



MAHATMA GANDHI UNIVERSITY
of
MEDICAL SCIENCES & TECHNOLOGY
JAIPUR

Super Specialty Courses

SYLLABUS **DM-NEURO ANAESTHESIA (DM10)**

Edition 2021-22

Notice

1. Amendment made by the National Medical Commission in Rules/Regulations of Post Graduate Medical Courses shall automatically apply to the Rules/Regulations of the Mahatma Gandhi University of Medical Sciences & Technology (MGUMST), Jaipur.
2. The University reserves the right to make changes in the syllabus/books/guidelines, fees-structure or any other information at any time without prior notice. The decision of the University shall be binding on all.
3. The Jurisdiction of all court cases shall be Jaipur Bench of Hon'ble Rajasthan High Court only.

Syllabus of DM / M.Ch. Courses
DM-NEUROANAESTHESIA (DM10)

SELECTION OF CANDIDATES:

There shall be a uniform entrance examination to all medical educational institutions at the Postgraduate level namely 'National Eligibility-cum-Entrance Test' for admission to postgraduate courses in each academic year and shall be conducted under the overall supervision of the Ministry of Health & Family Welfare, Government of India.

In order to be eligible for admission to Postgraduate Course for an academic year, it shall be necessary for a candidate to obtain minimum of marks at 50th percentile in the 'National Eligibility-Cum-Entrance Test for Postgraduate courses' held for the said academic year. However, in respect of candidates belonging to Scheduled Castes, Scheduled Tribes, and Other Backward Classes, the minimum marks shall be at 40th percentile. In respect of candidates with benchmark disabilities specified under the Rights of Persons with Disabilities Act, 2016, the minimum marks shall be at 45th percentile for General Category and 40th percentile for SC/ST/OBC.

The percentile shall be determined on the basis of highest marks secured in the All India Common merit list in National Eligibility-cum-Entrance Test for Postgraduate courses.

Provided when sufficient number of candidates in the respective categories fail to secure minimum marks as prescribed in National Eligibility-cum-Entrance Test held for any academic year for admission to Postgraduate Courses, the Central Government in consultation with Medical council of India may at its discretion lower the minimum marks required for admission to Post Graduate Course for candidates belonging to respective categories and marks so lowered by the Central Government shall be applicable for the academic year only.

The reservation of seats in Medical Colleges/institutions for respective categories shall be as per applicable laws prevailing in States/Union Territories. An all India merit list as well as State-wise merit list of the eligible candidates shall be prepared on the basis of the marks obtained in National Eligibility-cum-Entrance Test and candidates shall be admitted to Postgraduate Courses from the said merit lists only.

There shall be no admission of students in respect of any academic session beyond 31st August under any circumstances. The Universities shall not register any student admitted beyond the said date.

ELIGIBILITY:

Candidates must meet the eligibility criteria required to get admission to DM courses through NEET-SS.

Common Counseling:

There shall be a common counseling for admission to all Postgraduate Super specialty Courses (DM/ M.Ch.) in all Medical Educational Institutions on the basis of merit list of the National Eligibility-cum-Entrance Test.

Period of Training:

The period of training for obtaining DM/M.Ch Degrees shall be three completed years including the examination period.

Migration:

Under no circumstance, Migration/transfer of student undergoing any Super Specialty course shall be permitted by any University/ Authority.

Staff - Faculty:

Only those teachers who possess 6 years teaching experience out of which at least 2 years teaching experience as Assistant Professor gained after obtaining the higher specialty degree shall be recognized post graduate teacher.

No teacher shall be considered as a postgraduate teacher in any other institution during the period till the postgraduate course at the institute which has been granted permission considering him as a postgraduate teacher is recognized u/s 11(2) of the Indian Medical Council Act, 1956.

Minimum staff required (Super-speciality):

- 1- Professor
- 1- Associate Professor
- 1- Assistant Professor
- 1- Senior Resident
- 2- Junior Resident

Training Programme:

All the candidates joining the Post Graduate training programme shall work as 'Full Time Residents' during the period of training and shall attend not less than 80% (Eighty percent) of the imparted training during each academic year (Academic Term of 6 months) including assignments, assessed full time responsibilities and participation in all facets of the educational process.

No candidate shall be permitted to run a clinic/work in clinic/laboratory/nursing home while studying postgraduate super specialty course. No candidate shall join any other course or appear for any other examination conducted by this university or any other university in India or abroad during the period of registration.

Every institution undertaking Post Graduate training programme shall set up an Academic cell or a curriculum committee, under the chairmanship of a senior faculty member, which shall work out the details of the training programme in each speciality in consultation with other department faculty staff and also coordinate and monitor the implementation of these training Programmes.

The training programmes shall be updated as and when required. The structured training programme shall be written up and strictly followed, to enable the examiners to determine the training undergone by the candidates and the Medical Council of India inspectors to assess the same at the time of inspection.

Post Graduate students shall maintain a record (log) book of the work carried out by them and the training programme undergone during the period of training including details of surgical operations assisted or done independently by M.Ch. candidates.

The Record (Log) Books shall be checked and assessed periodically by the faculty members imparting the training.

During the training for award of Degree / Superspecialty in clinical disciplines, there shall

be proper training in Basic medical sciences related to the disciplines concerned; so also in the applied aspects of the subject; and allied subjects related to the disciplines concerned. In the Post Graduate training programmes including both Clinical and Basic medical sciences, emphasis has to be laid on Preventive and Social aspects. Emergency care, facilities for Autopsies, Biopsies, Cytopsies, Endoscopy and Imaging etc. shall also be made available for training purposes.

The Post Graduate students shall be required to participate in the teaching and training programme of undergraduate students and interns.

Training in Medical Audit, Management, Health Economics, Health Information System, basics of statistics, exposure to human behaviour studies, knowledge of pharmaco – economics and introduction to nonlinear mathematics shall be imparted to the Post Graduate students.

The teaching and training of the students shall include graded responsibility in the management and treatment of patients entrusted to their care; participation in Seminars, Journal Clubs, Group Discussions, Clinical Meetings, Grand Rounds, and Clinico-Pathological Conferences; practical training in Diagnosis and Medical and Surgical treatment; training in the Basic Medical Sciences, as well as in allied clinical specialities.

The training programme shall be on the same pattern as for M.D. / M.S. in clinical disciplines; with practical training including advanced Diagnostic, Therapeutic and Laboratory techniques, relevant to the subject of specialization. Postgraduate Superspecialty Residents in Surgical Specialties shall participate in Surgical operations as well.

A postgraduate student of a postgraduate degree course in super specialities would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/accepted for publication/sent for publication during the period of his postgraduate studies so as to make him eligible to appear at the postgraduate degree examination.

ENROLMENT AND REGISTRATION:

Every candidate who is admitted to DM/MCh. course in Mahatma Gandhi Medical College & Hospital shall be required to get himself/herself enrolled and registered with the Mahatma Gandhi University of Medical Sciences & Technology (MGUMST) after paying the prescribed eligibility and enrolment fees.

The candidate shall have to submit an application to the MGUMST through Principal of College for the enrolment/eligibility along with the following original documents and the prescribed fees within two months of his/her admission or up to November 30 of the year of admission whichever is later without late fees. Then after, students will have to pay applicable late fees as per prevailing University Rules.

- a. MD/MS pass Marks sheet/Degree certificate issued by the University.
- b. Migration certificate issued by the concerned University (in case the University is other than the MGUMST).
- c. Date of Birth Certificate
- d. Certificate regarding registration with Rajasthan Medical Council / Medical Council of India / Other State Medical Council.

No candidate shall be allowed to appear in University examination without his/her enrolment with the University

SCHEME OF EXAMINATIONS:

The examination shall be held at the end of three academic years (six academic terms). The academic term shall mean six months training period. The examination shall consist of: Theory and Clinical/Practical and Oral.

The examinations shall be organised on the basis of 'Marking system' to evaluate and to certify candidate's level of knowledge, skill and competence.

For passing DM/M.Ch. examination as a whole, a candidate shall secure not less than 50% marks in each head of passing which shall include (1) Theory (2) Clinical / Practical and Oral examination.

(1) Theory:

There shall be four theory papers of 3 hours duration and 100 marks each. 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 and Oral examination.

Paper I and II will be set by one external examiner from outside of the state and paper III and IV by another external examiner from outside of the state. The external examiner, who is paper setter for paper I & II shall evaluate the answer books of paper II. The external examiner, who is paper setter for paper III & IV shall evaluate the answer books of paper III. The answer books of paper I & IV shall be evaluated by internal examiners. The answer books of paper IV shall be evaluated by the Head of the Department and the answer books of paper I shall be evaluated by the second Internal Examiner.

Candidates will be required to attempt all the questions in every question paper. In Paper I, Paper II and Paper III there will be 10 questions. Each question shall carry 10 marks. In Paper IV there will be 5 questions of 20 marks each.

Obtaining a minimum of 40% marks in each theory paper and not less than 50% cumulatively in all the four papers shall be compulsory to pass the examination.

The paper wise distribution of the Theory Examination shall be as follows:

Paper I: Basic Sciences as applied to the subject

Paper II: Clinical Neuroanaesthesia and techniques in anaesthesia

Paper III: Clinical Neuroanaesthesia, interventional neuroradiology, and Neurointensive care

Paper IV: Recent advances in the subject

(2) Clinical / Practical and Oral:

Clinical/Practical examination shall be conducted to test / aimed at assessing the knowledge and competence of the candidate for undertaking independent work as a specialist / teacher. Practical examination shall consist of carrying out special investigative techniques for Diagnosis and Therapy. Candidates shall also be examined in surgical procedures. Oral examination may be comprehensive enough to test the candidate's overall knowledge and competence about the subject, investigative procedures, therapeutic technique and other aspects of the specialty, which shall form a part of the examination.

Obtaining of 50% marks in Clinical / Practical and Oral examination shall be mandatory for passing the Clinical / Practical and Oral examination-

Maximum Marks: 400.

Result:

For passing DM/M.Ch. Examination, a candidate will be required to obtain at least 40% marks in each theory paper, 50% marks in the aggregate of all the four theory papers and 50% marks in the aggregate of Clinical / Practical and Oral examination separately. A candidate failing in any theory paper or in the aggregate of all four theory papers or Clinical / Practical and Oral examination shall have to repeat the whole DM/M.Ch. examination.

Grace Marks:

No grace marks will be provided in DM/M.Ch. examinations.

Revaluation / Scrutiny:

No Revaluation shall be permitted in the DM/M.Ch. examinations. However, the student can apply for scrutiny of the answer books as per University Rules

Examiners:

As per the Amendment Notification of the MCI dated June 5, 2017, no person shall be appointed as an internal examiner in any subject unless he/she has three years experience as recognized PG teacher in the concerned subject. For external examiners, he/she should have minimum six years of experience as recognized PG teacher in the concerned subject.

For all Post Graduate Super specialties examinations, the minimum number of Examiners shall be four, out of which at least two (50%) shall be External Examiners, who shall be invited from other recognised universities from outside the State.

Number of Candidates:

The maximum number of candidates to be examined in Clinical / Practical and Oral on any day shall not exceed three for D.M./M.Ch. Examinations.

Number of Examinations:

The university shall conduct not more than two examinations in a year, for any subject, with an interval of not less than 4 and not more than 6 months between the two examinations.

GUIDELINES FOR COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR DM IN NEUROANAESTHESIA

Preamble

There has been significant progress in the understanding of basic and clinical neurosciences which has paved way for improvement in practices and care. Clinical research and individual disorder directed management strategies have greatly changed the clinical outcomes in many neurological conditions. With more advanced monitors being available, the clinical management of neurological and neurosurgical patients has changed for the better. Therefore, there is a need for the clinical personnel involved in patient care to be aware of the advances in all the related fields of neurosciences. Such knowledge should also be disseminated to the post graduate students and clinicians to change the outcomes of patient care in the peripheral centers. In order to achieve the above goals and also promote basic and clinical knowledge in related fields, neuroanaesthesia has now established itself well as a specialty for the past 15 - 20 years. The evolution of neuroanaesthesia as a separate specialty has definitely improved the outcome of treatment of neurological and neurosurgical patients. It has been the general experience that institutions with dedicated neuroanaesthesia services have provided better care and optimal outcomes for patients with neurological diseases.

SUBJECT SPECIFIC OBJECTIVES

The students admitted to the course must be exposed to the entire range of cases in Neurosurgical (those requiring surgery as also those requiring management in neuro-intensive care) and Neurological diseases (especially, those requiring management in neuro-intensive care). The student needs to perform meticulous history taking, thorough clinical examination, examine the necessary investigations required for surgery, order diagnostic tests, which he/she thinks are necessary for optimal preparation of the patient for surgical procedures; perform procedures; counsel and manage patients, use the antimicrobial and other drugs based upon local institutional policy. They will also need to appropriately and rationally work with other departments to provide patient-focused care. The student should also know the various ethical issues involved in the intensive management of such patients.

The student should also be able to manage patients presenting for neuro-interventional procedures, both diagnostic as well as therapeutic. He /she should also learn the management of patients for MRI/CT scan.

Teaching Skills

The student should be exposed to the basic methodology of teaching and develop competence in teaching medical, paramedical and nursing students at the undergraduate and postgraduate levels.

The student must be able to acquire the skills to engage and transfer his/her knowledge

in a clear and succinct manner and be able to motivate others to pursue further reading. The quality of the information must sustain to the high standards that are required to enhance the understanding of the subject discussed. This should include the ability to actively involve and guide the students in small groups and to provide them with the fundamentals of clinical methods and analytical thinking.

Research Skills

The students should gain the basic skills and knowledge to function as independent investigators. The students are exposed to state-of-the-art basic, translational, and clinical research and through active participation, develop a firm basis for continuing success in one or more of these areas. Skills include developing appropriate scientific knowledge and critical evaluation of the relevant literature, problem solving, design and interpretation of experiments, communication of progress and results in formal and informal settings, understanding national and international systems for funding of research, learn to write research protocols and sharpen critical thinking. Scientific professionalism would be stressed in clinical situations. Basic knowledge of statistics, along with clinical epidemiologic principles like appropriate study designs, critical appraisal of data management and analysis are also required.

Interpersonal and Communication Skills

Through experience in the pre-anaesthetic check up clinic, pain clinic, operation theatre, radiological diagnostic labs and Intensive Care Unit, the students would learn and practice communication skills appropriate to the situation. In their clinics, they will practice the building of a professional relationship with the patients and will develop the skills of proper communication about educating the patient regarding his/her care during hospital stay. The patients would be provided information about all anticipated complications of surgery and anaesthesia and effect on outcome. In the operating room setting, they will acquire skills of working with different caregivers like surgeons, nurses, technicians and other paramedical staff. The operating room environment of the neurosurgery operation theatres also will give them the training for handling crisis situations like difficult airway, massive blood loss, air embolism, cardiac arrhythmias and cardiovascular collapse. The students will learn the importance of working as a team and will develop the skills of getting the best out of the paramedical and nursing staff. In the intensive care unit, they will learn to develop the communication skills to deal with sick patients and their anxious relatives. The students will also learn the art of working together with colleagues from other specialties. By getting the opportunity to make presentations and attending the seminars, journal club, case presentations, students will also learn the art of making good presentation and teaching students.

Professionalism

The students are required to practice professionalism in the areas of academic, clinical and research activities. Under appropriate supervision, they will have primary responsibility for managing anaesthesia care in the operating room and remote locations, running the pre- anaesthesia check up clinics and pain clinics and also for providing intensive care for seriously ill patients. They would be dealing with patients of various ages and ethnicities. Intellectual integrity is emphasized in all settings, including in the clinics, operating room, ICU, conference room, in the conduction of research and publications.

SUBJECT SPECIFIC COMPETENCIES

At the end of the course, the student should have acquired the following:

1. Demonstrate sufficient understanding of knowledge in neuroanaesthesiology and allied specialties like neurosurgery, neurology and neuroradiology.
2. Develop the ability to take pertinent history from the patient/relatives (in case of unconscious patients), perform relevant clinical examination, decide appropriate investigations and derive anaesthetic management plan.
3. Acquisition of a reasonable level of theoretical and practical knowledge that empowers him/her to provide safe peri-operative and critical care of neurologically ill patients.
4. Proficiency in performing the mandatory procedures independently and other procedures under limited supervision at the end of three years.
5. Proficiency in advanced patient monitoring techniques like intracranial pressure, cardiac output, electroencephalography, evoked potential, transcranial Doppler, cerebral oximetry, jugular venous oximetry, microdialysis and echocardiography.
6. Become effective communicators to patients, their family, colleagues, inter-departmental personnel, technicians, nursing staff, teachers and students.
7. Develop essential skills in conducting medical research, and present them in scientific fora and publish in relevant peer-reviewed journals.
8. Acquire skills in emergency neurosurgical and neurotrauma procedures

By the end of the course, the student should have acquired knowledge (cognitive domain), professionalism (affective domain) and skills (psychomotor domain) as per details given below:

A. Cognitive domain (theoretical knowledge)

The post graduate student should acquire knowledge in the following areas by the end of the training programme.

1. General principles related to neuroanesthesia
2. Basic Neuroanatomy and Neurophysiology
3. Respiratory physiology
4. Cardiovascular physiology:
5. Renal physiology
6. Metabolic disorders
7. Neurologic diseases
8. Specific Neurological diseases
9. Neuroinfections
10. Peripheral Motor Neuron Disease
11. Traumatic Brain Injury:
12. Pharmacology:
13. Brain Death:
14. Cerebral Vascular Accidents:
15. Subarachnoid Hemorrhage:
16. Toxicity of anaesthetic agents on the developing brain:

17. Monitoring in Critical Care:
18. Nutrition in the neuro-critical care
19. Neuroimaging
20. Neuro-rehabilitation
21. Chronic neurological diseases
22. Temperature regulation

The topics are given under syllabus.

B. Affective domain

The student:

1. Should 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.
2. Always adopt ethical principles and maintain proper etiquette in dealings with patients, relatives and other health personnel and to respect the rights of the patient including the right to information and second opinion.
3. Develop communication skills to word reports and professional opinion as well as to interact with patients, relatives, peers and paramedical staff, and for effective teaching.

C. Psychomotor domain

1. Clinical Skills:

All students pursuing DM Neuroanaesthesia are required to follow the following structured teaching/clinical training, as given below:

Exposure to whole range of cranial and spinal surgical procedures, cranial and spine trauma, spinal instrumentation, peripheral nerve repair, ventriculo-peritoneal shunt insertion, movement disorders, and exposure to awake craniotomy. The student should be exposed to anaesthesia management of neurosurgical patients in brain suite, management of patients in neurosurgical (postoperative and other critical patients) and neurological intensive care units.

- **In the intensive care unit**, the student will learn:
 - To recognize complications arising in neurological patients,
 - Learn to sedate and manage patients on mechanical ventilation
 - Learn methodology of plasmapheresis in Myasthenia gravis and GB Syndrome patients
 - Use of fluids, vasoactive drugs and management of electrolyte disorders in ICU.
 - Insertion of central venous lines and arterial line with and without ultrasound guide
 - Learn to manage nutritional requirements in ICU
 - Learn prevention and management of deep vein thrombosis

- Management of acute ischaemic stroke patients in Neurological ICU
 - Management of other critically sick neurological patients like status epilepticus, encephalitis, meningitis, multiple sclerosis etc.
 - Bronchoscopy in patient with diseased lungs and for collection of samples for microbiology and culture
 - Percutaneous dilatational tracheostomy
 - Management of difficult airway and specialized equipments
 - Emergency neurosurgical and neurotrauma procedures
- **In the neuroradiology/radiology interventional laboratory**, they will be given exposure to diagnostic cerebral angiogram, carotid stent insertion, intra-arterial nimodipine infusion and embolization of cerebral aneurysm, arterio-venous malformation, vein of Galen malformation and carotico cavernous fistula. In addition, the student will also need to know:
- Management of ischaemic stroke for clot lysis or clot retrieval
 - Management of MRI and CT scan under MAC and general anaesthesia
 - Safety zones and other safety aspects in MRI room
 - Prevention and management of anaphylactic reactions to radiologic contrast media
- They will also be posted in **preanaesthesia clinic** for:
- a) Preanaesthetic evaluation of patients for elective neurosurgical procedures
 - b) The preoperative lab investigations need to be evaluated and special test need to be requested if required
- **In operation theatre**, the student should learn
- i) Induction, endotracheal intubation, positioning and maintenance of anaesthesia
 - ii) Management of difficult airways
 - iii) fluids, electrolytes, blood and blood products administration
 - iv) ventilation in the intra operative period
 - v) haemodynamic monitoring and management
 - vi) basic electrophysiology- EEG, Evoked potentials
 - vii) Management of blood gases and acid - base status

Syllabus

Course contents:

i) General principles:

1. General principles of Critical Care
2. Organization of Critical Care
3. An awareness of the importance of communication skills and interpersonal relationships
4. Various Scoring Systems
5. Admission and Discharge criteria in Neuro-intensive Care Unit
6. Transport of the patients – pre-hospital and intra-hospital
7. Internal Audit
8. Medical Ethics
9. Principles of consent taking and details of informed consent
10. Sterilization procedures
11. Maintenance of asepsis
12. Organizational capabilities, leadership qualities required to administer, manage and delegate responsibilities in Critical care
13. Training on development of protocols for Critical care management
14. Behaviour and team work in neuro critical care
15. Anaesthetic management of various CNS tumors

ii) Basic Neuroanatomy and Neurophysiology

1. Anatomy of the brain and spinal cord
2. Physiology of the brain and spinal cord
3. The cerebrospinal fluid circulation
4. Cerebral and spinal circulation, metabolism and effects of various anaesthetics (inhalational and intravenous agents)
5. Intracranial pressure and various herniation syndromes
6. Determinants of brain elastance, cerebral perfusion pressure, cerebral autoregulation, and metabolic coupling
7. Mechanism of neuronal injury and brain protection

(iii) Respiratory physiology

1. Physiology of spontaneous respiration and mechanical ventilation
2. Indications for mechanical ventilation
3. Modes of ventilation
4. Weaning from ventilatory support
5. Complications of mechanical ventilation – recognition and management
6. Monitoring during ventilatory support

(iv) Cardiovascular physiology:

1. Recognition and management of arrhythmias
2. Management of hemodynamic disturbances – hypotension, hypertension, myocardial ischemia, pulmonary edema and heart failure
3. Knowledge of commonly employed vasoactive and anti-arrhythmic drugs

- (v) **Renal physiology:**
 1. Fluid and electrolytes physiology and pathophysiology
 2. Prevention, diagnosis and management protocol for acute kidney disease
 3. Basic knowledge of dialysis

- (vi) **Metabolic disorders**
 1. Pathophysiology and management of the Electrolyte disturbances in neurosurgical patients
 2. Acid-base disorders
 3. Understanding of endocrine disorders

- (vii) **Neurologic diseases**
 1. Neurologic examination
 2. Manifestations of lobar syndromes
 3. Neurological illnesses which can cause altered sensorium and critical care management
 4. Differential diagnosis and work-up of patients presenting to Critical care.
 5. Evaluation of patients in altered mental status with various coma Scores, stroke score
 6. Nomenclature/criteria of altered levels of consciousness (coma, persistent & permanent vegetative states, minimally conscious states, etc)
 7. Pathophysiology, and therapy of coma arising from metabolic, traumatic, infectious, mass lesions, vascular-anoxic or ischemic, drug induced events

- (viii) **Specific Neurological diseases**
 1. Status epilepticus, refractory status epilepticus, super refractory status epilepticus, epilepsy and encephalopathies
 2. Understanding the pharmacology and interactions of various anti-epileptic drugs
 3. Guillian-Barrie syndrome
 4. Muscle dystrophies with complication
 5. Systemic illnesses causing neurological manifestations: Neuropathy, myopathy, dyselectrolytemias, renal and hepatic failures, multi organ failure etc.
 6. Myasthenia gravis
 7. Stroke (cerebrovascular accidents) and CVT (cortical venous thrombosis)
 8. Other neurological diseases requiring ICU management

- (ix) **Neuroinfections**
 1. Bacterial, Viral, Fungal meningitis
 2. Causative organisms of community-acquired & noscomial meningitis / ventriculitis / abscesses along with preferred antibiotic agents
 3. Describe the pharmacodynamic/ pharmacokinetic principles influencing CNS antibiotic activity

- (x) **Peripheral Motor Neuron Disease**
1. Review the natural history/expression of motor neuron disease related to degenerative diseases, infectious agents and inflammatory conditions
 2. List the changes that occur in denervated muscles and implications for use of medications with activity at the neuro-muscular junction
 3. Understand the presentation of respiratory failure and indications for non-invasive and invasive ventilatory support
 4. Indications for and problems associated with plasmapheresis and intravenous immunoglobulin
 5. Review the non-neurologic complications and management of motor neuron disease (cardiac denervation, intestinal movement disorders)
- (xi) **Traumatic Brain Injury:**
1. Pre-hospital care of the patient with neurologic injury
 2. Resuscitation of the head injured
 3. Airway management -conventional laryngoscopic intubation, insertion of LMA, fiberoptic intubation, manual inline stabilisation (MILS), use of videolaryngoscope and surgical airway
- (xi) **Pharmacology**
1. Basic idea on pharmacodynamics and pharmacokinetics of drugs, drug interactions, complications of various drugs used in neurological patients
 2. Sedatives and anaesthetic agents
 3. Analgesics - Narcotics and non-narcotic agents
 4. Muscle relaxants
 5. Anticonvulsants
 6. Vasopressors and inotropes
 7. Antibiotics
 8. Steroids
- (xii) **Brain Death:**
1. Criteria, determination and certification of Brain death
 2. Differential diagnosis e.g. drug induced, locked-in syndrome, etc
 3. Organ donation: metabolic and hemodynamic management pending organ harvesting
- (xiii) **Cerebral Vascular Accidents:**
1. Pathophysiology of stroke and management
 2. Treatment modalities for arterial and venous stroke
 3. Long term care of stroke patient, rehabilitation
 4. Understand the indications/contraindications/side effects of intrarterial / intravenous thrombolysis in ischemic cerebrovascular accident
 5. Describe the natural history, risk factors and management options for “malignant infarcts”. Understand about surgical options
 6. Describe the natural history of intracerebral haemorrhage along with the role of early surgical interventional, and medical treatment (i.e. Blood pressure & glycemic control, administration of factor VIIa)

(xiv) Subarachnoid Hemorrhage:

1. Various types of cerebral aneurysms
2. Describe the common aneurysm locations leading to SAH
3. Understand the clinical and radiographic grades of SAH
4. Methods used to detect cerebral vasospasm & strategies to treat Cerebral vasospasm to prevent secondary ischemic stroke
5. Indications for temporary external ventricular drains / permanent Shunts
6. Non-neurological complications of SAH and their management
7. Surgical clipping and coiling of cerebral aneurysm
8. Giant intracranial aneurysms and their implications
9. Anastomotic procedures in cerebral ischemia

(xv) Toxicity of anaesthetic agents on developing brain

(xvi) Monitoring in Critical Care

1. Neurological monitoring at the bedside
2. EEG- understanding basic EEG, role of continuous EEG monitoring in ICU
3. Monitoring cerebral oxygenation
4. Monitoring cerebral blood flow
5. Monitoring biomarkers
6. Hemodynamic monitoring
7. Respiratory monitoring
8. Intracranial pressure monitoring

(xvii) Nutrition in the neuro-critical care

1. General principles and indications
2. Total parenteral nutrition—indications, advantages/ disadvantages
3. Enteral nutrition: indications, advantages, and side effects
4. Nutrition in presence of metabolic and systemic diseases

(xviii) Neuroimaging

1. Basics of neuroradiology
2. CT, MRI, TCD (Trans cranial Doppler), USG (Ultrasound)
3. Interventional Neuroradiologic procedures
4. Identify the basic structures in the central nervous system(ventricles, cisterns, sinuses, major anatomic landmarks)
5. List the imaging techniques/signs used to identify acute intracranial hemorrhages, mass lesions, arterial and venous lesions, and ischemic penumbras / infarcts
6. Distinguish imaging characteristics of SAH, epidural hematomas, subdural hematomas, intra - parenchymal hemorrhage and relate to anatomic structure
7. Understanding the concepts of medical and surgical managements of various emergencies based on imaging and various decision paradigms
8. Management of complications in neuroradiological procedures

(xix) Neuro-rehabilitation

Head injured and spinal cord injured patients

1. Prevention of acute problems
2. Attendant training and counselling
3. Understanding long term goals in neuro- rehabilitation

(xx) Chronic neurological diseases

1. Stroke
2. Brain tumours postoperative
3. Epilepsy

(xxi) Temperature regulation

1. Understand the physiology of temperature regulation in OT and ICU and management of hypothermia/ hyperthermia in the neuro-intensive care population

Psychomotor Domain

At the end of the course the student should be able to perform independently the following:

I. Procedures in the OT and ICU

1. Arterial line placement
2. Central venous line placement
3. Tracheostomy – surgical and percutaneous dilatational tracheostomy
4. Chest drain insertion
5. Care of patients with invasive equipment e.g ICP monitor, EVD Deep epilepsy electrode , grid, etc.
6. Patient controlled analgesia pump
7. Application of transcranial Doppler
8. Ultrasound and its applications
9. Bronchoscopy
10. Transfer of critical neurosurgical patients to different areas of hospital

II. Traumatic Brain/Spinal Cord Injury Management of TBI (Traumatic Brain Injury)

1. Assessment and resuscitation
2. Airway management
3. Laboratory and radiological investigations
4. Pathophysiology of head injury
5. Factors causing secondary injury
6. ICP (Intracranial pressure) - physiology and pathophysiology, and principles of management. Controversies of ICP monitoring in TBI
7. CPP (Cerebral perfusion pressure); its role in TBI management, concept of individualized CPP
8. ICP-CPP targeted management of TBI
9. Biochemical markers of brain injury, molecular and cellular mechanisms of injury
10. Brain Trauma Foundation Guidelines in the management of TBI / spinal cord Injury
11. Role of hyperventilation in traumatic brain injury
12. Methods available to measure/estimate ICP/ cerebral perfusion along with advantages and disadvantages of each method
13. Approaches to management of refractory ICP elevation

Management of Spinal cord injury

1. Resuscitation and care of the affected area
2. Airway management of C-spine injury
3. Pathophysiology of spinal cord injury
4. Conservative management of spine injury
5. Role of steroids administration in spinal cord trauma
6. Spinal shock and autonomic hyperreflexia
7. Care of the cardiovascular and pulmonary complications

III. Miscellaneous

1. Sepsis - Pathophysiology and management
2. Haemodynamic management
3. Pregnancy and Neurosurgery
4. Cyanotic heart disease and neurosurgery
5. Multiple Organ Dysfunction Syndromes
6. Nosocomial infections
7. Antibiotics and immunotherapy
8. Reperfusion injury and antioxidants
9. Shock-types and management
10. Deep vein thrombosis prophylaxis, management and Pulmonary Embolism
11. Coagulopathies and their management
12. Infection Control in the ICU
13. Sterilisation procedures in ICU
14. Patient safety and prevention of adverse effects
15. Management of cardiac patients on antiplatelets/anticoagulants
16. Clinical Audit
17. Various ethical issues in Neurointensive care
18. End of life care issues in the intensive care unit

SUBJECT SPECIFIC LEARNING METHODS

1. **Journal Club:** The trainee will present a journal article relevant to neuroanaesthesia. The trainee is expected to present the article citing the relevance, background/context, study methods and statistical analysis, interpret results and discussion, summarize, present limitation and critically analyze the study methods and outcomes. The trainee should select good articles related to neuroanaesthesia, neurocritical care and neurotrauma from various journals on Neuroanaesthesia, anaesthesia, Neurosurgical, neurocritical, neurotrauma, Journal of Neurosurgery, Anesthesiology, British Journal of Anaesthesia, Neurocritical Care and other reputed non-anaesthesia journals. A student should present at least two articles along with an interesting relevant case report.
2. **Lectures:** Attend didactic lectures on basic neurosciences, biostatistics, research methodology, teaching methodology, from external faculty of specialties related to the subject, medical ethics and legal issues related to neuroanaesthesia, neurointensive care practice etc. should be conducted once or twice a week.

3. **Subject Seminar:** The trainee will present a subject topic allocated after doing a comprehensive preparation, relevant literature search and present the topic in detail covering all the relevant aspects, clinical applications and engage audience and answers questions.
4. **Hospital Grand Rounds:** The trainee will attend the Hospital Grand Rounds weekly, which involves presentations from anaesthesia, neuroanaesthesia, neurosurgery, neurology and intensive care unit. **If core lectures are arranged at the beginning of the course from the teaching departments in the hospital the students must be permitted to attend.**
5. **Clinical Case Presentation:** The trainee will present a clinical case (either from anaesthesia point of view or some neurocritical care case) after performing thorough history and physical examination. Trainee will elicit physical and non-physical aspects in history, elicit all physical signs, formulate diagnosis/differential diagnosis and able to plan a comprehensive care plan for the patient.
Timing of teaching and days of teaching would entirely depend upon the local arrangement at the teaching institute.

6. **Core Training:**

Both learning and teaching should be integral part of the programme. The chain of learning from peers and teaching the juniors should never be broken.

- Intensive Care rounds and on-hands teaching in the operating theatre should be the mainstay of the teaching programme, rather than didactic lectures.
- Journal Club meetings should be held once a week
- A mortality/morbidity review and departmental audit should be held at least bimonthly to review all deaths and complications attributed to anaesthesia, if any.
- Unscheduled and informal discussions to be held as often as possible depending upon the variety and the number of procedures seen. This method could be an excellent teaching tool rather than totally regimented scheduling at this level of education.
- The students should be encouraged to undertake epidemiological and /or clinical research programme on selected topic. They should be taught the basic methods of research and reporting.
- The postgraduate students shall be required to participate in the teaching and training programme of undergraduate students and interns.
- The department should encourage e-learning activities.
- Student should have a minimum of one publication in indexed international journals/National journals during three years course.
- They should be encouraged to deliver lectures/ present papers at the CME programmes conducted at the National, State and Local Levels as this would not only help them to learn to deliver scientific lectures, but also boost their confidence .
- They should submit at least one scientific paper per year to the annual conference of the Indian Society of Neuroanaesthesiology and critical care.

7. A. BED SIDE TEACHING

- All the postgraduate trainees posted in Neurointensive care unit will carry out their clinical work under supervision of faculty. This would involve around 1- 2 hours of dedicated teaching, ICU round in the morning, and consultation liaison.

7. B. ADDITIONAL TEACHING/TRAINING

- All the postgraduate trainees are expected to attend regular CMEs, Conferences, Workshops; Small group teaching organized by local/national/international institutes and required to be abreast with the current knowledge and recent advances in the field of neuroanaesthesia and neurocritical care. They should participate in pain clinic for the management of failed back (epidural steroids, facet block, etc), Complex regional pain syndrome II (CRPS II) of upper limb following brachial plexus trauma and neuropathic pain of trigeminal neuralgia.

8. Log book

Log books serve as a document of the trainee's work. The trainee shall maintain this Log book of the special procedures/ operations performed by him / her during the training period right from the point of entry and its authenticity shall be got regularly assessed by the faculty and certified by the concerned Postgraduate Teacher / Head of the Department. This shall be made available to the Board of Examiners for their perusal at the time of his / her appearing at the final exit Examination. The logbook should record cases anaesthetised (both in the operation theatre and also in the interventional neuroradiological / radiological lab and in the MRI and CT room) seen and presented, procedures performed, seminars, journal club and other (case) presentations. Log book entries must be qualitative and not merely quantitative, focusing on learning points and recent advances in the area and must include short review of recent literature relevant to the entry. It should also contain detailed documentation of a minimum of 5 interesting cases.

9. RESEARCH

A student shall be required to present at least two papers/posters at conferences of state, national or international levels. The work has also to be published or at least sent for publication in an Indexed journal before the completion of course. Three copies of each of the two papers; duly certified, shall be submitted by the student to the University 06 months before commencement of his/her final Examination for onward transmission to the examiners. Publication in an indexed journal is desirable as the University would be considering, that also in case it decides to provide awards to the best student.

Posting in allied Departments

A student should be posted to various allied departments, neurology (02 weeks) and neuroradiology/radiology (04 weeks) to acquire more knowledge. All students should be posted to all the units of the concerned department equally by rotation to get

training in all the units. All students should be exposed for one week each to modern principles of Clinical epidemiology and Biostatistics/Research methodology of the Institution. For this, he/she should attend lectures arranged by the Biostatistics and Epidemiology departments from time to time.

Training timeline during three years of residency in parent institute and out station institutes

The training programme should aim to provide sound knowledge in the diagnostic and investigative aspects of Neuroanaesthesia. It will provide additional exposure to the student. In addition to the exposure to neuroanaesthesia at the institute it is desirable that the student will also receive an opportunity during the training period to spend a period of up to two weeks in other similar advanced centers for enriching his/her experience in monitoring/ other techniques (including neurosurgical), not available at students' institution.

The following Rotations are recommended

1. Radiology: To learn the basics in imaging techniques.:

- a) To learn complications of contrast
 - Basics in other imaging modalities, such as CT angio and MR angiography.
- b) To learn various problems in MRI room
- c) To have basic knowledge of cerebral angiography and how to diagnose cerebralaneurysm, arteriovenous malformation, Moya-moya disease, cerebral vasospasm, etc.

2. Neurology: As many patients admitted in neuro ICU are from Neurology, a shortrotation of two weeks through neurology would be helpful to the student.

3. Clinical epidemiology department for learning research methodology, biostatistics, etc.

During the training period, the student shall work on full time student basis under the head of the Division of the respective department of posting. He shall take part in all activities of the department including participation in seminars, conferences, teaching assignments, ward duties, and other duties that may be assigned to him by the head of the Neurology/ Neuroradiology/Radiology/ clinical epidemiology departments.

1. The programme of training will be divided as follows:

a) 06 months:

First Year

During the first 02 weeks, the student shall be posted in the operation theatre and will do pre-anaesthesia check up of the patients. The student will receive progressively greater responsibility for the anaesthetic management of patients. He /she will learn placement of arterial cannula and insertion of neck line under ultrasound guidance, how to make proper position of the patients

and what are the problems faced during various neurosurgical positions. The student will learn all the advanced airway management equipments. The student will also learn how to handle patients with unstable cervical/suspected cervical spine injury, and how to perform fiberoptic intubation. The student will also learn neurophysiology monitoring and anaesthesia technique to monitor neurophysiology monitoring. The student will be responsible for preparation of anaesthesia record and mention postoperative intensive care instructions to the neuroanaesthesia posted in the neurointensive care.

b) 02 weeks in clinical epidemiology and biostatistics

c) 02 weeks in neurology

d) 04 weeks in neuroradiology/radiology

e) 01 month in pre-anaesthesia clinic

The student will look after pre-anaesthesia clinic. The student will examine all the prospective patients for the neurosurgical procedures. He/She will make sure that patients are physically fit to undergo anaesthesia/ surgery. If required he/she will refer the patients to other departments for management of underlying incidental systemic disease/s

f) 03 months in ICU

Next three months, the resident will be posted in the neurointensive care unit where the student will manage all the postoperative neurosurgical patients and critical neurology patients. The student will learn various techniques used in the neurointensive care.

g) 09 months

Second Year

The student will be rotated in all the operation theatres of neurosurgery so as to get exposure to work with all the consultants of neurosurgery and gets exposure to all kinds of neurosurgical procedures and management of neurotrauma patients. He/She will also do emergency duties; the frequency of this emergency duty will depend upon number of DM students.

h) 01 month: Pre-anaesthesia clinic

i) 02 months : The student will be posted in the ICU.

Third Year

The third year of posting will be as given below:

1. Four months in ICU - this will include neurological, neurosurgical and neuro-traumapatient

2. Two months of external postings to two or more other centres practicing neuroanaesthesia and critical care to gain different perspectives of care.
3. One month in other supporting departments of the parent Hospital like Neuroradiology, Transfusion Medicine, Neurology and Neurosurgery.
4. Five months in the operating room

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, ie., during the training

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.

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

The student to be assessed periodically as per categories listed in postgraduate student appraisal form (Annexure I).

SUMMATIVE ASSESSMENT, at the end of the course

The summative examination would be carried out as per the Rules given in **POST**

GRADUATE MEDICAL EDUCATION REGULATIONS, 2000.

The summative assessment examination shall include two heads:

- A. Theory examination.
- B. Practical, Clinical examination and Viva-voce.

Theory examination and Practical/Clinical, Viva-voce shall be separate heads of passing.

Theory examination shall comprise of four papers. Passing percentage shall be cumulatively 50% with minimum of 40% marks in each theory paper.

Practical /Clinical examination consisting of at least one long case, three short cases and viva- voce. Passing percentage shall be 50%.

Passing shall be separate for each head and failing shall be common, meaning thereby that clearance at theory and failure at practical / clinical shall amount to failure at Summative examination and vice versa.

1. Theory Examination

1) There shall be 4 theory papers of 3 hours each.

Paper I: Basic Sciences as applied to the subject

Paper II: Clinical Neuroanaesthesia and techniques in anaesthesia

Paper III: Clinical Neuroanaesthesia, interventional neuroradiology, and Neurointensive care

Paper IV: Recent advances in the subject

(c) Clinical / Practical and Oral Examination:

(i) Clinical presentation

Students shall examine a minimum one long case and 03 short cases.

(ii) Oral Examination shall be thorough and shall aim at assessing the student's knowledge and competence about the subject, investigative procedures, therapeutic techniques and other aspects of the specialty, which form a part of the examination.

Recommended reading:

Books (latest edition)

- Text Book of Neuroanaesthesia By JE Cottrell and Young
- Core Topics in Neuroanaesthesia by Matta, Menon and Smith
- Text Book of Neuroanesthesia By Albin
- Neurological and Neurosurgical Critical care by Ropper and Diringer
- Case studies in Neuroanaesthesia and neurocritical care –by J Andrzejowski and Sambamurthy
- Other anaesthesia books for postgraduates

Journals:

3-5 International and 02 national journals (indexed)

**Postgraduate Student Appraisal Form
Clinical Disciplines**

Name of the Department/Unit :

Name of the PG Student :

Period of Training : FROM.....TO.....

Sr. No.	PARTICULARS	Not Satisfactory			Satisfactory			More Than Satisfactory			Remarks
		1	2	3	4	5	6	7	8	9	
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										
6.	Thesis / Research work										
7.	Log Book Maintenance										

Publications

Yes/ No

Remarks*

***REMARKS:** Any significant positive or negative attributes of a postgraduate student to be mentioned. For score less than 4 in any category, remediation must be suggested. Individual feedback to postgraduate student is strongly recommended.

Signature Of Assessee

Signature Of Consultant

Signature Of Hod

MODEL PAPER

DM10301

Basic.Sc.-I

DM Examination Month, Year

NEURO ANAESTHESIA

Paper-I

Basic Sciences as applied to the subject

Time: Three Hours
Maximum Marks: 100

Attempt all questions
Each question carries 10 marks
Draw diagrams wherever necessary

- Q1. Pathophysiology to cerebral ischemia and potential treatment
- Q2. Describe the effect of various anesthetic agents on cerebral blood flow and cerebral metabolic rate for oxygen and ICP
- Q3. Describe un brief brain metabolism.
- Q4. What is ischemic pre conditioning and anesthetic pre conditioning and its implications
- Q5. Pathophysiology of traumatic brain injury
- Q6. Describe arterial supply and bran anatomy of circle of willis
- Q7. Describe the cerebral autorrgulation and factors affecting it
- Q8. Write down in brief about the effects of anesthetic agents and increased ICP on the formation abd reabsorption of CSF
- Q9. Basic principle of TRANSCRANIAL DOPPLER, it's advantages and short comings
- Q10. Anatomy of sella turcica, its anatomical relations and its applied anatomy

MODEL PAPER

DM10302

CNTA-II

DM Examination Month, Year

NEURO ANAESTHESIA

Paper-II

Clinical Neuroanaesthesia and Techniques in Anaesthesia

Time: Three Hours
Maximum Marks: 100

Attempt all questions
Each question carries 10 marks
Draw diagrams wherever necessary

- Q1 A patient with Parkinson's disease has been posted for lumbar spine fixation surgery. Kindly describe the preoperative and perioperative anaesthetic challenges.
- Q2 What is primary and secondary spinal cord injury? What are stages of spinal shock? What are the guidelines for use of steroids in acute spinal injury?
- Q3 Explain the causes of postoperative delirium? How can we prevent it?
- Q4 Elaborate the role of point of care ultrasound (pocus) in neuroanaesthesia.
- Q5 Explain the methods of ERAS in neuroanaesthesia.
- Q6 A patient presents to ER with history of worst headache of his life time and has signs of Subarachnoid hemorrhage on NCCT head. What are the options for surgery? Discuss anaesthetic considerations of each.
- Q7 A patient is being operated for pineal tumour removal in sitting position. How will you diagnose air embolism, if it happens? How can we treat it?
- Q8 What are the post operative complications of transnasal transphenoidal pituitary surgery? Write management for each.
- Q9 What are the anaesthetic challenges in a patient posted for cerebral convexity large meningioma?
- Q10 Enumerate different types of brain herniation. Explain measures to control malignant rise in ICP.

MODEL PAPER

DM10303

CNINN-III

DM Examination Month, Year
NEURO ANAESTHESIA

Paper-III

Clinical Neuroanaesthesia, Interventional Neuroradiology, and Neurointensive Care

Time: Three Hours
Maximum Marks: 100

Attempt all questions
Each question carries 10 marks
Draw diagrams wherever necessary

- Q1. Cerebral vasospasm - pathophysiology and management.
- Q2. Describe the anesthetic challenges faced by neuroanesthesiologist in 5yrs old child having hydrocephalus, posted for MRI under anaesthesia.
- Q3. Describe the anesthetic management in a patient posted for aneurysmal clipping
- Q4. TEE in neurosurgery
- Q5. Invasive and non invasive methods of ICP monitoring
- Q6. GBS - ICU management and weaning from mechanical ventilation.
- Q7. Role of neuroanesthesiologist in management of patient with acute ischemic stroke.
- Q8. Assessment of nutrition and calories calculation in neurocritical care
- Q9. Anesthetic Management of a patient posted for posterior fossa surgery.
- Q10. Management of status epilepticus.

MODEL PAPER

DM10304

Recnt.Adv.IV

DM Examination Month, Year

NEURO ANAESTHESIA

Paper-IV

Recent advances in the subject

Time: Three Hours
Maximum Marks: 100

Attempt all questions
Each question carries 20 marks
Draw diagrams wherever necessary

- Q1. Deep brain stimulation- indications, clinical application and complications.
- Q2. Anaesthetic management for intracerebral frontal lobe tumour posted for Awake craniotomy.
- Q3. Latest guidelines of Brain trauma foundation.
- Q4. Cerebral microdialysis catheter. Indications, scopes and shortcomings.
- Q5. Functional MRI and MR spectroscopy.