

CURRICULUM DEVELOPMENT

&

CREDIT-BASED EVALUATION

(Revised in September 2020)

**RECOMMENDATIONS BY BOARD OF STUDIES FOR
DM NEUROANAESTHESIOLOGY PROGRAM**

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Aims and Objectives

The DM Neuroanaesthesiology course in *Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST)* is a 3-year residency program which is conducted with a primary aim of training doctors who are already having a postgraduate degree (MD/DNB) in Anaesthesiology, the theoretical and practical nuances of Neuroanaesthesia and Neurocritical care. After completion of the 3-year period, the specialist ‘Neuroanaesthesiologist’ is expected to have an in-depth, comprehensive knowledge of all facets of neurological, neurosurgical diseases and their perioperative management, have skills to effectively deliver high quality anaesthesia services and critical care of these patients, have attitudes and behavior consistent with highest professional global standards, teaching, leadership and research in the field.

The candidate is expected to learn to deliver “state of the art” clinical care in a scientific, cost effective, ethical and compassionate manner to an individual and patients, and also develop an attitude of committed learning, teaching, and research for the welfare of the society.

Competence expected at end of training period

At the end of this training, the resident shall be able to;

1. Demonstrate sufficient understanding of vast knowledge in the subject of Neuroanaesthesiology and neurocritical care.
2. Develop the ability to take discerning history from the patient, perform relevant clinical examinations, decide the appropriate investigations and derive the perioperative and critical care management plan.
3. The residents acquire a reasonable level of theoretical and practical knowledge in line with the latest guidelines and management protocols that enables him to provide high quality perioperative and critical care of neurologically ill patients with due consideration to patient safety and outcomes.
4. Well versed and confident in performing the common practical procedures relevant to the field of neuroanesthesia and neurocritical care independently and other specialized procedures under limited supervision at the end of three years.
5. Well versed in basic and advanced diagnostic and monitoring techniques involving various organ systems needed in patient care like advanced

cardiac monitoring (echocardiography (transthoracic (TTE) and transesophageal (TEE)), cardiac output monitoring) and advanced neuromonitoring modalities. (Intracranial pressure, Electroencephalogram, electrocorticogram, intraoperative evoked potential monitoring, Transcranial doppler and cerebral oxymetry etc.)

6. Ability to manage acute perioperative pain and chronic pain related to neurological conditions.
7. Develop skills needed for effective communication with the patients, family members, colleagues, and ability to involve in the coordinated teamwork.
8. Develop essential skills in teaching, leadership, conducting medical research, and to get them presented in scientific forums and published in peer-reviewed journals.

Theoretical knowledge to be acquired

At 18 months

The candidate is expected to acquire theoretical knowledge of the following sub specialities relevant to neuroanesthesia during the period of training;

Anatomy

- a. Anatomy of the brain including the cranial nerves, the spinal cord, the autonomic nervous system, peripheral nerves and the muscles.
- b. The vascular anatomy of the central nervous system, extra cranial vessels.
- c. Anatomy of the head, neck, airways, special senses, lungs and heart, vertebral column.
- d. Neuro embryology.
- e. Applied anatomy.

Physiology

- a. Normal Physiology of the central nervous system, Autonomic nervous system, Peripheral nervous system, spinal cord, special senses, neuromuscular junction, Muscle physiology, Electrophysiology, respiratory physiology, cardiovascular physiology, hepatic and renal

physiology and their alteration in diseased state and Physiology with relevance to pain.

- b. Physiology related to different ages from preterm to elderly population, and frailty.

Pathology

- a. The pathologies affecting nervous system, respiratory system, cardiovascular system, renal and hepatic system and the implications of these pathologies in the perioperative management of the patients presenting with these pathologies.
- b. congenital malformations of nervous system and vertebral column.
- c. Development disorders of nervous system relevance to neuroanesthesiologist.

Pharmacology

- a. Basic understanding of drugs used in anaesthesiology, pain and critical care with relevance to pharmacokinetics and pharmacodynamics, mechanism of action, metabolism, adverse effects, drug interactions, drug development, and practice of prescription utilizing best scientific evidence.
- b.** Understanding of pharmacokinetics of drugs and pharmacodynamics of drugs used in treating nervous system, renal, cardiac disease, metabolic

disorders. Their mechanism of action, metabolism, adverse effects, drug interactions and their impact in perioperative care.

Microbiology

- a. Understanding the epidemiology, etiology, pathogenesis, investigations and therapeutic management, prevention of infectious diseases encountered in the neurologically ill patients.

Research methodology

- a. Basics of statistical methods, type of studies, issues involved in scientific methods and interpretations. Data presentation, Sample size calculations, Planning and conduct of a study, Confidence interval, Standard error, Standard deviation, Sensitivity, Specificity, type 1 and type 2 errors, Distribution of variables, Null hypothesis, Correlation coefficient, Tests of significance, Parametric and non-parametric tests, odds ratio, Student's t test, ANOVA, Analysis of covariance, Regression, ROC curve, Use of statistical software for data analysis.

Equipments

- a. Understanding basics, physics, technology, components, practical applications, indications, trouble shooting and its management, safety of commonly used equipments in neuroanesthesia operation theaters like anesthesia work station, airway gadgets, ventilators, drug delivery systems like TCI, PCA pumps, multipara monitors, advanced neuromonitoring

devices like ICP, TCD, IONM, EEG, SjVO₂, Cerebral oximetry, cerebral microdialysis, etc.

- b. Use of ultrasound in perioperative and critical care.
- c. Interpretation of Investigations: Biochemistry, arterial blood gas analysis, Chest X-ray, ECG, CT scans of brain, Basic of MRI sequences and safety.

Biomedical engineering

Basic understanding of physical principles of various biomedical instruments and devices used in diagnosis and therapeutics used in neuroanesthesia with a view to optimally utilize them.

Patient Safety

Basic understanding of the epidemiology, Risk factors, diagnosis, management reporting and preventive aspects of adverse events in relation to patient management in various areas.

At 36 months

Perioperative management

- a. Perioperative management of patients undergoing various neurosurgical procedures for diseases involving brain, spinal cord and related structures.
- b. Perioperative management of patients undergoing neuro radiological procedures for diagnostic and interventional purposes, outside the operation theaters.
- c. Perioperative management of patients in special situations like trauma and mass casualties, natural disasters, pandemics, etc.

Critical care Management

- a. Neurocritical care of patients with various neurological, neurosurgical, and systemic diseases with neurological manifestations.
- b. Critical care management of Trauma patient.
- c. Diagnosis, management of brain dead, comprehensive donor management, transport of critically patients.
- d. Prehabilitation, End of life care, Neurorehabilitation and Home ventilatory care.

Pain

- a. Understanding the etiology, pathophysiology, diagnosis and management of disease conditions responsible for various chronic pain syndromes.
- b. Acute pain management, organization of acute pain services.

Investigations and Monitoring

A thorough applied knowledge of the following monitoring in neuroanesthesia and neurocritical care settings;

- a. Interpretation of Transthoracic and Trans esophageal Echocardiogram (TEE), ultrasonography relevant to neuroanesthesia, Brain and spinal cord CT and CT angiography, Advanced MRI sequences, Intraoperative MRI, and MR angiography and Digital subtraction angiography (DSA) and electrophysiological monitoring like EEG, ECoG, IONM, evoked potentials, EMG and nerve conduction studies.
- b. Advanced Monitoring: Cardiac hemodynamics (invasive arterial pressure, central venous pressure, non-invasive cardiac output, fluid dynamics, TEE), advanced neuromonitoring (TCD, NIRS, jugular venous oximetry, ICP monitoring, raw and processed EEG, ECoG, electrophysiological monitoring (evoked potentials, cranial nerve

monitoring, brain mapping, D waves, etc), point of care monitoring of coagulation systems, various biomarkers, etc.

Scientific Advances

- a. Recent advances (including current guidelines) in the field of anesthesia, neurology, neurosurgery, neuroradiology in relation to perioperative and critical care of neurologically ill.

Patient Safety

- Understanding of the epidemiology, Risk factors, diagnosis, management reporting and preventive aspects of adverse events in relation to patient management in various areas.
- Health economics.

Practical / Clinical / Laboratory experience to be imparted at year I, II and Year III

Ist year

Clinical skills: Training to get proficiency in the ability to take discerning patient history, perform relevant clinical examination (including neurological examination), assesment of various risk factors and its management, Patient consent for anesthesia and procedures, explain the risks to patients and other clinicians, decide the appropriate investigations and derive the anesthetic and perioperative management plan.

At the end of 1st year, the candidate will be trained and is expected to be proficient in the following areas;

1. Basics of cannulations needed for patient management. (eg, arterial, central venous cannulation including ultrasound guided cannulation)
2. Clinical interpretation and management of arterial blood gas analysis (ABG), electrolytes, laboratory values and Chest X ray.
3. Management of fluid therapy, pain and sedation in the operation theater as well as intensive care unit.
4. Basics of hemodynamics, respiratory monitoring.
5. Basics and advanced mechanical ventilation in critical care patients.
6. Basics of advanced neuro and cardiac monitoring.

7. Anesthetic management of uncomplicated adult neurosurgical patients independently.
8. Anesthetic management of complicated adult neurosurgical patients under supervision.
9. Application of guidelines and safe practices, and patient evaluation scores in clinical scenarios.
10. Intra and interhospital Transfer of high-risk patients for various procedures required for diagnosis and treatment purposes.
11. Application of various protocols involving disinfection, Sterilization, CPR, infection control, record keeping and reporting.

IInd year

Clinical skills: Include the ability to take discerning history, perform relevant clinical examination, decide the appropriate investigations and derive the anesthetic and perioperative management plan

At the end of 2nd year, the candidate will be trained and is expected to be proficient in the following areas;

1. Basics of Transthoracic, Transesophageal echocardiography (views, indication, contraindications, handling the probe) in detecting venous air embolism, monitoring in hemodynamically unstable patients, management of patients with preexisting cardiac diseases for neurosurgery and other procedures.
2. Basics of transcranial Doppler and interpretation in the Operation Theater and ICU.
3. Basics, techniques of use, indications, contraindications of various airway equipments in difficult intubation scenarios and in patients with cervical spine instability.
4. Basics of ICP monitoring, jugular venous oximetry, near infrared spectroscopy and their clinical application.
5. Perioperative management of uncomplicated neurosurgical patients independently.

6. Perioperative management of complicated neurosurgical patients independently or with limited supervision.
7. Manage the patients during emergency neurosurgery independently.
8. Appropriate management of critically ill neurological patients in ICU under supervision.
9. Manage pediatric patients for various diagnostic and neurosurgical procedures under supervision.
10. Basics of raw and processed EEG , ECoG and their clinical applications in neurosurgery.
11. Basics of Evoked potential monitoring and interpretation of abnormalities under supervision.
12. Ability to interpret the CT, MRI and DSA and manage patients accordingly under supervision.
13. Ability to identify, manage, report and documentation of adverse event during patient care in OR and ICUs.

3rd year

Clinical skills: Include the ability to take discerning history, perform relevant clinical examination, decide the appropriate investigations and derive the anesthetic and perioperative management plan. (subject to successful assessment of core competency evaluation at the end of second year)

1. Perioperative management of uncomplicated neurosurgical patients / surgeries independently.
2. Perioperative management of complicated neurosurgical patients / surgeries independently.
3. Manage the patients during emergency neurosurgery independently.
4. Manage pediatric patients for various diagnostic and neurosurgical procedures independently.
5. Manage anesthesia care of patients undergoing various interventional neuro radiological procedures independently.
6. Performing Evoked potential monitoring and interpretation of abnormalities independently.
7. Able to perform neurological examination and come to a diagnosis in the ward and ICU.
8. Ability to incorporate advanced neuromonitoring and management of high risk patients in neurocritical care independently.
9. Proficient to manage neurotrauma independently.

10. Ability to interpret the laboratory values, X-ray, CT scans, MRI and utilize these investigations to manage neurologically ill patients independently.

Practical skills

The candidate should be able to perform and interpret relevant investigations independently, and should have a firm grasp on many others. To assure this, a minimum numbers are mandatory as given below;

Non-invasive

ECG interpretations	50
Transthoracic echocardiography	50
Transesophageal echocardiography	25
ICP	25
CT interpretations	50
MRI interpretations	50
DSA	25
EEG/ECoG	25
Transcranial Doppler	50
Intraoperative Evoked Potentials	50

- a. Invasive:** The training in invasive procedures is designed to provide maximum possible experience to the residents. These procedures should be under the supervision of a faculty member without affecting the safety of the patients at any cost. The goal of fixing the minimum number of cases to be performed is to make the resident well-versed

and confident in performing the common procedures independently and other procedures under limited supervision at the end of 3years. The minimum number of each procedure to be undertaken by the resident is given below, and the number as the primary operator under supervision is given in brackets:

Invasive arterial line	100 (20)
Central venous cannulation	50(20)
Ultrasound guided central venous cannulation	25 (10)
Anesthesia for Intracranial Aneurysms/AVMs	50(10)
Anesthesia for Intracranial tumors	50(20)
Anesthesia for Shunt/endoscopy Procedures	5(10)
Anesthesia for Spinal Procedures	25(10)
Anesthesia for Pituitary surgery	25(10)
Anesthesia for pediatric neurosurgery	15(10)
Anesthesia for TBI patients	15 (5)
Anesthesia for ECT	10 (5)
Anesthesia for MRI	25(15)
Anesthesia for endovascular	10 (5)
management of acute stroke	
Anesthesia for CT scans/ guided procedures	25(10)
Anesthesia for aneurysm coiling and	

AVM Embolization/carotid stenting	50(10)
Percutaneous tracheostomy	5(5)
Awake Fiberoptic intubation	5(5)
Jugular oximetry	3(3)

Textbooks and Periodicals/Journal

1. Miller's Textbook of Anesthesiology
2. Cottrel and Young 'Textbook of Neuroanaesthesiology'
3. Dorsch and Dorsch 'Understanding Anesthesia Equipment'
4. Calvey and Williams 'Principles and Practice of Pharmacology for Anaesthetists'
5. Trauma (A text book of Trauma society)
6. Aage R Moller 'Intraoperative neurophysiological monitoring'
7. David Sidebottom 'Practical perioperative echocardiography'
8. Paul Brazis 'Localization in neurological diseases'
9. Michel T Torbey 'Neurocritical care'
10. Greenberg's 'Handbook of Neurosurgery'
11. Aviva Petrie 'Medical statistics at a glance'
12. Stephen Waxman 'Clinical Neuroanatomy'
13. Arun K. Gupta, Adrian W. Gelb 'Essentials of neuroanesthesia and neurointensive care'
14. Steve Waldman 'Pain Management'
15. Sulpicio G Soriano, Craig D McClain 'Essentials of Pediatric Neuroanesthesia'
16. Mirela V Simon 'Intraoperative Neurophysiology'
17. Anne G Osborn 'Osborn's Brain- Imaging, Pathology and Anatomy'
18. Hemanshu Prabhakar "Textbook of Neuroanesthesia and neurocritical care"
19. ISNACC- "Acute Neuro care."
20. Washington 'Manual of Echocardiography'
21. Washington 'Manual of Critical care'.
22. Paul Mongan 'Practical approach to Neuroanesthesia.'

Journals

1. Journal of Neurosurgical Anesthesiology
2. JNACC
3. Anesthesia and Analgesia
4. British Journal of Anaesthesia
5. Anesthesiology
6. Acta Anaesthesiologica Scandinavica
7. Neurocritical care
8. Neurosurgery
9. Journal of Neurosurgery, Spine and Pediatrics
10. Pain
11. Pediatric Neurosurgery
12. Neurology India
13. Neurology
14. Stroke

Residents Postings

The residents will acquire the knowledge by undergoing training in the following areas

1. Neurosurgical operation theaters 7-8 months/year
2. ICU posting-2 months/year
3. Neurotrauma (NIMHANS or alternate trauma center) 1 month in 3rd Year
4. Cathlab-2 months/year
5. Neuroradiology dept-14 days
6. Neurology dept/neuromonitoring-14 days
7. Biostatistics-one week
8. Biotechnology-one week

ACADEMIC COMMITTEE OF THE DEPARTMENT

The structure and role of academic program committee. (APC)

The academic program committee consists of Head of the Department/Division,(HOD) Program-in charge,(PIC) Program Coordinator (PC) Mentor, Guide, Moderator and Resident Academic In charge.

Following are the responsibilities of each in the academic activities of the department;

A. Role of HOD:

1. Overall supervision of the conduct of academic programs and evaluation process in the department.
2. Assess the quality and adequacy of content of academic program.
3. Evaluate the progress of each student through the APC.
4. He / She will be member of the appraisal committee and will assess the remedial measures taken to enhance performance of the resident/student.
5. Conduct of the external examination and supervision of conduct of internal examinations.

B. Role of Program in charge. (PIC)

1. Will be responsible for ensuring the implementation of academic programs as envisaged by the BOS.
2. Assign equal number of academic programs for each resident for each year and ensure it is conducted.
3. Supervise the conduct of evaluation of academic programs by PC.
4. Supervise the internal evaluation process.
5. Organize external and internal examinations.

6. Verify and validate entry of marks in the e-portfolio after it has been verified and validated by PC.

7. Report to BOS/academic council, deficiencies, suggestions and feedback on the upgraded curriculum and evaluation.

C. Role of program coordinator. (PC)

1. Circulate monthly academic roster of department and send a copy to the academic division for its records.
2. Maintain dossier for each student till the end of the course.
3. Circulate and collect evaluation forms after each academic program.
4. Maintain register of attendance in academic programs of both students and faculty. In the attendance of faculty indicate why someone was not available (sabbatical, casual leave, duty leave, research posting, emergency surgery, OP duty) or for students (emergency, CL, duty leave). There should be no entries after the session is over. The names and number of faculty who did the evaluation should be clear on the evaluation form. A minimum of 3 members should evaluate. If sufficient number of faculty is available in a dept., senior residents programs are to be evaluated by faculty at the level of associate professor and above.
5. Enter and validate entry of information and marks for each student for each program at the end of each month in the e-portfolio.
6. E-portfolio entry, if made by dept secretary, should be verified and validated
7. Monitor log book entries.
8. Organize appraisal meetings.
9. Collect student feedback.
10. Organize internal examination.
11. Report to PIC periodically about progress and problems with implementation and resolve them. Can seek guidance from academic council if needed.

12. The residents will be continuously evaluated by the faculty day today on their clinical performances in work places like operation theaters, wards, ICUs, inter departmental consultations and the evaluation forms must be given to PC.

13. The PC will coordinate with PIC and HOD on the clinical Performance of the candidates.

D. Guide.

1.The mentor could be the thesis guide for post-doctoral courses or any other faculty member nominated by the APC.

2.He/ She can guide the student in the selection of appropriate thesis topic, process of submission to TAC and IEC, both procedures being mandatory.

3.Ensure participation and presentation in a national conference-mandatory requirement.

4.Guidance for publication of research paper.

5.Review abstract submitted for conference and ensures that abstract is sent to e-portfolio.

6. Participate in appraisal meeting conducted by departmental academic.

7.Committee and assist in planning remedial actions for candidates' progress.

E. Role of Guide/Mentor

Appointed by the HOD to help in the thesis of a particular resident. He along with the resident identifies topics, help in resident in getting ethics approval, writing proposal for funding if required, monitors the conduct of study including adverse events. He/ She reports to **Program In-charge** about the progress of thesis.

Guide and counsel students in managing work and stress.

Guidance students in planning their careers.

F. Moderator.

Appointed by Program coordinator to identify topics for journal club, helps the resident in seminars.

G. Resident -2-Student Representative (upto 18 months) &Academic In charge (from 19-36 months) (6 monthly rotation)

Identifies the cases and radiological films to be presented for discussion. In charge of documentation, record keeping. Discuss with fellow colleagues at intervals to find out problems and report to the Program In charge.

List of monthly academic programs for curriculum implementation:

	Academic session	Day	Time
1	Problem oriented case discussion/ clinical case discussions \	Wednesday	8-9 AM
2	Journal club/ Recent advances/ <u>Guidelines</u>	Friday	8-9 AM
4	Seminars/symposium	Saturday	10-12 AM
5	Seminars	Saturdays	2-4 pm
6	Critical care/ Bedside case discussion	Saturday	8-10 am
7	Radiology rounds	Thursday	8-9 AM

Thesis

Requirements of thesis, its external evaluation

The candidate is expected to undertake a mandatory research project for thesis submission. The mentor or the guide of the project will be identified by the **Head of department** in consultation with the **Program in Charge** in the initial 6 months of admission. The areas of project work should be decided in discussion with these mentors, and the research project should be presented in the departmental research meeting at the end of 9 months of joining the training period. The projects should be modified as per the suggestions from the department, and presented for approval from technical advisory committee and institute ethical committee. The regular progress of research work should be presented at 3-monthly research meetings in the department. **The completed research work should be presented at completion of 26 months of residency.** The completed thesis will be sent for external evaluation to examiner or expert from the panel and evaluation may be completed within two months.

Publication requirement

The research projects after completion should have been published or publishable in peer reviewed journals at the end of training period after the thesis evaluation by external examiners. The residents should have at least one clinical paper submitted in a peer-reviewed journal indexed in “Index Medicus” prior to appearing the final examination.

Conference participation requirement

Residents are encouraged to attend conference and present papers.

A minimum of one abstract presentation at conference at either national or regional/state level is also mandatory.

Internal evaluation

The examination includes internal assessment during the tenure and external examinations held at the end of 18 months and at the completion of the 3-year course. It should include both theory and practical aspects. Maintaining an appropriately documented clinical dossier as evidence having undertaken the minimum required training activities is essential. The external examination should be conducted in an appropriate manner befitting the highest academic degree. It should include both theoretical and practical evaluation.

An objective examination will be conducted covering the modules discussed at every six-month interval (3 each 1 ½ year) and will be evaluated for internal assessment. A minimum of 50% scoring is required for clearing the module. If the candidate gets lesser than 50%, a reappraisal can be done as per the BOS requirement.

E-portfolio and Log book

The students should maintain a logbook regarding the clinical, laboratory, academic activities they were involved, verified and countersigned by the consultants. An e-portfolio will be maintained by Program Coordinator for each student. The credits obtained by the student based on their clinical, academic performances, marks in the internal exam will be entered in the e-portfolio. The e-portfolio will be accessible to students which will enable them in judging their own performance at each year.

Contents of E-portfolio for each student

I. General information: Name, employee code, dept., course, year of joining, year of evaluation.

II. Evaluation of academic programs.

A. Name of academic activity

E.g. Journal club 1, 2, 3, 4, 5,

Seminar 1, 2, 3,

Before each academic activity

1. Name of topic (will link to archived file)
2. Name of Moderator
3. Actual marks scored

B. Each module clinical postings, Lab, OT, etc,

1. Name of Posting
2. Duration
3. Marks scored for each posting
4. Credit for the module

At the end of the year Grade will be assigned based on total mark for the module. For external posting each department has to formulate the evaluation form that has to be sent to the supervisor of the Lab, posting.

C. Mandatory courses.

Statistics: Attendance, marks, grade

BMT posting: Attendance marks, grade

D. Conference participation

1. National, international, regional
2. Type of presentation
3. Name of conference, venue
4. Organizer of conference
5. Title of abstract and link to
6. Awards if any

E. Any extra-curricular activities

EVALUATION OF CANDIDATES

The evaluation is based on internal and external evaluation. A total of 1000 marks is distributed as follows

Internal evaluation-200 marks

Part 1(2 theory papers) =200 marks

Part 2(2 theory Papers) =200 marks

Clinical & Practical Examination =400 marks

a. Internal Evaluation

Total marks for internal evaluation =200. This will be derived from the marks scored in the academic activities. The various areas of evaluation and the marks awarded are given in table. Each academic activity's mark will be based on the credit assigned to the activity. This will be finally converted to a score out of 200, which will be converted also to grade. The total marks for that year will be assigned at the end of each year based on the credit of the students' academic performance of that year and will be recorded in the E-portfolio. It will be made available to students at the end of each year. Pass requirement 50%. If student gets less than 40%, he/she cannot appear for final exams. Repeat the course for 6 months.

B. Grading

All academic programs will be evaluated. Each academic activity and module will be evaluated and marks allocated according the credits for the activity or module. The final marks at the end of each year will be converted to absolute grades

A = >80%, B=60 to 80%, C = 40 to 59%, D =<40%.

B External examination

External examinations are conducted by the academic division as per the rules governed by the institute. The department will follow the prescribed rules and regulations.

- 1) **Part 1:** At the end of 1 ½ year the candidate will take up Part 1 examination which consists of two theory papers each 100 marks. (Total 200 marks) Pass requirement 50% in each paper. If a candidate fails to get 50% in first attempt, he should pass the exam within a year. (Next Two 6 monthly attempts), otherwise he/she will not be eligible to appear in the final exam.
- 2) **Part 2:** At the end of three years of training the candidate will take up Part 2 exam which consists of;
 - a) Two theory papers each 100 marks. Pass requirement 50% in each paper. (200 marks)
 - b) Practical and Clinical examination. (400 marks)

The practical examination consists of Case discussion, Viva Voce, Pass requirement 50%. The following are the breakup of marks for the practical exam;

- a. One long case- 150 marks
- b. Two short case-150 marks (75 each)
- c. Viva voce-100 marks
 - Radiology X-rays, CT, MRI, DSA- 25 marks
 - ABG, ECG, Echo, TCD, ICP, Evoked potentials, SjVo2-25 marks
 - Evaluation of drugs -25 marks
 - Evaluation-of equipments-25 marks

SYLLABUS FOR DM (NEUROANESTHESIOLOGY)

PART-I BASIC SCIENCES

1. **APPLIED ANATOMY:** Basic and correlative anatomy of the Nervous system (brain, spinal cord, cranial and peripheral nerves), neurovascular anatomy. Embryological development of brain, spinal cord, skull and spinal structures.
2. **APPLIED PHYSIOLOGY:** Basic and correlative neurophysiology, positioning and its complications, ventilation & ABG, Pulmonary functions, cardiovascular and respiratory physiology in relation to nervous system,, temperature control, autonomic function.
3. **APPLIED PHARMACOLOGY:** Basic and correlative pharmacology of drugs acting on the nervous system and principles of neurotherapeutics, various drugs used in anesthesia and neurocritical care.
4. **APPLIED PATHOLOGY:** General and Medical neuropathology. (eg ICP, cerebral edema, neurogenic pulmonary edema, brain heart interactions, ARDS, disorders of fluid, electrolyte, blood glucose, biomarkers etc)
5. **APPLIED MICROBIOLOGY:** Pulmonary infections, infection of the brain , spinal cord and its meninges, infection following Neurosurgery, and nosocomial infection in the intensive care units, sepsis. Management, Prevention of infections, Sterilization and disinfection.

6. **NEURO APPLIED ENGINEERING:** Concept of developing hydrocephalus shunt, emphasis on types of investigative facilities for assaying various drug levels in the brain and CSF and their clinical correlates.
7. **Biostatistics-** Sensitivity, specificity, type 1& 2 errors, correlation coefficient, Regression analysis, odds ratio, sample size, Test for means, meta-analysis, planning a research study.

PART II- CLINICAL SCIENCES

1. Clinical and anesthetic, perioperative management of patients undergoing surgery of brain, spinal cord, skull, spine and peripheral nerves. (eg Tumors, trauma, vascular, movement disorders, epilepsy, endoscopy, image guidance)
2. Intensive care of patients following Neurosurgery, Neuro medical disorders.
3. Perioperative management of cases undergoing Neuro investigation and therapeutic interventional procedures including acute stroke.
4. Recent advances in Neuroanesthesia, Neurosurgery, neuroradiology procedures relevant to neuroanesthesia.
5. Neuromonitoring.
6. Neuroradiology.
7. Neuroprotection, neuronal plasticity, gene therapy, Neurorehabilitation, End of life care.
8. Acute pain services, Chronic pain syndromes, Neuropathic Pain, Trigeminal neuralgia, etc. - management.

SCHEME OF EXAMINATION

Part-I (At the end of 18 months of study)

Paper-I - 3hrs- 10 short essay type of questions in applied

neuroanatomy, Applied Neuro physiology, basic monitoring, patient safety **(10 marks each)**

Paper-II - 3hrs- 10 short essay type questions on Applied pharmacology, Applied pathology, Applied microbiology and applied Neuro engineering, biostatistics (10 marks each)

Part-II (To be taken at the end of the course and after passing Part-I)

Paper-I - 3hrs. 10 short essay types related to perioperative management in

Neurosurgery, neurotrauma and Neuroradiology (10 marks each)

Paper-II -3hrs. 10 short essay type questions on Neuromonitoring,

Recent advances in Neuroanaesthesia, Pain management, ICU management

(10 marks each)

Credit-based evaluation -E-portfolio

Students will be evaluated for internal marks based on a credit -based system by the faculty of the department. At the end of the course the performance of the candidates will be converted to grades. The grading will be based on the performance in each module with specified maximum credits against them. The respective modules, with the maximum credits allotted against them, are given below;

	SR1 year	SR 2 year	SR 3 year	Total (200)
Seminar	3	3	3	9
Journal Club	3	3	3	9
Case discussion	8	8	8	24
Core competency assessment (Clinical subtypes)	25	25	25	75
Log book			5	5
Patient Care	5	5	5	15
Theory examination (Internal exam)	5	5	5	15
BMT	3			3
Biostatistics	4			4
Papers publication + Award (5+5)			10	10
Conference presentation			5	5
Attendance /Punctuality	2	2	2	6
Thesis			20	20
Total				200/200

A) Mandatory marks

List mandatory courses and fixed credits

1. Medical Statistics and research methodology. (CREDIT=4)
2. Biomedical Technology posting. (CREDIT=3)
3. Publication in a journal (CREDIT=5)
4. Awards (Credit =5)
5. Presentation of Paper in national Conference (CREDIT=5)
6. Attendance and Punctuality (Credit =6)
7. Log Book (credit =5)

100% attendance is mandatory for Biomedical Technology and Biostatistics.

B) Evaluation of Thesis Projects (20 credits)

1. Mid-term evaluation of projects mandatory and will carry credits
2. Prospective / Retrospective Study
3. Ethical Committee clearance / Institute funding obtained
4. Contribution of candidates experience in the study
5. Descriptive data collection / Quantitative data subjected to statistical analysis.
6. Midterm Review: At 18 months of DM course: Aims and objectives, review of literature, materials and methods (exclusion / inclusion criteria), data collection and presentation (% of target of the project) and preliminary data analysis.
7. Review at 30 months: Presentation of the full project as thesis and also in publishable form, complete with statistical analysis, discussion, study limitations, conclusion, and bibliography.
8. Overall impact of the project in adding to our knowledgebase, and patient management.
Between 30-34 months, the project should be sent for publication to peer reviewed journals.

9. Presentation of the project work as scientific presentation at national level and at state level- mandatory.

C) Internal Examination (15 credits 5 per year)

There will be 5 internal examinations, each having 100 marks during the 3-year course. These examinations will have objective questions, applied aspects like case-based scenarios. It will be evaluated by the faculty members of the department. The results will be conveyed to the residents as a part of the regular appraisal.

Exam	Month of conduct	Topics
1(AFTER 6 MONTHS)	August	Comprehensive anatomy OF brain, SPINAL CORD, pathways, AIRWAYS Applied physiology of central nervous system, Respiratory, Applied cardiovascular physiology
2(AFTER 12 MONTHS)	January	Pharmacology of anesthetic drugs and drugs used in cns and cardiovascular diseases, Pathology OF CBF, Cerebral edema, ICP, Ventilation, ABG
3(AFTER 24 MONTHS)	January	Airway equipment, Neuromonitoring, Radiology , Neurotrauma, Neurocritical Care
4(AFTER 32 MONTHS)	August	Recent advances in diagnostic and therapy in CNS disorder, Chronic pain
5 (AFTER 34 MONTHS)	November	Mock exam/VIVA

Student feedback and Reappraisal

Feedback form from student at the end of completion of each module and seminars will be mandatory and will be handed over to Program in charge for identifying deficiencies and making corrective actions. Moreover, six monthly meetings with the residents by Program coordinator will be conducted to get their overall feedback and academic progress and will be reported to head of department.

Mentoring / monitoring / counseling mechanism to identify deficiency

An objective examination will be conducted covering the modules discussed at every six monthly interval (3 each 1 ½ year) and will be evaluated for internal assessment. A minimum of 50% scoring is required for obtaining adequacy of skills in the module. If the candidate gets lesser than 50%, reappraisal can be done as per BOS guidelines.

ANNEXURES

**A) EVALUATION OF JOURNAL REVIEW PRESENTATIONS (Credits 3/year
Total=9)**

Name of the Student:

Topic of Presentation:

Date:

Sl. No.	Items of observation during Presentation	Moderator	Faculty 1	Faculty 2	Faculty 3	Faculty 4
1	Extent of understanding of scope & objectives of the paper of the candidate					
2	To critically evaluate methods, analysis and interpretations of study					
3	Whether cross references have been consulted					
4	Whether other relevant publications consulted					
5	Ability to respond to questions on the paper / subject					
6	Ability to defend the paper					
7	Clarity of Presentation					
8	Audio – Visual aids used					
9	Ability to propose new research ideas based on study discussed					
	Total Score					

B) EVALUATION OF SEMINAR PRESENTATIONS (Credits 3/year Total=9)

Name of the student:

Topic of Presentation:

Date:

Sl. No.	Items of observation during Presentation	Moderator	Faculty 1	Faculty 2	Faculty 3	Faculty 4
1	Whether all relevant publications consulted					
2	Understanding of the subject					
3	Completeness of the preparation					
4	Clarity of presentation					
5	Current concepts coverage					
6	Ability to answer the questions					
7	Time scheduling					
8	Appropriate use of Audio – Visual aids					
9	Overall performance					
10	Any other observation					
	Total Score(/100)					

Final Aggregate Marks-

**C) EVALUATION FORM FOR CASE PRESENTATION (Credits 8/year
Total=24)**

Name of the student:

Name of the Faculty / Observer:

Date:

Sl. No.	Items of observation during Presentation	Poor 0	Below average 1	Average 2	Good 3	Very good 4
1	Completeness of history					
2	Accuracy of clinical signs					
3	Clarity of Presentation					
4	Assessment of problem and investigational plan					
5	Anesthesia management/Treatment plan					
6	Ability to defend diagnosis and plan					
7	Knowledge of the current and past literature					
	Grand Total					

D) Core competency evaluation (25 credits/year)

Name of The Resident:

Assessment period (every 3 months):

Name of the assessing faculty:

A. Medical Knowledge in Specialty and allied Subspecialties (5 credits)

SI No:	Points for Evaluation	Poor (1)	Below Average (2)	Average (3)	Good (4)	Very good (5)
1	Analytical skills					
2	Clinical knowledge					
3	Fundamental knowledge					
4	Knowledge of recent updates					
5	Knowledge of clinical guidelines in allied subspecialties					
	Cite reasons for poor grade & suggestions for future improvement Total Score (out of 25):					

B . Evaluation Of Clinical Work In Neuroanesthesia And Critical Care (20 credits)

1. Evaluation Of Clinical Work In Operating Room/ Radiology (10)

Sl No:	Points for Evaluation	Poor (1)	Below Average (2)	Average (3)	Good (4)	Very good (5)
1	Regularity of attendance and punctuality					
2	Preanesthetic evaluation work up					
3	Advanced monitoring skills					
4	Counselling, risk assessment and obtaining preoperative consent, blood donation					
5	Planning and Management of cases in perioperative period					
6	Management of complex neurosurgical scenarios					
7	Interaction with colleagues and supporting staff					
8	Teaching and training of junior colleagues					
9	Maintenance of case records					
10	Overall quality of clinical work					
	Cite reasons for poor grade & suggestions for future improvement Total score: (out of 50)					

2. Evaluation Of Clinical Work In Neurocritical Care (10)

Sl No:	Points for Evaluation	Poor (1)	Below Average (2)	Average (3)	Good (4)	Very good (5)
1	Gathering patient information					
2	Clinical judgment					
3	Presentation of cases during rounds					
4	Diagnostic skills (Xray/CT/MRI, Lab reports)					
5	Individualizing protocol based treatment plan					
6	Bed side case discussion					
7	Management of Complex Neurocritical care cases					
8	Ability to recognise and manage clinical adverse problems					
9	Completeness of clinical documentation					
10	Overall quality of clinical work					
	Cite reasons for poor grade & suggestions for future improvement					
	Total Score : (out of 50)					

E) Patient care (5 credits/year)

A) Professionalism

SI No.	Points for Evaluation	Poor (1)	Below Average (2)	Average (3)	Good (4)	Very good (5)
1	Compassion					
2	Ethical judgment					
3	Level of professionalism					
4	Self-awareness for improvement					
5	Team player					
	Cite reasons for poor grade & suggestions for future improvement Total Score(out of 25):					

B) Interpersonal and communication skills

SI No	Points for Evaluation	Poor (0)	Below Average (1)	Average (2)	Good (3)	Very good (4)
1	Communication skills (General)					
2	Presentation skills					
3	Writing skills					
4	Function as a role model					
5	Leadership skills					
	Cite reasons for poor grade & suggestions for future improvement Total Score(out of 25):					

Grading system for evaluation of Core competency and Patient Care

Poor (0)	Below Average (1)	Average (2)	Good (3)	Very good (4)
Cannot advance beyond the need for direct supervision in patient care and management	Requires direct supervision to ensure patient safety and quality of anesthesia care	Requires indirect supervision to ensure patient safety and quality of anesthesia care	Independently manages the anesthetic and critical care management of patients	Independently manages Unusual , rare or complex cases
Cannot manage patients who require urgent or emergent anesthetic or critical care	Inconsistent in the anesthetic management of patients presenting for simple procedures	Consistent in the anesthetic management of patients presenting for simple procedures	Seeks additional guidance or consultation from faculty as and when required	Aspirational and role model for junior colleagues
Does not assume responsibility for patient management decisions	Inconsistent in the management of patient in Neurocritical care settings	Consistent in the management of patient in Neurocritical care settings	Appropriately provides anesthetic and critical care management of patient presenting for urgent and emergent procedures	
	Unable to manage patients with complex pathologies	Under supervision provides appropriate care in operating room and ICU	Effectively supervises the patient care provided by junior colleagues in the team	
		Initiates anesthetic management plans for urgent and emergent procedures	Ready for unsupervised practice	
		Cannot independently supervise the patient care provided by junior colleagues in the team		

Outstanding achievements and Awards (5 credits)

A resident, who is outstanding in research or academic activities, has publication in high impact journals or getting awards in conference qualifies for additional credits which are given as follows;

Assessment of the outstanding achievements can be made using the following criteria;

1. Attendance & Punctuality
2. Overall marks scored in the exams
3. Publication in high impact journals

Contributions to patient management.

F)LOG BOOK (5 Credits Total)

Overview of activities during residency period

1) Posting details during residency period

AREAS OF POSTINGS	TOTAL DURATION			MINIMUM DURATION
Neurosurgical operation theatres				7-8 months/year
ICU posting				2 months/year
Neurotrauma (NIMHANS or alternate centre)				1 month in 3rd Year
Cathlab				2 months/year
Neuroradiology dept				14 days
Neurology dept/neuromonitoring				14 days
Biostatistics				one week
Biotechnology				one week

2) PROCEDURES PERFORMED DURING PERIOD OF RESIDENCY

A) Invasive procedures

TYPE OF PROCEDURE	NUMBER PERFORMED INDEPENDENTLY	MINIMUM NUMBER TO BE PERFORMED INDEPENDENTLY	NUMBER PERFORMED UNDER SUPERVISION	MINIMUM NUMBER TO BE PERFORMED UNDER SUPERVISION
Invasive arterial line		100		20
Central venous cannulation		50		20
Ultrasound guided central venous cannulation		25		10
Anesthesia for Intracranial Aneurysms/AVMs(surgical management)		50		10
Anesthesia for Intracranial tumors		50		20
Anesthesia for Shunt/endoscopy Procedures		5		10
Anesthesia for Spinal Procedures		25		10
Anesthesia for Pituitary surgery		25		10
Anesthesia for pediatric neurosurgery		15		10
Anesthesia for MRI		25		15
Anesthesia for endovascular management of acute stroke		10		5
Anesthesia for CT scans/ guided procedures		25		10
Anesthesia for Intracranial Aneurysms/AVMs		50		10

(coiling / embolisation)				
Percutaneous tracheostomy		5		5
Awake Fiberoptic intubation		5		5
Jugular oximetry		3		3

B)Non-invasive procedures

TYPE OF PROCEDURE	NUMBER PERFORMED	MINIMUM NUMBER TO BE PERFORMED
ECG interpretation		50
Transthoracic Echocardiography		50
Transesophageal echocardiography		25
ICP		25
CT interpretation		50
MRI interpretation		50
DSA		25
EEG/ECOG		25
Transcranial Doppler		50
Intraoperative Evoked potentials		50

3)ACADEMIC ACTIVITIES

Activity	Number		
Seminars			
Journal club			
Case presentation			

Student Feedback form

Name of resident

Topic

Date

	Poor	Average	Good	Very good
Understood the subject in depth				
Able to put the information to practice				
Speaker cleared all doubts				
Presentation was up to date				

Do you need further training-Yes/ No

Credit Distribution of Residents Evaluation

	SR1 year	SR 2 year	SR 3 year	Total (200)
Seminar	3	3	3	9
Journal Club	3	3	3	9
Case discussion	8	8	8	24
Core competency assessment (Clinical subtypes)	25	25	25	75
Log book			5	5
Patient Care	5	5	5	15
Theory examination (Internal exam)	5	5	5	15
BMT	3			3
Biostatistics	4			4
Papers publication + Award (5+5)			10	10
Conference presentation			5	5
Attendance /Punctuality	2	2	2	6
Thesis			20	20
Total				200/200

