**Musculoskeletal Module**

**First Professional Year MBBS**

**8 Weeks**

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**Introduction to Module**

Musculoskeletal system Module is designed to provide guidance on introduction to the basics of human musculoskeletal system. Moreover, the module is aligned to the general outcomes required at the exit level, and includes introductory sessions on preventive medicine, communication skills, professionalism, self- management, and developing scholarly skills. The module committee will facilitate the students with any issues that they have, while settling down in the new environment. You will also learn the skills required for practical implications in the field of medicine. Moreover, working within teams will enhance your co-operative and approachable working style

**General Learning Outcomes**

By the end of this module the students should be able to;

**Knowledge**

By the end of this module, students should be able to:

1. Develop an understanding of the fundamental components of the musculoskeletal system.

2. Explain the structure & function of the musculoskeletal (MSK) components of limbs and back.

3. Describe how injury and disease alter the MSK structure & function.

4. Integrate concepts relating to various metabolic processes, their disorders and relevant lab investigations in the study of human MSK system.

5. Describe the role of the limbs (upper/lower) in musculoskeletal support, stability and movements.

6. Describe the development of the limbs & correlate it with organization and gross congenital anomalies of the limbs.

7. Identify the anatomical features of bones, muscles & neurovascular components of the limbs and correlate them with their functions, injuries and clinical problems.

8. Describe the types, formation, stability, function & clinical significance of joints of the upper and lower limb.

9. Describe the basic histology of muscle fibers including its molecular structure (Sarcomere).

10. Explain the mechanism of excitation and contraction of skeletal and smooth muscles.

11. Describe the basis for the use of therapeutic agents to modulate neuromuscular transmission.

12. Describe the general principles of MSK pain management.

13. Describe ergonomics and its principles. Prevention of different MSK disorders.

14. Interpret the mechanism of post-mortem rigidity. (spiral II)

15. Give an overview of pathology of bones, muscles and joints.

16. Explain the role of different minerals, hormones and specific metabolic products related to the musculoskeletal system and correlate them with their relevant clinical metabolic disorders.

17. Interpret the relevant laboratory investigations for diagnosis of common musculoskeletal disorders. (Spiral two)

18. To develop the critical thinking and analysis in the context of various case scenarios pertaining to locomotors system.

**Skills**

By the end of this module, it is a core objective that students should have acquired the following skills:  
1. Demonstrate the anatomical structures of the limbs in a dissected cadaver/Model/prosecuted specimen & X-ray.  
2. Demonstrate the provision of first aid measures in case of a limb fracture.  
3. Communicate effectively in a team with colleagues and teachers**.**

**Attitude**

While not necessarily taught explicitly, students are expected to develop following attitudes throughout the course:

1. Demonstrate respect and care for the cadaver and prosected parts.

2. Demonstrate humbleness and use socially acceptable language during academic and social interactions with colleagues and teachers.

3. Make ethically competent decisions when confronted with an ethical, social or moral problem related to MSKS in professional or personal life.

4. Discuss ethical issues social and preventive aspect of health care in the context of MSK system.

5. To create awareness about the ethical, social and preventive aspect of health care in the context of locomotor system.

**THEMES FOR MUSCULOSKELETAL MODULE**

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| **SNO** | **Theme** | **Duration** |
| 1 | Orientation and shoulder pain | 2 weeks |
| 2 | Weak grip and painful hand | 1 week |
| 3 | Pain lower limb/limping | 2 weeks |
| 4 | Bony arches and fracture of foot | 1 week |
| 5 | Backache | 1 week |
| 6 | Muscle weakness and fatigue | 1 week |

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| **Musculoskeletal MODULE** |
| **THEME –I** |
| **ORIENTATION AND SHOULDER PAIN** |

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| **SNO.** | **Topic** | **Learning Outcomes** |
| **ANATOMY** | | |
| 1 | Introduction | * Define osseous tissue * Classify the skeletal system (axial and * appendicular) * Name and locate different bones of * axial and appendicular skeleton * Classify bones * Describe general features of bones * Describe Nerve/blood supply of bone * Describe bone marrow and its types * Describe ossification and its types * Describe surface markings of bones * Define fracture, osteoporosis, rickets, osteomalacia * Introduction to muscular system * Classify the muscles according to the * directions of fibers * Classify the skeletal muscles according to their action. * Types of skeletal muscle fibers(Type1 ,2,3) * Describe the nomenclature of skeletal muscles * Describe the principle of innervations * and nerve supply of muscles * Define paralysis, hyperplasia,hypertrophy,mysthena gravis |
| 2 | Introduction to locomotion  and upper limb | Identify the extent of the upper limb.Identify various regions of upper limb.Describe the division of the regions into compartments.State the contents of compartments of arm, forearm & handDescribe the joints of upper limb.Describe the clinical anatomy of upper limb |
| 3 | Osteology of clavicle | Recognize the boneIdentify the site of boneState the bony land marks of clavicle: like borders, surfaces & land mark used for bone determinationDescribe & demonstrate the attachments of muscles.Describe the common fractures of the bone.Identify and describe the salient features of the bones scapula and clavicleDescribe the surface anatomy clavicleDescribe the radiological anatomy clavicleDescribe the applied anatomy clavicle |
| 4 | Osteology of scapula | Recognize the bone.  Identify the site of bone.  State the bony landmarks of scapula: like borders, surfaces & land mark used for bone determination.  Demonstrate the attachment of  muscles on scapula  Describe the common fractures of the bone.  Identify and describe the salient features of the bones scapula.  Identify the attachments to scapula  Describe the surface anatomy scapula  Describe the radiological anatomy scapula.  Describe the applied anatomy scapula. |
| 5 | Osteology of humerus | Recognize the bone.  Identify the site of bone.  State the bony landmarks of humerus: like borders, surfaces & land mark used for bone determination.  Demonstrate the attachment of muscles & ligaments.    Describe the common fractures of the bone.    Identify and describe the salient features of the humerus  Identify the attachments to humerus  Describe the surface anatomy humerus  Describe the radiological anatomy  humerus  Describe the applied anatomy humerus |
| 6 | Muscles of the pectoral  girdle | Recognize the role of muscles of pectoral region in stabilizing the pectoral girdle.  List the muscle of pectoral girdle.  Describe & Demonstrate the attachments of muscle of pectoral girdle, nerve supply and actions.    Describe the structural organization of the clavi-pectoral fascia.  Identify the triangle of auscultation.  Describe the nerves and blood vessels of this region |
| 7 | Muscles of the shoulder  region | Recognize the extent of shoulder region.  Describe the muscle of shoulder region.  List the muscles of shoulder region.  State the detailed structures of each muscle with respect to Origin, Insertion, Nerve supply and Action of muscles with any characteristic features. |
| 8 | The shoulder joint & its  movements | Classify the type 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 the clinical anatomy of the  joint |
| 9 | Brachial plexus | Mention the formation of brachial plexus (roots, trunk, division, and cords).  Describe the relation of brachial plexus also in connection to clavicle (Supra, retro, infra clavicular parts).  State the branches arising the different cords.  Draw the brachial plexus.  Describe the clinical correlates of the brachial plexus.  Erb duchane palsy  Klumpke palsy  Saturday night palsy |
| 10 | Nerves of upper limb | Describe the course and branches of nerves of upper limbs.  Axillary nerve  Musculocutaneous nerve  Radial Nerve  Ulnar Nerve  Median Nerve  Explain the injuries associated with these nerves.  Identify the causes and motor and sensory loss associated with nerve injuries of upper limb.  Apply knowledge of gross anatomy to identify the deformities associated with these nerves. |
|  | Axilla | Describe the position, shape of axilla.  Describe the boundaries and content of axilla  Describe the boundaries and muscle forming the boundaries of axilla.  Describe the formation, course and relations of axillary vessels.  Describe arrangement and groups axillary lymph nod |
| 11 | Arm | Describe the compartments of arm and how they are formed.  Identify and explain the muscles and their actions found in the arm.  Describe the nerve supply of arm.  Describe the course of the nerves  Identify the branches of the nerves  Relate & integrate with the clinical  correlations  Describe cutaneous supply of arm. |
| 12 | Brachial vessels | Describe the extension, relation and branches of the Brachial artery.  Describe the course of the Basilic and cephalic veins  Describe and explain the formation and purpose of the scapular anastomosis. |
| 13 | Elbow joint | Identify the type of the joint.  State and Identify the muscles acting on the elbow joint.  Describe the neurovascular supply of the joint.  Describe the carrying angle and applied aspect of the joint.  Describe the anastomosis and collateral circulation.  Describe formation of anastomosis  around elbow joint |
| 14 | Osteology of ulna | Recognize the bone.  Determine the side of bone.  Identify the features of bone.  Identify the muscles attached to bone.  Describe the common fractures of the bone.  Describe and Identify the salient features of the ulna  Identify the attachments to ulna  Describe the surface anatomy ulna and the radiological anatomy ulna  Describe the applied anatomy ulna |
| 15 | Superficial veins, lymphatic’s  and lymph nodes of upper  limb | Describe the normal anatomy of veins of upper limb.  Differentiate between superficial and deep veins.  Describe the features of individual superficial veins of upper limb.  Correlate the applied anatomy with the gross anatomy of superficial  Veins of upper limb.  Describe the structure of a lymph node.  Identify the groups of lymph nodes.  Describe groups and area of drainage of each group of lymph nodes.  Describe the commencement, course and termination of superficial lymphatic vessels.  Describe the clinical conditions related to lymphatic channels of upper |
| 16 | Cubital fossa | Describe the boundaries, the contents and the relationship among structures of Cubital fossa.  Demonstrate the surface anatomy of the Cubital fossa.  Explain the clinical importance of the Cubital fossa. |
| 17 | Anterior compartment of  forearm | List the muscles of forearm.  State the nerve supply of these muscles.  Explain actions of the muscles of anterior compartment of forearm.  Describe attachment and functions of flexor retinaculum  Identify/Describe muscles of the anterior compartment of the arm (origin, insertion, nerve supply, blood supply, and action) |
| 18 | Posterior compartment of  forearm | Explain the organization of muscles of posterior compartment of forearm  Identify/Describe muscles of the posterior compartment of the arm (origin, insertion, nerve supply, blood supply, and action)  State the nerve supply of these muscles.  Explain the actions of the muscles of posterior compartment of forearm.  Describe the structural organization of the Extensor Retinaculum |
| 19 | Blood vessels & nerves of  the forearm | Describe the different vessels & nerves in forearm.  Describe the location, destination, course & relations of radial and ulnar arteries & their branches in forearm.  Describe the deep veins of forearm and their tributaries.  Describe the location, destination, course & relations of ulnar, radial and median nerves & their branch. |
| 20 | Radio-ulnar joint | Recognize the details of Radio-ulnar joint.  Describe and explain the movements occurring on Radio-ulnar joint.  Name the muscles acting in pronation and supination.  Describe the nerve supply and blood supply of Radio-ulnar joint.  Describe clinical problems related to Radio-ulnar joints. |
| 21 | Surface anatomy of upper  limb | Demonstrate the surface markings for various arteries of upper limb |
| **Embryology** | | |
| 22 | Somitogenesis | Define the process of gastrulation.  Describe the development of mesoderm.  Describe the process of somitogenesis.  Describe the formation of cartilage |
| 23 | Development of bone ,  cartilage and joints | Describe histogenesis of Bone  Describe the Intramembranous Ossification  Describe the Endochondral Ossification  Describe the Ossification of limb bones  Describe the development of joints  Describe the development of cartilage  Describe developmental events of fibrous joints  Describe developmental events of  cartilaginous joint  Describe developmental events of synovial joints  Describe important congenital correlates |
| 24 | Development of upper limb | Describe the early stages of upper limb development  Describe the development of upper limb buds  Describe the final stages of upper limb development  Describe and explain the anomalies of the upper limb |
| 25 | Development of muscles | Describe the development of skeletal muscle.  Describe the development of Myotomes and derivatives of epaxial divisions of myotomes and derivatives of hypaxial divisions of myotomes |
| **HISTOLOGY** | | |
| 26 | Bone histology | Define and identify compact and spongy bone  Describe and identify bone matrix (organic and inorganic component)  Describe and identify cells of boney tissue i.e. (osteoprogenitor, osteoblasts, osteoclast, and osteocytes)  Describe and identify periosteum and  endosteum  Describe and identify the microscopic structure of bone i.e. (primary  bone, secondary bone and haversian system)  Describe Functions of various bone cells  Describe important Functions and its role in calcium metabolism |
| 27 | Classification & histology of  cartilage | Describe the General properties of cartilage  Describe the Different types of cartilage  Describe the Hyaline, Elastic and Fibrocartilage  Explain the growth of cartilage |
| 28 | Histology of cartilage | Identify types of cartilages on microscopy, including distinctive features of each.  Describe the structural basis.  Classify and distinguish three types of cartilages  Describe the microscopic structure of hyaline cartilage  Describe the microscopic structure of Elastic cartilage  Describe the microscopic structure of fibrous cartilage  Describe important functional correlates of three types of cartilages |
| 29 | Classification & histology  of bone | Recognize bone and its functions and ncomposition.  Differentiate between woven bone and lamellar bone.  Differentiate between compact bone and spongy bone.  Describe the applied aspect of bone |
| 30 | Histology of bone | Identify three types of bone on microscopy, including distinctive features of each.  Describe the structural basis of classification. |
| 31 | Histology of muscles | Identify three types of muscles on microscopy, including distinctive features of each muscle fiber.  Describe the structural basis of muscle striations.  Recognize the structural elements that produces muscle contraction and brings the movement of a body part.  Recognize the function and organization of the connective tissue in muscle.  Classify and distinguish three types of muscles  Describe the microscopic structure of  skeletal muscle  Describe important functional correlates of skeletal, smooth  Describe the microscopic structure of  smooth muscle  Identify/Describe the microscopic structure of cardiac muscle fiber  Describe important functional correlates of cardiac muscle fiber |
| **Physiology** | | |
| 32 | Skeletal vs smooth muscle | Differentiate between skeletal muscle and smooth muscle. |
| 33 | Mechanism of muscle  contraction | Describe the general mechanism of muscle contraction.  Describe the molecular mechanism of muscle contraction |
| 34 | Energetics of muscle  contraction | Describe the energetics of muscle contraction. |
| 35 | Terms related to MSK | Describe the following terms related to MSK  Excitable tissue  Stimulus  Threshold  Depolarization  Hyperpolarization  Presynaptic potential  Post synaptic potential  Goldmann Equation  Nernst Equation |
| **Biochemistry** | | |
| 36 | Connective tissues | Explain in detail the biochemistry of connective tissues. |
| 37 | Glycosaminoglycan | Discus the role of glycosaminoglycan (GAG) in the formation of the connective tissues, cartilage, skin, blood vessels and tendons |
| 38 | Collagen | Describe the chemical structures of cellular matrix of collagen and elastin |
| 39 | Chemistry of Amino acids and Proteins | * Describe structure of amino acids & Proteins * Classify proteins * Describe different types of Plasma proteins |
| **Biochemistry Practical** | | |
| 40 | Detection of Sulphur containing amino acids | Define Sulphur containing amino acids their structure and types  Lead Sulphate test |

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| **Musculoskeletal MODULE** |
| **THEME –II** |
| **Weak grip and painful hand** |

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| **SNO.** | **Topic** | **Learning Outcomes** |
| **ANATOMY** | | |
| 1 | Osteology of radius & hand | Recognize the bones of forearm & hand  Determine side of bones.  Identify the features of bones.  Identify the muscles attached to bones.  Describe the ossification of bones  Explain the clinical significance of bones.  Describe the common fractures of the bone.  Describe and Identify the salient features of the radius  Identify the attachments to radius  Describe the surface anatomy radius and the radiological anatomy radius  Describe the applied anatomy radius  Describe and Identify the salient features bones of hand  Identify the attachments to bones of hand  Describe the surface anatomy main bones of hand and the radiological anatomy of main bones   * Describe the applied anatomy main bones of hand including carpal tunnel and fractures |
| 2 | Muscles of hand | Recall the structure and functions of palmar aponeurosis.  Describe the attachments, nerve supply & actions of muscles of hand.  Describe the thenar Muscles.  Correlate the movements of thumb with hand anatomy.  Identify the anatomical snuffbox.  Relate applied with gross anatomy of few structures of hand  Enumerate, describe and identify the small muscles of the hand  Describe Surface anatomy of important muscles of hand  Identify structures on transverse MRI hand taken at various levels  Describe relevant clinical anatomy of important muscles  Identify/Describe joints of the hand and fingers (intercarpal joints, carpometacarpal and intermetacarpal joints, carpometacarpal joint of the thumb, and metacarpophalangeal joints  Describe surface , radiological and clinical anatomy of important joints |
| 3 | Vessels & nerves of the  hand | Identify different vessels in hand.  Describe the location, destination course relations of radial and ulnar arteries in hand.  State the branches of radial and ulnar arteries in hand.  Describe the formation of superficial and deep palmar arch, veins of hand and their tributaries.  Describe the nervous supply of the hand. |
| 4 | Wrist joint | Recognize the details of wrist joints.  Describe and explain the movements occurring on wrist joints.  Name the muscles acting in pronation and supination.  Describe the nerve supply and blood supply of wrist joints.  Describe wrist joint, nerve supply and blood supply.  Describe clinical problems related to Wrist joints. |
| 5 | Spaces of the palm | Identify the different spaces of the hand on both palmar and dorsal aspects.  Describe the clinical importance of these spaces |
| **Physiology** | | |
| 10 | Describe the important  terms | Describe the following  Motor unit  Summation  Tetanization  Staircase effect  Skeletal muscle tone  Muscle fatigue  Agonist  Antagonists  Coactivation of agonist and antagonis |
| 11 | Excitation contraction  coupling in skeletal  muscles | Discuss the process of excitation contraction coupling in skeletal muscles.  Explain Transverse tubule-sarcoplasmic reticulum system  Describe Release of Calcium ions by sarcoplasmic reticulum  Explain Role of Calcium pump  Describe Excitatory pulse of Ca+ |
| 12 | Muscle action potential | Describe the muscle action potential. |
| 13 | Excitation contraction coupling | Describe excitation contraction coupling of skeletal muscle. |
| **BIOCHEMISTRY** | | |
| 14 | Role of calcium and  phosphorus | Explain the role of calcium and phosphorous in formation of cellular matrix and bone |
| 15 | Vitamins | Vitamins and their role  Define vitamins  Classify vitamins  Differentiate between Fats and water soluble vitamins  Describe role of Vitamin A  Explain the role of Vitamin D  Describe the role of Vitamin E  Describe the role of water soluble vitamins |
| 16 | Introduction to minerals | Define Minerals,  Define major and minor minerals  Describe classification of minerals |
| **Biochemistry Practical’s** | | |
| 17 | Detection of Cyclic amino  Acids | Define Cyclic amino Acids  Understand their structure and types  Xanthoproteic Test |

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| **Musculoskeletal MODULE** |
| **THEME –III** |
| **Pain lower limb/limping** |

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| **SNO** | **Topic** | | **Learning Outcome** |
| **1** | **Introduction to lower limb** | | **Recognize different parts of lower limb.**  **Describe regions of lower limb.**  **List the bones of lower limb.**  **Describe the vessels and nerves of lower limb.**  **Identify different land marks in different regions of lower limb** |
| **2** | **Hip bone** | | **Identify the different parts of the bone.**  **Describe side determination.**  **Describe muscle attachments.**  **Describe ligamentous attachments.**  **Describe the different bones articulating with the hip bone**  **Identify the different parts of the bone.**  **Describe the common fractures of the bone.**  **Identify and describe the salient features of the bones of hip bone**  **Identify the attachments of hip bone**  **Describe the surface anatomy of hip bone**  **Describe the radiological anatomy of hip bone**  **Describe the applied anatomy of hip bone.** |
| **3** | **The hip joint and**  **movements** | | **Describe the characteristics features of synovial joint**  **Describe the Articular surfaces of hip**  **joint**  **Identify the capsule of hip joint**  **Describe the synovial membrane,**  **cavity & fluid of hip joint**  **Enumerate the ligaments of hip joint**  **& describe their attachments**  **Describe the movements possible at**  **hip joint**  **Describe the clinical correlates of the**  **hip joint**  **Describe surface and radiological anatomy (X-rays and MRI) and clinical of hip joints** |
| **4** | **Gluteal region** | | **Describe the boundaries of gluteal**  **region**  **Describe bones and ligaments of gluteal region**  **Describe the different structures entering and leaving gluteal region**  **Describe muscles of the gluteal region.**  **Describe Vessels of the gluteal region.**  **Describe nerves of the gluteal region.**  **Describe about certain clinical correlates regarding gluteal region**  **Describe Surface anatomy of important muscles**  **Identify structures on transverse MRI of gluteal region taken at various levels**  **Describe clinical anatomy of important muscles** |
| **5** | **Femur** | | **Identify different parts of the femur**  **Determine the side of the bone**  **Identify the surfaces and borders of**  **the bone**  **Describe the common fractures of the bone.**  **Describe the attachments of the different muscles and ligaments on the bone**  **Describe the arterial supply of the bone**  **Relate to the general idea about fractures of femur and other clinical conditions Identify and describe the salient features of the bones of hip bone**  **Describe the surface anatomy of femur**  **Describe the radiological anatomy of**  **femur**  **Describe the applied anatomy of femur** |
| **6** | Nerves of lower limb and their injuries | | Identify the names of nerves and their main branches innervating lower limb  Identify the nerves closely related to  a bone or other structure of lower limb  Recognize the main nerves commonly vulnerable to injury  Identify the main area and loss of  function if particular nerve is injured  Define and understand terms neuritis, anesthesia, par aesthesia, paralysis,  neuralgia, sciatica |
| 7 | Superficial vessels and lymphatic’s of lower limb | | Enumerate and describe the superficial arteries of lower limb  Name and Describe superficial veins of lower limb   * List and Describe the superficial lymphatic vessels and lymph nodes of lower limb |
| 8 | Deep fascia of thigh,  iliotibialtract and superficial  vessels | | Describe the arrangement of deep  fascia in thigh  Describe how the iliotibial tract participates in walking and running  Describe the location of saphenous opening and its relations  Describe the great saphenous vein.   * Describe clinical correlates of saphenous vein |
| 9 | Muscles of the anterior fascial compartment of  thigh | | Describe the muscles of anterior compartment of thigh.  Describe the nerve supply of anterior  Compartment.   * Describe the action of these muscles |
| 10 | Nerves and vessels of  anterior compartment of  thigh | | Describe the nerve supply of the anterior compartment of thigh.  Describe the blood supply and the venous drainage of anterior compartment of thigh   * Describe the action of these muscles |
| 11 | The medial compartment  of thigh | | Describe the muscles of medial compartment of the thigh.  Describe the nerve supply of these muscles.  Describe the actions of the muscles of medial compartment of thigh   * Describe the vessels of medial compartment of the thigh |
| 12 | Posterior compartment of  thigh | | Describe the muscles of posterior  compartment of thigh  Describe the arterial supply of posterior compartment of thigh  Discuss the trochanteric and cruciate  anastomosis at the back of thigh  Describe the venous drainage of this  region  Describe the nerve supply of posterior compartment of thigh and   * Relate to the clinical conditions effecting the region |
| 13 | Popliteal fossa | | Describe the boundaries of popliteal fossa.  Describe the contents of the popliteal fossa.   * Describe some clinical correlates regarding popliteal fossa |
| 14 | Femoral triangle and its contents | | Describe the boundaries of femoral  triangle  List the contents of femoral triangle  Describe the femoral sheath & canal  Describe the clinical correlates of the Femoral triangle.   * Describe the location, boundaries and contents of adductor canal |
| 15 | Tibia bone | | Describe the division of tibia bone in  3 parts  Identify the surfaces and borders of  tibia  Describe the attachments of muscles  on the tibia bone  Describe the ossification of tibia and  its primary and secondary ossification centers  Describe the common fractures of the bone.  Identify and describe the salient features of the bone of leg  Identify the attachments to the bone of the leg  Describe the surface anatomy of leg  Describe the radiological anatomy of  leg   * Describe the applied anatomy of leg |
| 16 | Fibula & bones of foot | | Determine the side of bone.  Describe the bony features along with its different attachments on the fibula.  Name and describe the tarsal bones  and their arrangement  Name and describe the metatarsal bones and phalangeal bones.  Describe the common fractures of the bone.  Describe the muscles of the sole of  the foot (origin, insertion, nerve supply, blood supply, and action)  Describe the muscles of the dorsum of the foot (origin, insertion, nerve supply, blood supply, and action)  Describe Surface anatomy of important muscles  Identify structures on transverse MRI  of foot taken at various levels  Describe clinical anatomy of important muscles |
| 17 | Anterior and lateral  compartment of leg | | identify the boundaries of the compartments of leg  State the muscles of anterior and lateral compartment of leg  Describe the vessels of anterior and  lateral compartment of leg  Describe the nerves of lateral and anterior compartment of leg   * Describe action of these muscles |
| 18 | Posterior compartment of  leg | | Explain the muscles of posterior  Compartment of leg.  Describe nerve supply of these muscles.  Explain the actions of the muscles of   * posterior compartment of leg |
| 19 | Knee joint | | Describe the type of knee joint  Describe the articular surfaces of this  joint  Describe the articular capsule  Describe the synovial membrane and  the synovial cavity  Enumerate the ligaments of knee  joint  Describe the bursa around the knee  joint  Describe the blood and nerve supply  of the knee joint  Describe the mechanism of locking and unlocking of knee joint.  Describe surface and radiological  anatomy (Xrays and MRI) and clinical   * of knee joints |
| 20 | Surface anatomy of lower limb | | Demonstrate the surface anatomy of arteries of lower limb.  Demonstrate the surface anatomy of superficial & deep veins lower limb.  Demonstrate the surface anatomy of nerves of lower limb |
| **Embryology** | | | |
| 21 | Development of lower limb | | Describe the early stages of lower limb development  Describe the development of lower limb buds  Describe the final stages of lower limb development  Describe and explain the anomalies of the lower limb |
| Biochemistry | | | |
| 22 | Sodium, potassium and  chlorine in biology | | Discuss RDA, serum Levels  Enlist sources of Sodium, Potassium and chlorine,  Describe functions  Discuss absorption excretion,  Describe disorders related to increase and decrease in amount of  Sodium, Potassium and chlorine |
| **Biochemistry Practical’s** | | | |
| 23 | Salt Saturation Test | Perform Salt Saturation Test | |

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| **Musculoskeletal MODULE** |
| **THEME –IV** |
| **Bony arches and fracture of foot** |

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| **SN0** | **Topic** | **Learning Outcome** |
| **ANATOMY** | | |
| 1 | Muscles and neurovascular  supply of the foot | Describe the dorsal muscles of foot.  Describe the origin and insertion of planter muscles of foot.  Describe their nerve supply and actions.  Describe vascular and nervous supply  of sole and dorsum of foot  Describe their course through foot  Describe relationships  Identify and describe the salient features of the bone of foot  Identify the attachments to the bone  of the foot  Describe the surface anatomy of foot  Describe the radiological anatomy of  foot  Describe the applied anatomy of foot |
| 2 | Arches of foot | Describe the arches of foot  Describe the factors responsible for their maintenance of the arches of the foot  Recognize the injury when it occurs and be able to evaluate plantar fasciitis.  Describe about counselling regarding  the rehabilitation for plantar fasciitis |
| **Biochemistry** | | |
| 3 | Role of vitamin c & D | Describe the role of Vitamin C and Vitamin D in the formation of connective tissues and bones. |
| 4 | Iodine in Biology | Discuss RDA, serum Levels Iodine  Enlist sources of  Describe functions  Discuss absorption excretion,  Describe disorders related to increase and decrease in amount of Iodine |
| **PATHOLOGY** | | |
| 5 | introduction to Bone pathology | Define and differentiate osteopenia, osteoporosis, osteomalacia  Define osteomyelitis  Enlist various forms of arthriti |
| Forensic Medicine | | |
| 6 | Injury | Define injury on medico legal basis.  Classify injury.  Define mechanical injury  Classify mechanical injury  Describe mechanisms of injury.  Interpret the nature (manner) of injury. |
| 7 | Wound | Define wound.  Define hurt.  Identify factors affecting appearance of wound |

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| **Musculoskeletal MODULE** |
| **THEME –V** |
| **Backache** |

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| **SN0** | **Topic** | **Learning Outcome** |
| **ANATOMY** | | |
| 1 | Typical spinal nerve | Define a spinal nerve.  Recognize the spinal nerve as a part of PNS.  Enumerate the spinal nerves in different regions  Identify their location and site of emergence.  Identify various components of a typical spinal nerve.  Recall the fate of rami.  Associate the rami communicans with typical spinal nerve  Recall the distribution of gray rami |
| 2 | Vertebral column | Describe the muscles of back (origin,  insertion, nerve supply, blood supply,  and action)  Describe Surface anatomy of important muscles  Identify structures on CT/MRI of vertebral column taken at various levels  Describe clinical anatomy of important muscles |
| 3 | Lumbo sacral plexus,  cutaneous nerves | Describe the formation of lumbar Plexus.  List the branches of lumber plexus with their root values.  Describe relation of the nerves with Psoas major muscle.  List the structures supplied by lumbar plexus.  Describe the formation of sacral plexus.  Describe the composition and relations of sacral plexus.  List the branches of this plexus |
| **Biochemistry** | | |
| 4 | Phosphorus and Magnesium  in biology | Discuss RDA, serum Levels  Enlist sources of Phosphorus and Magnesium  Describe functions  Discuss absorption excretion,  Describe disorders related to increase and decrease in amount of Phosphorus and Magnesium |
| 5 | Sulphur in biology | Discuss RDA, serum Levels  Enlist sources of Sulphur  Describe functions  Discuss absorption excretion,  Describe disorders related to increase and decrease in amount of sulphur |
| 6 | Copper and cobalt in  biology | Discuss RDA, serum Levels Copper and cobalt  Enlist sources of  Describe functions  Discuss absorption excretion,  Describe disorders related to increase and decrease in amount of Copper and cobalt |
| Community Medicine | | |
| 7 | Back pain | Explain the causes of low back  pain  z Describe the prevention of low  back pain  z Describe the causes & prevention  of msd related to child labor |

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| **Musculoskeletal MODULE** |
| **THEME –VI** |
| **Muscle weakness and fatigue** |

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| **SN0** | **Topic** | **Learning Outcome** |
| **Physiology** | | |
| 1 | Physiologic anatomy of the  skeletal muscle fiber | Explain the physiologic anatomy of the skeletal muscle fiber.  Skeletal muscle fiber  Sarcolemma  Myofibrils  I band  A band  Z disk  M line  Sarcomere  Titin microfilament molecules  Sarcoplasm  Sarcoplasmic reticulum |
| 2 | Characteristics of whole  muscle contraction | Identify the characteristics of whole muscle contraction.  Compare isotonic and isometric exercises.  Compare and contrast slow and fast muscle fibers.  Describe the mechanics of skeletal muscle contraction.  Describe muscle tone and muscle fatigue.  Describe lever systems of the body and positioning of a body part.  Describe remodeling of muscle to match function. |
| 3 | Neuromuscular junction | Describe the transmission of impulses from nerve endings to skeletal muscle fibers.  Explain the physiologic anatomy of the neuromuscular junction |
| 4 | Neuromuscular  Transmission | Explain the mechanism of transmission of impulses from nerve endings to muscle fibers  Explain Formation and Secretion of acetylcholine at nerve terminals  Describe Action of acetylcholine at postsynaptic membrane  Describe Degradation/Destruction of released acetylcholine  Describe End plate potential  Describe Fatigue of junction |
| 5 | Neuromuscular drugs | Describe the physiologic basis of the drugs used in the neuromuscular disorders (Drugs that enhance or block the transmission  at neuromuscular junction)  Enlist the excitatory and inhibitory  transmitter substances secreted at the smooth muscle neuromuscular junction  Drugs that stimulate the muscle fiber by acetylcholine like action  Drugs that stimulate neuromuscular junction by inactivating acetylcholinesterase  Drugs that block transmission at  the neuromuscular junction  Enlist the excitatory and inhibitory transmitter substances secreted at the smooth muscle neuromuscular junction |
| 6 | Myasthenia gravis | Describe the pathophysiology of  myasthenia gravis |
| 7 | Smooth muscle | Classify smooth muscles  Describe the physiologic anatomy of the smooth muscle neuromuscular junction |
| 8 | Skeletal Muscle fiber | Discuss in detail types of muscles and arrangement of skeletal muscle fibers. |
| 9 | Contraction of smooth muscle | Describe the contractile mechanisms in smooth muscles  Describe excitation and contraction of smooth muscle.  Identify the types of smooth muscles.  Describe the chemical and physical basis for smooth muscle contraction.  Compare smooth and skeletal muscle contraction.  Chemical basis of smooth muscle  contraction  Physical basis of smooth muscle contraction  Explain how the calcium ions regulate the contraction.  Regulation of smooth muscle contraction by the calcium ions  Enlist the excitatory and inhibitory transmitter substances secreted at the smooth muscle neuromuscular junction |
| 10 | Nervous and hormonal  control of smooth muscle  contraction | Describe the nervous and hormonal control of smooth muscle  contraction |
| 11 | Resting Membrane  Potential | Enumerate the intracellular and extracellular concentrations of sodium, potassium, chloride and calcium ions in a resting/normal cell.  Describe the characteristics of major membrane ion channels and their role in the membrane potential  Describe the resting membrane  potential in a cell/nerve fiber |
| 12 | Muscle Remodeling | Describe following  Muscle hypertrophy  Muscle atrophy  Muscle hyperplasia  Rigor mortis  Muscle dystrophy  Recovery of muscle contraction in poliomyelitis |
| 13 | Membrane potentials and action potentials in smooth muscles | Describe the membrane potentials and action potentials in smooth muscles.  Describe Spike potentials  Describe Action potentials with plateaus  Describe Role of calcium channels in generating the smooth muscle action potential  Describe Slow wave potentials  Describe Excitation of visceral smooth muscle by muscle stretch  Describe Depolarization of multi-unit smooth muscle without action potentials |
| 14 | Control of smooth muscle  contraction | Describe the mechanism nervous, hormonal and local control of smooth muscle contraction. |
| 15 | Smooth muscle and skeletal  muscle contraction | Compare the smooth muscle  contraction and skeletal muscle contraction |
| 16 | Skeletal muscle contraction | Describe the three sources of energy for muscle contraction  Compare isometric and isotonic contractions  Compare characteristics of fast and slow muscle fibers.  Sources of energy for muscle contraction  Compare isometric and isotonic contractions  Compare characteristics of fast and slow muscle fibers |
| Biochemistry | | |
| 17 | Hormonal regulation | Explain the hormonal regulation of  calcium and phosphorous to maintain  musculoskeletal system |
| 18 | Sodium, potassium and chlorine in biology | Discuss RDA, serum Levels  Enlist sources of Sodium, Potassium and chlorine,  Describe functions  Discuss absorption excretion,  Describe disorders related to increase and decrease in amount of Sodium, Potassium and chlorine |
| 19 | Calcium in Biology | Discuss RDA, serum Levels  Enlist sources of Calcium  Describe functions  Discuss absorption excretion,  Describe disorders related to increase and decrease in amount of Calcium |
| 20 | Fluoride and Lithium in biology | Discuss RDA, serum Levels Fluoride  Enlist sources of  Describe functions  Discuss absorption excretion,  Describe disorders related to increase and decrease in amount of Fluoride  Brief description on role of lithium in biology |
| 21 | Molybdenum, Selenium, Zinc, chromium,manganese,silicon, vanadium in biology | Enlist sources of  Describe functions  Discuss absorption excretion,  Describe disorders related to increase and decrease of the said elements |
| 22 | Toxic element Aluminum , Arsenic,  Antimony, Boron, Bromine, Cadmium, Cesium, Germanium, Lead, Mercury, Silver, Strontium | Discuss different effects of toxic  elements |
| Pharmacology | | |
| 23 | Drug used in MSK | Define & classify NSAIDS  Classify neuromuscular blocking agents.  Enlist more most comomly used  analgesia aspirin , iburrofen , diclofenac, paracetamol, COX-2 Salicox  Classify corticosteroids |
| Community Medicine | | |
| 24 | MSK diseases | Explain the risk factors for different types of msd’s  Describe the preventive measures for different types of risk factors for msd’s |
| 25 | Epidemiology and  prevention of MSD | Describe work related msd’s  Identify risk factors of msd at workplace.  Describe prevention of exposure to risk factors related to workplace.  Describe the preventive strategies and safety guidelines in order to reduce the incidence of msds related to work place.  Describe the burden /epidemiology of work related msd’s  Describe application of ergonomics in the prevention of work related msd’s |