



JINNAH SINDH MEDICAL UNIVERSITY

STUDY GUIDE	
PROGRAM	MBBS-2026
MODULE TITLE	NERVOUS SYSTEM-I
ACADEMIC YEAR	2nd Year- 2026
INTRODUCTION	<p>The Nervous system module is developed to provide the learners with in- depth knowledge about how the brain is structured and how it works under normal circumstances. Students learn the developmental processes of the brain in order to understand where the structures come from and how each is linked with the others. This module deals not only with the brain but also with the peripheral & autonomic nervous systems. Students get to know how the human body carries out its myriad functions, some of which are under our control (e.g. walking) while others are not (e.g. beating of the heart).</p> <p>The Autonomic Nervous system, one of the essential systems maintaining our homeostasis, is dealt with in detail. One of the main reasons for this is because many medications alter Autonomic functions. A doctor has to have detailed knowledge about such medications and their interactions.</p>
RATIONALE	Since conditions related to the Nervous system are common in Pakistan, detailed knowledge of the normal gross, microscopic and molecular structure and functions are necessary at the initial level
DEPARTMENT	Physiology Biochemistry Anatomy
MODULE OBJECTIVES	By the end of the module, the students should be able to:
PHYSIOLOGY	1. Neuron membrane potential, generation & propagation of nerve

LECTURES

impulse

- Describe the structure and functions of a neuron.
- Discuss the classification & functions of nerve fibers.
- Describe the threshold, initiation of action potential and propagation of nerve impulse in neuronal cells.

2. Synapses, properties of synapses

- Describe the properties of chemical and electrical synapses.

3. Sensory receptors and neuronal circuits

- Discuss the classification of sensory receptors.
- Describe the functions & properties of different types of receptors.
- Explain the properties of different types of neuronal circuits.

4. Somatic sensations – I

- Explain the general organization of somatic sensations: tactile and position senses.
- Discuss the dorsal-column medial lemniscus pathway.

5. Somatic sensations – II

- Discuss the anterolateral pathway.
- Describe the mechanism of thermal receptors & their excitation.

6. Physiology of pain – I and headache

- Discuss the types of pain (slow & fast) and their characteristics.
- Explain the mechanism of stimulation of pain receptors.
- Discuss the clinical abnormalities of pain: hyperalgesia, headache & its causes.

7. Physiology of pain II- Brain analgesic system

- Explain the analgesic system of brain.

- Discuss the opiate system of brain.
- Describe visceral & referred pains.

8. Spinal cord and cord reflexes

Describe the motor functions of spinal cord.

- Explain the structure and function of muscle spindle.
- Discuss the stretch reflex and its clinical applications.

9. Muscles proprioceptors (muscle spindle and Golgi tendon organ)

- Discuss the mechanism of flexor reflex, crossed extensor reflex, scratch reflex, postural and locomotive reflexes.
- Discuss spinal cord transection and spinal shock (Brown-Sequard syndrome)
- Explain the mechanism of Golgi tendon reflex and its significance in controlling motor activities.

10. Somatosensory cortex

- Describe various areas of somatosensory cortex and their associated functions.
- Discuss the functional importance of somatosensory association areas.
- Define amorphosynthesis.

11. Function of brain stem

- Explain the role of brain stem nuclei in controlling motor functions.
- Discuss the vital and non- vital functions of brain stem (respiratory, cardiac, vasomotor centers & coughing, sneezing & vomiting reflexes).

12. Cerebellum and its functions

- Explain the functional areas of cerebellum.
- List the functions of Vermis, Intermediate zone and lateral zone of cerebellum.

13. Neuronal circuits of cerebellum and associated disorders

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- Discuss the afferent and efferent pathways of cerebellum.
- Describe the functions of Purkinje cells and deep cerebellar nuclei.
- Explain the motor abnormalities associated with cerebellar lesions.

14. Vestibular system and maintenance of equilibrium

- State the components of vestibular system.
- Explain the functions of the vestibular system.
- Discuss the role of utricle & saccule in static equilibrium.
- Discuss the role of semicircular ducts in angular acceleration

15. Functions of diencephalon

- Discuss the functions of thalamus and its nuclei.
- Elaborate the functions of various nuclei of epithalamus and hypothalamus.

16. Regulation of body temperature and fever

- Differentiate between skin temperature and core temperature.
- Describe the following mechanisms of heat loss from the body; conduction, convection, radiation and evaporation.
- Explain the role of anterior and posterior hypothalamus in regulation of body temperature.
- Elaborate “set-point” of temperature control mechanisms and the role of pyrogens in altering the set point to cause fever

17. Limbic system and hypothalamus

- Describe the functional areas of limbic system.
- Discuss the role of hypothalamus, hippocampus and amygdala in limbic system.
- Discuss the importance of reward and punishment centers in learning and memory.
- Discuss the effects of Kluver-Bucy syndrome

18. Basal ganglia and its nuclei

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- Explain the functions of caudate & putamen pathways.
- List the functions of specific neurotransmitters of basal ganglia.
- Explain the disorders associated with basal ganglia (hypokinetic and hyperkinetic).

19. Motor cortex, pyramidal tract, Upper and lower Motor Neurons

- Explain the functions of pyramidal tract.
- List the functions of specific cortical motor areas.
- Differentiate between upper & lower motor neuron lesions

20. Physiology of sleep and sleep disorders

- Explain the physiology of slow wave sleep & rapid eye movement (REM) sleep.
- Explain the basic theories of sleep & origin of brain waves.

21. Learning and memory

- Define the role of cerebral cortex in higher intellectual functions.

22. Classify the different types of memories. CSF: formation, circulation and function

- Describe the mechanism of CSF formation, its circulation and functions.

23. Autonomic Nervous System -I

- Explain the functional division of Autonomic Nervous System
- Discuss the organization of sympathetic & parasympathetic nervous system, their neurotransmitters and receptors in body systems.

24. Autonomic Nervous System-II

- Explain the effect of sympathetic and parasympathetic nervous system on various organs.
- Discuss various abnormalities caused by activation of sympathetic and

parasympathetic nervous system.

25. Speech and its disorders

- Explain the physiology of speech and associated disorders

**BIOCHEMISTRY
LECTURES**

1. Lipids of the nervous system: Chemistry of Brain Lipids

- Classify brain lipids with examples
- Explain the chemistry of brain lipids
- Describe the chemical composition and functions of myelin
- Discuss the clinical significance of lipid storage diseases

2. Blood Brain Barrier

- Define Blood Brain Barrier
- State the biochemical composition of the Blood Brain Barrier
- Explain the functions of the Blood Brain Barrier
- Explain the impact of Blood Brain Barrier disruption
- Discuss the clinical disorders associated with Blood Brain

Barrier disruption

3. Cerebrospinal fluid

- Describe the chemical composition of CSF and its functions
- Explain the mechanism of production, route of flow and reabsorption of CSF
- Explain the procedure of lumbar puncture
- Interpret the laboratory investigations of CSF in different diseases

4. Introduction of Neurotransmitters

- Define Neurotransmitters
- Classify Neurotransmitters with examples
- Describe the mechanism of action and functions of

- Neurotransmitters
- Classify receptors of Neurotransmitters
- Explain the synthesis and degradation pathways of Neurotransmitters
- Discuss the disorders associated with Neurotransmitter

5. Acetylcholine & Dopamine

- Describe the chemical structure of Acetylcholine and Dopamine
- Describe the metabolism of Acetylcholine and Dopamine
- Explain the mechanism of action and functions of Acetylcholine & Dopamine
- Discuss the receptors of Acetylcholine and Dopamine
- Explain the clinical disorders associated with Acetylcholine and dopamine

6. Serotonin & GABA

- Describe the chemical structure of Serotonin and GABA
- Describe the metabolism of Serotonin and GABA
- Explain the mechanism of action and functions of Serotonin and GABA
- Discuss the receptors of Serotonin and GABA
- Explain the clinical disorders associated with Serotonin and GABA

7. Neurodegenerative diseases of CNS

- List the common Neurodegenerative diseases
- Discuss the common mediators of Neurodegenerative diseases
- Discuss the biochemical changes in Neurodegenerative diseases
- Describe the biochemical phenomenon of ageing

8. Role of free radicals & Vitamins in CNS disorders

- Explain the role of free radicals in Neurodegenerative diseases
- List the free radicals causing degenerative diseases
- List the sources of free radicals

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	<ul style="list-style-type: none">• Explain the mechanism of free radical injury• Describe the role of free radicals in diseases• Classify the antioxidants with examples• Discuss the process of oxidative stress response• Discuss the biochemical importance of vitamins in neurological disorders• Discuss the sources, biochemical role and daily requirements of vitamins B1, B6, B9, B12 and folic acid• Explain the deficiency diseases related to these vitamins
<p>ANATOMY</p> <p>LECTURES</p>	<p>1. General organization & Histology of Nervous system, different types of nerve tissue cells (Neurons & Neuroglia)</p> <ul style="list-style-type: none">• Explain the general components of nervous system.• Discuss the division of nervous system into CNS, ANS & PNS.• Discuss the structural/ cellular organization of nervous system.• Classify the types of neuron & neuroglia.• Describe the structure of neuron & neuroglia. <p>2. Development of Brain and Spinal cord & anomalies (Embryology)</p> <ul style="list-style-type: none">• Describe the formation of primary & secondary vesicles and flexures.• Relate the components of ventricular system with the cavities of secondary vesicles.• Describe the differentiation of the layers from neuro-epithelium in primitive spinal cord.• Describe derivation of alar & basal plates, neuron and neuroglia cells.• Discuss positioning of spinal cord.• Describe the congenital anomalies of spinal cord viz. Spina bifida occulta, spina bifida cystica, Myeloschisis.

3. Gross external features of spinal cord

- Discuss the extent (starting & terminating point) of spinal cord.
- Describe the gross features of spinal cord and its blood supply.
- Discuss the regional enlargements of spinal cord.

4. Histology of spinal cord

- Discuss the microscopic structure of spinal cord.
- Compare the sections at different segmental levels (cervical, thoracic)

5. Internal features of spinal cord I- (Ascending tracts)

- Discuss the internal features of spinal cord, gray (groups) & white (columns) matter.
- Discuss 1st, 2nd & 3rd order neurons of sensory pathway.
- Discuss in detail the ascending (sensory) tracts of the spinal cord and their lesions.

6. Internal features of spinal cord II- (Descending tracts)

- Discuss in detail the descending (motor) tracts of the spinal cord.
- Relate the lesions of descending tracts.

7. Development of forebrain (Embryology)

- Discuss the process of development of forebrain and its anomalies.

8. Development of midbrain & hindbrain (Embryology)

- Discuss the process of development of midbrain & hindbrain and their anomalies.

9. Blood supply (arterial supply & venous drainage) of spinal cord and clinical manifestations of ischemia

- Describe the Vertebral Systems of arteries.

- Describe the area of spinal cord supplied by different branches.
- Discuss the role of radicular and feeder arteries.
- Describe the venous drainage of spinal cord.
- Relate the clinical consequences of ischemia of spinal cord.

10. Gross anatomy of Cerebellum

- Describe the gross anatomy of the cerebellum location, structural & functional division (lobes) and its blood supply.
 - Describe the folia, tracts and nuclei of cerebellum.
- Relate the clinical conditions associated with cerebellar dysfunction

11. Histology of Cerebellum

- Describe the layers of cerebellar cortex.
- Describe the cellular organization in each layer.

12. Diencephalon I- Thalamus

- Describe the gross features, boundaries and division of diencephalon and its blood supply.
- Describe the gross features and relations of Thalamus.
- Discuss the nuclei, connections and functions of thalamus.
- Relate the clinical conditions associated with thalamus.

13. Diencephalon II- Sub thalamus, Hypothalamus & Epithalamus

- Describe the location, relations, components and structure of subthalamus, hypothalamus & epithalamus.
- Discuss their nuclei, connections and functions.
- Discuss the lesions of sub thalamus, hypothalamus & Epithalamus.

14. Limbic system & Reticular formation

- Describe the various parts of limbic system.
- Explain the hippocampal formation.

- Discuss the disorders of limbic system.

15. Basal ganglia & its nuclei

- Describe the location and components of basal ganglia and their blood supply.
- Discuss their connections and functions.
- Discuss the lesions of basal ganglia.

16. Histology of cerebrum

- Describe the layers of cerebral cortex.
- Discuss the variation of layers in different cortical regions.
- Describe the types of neurons and fibers distributed in different layers.

17. White matter of cerebrum -I (Projection fibers and internal capsule)

- Discuss the basic concepts of white matter of cerebrum.
- Describe the location, parts, connections and relations of internal capsule and its blood supply.
- Discuss the common lesion associated with the internal capsule.

18. White matter of cerebrum- II (Commissural & Association fibers)

- Discuss the commissural fibers and their connections.
- Describe corpus callosum and its parts.
- Explain the association fibers and their connections.
- Discuss the common lesions associated with commissural and association fibers.

19. Meninges of brain & spinal cord

- List the meninges of brain & spinal cord.
- Describe the Dural layers, folds, extensions and spaces (subdural etc.)
- Discuss pia mater and its modifications (ligamentum denticulatum, telachoroidea).
- Describe the arachnoid mater, subarachnoid space and cisterns.

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	<ul style="list-style-type: none"> • Define hydrocephalus. • List causes of hydrocephalus. <p>Describe the different types of hydrocephalusSk</p>
<p align="center">BIOCHEMISTRY TUTORIALS</p>	<p>1. Neurotransmitters-1 Acetylcholine & Catecholamine</p> <ul style="list-style-type: none"> • Discuss the clinical importance of Acetylcholine & Dopamine • Interpret clinical conditions correlated with their Laboratory investigations <p>2. Neurotransmitters-2 Serotonin & GABA</p> <ul style="list-style-type: none"> • Discuss the clinical importance of Serotonin & GABA • Interpret clinical conditions correlated with their Laboratory investigations <p>3. Cerebrospinal fluid</p> <ul style="list-style-type: none"> • Discuss the clinical importance of Cerebrospinal fluid • Interpret clinical conditions correlated with their laboratory investigations <p>4. Neurodegenerative diseases of CNS</p> <ul style="list-style-type: none"> • Discuss the clinical importance of neurodegenerative diseases • Interpret clinical conditions correlated with their laboratory investigations
<p align="center">ANATOMY TUTORIALS</p>	<p>1. Skull as whole, vault of skull + Anterior cranial fossa</p> <ul style="list-style-type: none"> • Describe the gross anatomy of skull. • Discuss the sutures of skull. • Discuss different views (normal) of skull. • Discuss the divisions of the cranial cavity. • Describe the boundaries, bony prominences and foramina of anterior cranial fossa. <p>2. Middle & Posterior cranial fossa</p> <ul style="list-style-type: none"> • Describe the boundaries, bony prominences and foramina of the middle& posterior cranial fossa. <p>3. Spinal cord lesions, transection & spinal shock</p>

- Discuss the lesions of anterior & posterior nerve roots.
- Elaborate the lesions of ascending & descending tracts.
- Discuss the mechanism & consequences of tabes dorsalis, spinal shock syndrome, Brown Sequard syndrome, poliomyelitis, Syringomyelia.

4. Brainstem I- Medulla Oblongata

- Enumerate the parts of brainstem.
- Describe the gross anatomical features of Medulla Oblongata and its blood supply.
- Discuss in detail the internal features of Medulla Oblongata.
- Discuss the cranial nerves emerging from Medulla Oblongata.
- Discuss the clinical importance of Medulla Oblongata

5. Brainstem II-Pons

- Describe the location of Pons.
- Discuss the external & internal features of Pons and its blood supply.
- Discuss the relation of Pons with 4th ventricle.
- Discuss the cranial nerves emerging from Pons.
- Discuss the clinical conditions associated with Pons.

6. Brainstem III -Midbrain

- Describe the location of midbrain.
- Discuss the external & internal features of midbrain with its supply.
- Discuss the relation of Pons with cerebral aqueduct.
- Describes the cranial nerves emerging from midbrain.
- Discuss the clinical conditions associated with midbrain.

7. Gross anatomy of Cerebrum (external features, surfaces, gyri & sulci)

- Discuss the gross anatomical features of cerebrum (surfaces, borders, poles, lobes, sulci & gyri).

- Describe the blood supply of cerebrum.

8. Functional cortical areas of cerebrum & their lesions I(Frontal And Occipital)

- Identify the anatomical locations and boundaries of the frontal and occipital lobes.
- Describe the **functional areas** in the frontal lobe (primary motor cortex, premotor cortex, prefrontal cortex, Broca's area).
- Explain the functions of these areas in motor control, speech production, and executive behavior.
- Describe the **functional areas** of the occipital lobe (primary and secondary visual cortices).
- Discuss the visual processing pathway and the effects of lesions in the occipital cortex.

9. Functional cortical areas of cerebrum & their lesions II(Parietal And Temporal)

- Identify the anatomical locations and boundaries of the parietal and temporal lobes.
- Describe the **functional areas** in the parietal lobe (primary and secondary somatosensory cortex, association areas).
- Explain the **functional areas** in the temporal lobe (primary and secondary auditory cortices, Wernicke's area).
- Correlate clinical manifestations with lesions in these cortical areas

10. Ventricular system I- Lateral ventricle

- Describe the ventricles of brain.
- Discuss the location, boundaries and relations of lateral ventricles and its blood supply.
- Discuss the clinical conditions associated with lateral ventricles.

11. Ventricular system II- 3rd & 4th ventricles and CSF circulation

- Describe the structure and location of 3rd and 4th ventricles, and cerebral aqueduct.
- Briefly discuss the normal CSF secretion, circulation & blood brain barrier.

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- Discuss the applied anatomy of ventricles of brain and CSF flow.

12. Cranial nerves (I to VI)

- Mention the names of all the cranial nerves in sequence.
- List the locations of the cranial nerve nuclei (I to VI).
- Discuss their distribution.
- Describe the main effects of lesions of cranial nerves.

12. Cranial nerves (VII to XII)

- List the location of the cranial nerve nuclei (VII to XII).
- Discuss their distribution.
- Describe the main effects of lesions of VII to XII cranial nerves.

13. Functional cortical areas of cerebellum

- Discuss the location and lesions of the functional cortical areas of cerebellar cortex.

14. Blood supply of brain

- Discuss the carotid and vertebral systems of vessels.
- List the branches arising from them.
- Describe the formation of circle of Willis.
- Discuss its branches.
- Discuss the area of supply of the 3 cerebral arteries.
- Discuss the veins of brain and their area of drainage.
- Relate the clinical manifestations of ischemia of brain.

15. Spinal cord and its cut sections (Demonstration on Sectra)

- Discuss the various cut sections of spinal cord and associated lesions.

HISTOLOGY

1. Structure of neuron & neuroglia

- Describe the structure of neuron & neuroglia.
- List the types and functions of neuron & neuroglia.

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	<ul style="list-style-type: none">• Discuss the formation of blood brain barrier.• Identify the histological sections of neuron & neuroglia under light-microscope. <p>2. Spinal cord, spinal nerve & ganglia</p> <ul style="list-style-type: none">• Identify the histological features of spinal cord, spinal nerve & ganglia under light microscope.• Discuss the histological features of spinal cord, spinal nerve & ganglia. <p>3. Microscopic anatomy of cerebellar cortex</p> <ul style="list-style-type: none">• Identify the histological features of cerebellar cortex under light microscope.• Discuss the histological features, layers, cells & nuclei of cerebellum. <p>4. Microscopic anatomy of cerebral cortex</p> <ul style="list-style-type: none">• Identify the histological features of cerebral cortex under light microscope.• Discuss the histological features, layers, cells & nuclei of cerebrum.
PHYSIOLOGY	<p>1. Examination of Superficial reflexes</p> <ul style="list-style-type: none">• Perform superficial reflexes viz. Corneal reflexes, Abdominal reflexes & Plantar reflexes.• Describe their significance in different neurological disorders. <p>2. Examination of Deep reflexes</p> <ul style="list-style-type: none">• Perform deep reflexes: Bicep reflex, triceps reflex, knee jerk, ankle jerk, brachioradialis reflex.• Describe the significance of deep reflexes in upper and lower motor neuron lesions. <p>3. Cerebellar function tests</p> <ul style="list-style-type: none">• Perform cerebellar function tests.• Identify disorders of cerebellar function. <p>4. Body temperature</p> <ul style="list-style-type: none">• Determine the body temperature by oral route using mercury thermometer.• Describe the other routes of body temperature measurement (axillary,

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	<p>tympanic and rectal route)</p> <p>5. EEG</p> <ul style="list-style-type: none"> Record Electroencephalogram with the help of power lab. Interpret the given EEG. <p>6. Examination of Cranial Nerves (CN I – CN VI)</p> <ul style="list-style-type: none"> Perform different tests for examination of the cranial nerves I-VI. <p>7. Examination of cranial nerves (CN VII – XII)</p> <p>Perform different tests for examination of cranial nerves VII-XII.</p>
<p>BIOCHEMISTRY</p> <p align="center">SKILLS</p>	<p>1. Lumbar Puncture</p> <ul style="list-style-type: none"> Explain the procedure of Lumbar Puncture (LP) Identify the chemical tests and bio-techniques to detect analytes in CSF Identify the parts of LP needle Interpret the laboratory report in different CNS diseases Interpret clinical conditions correlated with their laboratory investigations <p>2.CSF Glucose Estimation</p> <ul style="list-style-type: none"> Identify the procedure & bio-technique to detect glucose in CSF Estimate glucose in CSF Interpret the laboratory report of glucose in CSF Interpret clinical conditions correlated with their Laboratory investigations <p>3. CSF Protein Estimation</p> <ul style="list-style-type: none"> Identify the procedure & bio-technique to detect proteins in CSF Estimate proteins in CSF Interpret the laboratory report of proteins in CSF Interpret clinical conditions correlated with their <p>Laboratory investigations</p> <p>4. CSF Chloride Estimation</p> <ul style="list-style-type: none"> Identify the procedure & bio-technique to detect chloride in CSF Estimate chloride in CSF Interpret the laboratory report of chloride in CSF Interpret clinical conditions correlated with their laboratory

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	<ul style="list-style-type: none">• investigations
INTERNAL ASSESSMENT	<ul style="list-style-type: none">• Internal assessment will be according to JSMU policy.• It consists of Modular Test, consisting of MCQs (50), Observed and unobserved OSPE• Internal assessment carries 20% weightage in the final, end-of-year examination.• Marks obtained will contribute to Internal Assessment.
ANNUAL EXAMINATION	<ul style="list-style-type: none">• Final Annual exam will consist of MCQs (One Correct & One Best) and OSPE (observed + unobserved stations)
MODULE EVALUATION	<ul style="list-style-type: none">• The module will be evaluated through a feedback form posted on JSMU website