COURSE DESCRIPTION

<table>
<tr><td>Course title</td><td colspan="5">Structure and function of the human body III</td></tr>
<tr><td>Course code</td><td colspan="5">MD-204</td></tr>
<tr><td>Course type</td><td colspan="5">Required</td></tr>
<tr><td>Level</td><td colspan="5">1st cycle: undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">Year 2 / Semester 4 (Spring)</td></tr>
<tr><td>Teacher’s name</td><td colspan="5">Sridevi Parvathareddy</td></tr>
<tr><td rowspan="2">ECTS</td><td rowspan="2">11</td><td>Large Group Learning per Week</td><td>Tutorials per Week</td><td>Small group work per Week</td><td>Laboratories per Week
**Includes basic sciences laboratories and anatomy practicals</td></tr>
<tr><td>10</td><td>4</td><td>4</td><td>2</td></tr>
<tr><td>Course purpose and objectives</td><td colspan="5">Musculoskeletal System
1. Understand the structure of bones, including both gross anatomy and microscopic organization, and identify skeleton elements in radiographic images.
2. Learn about the embryological development of bones and muscles, including relevant clinical aspects.
3. Explain physiological processes related to bone growth, remodelling, and repair, detailing the roles of osteoblasts, osteoclasts, and osteocytes, as well as the influence of hormones on bone metabolism.
4. Comprehend muscle structure and histology across different types (skeletal, smooth, cardiac) and their functional differences, alongside the mechanisms of muscle contraction and energy metabolism.
5. Explore the anatomical structures of major joints, their movements, and the histological features of cartilage and ligaments that contribute to joint stability.
6. Recognize common injuries through the anatomical analysis of joints and their stabilizing structures, including ultrasound interpretation.
7. Grasp the roles of tendons in muscle-to-bone attachment and identify both normal and abnormal imaging findings.
8. Integrate knowledge of the musculoskeletal system’s physiological roles, relating structure to function in terms of support, movement, and homeostasis.
9. Apply biomechanical principles to understand the collaborative functions of bones, muscles, and joints in posture, movement, and locomotion.

Nervous system

1. Outline the embryological development and gross anatomical structure of the nervous system, including central and peripheral components.</td></tr>
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	2. Describe the microscopic organization and histological characteristics of neurons, neuroglial cells, and synapses, relating structure to function. 3. Discuss the roles of the immune system in the nervous system, including microglial function and the blood-brain barrier. 4. Analyze the functional roles of the central nervous system, spinal cord, and autonomic nervous system, including their physiological functions in maintaining homeostasis. 5. Explain the mechanisms of action potentials, synaptic transmission, and neurotransmitter processes, and apply physics principles to neuronal communication. 6. Detail the motor pathways and the integration of motor control by the basal ganglia and cerebellum, including the impact of dysfunction on movement. 7. Describe the ascending sensory pathways and cortical processing of sensory input, including their roles in perception of touch, temperature, pain, and body position. 8. Explain temperature regulation and its physiological implications, including the body's response to fever. 9. Discuss cognitive functions, memory processes, and the impact of structural brain changes on learning. 10. Classify drug categories affecting the nervous system, detailing their indications, modes of action, and adverse effects across both central and peripheral systems. 11. Describe the anatomical and functional components of the visual and auditory systems, including common tests and their interpretation in assessing visual and hearing function. 12. Outline the interpretation of neurophysiological tests and their relevance in diagnosing and monitoring nervous system diseases.
Learning outcomes	**Musculoskeletal System** **<u>Theme 1: Bone</u>** 1. Describe the gross anatomical structure of bones and discuss the microscopic organization of bone tissue. 2. Identify elements of the skeleton on radiographs. 3. Outline the embryological development of bones and discuss clinical correlates. 4. Explain the physiological processes of bone growth, remodelling, and repair, including the roles of osteoblasts, osteoclasts, and osteocytes. 5. Discuss the role of parathyroid hormones, calcitonin and oestrogen in bone metabolism. 6. Discuss bone fracture models and their mechanical causes, analysing stresses (tensile, compressive, shear, bulk) and explaining the concepts of stress, strain, and deformation. 7. Briefly explain the role of the bone marrow in haematopoiesis. 8. Describe the stages in red blood cell maturation from stem cell to maturity in the bone marrow. 9. Describe the structure and function of the red blood cell, the synthesis of haemoglobin, and the normal breakdown and recycling of components.

Theme 2: Muscle

10. Describe the gross anatomical structure of muscles and the histological characteristics of skeletal, smooth, and cardiac muscle tissue.
11. Compare the function of skeletal, smooth, and cardiac muscle and relate it to the differences in structure.
12. Outline the embryological development of muscle.
13. Explain the molecular and cellular mechanisms of muscle contraction, including the sliding filament theory and excitation-contraction coupling.
14. Discuss the key biochemical processes involved in energy metabolism within muscle cells, such as glycolysis and the Krebs cycle.
15. Explain how bones, muscles, and joints work together to maintain posture and produce movement, including biomechanics of locomotion.
16. Explain how the musculoskeletal system contributes to overall homeostasis, including regulating calcium and phosphate during muscular activity.

Theme 3: Joints

17. Describe the histological and biochemical features of cartilage.
18. Outline the embryological development of the joints
19. Describe the structure of major joints and discuss relevant movements at these joints: shoulder girdle, elbow, wrist & hand, hip, knee, ankle & foot, spine.
20. Identify the structures contributing to the stability of these joints and illustrate the importance by discussing the anatomic basis of common injuries.
21. Describe the interpretation of joint ultrasound findings and recognize normal findings in the shoulder, hip, knee and ankle.
22. Recognize effusion, synovitis, tendon rupture, and soft tissue lesions in musculoskeletal ultrasound of these joints.

Theme 4: Ligaments

23. Describe the anatomical structure of ligaments and their role in joint stability.
24. Identify the anatomical structures contributing to joint stability and discuss their relevance in injury mechanisms.

Theme 5: Tendons

25. Describe the gross anatomical structure of tendons and their role in muscle-to-bone attachment.
26. Discuss normal and abnormal findings related to tendons in diagnostic imaging, including ultrasound and MRI.

Theme 6: Integrated functions of the musculoskeletal system

27. Outline the major physiological roles of the musculoskeletal system, including support, movement, protection of vital organs, and mineral storage and relate structure to function.
28. Explain how bones, muscles, and joints work together to maintain posture and produce movement.
29. Apply principles of physics, such as lever systems, torque, and mechanical advantage, to understand how muscles and bones function together to produce movement and generate force.

30. Explain the biomechanics of walking, running and other forms of locomotion.

Nervous System

Theme 1: Basic structure and function

31. Briefly outline the embryological development of the nervous system.
32. Describe the gross anatomical structure of the central nervous system (CNS), especially the brain & its blood supply, spinal cord, and peripheral nerves, as well as the microscopic organization of neurons, glial cells, and other neural tissue.
33. Describe the gross anatomical & microscopic structure of the peripheral nervous system (PNS), neuromuscular junction and muscle and outline the concept of upper and lower motor neuron weakness.
34. Describe the microscopic anatomy and histological characteristics of neurons, synapses, and neuroglial cells (astrocytes, oligodendrocytes, Schwann cells, ependymal cells and microglia), and relate their structure to their functional roles in the nervous system.
35. Describe the role of the immune system in the central and peripheral nervous systems, including the function of microglia and the immunological role of the blood-brain barrier.
36. Outline the functional roles of the structures of the central nervous system and the spinal cord.
37. Discuss the major physiological roles of the nervous system, including sensory processing, motor control, and autonomic regulation, as well as higher-order functions such as cognition and memory.
38. Explain the mechanisms underlying the generation and propagation of action potentials in neurons, the role of ion channels, and the process of synaptic transmission at chemical and electrical synapses.
39. Discuss the key biochemical processes involved in neurotransmitter synthesis, release, reuptake, and degradation, and how they relate to the function of excitatory and inhibitory synapses.
40. Apply principles of physics, such as membrane potentials, electrical conduction, and synaptic transmission, to understand how neurons communicate and process information within neural circuits.
41. Describe the structure and function of the autonomic nervous system (sympathetic and parasympathetic divisions), and explain how it contributes to the maintenance of body homeostasis by regulating visceral functions such as heart rate, digestion, and respiratory rate.
42. Classify the different drug categories that work in the peripheral nervous system depending on their mode of action (cholinergic, anti-cholinergic, adrenergic, anti-adrenergic drugs) and relate their indications and adverse effects to the role of the peripheral nervous system.

Theme 2: Motor Control

43. Explain the descending motor pathways, including the corticospinal and corticobulbar tracts and their roles in the regulation of voluntary movement, with an emphasis on upper and lower motor neuron function.
44. Describe the integration of motor control by the basal ganglia and cerebellum, including their roles in initiating, refining, and coordinating

movement, and understand the impact of dysfunction in these systems as illustrated by motor disorders such as Parkinson's disease and ataxia.

Theme 3: The sensory system

45. Describe the ascending sensory pathways, including the dorsal column, medial lemniscus and spinothalamic tracts, and their roles in transmitting proprioception, fine touch, temperature, and pain signals to the brain as well as the pathways involved in reflex arcs.
46. Define temperature and explain the principles of heat transfer and thermodynamics. Discuss how thermoregulation in the human body works, and explain how fever is a physiological response to infection.
47. Explain the cortical processing of sensory input in the somatosensory cortex, including the concept of topographical organization, and the mechanisms by which the brain integrates sensory signals for perception of body position and changes in the environment.

Theme 4: Higher functions of the nervous system

48. Explain the neural mechanisms of cognition, including attention, problem-solving, and decision-making, and correlate these functions with the roles of specific brain regions, such as the prefrontal cortex and association areas.
49. Describe the processes of memory formation, consolidation, and retrieval, with an emphasis on the roles of the hippocampus, amygdala, and cerebral cortex, and explain how structural changes in these areas, such as neurodegeneration, influence memory and learning.
50. Classify the different drug categories that work in the central nervous system depending on their mode of action (sedatives/hypnotics, anti-seizure drugs, opioid analgesics) and describe their indications and adverse effects.

Psychology

51. Define and describe the key components of memory and emotions.
52. Compare and contrast major theories of emotions.
53. Explain the role of the autonomic nervous system.
54. Identify the functions of key brain structures in processing and regulating emotions.
55. Understand Paul Ekman's theory of basic emotions.

Theme 5: Special senses

56. Describe the gross anatomical & microscopic structure and histological & functional components of the visual system, including the eye and the visual pathway from the retina to the visual cortex.
57. Explain the principles of normal image formation in the eye through the cornea and lens and analyse how common refractive errors, such as myopia, hyperopia, and astigmatism, alter the normal function of vision.
58. Explain the physiological processes involved in phototransduction, including the role of rods, cones, and photopigments in converting light into neural signals, and those processes involved in visual perception, including colour vision, depth perception, and motion detection.
59. Describe the commonly performed tests of visual function, including visual acuity, visual field assessment, and pupillary reflex testing, and explain the principles behind interpreting their results in the context of normal and pathological vision.

	60. Explain the behavior of light (including reflection and refraction), and discuss the application of optics in medicine, such as vision correction (glasses, contact lenses) and laser treatments used in medical procedures. 61. Describe the gross anatomical & microscopic structure and histological & functional components of the auditory pathway, from the outer ear to the auditory cortex. 62. Explain the process of sound transduction in the cochlea, including the role of hair cells and the basilar membrane in converting sound waves into neural signals. 63. Discuss the neural mechanisms underlying the interpretation of auditory input by the brain, including frequency, volume, and localisation of sound. 64. Describe the commonly performed hearing tests, including Rinne & Weber tests, audiometry, and tympanometry, and explain the principles behind their interpretation in distinguishing between conductive and sensorineural hearing loss. *Climate and Health* 65. Explain the general mechanism of the greenhouse effect 66. Illustrate trends and sources of greenhouse gas emissions 67. Analyze the drivers of climate change, including both natural and human-induced factors 68. Investigate the social dimensions of climate drivers, with a focus on population growth and economic growth **<u>Theme 6: Laboratory assessment of the nervous system</u>** 69. Outline the interpretation of common neurophysiological tests, such as electroencephalography (EEG), electromyography (EMG), nerve conduction studies, and imaging techniques (MRI, CT), and their relevance in diagnosing and monitoring nervous system diseases.		
Prerequisites	None	**Required**	None
Course content	**Musculoskeletal System Themes:** • Bone • Muscle • Joints • Ligaments • Tendons • Integrated functions of the musculoskeletal system **Nervous System Themes:** • Basic structure and function • Motor Control • The sensory system • Higher functions of the nervous system • Special senses • Laboratory assessment of the nervous system		
Teaching methodology	Lectures Tutorials Flipped learning Directed self-study Group Work		

Bibliography

Required Textbooks/Reading:

Authors	Title	Edition	Publisher	Year	ISBN
Arthur F. Dalley, Anne M. R. Agur	Moore's Clinically oriented anatomy	9th Int'l Edition	Wolters Kluwer Health	2024	9781975209544
Sadler, Thomas	Langman's Medical Embryology	15th Edition	Wolters Kluwer	2024	9781975180010
Pawlina, Wojciech	Histology: A Text and Atlas with correlated cell and molecular biology	9th Edition	Wolters Kluwer	2024	9781975181574
A.R. Crossman	Neuroanatomy : an illustrated colour text	6th Edition	Elsevier	2020	9780702074622

Recommended Textbooks/Reading:

Authors	Title	Edition	Publisher	Year	ISBN
Costanzo, Linda	BRS: Physiology	8th Edition	Wolters Kluwer	2023	9781976963467
Halliday, N.L. & Chung, H. M	BRS Gross Anatomy	10th Edition International	Lippincott Williams & Wilkins	2023	9781975181482

Assessment

- Final exam (80%)
- Coursework (20%)

Language

English