

# **ANATOMY CURRICULUM FOR MBBS**

## **Broad 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.

## **Programme Objectives:**

### **(A) Knowledge:**

At the end of the course the student should:

- a. Be able to comprehend the normal disposition, inter-relationships, gross, functional and applied anatomy of the various structures in the body including cross-sectional anatomy.
- b. Be able to identify the microscopic structure of various organs and correlate the structure with the functions as a prerequisite for understanding the altered state in various disease processes
- c. Be able to comprehend the basic structure and connections of the central nervous system to analyze the integrative and regulative functions of the organs & systems and he/she should be able to locate the site of gross lesions according to the deficits encountered.
- d. Know 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 should be able to explain the developmental basis of variations and congenital anomalies.
- e. Understand the anatomical basis of some common clinical procedures i.e., intramuscular and intravenous injection, lumbar puncture, liver, kidney and bone marrow biopsy, pleural, pericardial and peritoneal paracentesis
- f. Be able to comprehend the basic principles of different diagnostic procedures in radiology, normal plain and special X-rays of whole body and newer imaging techniques.

**(B) Skills:** At the end of the course the student should be able to:

- a. Identify all the major structures, organs, viscera of the body and mark the topography of important organs.
- b. Identify the tissues and organs under the light microscope.
- c. Identify normal anatomical structures, organs and viscera in radiographs, Computerized Tomography (CT) Scan, MRI etc. and correlate with the cross sections of the body.
- d. Locate ideal sites of intramuscular and intravenous injection, lumbar puncture, bone marrow, kidney and liver biopsy, pleural, pericardial & peritoneal tapping.
- e. Localise important pulsation and the structures against which pressure can be applied in case of bleeding from a particular artery.
- f. Demonstrate muscle testing and movements at joints.
- g. Locate the site for emergency tracheostomy
- h. Interpret common genetic abnormalities in karyotypes.

### **(C) Integration**

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

### **(D) Scope of training:**

Basic fundamentals of human gross, microscopic, developmental and radiological anatomy are covered in this course. Special emphasis is laid on its correlation with functional and applied aspects.

**Dissection** of cadaver is done by a group of students under the supervision of teacher so that they get accustomed to the structure of the human body .The dissection is preceded by lectures/ demonstrations and followed by tutorial and seminars on selected topics by the students.

**Histology:**A lecture is followed by practical .The students are shown demonstration microscopic slides and provided individually with slides to study under the light microscope. They maintain a workbook, which is checked by the teachers. They are introduced to electron micrographs of some selected organs.

**Embryology:** Lectures and demonstration of models at different developmental stages are taken.

Self-learning is encouraged. The students' progress is evaluated at regular intervals and internal assessment is calculated separately for theory and practicals.

## **Course Content**

### **General Anatomy**

Brief history of anatomy as related to medicine, subdivisions of anatomy; anatomical position descriptive terms, structures met with during dissection; skin, superficial fascia including contents, deep fascia including its modifications; muscles; parts, origin, insertion, tendon, aponeurosis, bursa, synovial sheath; ligament, bone including ossification, joints in general and classification, blood vessels, lymphatic and nervous system in general.

### **Gross Anatomy**

**Lectures/ demonstrations** in gross anatomy are taken under the general headings of: Introduction, position, important relations, blood, lymphatic and nerve supply, important applied aspects along with radiological features are emphasised wherever applicable. Emphasis is given on applied aspect of each structure dissected so that the student becomes aware of the clinical aspect of the structures in the body. The bones of the body are taught in details, which include general features, attachment of muscles and their actions and ossification of bones in demonstration classes.

**The topics covered under the different regions are as follows:**

#### **Head & Neck**

- Scalp
- Face, eye lid and the lacrimal apparatus
- Parotid gland
- Neck- posterior triangle, back of neck and suboccipital triangle
- Cranial cavity&meninges
- Orbit and its contents
- Anterior triangle& cervical fascia
- Thyroid and parathyroid glands
- Temporal and infratemporal regions
- Temporo-mandibular joint

- Pterygo-palatine fossa
- Submandibular Region
- Prevertebral region and root of neck
- Lymph nodes of head & neck & blood vessels of neck
- Last four cranial nerves and sympathetic trunk
- Oral cavity and tongue
- Pharynx, tonsil and Palate
- Nasal cavity
- Larynx
- Ear
- Seventh and eighth cranial nerves
- Eye ball
- Joints of head & neck
- Bones-Skull bones, mandible, cervical vertebrae, hyoid

## **Upper limb**

- Introduction and pectoral region
- Mammary gland
- Axilla: boundaries, contents, brachial plexus, axillary vessels & lymph nodes
- Back
- Shoulder region
- Shoulder joint, acromioclavicular and sternoclavicular joint
- Flexor and extensor compartment of arm
- Cubital fossa
- Flexor compartment of forearm and palm
- Extensor compartment of forearm
- Elbow and radioulnar joints
- Lymphatic and Venous drainage of upper limb
- Dermatomes and nerve injuries
- Bones-clavicle, scapula, humerus, radius, ulna, skeleton of hand

## **Thorax**

- Thoracic wall, Intercostal spaces
- Blood supply of thoracic wall
- Pleura and lungs
- Mediastinum: subdivisions
- Pericardium and heart
- Coronary circulation
- Superior mediastinum, its contents, arch of aorta
- Posterior Mediastinum, its contents
- Thoracic part of oesophagus, thoracic duct, vena azygos

- Autonomic nervous system
- Joints of thorax
- Mechanism of respiration
- Bones-sternum, ribs, thoracic vertebrae

## **Lower limb**

- Introduction & front of thigh, femoral triangle, boundaries & its contents, femoral hernia
- Medial side of thigh and adductor canal
- Gluteal region, muscles, nerves and vessels
- Popliteal fossa, boundaries and contents
- Back of the thigh, hamstring muscles
- Hip joint
- Front of leg & dorsum of foot
- Lateral & medial side of leg
- Back of leg
- Sole
- Knee joint
- Ankle joint
- Tibio-fibular joint and small joints of foot
- Venous drainage & lymphatic drainage.
- Nerve injuries
- Arches of foot
- Bones-Hip bone, femur, patella, tibia, fibula and bones of foot

## **Abdomen and Pelvis**

- Anterior abdominal wall
- Rectus sheath
- Inguinal canal& hernia
- Male genital organs
- Peritoneum
- Stomach
- Spleen and coeliac trunk
- Small and large intestines
- Mesentric vessels
- Duodenum
- Pancreas
- Liver and extra-hepatic biliary apparatus
- Portal vein
- Kidney, ureter and suprarenal
- Posterior abdominal wall

- Perineum-superficial and deep perineal pouches
- Ischioanal fossa
- Pelvis-Urinary bladder
- Female genital organs:ovary, fallopian tube, uterus and vagina
- Rectum and anal canal
- Prostate, vas deferens, seminal vesicles
- Male urethra
- Blood vessels, nerves and muscles of pelvis
- Bones-Lumbar vertebrae, sacrum, male and female pelvis

## **Neuroanatomy**

- Introduction, subdivisions of nervous system and meninges
- Spinal cord: external and internal features, nuclei, ascending and descending tracts, blood supply, lesions and their effects.
- Medulla oblongata: external and internal features, motor and sensory decussation, nuclei of cranial nerves, floor of the fourth ventricle, inferior cerebellar peduncle, blood supply and lesions.
- Pons: external and internal features, sections through upper and lower pons, nuclei of cranial nerves; middle cerebellar peduncle; blood supply and lesions.
- Midbrain: external and internal features, sections through superior and inferior colliculus, nuclei of cranial nerves, superior cerebellar peduncle, blood supply and lesions.
- Cerebellum: subdivisions, connections, white matter and nuclear masses, blood supply, functions and effect of lesions.
- Thalamic complex: dorsal thalamus, metathalamus, epithalamus, subthalamus, connections, functions, blood supply and lesions.
- Hypothalamus: nuclei, connections, functions, blood supply, third ventricle and applied anatomy.
- Cerebral hemispheres: functional areas, basal ganglion, white matter, internal capsule, blood supply, lesions and lateral ventricle.
- Visual and auditory pathways.
- Limbic system: parts and functions.
- Reticular system: parts and functions.

- Cerebrospinal fluid: production, circulation, absorption, functions and applied anatomy.
- Autonomic nervous system: Sympathetic, Parasympathetic.
- Ascending and descending pathways.

## **Surface Anatomy**

Important bony landmarks of the body, important vessels and nerves and projection of the outline of heart, its borders, surfaces and valves, lungs, their borders, fissures and hila, pleura, and various abdominal and pelvic organs.

## **Radiological anatomy**

Identification of normal anatomical features in commonly used skiagrams (plain & contrast), CT scans and MRI.

## **Embryology**

### **General Embryology**

#### **Introduction:**

- Relevance of Embryology to medicine; anatomy of male and female reproductive system.
- Oogenesis, ovarian cycle, uterine cycle.
- Spermatogenesis, spermiogenesis, sex determination, principles of family planning

#### **First two weeks of development:**

- Fertilization, cleavage & blastocyst formation
- Implantation, formation of decidua.
- Formation of embryoblast and trophoblast, bilaminar germ disc.
- Amniotic sac; yolk sac; extraembryonic mesoderm & extraembryonic coelome; connecting stalk; chorion; formation of prochordal plate.

### **Third week of development**

- Gastrulation: Trilaminar germ disc, formation of intraembryonic mesoderm, notochord, establishment of body axis.
- Trophoblast, secondary yolk sac, intraembryonic coelom

### **Third to eighth week of development: Embryonic period**

- Derivatives of ectoderm, endoderm and mesoderm
- Formation of somites, neural tube, foldings of the embryo, establishment of the body form, formation of the gut and its subdivisions.

### **Third month to birth :Fetus andFetal membranes**

- Development of fetus
- Placenta: formation, functions, features, types, circulation, placental barrier abnormalities
- Umbilical cord; amnion, amniotic fluid, its functions; amniocentesis

### **Multiple Pregnancies & birth defects:**

- Genetical and environmental causative factors for congenital malformations, mode of actions of teratogens and critical periods.
- Prenatal diagnosis of birth defects

## **Systemic Embryology**

### **Development of GIT& Body cavities**

- Divisions of gut: foregut, midgut & hepato-pancreatico-biliary system and hindgut
- Body cavities, peritoneal cavity
- Diaphragm, spleen and associated congenital anomalies

### **Development of respiratory system**

- Formation of lung bud, larynx, trachea, bronchi, pleural cavity, maturation of lungs and clinical correlates

### **Development of genitourinary system:**

- Kidney, ureter and urinary bladder
- Testis, ovary, suprarenal gland, descent of gonads
- Genital ducts, their derivatives, external genitalia and associated congenital anomalies

### **Development of cardiovascular system:**



- Establishment of cardiogenic area
- Heart loop and formation of the chambers of the heart
- Intraembryonic vessels
- Major veins and developmental abnormalities
- Foetal circulation and changes after birth

#### **Development of face and pharyngeal arches:**

- Pharyngeal arches, pharyngeal pouches, pharyngeal clefts and their derivatives, thyroid and parathyroid gland and common birth defects
- Face, nasal cavity, oral cavity, tongue, soft palate and associated anomalies

#### **Development of nervous system:**

- Neural tube: brain vesicles and their derivatives, neural crest and its derivatives, hypophysis cerebri and associated anomalies

#### **Development of organs of special senses**

- Eye and ear and their anomalies

#### **Development of skin and its appendages**

- Skin and its appendages
- Mammary gland and anomalies

#### **Development of musculoskeletal system**

- Skull, vertebral column, limb bones, sternum and common congenital anomalies
- Development of muscles in brief

### **Genetics**

#### **Introduction:**

Definition:

- Medical genetics
- Cytogenetics
- Clinical genetics

History:

- Gregor Mendel & laws of inheritance
- Cell cycle & division

#### **Chromosomes:**

- Structure & classification
- Karyotyping- methodology
- Sex chromatin & Lyon hypothesis

### **Chromosomal disorders:**

- Numerical abnormalities & their causes
  - Polyploidy
  - Aneuploidy
  - Trisomy and monosomy
  - Down's syndrome
  - Patau's syndrome
  - Edwards's syndrome
  - Klienfelter's syndrome
  - Turner's syndrome
  - Mosaicism
- Structural abnormalities
  - Deletion, inversion, translocation and ring chromosomes
  - Isochromosomes, chromosomal fragile sites, fragile X chromosome

### **Chromosome at molecular level:**

- Structure of DNA, RNA, genetic code, mutation, mutagens

### **Clinical genetics:**

- Pedigree chart
- Inheritance

### **Diagnosis of Genetic disease:**

- Prenatal diagnosis
- Indications
- Chorionic villi biopsy
- Maternal sera
- Amniocentesis

### **Genetic Counselling:**

- Indication & basis of gene therapy

## **Histology**

### **General Histology**

#### **Introduction: Cell & Microscope**

Microscope and basic principles of microscopy, commonly used stains, basophilic and acidophilic staining reactions and their significance, commonly encountered artifacts. Detailed structure of cell and its components and their functional mechanisms.

#### **Epithelial tissue:**

Microscopic characteristics of simple and stratified epithelium, functions& distribution  
Glands: mucous, serous and mixed

**Connective Tissue:**

Classification; cells, fibers and their structural features and functions.  
Intercellular substances, amorphous ground substance, types of connective tissue (loose areolar tissue, dense connective tissue) and their distribution.

**Cartilage:**

Specialized connective tissue, different types of cartilages and their functions and distribution.

**Bone:**

structural features of compact and cancellous bone, their distribution and functions, ossification.

**Muscular tissue:**

Structural and functional characteristics of skeletal, cardiac and smooth muscle.

**Lymphoid tissue:**

Structural and functional characteristics of lymph node, spleen, tonsil and thymus.

**Blood vessels:**

Conducting and distributing arteries, arterioles, types of capillaries, their structural features and distribution, structural characteristics of large and small veins, lymphatics and sinusoids.

**Nervous tissue:**

Structural characteristics of a neuron, types of neurons and their structural and functional features and distribution, neuroglia: types, structure and functions, ganglia, peripheral nerves, myelination, degeneration and regeneration in peripheral nerves.

## **Systemic Histology**

**Digestive system:**

General plan of GIT: Oesophagus, oral cavity, lip, tongue, salivary glands; parotid (serous), sublingual (mucous) and submandibular (mixed), stomach; body, fundus and pylorus ,small and large intestines; appendix and colon.

**Glands:**

Liver, gall bladder & pancreas.

**Urinary system:**

Kidney, ureters, urinary bladder and urethra

**Male reproductive system:**

Testis, epididymis, vas deferens, prostate and seminal vesicle

**Female reproductive system:**

Ovary, fallopian tube, different stages of functional activity of uterus, vagina  
Mammary gland, placenta and umbilical cord

**Integumentary system:**

Skin: hairy, Non hairy

**Respiratory system:**

Nose, nasopharynx, larynx, trachea, principal bronchi and lung

**Endocrine system:**

Pituitary, pineal; review of endocrine tissues in the pancreas, testis and ovary, thyroid, parathyroid and adrenal gland

**Special sensory organs:**

Eyeball

Taste buds

Olfactory mucosa

**Nervous System:**

Spinal cord, cerebrum, cerebellum

**(E) Evaluation**

Regular evaluation is done in the form of written and oral examination including dissection and histology practicals.

**Internal Assessment:** Existing as per MCI recommendations is 20% marks for theory and 20% for practical examination.

(The courses committee felt that internal assessment marks should have more weightage so that the students are regular in internal examinations throughout the academic year .)

**University assessment:**

**Theory:** Two papers of 50 marks each (**Total 100 marks**)

Each theory paper has three parts of two questions each.

The pattern and syllabus of question papers is as follows:

**PAPER I:**

**50 marks**

(Head & neck, Neuroanatomy, Upper limb, related Histology and Embryology, General Anatomy and General Histology)

**PAPER II**

**50 marks**

(Thorax, Abdomen, pelvis Lower limb, related Embryology, Histology and General Embryology and Principles of Genetics)

**Each Theory paper has:**

**PART I**

Q.1. Five short questions of two marks each

(Enumerate type)

**2 x 5=10**

Q.2 Five short questions of two marks each

(Includes diagrams on topics of histology and gross anatomy, short questions on applied, general anatomy and general histology)

**2 x 5 =10**

**PART II**

Q.3 Three specific short structured questions

**3 x 3 =9**

Q.4 Full question specific structured

**6**

**PART III**

Q.5 Two brief structured specific questions

**2 x 3 =6**

Q.6 Three short structured questions on applied anatomy

**3 x 3 =9**

The external examiners evaluate 50% of the theory papers.

**Practical and viva voce**

**(a) Viva voce:** **20 marks** (to be added to theory marks)

i) Soft parts viva 10 marks

ii) Hard parts viva 10 marks

**(b) Practical** **40 marks**

Dissection/prosection 6 marks

Surface Anatomy 4 marks

Histology 10 marks

Spotting 10 marks

Embryology 6 marks

Radiology 4 marks

**Internal Assessment:**

Theory **20 marks**

Practical **20 marks**

**Total (Theory & Practical)** **200 marks**

**Recommended Books**

**Gross Anatomy**

Romanes, C.J.: **Cunningham's Manual of practical Anatomy**, vol. 1, II, and III, 15th Ed. 1999 Oxford University Press.

Chaurasia, B.D **Human Anatomy- Regional & Applied**. Vol. I, II & III, 4th Ed. 2004, CBS Publishers, Delhi.

Indirbir Singh: **Textbook of Anatomy with coloured Atlas**, Vol.I, II, III 4<sup>th</sup> Ed. 2007, Jaypee Publishers, Delhi.

**Applied Anatomy**

Snell RS: **Clinical Anatomy by Regions**, 8th Ed. 2008 Lippincott Williams & Wilkins Baltimore.

Moore & Dalley: **Clinically oriented Anatomy**, 5th Ed. 2006, Lippincott Williams & Wilkins Baltimore.

**Histology**

Paul R. Wheater, H. George Surkitt & Victor G. Banials: **Functional Histology: A Text and Colour Atlas**, 4th Ed. 2000, ELBS, Churchill Livingston.

Inderbir Singh: **Textbook of Human Histology with colour Atlas**, 4th ed. 2002, Jaypee Publishers, Delhi.

**Neuroanatomy**

Vishram Singh: **A Textbook of Clinical Neuroanatomy**, 2006, Elsevier India private Ltd.

Inderbir Singh: **Textbook of Human Neuroanatomy**, 7th ed. 2006, Jaypee Publishers

Snell R.S.: **Clinical Neuroanatomy**, 6th ed. 2006, Lippincott Williams & Wilkins.

**Surface Anatomy, Radiological Anatomy, General Anatomy & Genetics**

Slaby and Jacob: **Radiographic Anatomy**, 1990, National Medical Series for Independent Study, Harwal Publishing Philadelphia.

Halim R.: **Surface & Radiological Anatomy**, 2nd Ed, 1993, CBS Publisher

Chaurasia BD: **General Anatomy**, 3rd Ed, 1996, CBS Publishers

Pal: **Basis of Medical Genetics** 1st Ed. 2003, AITBS Publishers.

**Embryology**

Sadler T.W.: **Langmans Medical Embryology**, 10th edition, Lippincott Williams and Wilkins, Baltimore.

Inderbir Singh: **Introduction to Human Embryology for Medical Students**, 7th Ed. 1999 Macmillan publishers, India.

