SYLLABUS MODULE – CLINICAL NEUROLOGY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Clinical examination	• Demonstrate an ability to undertake a detailed neurological history and examination. • Present the relevant examination findings to colleagues in a clear and concise manner.	• Demonstrate development of a comprehensive differential diagnosis based on focussed clinical history and examination. • Altered levels of consciousness • Discuss the anatomical basis and clinical features of persistent vegetative state, akinetic mutism, and the locked-in syndrome. • Discuss abnormalities of breathing, pupillary responses, eye movements, and other signs in various abnormalities of consciousness. • Discuss the care of the unconscious patient.	• Clearly demonstrate detailed and specific findings, such as fourth nerve palsy, internuclear ophthalmoplegia, and functional signs.
Altered levels of consciousness	• Discuss the anatomical basis for consciousness. • Discuss the causes of altered levels of consciousness. • Demonstrate a relevant neurological examination on the unconscious patient. • Discuss in detail the diagnosis of brain death and the methods of confirming brain death. • Describe in detail the structure and application of the Glasgow Coma Scale.		• Discuss the physiology of sleep. • Discuss abnormalities of sleep, including narcolepsy, cataplexy, and sleep apnoea.
Epilepsy	• Discuss the classification of seizures and epilepsy. • Explain the neurophysiology of epilepsy. • Discuss the pharmacology of common anticonvulsants. • Describe the formal recommendations for driving in	• Discuss the rationale for epilepsy surgery. • Discuss the level of risk of seizure for neurosurgical disorders and operative interventions. • Describe the rationale for prophylactic anticonvulsant therapy in various neurosurgical disorders. • Describe the normal wave patterns present on an EEG.	• Discuss patient selection for epilepsy surgery, including investigations and monitoring techniques. • Describe the different methods of cortical and depth electrode recording for pre-operative and intra-operative cases. • Discuss the issues regarding epilepsy and pregnancy.

	patients suffering seizures. • Describe the physiological basis for the EEG.		• Describe the different types of epilepsy and the underlying neurophysiology, clinical features, and EEG findings for each. • Discuss the use of intra-operative somatosensory evoked potentials, motor evoked potentials, and intra-operative electrophysiological localisation in neurosurgery.
Headache	• Discuss the differential diagnosis of headache. • Describe the clinical features of migraine and the differentiating features from other common types of headache. • Differentiate the features of benign headache from those of significant intracranial pathology.	• Discuss the theories of pathophysiology of migraine. • Discuss the general principles of pharmacological treatment of migraine. • Discuss common headaches such as muscle contraction headaches and occipital neuralgia. •	
Demyelination		• Describe the pathophysiology, epidemiology and clinical features of multiple sclerosis and other forms of demyelination. • Describe the imaging findings in multiple sclerosis. • Describe the CSF findings in multiple sclerosis. • Discuss the differential diagnosis of multiple sclerosis.	• Explain the diagnostic neurophysiological findings in multiple sclerosis, including visual evoked potentials. • Discuss the treatment of multiple sclerosis. • Discuss the leukodystrophies. • Discuss the role of biopsy in demyelinating disease.
Peripheral neuropathy	• Classify and describe the causes and clinical features of peripheral neuropathies.	• Describe the pathology and clinical features of herpes zoster infection.	• Describe the neurophysiological findings in the different neuropathies. • Discuss the treatments of peripheral neuropathies.
Peripheral electrophysiology	• Discuss the physiology of EMG and nerve conduction studies.	• Describe the findings of EMG and nerve conduction studies in lesions of peripheral nerves.	• Describe the findings of EMG and nerve conduction studies in myopathies. • Interpret the EMG and nerve conduction studies reports for the common compressive neuropathies. • Discuss the more specialised neurophysiology findings (such as H-waves).

Toxic and deficiency disorders of the nervous system	• Describe the more common vitamin deficiencies. • Describe the effects of alcohol on the nervous system. • Discuss the clinical management of alcohol intoxication and alcohol	• Discuss the pathology of Wernicke's encephalopathy. • Discuss the pathology of subacute combined degeneration of the spinal cord.	• Discuss the treatment of toxic and deficiency disorders of the nervous system. • Discuss the neurological effects of metal poisoning.
Paraneoplastic syndromes	• Describe the general concepts of the paraneoplastic syndromes.	• Discuss the clinical features and theories of pathogenesis of paraneoplastic syndromes. • Describe the pathology of Eaton-Lambert syndrome and neoplastic ADH production.	• Discuss specific paraneoplastic syndromes, including subacute cerebellar degeneration, spinal cord and dorsal root ganglia syndromes, and peripheral neuropathy.
Extra pyramidal disorders	• List the spectrum of diseases related to basal ganglia pathology. • Describe the clinical features, pathogenesis and epidemiology of Parkinson's Disease. • Discuss the uses and limitations of pharmacological therapy for Parkinson's Disease.	• Discuss other extrapyramidal movement disorders, including chorea, hemiballismus, athetosis, and dystonias.	• Discuss the surgical treatments for Parkinson's disease, including the indications and the effects of lesions in different sites. • Discuss the rationale for lesion generation versus stimulator implantation in movement disorder surgery. • Discuss the use of cell transplant therapy for Parkinson's Disease. • Discuss emerging treatment modalities for the surgical treatment of movement disorders.
Diseases of muscle	• Describe the structure and physiology of normal muscle. • Describe the common muscular dystrophies.	• Describe the gross and microscopic pathology of common myopathies. • Describe the clinical features, epidemiology and natural history of inflammatory myopathies. • Describe the association between inflammatory myopathy and diseases such as SLE, polyarteritis nodosa, rheumatoid arthritis, and scleroderma. • Describe the diagnosis, pathophysiology, investigation and treatment of myasthenia gravis.	• Describe the infectious and toxic causes of myopathy. • Discuss the role of muscle biopsy in the diagnosis of myopathies. • Discuss the general principles of mitochondrial diseases. • Describe the endocrine causes of myopathy. • Describe the general principles of familial and periodic paralysis.

SYLLABUS MODULE – INFECTION			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Primary bacterial infections	• Describe the clinical and diagnostic features of bacterial meningitis. • List the common responsible pathogens for bacterial meningitis, pathogenesis and appropriate antibiotic management. • Describe the clinical and diagnostic features of cerebral abscess. • List the common responsible pathogens for cerebral abscess, pathogenesis and appropriate antibiotic management. • Discuss clinical conditions predisposing to the development of bacterial meningitis. • Discuss clinical conditions predisposing to the development of cerebral abscess. • Describe in detail the clinical management of acute bacterial meningitis. • Describe the management options for intracerebral abscess. • Discuss the indications and contraindications of lumbar puncture in patients with CNS infections.	• Describe the clinical and diagnostic features of spinal epidural abscess. • Discuss the mechanisms by which spinal epidural abscess can cause neurological deficit. • Discuss in detail the management options for spinal epidural abscess. • Discuss the prognosis for spinal epidural abscess. • Describe the clinical and diagnostic features of spinal osteomyelitis. • Discuss in detail the management options for spinal osteomyelitis. • Discuss in detail mycobacterial infection of the spine and CNS. • Discuss the pathogenesis, clinical and diagnostic features of primary discitis. • Discuss the management options and long term outcome for primary discitis. • Discuss paranasal sinus infections and its relevance to CNS and skull infection. • Discuss the features of subdural abscess particularly in paediatric population and its management.	• Describe the common long term neurological sequelae following bacterial meningitis and intracerebral abscess. • Compare and contrast aspiration and surgical excision of intracerebral abscess. • Describe the neurological manifestations of syphilis. • Discuss the role of immunisation and prophylactic antibiotics in the prevention of bacterial meningitis in the community.
Primary viral infections	• Discuss the various viruses responsible for viral encephalitis. • Describe the clinical presentation, diagnostic features, pathogenesis and management of viral meningitis. • Describe neurological complications of HIV infection. • Discuss the various causes of	• Discuss prion diseases affecting the human CNS, including clinical features, diagnostic features, management and infection control. • Discuss the role of biopsy in prion disease.	• Discuss the CNS sequelae of in-utero viral infection. • Discuss the current NH&MRC Guidelines regarding prevention and management of CJD. • Discuss the spectrum of neurological conditions associated with herpes viral infections.

	immune compromise.		•
Primary fungal/parasitic infections	• Discuss the various fungal and parasitic infections that can affect the central nervous system. • Describe predisposing factors to fungal/parasitic infections of the CNS.	• Discuss the pathogenesis and management of hydatid disease of the brain. •	• Describe the pathogenesis, diagnostic features, clinical features and management for cryptococcal CNS infection . • •
Postoperative and post traumatic infections	• Discuss the common causes, diagnosis, predisposing factors and management of postoperative and post traumatic wound infections. • Discuss the common organisms responsible for post operative and post traumatic infections.	• Discuss the common causes, diagnosis, predisposing factors and management of shunt infections. • Discuss the evidence regarding the use of prophylactic antibiotics following trauma and neurosurgical procedures (contaminated and clean). •	• Discuss in detail the evidence for various measures to decrease operative infections • Discuss the management options, and evidence for their effectiveness, for an infected shunt. •
SYLLABUS MODULE – NEUROANAESTHESIA			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
General anaesthesia: effect on I.C.P. and cerebral blood flow	• Demonstrate emergency airway management including intubation, medications, tube sizes etc. • Discuss the uses of premedication in neurosurgical patients. • Describe the agents used in induction of general anaesthesia. • Describe drugs used for the maintenance of general anaesthesia including inhalational and intravenous agents. • Discuss drugs used for neuro muscular blockade including monitoring and reversal. • Discuss the role of hypnotics, analgesics, anaesthetic agents and muscle relaxants.	• Discuss awareness under anaesthesia. • Discuss the variations on anaesthetic induction appropriate for patients with raised intracranial pressure. • Discuss the variations on anaesthetic induction appropriate for patients with potentially unstable cervical spine. • Describe specific anaesthetic manoeuvres which may be used to reduce intracranial pressure. • Describe in basic terms the ASA classification. • Discuss the anaesthetic precautions and risks in the lateral and prone positions	• Discuss the anaesthetic precautions and risks in the sitting position. • Describe the anaesthetic detection and treatment of air embolism.

Regional anaesthesia	• Discuss the indications for the use of regional anaesthesia in neurosurgical patients. • Discuss the role of neuroleptic agents in addition to regional anaesthesia. • Discuss the use of adrenaline with local anaesthetics.	• Discuss the uses and risks associated with epidural anaesthetic and epidural analgesia.	• Discuss the use of regional anaesthesia in awake craniotomy.

SYLLABUS MODULE – NEUROANATOMY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Development of the nervous system - neuroembryology	• Describe the development of an embryo to week three. • Describe in detail the embryological development of the notochord, neural tube and neural crest into the mature nervous system. • Describe the recognisable divisions and subdivisions of the developing brain. • Describe the folding of the forebrain into the mature cerebral hemispheres. • Describe the embryological development of the skull and face. • Describe the embryological development of the vertebral column. • Describe the spinal cord levels relative to the vertebral column during development to adulthood	• Discuss the differences between the foetal and adult cerebral circulations. • Discuss the embryological basis for spinal dysraphism. • Discuss the development of the cerebral microcirculation. • Describe the embryological development of the pituitary gland.	• Discuss the embryological basis for cerebral arteriovenous malformations. • Discuss the embryological basis for craniopharyngioma and Rathke's cleft cyst. • Discuss theories of the embryological basis for colloid cysts. • Discuss the embryological basis for neuroectodermal cysts. • Discuss the embryological basis for cerebral heterotopias.
Cellular components of the nervous system - histology	• Describe the ultrastructure of a neurone. • Describe the different types of neurones. • Describe the layers of the cerebral and cerebellar cortices. • Describe the ultrastructure of the blood-brain barrier.	• Describe the anatomy of the different types of ganglia. • Describe the ultrastructural anatomy of the interneuronal junctions and the neuromuscular junctions. • Describe the anatomy of the alpha motor neurone in the spinal cord. • Describe the classification, histological features and function of the neuroglia.	

Gross anatomy of the cranium and brain	• Describe the gross anatomy of the frontal lobe with particular reference to boundaries, surfaces, anatomy relative to the skull and named surface structures. • Describe the functions of the frontal lobe and their topographical representation. • Describe the arterial supply and venous drainage of the frontal lobe. • Describe the gross anatomy of the parietal lobe with particular reference to boundaries, surfaces, anatomy relative to the skull and named surface structures. • Describe the functions of the parietal lobe and their topographical representation. • Describe the arterial supply and venous drainage of the parietal lobe. • Describe the gross anatomy of the occipital lobe with particular reference to boundaries, surfaces, anatomy relative to the skull and named surface structures. • Describe the functions of the occipital lobe and their topographical representation. • Describe the arterial supply and venous drainage of the occipital lobe. • Describe the gross anatomy of the temporal lobe with particular reference to boundaries, surfaces, anatomy relative to the skull and named surface structures. • Describe the gross anatomy of the cerebellum with particular respect to named surface structures, connections, arterial supply and venous drainage.	• Describe the gross and functional anatomy of the corpus callosum and commissures. • Describe the anatomy of the insular lobe. • Describe the anatomy of the external capsule and claustrum. • Describe the anatomy of the corona radiata and the internal capsule with particular respect to the arterial supply of the latter. • Discuss the concepts of dominance and non-dominance. • Describe the anatomy of the hippocampus in terms of its position, and layers. • Describe the components of the basal ganglia and their relationships. • Describe the components of the limbic system. • Diagramatically illustrate the internal structure of the midbrain at the levels of the superior colliculus and the inferior colliculus. • Describe the arterial supply of the midbrain. • Diagramatically illustrate the internal structure of the pons at the levels of the upper pons and the lower pons. • Describe the arterial supply of the pons. • Diagramatically illustrate the internal structure of the medulla at the levels of the closed medulla, upper part of the open medulla and the lower part of the open medulla. • Describe the arterial supply of the medulla. • Diagramatically illustrate and describe the anatomy of the floor of the fourth ventricle. • Describe the deep nuclei of the cerebellum. • Describe the anatomy of the floor of the third ventricle. • Describe the anatomy of the hypothalamus including its connections and named nuclei.	• Discuss, in general terms, the degree of eloquence of the named portions of the frontal lobe. • Describe the relationship of the gyrus rectus to the anterior communicating artery. • Describe the connections of the hippocampus. • Discuss the anatomical connections between the basal ganglia. • Describe the anatomy, connections and function of the reticular formation. • Describe the anatomy of the thalamus including its important nuclei. • Describe the surgical anatomy of the pineal region. • Discuss the anatomical basis for personality. • Discuss the anatomical and physiological basis for memory, both short and long term.

	• Describe in detail the anatomy of the pituitary gland including the stalk. • Describe the external relationships of the cerebral peduncles. • Describe the external relationships of the midbrain. • Describe the external relationships of the pons. • Describe the external relationships of the medulla.		
Gross anatomy of the scalp, the skull and associated muscles	• Describe the anatomy of the scalp including blood supply, innervation and muscles. • Describe the gross anatomy of the individual bones of the skull. • Describe the contents of the foraminae of the skull.	• Describe the surgical anatomy of the temporalis muscle and its fascia. • Discuss the surgical anatomy of the pterion and the lateral portion of the lesser wing of the sphenoid bone. • Describe the anatomy, relationships and approaches to the anterior clinoid process. • Describe the anatomy of the structures of the internal acoustic meatus. • Describe the anatomy of the structures of the craniocervical junction (C0 - C2) including the foramen magnum. • Describe the regional anatomy of the nose, sphenoid sinus and pituitary fossa. •	• Describe the surgical anatomy of the temporal bone. • Describe the anatomy of the structures encountered during the far lateral transcondylar approach to the posterior fossa. • Describe in detail the anatomy of the superior orbital fissure. • Describe in detail the anatomy of the jugular foramen. • Describe the anatomy of the structures encountered in the translabyrinthine approach for lesions of the cerebellopontine angle. •
Gross anatomy of the dura, its reflections and venous spaces	• Describe the coverings of the brain and spinal cord. • Describe the layers of the dura and how they separate to form the superficial dural venous sinuses. • Describe the reflection of the dura to form the falx cerebri and the tentorium cerebelli. • Discuss the attachments and relationships of the free edge of the tentorium cerebelli. • Describe the anatomy of the arachnoid villi.	• Describe the location, tributaries and outflow of the dural venous sinuses. • Describe the dural reflections of the middle cranial fossa. • Describe the dural reflections as they form the cavernous sinus. • Discuss the regional anatomy of the tentorial hiatus. • Describe the dural anatomy of the superior petrosal sinus and Meckel's cave. • Describe the vascular and nervous supply of the dura. • Describe the anatomy of the dural rings around the internal carotid artery. • Describe the anatomy of the dura related to the pituitary fossa. • Discuss the dominant flow from the superior sagittal sinus to the transverse sinuses.	• Discuss the relative surgical importance of the dural venous sinuses in terms of the options for sacrifice. • Discuss the anatomical basis for acute venous congestion syndromes associated with occlusion of different venous sinuses. • Describe the anatomy of the Dolenc approach to the cavernous sinus. • Describe in general terms the triangles of possible lateral entrance to the cavernous sinus.

The cranial nerve and their nuclei	• Tabulate the functions of each of the cranial nerves under the headings somatic motor, somatic sensory, autonomic motor, autonomic sensory and special sensory. • Identify the attachment of the cranial nerves to the brain. • Describe the anatomy of the cranial nerves external to the brain (intracranial and extracranial course).	• Assign the nucleus responsible for each of the functions of the cranial nerves. • Outline the anatomy and functions of each of the nuclei related to cranial nerves. • Describe in detail the anatomy of the cranial nerves as they connect the nuclei. • Tabulate the cranial nerves which attach to the midbrain, pons, pontomedullary junction and the medulla. • Describe the meningeal relationships to the optic nerve as it pertains to the development of papilloedema. • Describe the blood supply of the optic nerve. • Describe the relationships of the subarachnoid oculomotor nerve. • Describe the blood supply of the facial and vestibulocochlear nerves.	• Describe the anatomical basis for the clinical features of injury to various parts of the facial nerve. • Describe the anatomy of the cranial nerves of the cerebellopontine angle as visualised in an approach to the trigeminal nerve above the cerebellum. • Describe the anatomy of the cranial nerves as visualised in a retrosigmoid suboccipital approach to the cerebellopontine angle. • Describe the anatomy of the cranial nerves of the cerebellopontine angle as visualised in a translabyrinthine approach. • Describe the anatomy of the lower cranial nerves as visualised in a far lateral transcondylar approach.
The CSF filled spaces	• Describe, in general terms, the anatomy of the arachnoid cisterns. • Describe, in general terms, the anatomy of the ventricular system including the choroid plexus. • Describe the relevant anatomy associated with ventricular puncture.	• Name and describe in detail the anatomy of each of the arachnoid cisterns. • Describe the detailed anatomy of the Sylvian Fissure. • Describe the histological anatomy of the choroid plexus.	• Describe the anatomy of the choroidal fissure. • Describe in detail the anatomy of each of the ventricles and the Aqueduct of Sylvius. • Discuss the landmarks for navigation within the lateral ventricle. • Describe the anatomy of the approaches to the third ventricle. • Describe in detail the anatomy of the Foramen of Monro as it pertains to surgical access to the third ventricle.
The arterial supply and venous drainage of the cranium and brain	• Describe the anatomy of the aortic arch and list its branches. • Describe the anatomy of the external carotid artery, its branches and describe the anatomy of the major branches. • Describe the anatomy of the extracranial internal carotid artery. • Describe the anatomy of the internal carotid artery in the skull base and	• Discuss the relationship of the internal carotid artery to the middle ear. • Describe in detail the intradural microsurgical anatomy as exposed in a pterional craniotomy. • Describe in detail the anatomy of the perforating vessels arising from the anterior cerebral circulation. • Describe the anatomy of the anatomy of the anterior choroidal artery. • Discuss the normal variations of the anterior communicating artery complex.	• Describe the anatomical variants of the cerebral arteries such as persistent trigeminal artery. • Discuss the anatomical variations of the posterior communicating artery and its relationship to the oculomotor nerve. • Describe the anatomy exposed in the approaches to the basilar artery. • Describe the vascular relationships to the trigeminal, facial and glossopharyngeal

	the cavernous sinus. • List the branches of the supracavernous internal carotid artery. • Describe the anatomy of the ophthalmic artery. • Describe the anatomy of the posterior communicating artery. • Describe the surgical anatomy of the anterior cerebral artery and its branches. • Describe the surgical anatomy of the middle cerebral artery and its branches. • Describe the anatomy and significance of the Circle of Willis including its common variants. • Discuss in general terms the cerebral venous outflow including the concepts of superficial and deep drainage systems. • Describe the anatomy of the superficial venous system. • Discuss the surgical significance of the vein of Labbé, vein of Trolard and Rolandic vein. • Describe the surface anatomy of the superior sagittal sinus, torcula, transverse sinus and sigmoid sinus.	• Describe the anatomy of the vertebral artery in the neck. • Describe the detailed anatomy of the vertebral artery at the craniocervical junction. • Describe the course, branches and relationships of the intradural vertebral artery. • Describe the anatomy of the posterior inferior cerebellar artery including normal variants of origin. • Describe the anatomy of the basilar artery and its branches. • Describe the anatomy of the anterior inferior cerebellar artery. • Describe the anatomy of the superior cerebellar artery. • Describe the surgical anatomy of the posterior cerebral artery. • Describe in detail the anatomy of the perforating vessels which arise from the posterior circulation. • Describe the anatomy of the anterior and posterior perforated substance. • Describe the anatomy of the veins confluent on the Foramen of Monro. • Describe the anatomy and relationships of the internal cerebral vein. • Describe the anatomy and relationships of the basal vein of Rosenthal. • Describe the anatomy and relationships of the vein of Galen.	nerves as they pertain to microvascular compression syndromes. • Describe the venous anatomy as encountered in a supracerebellar infratentorial approach to the pineal gland.
Gross anatomy of the vertebral column, the spinal cord and associated structures	• Describe the bony anatomy of the vertebral column. • Describe the anatomy of the ligaments of the vertebral column including the joint capsules. • Describe the anatomy of the intervertebral discs including the biochemical and histological changes with age. • Discuss the arterial supply and venous drainage of the vertebral bodies.	• Describe the bony anatomy peculiar to each of the cervical, thoracic, lumbar, sacral and coccygeal portions of the vertebral column. • Discuss the surface anatomy of the levels of the vertebral column. • Discuss the blood supply of the intervertebral discs and its relationship to sepsis. • Discuss Batson's plexus and its role in the dissemination of malignancy. • Discuss the anatomy of the occipito-cervical junction (C0 - C2). • Discuss the biomechanics of the vertebral column	• Describe the anatomy of the cervical lateral masses and facet joints. • Describe the anatomy and orientation of the thoracic pedicles relative to the costotransverse structures and the vertebral body. • Describe the anatomy and orientation of the lumbar pedicles relative to the transverse processes and the vertebral body. • Describe the anatomy and orientation of the sacral pedicles relative to the ala of

	• Discuss the anatomy of the vertebral end-plate. • Describe the anatomy of the muscles attaching to the vertebral column, posterior to and including the posterior portion of the transverse processes. • Describe the anatomy of the muscles attaching to the vertebral column anterior to the posterior portions of the transverse processes. • Describe the general anatomy of the spinal cord with respect to the zones of grey and white matter, relationship of spinal nerves to the vertebral column levels, ligament attachments, dorsal root entry zone, the conus medullaris and filum terminale. • Describe the detailed anatomy of the spinal nerve including its dorsal root ganglion in the region of the intervertebral foramen. • Discuss the rib articulations with the vertebral column.	with particular reference to the internal axis of rotation, sagittal alignment and the moment arms of the spinal musculature. • Describe in detail the white matter tracts, and their connections, of the spinal cord. • Describe in detail the functional sections of the grey matter. • Diagrammatically illustrate the cross-sectional anatomy of the spinal cord at the mid-cervical, mid-thoracic and low-thoracic vertebral levels. • Describe the arterial supply of the spinal cord and its relationship to known arterial supply deficiency syndromes. • Describe the surgical anatomy of the Artery of Adamkiewicz. • Describe the position on the trunk and limbs of the key sensory levels of the spinal cord.	the sacrum (S1) and the sacral foraminae. • Describe the innervation of the intervertebral discs. • Describe the innervation of the facet joints. • Discuss the function of the facet joint as its varies between the cervical, thoracic and lumbar regions. • Describe the anatomical basis for correct level localisation in the thoracic spine during thoracotomy procedures.
Gross anatomy of the peripheral somatic nervous system	• Describe the anatomy of the brachial plexus. • Describe in detail the anatomy of the nerves of the upper limb including their relationships. • Describe the surgical anatomy of the ante-cubital fossa. • Describe the surgical anatomy of the cubital tunnel and Guyon's canal. • Describe in detail the anatomy of the volar aspect of the wrist and the carpal tunnel. • Demonstrate the dermatomes and myotomes of the upper limb, trunk and lower limb. • Describe the anatomy of the	• Discuss in detail the surgical anatomy of the common exposures of the peripheral nerves. • Describe the anatomy of the thoracic outlet with particular reference to vascular and neurological compression syndromes.	

	lumbosacral plexus and its branches within and exiting the pelvis. • Describe in detail the anatomy of the nerves of the lower limb including their relationships. • Describe the anatomy of the femoral triangle, popliteal fossa and tarsal tunnel.		
Gross anatomy of the autonomic nervous system	• Discuss the anatomy and function of the sympathetic nervous system. • Discuss the anatomy and function of the parasympathetic nervous system.	• Describe the origins and pathways of sympathetic supply in the central nervous system. • Describe the anatomy of the sympathetic chain including its connections to the spinal cord and regions of supply. • Describe the origins and pathways of the parasympathetic nervous system in the central nervous system. • Describe the parasympathetic ganglia of the head and neck. • Describe the parasympathetic supply of the thorax. • Describe the parasympathetic supply from the lumbosacral region. • Discuss the innervation of the urinary bladder.	• Discuss the anatomy exposed in a transthoracic endoscopic cervical sympathectomy.
Radiological anatomy of the cranium, vertebral column and the central nervous system	• Describe the normal radiological appearance of the prevertebral soft tissue of the cervical spine. • Describe the normal radiological distances in the occipito-cervical (C0 - C2) junction in all ranges of normal motion. • Identify the normal anatomical structures visible on plain radiology of the cervical, thoracic and lumbosacral spine.	• Identify anatomical structures on axial, coronal and sagittal sections of the brain. • Identify the anatomical structures visualised with 2-dimensional angiography. • Identify anatomical structures as represented in 3-dimensional imaging. • Identify anatomical structures on axial, coronal and sagittal sections of the spine.	• Demonstrate the vessels visible on spinal angiography. • Demonstrate the anatomy visible with ventricular and cisternal contrast injection.
Pathways	• Describe the motor pathways within the central nervous system. • Describe the somatic sensory pathways within the central nervous system. • Describe the visual pathways.	• Describe the auditory pathways. • Describe the pathway subserving pupillary responses.	• Describe the anatomical basis for extra-pyramidal motor control • Describe the neurological pathways for speech. • Describe the pathways for conjugate eye movement.

SYLLABUS MODULE – NEURO-ONCOLOGY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Tumours of the scalp and skull vault	• List the classification of tumours that occur at the skull vault and scalp. • Describe epidemiology, clinical presentation and natural history of scalp and skull tumours. • Perform a history, examination and pre-operative workup of patients with tumours of scalp and skull. • List the appropriate pre-operative investigations.	• Describe the histopathological features of scalp and skull tumours. • Describe findings of appropriate preoperative investigation (including neuroradiological findings) of benign and malignant scalp and skull tumours. • Describe the differential diagnosis of lytic and sclerotic skull lesions.	• Describe in detail the management options (surgical and non-surgical) for skull vault and scalp tumours. • Demonstrate the surgical management of skull vault and scalp tumours.
Cell kinetics, genetics and immunology of neurological tumours	• Describe the nature of cell division and the cell cycle. • Describe the abnormalities of the cell cycle commonly identified in neoplasia. • Define terms "benign", "neoplastic" and "malignant" as relevant to neurological tumours. • Define "tumour suppressor gene", "oncogene", "loss of heterozygosity", "growth factor", "growth factor receptor", and "cytokine". List examples of each under current investigation and explain their significance to common CNS neoplasms. • Define tumour invasion and angiogenesis and describe the underlying mechanisms. Discuss the significance of each to tumour progression for common CNS neoplasms. • Describe the impact of tumour	• Describe factors secreted by tumours which modulate the immune response and cause immunodeficiency and the mechanisms by which they do this. • Describe commonly used histopathological markers of cell kinetics and their significance. • Describe the immune deficiency syndromes in relation to neurological tumours.	• Describe imaging techniques that examine cell kinetics of brain tumours. • Describe common immunological deficits in patients treated for neurological tumours. • Discuss immune based adjuvant therapies with patients and refer them appropriately. • Describe the possible indications for immune system based therapy. • Describe current theories concerning apoptosis and necrosis. • Discuss the biological basis for anti-tumour vaccines in treatment of neurological tumours (primary and secondary). • Evaluate the literature on immune based system therapy and gene therapy as relates to neuro-oncology.

	invasion and tumour biology on the accuracy of biopsy of CNS tumours • Define "tumour markers" and their use in clinical practice. • Describe elements of immune system and immune response to brain tumours. • Define "cytokine", "autocrine' and "paracrine". • Define the blood brain barrier and discuss the immune privilege and immune quiescence of the brain. Discuss the consequences of disruption of the blood brain barrier and the mechanisms by which it may occur. • Define "tumour markers" and principles of their clinical use. • Describe elements of immune system and immune response to brain tumours. • Define tumour marker and discuss those relevant to CNS tumours and the difficulty of defining true tumour-associated antigens in the CNS. • Describe the immune deficiency syndrome related to CNS tumours, particularly malignant astrocytoma. Describe the clinical features and laboratory examinations abnormalities. • Define "cytokine", "autocrine' and "paracrine". Describe factors secreted by tumours which modulate the immune response and cause immunodeficiency and the mechanisms by which they do this. • Describe the mechanisms of action of commonly used medications for patients with CNS tumours and the effect on the immune system, in		

	particular, glucocorticoids and anticonvulsants. • Define the blood brain barrier and discuss the immune privilege and immune quiescence of the brain. Discuss the consequences of disruption of the blood brain barrier and the mechanisms by which it may occur.		
Classification and epidemiology of cerebral tumours	• Describe the history of brain tumour classification systems. • Describe different systems for classification of astrocytomas. • Discuss the incidence of brain tumours. • Summarise the epidemiology, incidence and risk factors for common CNS neoplasms. Discuss the influence of gender, ethnicity, age, occupation and predisposing conditions (such as the phakomatoses or other genetic syndromes). • Discuss the use of tumour grade within the classification • Discuss the differential diagnosis of brain tumour - list non-neoplastic lesions that may clinically or radiologically mimic a brain tumour. • Describe the multistep nature of tumour pathogenesis in general terms. • Describe the basis of general tumourigenesis by viruses, chemicals and radiation.	• Outline the current WHO system for brain tumour classification. • Identify on pathological slides the features on which classification of tumour type and tumour grade are based - particularly for common tumours including gliomas, meningiomas, metastases, pineal region tumours, acoustic neuroma, pituitary tumours and craniopharyngioma. • Describe the general relationships of tumour classification with management and prognosis. Discuss the influence of tumour type, tumour grade, tumours site, age at presentation and neurological function at time of presentation.	• Describe in detail current WHO classification for neurological tumours. • Describe common XRT-induced brain tumours - epidemiology, pathology and investigation. • Discuss controversies in tumour classification and review the literature of those encountered in clinical practice. • Describe the risks of developing a CNS tumour based on environmental or medical exposure to viruses, chemical or radiation.
Neurophakomatoses	• List the conditions known as neurophakomatoses. • Outline the classification of Neurofibromatosis I and II, its incidence and genetic characteristics	• Describe in detail the definition, genetic basis, pathology, clinical features and natural history of the neurophakomatoses • Describe the long-term risks and complications of the neurophakomatoses and the neoplasms associated	• Identify the macroscopic and microscopic differences between neurofibromas and schwannomas. • Discuss the indications for intervention in the treatment of neurofibroma in patients

	and diagnostic criteria used to identify subjects. • Perform a history, examination and pre-operative workup of patients with neurophakomatoses. • Demonstrate the clinical findings in a patient with a neurophakomatosis.	with them. • Discuss the genetic testing and prenatal diagnosis available for neurophakomatoses.	with neurofibromatosis. • Describe biochemistry and function of neurofibromatosis I protein (neurofibroma) and Neurofibromatosis I protein (schwannoma/merlin). • Provide genetic counselling for a patient with neurofibromatosis. • Discuss the indications for intervention in the treatment of conditions in patients with neurophakomatoses other than neurofibromatosis.
Gliomas	• Define the term glioma. • Describe the clinical presentation of a patient with glioma with consideration of grade and location. • Perform a history, examination and pre-operative workup of patients with supratentorial gliomas. • List the appropriate investigations of a patient with glioma. • List the clinical features, natural history and prognosis of optic nerve glioma and the conditions with which it is associated. • List the clinical features, natural history and prognosis of hypothalamic glioma and the conditions with which it is associated.	• Describe the gross and histopathological features of gliomas. • Interpret investigations in patients presenting with suspected glioma. • Describe the common types of adjuvant therapy for gliomas and the indications for them.	• Identify the common histological features used to classify gliomas such as "gemistocyte", "necrosis", "mitosis", "anaplasia", "endothelial hyperplasia", "Rosenthal fibres", "pilocytes", "palisading", "rosettes" and "pseudorosettes". • Describe the role of surgery and adjuvant therapy for gliomas and the effect on natural history/efficacy. • Discuss in detail the commonly available adjuvant therapies for glioma. • Discuss the indications for re-operation in recurrent glioma. • Describe, differentiate and compare the different techniques for excision, including ultrasonic aspiration, laser and suction. • Describe the clinical management of uncommon glial and mixed glial/neuronal tumours for example: gliomatosis cerebri, giant cell glioblastoma, gliosarcoma, pleiomorphic xanthoastrocytoma, subependymal giant cell astrocytoma, subependymoma, desmoplastic infantile ganglioglioma, DNET, ganglioglioma, gangliocytoma, hypothalamic hamartoma, protoplasmic astrocytoma, paraganglioma, and glioneurocytoma. • Critically evaluate the emerging and

			controversial adjuvant therapies for glioma. • Discuss controversies in the management of glioma including surgical management and adjuvant therapy of low grade gliomas, extent of surgical resection and biopsy vs. excision and timing of adjuvant therapy. Evaluate the literature on these issues and state a summary and conclusion. • Discuss the role of surgery in the management of tumours of the brain stem. • Critically evaluate the controversial issues in the management of brainstem glioma.
Intraventricular tumours	• List the tumours that may appear within the ventricular system by location. • Describe the clinical presentation of masses within the ventricular system. • Perform a history, examination and pre-operative workup of patients with an intraventricular tumour. • List the appropriate investigations of a patient with an intraventricular tumour. • Discuss the mechanisms of development of hydrocephalus in intraventricular tumours. • Describe the principles of management of acute ventricular obstruction.	• Describe the gross and histopathological features of intraventricular tumours. • Interpret investigations in patients presenting with intraventricular tumours. • Describe the distinguishing features of fourth ventricular tumours including medulloblastoma and ependymoma. • Describe the distinguishing features of third ventricular tumours including colloid cysts. • Describe the distinguishing features of lateral ventricular tumours including meningioma and choroid plexus tumours. • Describe the types of adjuvant therapy and their role in the treatment of childhood ventricular tumours.	• Describe role of surgery for treatment of medulloblastoma and ependymoma of posterior fossa. • Discuss the management of an incidental lesion in the third ventricle, with particular reference to colloid cyst. • Discuss the management of an incidental lesion in the lateral ventricle. • Critically evaluate the literature regarding developing and experimental adjuvant therapy for medulloblastoma and ependymoma. • Describe high and low risk medulloblastoma patients and the appropriate adjuvant therapy for these groups. • Describe appropriate adjuvant therapy for ependymoma. • Discuss grading of ependymomas and its significance.
Metastatic brain tumours	• List the tumours that tend to metastasize to the central nervous system with particular reference to age and gender. • Describe the clinical presentation of	• Describe the gross and histopathological features of cerebral metastases. • Interpret investigations in patients presenting with metastatic disease of the central nervous system. • Describe the common types of adjuvant therapy for	• Independently determine a differential diagnosis and comprehensive treatment plan for patients with metastases based on history, examination, laboratory examinations and radiology.

	patients with metastatic disease to the central nervous system. • Perform a history, examination and pre-operative workup of a patient with metastatic disease of the central nervous system. • List the appropriate investigations of a patient with metastatic disease of the central nervous system. • Describe current theories of metastatic spread of tumours to the central nervous system.	with metastatic disease of the central nervous system. • Describe primary brain tumours that metastasise to CSF and extraneural pathways involved.	• Discuss the role of surgery for solitary and multiple intracerebral metastases. • Describe role and types of radiation treatment in the management of intracerebral metastases, including stereotactic radiotherapy.
Meningioma	• Describe current WHO classification of meningiomas. • Describe the common intracranial locations of meningioma and the expected presentation at each location. • Discuss epidemiology of meningioma. • Define the cell of origin and cytogenetics of meningioma and theories of tumourigenesis. • List the appropriate investigations of a patient with meningioma	• Describe macroscopic and histological features of meningiomas. • Discuss the clinical significance of pathological sub types of meningiomas. • Discuss the features of meningioma related to prognosis such as extent of surgical resection, markers of proliferation, receptor status and histological grade. • Discuss surgical goals in treatment of meningiomas and general principles of operation. • Describe the Simpson classification of surgical resection of meningiomas. • Interpret investigations in a patient presenting with meningioma.	• Discuss the role of radiation treatment in the management of meningiomas. • Discuss non-radiation based adjuvant therapies in the management of meningiomas. • Discuss the presentation, epidemiology, pathology and management of haemangiopericytoma. • Discuss the management of meningiomas related to the dural venous sinuses. • Describe the pathological and clinical features of uncommon tumours of the meninges, including lipoma, angiolipoma, hibernoma, fibrosarcoma, fibromatoses, fibrous histiocytoma, tumours of muscle and cartilaginous origin, haemangioma, angiosarcoma, epithelioid haemangioendothelioma, Kaposi sarcoma, melanocytoma, melanocytosis and malignant melanoma. • Discuss the difficulties associated with managing a recurrent meningioma. • Discuss role of pre-operative embolisation in the surgical management of meningiomas.
Epidermoids, dermoids and teratoma	• Define and differentiate epidermoid, dermoid and teratoma. • Describe common locations of	• Identify the macroscopic and microscopic features of epidermoid, dermoid and teratoma. • Identify the radiological features of epidermoid,	• Discuss the options for surgical and non-surgical management of dermoid and epidermoid.

	epidermoid and dermoid and the epidemiology of both. • List the clinical features, natural history and prognosis of epidermoids, dermoids and teratomas.	dermoid and teratoma. • Differentiate mature, immature and malignant teratoma.	• Describe the indications for and types of adjuvant therapy for teratomas. • Describe the indications for complex resections of epidermoids, dermoids or teratomas, particularly those involving eloquent structures.
Pineal region tumours	• Describe the classification of pineal region tumours including WHO. • Describe the clinical presentation of a pineal region tumour. • Discuss the appropriate investigations including haematological, CSF and radiological. • Describe the incidence, classification and pathology of pineal region tumours. • Describe the anatomy and physiology of the normal pineal gland and the embryology and anatomy of pineal region tumours, particularly the vascular supply and adjacent important structures. • Describe Parinaud's Syndrome and its clinicopathological significance.	• Discuss the significance of pineal region tumour markers, age, gender and ethnic origin on classification diagnosis and prognosis. • Describe the classification of germ cell tumours and tumour markers associated with these.	• Discuss the indications for and surgical options for pineal region tumours. • Describe the indications for and types of adjuvant therapy for pineal regions tumours as related to pathological type, age at presentation and ethnic origin • Contrast appropriate management of parenchymal and germ cell pineal tumours (germ/non-germ), (XRT, chemotherapy).
Cerebellopontine angle tumours, especially vestibular schwannoma (acoustic neuroma)	• List the tumours that may arise in the cerebellopontine angle (CPA). • Describe the epidemiology and clinical presentation and natural history of vestibular schwannoma. • Discuss the association of vestibular schwannoma with other disorders, including NF-2 and the underlying genetic abnormalities. • List other sites at which cranial schwannomas can occur and compare and contrast with CPA schwannomas. • Perform a history, examination and pre-operative workup of patients	• Identify the diagnostic radiological features of CPA tumours. • Describe otological investigations required for CPA tumours. • Describe the gross and microscopic features of vestibular schwannoma.	• Discuss the role of stereotactic radiosurgery for management of CPA tumours. • Discuss indications for and types of adjuvant therapy for CPA tumours as related to pathological type. • Describe in detail surgical anatomy, risks and indications of different approaches for CPA tumours e.g. middle fossa, suboccipital and translabyrinthine. • Discuss the management of a patient with facial paresis. • Discuss the uses and indications for intraoperative monitoring during CPA surgery.

	with CPA tumours. • List the appropriate investigations of a patient with a CPA tumour. • Describe the House-Brackmann grading scale of facial nerve weakness.		• Discuss strategies of hearing preservation in CPA tumours. • Discuss surgical management of different types of hearing loss. • Discuss the issues relating to the management of patients with bilateral vestibular schwannomas.
Haemangioblastoma	• Describe the epidemiology, clinical presentation and natural history of haemangioblastoma. • Describe the epidemiology, clinical features and natural history of von Hippel Lindau syndrome. • Perform a history, examination and pre-operative workup of patients with haemangioblastoma. • List the appropriate preoperative investigations of a patient with suspected haemangioblastoma.	• Describe the gross and microscopic features of haemangioblastoma. • Identify diagnostic radiological features of haemangioblastoma.	• Describe the indications for and types of adjuvant therapy for haemangioblastoma. • Describe the on-going investigations, monitoring and genetic counselling of von Hippel Lindau disease. • Discuss strategies for managing vascularity in recurrent haemangioblastomas. • Discuss the role of angiography and embolization in the management of haemangioblastoma. • Describe the function of the protein product and the involved genetic defect in von Hippel Lindau disease.
Pituitary and parasellar tumours	• Describe the classification of pituitary tumours with respect to the cell of origin and size. • Describe the clinical presentation and the epidemiology of pituitary tumours. • List investigations of a patient presenting with a pituitary region mass. • Describe pituitary/hypothalamic emergencies including apoplexy, diabetes insipidus and Addisonian crisis. List their causes and emergency management. • Perform a full endocrinological assessment and demonstrate the medical management of common endocrinopathies. • Describe the postoperative care of	• Describe the gross and microscopic features of pituitary region tumours. • Demonstrate the diagnostic radiological features of pituitary region masses. • Perform and discuss the results of visual testing in patients with pituitary lesions. • Discuss the significance of serum prolactin levels. • Describe the complications and long term risks of endocrinopathies associated with pituitary tumours, both with and without treatment.	• Discuss in detail the indications for surgery and the application of various surgical approaches in management of pituitary region tumours. • Discuss adjuvant treatment for pituitary tumours. • Discuss the adjuvant treatment for craniopharyngioma. • Discuss the differential diagnosis of patients with empty sella syndrome based on history, examination, laboratory tests and radiology. Demonstrate the radiological abnormalities. • Discuss the management of CSF leak following pituitary region surgery. • Discuss in detail the relationship of pituitary region lesions and their management in relation to the treatment of fertility and pregnancy.

	patients who have had pituitary region surgery including fluid and electrolyte management, hormone replacement and assessment and treatment of acute visual loss. • Describe primary and secondary empty sellar syndrome. • Discuss the embryology of craniopharyngioma and Rathke's cleft cyst. • Discuss the epidemiology, clinical presentation and natural history of craniopharyngioma and Rathke's cleft cyst.		
Chordoma	• Discuss the embryogenesis of chordoma. • Discuss location, epidemiology, clinical features and natural history of chordoma. • Perform a history, examination and pre-operative workup of patients with chordoma.	• Describe the gross and microscopic pathological features of chordoma. • Describe the radiological features and differential diagnosis of chordoma.	• Discuss the therapeutic options in the management of chordoma. • Discuss the potential difficulties associated with preoperative biopsy of chordoma. • Describe the indications for and types of adjuvant therapy for chordoma. • Discuss the implications of incomplete resection for prognosis and adjuvant therapy. • Critically evaluate the literature on evolving adjuvant therapies for the management of chordoma such as boron neutron capture therapy.
Tumours of the orbit	• Perform a history, examination and pre-operative workup of patients with orbital tumours. • List the appropriate pre-operative investigations for a patient with orbital tumour. • Demonstrate the assessment of and discuss potential causes of proptosis.	• List the tumours that may arise in the orbit. • Describe the gross and microscopic pathological features of tumours which may appear in the orbit. • List the clinical features, natural history and prognosis of tumours and pseudotumours which occur in the orbit.	• Independently determine a differential diagnosis and comprehensive treatment plan for patients with orbital tumours based on history, examination, laboratory tests and radiology. • Discuss the role for adjuvant therapy for orbital tumours. • Discuss in detail surgical approaches to orbital lesions and their complications.
Lymphoma	• Discuss the classifications of lymphoma.	• Describe the gross and microscopic pathological features of cerebral lymphoma and the current WHO	• Discuss the role of surgery in cerebral lymphoma.

	• Discuss the relationship between lymphoma and associated conditions e.g. immunosuppression. • Describe the clinical features, natural history and prognosis of cerebral lymphoma.	classification. • Interpret the radiological features of cerebral lymphoma.	• Discuss the effect of steroids in cerebral lymphoma. • Discuss non-surgical treatments for the management of cerebral lymphoma.
Cranial and spinal lipoma	• Describe the common locations in which intracerebral and intraspinal lipomas occur, their anatomical relationships and relative frequency and embryological origin and development. • List the clinical features, natural history and prognosis of intracerebral and intramedullary lipomas.	• Discuss the pathology of CNS lipomas.	• Discuss the options for the management of CNS lipoma.
Spinal tumours	• List the tumours that tend to metastasize to the spine with particular reference to age, gender and frequency. • Classify the common extradural, intradural (extramedullary) and intramedullary tumours. • Describe the clinical features of spinal tumours with specific reference to site and location. • Discuss the natural history and prognosis of tumours within the spine, particularly as related to age at presentation and position in the spine. • Perform a history, examination and pre-operative workup of patients with spine tumours. List the appropriate pre-operative investigations. • Discuss the management of a patient with acute spinal cord compression.	• Demonstrate the radiological diagnostic features of spinal tumours. • Describe the gross and microscopic pathological features of spinal tumours. • Discuss level localization in spinal tumour surgery. • Discuss the indications for surgery, radiotherapy or conservative approach in spinal tumours.	• Discuss the indications for and types of adjuvant therapy for spinal tumours particularly related to pathology, site and age at presentation. • Discuss the controversies surrounding intramedullary resective surgery. • Discuss the role of neurophysiological monitoring and spinal tumour surgery. • Discuss the role of pre-operative embolisation in the management spinal tumours. • Discuss the appropriate investigation and differential diagnosis of a sacral mass. • Discuss en-bloc resection of spinal tumours with respect to appropriate indications, risks and complications. • Radiotherapy and CNS tumours • Discuss the controversies concerning radiotherapy and neoplasia with particular reference to metastases, low grade and benign tumours, paediatric patients and the elderly. • Discuss the indications, efficacy and side-effects of stereotactic radiosurgery and

			stereotactic radiotherapy. • Discuss the different delivery systems for stereotactic radiosurgery.
Radiotherapy and CNS tumours	• Describe the nature of ionizing radiation. • Describe the different types of ionizing radiation and their short and long term effects on normal and neoplastic tissue. • Describe the mechanisms by which radiotherapy induces cell death. • Describe and compare the sources of radiation commonly used in medical applications. • Describe and differentiate whole brain radiotherapy, stereotactic radiosurgery, stereotactic radiotherapy, 3-D conformal radiotherapy, intensity modulated radiation therapy and interstitial brachytherapy.	• Describe indications for radiotherapy and treatment of brain tumours. • Describe the indication for each type of radiotherapy as related to tumour type, position and patient age.	• Explain the rationale for fractionation in radiotherapy and describe radiosensitisers. • Discuss the clinical presentation, investigation, differential diagnosis and management of radionecrosis. • Describe common doses and dose regimens for treatment of gliomas.
Chemotherapy	• Discuss the basic principles of cancer chemotherapy. • Describe the side effects of chemotherapy and the management of these.	• List the commonly used drugs in central nervous system tumour chemotherapy. • Explain the rationale for multidrug therapy. • Discuss the influence of the blood brain barrier on chemotherapy delivery.	• Describe the role of chemotherapy in paediatric brain tumour patients. • Explain the indications for and risks and benefits of chemotherapy to individual patients with CNS tumours. • Describe the mechanism of action of commonly used drugs in central nervous system tumour chemotherapy, with particular reference to alkylating agents (particularly the nitrosureas and temozolamide), antimetabolites, vinca alkaloids, podophyllotoxins, antibiotics, platinum compounds, tamoxifen and hydroxyurea. • Describe the role of intracavitary chemotherapy for the treatment of brain tumours. • Discuss the evidence for the efficacy of chemotherapy for brain tumours.

			• Discuss drug delivery to the central nervous system and recent development of new methods - including intra-arterial delivery, blood brain barrier modification and intracranial/local delivery
SYLLABUS MODULE – NEURO-OPHTHALMOLOGY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Neuro-ophthalmology	• Describe in detail the visual pathways. • Describe the neurological control of conjugate eye movement. • Describe the anatomical and physiological mechanisms involved with the pupillary reflexes. • Demonstrate the assessment of visual acuity and discuss methods of correcting for refraction errors. • Demonstrate the clinical assessment of extra-ocular eye movements, visual fields and fundoscopic examination. • Discuss the mechanism and relevance of papilloedema and differential diagnosis. • Discuss the relevance and management of a spontaneous third nerve palsy. • Discuss the clinical features and causes of Horner's Syndrome. • Discuss the differential diagnosis of ptosis • Discuss the differential diagnosis of cavernous sinus syndrome.	• Discuss the mechanism and differential diagnosis of nystagmus. • Describe the diagnostic significance of different types of nystagmus. • Describe the appearance and relevance of common fundoscopic findings including vascular changes, exudates and haemorrhages. • Discuss the relevance of colour vision assessment in neurological examination. • Demonstrate formal visual perimetry. • Interpret the results of computerised visual field testing. • Discuss the specific features of cortical blindness. • Discuss the causes of proptosis. • Demonstrate the clinical localisation of lesions causing gaze palsy.	• Discuss neurological causes of alexia. •

SYLLABUS MODULE – NEURO-OTOLOGY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Evaluation of Hearing	• Describe in detail the anatomy of the external, middle and inner ear. • Describe the auditory pathway. • Demonstrate otoscopic examination of the ear. • Demonstrate the Rinne and Weber tests. • Discuss the examination findings and differential diagnosis of conductive and sensorineural hearing loss.	• Interpret audiometric evaluation - pure-tone audiometry, impedance testing, speech discrimination, auditory brain stem evoked response (ABSER).	
Disorders of Vestibular System	• Describe the anatomy of vestibular system.	• Describe the classification of peripheral and central vestibular disorders. • Interpret vestibular evaluation - electronystagmography (ENG), caloric tests, rotation chair testing. • Discuss the differential diagnosis and the management of dizziness. • Discuss the differential diagnosis and management of tinnitus.	• Discuss common neuro-otologic disorders eg. viral labyrinthitis, viral mononeuritis, benign paroxysmal positional vertigo, Meniere's syndrome, vertebrobasilar insufficiency, Wallenberg's syndrome.
Mastoiditis and Sinus Disorders	• Describe the pathophysiology of middle ear and mastoid infections including acute and chronic infections.	• Discuss cholesteatoma	• Describe the intracranial complications including otogenic sigmoid sinus thrombosis, extradural abscess, cerebellar and temporal lobe abscess.

SYLLABUS MODULE – NEUROPATHOLOGY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
General Pathology of neurons and glia	• Describe the normal weight of the brain at different ages. • Describe the appearance of neurons, astrocytes, oligodendrocytes and ependyma. • Describe the cellular processes of repair, regeneration and recovery of function. • Describe the methods used for neuropathological examination (tissue preparation, difference between frozen and paraffin-embedded sections, staining techniques, etc) and the artefacts that these methods produce.	• Describe the biochemical events of neuronal hypoxia resulting in cell death. • Describe Wallerian degeneration. • Describe the function of the various types of glial cells. • Describe the anatomical basis, structure and function of the blood brain barrier. • Discuss the features of necrosis versus apoptosis in cell death. • Describe the reaction of glial cells to neural injury.	• Describe Rosenthal fibres and their significance. • Describe mechanisms of cerebral injury associated with carbon monoxide poisoning. • Describe the changes in the normal central nervous system induced by radiation.
Congenital malformations	• Discuss environmental influences in the development of congenital neurological disorders. • Define the terms commonly used in congenital defects such as porencephaly, hydranencephaly, microcephaly, megalocephaly, encephalocele, meningocoele, holoprosencephaly, lissencephaly and spinal dysraphism. • Describe the classification of Chiari malformations. • Describe the congenital causes of hydrocephalus.	• Describe the detailed pathology of anencephaly, encephalocele and meningocoele. • Describe the pathology of arachnoid cysts. • Describe the detailed pathology of Chiari malformations including associated abnormalities. • Describe the pathology of cerebellar malformations eg. agenesis, aplasia of the vermis, and Dandy Walker syndrome. • Describe the pathology of craniosynostosis. • Describe the epidemiology, embryology and pathological characteristics of neural tube defects. • Describe the following malformations of the spinal cord: hydromyelia, diastematomyelia, diplomyelia, syringomyelia and syringobulbia. • Cerebral and spinal vascular disorders • Describe in detail the gross and microscopic pathology of the vascular malformations of the brain. • Describe the histological appearances of the various	• Describe the pathology of intracranial birth injury and haemorrhage, and ischaemic lesions. • Describe the disorders of forebrain induction eg. holoprosencephaly, agenesis of corpus callosum and anomalies of septum pellucidum. • Describe the pathology of cerebral heterotopias. • Describe in detail the CNS pathology associated with perinatal infections eg. syphilis, toxoplasmosis, cytomegalovirus, rubella and HIV.

		types of cerebral aneurysms. • Describe the pathological effects of subarachnoid and intraparenchymal haemorrhage. • Describe the gross and microscopic pathology of amyloid angiopathy. • Describe the secondary pathological changes that occur in ischaemic stroke. • Describe the microscopic pathology of infectious and immune mediated arteritis.	
Cerebral and spinal vascular disorders	• Discuss the common sites of spontaneous intracerebral haemorrhage and their likely causes. • Describe the pathological changes of the parenchyma and cerebral vasculature associated with chronic hypertension. • Describe the pathological differences between the various vascular anomalies eg. AVM, cavernoma, venous malformations, capillary telangiectasia, dural arteriovenous fistulae • Describe the pathological classification of cerebral aneurysms • Describe the pathology of atherosclerotic occlusive disease		• Describe the gross and microscopic effects of radiation on normal and abnormal cerebral vasculature. • Describe the pathology and sequelae of thrombosis of the dural venous sinuses and the deep venous system. • Describe the classification and detailed pathology of the vascular malformations of the spine. • Describe the pathology of Moya Moya disease and Takayasu's arteritis.
Brain and spinal cord trauma	• Discuss the clinicopathological correlates of head injury mechanisms eg. shear, rotation, contre-coup. • Describe the difference between primary and secondary injury. • Describe in detail the causes and patterns of secondary brain injury. • Describe in detail the differences between focal and diffuse axonal and vascular injury. • Discuss the spectrum of traumatic intracranial haemorrhage. • Describe the pathology of contusions	• Describe the cellular and molecular processes occurring after neuronal injury. • Describe the differences between low velocity and high velocity blunt injuries. • Describe the detailed gross and microscopic pathology of diffuse axonal injury. • Discuss in detail the gross and microscopic pathology of cerebral injury associated with raised intracranial pressure. • Describe the microscopic pathology and mechanisms of formation and enlargement of chronic subdural haematomas. • Describe the gross and microscopic pathology of acute spinal cord injury.	• Describe the pathology and pathophysiology associated with high velocity missile injuries. • Describe the cellular processes of repair in the nervous system.

	as it relates to the mechanism of injury and skull anatomy. • Describe the gross pathology of acute and chronic subdural haematomas. • Describe the gross pathology of extradural haematoma. • Describe in detail the different types of brain swelling. • Discuss the mechanisms of acute and secondary spinal cord injury.	• Describe long term pathological changes following spinal cord injury.	
Miscellaneous nervous system disease	• Describe the pathological findings in the brain associated with ageing.	• Describe the pathological features of Alzheimer's disease. • Describe in detail the pathological features of Parkinson's disease. • Describe the pathological features of Huntington's disease.	• Describe the pathological features of Pick's disease. • Describe the basic gross and microscopic pathological changes associated with peripheral neuropathies. • Describe the pathological features of motor neurone disease. • Describe the general pathology of mitochondrial diseases. • Describe the pathology of progressive supranuclear palsy. • Describe the pathology of the inherited spinocerebellar degenerative diseases. • Describe the pathology of acute haemorrhagic leukoencephalitis.
Demyelinating diseases	• Describe demyelination and classification of demyelinating disease.	• Discuss the gross and microscopic pathological findings in multiple sclerosis.	• Discuss the pathology and aetiology of central pontine myelinolysis. • Discuss the aetiological theories of multiple sclerosis.
Skull, spine and musculoskeletal system	• Describe the pathological changes in intervertebral disc degeneration. • Describe the pathological process of osteophyte formation. • Describe the pathology of osteoporosis and osteomalacia. • Describe the pathology of Paget's disease. • Discuss the process of fracture	• Describe the pathology of spinal canal stenosis. • Describe the pathology of spondylolysis and spondylolisthesis. • Discuss metabolic bone diseases (including renal osteodystrophy, primary hyperparathyroidism). • Describe the classification of myopathies and the basic pathological findings.	• Describe the pathology of ossification of the posterior longitudinal ligament and diffuse idiopathic skeletal hyperostosis. • Describe the gross and microscopic pathology of fibrous dysplasia. • Describe the gross and microscopic features of Paget's disease. • Describe in detail the pathology of vertebral haemangiomas.

	healing.		• Describe the pathology of Scheuermann's disease and Schmorl's nodes.
Central nervous system infections	• Discuss the possible routes of intracranial infection. • Discuss the normal CNS mechanisms of defence against infection. • Describe the pathogenesis of brain abscess, subdural empyema and epidural abscess. • Discuss the stages of brain abscess formation. • Describe the microbiology of common cerebral infection. • Describe abnormalities (cardiac, pulmonary, metabolic, syndromic) that predispose to abscess formation. • Describe the pathological features differentiating viral, bacterial and fungal CNS infections. • Discuss the systemic effects associated with meningitis and encephalitis eg. Skin lesions in meningococcal infection.	• Describe the gross and histological features of a brain abscess at various stages. • Describe the gross and histological features of subdural empyema and epidural abscess. • Describe the gross and microscopic features of bacterial meningitis. • Describe the pathology of herpes simplex encephalitis. • Discuss the pathology of tuberculous infections of the CNS. • Discuss the pathology of fungal infections of the CNS. • Describe the pathology of varicella zoster infections. • Describe the pathology of opportunistic infections in immunocompromised patients.	• Describe the pathology of prion diseases and the routes of transmission. • Describe the pathology of HIV infection of the nervous system. • Describe the pathology of parasitic infections of the CNS. • Discuss the tests used to diagnose bacterial, viral, fungal, and prion diseases (including culture techniques, PCR, tests for prion diseases, and EEG findings). • Describe the inclusion bodies found in various types of viral encephalitis.
Immunopathological disorders	• Describe the pathology of myasthenia gravis. • Describe the pathological features in rheumatoid arthritis with particular respect to vertebral column. • Describe in general terms the neuropathology of autoimmune diseases such as systemic lupus erythematosis.	• Describe the pathology of Guillain-Barre syndrome. • Describe the pathology of sarcoidosis and its neurological manifestations.	• Describe the pathology of immune-mediated vasculitis.
Toxic and deficiency disorders	• Discuss the neurological and pathological effects of alcohol intoxication and withdrawal and its implications with management. • Describe the neuropathology of chronic alcoholism including	• Describe the neurological effects of vitamin A intoxication. • Discuss the pathological changes associated with chronic phenytoin use.	• Discuss the effects of metal toxicities (e.g. lead, aluminium, mercury).

	Wernicke-Korsakoff syndrome. • Discuss the neuropathological effects of vitamin deficiencies e.g. A, B1, B12. • Describe the effects of protein and caloric deficiency, especially in the setting of trauma.		
Brain shifts and herniation	• Describe the stages of compensation for a space-occupying lesion. • Describe the pathology of trans-tentorial herniation. • Describe the pathology of tonsillar herniation. • Describe the pathophysiology of herniation after lumbar puncture. • Describe the pathology of subfalcine herniation. • Describe the pathology of brain herniation through a skull defect. • Describe the secondary effects of brain herniation: vascular compression, false-localising signs. • Describe Kernohan's notch. • Discuss the differences between slowly- and rapidly-expanding lesions.	• Discuss the pathophysiology of upward trans-tentorial herniation.	• Discuss the pathological effects of rapid reduction of intracranial pressure with treatment of herniation syndromes, including brain swelling and reperfusion injury.
Neuro-oncology	• Discuss the general molecular changes in neoplastic cells. • Discuss the method of growth and spread of intrinsic tumours. • Differentiate between intrinsic and extrinsic tumours on gross specimens. • List the classification of tumours that occur at the skull vault and scalp. • Describe the nature of cell division and the cell cycle. • Describe the abnormalities of the cell cycle commonly identified in neoplasia.	• Describe the histopathological features of scalp and skull tumours. • Describe factors secreted by tumours which modulate the immune response and cause immunodeficiency and the mechanisms by which they do this. • Describe commonly used histopathological markers of cell kinetics and their significance. • Describe the immune deficiency syndromes in relation to neurological tumours. • Outline the current WHO system for brain tumour classification. • Identify on pathological slides the features on which classification of tumour type and tumour grade are based - particularly for common tumours including	• Discuss the theories of oedema pathogenesis within the brain adjacent to extra-axial tumours. • Describe common immunological deficits in patients treated for neurological tumours. • Describe current theories concerning apoptosis and necrosis. • Describe in detail current WHO classification for neurological tumours. • Describe common XRT-induced brain tumours - epidemiology, pathology and investigation.

	• Define terms "benign", "neoplastic" and "malignant" as relevant to neurological tumours. • Define "tumour suppressor gene", "oncogene", "loss of heterozygosity", "growth factor", "growth factor receptor", and "cytokine". List examples of each under current investigation and explain their significance to common CNS neoplasms. • Define tumour invasion and angiogenesis and describe the underlying mechanisms. Discuss the significance of each to tumour progression for common CNS neoplasms. • Define "tumour markers" and their use in clinical practice. • Describe elements of immune system and immune response to brain tumours. • Define "cytokine", "autocrine' and "paracrine". • Describe the history of brain tumour classification systems. • Describe different systems for classification of astrocytomas. • Discuss the use of tumour grade within the classification. • Describe the multistep nature of tumour pathogenesis in general terms. • Describe the basis of general tumourigenesis by viruses, chemicals and radiation. • List the conditions known as neurophakomatoses. • Define the term glioma. • List the tumours that may appear within the ventricular system by location.	gliomas, meningiomas, metastases, pineal region tumours, acoustic neuroma, pituitary tumours and craniopharyngioma. • Describe in detail the pathology of the neurophakomatoses. • Describe the gross and histopathological features of gliomas. • Describe the gross and histopathological features of intraventricular tumours. • Describe the distinguishing features of fourth ventricular tumours including medulloblastoma and ependymoma. • Describe the distinguishing features of third ventricular tumours including colloid cysts. • Describe the distinguishing features of lateral ventricular tumours including meningioma and choroid plexus tumours. • Describe the gross and histopathological features of cerebral metastases. • Describe primary brain tumours that metastasise to CSF and extraneural pathways involved. • Describe macroscopic and histological features of meningiomas. • Identify the macroscopic and microscopic features of epidermoid, dermoid and teratoma. • Differentiate mature, immature and malignant teratoma. • Describe the classification of germ cell tumours and tumour markers associated with these. • Describe the gross and microscopic features of schwannoma. • Descriie the gross and microscopic features of haemangioblastoma. • Describe the gross and microscopic features of pituitary region tumours. • Describe the gross and microscopic pathological features of chordoma. • List the tumours that may arise in the orbit. • Describe the gross and microscopic pathological features of tumours which may appear in the orbit. • Describe the gross and microscopic pathological features of cerebral lymphoma and the current WHO	• Identify the macroscopic and microscopic differences between neurofibromas and schwannomas. • Identify the common histological features used to classify gliomas such as "gemistocyte", "necrosis", "mitosis", "anaplasia", "endothelial hyperplasia", "Rosenthal fibres", "pilocytes", "palisading", "rosettes" and "pseudorosettes". • Discuss controversies in tumour classification and review the literature of those encountered in clinical practice. • Describe the risks of developing a CNS tumour based on environmental or medical exposure to viruses, chemical or radiation. • Describe biochemistry and function of neurofibromatosis I protein (neurofibroma) and Neurofibromatosis I protein (schwannoma/merlin). • Describe the pathological features of uncommon tumours of the meninges, including lipoma, angiolipoma, hibernoma, fibrosarcoma, fibromatoses, fibrous histiocytoma, tumours of muscle and cartilaginous origin, haemangioma, angiosarcoma, epithelioid haemangioendothelioma, Kaposi sarcoma, melanocytoma, melanocytosis and malignant melanoma.

	• List the tumours that tend to metastasize to the central nervous system with particular reference to age and gender. • Describe current theories of metastatic spread of tumours to the central nervous system. • Describe current WHO classification of meningiomas. • Describe the common intracranial locations of meningioma. • Define the cell of origin and cytogenetics of meningioma and theories of tumourigenesis. • Define and differentiate epidermoid, dermoid and teratoma. • Describe common locations of epidermoid and dermoid and the epidemiology of both. • Describe the classification of pineal region tumours including WHO. • Describe the classification and pathology of pineal region tumours. • List the tumours that may arise in the cerebellopontine angle (CPA). • Discuss the association of vestibular schwannoma with other disorders, including NF-2 and the underlying genetic abnormalities. • Describe the classification of pituitary tumours with respect to the cell of origin and size. • Discuss the embryogenesis of chordoma. • Discuss the classifications of lymphoma. • Discuss the relationship between lymphoma and associated conditions e.g. immunosuppression. • Describe the common locations in which intracerebral and intraspinal lipomas occur, their anatomical	classification. • Discuss the pathology of CNS lipomas. • Describe the gross and microscopic pathological features of spinal tumours.	

	relationships and relative frequency and embryological origin and development • List the tumours that tend to metastasize to the spine with particular reference to age, gender and frequency. • Classify the common extradural, intradural (extramedullary) and intramedullary tumours.		
SYLLABUS MODULE – NEUROPHARMOCOLOGY AND NEUROCHEMISTRY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Blood brain barrier	• Discuss the relevance of the blood brain barrier to central nervous system drug delivery.		• Discuss the various interventions that have been used to alter the blood-brain barrier for drug delivery.
Steroids	• Describe the basic steroid ring and its modifications to produce the various subgroups. • Discuss the actions of the steroid subgroups. • Discuss the pharmacodynamics of dexamethasone, prednisone and hydrocortisone. • Discuss the side-effects of steroids commonly used in neurosurgery practice. • Discuss iatrogenic suppression of the adrenal cortex and its management.	• Discuss why dexamethasone is most commonly used in neurosurgery. • Describe the mechanism of action of glucocorticoids on various types of cerebral oedema.	• Discuss the evidence for glucocorticoid use in cerebral protection. • Discuss the evidence for glucocorticoid use in neurotrauma. • Discuss the role of steroids in the prevention of lipid peroxidation.
Anticonvulsants	• Classify the anticonvulsant medications based on their mechanism of action. • Describe in detail the pharmacology of phenytoin, sodium valproate, carbamazepine and gabapentin.	• Compare and contrast the indications and limitations of phenytoin, sodium valproate and carbamazepine. • Discuss the evidence for the use of prophylactic anticonvulsants in trauma, elective craniotomy and aneurysmal subarachnoid haemorrhage.	• Discuss the role of anticonvulsants in pain management. • Discuss the use of anticonvulsants in pregnancy.

	• Discuss the role of serum level monitoring in long-term anticonvulsant therapy administration. • Define status epilepticus and discuss in detail its management. • Discuss the effect of benzodiazepines on seizure activity.		
Calcium channel blockers	• Discuss the mode of action and side-effects of the groups of calcium channel blockers. • Describe the administration of nimodipine.	• Discuss the evidence for the use of calcium channel blockers in the management of cerebral vasospasm.	• Discuss the evidence for the use of calcium channel blockers in the management of neurotrauma.
Mannitol and diuretics	• Discuss in general terms the pharmacology and clinical use of diuretics. • Describe in detail the pharmacology of mannitol. • Describe the indications for mannitol use in acute head injury.	• Discuss the role of mannitol in neurosurgery practice. • Describe the potential negative effects of recurrent and prolonged mannitol use. • Compare and contrast the use of the various types of diuretics fro reducing raised intracranial pressure. • Discuss the effect of mannitol on the microcirculation.	• Discuss the role of mannitol in cerebral protection. • Discuss the role of urea in the management of raised intracranial pressure.
Barbiturates	• Describe the pharmacology of the barbiturates. • Describe the effect of the barbiturates on neuronal function	• Discuss the use of barbiturates in epilepsy management	• Discuss the role of barbiturate therapy in neuroprotection • Describe the effects of barbiturates on intracranial and cerebral perfusion pressures.
Antibiotics	• Describe the classes of antibiotics commonly used in neurosurgery. • Describe the mode of action of the commonly used antibiotics. • Discuss the bioavailability of antibiotics in the central nervous system. • Discuss the use of antibacterial skin preparations in neurosurgery.	• Discuss the evidence for prophylactic antibiotic therapy in operative neurosurgery. • Discuss the role of prophylactic antibiotic therapy in cerebrospinal fluid leak and drains. • Discuss the use of topical antibiotics in neurosurgery. • Discuss the serum monitoring of antibiotics. • Discuss the use of antibiotics in the presence of known allergy.	• Discuss the use of antiviral agents in neurological disorders.
Analgesics	• Describe the classes of analgesics commonly used in neurosurgery • Describe in detail the pharmacology	• Describe the relative efficacy of the analgesics commonly used in neurosurgery • Discuss the pharmacology of opiate dependence	

	of paracetamol and aspirin • Describe in detail the pharmacology of the opiates • Describe the pharmacology of the non-steroidal anti-inflammatory medications		
Other	• Describe the management of acute anaphylaxis. • Discuss the drug interactions of warfarin. • Describe the options for therapeutic anticoagulation. • Describe the options for reversal of anticoagulation. • Discuss the pharmacology of the anti-platelet agents. • Discuss, in general terms, the pharmacology of the benzodiazepines. • Discuss, in general terms, the pharmacology of the anti-depressants commonly encountered in neurosurgery. • Discuss the pharmacology of the commonly used anti-emetic drugs. • Discuss, in general terms, the basic pharmacology of the commonly used local anaesthetic drugs. • Discuss the pharmacology of the medications used for peptic ulcer prophylaxis. • Discuss the basic pharmacology of the major tranquillisers used in neurosurgery.	• Discuss the evidence for pharmacological deep venous thrombosis prophylaxis. • Discuss the uses of benzodiazepines in neurosurgery. • Discuss the uses of the anti-depressants in neurosurgery. • Discuss, in general terms, the pharmacology of the ionotropes. • Discuss the pharmacological management of acute hypertension in neurosurgery	• Discuss the clinical application of ionotropes. • Discuss the use of anti-platelet and anti-coagulant therapies following cerebral ischaemia.

SYLLABUS MODULE – NEUROPHYSIOLOGY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Fluid and electrolyte balance	• Demonstrate the clinical assessment of hydration status. • Define the clinical syndrome of shock. • Discuss the various types of shock and their management. • Define the normal electrolyte concentrations. • Describe the major intracellular and extracellular ions. • Describe the sodium potassium pump and calcium channels. • Calculate total body water deficit / excess. • Define and calculate the anion gap and discuss its relevance. • Define the normal fluid and electrolyte replacement. • Define the composition of normal saline, Hartman's solution, Ringer's solution and commonly used dextrose intravenous solutions.	• Describe the composition and uses of colloid solutions. • Discuss the causes, clinical features and management of hyponatraemia. • Discuss central pontine myelinosis, its causes and avoidance. • Describe in detail the causes and management of diabetes insipidus. • Describe the clinical syndromes associated with hypo and hyper calcaemia, including causes and management.	• Discuss cerebral salt wasting syndrome. • Discuss the role of the pituitary and hypothalamus in fluid and electrolyte homeostasis.
Acid base balance	• Differentiate respiratory and metabolic acidosis and alkalosis on blood gas analysis. • Discuss the management of metabolic acidosis and alkalosis.		
Respiratory function	• Define normal blood gases. • Discuss the uses and limitations of oxygen saturation monitoring. • Demonstrate the assessment and management of an adequate airway.	• Describe in physiological terms the cardio pulmonary changes associated with pulmonary embolism. • Describe the diagnostic features of pulmonary embolism. • Discuss the indications and uses of bicarbonate	• Discuss the effects of mechanical ventilation on intracranial pressure.

	• Define normal respiratory function test parameters. • Discuss V/Q mismatch. • Describe in detail the effects of blood gas derangement on cerebral blood flow. • Define the terms positive pressure ventilation, PEEP, CPAP, BiPAP and assisted/controlled ventilation, and discuss their clinical uses.	therapy.	
Principles of nutrition	• Define the normal caloric requirements. • Discuss the altered nutritional requirements in neurological disease states eg. Trauma •	• Discuss neurological disorders associated with vitamin deficiencies. •	•
Energy metabolism in the brain	• Define both aerobic and anaerobic pathways for energy production in the central nervous system.	• Define the term CMRO 2 • Discuss regional variations in cerebral energy metabolism.	• Define the therapeutic strategies for alteration of neuronal CMRO 2.
Cerebral blood flow	• Describe normal cerebral blood flow and oxygen consumption. • Define cerebral perfusion pressure • Describe in detail the autoregulation of cerebral blood flow.		• Describe the methods for measurement of regional cerebral blood flow and its clinical application.
Cerebrospinal fluid and intracranial pressure	• Define the normal contents of the cranium. • Discuss the Monro-Kellie doctrine. • Define normal intracranial pressure and physiological factors affecting it. • Define normal ICP wave form and discuss its components. • Define the normal processes of cerebrospinal fluid production, circulation and absorption. • Define the normal composition of cerebrospinal fluid. • Define normal cerebrospinal fluid pressures.	• Define the mechanisms for transmission of altered intrathoracic and intraabdominal pressure to the CNS.	• Discuss the concepts of compartmentalisation with respect to ICP.

Neural conduction and muscle contraction	• Define the resting potential of normal axonal membrane and the mechanisms of its maintenance. • Describe a normal action potential. • Discuss the role of myelin in action potential transmission. • Classify peripheral nerve fibres based on size and function. • Define the neurotransmitters at the neuromuscular junction. • Define the physiology of smooth and striated muscle contraction. • Define the monosynaptic spinal reflex arc. • Discuss the physiological factors affecting muscle tone. • Describe the more complex reflex arc. • Discuss the physiological effects of parasympathetic nervous system. • Discuss the physiological effects of sympathetic nervous system. • Define the neurotransmitters in the autonomic nervous system.	• Discuss the factors affecting normal axonal conduction rate. • List the normal excitatory and inhibitory neurotransmitters in the CNS. • Discuss the physiological basis for the different somatic sensory modalities including specific receptors and conduction pathways. • Discuss the physiological control of normal bladder and bowel function.	• Discuss the physiological control of normal sexual function.
Consciousness	• Discuss the factors affecting consciousness.	• Describe the function of the reticular activating system. • Define the normal sleep patterns. •	
Special senses and other	• Describe the physiology of the perception of light and colour. • Describe the mechanisms of visual accommodation. • Describe the physiology of taste and smell sensation. • Describe the physiology of hearing.	• Discuss the physiology of posture maintenance and balance. • Discussion the function of bulbar reflexes. • Describe the physiology of pain perception and modulation.	
Neuroendocrine	• Describe in detail the hypothalamic pituitary axis. • List the hormones released by the pituitary and the functions on the		• Discuss the functions of the pineal gland.

	end organs. • Discuss the diurnal variation in hormone production. • Describe the hypothalamic and pituitary regulation of the reproductive cycle. • Describe the regulation of adrenal function.		
SYLLABUS MODULE – NEURORADIOLOGY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Plain Xrays of the Skull and Spine	• Discuss the indications and limitations of plain radiography. • Identify the important bony landmarks in plain Xrays of the skull and spine. • Discuss the indications for spinal Xrays following trauma. • Describe the views of plain cervical spine and lumbar spine series and identify the normal anatomy. • Identify the radiological features of common spinal fractures and common spinal disorders. • Discuss the radiological determination of spinal stability following trauma. • Demonstrate a working knowledge of an image intensifier and basic radiation safety involved in its use.	• Discuss the plain Xray features associated with raised intracranial pressure. • Discuss the features of the sella turcica on plain skull Xray and its relevance to neurosurgery.	• Identify normal anatomical variations in complex pathological conditions identifiable on plain radiology, including differential diagnosis. • Describe the application of intraoperative image intensification eg spinal surgery and needle placement for trigeminal rhizotomy.
CT Scanning	• Describe in detail the physics and principles of CT scanning. • Discuss the development and evolution of CT scanning systems. • Discuss the role of Hounsefield in radiology and define the Hounsefield	• • Describe the levels and window settings for CT scanning and how they can be manipulated to gain maximum information. • Discuss the principles of image manipulation, 3D reconstruction and CT angiography.	• Demonstrate the manipulation of CT images to obtain data for frame based and frameless stereotaxy. • Demonstrate the ability to accurately interpret radiological examinations of neurosurgical patients.

	Unit. • Describe current CT scanning technology eg helical scanning, multislice scanning. • Identify the detailed anatomy of a normal cranial CT scan. • Describe the indications for cranial CT following head injury. • Describe the indications for CT scan of the spine following trauma. • On abnormal CT scans, identify the following: • skull fractures • intracranial haematomas • subarachnoid haemorrhage • ischaemic and venous infarction • tumours and cysts • hydrocephalus • Discuss the uses, indications and risks of contrast agents in CT scanning	• Identify spinal traumatic injuries of the cervical, thoracic and lumbar spines in CT scans, including vertebral body fractures (and subtypes) facet fractures and dislocations, posterior element fractures, vertebral subluxation/dislocation. • Describe radiological findings of traumatic craniovertebral junction, atlantoaxial and subaxial injuries.	• Critically appraise latest developments in the technology of CT scanning. • Discuss the application of CT angiography and compare it with conventional and magnetic resonance angiography.
MRI	• Describe the underlying principles of MRI. • Demonstrate the ability to identify normal anatomical structures on MRI. • Discuss the conditions for which MRI is superior to CT imaging. • Discuss the conditions for which MRI is inferior to CT imaging. • Discuss the risks and limitations of MRI. • Discuss the types and use of contrast in MRI. • Describe commonly used pulse sequences and standard MR protocols. • Identify the following pathological conditions shown on MRI: • Infarction • intracranial haemorrhages	• Discuss the risks and limitations of MR scan in patients with aneurysm clips. • Discuss spatial inaccuracies in MR scanning and its effect of stereotaxy. • Discuss the use and limitations of MRI in head and spinal trauma. • Demonstrate the ability to recognize detailed neuro-anatomy as shown by MRI. • Describe MRI appearance of spinal ligament injury, traumatic disc herniation, spinal cord contusion and spinal epidural haematoma. • Use MRI imaging findings to differentiate different types of focal intracranial lesions (neoplastic, inflammatory, vascular) based on anatomic location (e.g. intra- vs. extra-axial), contour, intensity and enhancement pattern. • Identify and differentiate on MRI diffuse intracranial abnormalities (e.g. hydrocephalus and atrophy). • Identify treatment-related findings on MRI (e.g. post-surgical and post-radiation).	• Describe how pulse sequences are combined to produce effective and efficient imaging protocols for common disease processes. • Discuss the applications of spin echo, gradient echo, inversion recovery, chemical shift imaging, suppression techniques, high-speed imaging, and evolving sequences. • Identify degenerative spinal conditions on MRI, including disc degeneration, disc herniation, degenerative spinal stenosis, facet hypertrophy, osteophyte formation, foraminal stenosis, spondylolisthesis, and ossification of posterior longitudinal ligament. • Discuss the uses and limitations of diffusion/perfusion MRI, functional MRI and MR spectroscopy. • Demonstrate the use of CT and MRI

	• infections • tumours • cysts • congenital abnormalities • Identify the signal characteristics of intracranial haemorrhage of different ages on MR scans. • Discuss the specific contraindications to a patient having MR scan.		sequences in image guided surgery. • Discuss the application of MR angiography and compare it with conventional and CT angiography.
Cerebral and Spinal Angiography	• Describe the evolution of angiographic techniques. • Describe the principles underlying equipment used for angiography e.g. Digital Subtraction Angiography. • Discuss the use of current angiographic techniques. • Describe detailed cerebral vascular anatomy on angiography. • Demonstrate a detailed understanding of the current indications, limitations and risks of angiography. For example, be able to identify all relevant extra- and intra-cranial arteries (secondary and tertiary branches of the carotid and basilar arteries) and veins (cortical and deep cerebral veins) on angiography.	• Identify uncommon vascular anatomical variations on angiography. • Identify anterior and posterior circulation aneurysms and other vascular anomalies.	• Identify normal and abnormal spinal vascular anatomy on angiography.
Interventional Neuroradiology	• Discuss the interventional techniques available in neuroradiology.	• Discuss the radiological equipment facilitating interventional techniques e.g. 3D versus biplanar versus uniplanar imaging. • Describe the indications, risks and benefits for neurointerventional procedures including embolization, angioplasty and stenting. • Discuss different types of available endovascular coils and their uses. • Discuss the uses and limitations of balloon technology in interventional radiology. • Discuss the uses, risks and limitations of stents in interventional radiology.	• Critically evaluate the use of interventional neuroradiology as an adjunct to conventional surgery. • Discuss in detail current indications of this modality for treatment of aneurysms, vasospasm, cranial and spinal vascular malformations, tumour embolization, carotid and vertebral stenosis, carotid and vertebral dissection. • Discuss the endovascular management of dural malformations and caroticocavernous fistulae.

		• Discuss the uses, risks and limitations of glues, particles and other embolic material in interventional radiology.	• Compare and contrast surgical and endovascular treatment of intracranial aneurysms. • Discuss the role of embolization and endovascular techniques in the management of AVMs. • Discuss the role of embolization and endovascular techniques in the management of intracranial and spinal tumours.
Radiographic Contrast Agents	• Discuss the basic chemical properties of radiographic contrast agents currently used for angiography, myelography, CT and MRI. • List the most commonly used contrast agents and discuss the properties of each. eg. Non ionic iodinated contrast media. Gadolinium. • Describe the features and management of contrast reaction. • List the indications, contra indications and risks of contrast agents.	• Discuss confounding factors influencing the use of contrast agents in radiology (e.g. renal function, age and iodine allergies).	
Ultrasound and Doppler	• Describe the principles of ultrasound, Doppler, how it works, and its limitations.	• Describe the neurological applications of ultrasound (for example its use in neonates and intra-operative ultrasound).	• Describe the technique and the uses and limitations of a transcranial Doppler.
Subarachnoid Contrast Agents	• Discuss the historical uses and application of ventriculography. • Discuss the current application indications and risks of myelography and cisternography.	• Identify normal and pathological findings on myelography.	•

SYLLABUS MODULE – NUCLEAR MEDICINE			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Radionuclide Imaging	• Discuss the various radiopharmaceuticals available and list those most commonly used eg. Technecium-99m-hexamethylpropyleneamineoxime (Tc-99m-HMPAO), Tc-99m-ECD, Tc-99m-DTPA. • Describe the function of the gamma camera. •	• Discuss the use of radionuclide cisternography in the diagnosis of normal pressure hydrocephalus and identification of cerebrospinal fluid (CSF) leaks. (In-111-DTPA). • PET scanning; SPECT scan • Discuss the history and the principles of Positron Emission Tomography. Describe the radiopharmaceuticals used in this technique, for example FDG (fluorodeoxyglucose) • Describe the function of a cyclotron and how this contributes to the clinical uses of PET scanning. • Discuss the clinical application of nuclear bone scans. •	• Discuss this technique in evaluating lung function, particularly as this applies to pulmonary embolus. For example, use of inhaled Xe-133 and intravenous Tc-99m-MAA. •
PET scanning; SPECT scan	• Describe the principle of Single Photon Emission Computered Tomography. • Discuss the radio pharmaceuticals used and understand the clinical indications, uses and limitations of this technique.	•	• Discuss the clinical applications of PET scanning, together with advantages, limitations and cost. •
SYLLABUS MODULE – OPERATIVE NEUROSURGERY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Surgical ligatures, knots, stapling devices and tissue glues	• Describe different types of suture materials, their uses, advantages and disadvantages. • Describe different surgical needle profiles, their uses, advantages and disadvantages. • Demonstrate different types of	• Discuss the origins, applications and limitations of different types of tissue glues. • Demonstrate cosmetic repair of facial wounds.	• Demonstrate rapid, precise and dexterous suture and knot tying techniques by all methods (hand and instrument ties).

	suturing techniques, including interrupted and continuous, simple, mattress and subcuticular. • Demonstrate dexterity with use of needle holders, forceps and standard surgical instruments, and detailed understanding of their appropriate applications. • Demonstrate hand-ties and instrument ties of sutures in dextrous manner and describe the applications of each. • Demonstrate use of skin staples. • Demonstrate use of basic micro-dissection instruments, including micro-suction, scissors and bayonette instruments. • Demonstrate careful and atraumatic tissue-handling techniques. • Expertly perform wound debridement, wound closure in layers and routine layered closure of standard cranial and peripheral surgical exposures.		
Haemostasis in neurosurgery	• Describe the physiological processes involved in clotting, including the intrinsic and extrinsic coagulation cascades, platelet and endothelial factors. • Describe the composition, mechanism of action, advantages and disadvantages of common neurosurgical haemostatic agents including oxidised cellulose, fibrillary collagen, gelatin sponge, and topical thrombin. • Define the haematological parameters of normal coagulation, and the acceptable range of these parameters for the safe performance of intracranial neurosurgery.	• Describe haemostatic techniques previously used commonly in neurosurgery, such as muscle stamps and hydrogen peroxide, and their application to modern neurosurgery. • Discuss techniques for definitive control of bleeding from a venous sinus. • Demonstrate effective haemostatic techniques as applicable to surgery for head injuries and intracranial haematoma. • Describe the types and applicability of wound drains to neurosurgical practice, their management, risks and complication avoidance.	• Demonstrate competency in obtaining effective and safe haemostasis in cranial and spinal surgery. • Describe techniques available for haemostasis following injury to major intracranial arteries. • Describe considerations relating to sacrifice of intracranial veins and venous sinuses.

	• Describe the factors which may predispose a patient to coagulopathy and the investigation and management of this. • Describe the investigation of abnormal haemostasis. • Describe the effects of common medications (including aspirin, low-dose heparin, low-molecular weight heparin, and warfarin) on haemostasis, investigation for these effects and management of coagulopathy due to these medications.		
Thrombo-embolic prophylaxis	• Discuss the management of a patient with pulmonary embolism after craniotomy. • Describe risks and benefits of types of anticoagulation for thrombo-embolic complications following surgery. • Discuss in detail the various methods (including drugs and mechanical devices, physiological manipulations) of thrombo-embolic prophylaxis available and their applicability to neurosurgical practice. • Identify neurosurgical conditions and individual patient factors which pre-dispose to thrombo-embolism, and recommend appropriate prophylaxis. • Identify the clinical features suggestive of thrombo-embolic complications, and perform appropriate investigation and management. • Describe in detail reversal of the effects of different types of anticoagulants and anti platelets agents in both emergency and	• Describe potential alternatives to anticoagulation for management of major venous thromboembolism. • Discuss appropriate management of DVT with no embolic complications following neurosurgery.	• Discuss appropriate prophylactic and therapeutic measures for arterial thromboembolism during and after intracranial interventional radiological procedures, such and aneurysm coiling, angioplasty and stenting, and thrombolysis of intra-arterial thrombo-embolism.

	elective situations.		
Tracheostomy	• Discuss the indications for a tracheostomy. • Describe the routine nursing management of a patient with tracheostomy. • Describe the common available types of tracheostomy tubes, including cuffed and uncuffed, fenestrated and removable inner tube. Describe the uses, limitations and risks associated with each type. • Demonstrate the management of a patient in respiratory distress possibly due to occluded tracheostomy tube. • Demonstrate a detailed knowledge of the cervical anatomy as pertaining to tracheostomy.	• Compare and contrast techniques of percutaneous and open tracheostomy. • Describe in detail the technique of open tracheostomy. • Describe the assessment of a patient for removal of tracheostomy.	• Demonstrate an open surgical tracheostomy. • Demonstrate alternative methods to control bleeding from a large thyroid isthmus during tracheostomy. • Discuss the alternative methods of opening the trachea for tracheostomy and the advantages and disadvantages of each method. • Discuss particular considerations for tracheostomy relating to paediatric patients. • Perform an open surgical tracheostomy. • Perform alternative methods to control bleeding from a large thyroid isthmus during tracheostomy.
Approaches to intraventricular lesions			• Demonstrate the foramen of Monro and landmarks in the lateral and 3rd ventricles with a ventriculoscope. •
Approaches to the brainstem			• Demonstrate the exposure of the cranial nerve attachments to the pons and medulla. • Describe the removal of a brain stem cavernoma.
Infection avoidance in neurosurgery	• Discuss in detail the methods of infection avoidance in neurosurgery. • Demonstrate uncompromising sterile technique in the operating room and during bedside procedures. • Discuss the aseptic management of CSF drains in the neurosurgical ward. • Describe the CSF parameters indicative of meningitis following a neurosurgical procedure.	• Discuss the role of prophylactic antibiotics in neurosurgery, evidence for their effectiveness, and risks associated with their use. • Discuss the role of patient health (including compromised states), drugs, radiotherapy and implants on the risk of surgical infection, and appropriate prophylactic measures • Compare and contrast different types of skin antiseptic preparation for neurosurgical procedures. • Discuss the evidence for the use of occlusive incise drapes.	• Discuss evidence for and against shaving the scalp for intracranial surgery.

Approaches to abdominal and thoracic cavities	• Describe the anatomy of the anterior abdominal wall and the chest wall with particular reference to the layers encountered and relations of vital structures encountered during access to these cavities. • Describe appropriate methods of layered closure of abdominal and thoracic cavities, including use of drains and suture types/techniques.	• Demonstrate proficient closure of thoracic/abdominal wall, for example, following VP shunt insertion or thoracotomy. • Discuss advantages and disadvantages of different types of approaches to plural and peritoneal cavity. •	
History of neurosurgery	• Discuss neurosurgery in antiquity. • Demonstrate appreciation of contributions of surgeons at the turn of the 20th century to neurosurgery, such as MacEwan and Horsely. • Discuss the contributions of Cushing and Dandy to the development of neurosurgery.	• Discuss the contributions of Yasargil and Drake to the development of microsurgical technique.	• Discuss specific published neurosurgical anatomy papers (e.g. the work of Rhoton). • Discuss the history of peripheral nerve surgery.
Patient positioning in neurosurgery	• Discuss in detail the devices and techniques for stabilising and holding the head during intracranial neurosurgery and their relevance to different procedures and positions. • Demonstrate proficient and safe use of the Mayfield 3-point head clamp or similar devices. • Describe in detail risks associated with skull-fixation devices during surgery, safe and appropriate pin placement and risks associated with its use. • Position a patient for burr-hole ventriculostomy. • Demonstrate safe and appropriate padding of pressure points and peripheral nerves for neurosurgical cases in the supine, prone and lateral positions. • Demonstrate rapid and safe	• Position a patient in the lateral position for posterior fossa surgery. • Discuss positioning options for surgery in the posterior fossa, including advantages and disadvantages. • Compare and contrast lateral and prone positions for posterior spinal surgery and position patients in these positions. • Discuss the risks and complication avoidance associated with the sitting position. • Demonstrate the appropriate selection and use of cushions and frames for positioning in the prone position for a variety of spinal procedures. •	

	positioning of the patient for large trauma craniotomy, including protecting the cervical spine during intubation and positioning. • Demonstrate the positioning of a patient for a pterional craniotomy. • Discuss appropriate care of the eyes and ears during intracranial surgery.		
Principles of micro neurosurgery	• Describe the design advantages and use of bayonette instruments. • Describe the advantages and disadvantages of the various types of magnification and illumination.	• Discuss the uses of sharp and blunt dissection techniques in the subarachnoid spaces with particular reference to the descriptions of Yasargil. • Demonstrate dexterity with use and selection of basic microsurgical instruments. • Discuss the principles and techniques of microsurgical anastomotic techniques. • Describe in detail techniques available to minimise brain retraction during microsurgical dissection. • Describe in detail exposure and dissection techniques as applied to all anterior circulation aneurysms.	• Demonstrate dexterity of use of microscopic dissection instruments under the operating microscope (eg splitting Sylvian fissure). • Discuss the principles of aneurysm clipping, including the use of temporary clipping and the selection and use of various clips including fenestrated clips. • Demonstrate competence in microscopic dissection technique in elective spinal procedures such and lumbar microdiscectomy and anterior cervical discectomy. • Discuss in detail complex microsurgical approaches including highly selective amygdalohippocampectomy, exposure and clipping techniques for posterior circulation aneurysms, microvascular anastomotic procedures. • Demonstrate microscopic suture techniques of dural closure under operating microscope. •
Surface anatomy	• Demonstrate the surface anatomy of the sylvian fissures, central sulcus, and the occipitoparietal sulcus. • Identify the surface anatomy of the transverse and sigmoid sinuses • Identify the surface anatomy of the sensorimotor cortex and Wernicke's and Broca's areas. • Define the pterion and identify its surface anatomy.	• Define the surface anatomy of the vertebral levels according to landmarks on the anterior aspect of the neck. • Define the vertebra prominens and describe its accuracy in assessment of vertebral levels. • Define the surface anatomy of the thoracic vertebra relative to the sternum. • Describe the surface anatomy of the cervical carotid artery and the level of the bifurcation. • Describe the surface anatomy of the internal jugular	• Describe the relations of the foramen magnum, and demonstrate a cisternal puncture. • Demonstrate surface representation on the scalp of lesions identified on CT and MRI, their relationship to eloquent brain, and perform appropriately placed craniotomy. • Perform the appropriately placed craniotomy and dural opening for a

	• Define the surface anatomy of the lumbar vertebrae and of the conus medullaris. • Demonstrate a safe diagnostic lumbar puncture. • Demonstrate the surface anatomy of the carpal tunnel and the neural and vascular structures at the wrist. • Describe the surface anatomy of the major peripheral nerves, including median, ulnar, radial, sciatic, medial and lateral popliteal (common peroneal), femoral, saphenous and sural nerves. • Demonstrate the cutaneous distribution of the sensory distribution of the major peripheral nerves, including median, ulnar, radial, sciatic, medial and lateral popliteal (common peroneal), femoral, saphenous and sural nerves and perform a full clinical examination of these nerves. • Demonstrate the dermatomes and the cutaneous sensory distribution of the cranial nerves. • Demonstrate the traditional points for diagnostic burr-holes used in trauma patients prior to scanning availability. • Discuss the reasons for their positions, the order of insertion, and the scalp incisions used for them and how these incisions could be extended for craniotomy.	and subclavian veins, their relationships to adjacent structures, and be able to demonstrate the safe insertion of central venous catheter into both of these veins. • Describe the surface anatomy of the thoracic cavity, including the diaphragm and internal mammary arteries. • Demonstrate safe insertion of an intercostal catheter and discuss placement options for drainage of haemothorax and pneumothorax. • Demonstrate the safe insertion of a lumbar drain using surface landmarks. • Describe the vascular and neural supply of the scalp, and discuss their importance in relationship to various scalp incisions used for craniotomy.	transcallosal approach to the third ventricle, with particular reference to the surface anatomy and venous anatomy. • Perform the appropriately placed craniotomy and dural opening for microvascular decompression of the fifth nerve, with particular reference to the surface anatomy and venous anatomy.
Craniotomy Flaps	• Describe in detail the technique of pterional craniotomy and its application to microsurgical exposure of the basal cisterns. • Describe the arterial and nervous anatomy as it relates to craniotomy	• Describe the implications of previous surgery in the position of skull flaps and craniotomy. • Demonstrate standard pterional craniotomy and craniotomies for a variety of supratentorial approaches, with particular attention to skin incision placement and appropriate placement of the bone	• Demonstrate a variety of supratentorial and posterior fossa craniotomies in preparation for standard neurosurgical elective and trauma procedures. • Cortical incisions • Describe the anatomy of the major white

	flaps and scalp flaps. • Discuss the significance of the size and shape of scalp flaps. • Describe the placement and bony anatomy of a pterional craniotomy. • Describe the placement of a trauma craniotomy for large acute hemispheric subdural haematoma. • Demonstrate the safe use of perforators and burrs using a Hudson brace, twist drill craniostomy and craniotomy using high-speed craniotome. • Demonstrate the use of the Gigli saw for craniotomy. • Compare and contrast the technique of free bone flap and pedicled bone flap for use in routine neurosurgical procedures. • Describe the anatomical factors relevant to dural opening in craniotomies.	flap. • Demonstrate a midline posterior fossa craniotomy. • Describe different posterior fossa craniotomies in detail for access to different areas of the posterior fossa. • Compare and contrast posterior fossa craniotomy with craniectomy in evidence-based terms. • Discuss the options for securing craniotomy flaps, and compare the results in terms of stability, cosmesis, infection, and other complications.	matter tracts in the cerebral hemisphere, and which parts of those carry significant motor or special sensory pathways and the deficit likely to be caused if these are injured. • Perform appropriate cortical incision for microscopic resection of a lesion (eg metastasis) from eloquent cortex. • Discuss the variety of means by which eloquent cortex can be localised, and the accuracy, reliability and applicability to neurosurgical procedures.
Cortical incisions	• Describe the topographical anatomy of the cerebral hemispheres with respect to localisation of eloquent cortex. • Describe the anatomy of a typical cerebral gyrus and adjacent sulci with respect to the thickness of the cortex and the local blood supply, and indicate how this may affect choice of alignment of cortical incisions.	• Describe the preferred alignment and placement with respect to sulci/gyri of a cortical incision into eloquent cortex. • Describe the preferred orientation of a cerebellar incision for access to a deep lesion • Describe the measurements from known landmarks which may be used to define eloquent cortex	
Lobectomy and Surgery for intra-axial lesions of the cerebral and cerebellar hemispheres	• Describe the anatomical boundaries to the cerebral lobes and their relationship to the skull bones/sutures and identify the areas of eloquent cortex. • Define the extent of a traditional frontal lobectomy relative to the	• Describe the tests which may be used to identify the location and extent of Wernicke's area with reference to temporal lobectomy. • Perform appropriate craniotomy and expose the brain and identify the extent of resection for a frontal and temporal lobectomy. • Describe the anatomy of structures on the medial	• Demonstrate a traditional frontal lobectomy. • Discuss the differences in aims and extent of resection in a temporal lobectomy for treatment of mesial sclerosis and low grade glioma.

	cranial vault and identify which parts of the frontal lobe are removed and which are resected. • Discuss the deficits which are likely to result from complete anatomical removal of the dominant temporal lobe. • Describe the extent of resection of the temporal lobe in a traditional temporal lobectomy, the measurements used for this, and whether this varies according to side.	aspect of the temporal lobe, the deficit caused if these are injured, and techniques to minimise risk of injury during temporal lobectomy. • Describe the anatomy of structures on the medial aspect of the frontal lobe, the deficit caused if these are injured, and techniques to minimise risk of injury during frontal lobectomy. • Describe the extent of the ventricular system in the cerebral hemispheres, and whether this is expected to be opened in a classical frontal and temporal lobectomy. • Discuss complications which may arise from opening the ventricular system during a lobectomy and methods by which these complications may be avoided	
Approaches to intraventricular lesions	• Demonstrate the appropriate position to place a burr-hole for ventricular puncture through a frontal approach and also through a parieto-occipital approach. • Compare and contrast twist drill craniostomy and burr hole for ventricular access. • Describe the surface landmarks and orientation of the trajectory for ventricular puncture. • Define the normal thickness of the cerebral mantle and appropriate lengths of catheters for ottimal ventricular placement using these approaches.	• Reliably demonstrate insertion of ventricular catheter (via both the frontal and parieto-occipital approaches), using surface landmarks. • Discuss in detail the advantages and disadvantages of the transcortical and transcallosal approach to the foramen of Monro (eg for colloid cyst resection). • Perform an appropriately placed craniotomy in preparation for colloid cyst resection. • Discuss the microsurgical access to lesions in the 4th ventricle, including whether incision of the vermis is required. • Discuss the site and trajectories which could be chosen for ventriculoscopy for lesions in various parts of the lateral ventricle. • Describe the significant features identifiable at surgery in the lateral ventricle and how to use them to navigate within the ventricle.	• Demonstrate exposure of the foramen of Monro by both transcerebral and transcallosal techniques. • Discuss in detail the variety of microsurgical approaches to the 3rd ventricle, their particular indications, risks and specific complications associated with them. • Describe in detail third ventriculostomy, including indications, ventriculoscopic and open methods, and specific risks and complications. • Discuss the surgical approaches to a lesion in the trigone of the left lateral ventricle, including the relative advantages and disadvantages of each. • Describe in detail the anatomy of the foramen of Monro, surgical methods of improving access from the lateral into the third ventricle, and problems associated with injury to structures in the region. • Demonstrate the exposure and identification of structures in the floor of the fourth ventricle.
Approaches to the	• Describe the gross anatomy of the	• Describe the anatomy of the floor of the fourth	• Describe the various approaches for open

brainstem	brain stem, cranial nerves and vascular structures of the posterior fossa. • Describe the anatomy of the cisterns adjacent to the brainstem. • Describe the relationships of the brainstem to the skull base, in particular to the posterior clinoids, petrous apex, clivus and foramen magnum.	ventricle. • Describe the brainstem nuclei and pathways at each level in the brainstem. • Describe the blood supply to the brainstem.	surgical exposure to the brainstem. • Discuss localisation of pontomedullary lesions according to visible landmarks on the floor of the 4th ventricle. • Demonstrate a framed stereotactic biopsy of a pineal lesion.
Surgical approaches to the spine	• Discuss the particular anatomical differences in the cervical, thoracic and lumbar spine and their influence on choice of approach to the disc space at each level. • Demonstrate exposure of the posterior aspect of the spinal column in preparation for laminectomy • Decompression of spinal cord • Describe the anatomical extent of the spinal cord, the relationship of neurological level and vertebral level, and the blood supply to the cord	• Describe the approach to the anterior cervical column, the anatomical relationships to this approach and specific risks and complications. • Describe the alternative surgical approaches for thoracic discectomy. • Describe the relationship of the ribs to the thoracic disc space, and methods of accurately determining the level during surgical discectomy.	• Discuss the options for surgical access to the anterior aspect of the upper thoracic spine. • Discuss surgical approaches to the anterior aspect of the thoracolumbar junction. • Describe the surgical options for exposure of the anterior aspect of the upper cervical spine (C1, C2, C3). • Describe the anterior relationships to the lumbosacral lesion.
Surgical approaches to the spine			• Demonstrate thoracic discectomy by different approaches. • Demonstrate the set up and surgical exposure for odontoid screw fixation. • Demonstrate the exposure and insertion of lumbar pedicle screws.
Approaches to the pineal gland		• Describe the anatomical relations of the pineal. • Describe the anatomy of the infratentorial space, and structures which would be encountered in approaching the pineal by this route. • Discuss the advantages and disadvantages of stereotactic biopsy of a pineal tumour. • Discuss the different approaches available for exposure of the pineal and the advantages and disadvantages of each (include infratentorial and	• Demonstrate the positing of the patient in each of the possible positions for access to the pineal, and be able to discuss with the anaesthetist specific problems which may be encountered during the procedure and how to minimise the risks of these complications. • Demonstrate the craniotomy in preparation for a pineal tumour by both

		transtentorial approaches). • Describe in detail the positioning options for the each of the different approaches to the pineal, and the advantages and disadvantages of each.	the infra- and supratentorial approach. • Discuss the options for the trajectory for a framed stereotactic biopsy of a pineal lesion, and the relative risks and merits of each approach. • Demonstrate a stereotactic biopsy of a pineal lesion. • Demonstrate the infratentorial exposure of the pineal region.
Decompression of spinal cord		• Demonstrate a cervical laminectomy.	• Demonstrate anterior cervical discectomy, fusion and stabilization. • Describe in detail the method of thoracic discectomy using both costotransversectomy and transthoracic approaches. •
Decompression of cauda equina and spinal nerves	• Define the anatomical relationship of the spinal nerve roots to the disc spaces in the cervical, thoracic and lumbar spine. • Describe in detail the pathological changes in lumbar canal stenosis, and their implications for surgery. • Describe the typical surgical approach to extradural compressive lesions of the cauda equina.	• Demonstrate the exposure, and accurately identify the nerve root for a lumbar microdiscectomy. • Perform a decompressive lumbar laminectomy. • Describe radiological findings of intradural and extradural compression of the cauda equina.	• Demonstrate a lumbar microdiscectomy and neurolysis . • Demonstrate intradural exposure of the cauda equina and perform precise anatomical closure. • Discuss the management options for intra-operative dural tear and CSF leak. • Spinal stabilisation and fusion techniques • Demonstrate the exposure of the atlanto-occipital junction for stabilisation procedure. • Describe the methods of C1/2 stabilisation in detail. • Describe the procedure of odontoid screw fixation. • Describe the entry points, trajectories, and complication avoidance techniques for cervical stabilisation using lateral mass screws and C1/2 transarticular screws. • Describe surgical options for stabilisation of the thoracic spine. • Describe the anatomical landmarks, technique and complication avoidance strategies for the insertion of lumbar

			pedicle screws. • Demonstrate anterior cervical discectomy fusion and instrumentation.
Spinal stabilisation and fusion techniques	• Define the terms spinal instability, spinal fusion, and spinal internal fixation (stabilisation). • Define the terms spondylolisthesis and spondylolysis, and any relationship they may have. • Discuss different types of spinal fusion. • Define the role of the various structural elements of the spine (joints, ligaments, discs) in maintaining physiological stability. • Demonstrate familiarity and understanding of the role of external spinal orthosis (collars and braces), and their suitability for management of instability at different spinal levels. • Demonstrate the application of cervical traction and describe the management in terms of nursing care and recommended weights for management of cervical subluxation • Demonstrate the application of a halo-thoracic brace	• Discuss the surgical options for management of lumbar canal stenosis with associated minor (Grade 1) degenerative spondylolisthesis, including the advantages and disadvantages of the different management options. • Describe anterior cervical discectomy and fusion by Cloward, Smith-Robinson and interbody cage techniques. • Compare and contrast the options of anterior cervical discectomy with and without fusion. • Define factors which affect bone union following spinal fusion. • Discuss the options for reduction of cervical subluxation with jumped facets. • Define the named fracture types involving C1 and C2, and the treatment options available for each	• Demonstrate the anatomical landmarks, technique and complication avoidance strategies for the insertion of lumbar pedicle screws. • Discuss the potential advantages and disadvantages of lumbar interbody fusion compared to posterolateral fusion. • Discuss the mechanism of stabilisation utilised by inter body devices, and compare their effectiveness with other techniques in the lumbar and cervical regions.
Surgical equipment	• Describe the history and development of surgical diathermy. • Discuss the differences between bipolar and monopolar diathermy and the application of each to safe neurosurgical practice. • Describe the difference between cutting and coagulation settings of diathermy. • Describe the surgical risks of diathermy including micro-shock and burns.	• Discuss effects of diathermy on bleeding dural sinuses. • Demonstrate the use and limitations of the neurosurgical operating microscope. • Describe the mechanism of action of the surgical ultrasonic aspirator, its uses and limitations. • Demonstrate frameless stereotactic localisation, including data acquisition, data transfer, registration and localisation. • Demonstrate framed stereotactic localisation, including frame application, data transfer and coordinate computation, and localisation.	• Demonstrate stereotactic biopsy of intracranial lesions. • Demonstrate frameless stereotactic localisation in spinal surgery. • Demonstrate use of the operating microscope with complete familiarity. • Demonstrate accurate use of high speed air drill in bone dissection for basic skull base exposure and in spinal applications. • Describe the procedure of electrophysiological localisation for functional stereotactic surgery.

	• Describe factors affecting risk of fire hazard in surgery. • Demonstrate safe and effective use of surgical diathermy, using monopolar and bipolar in appropriate circumstances. • Demonstrate the setup and balancing of the neurosurgical operating microscope, and be able to drape it in a sterile manner. • Describe the principles of stereotaxy, and how this is practically applied using framed and frameless stereotaxy. • Describe the mechanical principles of the high-speed air drill, and of cutting and diamond burrs. • Demonstrate safe use of Hudson Brace the perforator and burr, Gigli saw and the high-speed air craniotomy.	• Demonstrate the use of a high speed air drill for accurate bone dissection in the laboratory and in cranial and spinal applications. • Describe the mechanisms of action and use of the radiofrequency generator. • Discuss the principles and uses of ultrasound in neurosurgery. •	• Demonstrate a percutaneous rhizotomy of the trigeminal ganglion. • Discuss the surgical application of lasers, including risks, uses and limitations
Skull base surgery	• Define the skull base	• Describe the detailed anatomy of the skull base and upper cervical spine, including neurovascular relationships, and also relationships to orbital, facial, subtemporal and oro-pharyngeal structures. • Describe the history and anatomical principles in trans-sphenoidal surgery. • Describe skull base methods utilised for resection and repair of lesions involving the frontal sinus. • Describe the approaches and potential complications of different surgical approaches to the pituitary fossa.	• Discuss the options for resection of lesions in the cavernous sinus. • Describe the trans-oral and mid-facial approaches to the skull base. • Discuss the relative merits and risks of the retrosigmoid, translabarynthine, far-lateral (trans-condylar) and transpetrosal approaches to parts of the brain stem, with particular reference to which areas are well exposed and which are not. • Describe the approaches for skull base craniotomies, including anterior fossa floor, orbitozygomatic, petrosal and far-lateral (transcondylar) posterior fossa approaches. • Demonstrate the trans-oral and mid-facial approaches to the skull base. • Demonstrate the retrosigmoid and far-lateral (trans-condylar) approaches to parts of the brain stem.

			• Demonstrate the approach for skull base craniotomies, including anterior fossa floor, orbitozygomatic, petrosal and far-lateral (transcondylar) posterior fossa.
SYLLABUS MODULE – PAEDIATRIC NEUROSURGERY AND DEVELOPMENTAL NEUROLOGY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Neurological evaluation	• Describe the normal milestones of neurological development in the infant. • Describe the normal neurological examination of a neonate. • Describe the Babinski, Morrow, stepping and grasp reflexes at different ages. • Define the Apgar score. • Describe modifications of the Glasgow coma score for use in paediatrics. • Describe normal and abnormal states of the fontanelles.	• Describe normal child hood and adolescent neurological development.	• Describe normal child hood and adolescent neurological development.
Neural tube defects including spinal dysraphism	• Describe the risk factors associated with the development of neural tube defects. • Describe the spectrum of neural tube defects. • Discuss the significance of sacral skin lesions in infants. • Define diastematomyelia.	• Discuss the early management of spina bifida cystica. • Describe the intracranial anomalies commonly associated with spina bifida. • Discuss the presentation and management of lumbosacral lipomata.	• Discuss the clinical features, causes, diagnosis and management of tethered cord syndrome. • Discuss the specific problems and management associated with spina bifida in late childhood and adolescence. • Discuss the features on neurological and radiological diagnosis of major prognostic significance in a neonate with encephalocele. • Demonstrate the closure of all types of neural tube defects including techniques of skin coverage.
Craniovertebral	• Define the classification of Chiari	• Describe the clinical features of the various types of	• Discuss the management options for

junction anomalies	malformations.	Chiari malformations at different ages.	hydrocephalus associated with Chiari malformations. • Discuss the management options for syrinx associated with Chiari malformations. • Discuss platybasia and basilar invagination and their associations.
Hydrocephalus	• Describe normal CSF production, circulation and absorption. • Discuss the classification of hydrocephalus. • Discuss the causes of neonatal hydrocephalus. • Discuss the different management options for different types of hydrocephalus.	• Compare and contrast different shunt techniques such as VP, VA and LP diversions. • Discuss the indications and contraindications of third ventriculostomy. • Define the slit ventricle syndrome. • Define Dandy-Walker malformation. • Discuss aqueduct stenosis. • List the complications of shunt insertion.	• Describe the technique of third ventriculostomy. • Demonstrate the insertion of a VP shunt. • Discuss the different types of shunting systems available. • Discuss the options of flow and pressure regulated shunts. • Discuss in detail the management of an infected shunt. • Discuss treatment options for slit ventricle syndrome.
Craniosynostosis	• Describe the normal ages at which the sutures close	• Discuss the theories regarding premature suture closure. • Discuss the various types of craniosynostosis and their clinical features. • Discuss the indications for treating craniosynostosis. • Discuss the relationship of craniosynostosis and intracranial pressure.	• Describe the named craniofacial disorders associated with craniosynostosis. • Describe the spectrum of management techniques for craniosynostosis. • Discuss management of complex craniofacial dysmorphic syndromes. • Demonstrate the surgical management of sagittal craniosynostosis.
Arachnoid cysts	• Describe the common locations of arachnoid cysts. • Discuss the theories regarding formation of sylvian arachnoid cysts. • Describe clinical features that may be associated with arachnoid cysts.	• Discuss the indications for treatment of an arachnoid cyst. • Discuss the management options for a symptomatic arachnoid cyst.	• Compare and contrast techniques of shunting and fenestration of arachnoid cysts.
Paediatric trauma	• Discuss aspects of head injuries peculiar to children. • Discuss aspects of general trauma management peculiar to children. • Discuss the normal radiological appearance of the cervical spine in	• Describe the clinical and radiological features of shaken baby syndrome. • Discuss the features suggestive of child abuse. • Define a growing fracture and discuss its management.	• Discuss post traumatic brain swelling in infancy and its management. • Describe the methods of performing cranioplasty in children of various ages.

	infancy and childhood. • Describe the age at which there would be complete ossification of C2.		
Miscellaneous	• Discuss the common spectrum of paediatric CNS tumours. • Contrast the features of common paediatric gliomas compared to adult gliomas. • Describe the thickness of the cerebral mantle in childhood. • Describe in detail the clinical features of paediatric meningitis and its management. • Discuss the issues regarding consent in minors.	• Discuss differences in the management of gliomas between children and adults. • Discuss the effects of radiation on the developing brain. • Discuss differential diagnosis of fourth ventricular tumours. • Define holoprosencephaly. • Discuss the various neurological manifestations of in-utero infections.	• Discuss the management of subdural empyema in children. • Diiscuss the prognostic factors of paediatric fourth ventricular tumours. • Discuss dysembryoplastic neuroepithelial tumours (DNET) and their management. • Discuss surgical options for the treatment of epilepsy in children.
SYLLABUS MODULE – PAIN			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Pathophysiology of pain	• Describe the anatomy of pain pathways within the peripheral and central nervous systems. • Describe the physiology of nociception. • Describe the clinical features of the basic pain syndromes, including: • acute • chronic • nociceptive • neuropathic (including complex regional pain syndromes) • musculofascial • malignant	• Explain how central or spinal neurostimulation is thought to modulate pain perception.	• Discuss the role of the autonomic nervous system in chronic pain. • Describe subcortical and brainstem sites that appear to be involved in the modulation of nociception to targets for deep brain stimulation for pain control. • Describe the functional anatomy of the thalamic nuclei. • Discuss the possible therapeutic interventions for pain management related to thalamic nuclei.
General and psychosocial factors	• Discuss the interaction of physiological, pathological and psychosocial components of pain.	• Discuss methods of assessing outcomes of pain management. • Describe commonly used pain and disability	• Discuss specific problems associated with inappropriate post operative pain management.

in pain management	• Explain the rationale for multidisciplinary management of pain disorders. • Discuss controversies associated with pain management following intracranial and spinal surgery.	assessment scales.	• Describe the specific clinical features of various types of non organic pain-type behaviour. • Describe the clinical features of drug dependence.
Analgesics and pain relief	• Describe the major classes of medications commonly used for pain treatment eg. opioids, nonsteroidals and paracetamol, antidepressants, anticonvulsants. • Describe the pharmacology of local anaesthetic agents (e.g., lignocaine, marcain) and the use of adrenaline with local anaesthetic agents.	• Describe the mode of action of the major classes of medications listed in level one.	• Describe the indications, contraindications, drug interactions and side effects of the major classes of medications listed in level one.
Facial pain including trigeminal neuralgia	• Describe in detail the surgical anatomy of the trigeminal nerve. • Describe the clinical features of trigeminal neuralgia, trigeminal neuropathic pain, and atypical facial pain. • Discuss the medical management of trigeminal neuralgia.	• Describe the percutaneous techniques of trigeminal rhizotomy including radiofrequency, glycerol and balloon compression. • Describe alternative procedures to the peripheral branches of the trigeminal nerve. • Describe and contrast the approaches to the cerebellopontine angle for microvascular decompression or rhizotomy of the trigeminal and glossopharyngeal nerves.	• Demonstrate percutaneous techniques of trigeminal rhizotomy including radiofrequency, glycerol and balloon compression. • Discuss the potential complications of percutaneous procedures for trigeminal neuralgia. • Hemifacial spasm • Describe microvascular decompression of the facial nerve and complication avoidance. • Discuss the advantages and disadvantages of microvascular decompression versus percutaneous procedures in the management of trigeminal neuralgia. • Discuss the options if no vascular compression is found at MVD surgery. • Demonstrate microvascular decompression of the trigeminal nerve. • Discuss the role of radiosurgery in the management of trigeminal neuralgia. • Discuss the role of intra operative monitoring during microvascular decompression.

Glossopharyngeal neuralgia	• Describe the clinical syndrome and differential diagnosis of glossopharyngeal neuralgia.	• Discuss the medical and surgical management of glossopharyngeal neuralgia.	• Describe the detailed surgical anatomy of the glossopharyngeal and vagus nerves and the appropriate extent of resection for glossopharyngeal neuralgia.
Hemifacial spasm	• Describe the clinical syndrome and differential diagnosis of hemifacial spasm.	• Discuss the medical (including botulinum toxin) and surgical management of hemifacial spasm.	• Demonstrate microvascular decompression of the facial nerve.
Nerve blocks, electrical stimulation and radiofrequency lesions for pain relief	• Describe peripheral nerve blocking procedures including the techniques expected outcomes. • Discuss the potential complications of a peripheral neural blockade (including anaphylaxis, neural injury, and intravascular or intrathecal administration).	• Describe indications for ablative peripheral nerve procedures.	• Discuss the theoretical basis of acupuncture. • Discuss the methods of permanent neural block including neurolytic blocks (eg phenol, alcohol), ablative neurosurgical procedures (eg radiofrequency and neurectomy) and augmentative neurosurgical procedures (eg stimulation). • Review the indications and pathophysiological basis for radiofrequency facet denervation. • Describe the techniques of spinal cord stimulation. • Discuss the role of ablative brain and brainstem procedures (eg cingulotomy, mesencephalic tractotomy, trigeminal tractotomy) in the management of chronic benign pain and cancer pain. • Discuss the role of spinal cord stimulation in the management of pain. • Describe the maintenance and programming of spinal cord stimulation systems. • Discuss the role of peripheral nerve stimulation in the management of pain.
Intraspinal narcotic infusions		• Demonstrate the percutaneous insertion of epidural and intrathecal catheters. • Describe the classes of drugs used for intraspinal administration in the management of pain. • Discuss their mechanism of action. • Discuss the risks and potential complications of	• Discuss the role of intraspinal drug administration in pain management. • Compare the different methods of intraspinal drug administration (eg Epidural vs intrathecal, tunnelled catheter vs implanted infusion system).

		intrathecal drug administration.	• Demonstrate the insertion of an intraspinal drug infusion pump. • Describe the maintenance and programming of spinal drug administration systems. • Recognize and evaluate malfunctions of intraspinal drug administration systems. •
Spinal cord ablative procedures		• Discuss the indications for spinal cord ablative procedures (eg DREZ lesions, cordotomy and myelotomy) in the management of pain.	• Describe the techniques of spinal cord ablative procedures (eg DREZ lesions, cordotomy and myelotomy). • Describe the role of DREZ lesioning in the overall management of the patient with deafferented pain. • Demonstrate the procedure of DREZ lesioning including localization and lesion generation in cases of root avulsion.
SYLLABUS MODULE – PERIOPERATIVE CARE			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
History Examination	• Consistently demonstrate complete history examination and appropriate pre operative workup of all patients, taking into account all body systems and relevant personal and family history. • Consistently demonstrate complete and thorough history and examination of neurological patients presenting for surgery. •		
Blood coagulation and transfusion	• Demonstrate a knowledge of the coagulation pathways. • Describe the indications and complications of a blood, platelet and plasma protein transfusion. • Describe the clinical principles for	• Demonstrate knowledge of the congenital/abnormalities for coagulopathies. • Discuss the indications and mechanisms and risks for intra-operative blood salvage. • Discuss the indications and contra-indications for anti coagulation and anti platelet usage in neurosurgical	

	safe transfusion including appropriate laboratory testing.	patients. • Describe the diagnosis and treatment of disseminated common or severe coagulations (ie DIC).	
D.V.T. and pulmonary embolism	• Describe the pathophysiology of venous thrombosis and the general predisposing factors for a DVT. • Discuss the specific risk factors in neurosurgical patients. • Describe in detail the clinical features and appropriate diagnostic test and treatment of a DVT and pulmonary embolism. • Discuss the clinical indications and trials for DVT Prophylaxis as it relates to neurosurgery.		
Fever in neurosurgical patients	• Discuss in detail causes and appropriate investigations for neurosurgical patients. • Discuss in detail causes of fever in neurosurgical patients and how to diagnosis a CNS. • Discuss the appropriate investigations of a patient with a fever and common organisms in neurosurgical infection. • Discuss of the major class of modern antibiobiotic, antimicrobial spectrum and the associated side effects. • Discuss the use of CSF penetration of the above antibiotics. • Discuss the use of universal precautions in preventing infection.		
Acute Confusion in the Peri Operative Patient	• Discuss indication and risks associated with medical therapy in an agitated patient. • Demonstrate a knowledge of the appropriate pharmacological agents to manage a patient who is agitated. • Discuss the examination and		

	appropriate investigations of the causes of confusion. • Demonstrate an ability to perform a neurological examination in a confused patient.		
Perioperative	• Discuss the incidence and etiological factors of seizures following a craniotomy. • Describe the classification of seizures. • Discuss the knowledge of the common anti-epileptic medications and their side effects. • Discuss the management of a postoperative seizures and seizure control in patients. • Discuss the use of anti-prophylactics and their duration		
Informed consent and medico-legal aspects	• Discuss in detail the concept of informed consent. • Demonstrate an ability to obtain informed consent. • Demonstrate an ability to maintain accurate medical records.	• Demonstrate an ability to interact effectively with a patient and family members following a surgical complication.	• Discuss the importance of tracking morbidity, mortality and patient outcomes. • Discuss the common causes of medical malpractice and effective measures to reduce risk. • Demonstrate an ability to maintain a personal patient morbidity/mortality outcome database. • Discuss current medico legal aspects of informed consent.
Persistent headache after craniotomy	• Demonstrate an ability to perform a neurological examination of a patient with a head ache following a craniotomy. • Discuss the appropriate investigation in a patient with a postoperative headache	• Discuss the incidence and etiological factors of headaches following a craniotomy. • Discuss the knowledge of the common analgesic medication and their side effects to manage a patient with a postoperative headache.	
Intracranial Hypertension	• Describe the pathophysiology of intracranial hypertension.	• Demonstrate an understanding of the appropriate investigation to diagnosis with intracranial	• •

	• Demonstrate an understanding of the clinical manifestation of intracranial hypertension. • Demonstrate an ability to perform a clinical examination and direct emergency management on a patient with intracranial hypertension. Describe in detail the relationship between intracranial hypertension and cerebral perfusion and the appropriate management. • Demonstrate an understanding of the symptoms and signs suggestive of raised intracranial hypertension.	hypertension. • Demonstrate the treatment options for the various causes of intracranial hypertension. • Discuss the common conditions that cause sodium abnormalities. • Discuss the risks and roles of ventricular puncture and lumbar puncture in the presence of intracranial hypertension.	• Demonstrate emergency ventriculostomy. • Describe placement of emergency burr holes. • Discuss in detail the role of decompressive craniotomy and perform this proficiently when appropriate.
Epilepsy after craniotomy		• Discuss the role of prophylactic antiepileptic medication.	• Demonstrate the diagnosis of pseudoseizures and discuss the use and limitations of EEG's. • Discuss the role and controversies associated with prophylactic medication.
Management of peri operative fluid, electrolyte and circulatory status	• Demonstrate the management and diagnosis of circulation disorders. • Post operative fluid requirements in neurosurgical patients. • Identification and management of hyponaraemia, cerebral salt wasting and diabetes inc. • Describe the pathophysiology of hypertension. • Discuss the etiological causes of hypertension. • Demonstrate a detailed knowledge of hemodynamic monitoring. • Demonstrate detailed understanding of water and electrolyte including fluid balances and losses. • Discuss why sodium, magnesium and water balance are particularly important. • Demonstrate a knowledge of the physiology of the hypothalamic -	• Demonstrate knowledge of the etiological cause of DI. • Demonstrate an ability to diagnosis DI.	

	pituitary axis. • Discuss the principle physiology/pathophysiology of water balance. • Discuss the role of mannitol and diuretics in neurosurgery and problems associated with this.		
Peri Operative Steriod Use		• Discuss the indications, benefits and risks for perioperative steroid use.	•
Principles of Discharge Planning and Rehabilitation	• Demonstrate appropriate forward planning in all patients. • Discuss in detail the principles of planning and post operative care as it relates to discharge planning and continuity of care. • Discuss the general principles of rehabilitation. • Discuss in detail the neurobiological process underlying functional brain recovery. • Describe the principles of head injury rehabilitation. • Describe who is the appropriate person to give informed consent.	• Describe the principles of spinal injury rehabilitation and stroke rehabilitation	• Demonstrate an ability to develop patient focused rehabilitation goals and program planning. • Demonstrate an ability to lead a multidisciplinary rehabilitation team
Diagnosis of brain death	• Discuss the indications for brain death. • Demonstrate the formal assessment of brain death.	• Discuss the differences in regional and international legislations relating to brain death. • Demonstrate an ability to examine a patient to determine brain death. • Demonstrate ability to interpret ancillary criteria fro brain death.	• Demonstrate an ability to oversee junior medical staff in the diagnosis of brain death. • Discuss the issues associated with the removal of life support. • Discuss potential perceived conflicts of interest for neurosurgeons being involved in organ donation and brain death including morale issues.

SYLLABUS MODULE – PERIPHERAL NERVE			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Peripheral nerve injuries and entrapment neuropathies	• Discuss the classifications of peripheral nerve injury. • Expertly demonstrate clinical examination of common peripheral nerve lesions. • Describe the symptoms and signs of common entrapment neuropathies. • Describe the surgical treatment of carpal tunnel syndrome and ulnar nerve entrapment at the elbow. • Describe Wallerian degeneration. • Describe the rating scale of motor power. • Describe nerve regeneration.	• Discuss the differential diagnosis and investigation of entrapment neuropathies. • Discuss the operative and non-operative treatment of entrapment neuropathies. • Describe the procedure of peripheral nerve. electrophysiological studies. • Describe the uses and limitations of electrophysiological studies in peripheral nerve lesions. • Describe in detail the surgery of the common sites of peripheral nerve entrapment. • Describe stretch injury, missile injury and avulsion injury: definition, non-operative management and indications for surgery. • Discuss the optimal timing of surgery for peripheral nerve injuries. • Discuss non-surgical peripheral neuropathies e.g. brachial plexopathy, mono and polyneuropathies.	• Discuss diagnostic features of the uncommon entrapment neuropathies. • Expertly demonstrate the clinical examination of uncommon peripheral nerve lesions. • Describe the symptoms and signs of uncommon entrapment neuropathies. • Describe in detail the surgery of the uncommon sites of peripheral nerve entrapment. • Describe the exposure of the brachial plexus. • Describe the uses and limitations of intra-operative electrophysiological nerve evaluation. • Discuss the techniques of nerve repair and grafting. • Discuss in detail the surgical options for decompression of the ulnar nerve at the elbow. • Interpret electrophysiological studies of the common entrapment neuropathies. • Independently perform decompression of entrapment neuropathies. • Demonstrate exposure of the brachial plexus. • Demonstrate nerve repair techniques and nerve grafts.
Autonomic nervous system disorders	• Discuss the clinical features of a patient with hyperhidrosis. •	• Describe the various conditions for which sympathectomy could be considered therapeutic. • Discuss the risks and complications of sympathectomy.	• Describe the surgical approaches for an upper thoracic sympathectomy. • Demonstrate an upper thoracic sympathectomy.

Neoplasms of peripheral nerves	• Describe the classification of peripheral nerve tumours and their relationship to neurofibromatosis. • Describe the clinical presentation, epidemiology and natural history of peripheral nerve tumours. • Demonstrate the clinical assessment of a patient with peripheral nerve tumour.	• Describe the gross and microscopic pathological features of peripheral nerve tumours. • Identify the diagnostic radiological features for peripheral nerve tumours.	• Describe the operative and non-operative management of a patient with a peripheral nerve tumour. • Demonstrate the exposure of a peripheral nerve tumour. • Independently perform the resection of a peripheral nerve tumour with appropriate reconstruction. • Discuss the treatment options for a malignant peripheral nerve tumour.
SYLLABUS MODULE – PSYCHIATRY AND NEUROPSYCHOLOGY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Abnormal Illness Behaviour	• Describe the features of abnormal illness behaviour (including not only the problems of patients with bodily symptoms for which no adequate organic cause can be found, but also those who deny the presence of disease which is obvious to others). • Define acute confusional state. • Discuss the assessment, differential diagnosis and investigation of an acutely confused patient. • Define dementia. • Discuss the assessment, differential diagnosis and investigation of a patient with dementia. • Identify treatable causes of dementia.	• Define and discuss the commonly used terms including somatisation, hypochondriasis, hysteria, conversion disorder, malingering, chronic fatigue syndrome.	• Describe in detail the bio-psycho-social model of abnormal illness behaviour. • Describe in detail how the features of abnormal illness behaviour impacts on the management of chronic pain. • Describe medicolegal implications of abnormal pain behaviour and incorporate this in a meaningful and constructive way in medical assessments and reports.
Principles of Neuropsychological Testing	• Discuss the use of neuropsychological testing and its application to the following areas: • General intellectual ability • Reasoning and problem solving ability		• Describe examples of neuropsychological sequelae that commonly occur after brain injury.

	• Receptive and expressive language ability • Visuoperceptual and visuoconstructional ability • Speed of information processing • Attention and concentration • Memory and learning • Executive functioning (i.e. problem identification, goal formulation, generation of alternative responses, choosing and initiating responses, planning and organising, monitoring and regulating responses) • *Describe the testing instruments that can be used to assess a patient's cognitive functioning.* • Describe the testing instruments that can be used in neuropsychological testing.		
Psychiatric Evaluation	• Describe the principles of a psychiatric evaluation and formulation of a diagnosis. • Discuss the clinical uses of sedative drugs, particularly benzodiazepines (uses, limitations and dependence.) • Discuss the uses, indications and classification of psychotropic drugs. • Discuss features and management of drug dependency.	• Discuss the application of the DSM IV. Describe the general structure of this text. • Describe the Multiaxial Assessment Classification (Axis I-V) and clinical application of the DSM IV system.	• Define the following conditions: • Depressive Disorders • Anxiety Disorders (including post traumatic stress disorder) • Conversion Disorder • Somatoform Disorders • Personality Disorders • Pain disorder • Adjustment disorders • Psychological Factors Affecting Medical Condition • Discuss pharmacology of antidepressant medication. Describe indications and side effects of tricyclics, MAO Inhibitors and serotonin selective reuptake inhibitors (SSRIs) http://www.biopsychiatry.com/options.htm
Psychosurgery	• Discuss the history of psychosurgery. • Discuss the impact of Egas Moniz in		• Describe the anatomical lesions for different psychiatric conditions. • Discuss the effectiveness of surgery in

	neurosurgery.		the treatment of depression. • Discuss in detail local legislation regarding psychosurgery.
SYLLABUS MODULE – SPINAL SURGERY			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Operative Spinal Surgery	• Refer to the Operative Surgery syllabus module of the curriculum.	• Refer to the Operative Surgery syllabus module of the curriculum.	• Refer to the Operative Surgery syllabus module of the curriculum.
Anatomy	• Refer to the Anatomy syllabus module curriculum.	• Refer to the Anatomy syllabus module curriculum.	• Refer to the Anatomy syllabus module curriculum.
General	• Demonstrate history acquisition and detailed physical examination on patients with spinal disorders. • Demonstrate the normal anatomical features of plain cervical xrays, CT scans and MRI scans of the cervical, thoracic and lumbar regions. • Discuss the management of postoperative complications of spinal surgery including hematoma, infection, spinal fluid leak, new neurologic deficit. • Define the terms spondylosis, spondylolysis and spondylolisthesis. • Describe the clinical assessment and differential diagnosis spinal pain. • Define spinal stability and describe how it is most appropriately assessed. • Demonstrate the expected age-related changes not indicative of significant spinal pathology in elderly patients on plain cervical xrays, CT scans and MRI scans of the cervical, thoracic and lumbar regions.	• Describe the indications and limitations of spinal surgery to relief different types of neurological deficit (spinal cord, cauda equine and nerve root). • Describe the indications and limitations of spinal surgery to relief different pain syndromes. • Discuss in detail the management options for patients in whom spinal surgery has failed to relieve symptoms • Describe the differences between spinal fusion and spinal instrumentation, and the indications, risks and limitations of each.	• Discuss the indications for, and physiology of, intraoperative spinal cord monitoring. • Describe the management options for intraoperative and postoperative cerebrospinal fluid leaks. • Discuss the role of rehabilitation in patients with spinal disorders. • Describe the technical aspects and limitations of intraoperative spinal cord monitoring.
Biomechanics and	• Describe in detail the normal	• Discuss the biomechanics of the craniocervical	• Discuss the concepts of load bearing

kinematics of the spine	movements of the vertebral column at each level. • Describe the normal alignment of the vertebral column. • Discuss the factors responsible for stability of the spinal column.	junction, cervical spine and thoracolumbar and lumbar spine. • Discuss the concepts of motion of the vertebral column including instantaneous axis of rotation.	relative to each section of the vertebral column. • Discuss the effects of abnormal loading on individual spinal components such as vertebrae, discs and ligaments. • Discuss the biomechanical consequences of common procedures such as laminectomy.
Degenerative and inflammatory disorders	• Describe in detail the clinical features of neurological compression syndromes of the spine including radiculopathy, myelopathy, cauda equina compression and neurogenic claudication. • Discuss the importance and relative urgencies of the various compressive syndromes especially cauda equina syndrome. • Discuss the differential diagnosis of cervical, thoracic, and lumbar pain. • Discuss the effects of rheumatoid arthritis on the spine. • Describe the indications for cervical, thoracic and lumbar discectomy. • Demonstrate the expected age-related changes not indicative of significant spinal pathology in elderly patients on plain cervical xrays, CT scans and MRI scans of the cervical, thoracic and lumbar regions.	• Discuss the theories of spinal stability eg Punjabi and White, Denis and AO classification. • Compare and contrast indications for anterior and posterior approaches to the cervical spine for the treatment of herniated cervical discs, spondylosis, and instability. • Compare and contrast the indications for anterior cervical discectomy with and without anterior interbody fusion. • Describe the pathological and radiological features of OPLL and DISH. • Discuss the management options of degenerative lumbar spondylolisthesis in association with canal stenosis. • Discuss the clinical features, pathological findings and management of osteoporosis. • Discuss the appropriate radiological investigations for patients with degenerative spine disease.	• Discuss the role of corpectomy in the management of cervical disorders. • Discuss the management of rheumatoid cervical disease and describe factors which make it different from the management of non-rheumatoid disease. • Discuss the clinical features and management of ankylosing spondylitis. • Compare and contrast the various approaches to a herniated thoracic disc. • Discuss the indications for lumbar fusion for iatrogenic disease and degenerative disease. • Discuss the controversies surrounding the management of asymptomatic radiological cord compression from degenerative disease. • Discuss the controversies surrounding kyphoplasty and vertebroplasty.
Trauma	• Describe in detail the clinical features and pathophysiology of spinal cord injury including complete and incomplete injury, anterior cord injury, central cord injury, Brown-Sequard injury, cruciate paralysis, conus syndrome and sacral sparing. • Describe the early management of spine and spinal cord injured patients including immobilization, traction, reduction, appropriate radiographic studies and medical	• Classify fractures, dislocations, and ligament injuries of the craniocervical region, subaxial cervical spine, thoracic, thoracolumbar junction, lumbar and sacral spine. • Discuss the indications for surgical management of spinal instability. • Discuss briefly the concept of grading schemes for spinal cord injury and myelopathy. • Discuss the indications, uses and relative effectiveness of common spinal orthoses. • Discuss the degree of segmental and regional immobilization different spinal orthoses provide.	• Discuss the indications for types of imaging and re-imaging. • Discuss the implications for the management of trauma in the presence of ankylosing spondylitis. • Discuss the pathogenesis, clinical presentation and management options for post traumatic syringomyelia. • Demonstrate the placement and management of cranial traction devices for reduction and immobilization of the unstable cervical spine.

	management. • Discuss in detail the definitions of spinal stability. • Describe the named fractures in the cervical spine. • Demonstrate the normal anatomical features of plain cervical xrays, CT scans and MRI scans of the cervical, thoracic and lumbar regions. • Describe the indications for spinal immobilisation and/or investigation in trauma patients. • Describe the appropriate investigations required for trauma patients considered at risk of having spinal injury. • Discuss the appropriate radiological investigations for trauma patients with spinal trauma. • Demonstrate the expected age-related changes not indicative of significant spinal injury in elderly patients on plain cervical xrays, CT scans and MRI scans of the cervical, thoracic and lumbar regions • Demonstrate the correct technique for cervical immobilization for an emergency trauma endotracheal intubation.	• Discuss the management principles for penetrating wounds to the spine. • Discuss non-operative and operative treatment options for fractures and dislocations affecting the atlas and axis. • Compare and contrast the indications for non-operative treatment, anterior approaches and posterior operative approaches for the treatment of fractures and dislocations of the subaxial cervical spine. • Describe in detail the indications for, risks and complications, and alternative techniques for cervical spinal traction. Demonstrate, or describe in detail, the application of cervical traction. • Describe in detail the indications for, risks and complications, and alternative techniques for cervical spinal traction. Demonstrate, or describe in detail, the application of cervical traction, and describe the subsequent management of the patient in traction. • Describe in detail the indications for, risks and complications, and alternative techniques for external cervical orthoses. Demonstrate, or describe in detail, the correct fitting of common cervical external orthoses, including the application of a halothoracic brace.	• Demonstrate the application and management of a halo-thoracic brace. • Demonstrate the application and management of cervical traction for instability. • Discuss the indications and techniques for complex internal fixation for spinal trauma. • Discuss current theories of spinal cord regeneration. • Discuss the controversies surrounding the management of compression fractures. • Describe the controversies surrounding the management of odontoid fractures. • Discuss the controversies surrounding and evidence relating to the use of steroids in spinal injury. • Discuss controversies, risks and indications of dynamic radiological investigations in acute spinal trauma. • Discuss controversies regarding diagnosis, management and prognosis of chronic musculoligamentous spinal injuries (including "whiplash").
Neoplasia	• Describe the clinical and radiological features of intra-axial and extra-axial spinal tumours affecting the cervical, thoracic and lumbar regions. • Discuss the appropriate radiological investigations for patients with spinal neoplasia.	• Discuss the options of surgery and radiotherapy for acute neoplastic spinal cord compression. • Discuss the diagnosis and management of primary spinal tumours, spinal cord tumours, and spinal metastatic disease. • Describe the most common types of spinal tumours in the following categories: o intradural/intramedullary; o intradural/extramedullary; o extradural.	• Discuss the indications for dorsal decompression and ventral decompression of acute neoplastic spinal cord compression at various levels. • Discuss the options for spinal fixation of neoplastic disease. • Discuss controversies regarding surgery for intra-axial spinal tumours. • Discuss the controversies surrounding the extent of surgical vertebral column.
Infection	• Discuss the pathogenesis and bacteriological features of spinal	• Discuss the management principles for epidural abscess and discitis, and clearly described the	• Discuss the management options for infected post operative stabilisation

	infections. • Describe the clinical and radiological features of discitis. • Describe the clinical and radiological features of epidural abscess.	indications/contra-indications for both surgical and medical management. • Discuss the factors contributing to post operative spinal infections. • Describe the evidence for the use of prophylactic antibiotic in spinal surgery.	procedures.
Congenital and developmental	• Describe the normal embryological development of the spine and spinal cord. • Discuss the embryology and anatomy of major forms of spinal dysraphism. • Describe the clinical features of spinal dysraphism presenting at different ages (neonatal, childhood and adulthood).	• Discuss the pathophysiology, clinical presentation (signs & symptoms) and management options in the treatment of syringomyelia. • Discuss the pathophysiology, clinical presentation (signs & symptoms) and management options in the management of the adult tethered cord syndrome. • Describe the indications for spinal cord detethering,and the surgical options available to do this.	• Discuss the pathological significance and management options for Tarlov cysts and spinal arachnoid cysts. • Describe in detail the surgical procedure for closure of a neonatal myelomeningocoele. • Describe the management options for incontinence secondary to neonatal spinal dysraphism. • Describe the surgical and non-surgical options available for the management of chronic spasticity secondary to spinal cord pathology.
Principles of spinal fusion and stabilisation	• Describe in detail the definition spinal instability, and describe the various mechanisms causing this. • Discuss the biology of bone healing. • Define the terms stabilisation, instrumentation and fusion in relation to spinal pathology. • Discuss the principles of bone grafting in spinal surgery. • Describe the general indications for spinal stabilisation, and whether this requires fusion &/or instrumentation.	• Discuss the materials available for spinal fusion and describe the relative risk/benefit analysis of each. • Compare and contrast the indications/contra-indications and techniques for anterior and posterior cervical spinal stabilisation. • Compare and contrast the indications for anterior or posterior lumbar interbody fusion and intertransverse fusion for lumbar disease. • Discuss the indications and options for internal fixation in association with lumbar fusion. • Discuss in detail the role of non-surgical management of spinal instability in both acute (eg post-traumatic or following surgical decompression) and chronic (eg degenerative) spinal instability in the cervical and lumbar.	• Discuss the properties of various grafting materials eg osteoconductive, osteoinductive and osteogenic. • Discuss additional measures to enhance fusion. • Discuss the controversies surrounding the role of fusion associated with discectomy for radiculopathy in the cervical and lumbar regions. • Describe the principles and techniques of use of commonly use commercial spinal internal fixation systems available for the different spinal regions (anterior and posterior). • Discuss the literature regarding the relative merits of arthrodesis versus arthroplasty in the cervical and lumbarspine.
Spinal vascular conditions	• Describe in detail the normal blood supply and venous drainage of the spinal cord. • Describe the venous anatomy of the	• Demonstrate the normal and abnormal anatomy demonstrated of spinal angiography for spinal AVM and spinal dural AVF • Discuss the role of endovascular procedures in the	• Demonstrate, or describe in detail indications for and technical nuances of surgery for a spinal dural AVF. • Demonstrate, or Describe in detail

	spinal column • Describe the anatomy and clinical significance of the Artery of Adamkiewicz • Describe the risks and indications of spinal angiography.	management of spinal disorders. • Discuss the aetiology, presentation, diagnostic features and natural history of spinal cord cavernous haemangioma • Discuss the aetiology, presentation, classification and natural history of spinal cord arteriovenous malformations (spinal AVM). • Discuss the aetiology, presentation, classification and natural history of spinal dural arteriovenous fistulae (spinal dural AVF) • Discuss the treatment options for spinal AVMs. • Describe the clinical presentation, epidemiology, radiological features, pathology and natural history of vertebral haemangioma.	indications for and technical nuances of surgery for a spinal cord cavernoma • Describe in detail indications for and technical nuances in surgery for a spinal cord AVM.

SYLLABUS MODULE – VASCULAR DISEASE			
	Basic Learning Outcomes	**Intermediate Learning Outcomes**	**Advanced Learning Outcomes**
Stroke (excluding subarachnoid haemorrhage)	• Describe in detail the anatomy of intracranial arteries and extracranial cervical arteries. • Describe in detail the anatomy intracranial veins and extracranial cervical veins. • List the causes of cerebral ischaemia. • Discuss the risk factors for occlusive cerebrovascular disease. • Describe the risk factors for thromboembolic cerebrovascular disease. • Discuss the clinicopathological effects of progressive cerebral ischaemia. • Describe the clinical presentation of ischaemia to each of the major intracerebral vascular territories. • Describe the clinical syndrome of vertebral steal. • Describe the vascular supply of the spinal cord. • Describe the clinical presentation of anterior and posterior spinal territory ischaemia. • Discuss the use and limitations of CT scan and MRI in cerebral ischaemia. • Discuss the use and risks of angiography in cerebral ischaemia. • Describe the mechanisms of thrombus formation and dissolution. • Describe the techniques, uses and limitations of doppler sonation in cerebral vascular disease. • Discuss the prothrombotic disorders. • Discuss the aetiology, clinical presentation and natural history of arterial dissection. • List the investigations of suspected arterial	• Discuss the use and limitations of nuclear medicine investigations in cerebral ischaemia. • Describe the aetiology, clinical presentations, natural history, histopathology and investigation of moya-moya syndromes. • Describe the gross and microscopic pathology in arterial dissection. • Describe in detail the diagnostic studies to confirm arterial dissection. • Discuss the management options of arterial dissection. • Describe the clinical syndromes associated with intracranial venous occlusion. • Discuss in detail the investigations of intracranial venous occlusive disease. • Discuss the long-term complications of intracranial venous occlusion. • Discuss in detail the approaches to and techniques of evacuation of spontaneous intracerebral haemorrhage. • Discuss gross and microscopic pathology of intracerebral haemorrhage eg Amyloid.	• Discuss the uses and risks of anticoagulation in the prevention and treatment of cerebral ischaemia. • Discuss the uses and risks of antiplatelet therapy in the prevention and treatment of cerebral ischaemia. • Discuss the uses and risks of thrombolysis in cerebral ischaemia. • Discuss in detail the role of angioplasty in cerebral ischaemia. • Discuss the management options, complications and follow up of moya-moya syndromes. • Describe the complications of management of arterial dissection and explain the reasons for long-term follow-up. • Discuss the method and indications for endovascular management of venous occlusive disease. • Discuss in detail controversies surrounding surgery for spontaneous intracerebral haemorrhage. • Discuss the evidence for the role of specialist stroke units and rehabilitation units.

	dissection. • Discuss risk factors, medical management and prognosis of brain haemorrhage. • Discuss the common sites of spontaneous intracerebral haemorrhage and their likely causes.		
Extracranial vascular disease	• Describe the risk factors for atheromatous carotid disease. • Discuss the clinical diagnosis, differential diagnosis and significance of transient ischaemic attack (TIA). • List the treatment options for carotid stenosis. • Describe the perioperative management of carotid endarterectomy. • Describe the perioperative management of stent deployment. •	• Discuss the investigation and management options for TIA. • Discuss the natural history of asymptomatic and symptomatic carotid stenosis. • Discuss the indications, risks and benefits of carotid endarterectomy. • Discuss the management of complications of carotid endarterectomy. • Discuss the indications, risks and benefits of carotid stenting. • Discuss the management of complications of carotid stenting. • Demonstrate the surgical exposure of carotid bifurcation, protecting the cranial nerves. • Discuss the natural history of acute arterial sacrifice. • Discuss methods of assessing risk of acute arterial sacrifice. • Demonstrate microsurgical anastomotic suturing techniques in laboratory. • Demonstrate harvesting vein or artery for use in bypass.	
Aneurysms and non-traumatic subarachnoid haemorrhage	• Describe in detail the clinical and radiological grading systems of subarachnoid haemorrhage. • Discuss the aetiology, clinical presentation and natural history of non-traumatic subarachnoid haemorrhage. • List the investigations of a patient with presumed non-traumatic subarachnoid haemorrhage. • Define the features on CT of subarachnoid haemorrhage.	• Discuss the systemic effects of non-traumatic subarachnoid haemorrhage. • Describe in detail the management of the complications of subarachnoid haemorrhage including vasospasm and hydrocephalus. • Describe the histopathology of intracranial aneurysms. • Discuss the influence of site, size, shape, age, environment and hereditary factors in natural history of intracranial aneurysms. • Discuss the outcome and natural history of	

	• Describe the early management of non-traumatic subarachnoid haemorrhage. • Describe the outcome of intracranial aneurysm rupture. • Discuss the risks associated with surgical and endovascular treatment of aneurysm treatment (for obtaining informed consent). • Discuss the aetiology, common sites, clinical presentation and natural history of traumatic aneurysms. • Discuss the aetiology, microbiology, common sites, clinical presentation and natural history of mycotic aneurysms.	symptomatic unruptured intracranial aneurysms. • Discuss the endovascular and surgical role for aneurysm treatment. • Discuss the role of non-interventional management of intracranial aneurysms. • Discuss the investigation of a patient with mycotic aneurysms.	
Cerebral AVMs	• Discuss the epidemiology, aetiology and gross pathology of brain AVMs. • Discuss the spectrum of presentation of cerebral AVMs.	• Discuss haemodynamics of brain AVMs. • Describe the microscopic pathology of cerebral AVMs. • Discuss the natural history of AVMs. • Discuss the risk of haemorrhage from an AVM including the impact of angiographic factors, demographic and clinical factors. • Describe the grading scales for cerebral AVMs and the risks of surgical treatment. • Describe the non-interventional management of AVMs. • Discuss perioperative management of cerebral AVMs.	
Spinal AVMs		• Discuss the aetiology, presentation, classification and natural history of spinal AVMs.	
Cavernous angioma	• List the angiographically occult vascular malformations. • Discuss the clinical presentation of angiographically occult vascular malformations.	• Discuss the gross and microscopic pathology of angiographically occult vascular malformations. • Discuss the radiological findings in angiographically occult vascular malformations	