

Jordan University of Science and Technology

Faculty of Medicine

COURSE TITLE : NEUROSCIENCE.

COURSE CODE : MED 282.

CREDIT HOURS : 7 CREDIT HOURS

SEQUENCE : YEAR 2, SECOND SEMESTER, 7 WEEKS

COURSE COORDINATOR: Dr. Ahmad Altarifi; Dr. Ahmad Yassin

CONTACT : aaaltarifi@just.edu.jo; amyassin@just.edu.jo;

Course Description:

This course integrates all basic science disciplines in one system-based course to discuss neuroscience-related topics. Each of the basic science departments is incorporated into an integrated body of knowledge covering neuroanatomy, neurophysiology, neurological correlation, neuropharmacology, neuropathology, microbiology, and human behavior. Also, Clinical implications for these information will be addressed by specialists in the clinical departments including Neurology, neurosurgery, radiology, and Orthopedic. These subjects will be addressed by Anatomists, Physiologists, Pathologists, Pharmacologists, Microbiologists, and Clinicians. Goals of this course will be achieved via lectures, relevant laboratory sessions, seminars or small group discussions, and self-directed learning methods.

More specifically, central nervous system (CNS)-related topics will be covered at first to provide basic knowledge and understanding of the structure, function of the nervous system, biochemical basis of human behavior, as well as the pathological basis of neurological and mental disorders in brain and spinal cord. Fundamental principles of basic medical sciences and human behavior will be applied to pathological situations to distinguish the clinical basis for central nervous system disorders. Afterward, all parts of the peripheral nervous system is tackled starting from the origin in the central nervous system down to the target organs. This will include cranial nerves and spinal plexuses with their branches.

During the course and whenever relevant the students are exposed to clinical problems to emphasize the explanations of symptoms, signs, investigations and forms of treatments. Practical sessions are planned to be stations around tables to give students the opportunity to expose their knowledge for discussion and confirm concepts learned in lectures. Small group discussions of clinical cases are planned at the end of the course where students are divided into small groups and with the help of an instructor they analyze and discuss the problem.

Course Learning Outcomes

1. Describe the gross features of the human central nervous system (brain and spinal cord), including brain coverings, cerebrospinal fluid (CSF), and blood supply of the central nervous system.
2. Discuss chemical synaptic transmission in terms of mechanisms, functions, and properties, and drugs mechanisms to modify the functions of this system.
3. Analyze the structures conveying information to and from the central nervous system, and define the structural basis, physiological, and pharmacological properties transmit sensory and motor information in the CNS.
4. Describe the anatomical and physiological basis for higher-order cortical functions in the central nervous system.
5. Describe pathogens that infect the nervous system and the pathological changes related to the infection process.
6. Describe the principles that guide our understanding of human behavior and the biochemical basis of various behavioral disorders.
7. Correlate lesion sites at specific levels of the central nervous system with neurological and pathological findings of various neurological disorders.
8. Describe the pharmacology of drugs employed in the management of various mental and neurological disorders.
9. Be able to explain symptoms, signs, investigations, and forms of treatments of nervous system's anomalies.

Recommended Textbooks and Atlases:

Subject	Book (Resources)
Anatomy	<ul style="list-style-type: none"> • Clinical Anatomy for Medical Students. By Snell, Latest Edition. • Neuroanatomy by Snell, Latest Edition • Grants Atlas of Anatomy or any other Atlas of Human Anatomy, Latest Edition. • Before we are born. By Morre and Persaud, Latest Edition. • Clinical Embryology by Langmann, Latest Edition
Physiology	<ul style="list-style-type: none"> • Textbook of Medical physiology. By Guyton and Hall, Latest Edition.
Pathology	<ul style="list-style-type: none"> • Basic Pathology. By Kumar, Cotran, and Robbins, Latest Edition.
Pharmacology	<ul style="list-style-type: none"> • Lippincott's Illustrated Reviews: Pharmacology, 6th edition, 2014. • Goodman and Gilman's: The pharmacological basis of therapeutics, latest edition. • Articles that are recommended by the instructor
Microbiology	<ul style="list-style-type: none"> • Sherris medical microbiology an introduction to infectious diseases.
Clinical Lectures	<ul style="list-style-type: none"> • To be assigned by the lecturer.

Learning Objectives

(A) Lectures objectives

		Orientation
1	Brain and Spinal cord (Anatomy)	<ol style="list-style-type: none"> 1. Classify the types of neurons. 2. Describe the structure of the different parts of neurons. 3. Describe the structure and types of synapses. 4. Describe the types of glia cells and their functions. 5. Describe the elements of the blood-brain barrier. 6. Over view of the main parts of the CNS. 7. Identify main parts of the diencephalon and name the main functions of each part. 8. Identify the basal ganglia nuclei. 9. Describe the gross anatomical features of the spinal cord. 10. Describe the level of the different spinal segments compared to the level of their respective vertebrae. 11. Identify important gross features of spinal cord, nerve roots, and spinal ganglia. 12. Describe the internal features of spinal cord (gray matter and white matter) in the different regions.
2	Brain Meninges, Ventricles, and CSF (Anatomy)	<ol style="list-style-type: none"> 1. Describe the arrangement of the meninges and their relationship to brain and spinal cord. 2. Explain the occurrence of epidural, subdural and subarachnoid spaces. 3. Locate the principal subarachnoid cisterns, and arachnoid granulations. 4. Describe the ventricles of brain. 5. Discuss the structure of choroids plexus and CSF-blood barrier. 6. Locate the safe sites for the lumbar puncture. 7. Identify brain ventricles in CT scan and MRI.
3	Cerebral hemispheres	<ol style="list-style-type: none"> 1. Describe the organization of the cerebral cortex. (Layers and columnar organization). 2. Locate the motor, sensory and other cortical areas. 3. Identify the structures in coronal, sagittal, and horizontal

	(Anatomy)	sections of brain. 4. Describe the types of fibers in the internal capsule. 5. Describe the types of fibers in the white matter of the cerebral hemisphere: projection (internal capsule), commissural and association fibers.
4	Pathological features of CNS inflammatory conditions (Pathology)	1. Compare & contrast the clinical and pathological findings in bacterial and viral meningitis. 2. Know the pathology of tuberculous meningitis and tuberculoma 3. List the types of syphilitic & fungal diseases in the brain 4. Describe viral encephalitis and the main morphological features in the commoner types. 5. Know about prion diseases in the CNS.
5	Management of meningitis (Clinical)	1. Recognize and understand the urgency in the management of meningitis. 2. Become familiar with the diversity of therapeutic choices in the management of meningitis. 3. Appreciate the role of the non-pharmacological approaches (adjuvant therapy) in the management of meningitis. 4. Understand the differences between adults and children in the management of meningitis.
6	Ticks and Prions (Microbiology)	1. Definition of Ticks, Morphology, Life cycle, Pathogenesis and clinical disease, Clinical manifestations, Laboratory diagnosis, Treatment and Prevention. 2. Prions: Historical back ground, basic structure, classification of diseases involved, epidemiology, pathogenesis and pathology, laboratory diagnosis, treatment and prevention.
7	Blood supply of brain and spinal cord (Anatomy)	1. Follow up each artery to its destination. 2. Describe the circle of Willis and its branches. 3. Discuss the principle of end artery type of circulation and water shed zones. 4. Describe venous drainage of the brain.
8	Regulation of cerebral blood flow (Physiology)	1. Metabolic regulation of cerebral blood flow; effect of CO ₂ , H ⁺ , and O ₂ concentrations. 2. Autoregulation of cerebral blood flow; the myogenic hypothesis. 3. Pathophysiology and types of brain edema and cerebral strokes.
9	Vascular diseases of the CNS (Pathology)	1. Define stroke, transient ischemic attack, and the areas & cells in the brain which are most susceptible to ischemia & hypoxia. 2. Describe global/ ischemic encephalopathy, laminar necrosis, Border-Zone (Watershed) infarcts. 3. Understand regional infarction and describe their pathology. 4. Know the types of intracranial hemorrhage & their

		<p>pathological features.</p> <ol style="list-style-type: none"> 5. Know the effects of hypertension on the brain. 6. Describe the pathology of subarachnoid hemorrhage and its main causes: Berry aneurysms and vascular malformation. 7. Describe the types, morphology, pathology and complications of open and closed injury to the brain. 8. Describe the pathology of vascular trauma in the CNS. 9. Describe the pathology of diffuse axonal injury, and spinal cord trauma. 10. List the types of perinatal brain injury
10	Diencephalon (Anatomy)	<ol style="list-style-type: none"> 1. Identify the anatomical structure and nuclei of the Thalamus. 2. Identify the anatomical structure and nuclei of the Hypothalamus. 3. Identify the efferent and afferent connections of the Thalamus. 4. Identify the efferent and afferent connections of the hypothalamus.
11	Brain Metabolism and Neurotransmitters (Biochemistry)	<ol style="list-style-type: none"> 1. Discuss the synthesis and degradation of gamma-aminobutyric acid (GABA) 2. Discuss the synthesis and degradation of dopamine, epinephrine and nor-epinephrine 3. Discuss the formation and catabolism of serotonin 4. Discuss the glutamate metabolism 5. Understand the brain peptides as neurotransmitters
12	Stroke (Majdi) (Medicine)	<ol style="list-style-type: none"> 1. Define stroke and its different subtypes 2. Describe the pathophysiology of stroke 3. Understand the diagnostic procedures in stroke 4. Discuss treatment options and preventive measure
13	Antidepressants (Pharmacology)	<ol style="list-style-type: none"> 1. Describe the monoamine theory of depression 2. Describe the classification of antidepressants. 3. Describe pharmacodynamic properties and side effects of tricyclic antidepressants. 4. Describe the therapeutic use and toxic effects of MAO inhibitors. 5. Describe the therapeutic use and toxic effects of SSR and SNR inhibitors. 6. Identify the major drug interactions associated with the use of antidepressant drugs. 7. Describe the pharmacokinetics and pharmacodynamic of lithium.
14	Brainstem (Anatomy)	<ol style="list-style-type: none"> 1. Identify the gross features of the brainstem. 2. Briefly describe the internal structure of the brainstems (ascending and descending pathways, sensory and motor cranial nuclei, substantianigra, red nucleus, olivary nucleus and reticular formation). 3. Describe the main connections of the sensory cranial nuclei.

		<ol style="list-style-type: none"> 4. Describe the main connections of the motor cranial nuclei. 5. Describe lesions in the brainstem such as medial medullary syndrome and lateral medullary syndrome.
15	Antipsychotics (Pharmacology)	<ol style="list-style-type: none"> 1. Discuss types of dopamine receptors that are blocked by antipsychotic drugs. 2. Describe the classifications of antipsychotic drugs 3. Describe the pharmacodynamics of antipsychotic drugs and correlate these pharmacodynamics to their clinical uses. 4. List major adverse effects and the behavior effects of the major antipsychotic drugs.
16	General sensory pathways of the trunk and limbs (Anatomy)	<ol style="list-style-type: none"> 1. Describe gracile and cuneate tracts and pathways for conscious proprioception, touch, pressure and vibration from the limbs and trunk. 2. Describe dorsal and ventral spinocerebellar tracts and pathways for unconscious proprioception from the limbs and trunk. 3. Describe lateral spinothalamic tract and pathways for pain and temperature from the limbs and trunk. 4. Describe ventral spinothalamic tract and pathways for simple touch from the limbs and trunk.
17	Pain Sensation (Physiology)	<ol style="list-style-type: none"> 1. Mechanisms of fast and slow physiological pain. 2. Know different types of pain like: superficial, deep, and visceral pain; chronic and acute pain; physiological and neuropathic pain. 3. Define hyperalgesia and allodynia and give examples of primary and secondary hyperalgesia. 4. List and explain ways to inhibit pain sensations and describe the brain analgesic system.
18	Opioids (Pharmacology)	<ol style="list-style-type: none"> 1. Describe the neural mechanisms of pain sensation and its control. 2. List the receptors affected by opioid analgesics and the endogenous opioid peptides, and the differences between them. 3. List of major opioid agonists and rank them in analgesic efficacy. 4. Describe the main pharmacodynamics and pharmacokinetic properties of opioid receptors agonists and list their clinical uses. 5. List the main adverse effects of acute and chronic use of opioid analgesics. 6. Identify opioid receptor antagonists and mixed agonist-antagonist drugs. 7. Describe methods of treatment of opioids dependency.

<p style="text-align: center;">19</p>	<p style="text-align: center;">Motor pathways (Anatomy)</p>	<ol style="list-style-type: none"> 1. Define the terms upper and lower motor neurons with examples 2. Describe the corticospinal (pyramidal) tract and the direct motor pathways from the cortex to the trunk and limbs. 3. Briefly describe the indirect motor pathways from the cortex to the trunk and limbs through extrapyramidal tracts such as rubrospinal and reticulospinal tracts. 4. Describe motor pathways to the face muscles. 5. Compare the signs and symptoms of the upper and lower motor neuron lesions.
<p style="text-align: center;">20</p>	<p style="text-align: center;">Basal nuclei (Anatomy)</p>	<ol style="list-style-type: none"> 1. Understand the anatomical and functional definition of the basal ganglia. 2. Identify the different components of the basal ganglia. 3. Describe the connections of the different components of the basal ganglia and the indirect pathways from the basal ganglia to the lower motor neurons. 4. Describe signs and symptoms of lesions which affect different components of the basal ganglia.
<p style="text-align: center;">21</p>	<p style="text-align: center;">Cerebellum (Anatomy)</p>	<ol style="list-style-type: none"> 1. Identify the major lobes and regions of cerebellum. 2. Summarize the structure of the cerebellar cortex; identify the deep cerebellar nuclei and their connections. 3. Summarize the afferent and efferent connections of the cerebellum and their arrangement in cerebellar peduncles. 4. Describe the major functions of the cerebellum and how each side of the cerebellum controls the ipsilateral side of the body. 5. Explain the effects of lesions of cerebellum and motor disorder associated with cerebellar lesions.
<p style="text-align: center;">22</p>	<p style="text-align: center;">Control of movements and posture (Physiology)</p>	<ol style="list-style-type: none"> 1. Outline the function of each of the main components of the regulatory systems of motor functions; cortex, brain stem, basal ganglia, and cerebellum. 2. Discuss controlling motor functions of the motor cortex. 3. Discuss the role of brain stem in controlling motor function.
<p style="text-align: center;">23</p>	<p style="text-align: center;">Epilepsy/Headache (Salma Bashaireh) (Clinical)</p>	<ol style="list-style-type: none"> 1. Define and differentiate between the concept of Seizure and the concept of Epilepsy. 2. Recognize the clinical types of Seizures and Epilepsy. 3. Understand the aspects of clinical evaluation for patients with Seizure and Epilepsy. 4. List and understand the required investigations for patients with Seizure and Epilepsy. 5. Understand the management outlines for patients with Seizure and Epilepsy. 6. Summarize the electroencephalographic and describe the mechanisms responsible for its production.

24	Antiepileptic's (Pharmacology)	<ol style="list-style-type: none"> 1. Define epilepsy and understand the general classification of seizures 2. Understand cellular mechanisms underlying epilepsy 3. Describe the major drugs different types of epilepsy and status epilepticus. 4. Discuss differences between different antiepileptic drugs in their mechanism of action, adverse effects and drug-drug interaction of each drug. 5. List the new antiepileptic drugs and describe their advantages, major indications and adverse effects.
25	Higher functions of the neocortex: Learning and memory (Physiology)	<ol style="list-style-type: none"> 1. Name, locate, and describe the function of the parieto-occipitotemporal, frontal, and limbic association areas and review related disorders. 2. Describe the language function of the cortex. 3. Discuss the neural basis of learning and memory and review the common types of aphasia.
26	Degenerative diseases (Pathology)	<ol style="list-style-type: none"> 1. Know the general features of degenerative diseases & dementias. 2. Special Emphasis on Alzheimer's disease, its clinical & morphological findings. 3. Know briefly about Parkinson Disease, Huntington disease and amyotrophic lateral sclerosis 4. Know briefly about acquired nutritional and metabolic diseases affecting the nervous system.
27	Parkinson's Disease (Clinical or Pharmacology)	<ol style="list-style-type: none"> 1. Describe the neurochemical imbalance underlying the symptoms of parkinson's disease. 2. Identify the mechanism of action of the drugs used in the management of Pakinson's disease. 3. Describe the therapeutic and toxic effects of these drugs. 4. Identify the chemical agents and drugs that cause Parkinson symptom.
28	Arousal mechanisms and consciousness and sleep (Physiology)	<ol style="list-style-type: none"> 1. Describe the functions of the reticular formation and discuss the nonspecific sensory system in the reticular formation. 2. Describe the primary types of rhythms that make up the EEG and the behavioral states that correlate with each. 3. Summarize the behavioral and electroencephalographic characteristics of each of the stages of slow-wave sleep. 4. Summarize the characteristics of rapid eye movement (REM) sleep, and describe the mechanisms responsible for its production. 5. Describe the pattern of normal nighttime sleep in adults and the variations in this pattern from birth to old age.

<p style="text-align: center;">29</p>	<p style="text-align: center;">Sedative-hypnotics (Pharmacology)</p>	<ol style="list-style-type: none"> 1. Identify the major chemical classes of sedative-hypnotics. 2. Describe the clinical uses of sedative-hypnotics. 3. Describe the sequence of CNS effects of a typical sedative-hypnotic over the entire dose range. 4. Describe the pharmacodynamics of benzodiazepines, including interactions with neuronal membrane receptors. 5. Compare the pharmacokinetics of commonly used benzodiazepines and barbiturates and discuss how differences among them affect clinical use. 6. Describe the common adverse effects and drug interaction of sedative-hypnotics and their antidotes. 7. Understand tolerance and dependence induced by sedative-hypnotics.
<p style="text-align: center;">30</p>	<p style="text-align: center;">Development of CNS (Anatomy)</p>	<ol style="list-style-type: none"> 1. Describe the formation of neural tube and neural crest. 2. Describe the positional changes of spinal cord. 3. Describe the development of the spinal nerves and their spinal ganglia. 4. Describe the development of meninges. 5. Describe the development of the different parts of brain. 6. Describe the development of brain ventricles and choroid plexuses 7. Describe the development of pituitary gland 8. Describe the development of the cranial nerves and their ganglia.
<p style="text-align: center;">31</p>	<p style="text-align: center;">General anesthetics (Pharmacology)</p>	<ol style="list-style-type: none"> 1. Understand the physiochemical theories of anesthesia; lipid and protein theory. 2. Describe stages of anaesthesia 3. Describe drugs used as pre-anesthetics and the rationale of their use. 4. Identify the main inhalation anesthetic agents and describe their pharmacodynamic, pharmacokinetics, and side effects. 5. Describe the pharmacodynamic, pharmacokinetics, and major side effects of commonly used intravenous anesthetics.
<p style="text-align: center;">32</p>	<p style="text-align: center;">Subarachnoid Hemorrhage/Low Back Pain (Neurosurgery)</p>	<ol style="list-style-type: none"> 1. A brief of hemorrhages in the CNS will be explained by the department of Neurosurgery 2. Understand surgical treatment options for low back pain.
<p style="text-align: center;">33</p>	<p style="text-align: center;">Imaging of the CNS (Clinical/Radiology)</p>	<ol style="list-style-type: none"> 1. Introducing the most common radiological investigations which are used in the diagnosis of neurological disorders and to recognize when to use each investigation. 2. Gaining the ability to use the radiological findings (pathological appearance) in deciding the proper approach for the diagnosis and management of the most common CNS disorders.

		3. Understanding the radiological approach for the diagnosis of the most common emergencies in Neuroradiology.
34	Drugs of abuse (Pharmacology)	<ol style="list-style-type: none"> 1. Discuss differences between stimulants and depressants. 2. Describe the pharmacological types of drug dependence. 3. Discuss the neurobiology of drug addiction. 4. Describe the major pharmacological actions of drugs that are commonly abused. 5. Describe the major signs and symptoms of withdrawal of drugs that are commonly abused. 6. Identify the most likely causes of fatalities from commonly abused agents. 7. Describe methods of treatment of drugs abuse. 8. Discuss challenges in fighting recent abused medications such as Joker.
35	Bacterial infections of the CNS (Microbiology)	<ol style="list-style-type: none"> 1. Understand the characteristics, laboratory diagnosis and management of mycobacterium leprae, group B streptococcus and listeria. 2. Understand the bacteriological aspects, laboratory diagnosis, management and prevention of Clostridium Tetani and Botulism.
36	Tumors of the Nervous system (Pathology)	<ol style="list-style-type: none"> 1. Classify tumors and describe the general features of primary brain tumors in comparison to other tumors in the body. 2. Know the pathology and prognosis of the various types of brain tumors. 3. Know the common types of metastatic tumors and their pathologic characteristics. 4. Know common types of spinal cord tumors. 5. Describe tumors of the peripheral nerves.
37	Eye and Visual Pathway (Anatomy)	<ol style="list-style-type: none"> 1. Discuss the structure of the coats of the eyeball. 2. Describe the contents of the eyeball. 3. Know how and where the optic nerve leaves the retina. 4. Describe the sensory and autonomic nerve supply of the orbit and eyeball, and blood supply and lymph drainage of the orbit. 5. Understand the organization of visual paths and reflexes.
38	Physiology of the eye and retina (Physiology)	<ol style="list-style-type: none"> 1. Describe the light refraction by the eye and know the refractive indices of the cornea, lens aqueous humor and vitreous humor. 2. Define accommodation and know its mechanism of action as well as its importance for near vision 3. Define visual acuity and know that the fovea has the highest visual acuity 4. Know the types of photoreceptors in the retina. 5. Understand the mechanism of phototransduction and the ionic basis of receptor potential in rods and cones 6. Describe different types of neuronal cells in the retina and

		<p>their synaptic connections (neural circuit in retina)</p> <p>7. Know the functions of bipolar cells ,horizontal cells, amacrine cells and their role in processing of visual signal.</p>
39	<p>Neurophysiology of vision (Physiology)</p>	<ol style="list-style-type: none"> 1. Describe the functions of the visual cortex in perception of visual signals. 2. Review the major relay stations of the visual pathway. 3. List the major functions of the geniculate nucleus and superior colliculus. 4. Discuss the role of the visual cortex in perception of vision. 5. Outline briefly the major pathways of color and black and white vision. 6. Describe the major types of visual cortex cells and their role in visual perception.
40	<p>Introduction to eye diseases (Clinical)</p>	<p>Will be provided separately.</p>
41	<p>Ear and auditory pathways (Anatomy)</p>	<ol style="list-style-type: none"> 1. Make a list of structures making the external, middle and inner ear. 2. Discuss the features of the tympanic membrane and external auditory meatus. 3. Describe the walls boundaries of the middle ear, facial canal, and auditory tube and describe the hearing ossicles, their muscles, and mastoid air cells and their connection to the middle ear. 4. Describe the hearing and balance receptors. 5. Follow the course of the VIII nerve down to its point of entry to the brain. 6. Understand the organization of auditory pathway.
42	<p>Hearing physiology (Physiology)</p>	<ol style="list-style-type: none"> 1. Review the ossicular system of the ear and discuss its role in the conduction of sound waves from the tympanic membrane to the cochlea sound waves. 2. Outline the properties of traveling waves and describe how, via these waves, particular movement of the foot plate of the stapes produce maximal deflection of the basilar membrane at a particular point. 3. Discuss the functions of the organs of Corti and describe how deformation of the basilar membrane is converted to impulses in auditory fibers. 4. Describe the ionic basis of auditory receptors. 5. Explain how pitch (frequency) and loudness of sound are coded in the auditory pathways. 6. Discuss the mechanisms that permits sound localization

43	Physiology of Equilibrium (Physiology)	<ol style="list-style-type: none"> 1. Explain how hair cells in the semicircular canals detect rotational acceleration 2. Explain how hair cells in the utricle and saccule detect linear acceleration 3. Describe the role of the vestibular system in stabilizing eye movements during acceleration. 4-Review the major connections of the vestibular system with the brainstem and cerebellum. 4. List the major sensory input that provides the information which is synthesized in the brain into the sense of position in space. 5. Describe the <u>caloric test</u> for evaluation of vestibular functions.
44	Introduction to ear diseases (Clinical)	<p>Will be provided individually</p>
45	Fungal and Parasitic Infections (Microbiology)	<p>To be determined Later</p>
46	Cranial nerves Part I (Anatomy)	<ol style="list-style-type: none"> 1. Describe the course of each cranial nerve, and its branches, from its point of exit of the brain and down to its target organs. 2. Make a list of types of nerve modalities conveyed by each cranial nerve.
47	Cranial nerves Part II (Anatomy)	<ol style="list-style-type: none"> 1. Describe the course of each cranial nerve, and its branches, from its point of exit of the brain and down to its target organs. 2. Make a list of types of nerve modalities conveyed by each cranial nerve.
48	Physiology of peripheral nerves (Physiology)	<ol style="list-style-type: none"> 1. Review of action potential; its characteristic features, propagation in different types of nerve. 2. Describe the synapses and factors affecting transmission through them 3. List various types of nerve fibers in peripheral nerves and know their function. 4. Describe and explain the compound action potential and understand its clinical significance 5. Define latent period and know how to calculate the conduction velocity of peripheral nerves
49	Demyelinating diseases	<ol style="list-style-type: none"> 1. Know the general features of demyelinating diseases, with special emphasis on Multiple Sclerosis, its clinical & morphological characteristics. 2. Know about various axonal degeneration and injuries.

	(Pathology)	3. Know the various causes and types of peripheral neuropathies.
50	Local anesthetics. (Pharmacology)	<ol style="list-style-type: none"> 1. Describe the classification of the local anesthetic 2. Indicate the pharmacological characteristics of their chemical structures 3. Describe the mechanism of action, and the relation between pH, pKa, and the speed of onset of local anesthesia. 4. List the factors that determine the susceptibility of nerve fibers to blockade by local anesthetics. 5. List the major toxic effects of the local anesthetics.
51	Enteroviruses (Microbiology)	1. Enteroviruses : Polio viruses, coxsaki viruses, echo viruses, basic structural , morphological and physical properties, epidemiology, pathogenesis, clinical presentation, laboratory diagnosis, treatment, and prevention.
52	Cervical and brachial plexuses (Anatomy)	<ol style="list-style-type: none"> 1. Describe how spinal nerves are formed. 2. Make a list of contributing roots to cervical and brachial plexuses. 3. Describe the location of these plexuses. 4. List branches of these plexuses and their root value. 5. Describe the course and function of each of these branches.
53	Lumbosacral plexus and nerves (Anatomy)	<ol style="list-style-type: none"> 1. Make a list of contributing roots to lumbosacral plexus. 2. Describe the location of this plexus. 3. List branches of this plexus and their root value. 4. Describe the course and function of each of these branches.
54	Introduction to peripheral nerves injury (Clinical)	<ul style="list-style-type: none"> • Will be provided individually
55	Autonomic nervous system (ANS): Sympathetic, Parasympathetic, and Enteric divisions (Anatomy)	<ol style="list-style-type: none"> 1. Review the general arrangement of the sympathetic system including origin, paravertebral and prevertebral ganglia, sympathetic trunk, splanchnic nerves and plexuses in the thorax and abdomen. 2. Discuss sympathetic innervation of the head 3. Review the general arrangement of the parasympathetic system including origin, ganglia, and plexuses. Discuss the sacral part of the system 4. Make a list of cranial nerves having parasympathetic activity and their targets. 5. Describe the enteric division of the autonomic nervous system

<p style="text-align: center;">56</p>	<p style="text-align: center;">ANS and central regulation of viscera (Physiology)</p>	<ol style="list-style-type: none"> 1. Review the functions of the ANS and the response of effector organs on the neurotransmitters releases by the two divisions. 2. Understand the concept that ANS is a reflex based control system and emphasize the general feature of autonomic neuronal reflexes. 3. Describe autonomic reflexes integrated at the level of spinal cord and brain stem 4. Describe central regulation of autonomic output and the role of nucleus of the solitary tract, limbic system and hypothalamus in the control of autonomic functions . 5. List the major functions of the hypothalamus including body rhythm, temperature regulation, and appetite control and water intake.
<p style="text-align: center;">57</p>	<p style="text-align: center;">Cholinergic agonists and Antagonists (Pharmacology)</p>	<ol style="list-style-type: none"> 1. Review the steps involved in the synthesis, storage, release and the termination of action of acetylcholine 2. Mention examples on inhibitors of acetylcholine synthesis, storage, and release. 3. Review the locations and types of acetylcholine receptors in various organ systems. 4. Describe the effects of acetylcholine on major organ systems. 5. Correlate the pharmacokinetic properties of various choline esters and cholinomimetic alkaloids with their chemical properties. 6. List the major clinical indications and adverse effects of cholinomimetic agonists. 7. Describe the distribution and function of cholinesterase 8. provide a classification and examples on drugs that inhibit cholinesterase 9. Describe the pharmacodynamic differences between direct and indirect-acting cholinomimetic agents. 10. List the major signs and symptoms of organophosphate insecticide poisoning. 11. Describe the treatment modalities of organophosphate poisoning.
<p style="text-align: center;">58</p>	<p style="text-align: center;">Rabies and, arboviruses (Microbiology)</p>	<ol style="list-style-type: none"> 1. Rabies, Arboviruses: Classification, basic structural, morphological and physical properties, epidemiology, pathogenesis, clinical presentation, laboratory diagnosis, treatment, and prevention.
<p style="text-align: center;">59</p>	<p style="text-align: center;">Adrenergic agonists and Antagonists (Pharmacology)</p>	<ol style="list-style-type: none"> 1. Review the steps involved in the synthesis, storage, release and the termination of action of epinephrine and norepinephrine 2. List examples on the inhibitors of norepinephrine synthesis, storage, release and re-uptake. 3. List tissues that contain significant numbers α_1 or α_2 adrenergic receptors.

		<ol style="list-style-type: none"> 4. Describe the major systemic effects of a pure alpha agonist. 5. Indicate the major clinical applications and major adverse effect of α-receptor agonists. 6. List tissues that contain significant numbers of β_1 or β_2 receptors. 7. Describe the major organ system effects of a pure beta agonist, and a mixed alpha and beta agonist. 8. List the major clinical applications and adverse effect of β-receptor agonists (turn page). 9. Indicate the pharmacodynamic differences between direct and indirect acting sympathomimetic amines.
60	Development of the Head and Neck, Eye, and Ear (Anatomy)	<ol style="list-style-type: none"> 1. Describe the development of the face 2. Describe the development and fate of Pharyngeal arches. 3. Describe development of the Eye 4. Describe the development of the Ear.

(B) Labs objectives

Title	Objectives
Anatomy 1	<ul style="list-style-type: none">• Identify major components of brain.• Know major lobes, major gyri and sulci of the cerebrum.• Study and identify the major components of brain in coronal transverse and sagittal sections.
Anatomy 2	<ul style="list-style-type: none">• Identify the arteries of the brain including the circle of Willis.• Study external and internal features of spinal cord.• Recognize the structure of different coats of the eyeball.• Identify nerves of the orbit.• Recognize the different parts of the ear and their contents.
Anatomy 3	<ul style="list-style-type: none">• Identify branches of trigeminal and facial nerves.• Identify muscles of facial expression and muscles of mastication.• Identify branches of cervical, brachial, and lumbosacral plexuses.• Identify nerves of upper and lower limbs
Pathology 1	Study Gross, radiographic and microscopic images of the following: <ul style="list-style-type: none">• CNS hemorrhages and infarctions.• Vascular and congenital malformations in the CNS.• Edema and herniation.• Brain injuries.• CNS infections.
Pathology 2	Students are expected to study computerized images of gross & microscopic findings of: <ol style="list-style-type: none">1. CNS Tumors.2. Gross & microscopic findings in Multiple Sclerosis, Parkinson's disease and Alzheimer's disease and other degenerative diseases
Physiology 1	Students are expected to do experiments demonstrating the following tests: <ol style="list-style-type: none">1-Visual acuity test, Snellen, Charts.2-Color vision test using Ishihara charts..3-Confrontational perimetry and mapping of blind spot.4-Use of ophthalmoscope and examination of the retina.
Physiology 2	Students are expected to perform auditory tests, including Rennn's and Webber's tests. Demonstrating physiology of balance and equilibrium using Barny chair.
Microbiology	1. Describe the method of specimen collection

	<p>including the process of lumbar puncture, transportation of specimen and storage.</p> <ol style="list-style-type: none"> 2. Describe the findings of CSF: CSF Color, Glucose level, Protein level and leukocytes count. 3. Describe the laboratory method used for the specimen processing, including; microscopy, media used, cultivation technique, incubation, colonial morphology, antibiotic sensitivity testing and biochemical reaction tests for identification of the disease agents. 4. Release the result by the system and inform the patient's doctor.
Pharmacology 1	<p>Students will evaluate the cases that will be presented in the simulation lab. Students will discuss the signs and symptoms and medications involved in the case presented. The case will involve opioid and benzodiazepines overdose and the clinical management of such situation</p>
Pharmacology 2	<p>Students will evaluate the cases that will be presented in the simulation lab. Students will discuss the signs and symptoms and medications involved in the case presented. The cases may include but not limited to:</p> <ol style="list-style-type: none"> 1) Anaphylactic shock. 2) Organophosphate poisoning. 3) Atropine toxicity.

Course Assessment

Assessment		
Assessment Type	Expected Due Date	Weight
First Exam		--
Second Exam		--
Midterm Exam (Theory)		60
Evaluation		5
Quizzes		--
Research activity		5
OSCE		--
Mini-OSCE		--
Final Exam (Practical)		30
Final Exam(Oral)		--
Total		100

Students Learning Outcomes

Student Learning Outcomes(SLOs) (4-8 Maximum) Upon successful completion of this course, students should be able to:			
SLOs	Related ILO(s)* (numbers only)	Evaluation Criteria (MCQ, OSCE, Homework...)	
		Type of Criteria (MCQ, OSCE, Homework...)	Weight (%)
Describe the anatomical and physiological basis for higher-order cortical functions in the central nervous system	1	MCQ	20
Describe the principles that guide our understanding of human behavior and the biochemical basis of various behavioral disorders	2	MCQ	10
Able to explain symptoms, signs, investigations, and forms of treatments of nervous system's anomalies	3,5,7	MCQ	30
Describe the gross features of the human central nervous system (brain and spinal cord), including brain coverings, cerebrospinal fluid (CSF), and blood supply of the central nervous system	1	MCQ	15
Analyze the structures conveying information to and from the central nervous system, and define the structural basis, physiological, and pharmacological properties transmit sensory and motor information in the CNS	1,9	MCQ	25
			100

Intended Learning Outcomes (ILOs)

- 1) Demonstrate a sufficient understanding of the structural organization and functions of the following systems of the human body: circulatory, respiratory, gastrointestinal, endocrine, hematopoietic & lymphatic, musculoskeletal, nervous, and genitourinary systems.
- 2) Conceptualize the cellular, molecular, genetic, and biochemical mechanisms that maintain body's homeostasis and their derangements in disease states.
- 3) Apply their knowledge of human anatomy and function to solve questions regarding major clinical cases and diseases.
- 4) Attain appropriate and systematic clinical history of different medical conditions and settings.
- 5) Demonstrate proficiency in performing clinical skills and procedures.
- 6) Perform relevant physical examination on patients professionally and ethically.
- 7) Identify the major signs and symptoms of disease states, recognizing risk factors and etiologies, in an interdisciplinary approach to differentially diagnose patients.
- 8) Order and interpret results of relevant basic diagnostic procedures, such as laboratory investigations and conventional imaging procedures.
- 9) Apply safe and accurate methods of pharmacotherapy of major disease states.
- 10) Critically appraise research studies guided by evidence-based medicine.
- 11) Demonstrate ability to work in diverse settings and communities.