Jinnah Sindh Medical University

	Spiral-I
COURSE TITLE	**Locomotor-I module**
INTRODUCTION	The Locomotor system is one of the basic and most essential systems of the human body since it allows humans to move and perform various functions, some of which are necessary for survival. The understanding of the structures, their functions and biochemical aspects are crucial for physicians. This module attempts to build a solid foundation regarding knowledge of the Locomotor system and its clinical applications.
RATIONALE	This module will help the learners better understand the pathology and prevalence of limb-related disorders which they will study in Locomotor-2 in the 2ndspiral of the curriculum. Ultimately this will provide a firm grasp on the underlying mechanisms of the relevant clinical conditions in their ward rotations and clerkships.
TARGET STUDENTS	**1st year MBBS, 2022**
DURATION	**8 weeks**
MODULE OUTCOMES	By the end of the module, students will be able to • Predict loss of functions due to injury to various parts of the Locomotor system based on their knowledge of its normal structure, function and biochemical mechanisms • Identify common structures and features of the skeletal system on plain X rays
DEPARTMENTS	Anatomy Biochemistry Physiology
OBJECTIVES	At the end of the module, the students should be able to:

LECTURES

ANATOMY

1. Introduction to the Musculoskeletal system

- Discuss the division and functions of skeletal system
- Enumerate the parts of axial and appendicular skeleton
- Define pectoral & pelvic girdle
- Describe the division and curvature of vertebral column
- Discuss the types and number of vertebrae found in adults

2. Embryology Development of Paraxial Mesoderm& muscles

- Define epiblast and hypoblast
- Explain the differentiation of tri-laminar germ disc
- Discuss the formation of mesoderm and paraxial mesoderm
- Discuss the developmental relation of hypaxial and epaxial muscles
- Describe the process of myogenesisin the types of muscle

UPPER LIMB

3. Sternoclavicular and Acromioclavicular Joints

- Classify the types of Sternoclavicular and Acromioclavicular of joint
- Describe their structure
- Name the muscles acting on these joint
- Explain the movements at these joint
- Explain clinical aspects of these joint

4. Breast Development, Gross and Histology

- Discuss the anatomy of breast
- Explain the relation of breast within pectoral region
- Describe the blood supply & lymphatic drain age of breast
- Discuss the relation of breast disease with axilla
- Explain the development of breast
- Discuss the histological features of breast

5. Brachial Plexus

- Describe the formation of brachial plexus, with its root value and divisions (roots, trunk, division, and cords)
- Discuss the relation of brachial plexus also in connection to clavicle (Supra, retro, infra clavicular parts
- Enumerate the branches arising from the cords
- Draw the brachial plexus
- Name the muscles and skin supplied by the branches of brachial plexus

6. Development of limbs &joints and their congenital anomalies

- Discuss the site and time of appearance of upper and lower limb buds
- Define apical ectodermal ridge (AER)
- Describe the mesenchymal proliferation under the influence of AER and differentiation into cartilaginous models of future limb bones
- Define the source of mesoderm forming the limb muscles
- Discuss the hand plate and formation of digital rays resulting into digits
- Describe the muscles involved in and process of rotation of both limbs
- Discuss the differentiation of mesenchyme to form fibrous, cartilaginous and synovial

joints
- Discuss the congenital anomalies of both limbs & joints

7. Muscles of anterior compartment of arm & neurovascular supply
- Enumerate the muscles of anterior compartment of arm
- Discuss the attachment of muscles, their nerves supply and their actions
- Explain the course of muscular cutaneous nerve, its branches and distribution
- Discuss the large nerves of arm
- Predict the impact of lesions of main nerves of compartment

8. Muscles of Posterior compartment of arm & neurovascular supply
- Name the muscles present in the posterior compartment of arm
- Describe the actions performed by the muscles of posterior compartment of arm
- Name the nerve supply of the muscles of this compartment
- Explain the course of vessels present in this compartment along with the supply to the structures in this compartment
- Discuss the clinical aspect related to the topic

9. Muscles of the anterior compartment of forearm & neurovascular supply
- Name the muscles present in the anterior compartment of forearm
- Explain the division of muscle layer in the anterior compartment
- Explain actions of the muscles of anterior compartment of forearm
- Discuss the nerve supply of the muscles of this compartment
- Describe the course of vessels present in this compartment along with the supply to the structures in this compartment
- Discuss the clinical aspect related to the topic

10. Muscles of the posterior compartment of forearm & neurovascular supply
- Name the muscles present in the posterior compartment of forearm
- Explain the division of muscle layer in the posterior compartment
- Explain actions of the muscles of posterior compartment of forearm
- Discuss the nerve supply of the muscles of this compartment
- Describe the course of vessels present in this compartment along with the supply to the structures in this compartment
- Discuss the clinical aspect related to the topic

11. Wrist joint, Radioulnar & small joints of hand
- Describe the morphology of wrist joint
- Discuss the neurovascular supply of wrist joint
- Describe radioulnar joints and discuss its neurovascular supply
- Discuss the movements occurring at these joints
- Classify the intercarpal, metacarpal and interphalangeal joint
- Discuss the clinical aspect related to the topic

12. Blood vessels and nerves of hand
- Enumerate the arterial supply of hand
- Describe the course and relations of radial and ulnar arteries, and branches of radial and ulnar arteries, with relation to hand
- Discuss the formation of superficial and deep palmar arch, veins of hand and their tributaries
- Describe the nerves of the hand and their injuries

13. Cutaneous supply of upper limb

- Describe in detail the cutaneous supply and dermatomes of upper limb

14. Superficial veins and Lymphatic drainage of upper limb

- Discuss the normal Anatomy of veins of upper limb
- Difference between superficial and deep veins
- Explain the course of major superficial veins of upper limb
- Describe the applied anatomy of superficial veins of upper limb
- Describe group sand area of drain age of each group of lymph nodes
- Discuss the commencement, course and termination of superficial lymphatic vessels
- Discuss the clinical conditions related to lymphatic channels of upper limb

15. Nerve injuries of Upper limb

- Recall the different nerve of upper limb and their root value
- Discuss the causes of nerve injuries in upper limb
- Enumerate the common sites of injury of the most commonly injured nerves
- Discuss the symptoms caused by these nerve injuries

LOWER LIMB

16. Formation of lumbosacral plexus, & its injuries

- Discuss the formation of lumbar plexus
- List the branches of lumber plexus with their root values
- Discuss relation of the nerves with psoas major muscle
- Structures supplied by lumbar plexus
- Explain the formation of sacral plexus
- Describe the composition and relations of sacral plexus
- Enumerate branches of this plexus
- Discuss the cutaneous supply of lower limb

17. Muscles of Anterior compartment of thigh (Femoral triangle, femoral sheath & Neuro vascular supply)

- Discuss the arrangement of thigh into compartments
- Explain the muscles of anterior compartment of thigh and their respective actions
- Describe the innervation and blood supply of muscles of anterior compartment of thigh
- Describe Femoral triangle, its boundaries and contents, and Femoral sheath and its contents
- Discuss the clinical conditions associated with anterior compartment of thigh, femoral triangle and femoral sheath

18. Gluteal Region

- Describe the location of gluteal region
- Discuss about bones and ligaments of gluteal region
- Discuss the muscles of the gluteal region and their respective actions
- Discuss the nerves and blood vessels of the gluteal region
- Enumerate different structures entering and leaving the gluteal region
- Discuss the clinical conditions associated with the gluteal region

19. Muscles of Posterior compartment of thigh and neurovascular supply

- Discuss the arrangement of thigh into compartments
- Explain the muscles of posterior compartment of thigh and their respective actions
- Describe the innervation and blood supply of muscles of posterior compartment of thigh
- Discuss the greater and cruciate anastomoses at the back of thigh

- Discuss the clinical conditions associated with the posterior compartment of thigh

20. Muscles, Nerve and vessels of medial compartment of thigh

- Explain the muscles of medial compartment of thigh and their respective actions
- Describe the innervation and blood supply of muscles of medial compartment of thigh
- Discuss the clinical conditions associated with the medial compartment of thigh

21. Anterior & Lateral compartment of leg (muscles, nerves and vessels)

- Discuss the facial compartments of leg
- Explain muscles of anterior and lateral compartment with its neurovascular supply
- Describe clinical like the compartment syndrome

22. Posterior compartment of leg

- Enumerate the muscles of posterior compartment of leg
- Discuss the actions of muscles of posterior compartment of leg
- Describe nerves and vessels of compartment and their supply

23. Sole of foot & nerves and vessels of foot

- Describe the architecture of sole of foot
- Enumerate the layers of sole of foot
- Discuss the muscle presenting the sole of foot
- Discuss the blood supply and nerve supply of sole of foot

24. Cutaneous supply of lower limb

- Describe in detail the cutaneous supply of lower limb

25. Superficial veins and lymphatic drainage of lower limb

- Enumerate the superficial veins
- Discuss the course of great and small saphenous veins and their connections with the deep veins of the leg
- Explain clinical conditions related to the Superficial veins; like venous thrombosis
- Describe the lymphatic drainage of lower limb

26. Injuries of lower limb

- Recall the different nerves of lower limb and their root value
- Discuss the causes of their injuries
- Enumerate the sites of injury of the most commonly injured nerves
- Discuss the symptoms caused by these nerve injuries
- Discuss the fracture of bones of lower limb
- Explain injuries of lower leg and ankle
- Discuss Pott's fracture
- Explain Sprain ankle

PHYSIOLOGY

1. Membrane Potential

- Define Nernst Potential, Nernst equation
- Explain the significance of Nernst potential
- Define the origin of resting membrane potential
- Describe the role of Na, K & Cl, Na-K ATPase pump

2. Action Potential (phases, generation & propagation)

- Identify different phases of action potential

- Describe the generation & propagation of action potential
- Define threshold potentials

3. Physiological properties of skeletal muscle

- Define contractility (isometric & isotonic) & excitability
- Define fatigue
- Define summation (spatial & temporal)
- Differentiate between tetanization, tetanus & tetany
- Briefly describe the staircase phenomenon (treppe)
- Define motor unit

4. Mechanism of skeletal muscle contraction

- Briefly describe the structure of Sarcomere
- Explain sliding filament mechanism & power stroke
- Define troponin tropomyosin complex

5. Neuromuscular Junction Transmission

- List the components of neuromuscular junction
- Explain the sequence of events during transmission
- Define end plate potential
- Describe excitation contraction coupling
- Briefly describe the role of Sarcoplasmic reticulum

6. Disorders of Neuromuscular Junction

- Identify disorders of neuromuscular junction ((Myasthenia gravis, Lambert Eaton syndrome)

7. Muscle adaptation to exercise

- Identify the types of muscle fibers (type I & II)
- Describe the effect of exercise on muscular blood flow
- Define the effect of training, endurance & resistance on muscle fibers

BIOCHEMISTRY

TOPIC 1: EXTRACELLULAR MATRIX

1. Glycosaminoglycans

- Describe the biochemical structure and composition of extracellular matrix
- Discuss the functions of extracellular matrix
- Describe the structure of Glycosaminoglycans
- Classify the Glycosaminoglycans
- Discuss the biochemical functions of Glycosaminoglycans
- Discuss the clinical significance of the diseases associated with Glycosaminoglycans

2. Collagen & Elastin

- Describe the structure of Collagen & Elastin
- Classify Collagen & Elastin.
- Discuss the biochemical functions of Collagen & Elastin
- Discuss the clinical significance of the diseases associated with Collagen & Elastin

TOPIC 2: VITAMIN C

3. Vitamin C

- Explain the dietary sources and daily recommended allowance of Vitamin C.
- Discuss the metabolism of vitamin C in the human body.
- Describe the physical and chemical properties of vitamin C
- Discuss the biochemical functions of vitamin C specially with respect to Collagen and extracellular matrix
- Discuss the clinical significance of vitamin C deficiency

TOPIC 3: BONE METABOLISM

4. Vitamin D

- Explain the dietary sources and daily recommended allowance of Vitamin D.
- Discuss the metabolism of vitamin D in the human body.
- Discuss the regulation of serum calcium in relation to bone metabolism.
- Discuss the biochemical functions of vitamin D
- Discuss the clinical significance of vitamin D deficiency and its prevention.

5. Calcium & PO4- Metabolism

- Explain the dietary sources and daily recommended allowance of Calcium & PO4-
- Discuss the metabolism of Calcium & PO4- in the human body.
- Discuss the regulation of serum calcium in relation to bone metabolism.
- Discuss the biochemical functions of Calcium & PO4-
- Discuss the clinical significance of Calcium & PO4- deficiency and its prevention.

TOPIC 3: PROTEIN METABOLISM

6. Reactions of Amino acids

- Describe various sources and utilization of amino acid.
- Define and explain the reactions of amino acids (Domination, Transamination etc.)
- Explain the nitrogen balance in the body
- Discuss the diagnostic value of plasma Aminotransferase
- Discuss the clinical significance of biomarkers

7. Ammonia Metabolism

- Discuss the major sources of ammonia.
- Discuss the utilization, formation and secretion of ammonia in human body.
- Explain Ammonia metabolism and its detoxification
- Discuss the clinical significance and management of Ammonia toxicity

8. Urea Cycle

- Discuss the process of amino acid oxidation and the production of urea.
- Describe the metabolic pathway of Urea synthesis
- Discuss the fate of urea
- Describe the regulation of urea cycle
- Discuss the clinical significance of urea cycle disorders

9. Phenylalanine & Tyrosine Metabolism

- Discuss the metabolism of Phenylalanine & Tyrosine and its related disorders
- Discuss the metabolism of Melanin and its related disorder (Albinism)
- Discuss the metabolism of Thyroid hormones and their related disorder
- Discuss the metabolism of neurotransmitters and their related disorder

10. Metabolism & Disorders of Tryptophan

- Discuss the metabolism of tryptophan and its related disorders
- Describe the importance of tryptophan derived biologically important compounds

- Explain clinical significance of disorders of tryptophan

11. Metabolism of Sulphur Containing Amino Acids

- Discuss the metabolism of Sulphur containing amino acids
- Describe the functions of Sulphur containing amino acids
- List the steps of formation of cysteine and methionine
- Explain clinical significance of disorders of Sulphur containing amino acids

12. Metabolism of Branched Chain Amino Acids

- Discuss the metabolism of branched chain amino acids
- Describe the functions of branched – chain amino acids
- Explain the clinical significance of disorders of branched chain amino acids

13. Catabolism of Carbon Skeleton of Amino Acids

- Explain the catabolism of carbon skeleton of amino acids
- List the Glucogenic & Ketogenic amino acids
- Explain the significance of carbon skeleton of Amino acids
- Describe the mechanism of entry of carbon skeleton in amino acid metabolism
- Discuss the process of vitamin B12 as a co-factor and methyl donor in metabolism of amino acids

TUTORIALS/ DEMONSTRATION

ANATOMY

UPPER LIMB

14. Clavicle (Osteology & muscle attachments)

- Identify the features of Clavicle like borders, surfaces and land marks used for side determination
- Discuss the attachments of muscles on Clavicle, their nerve supply and actions

15. Scapula (Osteology & muscle attachments)

- Identify Scapula and its sites
- Mention the bony landmarks of Scapula like borders, surfaces & land mark used for side determination
- Discuss the attachment of muscles on Scapula, their nerve supply and actions
- Discuss the Clinical anatomy of Scapula

16. Humerus (Osteology & muscle attachments)

- Identify Humerus and its site
- Mention its bony landmarks like borders, surfaces & land mark used for side determination
- Discuss the attachment of muscles on Humerus, their nerve supply and actions
- Explain the clinical conditions associated with Humerus anatomy

17. Pectoral Region

- Enumerate the muscles of pectoral girdle
- Describe the attachments of muscle of pectoral girdle and its neurovascular supply
- Explain the role of muscles of pectoral region in stabilizing the pectoral girdle
- Discuss the clavi-pectoral fascia
- Describe the triangle of auscultation

- Name the nerves and blood vessels of this region

18. Anatomy of Shoulder joint & its movements

- Classify the types of shoulder joint
- Describe the structure of shoulder joint
- Name the muscles acting on the joint/rotator cuff muscles
- Explain the range of mobility
- Describe the movements of shoulder joint
- Explain clinical aspects of the joint

19. Axilla, boundaries and contents along with axillary artery and veins

- Describe the position and shape of axilla
- Name the boundaries of axilla, and the muscles forming these boundaries
- Discuss the formation, course and relations of axillary vessels
- Describe the groups of axillary lymph nodes and their arrangement

20. Brachial Plexus (See lecture objectives)

21. Muscles of anterior compartment of arm & neurovascular supply (See lecture objectives)

22. Posterior compartment of arm, muscles &neurovascular supply (See lecture objectives)

23. Radius (Osteology & muscle attachments)

- Identify the bones of forearm & hand
- Determine side of bones
- Identify the features of bones & muscles attached to bones
- Describe the nerve supply and actions of muscles
- Discuss clinical significance of bones

24. Ulna (Osteology & muscle attachments)

- Identify the bone
- Determine the side of bone
- Describe the surfaces, borders and ends of the bone
- Identify the bony landmarks of bone & muscles attachment sites on the bone
- Describe the nerve supply and actions of muscles
- Discuss clinical significance of this bone

25. Cubital fossa & Anastomosis around elbow

- Describe the boundaries, contents and relationship among structures of cubital fossa
- Identify the surface anatomy of cubital fossa
- Discuss the clinical importance of the cubital fossa
- Describe formation of anastomosis around elbow joint
- Describe the significance of anastomosis and collateral circulation

26. Elbow Joint

- Identify the morphology of the join.
- Discuss the muscles acting on the elbow joint
- Explain the neurovascular supply of the joint
- Describe the carrying angle and applied aspects of this joint

27. Muscles of anterior compartment of forearm & neurovascular supply (See lecture

objectives)

28. **Muscles of the posterior compartment of forearm & neurovascular supply (See lecture objectives)**

29. **Osteology of hand**
- Describe the bony arrangement of hand

30. **Muscles & Spaces of Hand**
- Discuss the muscles of the hand
- Locate the different spaces of the hand on both palmar and dorsal aspects
- Describe the spaces of hand
- Discuss the clinical importance of these spaces

31. **Surface Anatomy of Upper limb**
- Perform surface markings for main vessels of upper limb

32. **Radiology of upper limb**
- Identify the normal bony land marks on X-Ray

LOWER LIMB

33. **Hip Bone (Osteology & muscle attachments)**
- Enumerate the parts of hip bone
- Discuss its side determination
- Describe in detail the osteology of each part of hip bone
- Discuss its muscle and ligamentous attachments
- Discuss the clinical conditions related to Hip bone

34. **Femur (Osteology & muscle attachments)**
- Identify Femur and its side
- Describe its anatomical position
- Identify its bony landmarks
- Discuss the muscles and ligaments attached to Femur
- Discuss the clinical conditions related to it

35. **Hip joint; movements & anastomoses around hip joint**
- Describe the formation of hip joint
- Discuss the characteristics features of synovial joint
- Describe the articular surfaces of hip joint
- Discuss the attachment of its joint capsule
- Explain the ligaments stabilizing the hip joint
- Discuss the muscles acting on the hip joint and different movements performed at it
- Describe its innervations and blood supply
- Describe the arterial anastomosis around the hip joint.
- Discuss the clinical conditions associated with the hip joint

36. **Deep fascia of thigh, its modification (Inguinal ligament)**
- Explain the arrangement and attachment of deep fascia of thigh
- Discuss the location of saphenous opening and its relations
- Describe the attachments of inguinal ligament

- Discuss the clinical conditions associated with deep fascia of thigh and inguinal ligament

37. Gluteal Region (See lecture objectives)

38. Muscles of Posterior compartment of thigh & neurovascular supply (See lecture objectives)

39. Muscles, nerve and vessels of medial compartment of thigh (See lecture objectives)

40. Tibia (Osteology & muscle attachments)

- Identify the Tibia and its side
- Describe its anatomical position
- Identify its bony landmarks
- Discuss the muscles and ligaments attached to Tibia
- Describe the ossification of tibia and its primary and secondary ossification centers
- Discuss the fractures and other clinical conditions associated with it

41. Fibula (Osteology & muscle attachments)

- Identify Fibula and its side
- Mark the attachment of muscles and ligaments
- Elaborate the joints formed by it
- Describe the nerve injuries related to it

42. Popliteal Fossa & its contents

- Discuss the boundaries of popliteal fossa
- Enumerate the contents of popliteal fossa
- Describe the relationship of the contents.
- Explain how popliteal artery can be palpated
- Discuss clinical conditions related to popliteal fossa (e.g. the Baker's cyst)

43. Knee joint, genicular anastomosis, and locking and unlocking

- Classify the knee joint
- Discuss its articular surfaces, the synovial capsule
- Explain types of movement performed at knee joint and the muscles responsible for that movement
- Describe the locking and unlocking mechanism
- Discuss the neurovascular supply of knee joint

44. Anterior & Lateral compartment of leg (Muscles, nerves and vessels) (See lecture objectives)

45. Posterior compartment of leg (See lecture objectives)

46. Osteology of foot

- Describe the bony arrangement of foot

47. Sole of foot &nerves and vessels of foot

- Describe the architecture of sole of foot.
- Enumerate the layers of sole of foot.
- Discuss the muscle presenting the sole of foot.

- Discuss the blood supply and nerve supply of sole of foot

48. Arches of foot

- Describe the architecture of arches of foot and the fact responsible for their maintenance
- Elaborate the bones which are responsible for forming these arches
- Describe the ligaments which are holding these arches
- Describe the function of the arches of foot
- Describe Plantar Fascitis and relevant injuries

49. Ankle joint, superior & Inferior tibio-fibular joint

- Describe the Ankle Joint, the type, articular surface and the synovial capsule
- Discuss the Superior and Inferior Tibio-Fibular Joints, Sub-talar Joint, transverse tarsal Joint or mid-tarsal joint.
- Describe the movement performed and the muscles responsible for these movement
- Discuss the neurovascular supply of the joints

50. Surface anatomy of lower limb

- Mark the different joints of lower limb
- Mark the course of blood vessels of lower limb
- Palpate the blood vessels
- Mark the course of important nerves of lower limb

51. Radiology of lower limb

- Identify the normal bony landmarks as seen on X-Ray

DEMONSTRATION ON SECTRA

Overview of compartments of Upper and Lower limb (The objectives of these topics have been mentioned above with their respective lectures/demos.)

UPPER LIMB

- Muscles of anterior compartment of arm muscles & tits neurovascular supply
- Posterior compartment of arm, muscles & its neurovascular supply

LOWERLIMB

- Muscles of Anterior compartment of thigh, femoral triangle, femoral sheath & its neurovascular supply
- Gluteal Region
- Muscles &Nerve and vessels of medial compartment of thigh
- Muscles of Posterior compartment of thigh and neurovascular supply
- Anterior & Lateral compartment of leg (muscles, nerves and vessels)
- Posterior compartment of leg

BIOCHEMISTRY

1. Extracellular Matrix (Glycosaminoglycans)

- Discuss the clinical importance of Glycosaminoglycans
- Correlate the laboratory investigations with relevant clinical conditions

2. Bone Minerals (Calcium & PO4- Abnormalities)

- Discuss the clinical importance of Calcium & PO4- abnormalities

- Correlate the laboratory investigations with relevant clinical conditions

3. **Vitamin C & D**
- Discuss the clinical importance of Vitamin C & D
- Correlate the laboratory investigations with relevant clinical conditions

4. **Protein Metabolism (Urea Cycle)**
- Discuss the clinical importance of Urea Cycle
- Correlate the laboratory investigations with relevant clinical conditions

5. **Metabolic Abnormalities of Amino Acids (Phenylalanine and Tyrosine)**
- Discuss the clinical importance of metabolic abnormalities of above amino acids
- Correlate the laboratory investigations with relevant clinical conditions

6. **Metabolic Abnormalities of Amino Acids (Tryptophan, Sulphur containing & branched chain amino acids)**
- Discuss the clinical importance of metabolic abnormalities of above amino acids
- Correlate the laboratory investigations with relevant clinical conditions

PRACTICALS

ANATOMY

1. **Histology of bone**
- Define bone tissue
- Classify bones macroscopically (compact & spongy) and microscopically
- Differentiate compact and spongy bones on the basis of cells and matrix
- Describe the arrangement of spongy and compact bones in different parts of long bones
- Define Periosteum & Endosteum
- Discuss bone formation, growth, remodeling & repair

2. **Histology of cartilage**
- Describe the components of cartilage that is cells, fibers and ground substance
- Differentiate the 3 types of cartilage on the basis of differences in components and presence or absence of perichondrium
- Discuss chondrogenesis, growth and repair

BIOCHEMISTRY

1. **Estimation of Calcium & Phosphate**
- Outline the bio-techniques for detection of Calcium & Phosphate in a sample
- Perform the estimation of serum Calcium & Phosphate.
- Correlate the laboratory investigations with relevant clinical conditions

2. **Estimation of Alkaline Phosphatase**
- Outline the bio-techniques for detection of Alkaline Phosphatase in a sample
- Perform the estimation of serum Alkaline Phosphatase.
- Correlate the laboratory investigations with relevant clinical conditions

3. **Chromatography**

- Describe the principle of chromatography
- Describe different types of chromatography and HPLC
- Describe the instruments used in different types of chromatography
- Correlate the laboratory investigations with relevant clinical conditions

4. Paper Chromatography

- Describe the principle of paper chromatography
- Describe the method of performance of paper chromatography
- Perform amino acids detection on paper chromatography
- Correlate the laboratory investigations with relevant clinical conditions

PHYSIOLOGY

1. Introduction to power lab & performance of Nerve conduction velocity

- Describe different parts of power lab & their application in different experiments
- Determine nerve conduction velocity in human

2. Electromyogram (EMG)

- Explain the physiology of muscle contraction & changes during EMG recording

3. Simple muscle twitch (SMT) & Fatigue

- Define simple muscle twitch & summation
- Identify the graphs of SMT & summation

4. Summation & Tetanization

- Define tetanization & fatigue
- Identify the graphs of tetanization & fatigue

INTERNAL ASSESSMENT	• Continuous monitoring of attendance and practical assessment in short groups. • It will be in the form of MCQs, assignments, stages/sub-stages, projects, quiz or OSPE. • Internal evaluation carries 20% weightage in summative semester examination.
FINAL EXAM	Final Annual exam will consist of MCQs (One Correct & One Best) and OSPE (observed + unobserved stations)