



# ODISHA UNIVERSITY OF HEALTH SCIENCES, BHUBANESWAR



## PG Curriculum DM Neurology

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# **GUIDELINES FOR COMPETENCY BASED POSTGRADUATE SUPER-SPECIALTY TRAINING PROGRAMME FOR DM IN NEUROLOGY**

## **1. Preamble**

The aim of the DM Programme is to impart advanced training in neurology to produce competent super-specialists who can provide clinical care of the highest order to patients with neurological diseases and serve as future teachers, trainers, researchers, and leaders in the field of neurology. After successfully completing the course, they would work as productive members of interdisciplinary teams consisting of physicians, neurosurgeons, geriatric specialists, psychiatrists, psychologists, rehabilitation experts, and other specialists, nurses, and other healthcare functionaries providing care to the patients with various neurological disorders in any setting of the health care system. This document has been prepared by subject-content specialists of the National Medical Commission. The Expert Group of the National Medical Commission had attempted to render uniformity without compromise to the purpose and content of the document. Compromise in purity of syntax has been made in order to preserve the purpose and content. This has necessitated retention of “domains of learning” under the heading “competencies.

### **SUBJECT SPECIFIC OBJECTIVES**

The training program is designed to facilitate the ‘acquisition of learning’ by the postgraduate student in the following three domains of learning:

- Cognitive (knowledge),
- Affective (communication),
- Psychomotor (practice).

#### **1.1 Predominant in Cognitive domain (Knowledge)**

The student should:

- Understand the basic sciences (embryology, anatomy, physiology, biochemistry, pharmacotherapeutics, etc.) related to the field of neurology.
- Be conversant with the etiology, pathophysiology, diagnosis, and management of common neurological problems.
- Should understand the importance of providing acute care with the goal of ‘full recovery of function’.
- Know the common problems in Neurology, the acute, life threatening conditions which require redressal in a “time sensitive” manner as well as the transdisciplinary acute medical and surgical conditions which requires team work of different specialities.
- Know the chronic problems encountered in the out patients clinics of Neurology and Medicine including specific neurological disorders and neurological complaints in various systemic diseases spanning a host of medical and surgical conditions. This includes all ages and also certain age specific neurological diseases involving post delivery, neonatal, infantile., genetic and inherited conditions, adolescence, adult and elderly age specific neurological diseases and syndromes.
- Be able to analyze neonatal health problems and develop preventive strategies to decrease neurological morbidity and mortality at hospital and community level including National programs.
- Know neurological end of life care and bereavement follow up.

#### **Group/team approach:**

At the end of the course, the postgraduate student should be able to:

- Recognize the role of multi-disciplinary and interdisciplinary approaches in managing various neurological disorders and recognize the importance of family, society, and socio-cultural environment in treating the sick patient.

- Function as a part of a team, co-operate with colleagues, and interact with the neonate's family to provide optimal medical care.

**Evidence-based approach:**

At the end of the course, the postgraduate student should be able to critically appraise medical literature in order to provide evidence-based care.

**Research Methodology:**

The postgraduate student should acquire:

- (a) basic knowledge of research methodology and biostatistics,
- (b) familiarity and participation in clinical and experimental research studies, and
- (c) knowledge in scientific presentation and publication.

**Skills:**

- At the end of the course, the postgraduate student should acquire (a) skills necessary for neurological patient care. He/She should be able to undertake preparation of oral presentation, medical documents, professional opinion in interaction with patients, caretakers, peers, and paramedical staff - both for clinical care and medical teaching. Effective communication with the patient/caretakers regarding the nature and extent of disease, treatment options, realistic outcomes, and optimal management is essential.

**1.2 Predominant in Affective domain (Communication )**

The PG student should:

- Acquire adequate communication skills to counsel and support the parents and families of the neurological patients. Regular clinical rounds and academic presentations during the teaching program should help the trainees to develop patient-centric and family-centric attitudes, knowledge, and communication skills.
- Establish effective communication with the patient's caregivers, including appropriate counseling for sickness, terminal illness, and bereavement care.
- Interact professionally and obtain relevant specialist/ancillary 'services' consultation where appropriate.
- Ensure effective communication and teamwork while teaching others, including undergraduates in a clinical care unit.
- Be able to communicate and work effectively with a multi-disciplinary team and understand the role of other team members, including nurses, physiotherapists, dieticians, psychologists, and others.
- Inculcate ethical principles in all aspects of neurological, pediatric and adult, medical and surgical care/research (professional honesty and integrity, humility, moderation, informed consent, counseling, awareness of 'patients' rights and privileges) and be a role model for other health care team members and respect patient confidentiality.
- Maintain proper etiquette in dealings with patients, caretakers, and other health personnel, including due attention to the 'patient's right to information, consent, and second opinion. Maintain professional integrity while dealing with patients, colleagues, seniors, pharmaceutical companies, and equipment manufacturers.
- Take rational decisions in the face of ethical dilemmas in neurological practice.
- Develop a communication style - both verbal and written, to ensure that the content is accurately understood by the audience.

**3 Predominant in Psychomotor domain (Practice)**

The PG student should:

- Evaluate a patient thoroughly (history, clinical examination), order relevant investigations, and interpret them to reach a diagnosis and plan of management.
- Plan and carry out simple investigations/procedures (bedside, laboratory, imaging) independently.
- Plan and carry out Neurointerventions such as Digital Substraction Angiography ( DSA) procedures through femoral route and assist in diagnostic and therapeutic procedures such as Mechanical Thrombectomy in acute ischemic stroke with large vessel occlusion ( AIS with LVO).
- Provide Basic and Advanced Life Support services in emergencies.
- Acquire familiarity with and provide critical care of post neurosurgery and neurointervention patients, including airway support, ventilation, central vascular access.
- Prepare a patient for an elective/emergency surgery and provide specific post-operative care.
- Provide counseling to the patient and primary caretakers for the smooth dispensation of medical care.
- Acquire skills in neurological procedures (including but not limited to invasive and non-invasive respiratory support, peripheral and central venous access, resuscitation, bladder catheterization, DSA, interpretation of acute stroke imaging, ( ASPECTS etc), planning and preparation of nutrition ( swallowing test, Tube feeds etc), insertion of chest tubes, sepsis workup, suprapubic urine sampling for culture, lumbar puncture, use of medical equipment such as ventilators, including high-frequency ventilation, exchange transfusion, therapeutic hypothermia, etc.).
- Monitor and manage patients in the standard ward / high dependency unit / and in the intensive care setting.
- Provide specific and relevant advice to the patient and family at discharge time for proper domiciliary care, hospital reporting in an emergency, and routine follow-up.

### **SUBJECT-SPECIFIC COMPETENCIES**

#### **3.1 Predominant in Cognitive (knowledge) domain:**

*After completing the DM (Neurology) course, the student be able to :*

1. Know and analyze neurological health problems scientifically, considering the biological basis and socio-behavioral epidemiology of the neurological disease, and be able to advise and implement strategies to prevent neurological morbidity and mortality.
2. Acquire knowledge on providing evidence-based primary, secondary, and tertiary care of highest quality, including intensive care of the highest standard to the critically sick patients with neurological diseases using advanced therapeutic and supportive modalities and skills.
3. Acquire knowledge on developmental assessment of sensory and motor function of pediatric patients with neurological diseases and coordinate post discharge comprehensive follow up.
4. Acquire knowledge to be able to take rational decisions in the face of ethical dilemma in neurological practice.
5. Plan and carry out research in neurological/brain health in the clinical, community, and laboratory settings.
6. Teach basics and critical/mandatory information on common neurological diseases and neurological emergencies to the medical and the nursing students and other paramedical/community health functionaries, and develop learning resource materials.
7. Plan, establish, and manage acute stroke, acute epilepsy, and other acute neurological emergency units independently.
8. Contribute toward the development and adaptation of neurological care technologies.

9. Organize stroke, epilepsy, dementia care in the community and at the secondary health system level and play the assigned role in the national programs aimed at the non – communicable diseases.
10. Work as a focal point for a multi-disciplinary endeavor for clinical care, education, research, and community action with other stakeholders and partners.
11. Seek and analyze new literature and information on neurology, update concepts, and practice evidence-based neurology.
12. Lead development of quality improvement projects & develop standard care practices/ protocols for the unit.
13. Develop skills to train nurses in key components of essential neurological care.

### 3.2 Predominant in Affective domain (communication and values)

During the course of three years, the postgraduate student is expected to attend instructive courses that facilitate proficiency relevant to this domain (eg., communication skills, biomedical ethics, patient counseling).

*After completing the DM (Neurology) course, the student should be able to do the following:*

- Have empathy for patients and their family and should address them as worthy human beings.
- Discuss options, including the advantages and disadvantages of each investigation and treatment. She/he should be able to discuss medical issues with them in 'layperson's language'.
- Become **confident communicator** and well-accomplished professional.
- Acquire communication skills to be able to debate & deliver a scientific lecture and participate in panel discussions, hold group discussions and be able to deliver the knowledge received by him/her during the course.
- Be able to function as a part of a team, develop an attitude of cooperation with colleagues, and interact with the patient and the clinician or other colleagues to provide the best possible diagnosis or opinion.
- Always adopt ethical principles and maintain proper etiquette in dealing with patients, relatives, and other health personnel and respect the patient's rights, including the right to information and second opinion.
- Acquire communication skills of a high order to write reports, interact with peers, and paramedical staff, and with students for effective teaching.
- Demonstrate humane and compassionate attributes befitting a caring neonatologist.
- Acquire communication skills to give a professional opinion and interact with patients and relatives in a caring manner.

### 3.3 Predominant in Psychomotor domain (skills)

**A. At the end of the course, the student should acquire the following skills (table 1):**

**Table 1: Must know, desirable to know and observed skills**

<b>Must know skills</b>	<b>Desirable skills</b>	<b>Observed skills</b>
<i>These are <b>mandatory skills</b>. The student should be able to perform the following procedures independently:</i>	<i>These are <b>good to know skills</b>. The student should be able to perform the following procedures independently or as a part of a team and/or interpret the results of:</i>	<i>These are mandatory skills but <b>need to be ONLY observed</b></i>

<p>Common neurological procedures to be performed:</p> <ol style="list-style-type: none"> <li>1. Lumbar puncture: 15</li> <li>2. Muscle and nerve biopsy: 5</li> <li>3. CSF tap test for NPH: 5</li> <li>4. Nerve conduction studies and interpretation: 100</li> <li>5. EMG and interpretation: 100</li> <li>6. EEG and interpretation: 250</li> <li>7. Interpretation of VEEG: 75</li> <li>8. Interpretation of PSG and Sleep titration: 25</li> <li>9. Endotracheal intubation: 50</li> <li>10. Perform Digital Subtraction Angiography: 10</li> <li>11. Oro/nasogastic tube insertion: 75</li> <li>12. Central venous line insertion: 75</li> <li>13. Interpretation of VEP/BAER/SSEP: 250</li> <li>14. Interpretation of acute stroke imaging: 150</li> <li>15. Interpretation of cerebral angiogram: 100</li> <li>16. Botulinum Toxin injection for Movement Disorders such as Blepharospasm, Hemi facial Spasm, Meigs Syndrome: 50</li> <li>17. Application of CPAP: 20</li> <li>18. Intravenous cannulation: 100</li> <li>19. Peripheral arterial cannulation: 200</li> <li>20. Arterial stab sampling: 50</li> <li>21. TCD for stroke patients : 50</li> </ol> <p>Laboratory investigations</p> <ol style="list-style-type: none"> <li>22. Perform the following basic tests in the side lab: microscopy of CSF and peripheral smear, point of care screening tests. and blood gas analysis.</li> </ol>	<ol style="list-style-type: none"> <li>1. Assessment Tools: NIHSS/MRS ADL Scores UPDRS Cognitive Scales EDSS</li> <li>2. Botulinum Toxin injection for Spasticity, Vocal cord dystonia, other rarer conditions</li> </ol>	<ol style="list-style-type: none"> <li>1. Observe neurological surgery</li> <li>2. Observe Epilepsy surgery</li> <li>3. Observe DBS</li> <li>4. Observe house-keeping protocols and asepsis routines of individual units.</li> </ol>
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**Skills Training and Simulation (All medical colleges are mandated to have simulation labs by NMC )**

- ✚ The postgraduate students are encouraged to utilize low and hi-fidelity mannequins; individual task trainers are to be made available in the department for skill practice.
- ✚ Sessions in workshop mode are specially organized for new trainees to teach interventional procedures such as cerebral angiography, interpretation of neuroimaging mandatory for treatment of acute stroke; intractable epilepsy work up, electrophysiological procedures, and Botulinum toxin injections etc.
- ✚ Simulation sessions on team training and communication also must be organized.

**B. Should be able to interpret the results of the following procedures and take necessary action:**

- ✚ Biophysical profile, interpretation of genetic tests, interpret metabolic screen/diagnosis.

- ✚ Interpretation of cranial CT scan (both NCCT and CECT), MRI (T1 weighted, T2-weighted, DWI and flair); basic interpretation of FDG-L-dopa PET-CT scan interpretation of electrophysiological tests (BERA, VEP, aEEG); use of wide-angle cameras to image retina for ROP.
- ✚ Participate in morbidity and mortality review (death audits).

***C. The student should be able to observe or perform under supervision the following procedures –desirable skills:***

- Community-based death surveillance and audit
- Partnership with IT for newer and simpler LMIC specific technology innovation
- Systematic reviews

**TRAINING OBJECTIVES OF POST-GRADUATE TRAINING EXPECTED FROM STUDENTS AT THE END OF POST GRADUATE TRAINING AS RECOMMENDED BY THE NMC**

1: Acquire comprehensive knowledge of the basics of Neurology including all allied specialities related to Neurology like Neuroanatomy, Neurophysiology, Neurochemistry, Neuropharmacology, Neuroimaging, Neuropathology, Neuroinfections, Neuroimmunology, Preventive Neurology, Neuroepidemiology, Paediatric Neurology and Neurosurgery.

**SKILLS**

- 2: Possess complete Clinical Diagnostic Skills for the recognition of common Nervous system diseases.
- 3: Possess a complete knowledge of all the commonly used Neurophysiological diagnostic Tests like Electroencephalography, Electroneurography, Electromyography, Cerebral evoked potentials.
- 4: Acquire skills in the performance and interpretation of special investigations such as Polysomnography, Video EEG monitoring, EEG-Telemetry, autonomic function tests, Transcranial Doppler tests
- 5: Acquire skills in interpretation of common neuroimaging investigations such as CT scanning, MRI scanning, MR and Digital subtraction angiography, Myelography, MR spectroscopy and Single Photon Emission Computerised Tomography.
6. Acquire skills in invasive procedures such as lumbar puncture, intrathecal drug administration, CSF manometry; performing digital subtraction angiography, intra venous and intraarterial thrombolysis; assisting in endovascular thrombectomy in acute ischemic stroke, and Nerve and muscle biopsy and their interpretation of relevant histopathology;
7. Acquire exposure in sophisticated neuromodulation procedures such as planning of deep brain stimulation, vagal nerve stimulation;.
8. Able to apply sound clinical judgement and recommend rational cost effective investigations for the diagnosis and management of Neurology cases in the OPD, Wards, Emergency Room and Intensive Care unit.

**SYLLABUS**

**Course contents**

AIM:

To produce specialists with necessary skills, judgement and sense of dedication to tackle all major and minor cardiac problems. The candidates will be trained in all aspects of Neurology starting from Basic Sciences to recent advances.

**PAPER I: BASIC SCIENCES RELATED TO NEUROLOGY**

**NEUROANATOMY**

The Neuroanatomy with special emphasis on development of:

- Neuroaxis (brain, spinal cord and neurons and glia),
- Autonomic nervous system and their maturation process in the post-natal, childhood and adolescent states;
- Location and significance of stem cells,
- CSF pathways,
- Blood supply and sino venous drainage of brain and spinal cord, the meninges,
- Skull and vertebral column, the cranial nerves, spinal roots, plexuses, and their relation to neighboring structures;
- Anatomy of peripheral nerves,
- Neuromuscular junction and muscles;
- Histology of cerebrum, cerebellum, pituitary gland, brain stem and spinal cord, nerves and neuromuscular junction and muscle.
- Functional anatomy of lobes of cerebrum and white matter tracts of brain and spinal cord, craniovertebral junction, conus and epiconus and cauda equina, brachial and lumbosacral plexuses, cavernous and other venous sinuses;
- New developments in understanding of:
  - Ultrastructural anatomy of neurons,
  - axonal transport,
  - neural networks and synapses and nerve cell function at molecular level.

### **NEUROPHYSIOLOGY**

- Neurophysiology will cover all the physiological changes in the nervous system during its normal function with special reference to nerve impulse transmission along myelinated fibers,
- neuromuscular junction and synaptic transmission,
- muscle contraction;
- visual, auditory and somatosensory and cognitive evoked potentials;
- Regulation of secretions by glands, neural control of viscera such as heart, respiration, GI tract, bladder and sexual function; sleep-wake cycles;
- Maintenance of consciousness,
- special senses,
- control of functions of (a) pituitary, (b) autonomic system (c) cerebellum, (d) and extrapyramidal functions,
- reflexes,
- upper and lower motor neuron concepts and sensory system.

### **MOLECULAR BIOLOGY**

Brain is the one structure where maximum genes are expressed in the human body. The topics include:

- Principles of molecular biology including Gene Structure, Expression and regulation;
- Recombinant DNA Technology;
- PCR Techniques,
- Molecular basis for neuronal and glial function,
- Molecular and cellular biology of the membranes and ion-channels,
- Mitochondrial genome,
- Role of RNA in normal neuronal growth and functional expression,



- Receptors of neurotransmitters,
- Molecular and cellular biology of muscles and neuromuscular junction, etc.
- The Human Genome and its future implications for Neurology including developmental and neurogenetic disorders,
- bioethical implications and genetic counselling,
- Nerve growth and other trophic factors and neuroprotectors,
- Neural Tissue modification by genetic approaches including Gene Transfer, stem cell therapy etc.
- Molecular Development of neural tissue in peripheral nerve repair

### **NEUROCHEMISTRY**

- All aspects of normal and abnormal patterns of neurochemistry including:
- Neurotransmitters associated with different anatomical and functional areas of brain and spinal cord, especially with respect to dopaminergic, serotonergic, adrenergic and cholinergic systems,
- Opioids,
- Excitatory and inhibitory amino acids and their role in pathogenesis of Parkinsonism, depression, migraine, dementia, epilepsy,
- Neuromuscular junction and muscle contractions,
- Carbohydrate, amino acid and lipid metabolism,
- Neural expression of disorders of their metabolism,
- Electrolytes and their effect on encephalopathies,
- Muscle membrane function, storage disorders,
- Porphyria.

### **NEUROPHARMACOLOGY**

- Application of neuropharmacology in medical therapy of epilepsy, Parkinsonism, movement disorders, neuropsychiatric syndromes, spasticity, pain syndromes, disorders of sleep and dysautonomia syndromes.
- Antiepileptic drugs, usage during disorders of renal, hepatic function and in dementia.
- Adverse drug reactions of common drugs used in Neurological disorders including antiepileptic drugs, antiplatelets, anticoagulants etc.

### **NEUROPATHOLOGY**

- Pathological changes in various neurological diseases with special reference to vascular, immune-mediated, demyelinating and dysmyelinating, metabolic and nutritional, genetic and developmental, infectious and iatrogenic and neoplastic etiologies and clinical correlation.
- Pathological changes in nerve and muscle in neuropathies and myopathies.
- Ultrastructural pathology such as apoptosis, ubiquitinopathies, mitochondrial diseases, channelopathies, peroxisomal disorders, inclusion bodies, prion diseases, disorders mediated by antibodies against various cell and nuclear components, paraneoplastic disorders etc.

### **NEUROMICROBIOLOGY**

Microbiological aspects of infectious neurologic diseases including:

- Encephalitis, meningitis, brain abscess, granulomas, myelitis, cold abscess, cerebral malaria, parasitic cysts of nervous system, rhino cerebral mycoses, leprosy neuritis, neuro leptospirosis, primary and secondary Neuro HIV infections, congenital TORCH infections of brain, slow virus infections such as CJD and SSPE.
- Neurological complications of viral infections such as Polio, EBV, Chickenpox, Rabies, Herpes, Japanese encephalitis and other epidemic viral infections.

## **NEUROTOXICOLOGY**

Diagnosis and effective therapy of:

- Organophosphorus poisoning,
- hydrocarbon poisoning,
- lead, arsenic, botulinum toxin and tetanus toxicity,
- snake, scorpion, spider, wasp and bee stings.

## **NEUROGENETICS AND PROTEOMICS:**

- Autosomal dominant and recessive and X-linked inheritance patterns,
- disorders of chromosomal anomalies,
- Gene mutations, trinucleotide repeats, dysregulation of gene expressions,
- Enzyme deficiency syndromes,
- Storage disorders,
- Disorders of polygenic inheritance,
- Proteomics in health and disease.

## **NEUROEPIDEMIOLOGY:**

- Basic methodology in community and hospital based neuro-epidemiological studies such as systematic data collection, analysis, derivation of logical conclusions,
- Concepts of case-control and cohort studies, correlations,
- Regressions and survival analysis,
- Basic principles of clinical trials.

## **PAPER II: CLINICAL NEUROLOGY INCLUDING PEDIATRIC NEUROLOGY and NEUROPSYCHIATRY.**

### **GENERAL EVALUATION OF THE PATIENT**

- The science and art of history taking,
- Physical examination including elements of accurate history taking, symptoms associated with neurological disease,
- Physical examination of adults, children, infants and neonates, syndromes associated with congenital and acquired neurological disease, cutaneous markers,
- Examination of unconscious patients,
- Examination of higher mental functions, cranial nerves, the ocular fundus,
- Examination of tone, power of muscles,

- Proper elicitation of superficial and deep reflexes including alternate techniques,
- Neonatal and released reflexes,
- Neurodevelopmental assessment of children, sensory system, peripheral nerves, signs of Meningeal irritation, skull and spine examination including measurement of head circumference, shortness of neck and carotid pulsations .and vertebral bruits.

### **DISTURBANCES OF SENSORIUM**

- Pathophysiology and diagnosis of COMA,
- Diagnosis and management of coma, delirium and acute confusional states, reversible and irreversible causes,
- Persistent vegetative states and brain death,
- Neurophysiological evaluation and confirmation of these states,
- Mechanical ventilation and other supportive measures of comatose patient,
- Prevention of complications of prolonged coma,
- The significance of timely brain death in organ donation and ICU resource utilization.

### **SEIZURES and EPILEPSY and SYNCOPE**

- Diagnosis of seizures, epilepsy and epileptic syndromes,
- Recognition, clinical assessment and management of seizures especially their electrodiagnosis, video monitoring with emphasize on phenomenology and their correlation with EEG,
- Structural and functional brain imaging such as CT and MRI and fMRI and SPECT scan,
- Special situations such as epilepsy in pregnant and nursing mothers, driving, risky occupations, its social stigmas differentiation from pseudo seizures,
- Use of conventional and newer antiepileptic drugs, their drug interactions and adverse effects etc.,
- Modern lines of management of intractable epilepsies, such as ketogenic diet, vagal nerve stimulation, epilepsy surgery,
- Pre-surgical evaluation of patients,
- Management of status epilepticus and refractory status epilepticus,
- Differentiation of seizures from syncope, drop attacks, cataplexy, startles etc.

### **HEADACHES and OTHER CRANIAL NEURALGIAS**

- Acquisition of skills in analysis of headaches of various causes such as those from raised intracranial pressures, migraines, cranial neuralgias, vascular malformations,
- Meningeal irritation, Psychogenic etc. and their proper pharmacologic management.

### **CEREBROVASCULAR DISEASES**

- Vascular anatomy of brain and spinal cord,
- Various causes and types of cerebrovascular syndromes, ischemic and hemorrhagic types, arterial and venous types, anterior and posterior circulation strokes,
- OCSP and TOAST classifications,
- Investigation of strokes including neuroimaging using Dopplers,
- CT and MR imaging and angiography, acute stroke therapy including

- thrombolytic therapy,
- Interventional therapy of cerebrovascular diseases,
- Principles of management of subarachnoid hemorrhage etc.
- Special situations like strokes in the young, strategies for primary and secondary prevention of stroke.

## **DEMENTIAS**

- Concept of minimal cognitive impairment,
- Reversible and irreversible dementias, causes such as Alzheimer's and other neurodegenerative diseases and vascular and nutritional and infectious dementias, their impact on individual, family and in society.
- Genetic and familial syndromes.
- Pharmacotherapy of dementias, potential role of cognitive rehabilitation and special care of the disabled.

## **PARKINSONISM AND MOVEMENT DISORDERS**

- Disorders of extrapyramidal system such as Parkinsonism, chorea, dystonia, athetosis, tics, their diagnosis and management,
- Pharmacotherapy of Parkinsonism and its complications,
- management of complications of Parkinsonism therapy, including principles of deep brain stimulation and lesion surgeries.
- Use of EMG guided botulinum toxin therapy,
- Management of spasticity using intrathecal baclofen and TENS.

## **ATAXIC SYNDROMES:**

- Para infectious demyelination, cerebellar tumors, hereditary ataxias, vestibular disorders,
- Diagnosis and management of brainstem disorders,
- Axial and extra-axial differentiation.

## **CRANIAL NEUROPATHIES:**

- Disorders of smell, vision, visual pathways, pupillary pathways and reflexes,
- Internuclear and supranuclear ophthalmoplegia,
- Other oculomotor disorders,
- Trigeminal nerve testing,
- Bell's palsy,
- Differentiation from UMN facial lesions,
- Brain stem reflexes,
- Investigations of vertigo and dizziness,
- Differentiation between central and peripheral vertigo,
- Differential diagnosis of nystagmus,
- Investigations of deafness, bulbar and pseudobulbar syndromes.

## **CNS INFECTIONS:**

- Diagnosis and management of viral encephalitis, meningitis bacterial, tuberculous, fungal, parasitic infections such as cysticercosis, cerebral malaria, SSPE, Neuro HIV primary and secondary infections with exposure to gram stain and cultures, bac tec, QBC, ELISA and PCR technologies.

### **NEUROIMMUNOLOGIC DISEASES**

- Diagnosis and management of CNS conditions such as Multiple Sclerosis, PNS conditions such as GBS, CIDP, Myasthenia gravis, polymyositis.

### **NEUROGENETIC DISORDERS**

- Various chromosomal diseases,
- Single gene mutations such as enzyme deficiencies,
- Autosomal dominant and recessive conditions and X-linked disorders, trinucleotide repeats,
- Disorders of DNA repair. Genetics of Huntington's disease, familial dementias, other storage disorders, hereditary ataxias,
- Hereditary spastic paraplegias, HMSN, muscular dystrophies, mitochondrial inheritance disorders.

### **DEVELOPMENTAL DISORDERS OF NERVOUS SYSTEM**

- Neuronal migration disorders,
- Craniovertebral junction diseases,
- Spinal dysraphism,
- Phacomatoses and other neurocutaneous syndromes- their recognition and management.

### **MYELOPATHIES**

- Clinical diagnosis of distinction between compressive and non-compressive myelopathies,
- Spinal syndromes such as anterior cord, subacute combined degeneration,
- Central cord syndrome,
- Brown-Sequard syndrome,
- Tabetic syndrome,
- Ellsberg phenomenon.
- Diagnosis of spinal cord and root compression syndromes,
- CV junction lesions,
- Syringomyelia, conus cauda lesions,
- Spinal AVMs,
- tropical and hereditary spastic paraplegias,
- Fluorosis.

### **PERIPHERAL NEUROPATHIES**

- Immune mediated, hereditary, toxic, nutritional and infectious type peripheral neuropathies; their clinical and electrophysiological diagnosis.

### **MYOPATHIES AND NEUROMUSCULAR JUNCTION DISORDERS**

- Clinical evaluation of patients with known or suspected muscle diseases aided by EMG,
- Muscle pathology, histochemistry, immunopathology and genetic studies,

- Dystrophies, polymyositis, channelopathies, congenital and mitochondrial myopathies,
- Neuromuscular junction disorders such as myasthenia, botulism, Eaton-lambert syndrome,
- Snake and organophosphorus poisoning, their electrophysiological diagnosis and management.
- Myotonia, stiff person syndrome.

#### **PAEDITRIC NEUROLOGY:**

- Normal development of motor and mental milestones in a child, Cerebral palsy,
- Attention deficit disorder,
- Autism,
- Developmental dyslexia,
- Intrauterine TORCH infections,
- Storage disorders,
- Inborn errors of metabolism affecting nervous system,
- Developmental malformations,
- Child hood seizures and epilepsies,
- Neurodegenerative diseases.

#### **COGNITIVE NEUROLOGY AND NEUROPSYCHIATRY:**

- Detailed techniques of higher mental functions evaluation,
- Basics of primary and secondary neuropsychiatric conditions such as anxiety, depression, schizophrenia, acute psychosis, acute confusional reactions (delirium), organic brain syndrome,
- Primary and secondary dementias, differentiation from pseudodementia.

#### **TROPICAL NEUROLOGY**

Conditions which are specifically found in the tropics like to be taught in detail;

- Neuro-cysticercosis,
- Cerebral malaria,
- Tropical spastic paraplegia,
- Snake/scorpion/ Chandipura
- Encephalitis,
- Madras Motor Neuron disease etc.

#### **PAPER III: DIAGNOSTIC and INTERVENTIONAL NEUROLOGY INCLUDING NEUROLOGICAL INSTRUMENTATION, DIAGNOSTIC NEUROLOGY**

- Performing and interpreting Digital Electroneurogram, Electromyogram,
- Evoked potentials, Electroencephalography,
- Interpretation of skull and spine X-rays,
- Computerized tomography of brain and spine,
- Magnetic resonance images of brain including correct identification of various sequences, angiograms, MR spectroscopy,
- Basics of functional MRI,

- Interpretation of digital subtraction imaging, SPECT scans of brain, subdural EEG recording, transphenoidal electrode EEG techniques for temporal lobe seizures,
- video EEG interpretation of phenomenology and EEG-phenomenology correlations,
- EEG telemetry,
- Transcranial Doppler diagnosis and monitoring of acute ischemic stroke,
- Subarachnoid hemorrhage,
- Detection of right-to-left shunts etc;
- Color duplex scanning in Carotid and vertebral extracranial segment screening.

## **NEUROINSTRUMENTATIONS**

Acquire skills in procedures like:

- Intrathecal administration of antispasticity drugs, beta interferons in demyelination, opiates in intractable pain etc.,
- EMG guided Botox therapy for dystonia,
- Subcutaneous administration of antimigraine and antiparkinsonian drugs,
- Intraarterial thrombolysis in extended windows of thrombolysis in ischemic strokes,
- Transcranial Ultrasound clot-bust intervention in a registry in acute stroke care unit,
- Planning in deep brain stimulation therapy in uncontrolled dyskinesias and on-off phenomena in long standing Parkinsonism,
- Planning in vagal nerve stimulation in intractable epilepsy.

## **PAPER IV: RECENT ADVANCES IN NEUROLOGY:**

### **ADVANCES IN NEUROIMAGING TECHNIQUES, BIONICS IN NEURAL PROSTHESIS and REHABILITATION, NEUROPROTEOMICS and NEUROGENETICS, STEM CELL and GENE THERAPY**

#### **ADVANCES IN NEUROIMAGING TECHNIQUES:**

- Integration of CT, MR, SPECT, and PET images with each other and with EEG.
- EVOKED potentials based brain maps in structural and functional localization in neurological phenomena and diseases.
- DSA interpretation and diagnosis.

#### **BIONICS IN NEURAL PROSTHESIS AND REHABILITATION:**

- Advanced techniques in neuro-rehabilitation such as TENS, principles of man-machine interphase devices in cord, nerve and plexus injuries, cochlear implants, artificial vision.

#### **NEUROPROTEOMICS AND NEUROGENETICS:**

Brain functions are regulated by proteomics and genomics linked to various proteins and genes relevant to the brain, body's maximum number of proteins and genes being expressed in brain as neurotransmitters or channel proteins and predisposing brain to a number of disorders of abnormal functioning of these proteins.

#### **STEM CELL AND GENE THERAPY:**

- Principles of ongoing experiments on stem cell therapy for nervous system disorders such as foetal brain tissue transplants in parkinsonism; intrathecal marrow transplants in MND,MS, Spinal trauma; myoblasts infusion therapy in dystrophies.

### **NEUROEPIDEMIOLOGICAL STUDIES AND CLINICAL TRIALS:**

The students of the DM course will be trained in conducting sound Neuro-epidemiology studies on regionally and nationally important neurological conditions as well as on diseases of scientific and research interest to the department. They will also be trained in principles of clinical trials.

### **Essential Practical Knowledge**

1. Online certification in Research Methodology Course
2. Certification of NIHSS, MRS, mBI, EDSS
3. Interpretation of acute stroke imaging
4. Performance of cerebral angiography and interpretation of DSA
5. Performance of TCD
6. Performance and interpretation of electrophysiological tests

### **TEACHING AND LEARNING METHODS**

#### **Postgraduate teaching program**

##### **General principles**

Acquisition of practical competencies being the keystone of postgraduate medical education, PG training should be skills-oriented. Learning in PG program should be essentially self-directed and primarily emanating from clinical and academic work. The formal sessions are merely meant to supplement this core effort.

##### **Teaching Methodology**

The postgraduate student should be given the responsibility of managing and caring for patients gradually under supervision.

##### **Formal teaching sessions and learning opportunities**

##### **A. Intramural activities**

Teaching and learning during bedside rounds of various areas, case discussions in NICU, wards by self-reflection, and follow up clinics are mainstays. Several organized learning experiences should be provided to the students to facilitate the refinement of knowledge and skills. Students are expected to actively participate in the teaching program of the department and allied specialties within the department and other departments of the institute. They get regular opportunities to prepare and make presentations in these teaching programs.



Following formal sessions are recommended in order to facilitate learning\* :

- Journal club (once 15 days )
- Perinatal round (once 15 days)
- Seminar (once 15 days)\*
- Clinical case discussion (once 15 days )
- Perinatal audit/CPC (once a month)
- Research review (once a month)
- Neonatal surgery (once 3 month)

*\*In addition, depending on the strength of the institutions, sessions on imaging, pathology, microbiology, biostatistics/epidemiology, and interdepartmental seminars may be undertaken.*

*The list of seminar topics is given in Annexure I.*

### **B. Extramural opportunities**

The postgraduate students are encouraged to attend continuing education symposia, workshops, and academic conferences, including meetings of national and international societies, workshops.

### **Learning by Teaching**

The students will participate in teaching junior residents, nurses, nursing students, and trainees from other hospitals coming for observership. They will also be given the exposure of teaching and training during workshops and CMEs organized by the faculty within the institution and outreach activities.

- In addition, the student should attend accredited scientific meetings (CME, symposia, and conferences) once or twice a year.
- A postgraduate student of a postgraduate degree course in super specialties would be required to present one poster presentation or read one paper at a national/state conference; should write a research paper from his/her work which should be published/accepted for publication/sent for publication during the period of his postgraduate studies.

**C. Log Book:** During the training period, the postgraduate student should maintain a Log Book indicating the duration of the postings/work done in Wards, OPDs, and Casualty. This should indicate the procedures assisted and performed and the teaching sessions attended. The purpose of the Log Book is to:

- a) Help maintain a record of the work done during training,
- b) Enable Consultants to have direct information about the work; intervene if necessary,
- c) Use it to assess the experience gained periodically.

The Log Book should be used to aid the internal evaluation of the student. The Logbook shall be checked and assessed periodically by the faculty members imparting the training. Candidates will be required to produce the logbook original or copy at the time of practical examination. It should be signed by the Head of the Department. A proficiency certificate from the Head of Department regarding the clinical competence and skillful performance of procedures by the student will be necessary before he/she would be allowed to appear in the examination. The teaching faculty are referred to the NMC Logbook Guidelines uploaded on the Website.

### **E. POSTINGS**

#### **Overview**

The total period of the DM course is 36 months. Of this, at least 27 months will be spent in the newborn service, 6 months will be meant for essential rotations in related specialties, and the rest 3 months will be apportioned for either elective rotations or the newborn service.

#### **Period of postings in various units, divisions / departments**

The trainee will be posted in different specialties as follows :-

- Neurology 2 years
- Neuro-physiology 4-6 months

- Neuro-surgery 1 month
- Neuro-pathology 1 month
- Neuro-radiology 1 month
- Elective posting 2 weeks

The elective posting may consist of posting in the other institutes or own institute for training in specific fields

- Psychiatry 1 month
- Neuro-anaesthesia/ICU 1 months

During Clinical Neurology posting the trainee is required to undertake:-

- Ward work
- Consultations

Neuro-investigations

- EEG reporting
- Out patient clinics
- Neuro-emergency

The above postings should be for a period of 2-4 months at different times over the training period. All the patients seen in the OPD by the trainee or on consultation are to be shown by him/her to the consultants and management planned.

#### **F. Patient safety**

**During the training programme, patient safety is of paramount importance; therefore, skills are to be learnt initially on the models, later to be performed under supervision followed by performing independently. For this purpose, provision of skills laboratories in medical colleges is mandatory.**

#### **ASSESSMENT**

**FORMATIVE ASSESSMENT**, during the training program: Formative assessment should be continual and should assess medical knowledge, patient care, procedural & academic skills, interpersonal skills, professionalism, self-directed learning, and ability to practice in the system.

#### **Periodic Evaluation:**

Candidates will be evaluated continuously for their performance in all areas such as clinical and investigative work, case presentations, seminars, journal clubs, procedures undertaken/participated in etc. Additional periodic assessment will include theory and practical assessment mimicking the final examination and should be conducted every 6 months. Such an evaluation will help assessing the progress of the trainees and the quality of the training programme. Evaluation will be communicated to trainees and their feedback would be taken into consideration for modifications in the training programme.

**Internal Assessment** should be frequent, cover all domains of learning and used to provide feedback to improve learning; it should also cover professionalism and communication skills.

**Quarterly assessment during the DM training should be based on:**

1. Journal based / recent advances learning
2. Patient based /Laboratory or Skill based learning
3. Self-directed learning and teaching
4. Departmental and interdepartmental learning activity
5. External and Outreach Activities / CMEs/Workshops/Conferences

## 6. Participation/conduct of research project - desirable

Regular internal assessment will be made on day to day work of the trainee which involves patient's care, learning, bed side care presentation and research. Grading is done every six months and final assessment will be made at the end of training period.

In **Medical disciplines**, the student should be assessed in all aspects of case management including history taking, physical examination, differential diagnosis, cost effective and appropriate investigations, treatment plan, monitoring and evaluation, patient and family counselling and interaction with all the health workers involved in the care of patients and academic presentations.

Clinical skills and performance, academic performance and personal attributes shall be graded on a scale of 1 to 5 (5 being the highest). The academic presentations shall be graded at the time of presentation, by the faculty in-charge. Evaluation on clinical skills shall be done by the unit/department in-charge at the end of every semester.

The student to be assessed periodically as per categories listed in post graduate student appraisal form (Annexure II).

### SUMMATIVE ASSESSMENT

The summative examination would be carried out as per the Rules given in the relevant POSTGRADUATE MEDICAL EDUCATION REGULATIONS.

Essential pre-requisites for appearing for examination include:

1. **Log book** of work done during the training period including rotation postings, departmental presentations, and internal assessment reports should be submitted.
2. At least **two presentations** at national level conference. At least one research paper should be published/ accepted in an indexed journal. **(It is suggested that the local or University Review committee assess the work sent for publication).**
3. **Submission of thesis/ research work (desirable: As per PG Regulations)**

#### 1. Theory

There shall be four theory papers:-

Paper I: Basic sciences as related to Neurology (This should include anatomy, physiology, Pathology, biochemistry, pharmacology and genetics as applicable to neurology)

Paper II: Clinical Neurology (This should include all aspects of clinical neurology i.e. diagnosis, management, therapeutics, approach to clinical situations)

Paper III: Investigative Neurology (This should include all the investigative procedures i.e. electrophysiology, imaging, neuropathology, magneto-encephalography etc)

Paper IV: Recent advances in Neurology (This should include recent advances in neurosciences including genetics, immunology, therapeutics, pathophysiology etc)

**Theory and Practical/Oral Examinations:** Theory and Practical/Oral examinations will be conducted as per University guidelines. The theory examination shall be held in advance before the clinical and practical examination, so that the answer books can be assessed and evaluated before the commencement of the clinical/practical/oral examination.

The practical examination should consist of the following and should be spread over two days, if the number of candidates appearing is more than five. Oral examination shall be comprehensive enough to test the student's overall knowledge of the subject.

**This will consist of:**

**1. Up to 10 spotters for Objective Structured Clinical Examination ( OSCE) pattern**

**2. Two clinical cases**

The candidates shall also be given EEG, Pathology specimens, histology slides and neuro-radiology for interpretation, followed by Viva Voce.

The clinical examination and viva-voce will last for not less than two days

1. There should be one long or semi-long case which must be on acute care of a sick neonate. The long case should include: History taking, physical examination, interpretation of clinical findings, differential diagnosis, investigations, prognosis and management.
2. Three short cases from various sections of the specialty.
3. The log book of procedures and interventions shall also be assessed in the practical examination.

**Annexure I**

**List of seminars**

Following is the list of essential seminars which a postgraduate student is required to attend during the three years. Other relevant topics may be included from time to time:-

- Neuron
- Synapse
- Neuroglia
- Cerebral cortex - anatomy and physiology
- Frontal lobe
- Parietal lobe
- Temporal lobe
- Occipital lobe
- Limbic system
- Thalamus
- Basal Ganglia
- Cerebellum
- C.S.F. formation, composition and dynamics
- Cerebral circulation
- Cerebral oedema
- Cerebral perfusion
- CSF & ICP → physiological considerations
- Spinal cord circulation
- Spasticity – Pathophysiology
- Rigidity – Pathophysiology
- Tremors
- Myoclonus
- Genesis of E.E.G.
- Ontogenesis of E.E.G.
- EMG routine, F. wave, H. reflex
- EMG recent advances:
  - Evoked potentials – General and Auditory
  - Visual and somatosensory evoked response and event related potentials

- Basic principles and clinical application of computed tomography
  - Epilepsy – Pathophysiology
  - Epilepsy – Neurochemistry
  - Epilepsy – Management
  - Temporal lobe epilepsy – theory, recent controversy and management
  - Surgery in epilepsy
  - Supra nuclear control of ocular movements
  - Nystagmus
  - Sleep
  - Central speech disorders
  - Mechanism of memory
  - Dementia – Pathophysiology and approach
  - Mechanism and Neurochemistry of pain
  - Immunological and immune related disorders of nervous system
  - Myasthenia gravis – pathophysiology and treatment
  - Slow virus infections of CNS
  - Radiotherapy, immunotherapy and chemotherapy of CNS malignancy
  - MRI – Principles and clinical application
  - Spinal dysraphism
  - PET - Principles and clinical application
  - Hypertension and brain
  - Neurolipidosis – biochemical aspect
  - Neurolipidosis – clinical aspect
  - Subarachnoid haemorrhage – Presentation and management
  - Muscular dystrophies – Current concepts
  - Stroke – Current aspect of aetiopathogenesis
  - Stroke management – Medical / Surgical
  - Wilson's disease
  - Demyelinating diseases in India
- Functional Imaging in Neurology
  - Neuromuscular Channelopathies
  - Neurology of pain/migraine
  - Neurology of emotions
  - Neurointervention in Stroke
  - Approach to intracranial granulomatous disorders
  - Neurology of HIV infection
  - Neuroprotection in Stroke – An update
  - Update on Aphasias
  - Statins in Neurological disorders

- Neuromuscular Junction- Physiology and Pathophysiology
- Stem cells in Neurology
- Epileptogenesis
- Multiple Sclerosis – Pathophysiology
- Multiple Sclerosis – Therapeutic update
- Ultrasound in Neurology
- Pathophysiology of Mitochondrial disorders (including genetics)
- Excitotoxicity in Neurological Disorders
- Disorders of sleep (Including parasomnias)
- Parkinsonism – Pathophysiology and treatment
- Peripheral nerve – Biochemistry and Physiology
- Skeletal muscle – Ultra, Structure and Biochemistry
- Surgery in Parkinson's disease and related disorders
- Visual pathways with pathological correlates
- Non motor functions of the cerebellum
- Approach to Chronic polyneuropathies
- Pathology of Myopathies
- Neuro-radiology of Myopathies

Student appraisal form for DM in Neurology											
	Element	Less than Satisfactory			Satisfactory			More than satisfactory			Comments
		1	2	3	4	5	6	7	8	9	
<b>1</b>	<b>Scholastic Aptitude and Learning</b>										
1.1	Knowledge appropriate for level of training										
1.2	Participation and contribution to learning activity e.g., Journal Club, Seminars, CME etc)										
1.3	Conduct of research and other scholarly activity assigned (e.g Posters, publications etc)										
1.4	Documentation of acquisition of competence (eg Log book)										
1.5	Performance in work based assessments										
1.6	Self Directed Learning										
<b>2</b>	<b>Care of the patient</b>										
2.1	Ability to provide patient care appropriate to level of training										
2.2	Ability to work with other members of the health care team										
2.3	Ability to communicate appropriately and empathetically with patients families and care givers										
2.4	Ability to do procedures appropriate for the level of training and assigned role										
2.5	Ability to record and document work accurately and appropriate for level of training										
2.6	Participation and contribution to health care quality improvement										

<b>3</b>	<b>Professional attributes</b>																		
3.1	Responsibility and accountability																		
3.2	Contribution to growth of learning of the team																		
3.3	Conduct that is ethical appropriate and respectful at all times																		
<b>4</b>	<b>Scholarship</b>																		
4.1	Teaching and mentoring skills appropriate to level of training																		
4.2	Ability to formulate research questions, initiate conduct and complete research projects																		
4.3	Ability to review and use the published literature appropriately in care of the patient lab or workspace																		
4.4	Ability to provide consultations to other specialties as may be required																		
<b>5</b>	<b>Space for additional comments</b>																		
<b>6</b>	<b>Disposition</b>																		
	Has this assessment been discussed with the trainee?	Yes	No																
	If not explain																		
	Name and Signature of the assessee																		
	Name and Signature of the assessor																		
	Date																		