissures and hilum; Pleurae, Trachea

v) **HEAD FACE NECK**

ORGANS: Parotid gland & duct

Middle meningeal artery, Facial artery

Pterion, Bregma, Reid's base line, Suprameatal triangle

Thyroid gland

Common carotid artery, External carotid artery, Internal carotid artery, Internal jugular vein, Trachea

vi**)** **Brain:** Lateral sulcus, Central sulcus, Median longitudinal fissure, Superior sagittal sinus, Sigmoid sinus, transverse sinus

II) LIVING ANATOMY:

i) Upper Limb

(BONY) LANDMARKS(PALPATION OF):

Clavicle, Spine of scapula, Inferior angle, Coracoid process, Epicondyles of humerus, Olecranon process of ulna; Head and styloid processes of radius and ulna, Heads of metacarpals (knuckles), Pisiform, Hook of Hammate

JOINTS (DEMONSTRATION OF MOVEMENTS):
Shoulder girdle, Shoulder joint, Elbow joint, Radio-ulnar joints, Wrist joint, 1st carpo-metacarpal joint, MP and IP joints

MUSCLES (DEMONSTRATION OF ACTION)
Principle of testing: Trapezius, Serratus anterior, Latissimus dorsi, Pectoralis major, Deltoid, Biceps Brachii, Brachioradialis, Brachialis, Extensors at the elbow, Supinators, Wrist extensors, Wrist flexors, Small muscles of the hand

NERVES: Dermatomes, Ulnar
Ulnar nerve thickening in Leprosy

VESSELS (PALPATION OF): Axillary artery, Brachial artery, Radial artery

OTHERS: Axillary groups of lymph nodes; Anatomical snuff-box (boundaries)

ii) Lower Limb

(BONY) LANDMARKS (PALPATION OF): Anterior superior iliac spine, Iliac crest, Tubercle of the iliac crest, Ischial tuberosity, Greater trochanter, Adductor tubercle, Head and neck of fibula, Lateral and medial malleoli, Tibial tuberosity, Subcutaneous surface of tibia, Patella
JOINTS (DEMONSTRATION OF MOVEMENTS): Hip , Knee , Ankle , Subtalar Joints
MUSCLES (DEMONSTRATION OF ACTION): Hip-Flexors, Extensors, Abductors, Adductors
Knee: Flexors, Extensors,
Ankle: Dorsiflexors, Plantar flexors
Subtalar: Invertors, Evertors
NERVES: Dermatomes, Sciatic, Tibial, Common peroneal, Femoral, Obturator Thickening of common peroneal nerve in Leprosy

VESSELS (PALPATION OF): Femoral, Popliteal, Dorsalis pedis, Posterior tibial
OTHERS: Ligamentum patellae, Inguinal lymph nodes
TENDONS: Semitendinosus, Semimembranosus, Biceps femoris, Iliotibial tract

iii) ABDOMEN

(BONY) LANDMARKS (PALPATION OF): Anterior superior iliac spine, Pubic tubercle
JOINTS (DEMONSTRATION OF MOVEMENTS): Intervertebral

MUSCLES (DEMONSTRATION OF ACTION): Obliques, Transversus abdominis, Rectus abdominis
NERVES: Dermatomes
OTHERS: Enlarged liver, spleen, kidneys, Abdominal quadrants and regions; Position of superficial and deep inguinal rings; Renal angle; McBurney's point;
Level2: Murphy's sign

iv) **THORAX (BONY) LANDMARKS(PALPATION OF):** Sternal angle, Counting of rib spaces, locating thoracic spines
JOINTS (DEMONSTRATION OF MOVEMENTS): Intervertebral
MUSCLES (DEMONSTRATION OF ACTION): Respiratory movements
NERVES: Dermatomes
OTHERS: Apex beat, Apices of the lungs, Triangle of auscultation

v) HEAD FACE NECK - **(BONY) LANDMARKS(PALPATION OF):** Nasion, Glabella, Inion, Mastoid process, Suprameatal triangle, Zygoma, Zygomatic arch, Angle of mandible, Head of mandible,
JOINTS (DEMONSTRATION OF MOVEMENTS): Temporomandibular joint
MUSCLES (DEMONSTRATION OF ACTION): Of Mastication, Of Facial expression Cranial nerves (I to XIII) testing
(PALPATION OF): Superficial temporal artery, Facial artery
(PALPATION OF**):** Symphysis menti, Hyoid bone, Thyroid cartilage, Cricoid cartilage, Tracheal rings, Suprasternal notch, Transverse process of atlas, Spine of C_7
(DEMONSTRATION OF MOVEMENTS): Atlanto-occipital joint, Cervical joints
(DEMONSTRATION OF ACTION): Sternocleidomastoid, Neck flexors and extensors
(PALPATION OF): Common carotid artery, External carotid artery
OTHERS: Thyroid gland, Cervical lymph nodes, (Horizontal and vertical), Midline structures in the neck

NOTE :- Level 2 and 3 mentioned in the above syllabus includes the topics " desirable to know" (level-2) and " Nice to know" (level-3. The remaining topics fall under the group " Must Know" (level-1.

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H) University Exam. Pattern

I) Theory Examination Pattern (In Anatomy)

ANATOMY PAPER -I

Includes gross anatomy, systemic histology and systemic embryology of the region above diaphragm.

ANATOMY PAPER-II

Includes the gross anatomy, systemic histology and systemic '1 embryology of the region below diaphragm. It also includes General histology, General 1 embryology, general anatomy & genetics.

NATURE OF EACH QUESTION PAPER

Section A

Q. No.1 Multiple choice questions (MCQ) 15 marks (30 minutes)

Section B

Q. No2 Write in brief (Five out of Six) 2 marks each 10 marks

Q.No3. On applied Anatomy(Two out of three) 08 marks

Section C

Q .No.4 Long question OR 09 marks

Q .No.4 Long question 09 marks

O.No5 Write short notes (Any two out of three) 08 marks

Time for Section B and Section C is 2 hours.

II) Practical Exam. Pattern:

Marks for viva - 20

i) Axial Skeleton ...10 marks } Total 20 marks
ii) Appendicular skeleton ....5 marks } of viva
iii)Embryology models …5 marks

Practical marks ..40

iii) Soft parts dissected body, organs, viscera, brain ...20 marks }
v) Histology -spotting ...6 marks } 10 marks
-one slide for discussion ...4 marks }
v) Radiology ...5 marks
vii) Surface living anatomy ...5 marks

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I) Anatomy books recommended

1) Gray's Anatomy
2) Sahana's Human Anatomy
3) Chouraia's Human Anatomy 3 volumes
4) Cunningham's manual of Practical Anatomy
5) Regional Anatomy by R. J. Last
6) Human Histology by Inderbir Singh
7) Atlas of Human Histology- DIFORE
8) Surgical Anatomy- McGregor
9) Histolgoy- by ham,
10) Human Embryology – Inderbir Singh,
11) Medical Embryology – Langman,
12) Surface Anatomy & Radiology – Halim Das,
13) General Anatomy by – Chowrisia
14) Text book of Neuroanatomy – Inderbir Singh
15) Central Nervous System – Podar Bhagat
16) Clinical anatomy for medical students – Richard Snell
17) J.S.P. Lumbley at all – M.C.Q's in Anatomy

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HUMAN PHYSIOLOGY

I) GOAL

The broad goal of the teaching of undergraduate students in physiology aims at providing the student comprehensive knowledge of the normal functions of the organ systems of the body to facilitate an understanding of the physiological basis of health and diseases.

II) EDUCATIONAL OBJECTIVES:

1) At the end of the course, the student will be able to: describe the normal functions of all the organ systems, their regulatory mechanisms and interactions of the various systems for well-coordinated total body function.

2) Understand the relative contribution of each organ system in the maintenance of the milieu interior (homeostasis).

3) Explain the physiological aspects of normal growth and development.

Analyse the physiological responses and adaptation to environmental stresses.

4) Comprehend the physiological principles underlying pathogenesis and treatment of disease.

5) Correlate knowledge of physiology of human reproductive system in relation to National Family Welfare Program.

III) SKILL :

At the end of the course the student shall be able to :

1) Conduct experiments designed for study of physiological phenomena.

2) Interpret experimental/investigative data.

3) Distinguish between normal & abnormal data derived as a result of tests which he/she has performed and observed in the laboratory.

IV) INTEGRATION :

At the end of the integrated teaching the student shall acquire an integrated knowledge of organ structure and function and its regulatory mechanisms.

V) COURSE CONTENT :

Theory

List of topics.

A) GENERAL PHYSIOLOGY. (5 hours)

Must know.

- Introduction to Physiology
- Branches of Physiology

- Functional organization of human body.
- External and internal environment
- Homeostasis, Biofeedback mechanisms

Cell Physiology:

- Transport across cell membrane.

B) HEMATOLOGY : (15 hours)

Must know

- Composition of blood
- Functions of blood
- Plasma proteins: Types, concentration, functions.
- Erythrocytes: Morphology, functions, normal count physiological variations in normal count & anaemia, polycythemia.
- Haemopoesis: general concepts
- Erythropoiesis: stages, Sites, regulation, reticulocyte & its clinical significance.
- Haemoglobin: Functions, normal values, physiological variations.
- Fate of erythrocytes: life span, Catabolism of Hb, bilirubin metabolism, jaundice.
- Physiological basis of anaemia, nutritional anaemia.
- Polycythemia: Primary & secondary.
- Leukocytes: differences between R.B.C. & W.B.C., types of W.B.C.s normal count & differential W.B.C. count, physiological variations, properties, functions of W.B.C.s,,

Granulopoiesis – stages, regulation,

Lymphopoiesis.

Pathological variations in total & differential W.B.C. count.

- Immunity: definition, concept of antigen & antibody, types of immunity-Innate & Acquired, & their mechanism, cell mediated & humeral immunity, B lymphocytes, T lymphocytes & their types.

Primary & secondary response, basis of vaccination.

- Blood groups: Landsteiner's law,

ABO System – type A & B antigen, ABO system & inheritance, relation to transfusion, cross matching major & minor.

Rh System – inheritance, Rh incompatibility & blood transfusion, Erythroblastosis foetalis.

- Blood transfusion: indications, storage of blood & changes during storage, transfusion reactions.
- Monocyte - macrophage system: Classification, functions, functions of spleen.
- Hemostasis: definition, basic mechanisms of Hemostasis,
- Platelets:structure, normal count & variations, functions, role in platelet plug formation, Hemostasis & clot retraction.
- Blood coagulation: Coagulation factors in plasma, basic mechanism of blood clotting, intrinsic & extrinsic pathways & difference between two pathways, role of calcium in coagulation, role of vitamin K, fate of clot.

  Anticoagulants – commonly used & their mechanism of actions, blood coagulation tests – bleeding time, clotting time.

  Haemophilia.
- Body fluid compartments: role of water in body & its distributions, different body fluid compartments & composition of their fluid.
- Blood volume: normal value, physiological & pathological variations, blood volume regulation in detail (To be taken at end of lectures on C.V.S, kidney and endocrines)

Desirable to know

- Physical properties of blood.
- Plasma proteins: Plasmapheresis, role of liver in plasma protein synthesis, relationship of diet & plasma protein synthesis.
- R.B.C.: advantages of biconcave shape.
- Bone marrow structure and cellular elements.
- Common Haemoglobinopathies (Hbs, Hbc, Thalassaemia)
- Method of determination of life span of R.B.Cs.
- Types of jaundice.
- Polycythemia – effects on haemodynamics,.
- Immunity: Antibody structure & types, antigen – antibody reactions.
- Blood group: M. N. system, other blood groups.
- Thrombocytosis, thrombocytopenia purpura.
- Anticoagulants: used in vitro & in vivo.
- Other blood coagulation tests.
- Classification of haemorrhagic diseases, D.I.C.
- Measurement of: total body water, blood volume, plasma volume, I.C.F. volume.

Nice to know

- Blood component therapy.
- Effects of splenectomy.
- Plasmin system.

C) NERVE (5 hours)

Must know:

- Distinctive histological features relevant to functions of nerve fibers.
- Classification of nerve fibers: based on structure, diameter, functions and only for sensory nerves.
- R.M.P. definition, production & maintenance, method of measurement, significance.
- Action potential: definition,

  Phases – depolarization, repolarisation, ionic basis of depolarization & repolarisation.

  Production & propagation of A.P.,

  Properties of A.P., significance.
- Properties of nerve fibers.
- Strength duration curve: chronaxie and factors affecting it.
- Factors affecting conduction in a nerve.

Desirable to know:

- Experimental techniques to study the mechanism of production of R.M.P. & A.P.: patch clamp, voltage clamp
- Methods of recording of A.P.

D) MUSCLE (7 hours)

Must know.

- Classification of muscles,
- Structure of skeletal muscle:

  Electronomicroscopic structure, muscle proteins – contractile, regulatory, structural & enzymatic.

  Sarcoplasmic tubular system: concept of sarcoplasmic triads & their functions.
- Neuromuscular transmission: Physiologic anatomy, events, N-M blocking & its clinical significance, applied aspect – myasthenia gravis.
- Excitation – contraction coupling.

- Molecular basis of skeletal muscle contraction: sliding filament theory, power stroke – corss bridge cycle, role of calcium.
- Energetics: fuel used by skeletal, muscle at rest & in exercise, metabolic pathways involved to yield A.T.P.,

  Oxygen debt: definition, types (lactic, alactic), incurring of debt, repaying the debt, significance.
- Properties of skeletal muscle: excitability, refractory period (absolute, relative), conductivity, contractility – types (isometric, isotonic), effects of summations (multiple motor unit summation, frequency summation & tetanizibility), all or none law, extensibility & elasticity, fatiguability.
- Factors affecting development of tension in the muscle:
  a) number of motor units contracting- type of muscle, number of muscle fibers in each unit activated, supraspinal influences.
  b) length – tension relationship
  c) frequency of stimuli, duration of stimulation
  d) load
  e) type of contraction
  f) chemical composition of muscle fibers and ions.
- E.M.G. (in brief)
- Skeletal muscle circulation.
- Smooth muscle: structure, distribution, types molecular mechanism of contraction, properties, regulation, and disorders.

Desirable to know

- Heat liberated during various phases of contraction, Fenn effect.
- Recording of muscle activity.

Nice to know

- E.M.G. details.

E) RESPIRATORY PHYSIOLOGY (15 hours)

Must know:

- Physiologic anatomy
- Functions of respiratory system, non respiratory functions of lung
- Mechanics of respiration:

Ventilation :

Inspiratory & expiratory muscles, intraplural pressure, lung & thoracic compliance, factors affecting compliance, work of breathing, surface tension forces & role of surfactant, airway resistance, elastic resistance.

- Lung volumes and capacities. Measurement, physiological & significance (tidal volume, vital capacity, forced vital capacity – details)
- Pulmonary ventilation, alveolar ventilation, alveolar dead space, - applied aspect, Maximum breathing capacity & breathing reserve.

Diffusion of Gases :

- Exchange of respiratory gases at alveolar – capillary membrane, factors affecting diffusion.

Gas Transport :

- Transport of oxygen, role of Haemoglobin, oxygen dissociation curve & factors affecting it.
- Transport of carbon dioxide

Control of Breathing :

Neural control – higher centers, reflexes.

Chemical control – central & peripheral chemoreceptors role of CO_2, O_2, H^+

Pulmonary Circulation

- Characteristics
- Ventilation perfusion ratio
- Respiratory adjustment in exercise.
- Hypoxia: types & high altitude hypoxia.
- Artificial respiration:
- Pulmonary function tests - principles

Desirable to know.

- Method of determination of dead space, residual volume, functional residual capacity.
- Oxygen therapy: indications, hazards of hyperbaric oxygen & use.

Nice to know

- Concept of P_{50}
- Positive pressure breathing.

F) CARDIOVASCULAR PHYSIOLOGY (20 hours)

Must know:

- Introduction, functions & importance of the system.
- General organization.

- Structure of heart, pericardium, myocardium, endocardium, nerve supply, Histology, details of cell junctions, syncytium, contractile & conducting fibers.
- Properties of cardiac muscle: excitability, conductivity, contractility, autorhythmicity, all or none law, long refractory period.
- Junctional tissues of heart, pacemaker potential, action potential of cardiac muscle.
- Generation & conduction of cardiac impulse.
- ECG: lead arrangement, normal waves & their significance with reference to lead II
- Cardiac cycle: pressure – volume changes, heart sounds & their clinical significance, correlation of pressure, volume, ECG, heart sounds in cardiac cycle.
- Heart rate & its regulation.
- Haemodynamics - def.,blood flow, resistance
- Cardiac output: normal values, physiological variations, factors affecting cardiac output – details, regulation, measurement – principles.
- Blood pressure:
  Normal levels, measurement, determinants, short term & long term regulation - details.
- Capillary circulation, tissue fluid formation.
- Lymphatic system: Anatomy & structure, formation of lymph, composition of lymph , functions of lymphatic system, lymphflow & factors affecting it.
- Regional circulation: Physiologic anatomy, factors affecting, special features: coronary, cerebral , skin, portal
- Adaptation of cardiopulmonary system to various grades of exercise.
- Hemorrhagic shock – stages & compensatory mechanisms, effects on body, physiological basis of treatment in brief.

Desirable to know:

- Ion channel & receptors (physiological, pharmacological & clinical significance)
- E.C.G. – electrical axis of heart, heart blocks, arrhythmias, ischaemia, infarctions.
- Heart sounds: murmurs & their clinical significance.

Nice to know

- Experimental methods of studying cardiovascular physiology,
- Patho physiology of oedema

G) RENAL PHYSIOLOGY(10 hours)

Must know:

- General introduction, structure & functions of kidney.

- Renal circulation: special features from functional point of view.
- Concept of clearance: to study renal physiology, for :

a) GFR – Inulin, Creatinine, basic principle of radioisotope method.

b) renal blood flow – PAH

c) concentration & dilution of urine – free water.

- Formation of urine:

1) Glomerular stage – GFR (definition, dynamics, factors affecting & measurement))

2) Tubular stage – Reabsorption & secretion.

a) Sodium, potassium, glucose : details
b) Handling of water – concentration & dilution of urine.
c) Secretion of H^+

3) Role of kidney in acid – base balance.

- Physiology of micturition: basic reflex & control, cystometrogram.
- Artificial kidney: basic principles of dialysis.

Desirable to know:

- Experimental studies for renal functions.

Nice to know

- Disorders of micturition.

H) BODY TEMPERATURE REGULATION: (2 hours)

Must know:

- Homeothermia – Balance between heat gain & heat loss.
- Regulation of body temperature,

Desirable to know:

- Hyperthermia, Hypothermia.

I) ALIMENTARY SYSTEM: (12 hours)

Must know:

- General introduction & organizational plan, innervations and blood supply.

Salivary secretion :

- General principles & basic mechanisms of secretion composition ,and functions of saliva, mechanism & regulation of salivary secretion.

Mastication and deglutition:

- Three phases of deglutition- physiologic anatomy, mechanism & control

Gastric secretion:

- Functional anatomy, histology, functions of stomach, composition of gastric juice, cellular mechanism of gastric secretion of acid, pepsin, intrinsic factor, other enzymes, phases of gastric secretion, regulation of gastric secretion.
- Gastric Motility:

  Electrical activity of stomach, pylorus, emptying of the stomach-pyloric pump, regulation & factors promoting & inhibiting emptying.

Pancreatic secretion:

- Structure, composition & mechanism of secretion of electrolytes & enzymes, regulation of secretion.
- Liver & gall bladder:

  Microscopic structure, functions of liver, composition of bile, cellular mechanism of bile formation, enterohepatic circulation of bile salts, control of secretion, concentration & storage of bile in gall bladder. filling & evacuation of gall bladder functions of gall bladder

Intestinal secretion:

- Structure, innervations.
- Composition & mechanism of secretion of small intestinal juice, regulation of secretion.
- Secretion of large intestine: mucous, water, electrolyte.
- Motility of small intestine:

  Structure & innervation electrical activity of smooth muscle, resting membrane potential, slow waves, spike potentials, rhythmic segmenting contractions, peristalsis, control – neural & hormonal, functions of ileocecal valve.
- Motility of large intestine:
- Structure & innervation,'mixing & mass movements, defecation reflex' and its control
- G.I. hormones: in brief.

Digestion & absorption:

Digestion & absorption of - carbohydrate,

- Proteins
- Fats

absorption of water, electrolytes and vitamins.

Desirable to know:

- Gastric mucosal barrier, experiments to study regulation of gastric juice secretion, disorders of secretion, peptic ulcer., inhibitors of gastric secretion
- Effects of vagotomy, abnormal gastric motility vomiting.
- Barium meal studies, endoscopy, biopsy.
- Pathophysiology of small intestinal motility, paralytic ileus, diarrhea, obstruction.
- Pathophysiology of colonic motility, irritable bowel syndrome, drugs, constipation.
- Pancreatic function tests.
- Gall stone, effects of removal of gall bladder

Nice to know

- disturbances of esophageal motility, spasm, achalasia, hiatus hernia.
- Methods for study of intestinal absorption.
- Effects of hepatectomy.

J) NUTRITION: (2 hours)

Must know:

- concept of balanced diet
- factors affecting caloric requirements
- requirements of various nutrients, sources, daily needs.
- nutrition under special conditions – pregnancy, lactation, growing child.

K) ENDOCRINE SYSTEM (10 hours)

Must know:

- Introduction
- Endocrine functions of Hypothalamus – releasing hormones, Mechanism of hormone action
- Anterior pituitary hormones:

  functions, regulation, disorders.

  posterior pituitary hormones,ADH, Oxytocin. functions, regulation, disorders.

  Thyroid:

  hormone: synthesis, fate, functions, regulation, disorders.
- Parathyroid:

  hormone: synthesis, functions, regulation, disorders – tetany.
- Adrenal cortex: and medulla.

  hormone: secretion, functions, regulation, disorders

- Pancreatic hormones:
  secretion, functions, regulation, disorders.

Desirable to know:

- Radioimmuno assays.

Nice to know

- Experimental studies.

L) REPRODUCTIVE PHYSIOLOGY: (8 hours)

Must know:

- Sex chromosomes, sex determination, sex differentiation
- Functional anatomy of reproductive system.
- Puberty: changes in males & females and its control.
- Spermatogenesis: stages & regulation
  Semen analysis.
- Testosterone: actions & regulation.
- Male sexual act.
- Menstrual cycle & ovarian cycle:
  Phases & hormonal regulation.
- Menopause.
- Ovulation: indicators & importance
- Fertilization, implantation of ovum.
- Functions of placenta
- Physiology of pregnancy;
- Maternal changes during pregnancy
- Parturition: in brief – stages and mechanism.
- Lactation: initiation & maintenance and control.
  advantages of breast-feeding.
- Contraception: to be taken as integrated topic.

Desirable to know:

- Sex chromosomes: Barr bodies.
- Development of genitals & gonads

Nice to know

- Precocious & delayed puberty.

M) SPECIAL SENSES (8 hours)

Must know:

- Eye:

  Functional anatomy of eye, optics, microscopic structure of retina with retinal circuits, image formation,

  Photochemistry of vision (photopic & scotopic vision, dark & light adoption),

  Pupillary reflexes, Accommodation reaction, Errors of refraction and their correction, Colour vision – physiological & neural basis, accepted theory of colour vision, classifications, basis of colour blindness and tests of colour blindness, significance.

  Visual pathway – processing of information at different levels in visual pathway, organisation of visual cortex. Effects of lesion at different levels in visual pathway,

  Movements of eyeballs: functions & control.

- Ear:

  Physics of sound, decibel system,

  Functions of external ear,

  Functional anatomy of middle ear, functions of middle ear in detail, assessment of functions of middle ear, Functional anatomy of cochlea, functions of inner ear, place principle, theories of hearing.

- Audiometry,

  Auditory pathway & important features, auditory cortex (role in hearing & speech development)

- Taste:

  Functional anatomy of taste buds, different taste modalities, pathway, factors affecting taste sensation,

- Smell:

  Functional anatomy of receptors, primary olfactory sensations, pathway, factors affecting smell sensation,

Desirable to know:

- Resolution of images,
- Electrophysiology of internal ear: cochlear micro phonics.

Nice to know

- Electrophysiology of retina.
- Theories of hearing.

N) CENTRAL NERVOUS SYSTEM: (50 hours)

Must know

- Outline of nervous system.

1) General nervous system:

Synapse: definition, physiological anatomy, sequence of events of synaptic transmission, properties, (state the property & its significance), significance of synaptic transmission, applied aspect.

Neurotransmitters – in brief.

Receptors: definition, classification (basis of each classification with example), properties (state each property with underlying mechanism & significance), significance (homeostasis, conscious awareness of environment, tone posture, protection).

Sensations: different modalities, classification with examples and significance

- sensation of touch, pain proprioception : details of each

Reflexes: definition, classification (basis of classification with example), reflex arc & its components, properties (state each property with basis & importance)

Stretch reflex – definition, muscle spindle (details with innervation, role of gamma motor neurons) role of supra spinal control – in brief, functions of stretch reflex (regulation of muscle tone) inverse stretch reflex.

Polysynaptic reflexes: withdrawal reflex.

2) Tracts:

Ascending & descending tracts: details of each tracts – (situation & extent in spinal cord, origin, course & termination, collaterals, somatotopic arrangement, functions, applied aspect, tests)

Ascending tracts: Basic plan of somato sensory pathway for conscious Sensation, pathway from head, face region.

Descending tracts: pyramidal tracts – details., extra pyramidal tracts, differences between UMN & LMN lesions.

3) Sections at various levels in CNS :

a) Spinal transection – spinal animal.

Complete – 3 stages – spinal shock, stage of recovery, stage of reflex failure – details of each stage.

Incomplete. Transection

Hemisection

b) Low midbrain section – decerebrate animal : Decerebrate rigidity. (Classical & ischaemic with mechanisms, characteristics features, physiological significance)

c) High midbrain section – High decerebrate animal.

d) Thalamic or Decorticate animal.

4) Posture - & Equilibrium.

Definition, classification of postural reflexes.

(Details of each reflex and its function.)

regulation of posture (integrating centers at various levels of CNS)

vestibular apparatus : Physiologic anatomy, mode of function of utricle & saccule and semicircular canals, vestibulo occular & vestibulo spinal reflexes.

5) Thalamus :

Functional classification of Thalamic nuclei, with connections of different nuclear groups, functions of thalamus, thalamic syndrome.

6) Hypothalamus :

Functional classification of different hypothalamic nuclei, connections in brief, functions in details.

7) Limbic system :

Parts of limbic system, connections in brief, functions.

8) Reticular formation :

Introduction, anatomy in brief, functional divisions.

(A) Ascending reticular activating system – details with connections & role in sleep wakeful cycle, applied aspect.

(B) Descending reticular system – role in regulation of muscle tone by pontine & medullary regions.

(C) Visceral centres.

9) E. E. G. :

Definition, different waves, characteristics & functional significance of each wave, physiological variation, clinical application in brief.

10) Sleep & Wakefulness :

Concept of alertness & wakefulness with their physiological basis,

Definition of sleep, stages of sleep correlated with EEG, sleep cycle – types of sleep, salient features of NREM & REM sleep, physiological effects of sleep on different systems of the body, Neurophysiological mechanisms of sleep, functions of sleep.

11) Cerebellum :

Introduction, functional classification, intracortical circuit, deep cerebellar nuclei, connections of different lobes, functions of cerebellum, cerebellar function tests, effects of lesion in brief.

12) Basal Ganglia :

Introduction, classification of nuclei, connections, intracortical circuits, functions, lesions - Parkinsonism.

13) Cerebral Cortex :

Gross anatomy & divisions, concept of Broadmann's mapping with diagram, Parietal lobe – anatomical & functional divisions, details of each functional part as regards connections, topographic organisation, functions.

Frontal lobe – excitomoter Cortex – anatomical & functional parts, details of each part as regards connections, topographic organisation, functions.

Prefrontal Cortex – different areas, connections in brief, functions, effects of lobectomy.

14) speech –

Afferent and efferent mechanisms and role of cortical centers in speech, concept of cerebral dominance, development of speech, vocalization.

15) Memory :

Definition, stages, types, physiological basis, factors affecting, applied – amnesias in brief.

16) Learning :

Definition, types with examples, stages, factors influencing, role of motivation (positive & negative reinforcement, reward & punishment), physiological basis – role of different parts of CNS, structural, biochemical changes.

17) Conditioned reflexes :

Definition, difference between unconditioned & conditioned reflexes, development of conditioned reflexes, properties, significance.

18) Autonomic nervous system :

Organization and functions of Parasympathetic & Sympathetic and their control.

19) CSF :

Introduction, composition, normal CSF pressure, formation & circulation, functions, applied aspect – brief, blood brain barrier, blood CSF barrier.

Desirable to know :

General nervous system :

Neurotransmitters – details, susceptibility of synapse to hypoxia drugs etc., Mechanisms of referred pain, differences between superficial & deep pain, central analgesia system, supraspinal control of stretch reflex – details.

Thalamus - applied aspects – effects of lesions.

Hypothalamus - applied aspects – effects of lesions

Reticular formation – effects of lesion

EEG – Method of recording, abnormal patterns.

Basal Ganglia – lesions, involuntary movements.

Cerebellum – Embryology, evolution, effects of stimulation & ablation.

Cerebral cortex – effects of stimulation & ablation in different regions.

Speech – aphasias.

Nice to know

Experimental studies – effects of stimulation & ablation.

Sleep, wakefulness – effects of sleep deprivation, disorders.

Books recommended :

1) Textbooks of Physiology :
   - Guyton - Textbook of Physiology
   - Ganong - Review of Medical Physiology
   - S. Wright - Applied Physiology
2) Reference Books :
   - Best and Taylor - Physiological basis of medical practice
   - Berne & levy. - Principles of Physiology
   - Dr. V.G. Ranade- Laboratory Manual and Journal of Physiology

Practicals

(A) Haematology

Hb% R. B. C. W. B. C. Differential, B.T.C.T. Blood group, ABO system Rh typing, Blood Indices

(B) Clinical examination and Human experiments

Stethography, Spirometry, Ergography, Perimetry, Tests for physical fitness, Clinical examination of all systems.

(C) Demonstrations

Reticulocyte count. Platelet count, P. C. V., E. S. R, fragility, peripheral blood smear, bone marrow slides,

E.M.G. S.D. curve, conduction velocity of nerve (Human), E.C.G., E.E.G., Audiometry, H.R.T. (Human reaction time)

Visit to blood bank, wards to show common disorders or video tapes (list given in appendix I), X-rays (list given in appendix II)

Animal experiments on frogs,

a) Skeletal muscle:

effect of graded stimuli,

simple muscle twitch

genesis of tetanus,

effect of load on skeletal muscle

fatigue.

b) Cardiac muscle.

normal cardiogram, effect of temperature,

properties of cardiac muscle,

effect of vagal stimulation and phenomenon of vagal escape.

effect of drugs (Acetyl choline, Adrenaline, Nicotine) on frog's heart.

perfusion of isolated frogs heart with effects of Na^{+} , K^{+} and Ca^{++},

- and demonstration of Starling's law

Museum to be developed

Historical land marks, Nobel laureates

VII) EVALUATION :

A) THEORY – SYSTEMS TO BE INCLUDED ARE

Paper I

Cardiovascular, Respiratory, Gastrointestinal, Endocrines, Reproduction, Acclimatization to hypoxia, Temperature regulation, Exercise physiology

Paper II

Cell membrane and transport systems across the cell membrane, Homeostasis Nerve and Muscle Physiology, Blood, Excretory, C.N.S. and special senses.

Duration of each paper : 2 Hours & 30 minutes

(30 minutes – **Section** A – M.C.Q.

2 hours – **Section B** & C)

MCQ Section A will be given to the candidate at the beginning of the examination. After 30 minutes, Section A will be collected . Paper containing Section B and Section C will then be handed over to the candidate. Section B and Section C are to be written in separate answer sheets.

Marks : Total marks for each paper: 50

B) NATURE OF QUESTION PAPER

Section A

Q. No. 1 Multiple choice question (MCQ) 15 marks

Section B

Q. No. 2 Write in brief (Five out of Six) 2 marks each 10 marks

Q. No. 3 On applied Physiology (Two out of three) 8 marks

(List of topics to be asked is given in appendix III)

Section C

Q. No. 4 Long question 9 marks

OR

Long Question

Q. No. 5 Write short notes (Any two out of three) 8 marks

C) PATTERN OF VIVA VOCE AND PRACTICAL EXAMINATION

There shall be separate batches of students for viva and Practicals.

(i) Viva examination(orals) Total marks 20 Duration – 20 minutes.

Four Examiners (5 minutes with each examiner)

(ii)Two Examiners for topics of paper I systems to be distributed,

Two Examiners for topics of paper II systems to be distributed,

(B) Practical examination Total marks 40

3 Exercises :

Exercise (1) Clinical examination … 20 marks,

4 sub questions each of 5 marks,

(i) C.V.S. …5
(ii) R.S. …5
(iii) C.N.S. & Special senses …5
(iv) Abdomen …5

Exercise (2) Haematology …10 marks,

Exercise (3) Short exercise …10 marks,

Sub questions each having 2 marks,

Calculations,

Interpretation of graphs,

Charts,

Data analysis and interpretation

Photographs on-endocrine disorders,

Neurological disorder,

APPENDIX I

List of common disorders to be shown during word visits or using video tapes.

1.Generalised Oedema

2. Anaemia

3. Jaundice

4. Hepatomegaly

5. Splenomegaly

6. Ascites

7. Myxoedema

8. Cretinism

9. Hyperthyroidism

10. Dwarfism

11. Acromegaly

12. Facial nerve paralysis

13. Hemiplegia

14. Paraplegia

15. Parkinsonism

16. Cerebellar dysfunction.

APPEDIX II

List of X-rays to be shown along with clinical examinations to improve understanding.

1. Normal X-ray chest
2. Consolidation of lung
3. Pleural effusion showing mediastinal shift
4. Collapse of lung / cavity in lung
5. Hyper inflated lungs in emphysema
6. Left ventricular hypertrophy showing shift of apex beat
7. Barium meal follow through – oesophagus, stomach, small and large intestine.

APPENDIX III

Topics to be asked as applied questions in theory .

A brief history and diagnosis to be provided.

1. Erythroblastosis foetalis
2. Haemophilia, purpura
3. Myasthenia gravis
4. Peptic ulcer
5. Oedema
6. Jaundice and anaemia – due to mismatched transfusion
7. Myxoedema
8. Cretinism
9. Hyperthyroidism
10. Tetany
11. Acromegaly, Gigantism
12. Respiratory distress syndrome
13. Parkinsonism
14. Asthma
15. Hemiplegia
16. Spinal cord injury
17.Deafness
18 Hemorrhagic shock
19 Cushing’s syndrome
20 Dwarfism

HUMAN BIOCHEMISTRY

Human Biochemistry – Phase I M.B.B.S.

i) Goal :-

The broad goal of the teaching of undergraduate students in biochemistry is to make them understand the scientific basis of the life processes at the molecular level and to orient them towards the application of the knowledge acquired in solving clinical problems.

ii) Objectives :-

a) Knowledge

At the end of the course, the student shall be able to :

1) describe the molecular and functional organization of a cell and list its subcellular components;
2) delineate structure, function and inter-relationships of biomolecules and consequences of deviation from normal;
3) summarize the fundamental aspects of enzymology and clinical application wherein regulation of enzymatic activity is altered;
4) describe digestion and assimilation of nutrients and consequences of malnutrition;
5) integrate the various aspects of metabolism and their regulatory pathways;
6) explain the biochemical basis of inherited disorders with their associated sequelae;
7) describe mechanisms involved in maintenance of body fluid and pH homeostasis;
8) outline the molecular mechanisms of gene expression and regulation, the principles of genetic engineering and their application in medicine.
9) Summarize the molecular concept of body defences and their application in medicine;
10) Outline the biochemical basis of environmental health hazards, biochemical basis of cancer and carcinogenesis;
11) familiarize with the principles of various conventional and specialized laboratory investigations and instrumentation analysis and interpretation of given data;
12) suggest experiments to support theoretical concepts and clinical diagnosis;

b) SKILLS

At the end of the course, the student shall be able to :

1) make use of conventional techniques / instruments to perform biochemical analysis relevant to clinical screening and diagnosis;
2) analyze and interpret investigative data;
3) demonstrate the skills of solving scientific and clinical problems and decision making.

c) INTEGRATION

The knowledge acquired in biochemistry shall help the students to integrate molecular events with structure and function of the human body in health and disease.

1. Total no. of teaching hours allotted to Human Biochemistry – 240 hrs.

2. Theory examination :

There will be TWO papers, each of two and half hours duration. Each paper will be of 50 marks with one compulsory question on applied biochemistry.
Each paper will consist of FIVE questions.

3. Paper wise distribution of theory topics :
Structural formulae are not obligatory.

Paper- I (50 marks) 2 ½ hours duration.

1 Molecular and functional organization of a cell and its sub-cellular components.
2. Chemistry of enzymes and their clinical applications.
3. Chemistry and metabolism of proteins and related disorders.
4. Chemistry and metabolism of purines and pyrimidines and related disorders.
5. Chemistry and functions of DNA and RNA , Genetic code ; Protein biosynthesis &.regulation (Lac-operon)
6. The principles of genetic engineering and their applications in medicine.
7. Chemistry and Metabolism of haemoglobin.
8. Biological oxidation.
9. Molecular concept of body defence and their applications in medicine.
10. Vitamins and Nutrition.

PAPER - II (50 marks) 2 ½ hours duration.

1. Chemistry and metabolism of carbohydrates and related disorders.
2. Chemistry and metabolism of lipids and related disorders.
3. Mineral metabolism: Water and electrolyte balance & imbalance.
4. Acid base balance and imbalance.
5. Integration of various aspects of metabolism and their regulatory pathways. Starvation metabolism.
6 Mechanism of hormone action.
7 Environmental biochemistry.
8 Liver function tests, Kidney function tests, Thyroid function tests.
9 Detoxification mechanisms.
10 Biochemical basis of cancer and carcinogenesis.
11 Radioisotopes.
12 Investigation techniques : (LCD-Topics) Colorimeter, Electrophoresis, Chromatography & Flame photometer.

5 NATURE OF QUESTION PAPER - Theory

MCQ Section A will be given to the candidate at the beginning of the examination. After 30 minutes Section A will be collected . Paper containing Section B and Section C will then be handed over to the candidate. Section B and Section C is to be written in separate answer sheets.

SECTION -A

Q.No. 1. Multiple choice questions (MCQs 30)
(30 minutes duration) 15 marks.

SECTION -B

Q.No. 2.Write in brief (Any five out of six) 2marks each 10 marks.
Q.No 3. On applied Biochemistry (Any two out of three) 8 marks.

SECTION-C

Q.No.4. Long question (A) 9 marks.
OR
Long question (B)
Q. No.5 . Write short notes(any two out of three) 8 marks.

6. PRACTICAL :
Practical examination in Biochemistry will be of
TWO hours duration 40 marks

B) Exercise
Q.1. : One quantitative experiment from group A 20 marks
(15 marks for expt. & 5 marks for table viva)

Q.2. : One qualitative/ quantitative experiment from 15 marks
group B.(10 marks for expt. & 5 marks for table viva

Q.3. Spot identification from group C. 5 marks.

Group A :

Blood sugar, Blood urea; Serum total protein, Albumin and A/G ratio, Alanine amino transaminase(SGPT), Aspartate amino transaminase(SGOT) , Alkaline phosphatase, Serum amylase, Serum total bilirubin, Serum uric acid, Serum calcium, CSF sugar.

Group B :

Creatinine in urine, Serum cholesterol, Serum phosphorus, CSF protein, Tests for monosaccharides (Ben edict, Barfoed,Selivanoff, Nylander, rapid furfural) , Tests for disaccharides, Colour reactions of proteins, Precipitation reactions of proteins, Normal Organic constituents of urine, Abnormal constituents of urine.

Group C :

Identification of slide under microscope, Use of reagent. Significance of test.
Use of Instrument /Appliances. Identification of Hb - derivative. Identification of GTT , Electrophoretogram and chromatogram.

Candidate will be allowed to use flow chart for quantitative exercise only.
There will be table viva on Q.1 & Q.2 exercise.

7. SYLLABUS FOR PRACTICAL

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.

Lecture –cum- Demonstrations :

1. PH- measurement,
2. Colorimetry.
3. Electrophoresis.
4. Chromatography.
5. Flame photometry.

APPOINTMENT OF EXAMINERS:

There shall be at least four examiners. Out of whom not less than 50% must be an external examiners. Of the four examiners, the senior most internal examiner will act as Chairman/Convenor. The Chairman will make distribution of . Practical & viva-voce, so that all examiners will examine each candidate.

Theory.

Paper I.	50 marks.
Paper II.	50 marks.
TOTAL	100 marks.

Theory – viva. 20 marks
(paper I & II – 10 marks each.)

Practical :

Q.1. Quantitative.	20 marks.
Q.2. Qualitative/Quantitative.	15 marks.
Q.3. Spotting.	5 marks.
Total	40 marks.

Internal assessment

Theory	20 marks.
Practical	20 marks.
Total	40 marks.

Standard of passing : A candidate must obtain 50% in aggregate with Minimum of 50% in theory & Minimum of 50% in practical & minimum of 50% in Internal Assessment.

DETAILS OF SYLLABUS FOR HUMAN BIOCHEMISTRY.
Structural formulae are not obligatory.
Must know:

1. **Chemistry of carbohydrates:** classification and biochemical importance, chemistry and functions of monosaccharides(excluding isomerism), disaccharides and polysaccharides including Glycosaminoglycans (mucopolysaccharides).

2. **Chemistry of Lipids:** classification and biological importance of triacyl glycerol, phospholipids, glycolipids, fatty acids (PUFA), prostaglandin, steroids and lipoproteins.

3. **Chemistry of proteins:** general nature of amino acids, various ways of classification of amino acids, biologically important peptides, classification, properties and biological importance of proteins. Structural organization of proteins, Plasma

proteins-functions, clinical significance of various fractions, methods of separation (only principle).

4. **Enzymes :** General nature, classification of enzymes, specificity and mode of action of enzymes, factors affecting enzyme activity. Enzyme inhibitions (Kinetic not required).Clinical importance (Diagnostic, therapeutic and as a Laboratory reagent) of enzymes and isoenzymes.

5. **Biological oxidation:** General concept of oxidation and reduction. Role of enzymes and co-enzymes. Electron transport chain. Substrate level and Oxidative phosphorylation, Role of uncouplers and inhibitors.

6. **Haemoglobin:** Chemistry and functions of haemoglobin . Types of normal and abnormal hemoglobins.(HbS, M,Thalassemia). Haemoglobin derivatives.

7. **Vitamins:** General nature, classification, sources,active forms and metabolic role, deficiency manifestations, daily requirement and hypervitaminosis.

8. **Nutrition:** Balance diet for normal adult, Quality of dietary protein, SDA, protein energy malnutrition (Kwashiorkor and Marasmus).

9. **Carbohydrate Metabolism:** Biochemical aspects of digestion and absorption of carbohydrates. Synthesis and break down of glycogen, Glycolysis, Rapoport Lumbering cycle, Citric acid cycle, Gluconeogenesis, HMP shunt pathway and its biological significance,Uric acid pathway (significance only). Metabolism of Galactose and Galactosemia. Blood sugar level and its regulation, oral GTT and glycosuria, Biochemistry of diabetes mellitus.

10. **Protein Metabolism:** Biochemical aspects of digestion and absorption of proteins. Fate of amino acid in the body (Deamination, Transmination, Transdeamination,Decarboxylation), Fates of ammonia (Urea cycle, glutamine formation), Metabolism of aromatic and sulphur containing amino acids and their inborn errors. Metabolism of Glycine.

11. **Lipid Metabolism:** Biochemical aspects of digestion and absorption of Lipids. Beta oxidation, biosynthesis of saturated fatty acids only, cholesterol biosynthesis, transport (role of HDL & LDL) Excretion, Ketogenesis, Ketolysis and Ketosis. Adipose tissue metabolism, Lipolysis and re-esterification, fatty liver and atherosclerosis.

12. **Chemistry and Metabolism of purines:**, nucleosides, nucleotides. Biologically important free nucleotides, Biosynthesis of purines(sources of ring & regulatory steps only, conversion of IMP to GMP & AMP) and salvage pathway, Biosynthesis

of pyrimidines, Breakdown of purines and pyrimidines, Gout, Lesch- Nyhan Syndrome

13. Metabolic interrelationship of carbohydrates, lipids and proteins metabolism.

14. **Hormones :** General characteristics and Mechanism of hormone action. cAMP the second messenger, phosphotidyl inositol /calcium system as second messenger.

15. **Chemistry of nucleic acids:** structure and function of DNA and RNA, Genetic code, DNA Replication, Transcription, Translation, chain initiation, chain elongation , chain termination, Inhibitors of protein biosynthesis.

16. Molecular Mechanism of gene expression and regulation 1) Lac-operon model, Mutations.

17. **Mineral Metabolism :** Study of (i) Calcium and phosphorous (ii) sodium, potassium & chloride; (iii) magnesium, copper & iodine; (iv) Iron, (v) manganese, selenium, zinc & fluoride. Their importance in body in brief.

18 Water and electrolyte balance and imbalance.

19. Acid base balance and imbalance.

20 **Haemoglobin Metabolism :** Synthesis and break down of haemoglobin, porphyria (in brief), Fate of bilirubin, different types of Jaundice.

21 **Function tests:** (i) Liver function tests, (ii) Kidney function tests & (iii) Thyroid function tests.

22 **Detoxication mechanisms:** (Bio- transformation) oxidation, reduction, conjugation, hydrolysis.

Desirable to know :

1. Introduction of Biochemistry as a basic science for the study of medicine, It's importance in clinical practice.

2. Molecular and functional organization of a cell and its subcellular components.

3. **Genetic engineering :** Recombinant DNA , Restriction endonuclease, Chimeric molecule, and Gene library. Applications of recombinant DNA technology in relation to medicine.

4. **Molecular concept of body defence and their applications:**
i) Immunoglobulins- structure & functions, ii) Free radicals, enzymatic and non-enzymatic antioxidants .

5. **Radioisotopes :** Uses of radioisotopes (therapeutic, diagnostic) and hazards.

6. Metabolic changes during starvation.

Nice to know :

1. **Environmental Biochemistry:** Definition, chemical stress, air & water pollution.

2. **Biochemistry of cancer** : carcinogens, and outline mechanism of carcinogenesis.

TOPICS OF THE LECTURES AND APPROXIMATE NUMBER OF LECTURES, HUMAN BIOCHEMISTRY - FIRST PHASE- M.B.B.S.

Lectures.

1.	Introduction to Biochemistry, Cell structure and function.	1
2.	Chemistry of Carbohydrates.	4
3.	Chemistry of Proteins.	4
4.	Chemistry of Lipids.	4
5.	Chemistry of Nucleo proteins.	2
6.	Enzymes.	6
7.	Biological oxidation.	2
8.	Chemistry and functions of Haemoglobin; abnormal haemoglobin.	2
9.	Carbohydrate Metabolism.	6
10.	Protein Metabolism.	6
11.	Lipid Metabolism.	6
12.	Integration of metabolism and metabolic changes during starvation.	2
13.	Mechanism of hormones action.	1
14.	Vitamins (Fat & Water soluble)	6
15.	Nutrition.	2
16.	Purines and Pyrimidine metabolism.	2
17.	Chemistry and functions of Nucleic acids.; Protein biosynthesis, Gene expression,mutations.	5
18.	Genetic engineering and it applications.	2
19.	Biochemistry of cancer.	1
20.	Radioisotopes.	1
21.	Haemoglobin metabolism, liver function tests,Detoxification mechanisms.	3
22.	Kidney function tests,Thyroid function tests	2
23.	Mineral Metabolism.	4
24.	Water and Electrolyte Balance.	2
25.	Acid base balance,	2
26.	Environmental Biochemistry.	1
27.	Molecular concept of body defence.	2

BOOKS RECOMMENDED:

TEXT BOOKS ;

1. Medical Biochemistry - U.Satyanarayan.
2. Biochemistry for Medical students by D.M.Vasudevan & Shree Kumari.
3. Medical Biochemistry by M.N. Chatterjea and Rana Shinde.
4. Text Book of Medical Biochemistry by Ramakrishnan, Prasannan & Rajan.
5. Medical Biochemistry by Debajyoti Das.
6. Biochemistry by A.C.Deb.

REFERENCE BOOKS:

1. Harper's Biochemistry.
2. Medical Biochemistry by N.V.Bhagwan.
3. Biochemistry by L.Stryer.
4. Biochemistry by Orten & Neuhans.
5. Biochemistry by Dr. Mrs. Pankaja Naik.