

MUSCULOSKELETAL SYSTEM (GMT 204)

NO.	TOPIC/SUBTOPIC	LECTURE	PRACTICAL	OTHER TEACHING MODE	DEPARTMENT	LEARNING OUTCOME
						By the end of the course, students will be able to:
	Skeleton & muscle dynamics					
1.	Development of musculoskeletal system & congenital anomalies	√			ANATOMY	<p>explain the formation and derivatives of somite</p> <p>explain the development of dermatome, myotome and sclerotome</p> <p>describe the neural crest cells and its formation of bones of the face and skull</p> <p>describe the development of sutures</p> <p>describe the limb growth and development and the significant of apical ectodermal ridge</p> <p>describe the development of vertebrae, ribs and sternum</p> <p>describe the origin of the muscles with regard to its primaxial or abaxial domain</p> <p>describe the patterning of the muscle</p> <p>state the origin of the smooth muscle and cardiac muscle</p> <p>describe the developmental basis of congenital anomalies of musculoskeletal system</p>
2.	Skeleton & muscle	√			ANATOMY	<p>describe the general features of cartilage</p> <p>state the classification and general features of cartilage</p> <p>list the functions of bone</p> <p>compare between lamellar and non-lamellar bone</p> <p>compare between spongy and compact bone</p> <p>describe the parts of long bone</p> <p>describe the blood supply of long bone</p> <p>describe the classification of bones</p> <p>differentiate between axial and appendicular skeleton</p> <p>describe the attachments and the arrangements of fibres of skeletal muscle</p> <p>define prime movers, antagonists, synergists,</p>

						<p>fixators with examples</p> <p>describe the innervation of skeletal muscle</p> <p>define motor unit</p>
3.	Joints	√			ANATOMY	<p>define joints and list its function</p> <p>describe the structural and functional classification of joints</p> <p>describe the features of the fibrous joint</p> <p>describe the features of the cartilaginous joint</p> <p>describe the features of the synovial joint</p> <p>distinguish the different subtypes of fibrous joint with examples</p> <p>distinguish the different subtypes of cartilaginous joint with examples</p> <p>distinguish the different subtypes of synovial joint with examples</p> <p>define synarthrosis, amphiarthrosis and diarthrosis</p> <p>describe the range of motion of diarthrotic joints</p> <p>describe the factors that contribute to joint stability</p>
4.	Skeleton, muscle & joints		√		ANATOMY	<p>identify the different types of bones</p> <p>identify the different arrangements of fibres of skeletal muscle</p> <p>identify the different types of joints</p>
5.	Histology of cartilage, bone & ossification	√			ANATOMY	<p>describe the microscopic structure of cartilage with regard to the following</p> <p>describe the composition and covering of cartilage</p> <p>describe the hyaline cartilage</p> <p>describe the elastic cartilage</p> <p>describe the fibrocartilage</p> <p>describe the composition and coverings of bone</p> <p>describe the microscopic features of compact bone</p> <p>describe the microscopic features of spongy bone</p> <p>describe intramembranous ossification</p> <p>describe endochondral ossification</p>
6.	Histology of muscle tissue	√			ANATOMY	<p>distinguish the microscopic features of skeletal, cardiac and smooth muscles</p>
7.	Histology of cartilage, bone, muscle tissue & ossification		√		ANATOMY	<p>identify the histological features of different types of cartilages</p> <p>identify the microscopic features of bone</p> <p>compare histological features between intramembranous and endochondral ossifications</p> <p>compare histological features between skeletal</p>

						muscle, cardiac muscle and smooth muscle
8.	Neuromuscular transmission	√			PHYSIOLOGY	Outline the events that occur during neuromuscular transmission with reference to end-plate potentials
9.	Functional organisation of the skeletal muscle	√			PHYSIOLOGY	Describe the functional organisation of the skeletal muscle
10.	Mechanism of contraction in the skeletal muscle	√			PHYSIOLOGY	Describe the electrical and mechanical mechanisms of contraction and relaxation in skeletal muscle
11.	Mechanical properties of the skeletal muscle	√			PHYSIOLOGY	Explain the mechanical properties of skeletal muscle contraction
12.	Growth plate			√ (PBL)	ORTHOPAEDIC	<p>1) To Define</p> <ul style="list-style-type: none"> • The growth plate • The anatomical relationship between joint surface, epiphysis, physis, metaphysis and diaphysis • The function of the growth plate • The location of the growth plate in long bones • The age group in which the growth plates are still open <p>2) To visualize the growth plate on plain radiographs</p> <p>3) To differentiate the growth plate from a fracture on plain radiographs</p> <p>4) To explain how the growth plate could be injured or damaged</p> <p>5) To discuss the complications of growth plate injury</p>
	Pectoral girdle & Upper limb					
13.	Shoulder and pectoral regions	√			ANATOMY	<p>define pectoral girdle</p> <p>describe the features of clavicle and scapula</p> <p>describe the attachments, actions and innervations of muscles of shoulder and pectoral regions</p> <p>state rotator cuff muscles and their functions</p>
14.	Axilla & brachial plexus	√			ANATOMY	<p>describe the boundaries and contents of the axilla</p> <p>describe the axillary artery and its branches</p> <p>describe the axillary vein</p> <p>describe the axillary lymph nodes and applied anatomy</p> <p>describe formation, branches and applied anatomy of brachial plexus</p> <p>describe the course, important relations, motor distribution and sensory distribution of median nerve</p> <p>describe the course, important relations, motor distribution and sensory distribution of axillary nerve</p> <p>describe the course, important relations, motor distribution and sensory distribution of radial nerve</p>

					<p>describe the course and distribution of musculocutaneous nerve</p> <p>describe the course, important relations, motor distribution and sensory distribution of ulnar nerve</p>
15.	Arm & forearm	√			<p>describe the attachments, actions and innervations of the muscles of the arm</p> <p>state the compartments of the forearm</p> <p>describe the attachments, actions and innervations of the muscles of the forearm</p> <p>describe the blood supply of the arm and forearm</p> <p>describe the origin, course and distribution of the brachial, radial and ulnar arteries</p> <p>describe the formation, courses and tributaries of the cephalic and basilic veins</p> <p>describe the boundaries and contents of the cubital fossa</p> <p>describe the applied anatomy of the arm and forearm</p>
16.	Hand	√			<p>describe the bony components of the wrist and hand</p> <p>describe the fascial sheath and bursa of the hand</p> <p>describe the attachment and function of retinacula at wrist</p> <p>define the carpal tunnel</p> <p>describe the formation of carpal tunnel and the cause and manifestation of carpal tunnel syndrome</p> <p>describe the attachments, actions and innervations of the intrinsic muscles of the hand</p> <p>describe the blood supply of the hand</p> <p>describe the applied anatomy of the hand</p>
17.	Joints of the upper limbs	√			<p>list all the joints of upper limbs</p> <p>describe the gross features, movements and factors maintaining the stability of glenohumeral (shoulder) joint</p> <p>describe the gross features and movements of elbow joint</p> <p>describe the gross features and movements of radioulnar joints</p> <p>describe the gross features and movements of radiocarpal (wrist) joints</p> <p>describe the applied anatomy of the joints of upper limb</p>
18.	Shoulder and pectoral regions; Axilla & brachial plexus		√		<p>identify bones, muscles, nerves and blood vessels of shoulder and pectoral regions</p> <p>identify the relations of the structures in the shoulder and pectoral regions</p>

					illustrate the brachial plexus and its branches
19.	Arm & forearm		√		ANATOMY identify bones, muscles, nerves and blood vessels of arm and forearm identify the relations of the structures in the arm and forearm
20.	Hands & joints of the upper limb		√		ANATOMY identify bones, muscles, nerves and blood vessels of arm and forearm identify the relations of the structures in the arm and forearm
	Pelvic girdle & lower limbs				ANATOMY
21.	Bony pelvis & gluteal region	√			ANATOMY state the landmarks of gluteal region describe the osteology of hip bone and pelvis describe the gluteal region and layers of muscles forming gluteal region describe the attachments, actions and innervations of muscles of gluteal region describe the blood supply and nerves of gluteal region state the sacral plexus and its branches describe the applied anatomy of gluteal region
22.	Thigh	√			ANATOMY describe the osteology of femur and patella describe the fascia of the thigh state the anterior, medial and posterior compartments of thigh describe the attachments, actions and innervations of the muscles in each compartment describe the blood supply of each compartment describe the femoral triangle and its content including the femoral sheath and canal describe the adductor canal and structure passing through it describe the cutaneous innervations of the lower limb describe the venous drainage of lower limb which include the superficial and deep veins describe the boundaries and content of the popliteal fossa describe the applied anatomy of thigh
23.	Leg & foot	√			ANATOMY describe the bony landmarks of tibia and fibula describe the osteology of tibia, fibula, tarsals, metatarsals and phalanges state the anterior, posterior and lateral compartments of the leg describe the attachments, actions and innervations of the muscles in each compartment

						<p>describe the blood supply and nerve supply in each compartment</p> <p>describe the tarsal tunnel and its contents state the four layers of muscles in the sole of the foot describe the blood supply and innervation of the sole of the foot explain the arches of the foot and its significant describe the applied anatomy of the foot</p>
24.	Joints of the lower limbs	√			ANATOMY	<p>describe articulation, ligaments and movements of the hip joint</p> <p>describe articulation, ligaments and movements of the knee joint</p> <p>describe articulation, ligaments and movements of the ankle joint</p> <p>describe articulation, ligaments and movements of the intertarsal joints (subtalar and talocalcaneonavicular joint) and metatarsophalangeal joints</p> <p>describe the applied anatomy of the joints of the lower limb</p>
25.	Bony pelvis, gluteal region & thigh		√		ANATOMY	<p>identify bones, muscles, nerves and blood vessels of gluteal region & thigh</p> <p>identify the relations of the structures in the gluteal region & thigh</p>
26.	Leg, foot & joints of the lower limb		√		ANATOMY	<p>identify bones, muscles, nerves and blood vessels of leg & foot</p> <p>identify the relations of the structures in the leg & foot</p>
27.	Pathology of arthritis	√			PATHOLOGY	<ol style="list-style-type: none"> Understand the different types of arthritis which include; osteoarthritis, rheumatoid arthritis, seronegative spondyloarthropathies, gout and pseudogout Explain the etiology, pathogenesis and the morphology of the different types of arthritis.
28.	Osteoarthritis and osteonecrosis			√ (PBL)	ORTHOPAEDIC	<p>NORMAL STRUCTURE AND FUNCTION</p> <ol style="list-style-type: none"> Classify joints. Describe the anatomical organization of a synovial joint. Describe the structure and function of : <ol style="list-style-type: none"> articular cartilage capsule and ligaments synovial membrane Describe the process of formation, composition and functions of synovial fluid. Describe the structure of the hip joint in particular & other major joints such as shoulder, elbow, wrist, knee and ankle joints. Enumerate the movements of the above-mentioned joints, name the muscles

					<p>responsible and give their nerve supply.</p> <p>II. <u>ALTERED STRUCTURE AND FUNCTION</u></p> <p>1. Describe the aetiology, pathogenesis and complications of:</p> <p>1.1 Avascular necrosis (AVN) in general</p> <p>1.2 AVN specifically for the hip joint</p> <p>2. Describe the gross and histomorphology of:</p> <p>2.1 Osteoarthritis</p> <p>III. <u>RADIOLOGY</u></p> <p>1. Recognise a normal joint and explain the term “normal joint space”</p> <p>2. Explain the reasons for diminution of joint space.</p> <p>3. Recognise the salient radiological features of a joint in</p> <p>3.1 Infective arthritis</p> <p>3.2 Rheumatoid arthritis</p> <p>3.3 Osteoarthritis (Primary & Secondary)</p> <p>3.4 Seronegative arthritis</p> <p>IV. <u>LABORATORY INVESTIGATIONS</u></p> <p>Explain the scientific basis of each of the following investigations and recall the normal range wherever applicable.</p> <p>1. <u>Haematology</u></p> <p>1.1 Total and differential WBC count</p> <p>1.2 R.B.C count</p> <p>1.3 Haemoglobin</p> <p>1.4 Erythrocyte sedimentation rate</p> <p>2. <u>Urine Analysis</u></p> <p>2.1 Albumin</p> <p>2.2 Sugar</p> <p>3. <u>Biochemical and immunological tests</u></p> <p>3.1 Serum proteins</p> <p>3.2 Serum uric acid</p> <p>3.3 C-reactive protein</p> <p>3.4 Antinuclear antibodies</p> <p>3.5 Rheumatoid factor</p> <p>4. Enumerate the indications and explain the scientific basis of synovial biopsy and synovial fluid examination.</p> <p>V. <u>MANAGEMENT</u></p> <p>1. Describe the mechanism of action and list the adverse effects of:</p> <p>1.1 Anti-inflammatory drugs</p> <p>2. Describe the principles of management with regard to :</p>
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						<ul style="list-style-type: none"> a. Non-pharmacological/ lifestyle changes b. Pharmacological c. Surgical
	Head & neck					
29.	Development of the pharyngeal arches	√			ANATOMY	describe the development of the branchial arches and its derivatives
30.	Scalp, face & temporal region	√	√		ANATOMY	<p>describe the actions and nerve supply of muscle of facial expression</p> <p>describe the attachment, actions and nerve supply of muscle of mastication</p> <p>describe the blood supply and sensory innervation of the face</p> <p>describe the layers, blood supply and sensory innervation of the scalp</p> <p>state the boundaries and contents of the temporal fossa</p> <p>state the boundaries and contents of the infratemporal fossa</p> <p>state the boundaries and contents of the pterygopalatine fossa</p> <p>describe the articulations, ligaments and movements of the temporomandibular joint</p> <p>describe the applied anatomy of the scalp and face</p> <p>identify the nerves, vessels, muscles, fascia and other relevant structures in the scalp and face</p> <p>identify the relations of the structures in the scalp and face</p>
31.	Triangles of the neck	√	√		ANATOMY	<p>describe the osteology of the hyoid bone</p> <p>describe the superficial and deep fasciae of the neck</p> <p>describe the boundaries and contents of the anterior triangle of the neck</p> <p>describe the boundaries and contents of the posterior triangle of the neck</p> <p>describe the contents of the carotid sheath</p> <p>describe the blood supply of the neck</p> <p>describe the lymphatic drainage of the head and neck</p> <p>describe the formation and distribution of the cervical plexus</p> <p>describe the formation and distribution of ansa cervicalis</p> <p>recall cervical vertebrae including the atlanto-occipital and atlantoaxial joints</p> <p>describe the applied anatomy of the neck</p> <p>identify the nerves, vessels, muscles, fascia and other relevant structures in the neck</p>
32.	Skeleton & muscles of thoracic wall	√	√		ANATOMY	describe the osteology of sternum

						<p>describe typical and atypical ribs</p> <p>describe typical and atypical thoracic vertebrae</p> <p>describe manubriosternal joint</p> <p>describe vertebro-costal joints</p> <p>state the attachments, actions and innervation of the muscles of the thoracic wall</p> <p>describe the movements of the thoracic wall during respiration</p> <p>identify the bones, joints, muscles, blood vessels and nerves of the thorax</p>
	Abdominal wall					
33.	Anterolateral abdominal wall	√			ANATOMY	<p>describe the surface anatomy, fascia and cutaneous nerves of anterior abdominal wall</p> <p>describe the attachments, nerve supply and actions of the muscles of anterior abdominal wall</p> <p>describe the formation and contents of the rectus sheath</p> <p>describe the blood supply of anterior abdominal wall</p> <p>describe inguinal ligament</p> <p>describe the applied anatomy of the anterior abdominal wall</p>
34.	Inguinal canal & posterior abdominal wall	√			ANATOMY	<p>describe the position, extend, boundaries and contents of the inguinal canal</p> <p>recall the lumbar vertebrae</p> <p>describe the thoracolumbar fascia</p> <p>describe the attachments, nerve supply and actions of the muscles of the posterior abdominal wall</p> <p>describe the lumbar plexus</p> <p>describe the applied anatomy of the inguinal canal and posterior abdominal wall</p>
35.	Anterolateral abdominal wall; Inguinal canal & posterior abdominal wall		√		ANATOMY	<p>illustrate the surface anatomy of the abdominal wall</p> <p>identify the muscles, blood vessels and nerves of the anterior and posterior abdominal wall</p>
36.	Pelvic wall & perineum	√	√		ANATOMY	<p>describe the division of pelvis</p> <p>describe the boundaries of the pelvic inlet and outlet</p> <p>describe the pelvic inlet and outlet diameters</p> <p>state the pelvic fascia</p> <p>state the structures forming the pelvic diaphragm</p> <p>state the function and innervation of pelvic diaphragm</p>

						<p>state the triangles of the perineum</p> <p>describe the layers of the perineum</p> <p>state the perineal fascia</p> <p>describe the boundaries and contents of the superficial and deep perineal spaces (pouches) in male and female</p> <p>describe the boundaries and contents of the ischioanal fossae</p> <p>state the structures forming the urogenital diaphragm</p> <p>state the function and innervation of urogenital diaphragm</p> <p>state the location and structures attached to perineal body</p> <p>state the location and contents of the pudendal canal</p> <p>describe the applied anatomy of the pelvic wall and perineum</p> <p>identify the nerves, vessels, muscles, fascia and other relevant structures in the pelvis and perineum</p>
37.	Structure and function of connective tissue protein	√			CHEMICAL PATHOLOGY	Describe the composition, structure and functions of connective tissue proteins
38.	Energy sources in muscle	√			CHEMICAL PATHOLOGY	<p>Describe the energy sources and the following metabolic pathways for muscle contraction under aerobic & anaerobic conditions:</p> <ul style="list-style-type: none"> • glycolysis • oxidative decarboxylation of pyruvate • beta oxidation of fatty acids • ketolysis • citric acid cycle
39.	Oxidative phosphorylation	√			CHEMICAL PATHOLOGY	<p>Describe the electron transport chain and the process of oxidative phosphorylation with regards to</p> <ul style="list-style-type: none"> • chemiosmotic hypothesis • uncouplers • inhibitors • shuttle system across the mitochondrial membrane
40.	Metabolism of bone mineral and vitamin D	√			CHEMICAL PATHOLOGY	<p>Describe the functional, metabolic and nutritional aspects of bone minerals (Ca, Phosphate, Mg) and vitamin D.</p> <p>Describe the factors which regulate plasma calcium</p>
41.	Gluconeogenesis	√			CHEMICAL PATHOLOGY	Describe gluconeogenesis and its regulation
42.	Glycogen metabolism	√			CHEMICAL PATHOLOGY	Describe glycogen metabolism and its regulation
43.	Neurochemistry of movement disorder	√			PHYSIOLOGY	<p>Relate neurotransmitters to their role in nervous system functions.</p> <p>Describe the pathophysiological changes that occur in the following conditions: Involuntary movements</p>
44.	Analgesics	√			PHARMACOLOGY	Describe mechanism of action, distribution, excretion and side effects of analgesics

45.	Muscle relaxants	√			PHARMACOLOGY	Describe: -the classification of muscle relaxants -neuromuscular junction and mechanism of skeletal muscle contraction -mechanism of action of drugs -drug interaction -pharmacokinetics -side effect of drugs
46.	Pathology of myopathies	√			PATHOLOGY	Describe the structure of the sarcolemma and key intracellular, transmembrane, and extracellular proteins associated with it, and how they are involved in the pathogenesis of muscular dystrophies. Describe how type I and type II fibers are distributed in normal muscle and in the denervation atrophy. Name two types of conditions that cause denervation atrophy. Describe the microscopic and histochemical findings in denervation atrophy. Describe the pathogenesis of Duchenne and Becker muscular dystrophies. Discuss the pathogenesis of limb-girdle and other dystrophies. What is the most useful laboratory study in distinguishing denervation atrophy from muscular dystrophy and inflammatory myopathy? What are the key pathological findings in Duchenne muscular dystrophy? Discuss the genetics and key pathological changes of myotonic dystrophy. Name three congenital myopathies. What are ragged red fibers and what is their significance? Name the three most common types of inflammatory myopathy. Discuss the differences in pathology and pathogenesis between polymyositis and dermatomyositis. Discuss the pathology and chemistry of inclusion body myositis..
47.	Metabolic bone disease	√			PATHOLOGY	1. Define and state common metabolic bone diseases 2. Understand the etiology, pathogenesis and morphology of metabolic bone diseases which include : a) Diseases associated with decreased bone mass b) Diseases caused by osteoblast dysfunction c) Diseases associated with abnormal mineral homeostasis
48.	Long bone fracture & soft tissue injury			√ (PBL)	ORTHOPAEDIC	1) Knowledge about anatomy of the long bones 2) Basic knowledge about fractures of the upper or lower limbs a. Causes b. Classification c. Fracture healing d. Factors that influence the fracture healing e. Clinical presentation & how to diagnose f. Principal of treatment 3) Basic knowledge about dislocation & subluxation of the large joints a. Definition b. Clinical presentation & how to diagnose c. Principal of treatment

						<p>4) Knowledge about the main soft tissues of the upper & lower limbs</p> <p>5) Basic knowledge about soft tissue injury within the upper & lower limbs</p> <ol style="list-style-type: none"> Overview on various type of soft tissue injuries Clinical presentation – common & specific Principal of treatment
	Musculoskeletal tumours					
49.	Primary bone tumours	√			PATHOLOGY	Describe gross and microscopic features of common benign and malignant primary bone tumours .
50.	Batson plexus and spinal metastasis	√			ORTHOPAEDIC	<ol style="list-style-type: none"> Batson Venous Plexus <ul style="list-style-type: none"> its organization characteristic of these veins Its function in normal and abnormal conditions Its importance in spreading of metastases and infection bypassing the other venous system Discuss the other venous system (ie portal, caval and pulmonary venous system) List examples of tumours and infection that can be spread by Batson venous plexus
51.	Soft tissue & bone tumours	√			PATHOLOGY	Describe gross and microscopic features of common soft tissue tumors and bone tumours (other than primary bone tumours)
52.	Musculoskeletal Pathology		√		PATHOLOGY	Recognise the morphological changes of bone and soft tissue tumours at tissue and cellular level, for example osteosarcoma and giant cell tumour.
53.	Musculoskeletal tumour			√ (PBL)	ORTHOPAEDIC	<ol style="list-style-type: none"> Discuss the pathology & clinical manifestations of common primary bone and soft tissue tumours <ul style="list-style-type: none"> Benign Malignant (especially Osteosarcoma & Ewing’s Sarcoma) Discuss regarding malignant transformation of benign tumours Discuss the common primary causes of bone metastasis and their characteristics Explain the pathogenesis of tumour metastasis Outline the investigations for <ul style="list-style-type: none"> Confirming the diagnosis Looking for primaries Local staging Systemic staging General well being & pre-treatment baseline values Outline the general principles of musculoskeletal tumour management (benign & malignant) <ul style="list-style-type: none"> Complete management for Osteosarcoma

	Infections for Musculoskeletal system					
54.	Bone and soft tissue infections	√			MICROBIOLOGY	<ol style="list-style-type: none"> List the causes of bone and soft tissue infections Describe the pathogenesis, clinical features, complications and laboratory diagnosis Outline the principles of management, control and preventive measures
55.	Osteomyelitis			√ (PBL)	ORTHOPAEDIC	<p>Define the various types of tissue infection of the musculoskeletal system (which includes)</p> <ul style="list-style-type: none"> Impetigo Erysipelas Cellulitis Abscess Necrotizing fasciitis Septic arthritis Septic tenosynovitis Osteomyelitis Musculoskeletal tuberculosis Fungal osteomyelitis <p>Discuss the pathogenesis of musculoskeletal infection</p> <p>Describe the pathophysiology of symptoms and signs pertaining to acute osteomyelitis</p> <p>Discuss the common micro organisms causing musculoskeletal infection</p> <p>Discuss the natural history of acute , sub acute and chronic osteomyelitis</p> <p>List the treatments available for osteomyelitis</p> <p>Discuss the actions of common antibiotics used in treatment of osteomyelitis</p>
56.	Immunology of musculoskeletal system	√			IMMUNOLOGY	<p>Understand and describe</p> <ol style="list-style-type: none"> Spectrum of musculo-skeletal diseases Organ specific and non-organ specific autoimmune diseases Types and targets of immune responses Brief introduction of SLE and Rheumatoid arthritis Brief introduction to serological tests for major autoimmune disorders