

Nervous System- Year 2 Semester 1 Number of Credit – 8

Topic/ Concept	Objectives	Time	T/L activity	Responsible Department
Overview of the Nervous System 1.Structure	1. List the major divisions of the Nervous System (NS) i.e. Central Nervous System (CNS) and Peripheral Nervous System (PNS), and the component parts in each division 2. Describe that the CNS is composed of grey matter containing nerve cell bodies and the white matter containing axons <ol style="list-style-type: none"> i. <u>Brain</u> - State basic arrangement of grey matter and white matter ii. <u>Brain stem</u> - List the major parts – mid brain, pons, medulla and state the functional arrangement of the grey and white matter i.e. Grey-cranial nerve nuclei and White-functional tracts, lemnisci etc. iii. <u>Spinal cord</u> - State the segmental arrangement, basic cross sectional arrangement and arrangement of grey and white matter 3. <u>Peripheral nerves</u> - State the basic arrangement of spinal nerves and cranial nerves 4. Understand the arrangement of structures in the head and neck region 5. Understand the order in which the dissections of the head and neck region is done	1 hr	Lecture	Anatomy
2.Function	6. Recognize that the CNS receives sensations from receptors and performs functions via muscles, glands etc	1 hr	Lecture	Physiology

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	<p>11. Describe the main components of the neuromuscular junction in a skeletal muscle and describe how it differs in smooth muscle.</p> <p>12. Describe the sequence of events during neuromuscular transmission with special reference to acetylcholine release, acetylcholine receptors, ligand-gated ion channels, role of Ca²⁺, cholinesterases and end-plate potentials.</p> <p>13. Explain the actions of different substances that stimulate or inhibit neuromuscular transmission.</p>		1 hr lecture - synaptic transmission	
	14. Explain the derangement in neuromuscular transmission in myasthenia gravis.	2hrs	SGD- to revise RMP & AP & NMJ disorders	Physiology
<p>Neurotransmitters</p> <p>(a) Neurotransmitters and their function</p>	<p>1. Define the term neurotransmitter, list the types of neurotransmitters and explain their modes of action</p> <p>2. Describe the biochemical aspect of specific receptors for neurotransmitters- ionotropic receptors (ion channels) -metabotropic receptors</p> <p>3. Explain the mechanism of action of receptor</p> <p>4. Explain the biochemical regulation of neurotransmitters</p> <p>5. State the mode of action of neurotransmitters</p> <ul style="list-style-type: none"> ▪ γ-aminobutyric acid (GABA) ▪ Norepinephrine and epinephrine ▪ Dopamine ▪ Serotonin ▪ Acetyl choline ▪ Glutamate ▪ Nitric oxide ▪ Peptides <p>6. Explain how neurotransmitters act as neuromodulators</p> <p>7. Recognize that all of the known amino-acid neurotransmitters are non- essential amino acids.</p>	4 hr	<p>2 hr Lecture</p> <p>2 hr SGD</p>	Biochemistry
<p>(b) Neurotransmitters and disease</p>	<p>1. Biochemical basis of disorders associated with neurotransmitters (also combined to objective 6 in SBM 2)</p>	1hr	Lecture	Biochemistry
<p>(c) Vitamins and neuronal functions</p>	2. List the vitamin deficiencies affecting neuronal function and outline their mechanisms.	1hr	Lecture	Biochemistry

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<p>Head and neck regional anatomy</p> <p>(a) Bones of the head and neck</p>	<ol style="list-style-type: none"> 1. Identify, orientate and articulate the bones of the skull, cervical vertebrae and hyoid bone including the joints 2. Identify the different regions of the vertebral column and relate them to the regions of the spinal cord 3. Describe the structure and the function of the intervertebral disc 4. Identify the skull bones and the mandible including the structures passing through the foramina 5. Identify important anatomical landmarks 6. Identify the cranial fossae 7. Describe the changes that occur in the skull and the mandible with growth 8. Describe and identify the bones that contribute to form the neck and thoracic inlet 	3hrs	3hr Practical	Anatomy
<p>(b) face and Scalp</p>	<ol style="list-style-type: none"> 1. Identify the anatomical land marks of the face ,parts of the eye, external nose and external ear 2. Be aware that the face contains muscles of expression and muscles of mastication 3. State the blood supply and the lymphatic drainage of the face. 4. Describe the attachments, actions and nerve supply of the muscles of the face 5. Demonstrate the actions of muscles of facial expression 6. Outline the sensory supply of the face 7. Surface mark the facial artery 8. Describe the structure, blood supply, lymphatic drainage and the nerve supply of the scalp 9. Describe the arrangement of the tissues in the scalp and its clinical importance. 	3hrs	Practical using prosections and dissections	<p>Anatomy</p> <p style="text-align: right;"><i>J.A. Edmundo</i></p> <p style="text-align: right;">Chairperson Curriculum Co-ordinating Committee Faculty of Medicine University of Peradeniya</p>
<p>(c) Development of the face</p>	<ol style="list-style-type: none"> 1. Recall pharyngeal arches. 2. Describe the development of the face including the abnormalities 	1hr	lecture	Anatomy
<p>(d) Brain, spinal cord and peripheral nerves</p> <p>i. Parts of the brain - forebrain, mid brain, hind brain</p>	<ol style="list-style-type: none"> 1. Describe the development of the brain 2. Describe the coverings of the brain, extent of Meninges, their blood supply and dural venous sinuses 3. List the major parts of the brain and describe their locations 4. Describe the arrangement of gray & white matter in the brain 5. Define the association, commissural and projection 	14hrs	<p>5 hrs of lectures</p> <p>9 hrs of Practical</p> <p><i>In 3 sessions</i></p> <p><i>I,II & III</i></p>	Anatomy

	fibres and their locations 6. Describe the microscopic structure of the cerebral cortex. 7. Name the components of the basal ganglia 8. State the locations of functional representation in the brain. 9. Describe and identify the ventricular system of the brain and their relations. 10. State the components of the diencephalon 11. Explain briefly the structure of the thalamus and the arrangement of the thalamic nuclei. 12. Describe the external & internal morphology of the brain stem 13. Explain briefly the structure & function of the cerebellum 14. Name the afferents and efferents of the cerebellum. 15. Identify the important macroscopic structures in given specimens/sections of the brain		 Chairperson Curriculum Co-ordinating Committee Faculty of Medicine University of Peradeniya	
ii. Blood supply of the brain and spinal cord & intra cranial haemorrhages	1. Name the major arteries and their important branches that supply the brain and spinal cord 2. Describe the basic pattern of venous drainage of the brain and spinal cord 3. Describe the clinical importance of the middle meningeal artery and intracranial haemorrhages 4. List the types of haemorrhages that occur within the skull. 5. Explain the consequences of raised intracranial Pressure 11. Describe the clinical importance of the middle meningeal artery and intracranial haemorrhages 12. List the types of haemorrhages that occur within the skull. (<i>revise objectives on meninges</i>) 13. Explain the consequences of raised intracranial Pressure	2 hrs	2 hr of lectures <i>Practical demonstration with parts of the brain practical. Above</i>	Anatomy
iii. Spinal cord. Peripheral nerves - cranial and spinal nerves (plexus, dermatomes etc)	1. State the extent of the spinal cord in a neonate and an adult 2. State the relationship between vertebral segments and spinal segments. 3. Describe the structure of the spinal cord segment. 4. Identify the contents in the vertebral canal 5. Describe the arrangement of a typical spinal nerve (done in locomotion module- Recall) 6. Define plexus and locate the major plexuses of the spinal nerves	2hrs	2 hr lecture <i>Practical demonstration with parts of the brain practicald. above</i>	Anatomy

iv. CSF	7. Compare and contrast spinal and cranial nerves 8. List the cranial nerves			
	9. Describe the arrangement of main ascending and descending nerve tracts of the spinal cord. 10. Describe with reasons the clinical presentation of spinal cord lesions	1hrs	1hr lecture <i>Practical demonstration with parts of the brain practicald. above</i>	Anatomy
	11. Name the cranial nerves 12. Describe the location of cranial nerve nuclei in the brain stem 13. Describe the distribution of the cranial nerves 14. List the functional components of cranial nerves indicating the structures supplied by them	4hrs	2hr lectures 2hr Practical using prosections, and dissections	Anatomy
	15. Localize the spinal cord lesions	2hrs	2 hr SGD	
	1. Explain how cerebrospinal fluid is produced and its function. 2. Describe the CSF circulation with the help of a diagram 3. State the clinical importance of the interruption to CSF circulation 4. State the normal volume of CSF and its rate of production. 5. State the composition of CSF. 6. Describe the relevance of CSF examination in clinical practice	1hr	Lecture	Physiology
	7. Describe the chemical environment of the brain with special reference to blood-cerebrospinal fluid barrier and the blood-brain barrier	1hr	Lecture	Biochemistry



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(e) Orbit & Eye	<ol style="list-style-type: none"> 1. Describe the arrangement of bones of the orbital cavity 2. Describe the structure , movements blood supply and nerve supply of the eye lids 3. Describe the lacrimal apparatus 4. Describe the attachments and nerve supply of the muscles of the orbit and the movements of the eye 5. Describe the facial sheath of the eye 6. Describe the course and relations of nerves and blood vessels of the orbit 7. Describe the component parts of the eye 8. Describe the microscopic and macroscopic structure of the eye 9. Describe the development of the eye 10. Identify the component parts of the visual pathway 11. Discuss the clinical anatomy of the eye and the orbit 	6 hrs	1 hr lecture	Anatomy
			2 hrs practical dissections	
			<i>2 hr practical on histology & models combined with Ear practical</i>	
			1hr lecture by Eye Surgeon	Anatomy
(f) Ear	<ol style="list-style-type: none"> 1. Describe the component parts of the ear 2. Describe the microscopic and macroscopic structure of the ear 3. Describe the development of the ear 4. Describe the course of the facial nerve and the relations in the ear 5. Discuss the clinical anatomy of the ear 	1 hrs	1hr lecture by ENT surgeon	Anatomy
			<i>histology practical and practical on models combined with eye practical above</i>	
(g) Suboccipital region	<ol style="list-style-type: none"> 1. Identify the superficial, intermediate and deep muscles of the back. 2. Identify the bony land marks at the suboccipital region. 3.State the boundaries of the suboccipital triangle 4. Identify the structures passing over the roof of the suboccipital triangle 5. Identify/list the contents of the of the suboccipital triangle 	3 hrs	3 hrs Practical Dissections	Anatomy

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(j) Infra temporal region and Pterygopalatine fossa	1. Study the bony land marks and define the boundaries of the infra temporal fossa 2. Describe the contents and their relations including the muscles ,maxillary artery,, mandibular nerve ,otic ganglion, carotid sheath and its contents and the cranial nerves related to carotid sheath and styloid apparatus 3. Define the boundaries of the Pterygopalatine fossa 4. Describe the contents and their relations(including the maxillary nerve and pterygopalatine ganglion,)	3 hrs	3hrs Prosections and dissections & body side tutorials	Anatomy
	5. Clinical anatomy/correlation of oral/maxillary/facial region	1 hr	Lecture	Anatomy to arrange a dental surgeon
(k) Pharynx & Larynx	1. Describe the structure of the pharynx including the arrangement of the muscles, fascia and relations of the pharynx 2. Describe the blood supply lymph drainage and nerve supply of the pharynx 3. Describe the muscles involved in swallowing 4. Understand the structure adapted to perform the functions of the larynx (including the skeleton of the larynx) 5. Describe the nerve supply, blood supply and the lymph drainage of the larynx 6. Describe the muscles of the larynx including their actions, blood supply and nerve supply	5 hrs	2 hrs Lecture 3 hrs Practical using prosecutions and models Pharynx/ larynx	Anatomy
(l) Nose and Para nasal sinuses	1. Describe the parts of the nose, their structure, relations blood supply and lymph drainage and nerve supply 2. Describe the bony boundaries of paranasal sinuses 3. Describe the structure, relations and the locations of para nasal sinuses and their blood supply lymphatic drainage and nerve supply 4. Describe the clinical importance of Para nasal sinuses and their relations	2hrs	2 hrs Practical using prosections and models & body side tutorials	Anatomy

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(m) Oral Cavity, Soft palate and hard palate	<ol style="list-style-type: none"> Describe the structure of soft palate and the hard palate Describe the nerve supply of the palate Describe the function of the palate in swallowing Describe the development of the palate, nose and para nasal sinuses Define the extent and describe the parts of the oral cavity Describe the structure and nerve supply of the structures in the mouth Describe the structure of the tongue and the arrangement of the muscles and movements Describe the structure location, innervation, blood supply and lymphatic drainage of the sublingual salivary glands Clinical correlation of the oral cavity 	4 hrs	2 hr lecture 2 hrs Practical using prosections and models & body side tutorials	Anatomy
(n) Round up session	Objectives of 2009– SBM 4	2 hrs	2 hrs of SGD in the form of Anatomy tutorials	Anatomy
(o) Lymph nodes and lymph drainage & Joints of H/N region	<ol style="list-style-type: none"> Describe the arrangement of lymph nodes and lymph drainage of the head and neck including the clinical correlations. Describe the structure, movements, muscles involved and nerve supply of the TM joint, atlanto-occipital joint, atlanto-axial joints. 	1 hr	Lecture	Anatomy
(p) Dermatomes	<ol style="list-style-type: none"> Delineate the dermatomes of the head and neck region Describe the sensory supply of the head and neck region 			
(q) Surface anatomy	<ol style="list-style-type: none"> Identify the anatomical landmarks in the head and neck region Be able to surface mark the structures of the head and neck region 			
(r) Round up session-2		4hrs	Mock spot an SGD	Anatomy

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<p>How brain receives information</p> <p>(a) General sensations</p>	<ol style="list-style-type: none"> 1. List the general sensations and sensory receptors. 2. Name the ascending pathways 3. State the functional localization of the cerebral cortex 4. List the general sensations and special sensations 	2hrs	<p>1hr Lecture Sensory receptors 1 hr Lecture ascending pathways; Sensory cortex</p>	Physiology
<p>(b) Special sensations</p> <p>(i) Physiology of vision</p>	<ol style="list-style-type: none"> 1. Explain the basic principles underlying the optics of vision 2. List the errors of refraction, describe how they occur and explain the basis of correcting each of them. 3. Explain the term accommodation as applied to the eye. 4. Explain the basis of the accommodation-convergence reflex and pupillary light reflex. 5. Explain the principles underlying visual acuity 6. Describe the functions of the retina including photochemistry of vision 7. Explain the mechanisms of dark and light adaptation. 8. State the different types and explain the genetic basis of colour blindness. 9. Draw a labelled diagram showing the visual pathway from the retina up to the occipital cortex and describe the effects on visual function caused by lesions at the following sites: optic nerve, optic chiasma, optic tract, optic radiation and occipital cortex 	4hrs	4 hrs of lectures	Physiology
<p>(ii) Testing of visual acuity (near & distant vision) and colour vision</p>	<ol style="list-style-type: none"> 1. Describe the tests used to assess visual acuity (near and distant vision) and colour vision using Snellen's charts, Jaeger charts and Ishihara charts and interpret the results 2. Examine the optic fundus using an ophthalmoscope 3. Describe the tests used to assess visual fields (confrontation test and perimetry) and interpret the findings 	2hr	Practical	<p>Physiology</p> <p style="text-align: right;"><i>J.A. Edmundo</i></p> <p>Chairperson Curriculum Co-ordinating Committee Faculty of Medicine University of Peradeniya</p>
<p>(iii) Physiology of hearing (properties of sound and transmission of sound)</p>	<ol style="list-style-type: none"> 1. Explain the properties of sound with special reference to frequency and loudness. 2. Recognise that the sound can be transmitted by air conduction and bone conduction. 3. Describe the functions of the cochlea: transmission of sound waves in the cochlea and the receptor function of the organ of Corti. 	2hrs	Lecture	Physiology

	4. Trace the pathway through which impulses are transmitted from the auditory nerve through the brain stem tracts up to the temporal cortex			
(iv) Tests of hearing	1. Perform Rinne's and Weber's tests and interpret results 2. Perform an auroscopic examination and identify the anatomical structures in a normal ear 3. Interpret the findings in pure tone audiometry	2 hrs	Practical	Physiology
(v) Smell and taste	1. Describe the functional anatomy of the olfactory membrane. 2. Explain how olfactory receptors are stimulated. 1. Describe the olfactory pathway 2. Describe the functional anatomy of taste buds and state their locations. 3. State the primary taste modalities. 4. Explain the term taste threshold 5. Describe the taste pathway 6. Explain the role of smell and taste in the perception of "flavour"	1hr	Lecture	Physiology
(vi) Pain	1. Explain what is meant by the term 'pain' and state the different types of pain (somatic, visceral, neuropathic) 2. Explain terms used to describe different states of pain perception: hyperesthesia, allodynia, hyperalgesia, neuralgia, analgesia, anaesthesia, paraesthesia 3. State the main features of nociceptors. 4. List the stimuli that can excite nociceptors and explain the role of prostaglandins in sensitizing the nociceptors 5. Trace the ascending pathway through which pain impulses are transmitted. 6. List the components of the descending pain inhibitory pathway 7. Describe the central projections of the pain pathway and explain their role in pain perception. 8. Describe the role of substance P in pain impulse transmission 9. Describe the descending pain modulatory system. 10. List the opioid peptides that are involved in pain inhibition and describe their actions. 11. Discuss the gate-control theory of pain.	2 hrs	Lecture	Physiology

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	12. Explain the role of other neurotransmitters involved in pain modulation			
(vii) Psycho-social aspects of pain	1. Describe the physiological basis of different methods of pain relief 2. Discuss the clinical applications of different methods of pain relief 3. Discuss how pain is modulated by emotions and the Psychological aspects of perception of pain.	2 hr	Staff seminar Physiology, Anaesthesiology, Psychiatry	Phys Anaesth Psych
(viii) Round up session -3		2 hrs	SGD on all Special senses	Physiology
How brain responds (Motor system) (a) Introduction	State the locations of the motor areas of the cortex Describe the descending tracts	2hrs	2hrs lecture	Physiology
(b) Reflexes and control of motor functions	1. Explain the physiological basis of reflexes 2. Recall the mechanism of stretch reflex 3. Explain the basis of Golgi tendon reflex, the withdrawal reflex, crossed extensor reflex, and primitive reflexes 4. Discuss the supraspinal control of spinal cord reflexes. 5. Recall the term muscle tone and the role of the gamma motor neurone in maintaining muscle tone 6. Recall the functional anatomy of motor cortex and motor pathways 7. Describe the cortical & brain stem control of motor functions 8. Explain the functions of the reticular formation 9. Explain the physiological basis of the clinical features of upper motor and lower motor neuron lesions	6 hrs	4 hr lectures 2hrs SGD	Physiology
(c) Cerebellum and motor coordination	1. Describe the functional anatomy of the cerebellum and its main input and output connections. 2. Explain the role of the cerebellum in motor coordination, posture, balance and muscle tone. 3. List the clinical features seen in cerebellar disorders and explain the physiological basis of each of them.	1 hr	lecture	Physiology
(d) Basal Ganglia	1. Name the basal ganglia and state their locations. 2. Explain the role of the basal ganglia in motor functions. 3. List the neurotransmitters in the basal ganglial circuits and state their functions. 4. Describe the clinical features of basal ganglia	2 hrs	2 hrs lecture	Physiology

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	dysfunction.			
(e) Posture	<ol style="list-style-type: none"> List the sensory inputs, the levels of integration and the reflexes involved in the maintenance of posture. Describe the mechanisms integrated at the spinal cord level including stretch reflexes, positive supporting reaction, negative supporting reaction and righting reflexes Discuss the effects of transection of spinal cord and brain stem at different levels explaining the phenomena – spinal shock, decerebrate rigidity and decorticate rigidity 	2 hrs	2 hr lecture	Physiology
(f) Physiology of Balance	<ol style="list-style-type: none"> Describe the functions of the vestibular apparatus: semicircular canals, utricle and saccule. Describe the afferent and efferent connections of the vestibular nuclei. Explain the role of the vestibular apparatus and the vestibular nuclei in maintenance of posture and balance. Explain the physiological basis of nystagmus. List the tests used to assess balance and explain their basis. 	2 hrs	Lectures	Physiology
(g) Round-up Session -4	Objectives of 2008-2 / SBM-8/5 above	2hr	SGD on motor system (nerve lesion)	Physiology
Autonomic nervous system	<p>Compare and contrast the sympathetic and parasympathetic divisions, in terms of</p> <ol style="list-style-type: none"> stimulatory and inhibitory actions on different organs stimulatory and inhibitory drugs that act on the autonomic receptors (eg:- atropine, adrenaline, propranolol, salbutamol) Describe the distribution of the different branches of the sympathetic and parasympathetic systems and their effects on each organ system. Describe the autonomic reflexes concerned with different organ systems. 	1hr	Lecture	Physiology



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CCR		5hrs	CCR	Anatomy
Mind & Behaviour in relation to neuronal function (a) Psychological aspects of higher functions	<ol style="list-style-type: none"> 1. Explain the term ‘higher mental processes’. 2. Describe the psychological aspects of memory, cognition, reasoning, language, emotion and other higher functions 3. Describe the theories of learning. 6. Discuss the concept of consciousness (definition, basis, assessment) 	1hr	Lecture	Psychiatry
(b) Physiology of memory and functions of the limbic system	<ol style="list-style-type: none"> 1. Describe the physiological basis of memory 2. Describe the terms: immediate, short-term and long-term memory. 3. Explain the mechanisms involved in the storage of information. 4. State the brain areas involved in memory. 5. Describe the functions of the limbic system 	2 hrs	Lecture	Physiology
(c) Speech and language	<ol style="list-style-type: none"> 1. Describe the structures and mechanisms involved in phonation and articulation. 2. Describe the mechanisms involved in central control of speech. 3. List the disorders of speech and explain the mechanisms of their causation. 	1 hr	Lecture	Physiology
(d) Sleep and arousal	<ol style="list-style-type: none"> 1. State the different stages of sleep and describe a typical sleep cycle. 2. Compare and contrast slow wave sleep and REM sleep. 3. Discuss the role of the reticular system in arousal and sleep. 4. State the neurotransmitters involved in arousal and sleep. 5. Explain the physiological basis of electroencephalography (EEG). 6. State the different waves seen in a typical EEG tracing. 7. Describe the EEG patterns seen in different stages of sleep. 	2 hrs		

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Physical examination of the nervous system (a) Motor (b) Sensory (c) Cranial nerves	Perform complete clinical examination of the nervous system	8hrs	3 hr for motor 2 hrs for Sensory 3 hrs for cranial nerves practical Sessions	Physiology
Investigation of neural functions	Explain the basis of neurophysiological tests and be able to understand their results.	2 hrs	practical	Physiology
Appearance of the brain and spinal cord on imaging	List the structures that could be identified in the brain spinal cord, CSF pathway, and the vasculature by radiological imaging.	1 hrs	1 hr lecture	Radiology



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