SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY

THIRUVANANTHAPURAM -695011

KERALA

DEPARTMENT OF NEUROLOGY

CURRICULUM

FOR

POST GRADUATE DIPLOMA IN NEUROTECHNOLOGY

SYLLABUS, TRAINING PROGRAMME AND EXAMINATION SCHEME

With the advent of rapid advances in the field of Science and Technology, the neurological evaluation and management have changed from a clinical science to a technically supported service. New electronic and electrical equipment, investigatory techniques and therapeutic procedures have become the standard of neurology today. Even important decisions regarding the management, both medical and surgical are often taken in the light of these investigations. Simultaneously, the need for well-trained technicians to maintain and use these machines has become all the more relevant. However, there are only very few centers in our country which offer an adequate training in this field. This post graduate programme in Neurotechnology is a two-year comprehensive course along the lines of that offered by the American EEG society.

Minimum Educational Qualification for Admission.

B. Sc Degree with a science as a major or ancillary subject, and 60% marks in the qualifying examination. Candidates belonging to SC/ST are required to secure only 50% in the qualifying examination.

I. SYLLABUS

A.Theory:

1. Anatomy and Physiology

(a) Brain

(b) Functional areas of brain

(c) Spinal cord

(d) Peripheral and cranial nerves

(e) Autonomic nervous system

(f) Brachial plexus

(g) Lumbosacral plexus

(h) Visual pathway and anatomy

(i) Auditory pathway and anatomy

(j) Somatosensory system

(k) Sleep physiology

(l) Reticular activating system

(m) Nerve structure and physiology

(n) Muscle structure and physiology

(o) Neuromuscular junction structure and physiology

2. Basic Electronics

a) Amplifier and Filters

b) Common mode rejection

c) Analogue to Digital Conversion

d) Grounding, Impedance testing and calibration principles

3. Electroencephalography (EEG)

(a) Basic knowledge of normal brain anatomy and function.

(b) Instrumentation and Electronics in EEG and evoked potentials (EP)

(c) Terminology, waveforms, frequencies and artifacts

(d) Polarity and montages

(e) Technical application of the international 10-20 system for EEG

(f) Electrodes and methods of application, concepts of resistance and impedance

(g) Calibration techniques

(h) Safety measures in EEG recording and grounding

(i) Minimal technical requirements for EEG, EP and standards of practice guidelines of the American Electroencephalographic Society

(j) Normal EEG patterns and waveforms

(k) Activation procedures and specialized recording techniques.

(l) Medication and drug effects on the EEG.

(m) Maturational changes, evolution of sleep pattern

(n) Abnormal EEG pattern; Epileptiform abnormalities

(o) Emergent EEG recording procedures and techniques

(p) Seizure classification

(q) Status epilepticus

(r) Organic brain function

(s) EEG in metabolic disorders

(t) Periodic Discharges

(u) Neonatal EEG

(v) Brain death recording.

4. Electromyography (EMG)

(a) Instrumentation of the EMG machine

(b) Safety and maintenance of the EMG machine

(c) Principles of nerve conduction study (NCS)

(d) Techniques of motor and sensory NCS

(e) F response and H reflex

(f) Normal nerve conduction parameters

(g) Abnormalities in demyelination and axonopathy

(h) Blink Reflex

(i) Uncommon NCS

(j) Repetitive nerve stimulation

(k) Needle EMG study

(l) Normal and abnormal EMG patterns

(m) Single fiber EMG

(n) Sphincter EMG

(o) Sympathetic skin response, RR interval testing

(p) Electroneuromyography (ENMG) study protocols in different diseases

(q) ENMG studies in anterior horn cell disease

(r) ENMG in peripheral neuropathy

(s) ENMG in radiculopathy

(t) ENMG in brachial and lumbosacral plexopathies

(u) ENMG in muscle diseases.

(v) Sterilization of ENMG electrodes and care of Electrodes

(w) Safety precautions in ENMG lab

5. Evoked Potential study

(a) Basic Principles of evoked potentials

(b) Visual Evoked potential (VEP)

(c) Brainstem Auditory Evoked Potential(BAEP)

(d) Somatosensory evoked potential (SSEP)

(e) Motor Evoked Potential (MEP)

(f) Intraoperative Evoked Potential and monitoring

6. Video EEG

(a) International Extended 10-10 system of electrode placement

(b) Special recording electrodes

(c) Sphenoidal recording

(d) Seizure semiology and response checking in different seizures

(e) Invasive monitoring

(f) Cortical stimulations

7. Electrocorticography (ECoG)

(a) Types of electrodes

(b) ECoG recording principles and protocols

(c) Sterilization techniques

(d) Safety precautions in operation theatres

8. Sleep studies

   (a) Sleep physiology

   (b) Sleep structures and stages.

   (c) Sleep disorders

   (d) Polysomnography; recording and analyzing

   (e) American Academy of Sleep Medicine (AASM) guidelines of sleep scoring

   (f) Multiple Sleep Latency Test (MSLT)

   (g) Maintenance of wakefulness test (MWT)

   (h) Suggested Immobility Test (SIT)

   (i) CPAP titration; machine and protocol.

9. fMRI-EEG
10. Transcranial magnetic stimulation
11. Vagus Nerve Stimulation
12. Magneto-encephalography

B. Practical:

1. Role and Responsibility of Technologist in the care and handling of a patient
2. Electrical safety of machines
3. EEG laboratory

   The students learn to accurately record electrical impulses from the brain with increasing independence through practice. This entails the acquisition of knowledge and skills necessary to:

   (a) Apply suitable electrodes on predetermined measured position on the patient's head and check their performance.

   (b) Calibrate and adjust the EEG apparatus.

   (c) Select predetermined electrode combinations as well as special combinations made necessary by the case under study and perform a standard recording.

(d) Recognize artifacts and take appropriate steps to eliminate them, describe normal and abnormal clinical manifestations observed during the test.

(e) Use activating procedures such as hyperventilation, intermittent photic stimulation and sleep; obtain the patient's cooperation for best performance of these procedures.

(f) Monitor other variables such as electromyograms, electrocardiograms, electrooculograms, respiration etc., when indicated by the circumstances of the EEG recoding.

(g) Abstract relevant information from the patient's clinical record and obtain additional information by questioning.

(h) Keep equipment in a clean operating condition, detect instrument malfunction and make minor maintenance, adjustments or report need for further repairs.

(i) Able to record EEG in the ICU for emergent indications.

4. EMG laboratory

The students learn to accurately perform nerve conduction studies and assist EMG recordings. This entails skills and knowledge needed to

(a) Operate and maintain the EMG machine

(b) Assess the risks and concerns of the patient and explain the procedure

(c) Place the recording, reference and ground electrodes at specific standard positions and stimulate at sites appropriate for the nerves being studied

(d) Note impedance and artefacts and learn to rectify the same.

(e) Note the influence of temperature on the recording parameters and adjust the ambient temperature as stipulated for nerve conduction studies.

(f) Perform F wave and H reflex studies and cross check the findings repeatedly till there is consistency.

(g) Perform slow and fast repetitive nerve stimulation tests and post exercise tests from specific nerves

(h) Perform uncommon nerve conduction techniques like phrenic nerve study, plantar stimulation, comparison tests etc.

(i) Assist the techniques of needle EMG with concentric and monopolar needles

(j) Assist special EMG like sphincter EMG, diaphragmatic EMG and single fibre EMG

(k) Perform and assist pediatric NCS and EMG

(l) Record NCS in a seriously ill patients and assume safety precautions

(m) Assess and troubleshoot problems with electrodes and EMG machine

5. Evoked potentials

   The students learn to carry out BAEP ,VEP and SSEP appropriately

6. Video EEG recording

   a) Continuous recording of EEG activity with telemetric monitoring of physical events, instituting potentiating stimuli and procedures to precipitate ‘absences‘ and ‘pseudo-seizures’ and keeping a record of all relevant events.

   b) Special Procedures like Depth Electrode Recording, Cortical Stimulation and Sphenoidal Electrode Recording.

7. Sleep Lab and Polysomnography

   a) Continuous night study for 6-8 hours

   b) Recording of events like apnea, periodic Motor syndromes, parasomnias etc.

   c) Sleep scoring techniques - AASM guidelines

   d) Continuous positive airway pressure (CPAP) titration

   e) MSLT and MWT Recording

8. Emergency procedures like EEG recording of patients with status epilepticus in the ICUs of other specialties, special recording for Brain death.

9. Intraoperative monitoring like electrocorticography recording, intraoperative evoked potentials, intraoperative nerve stimulation etc.

10. 24-hour resident duty in the hospital for independent management of machine and lab in emergency situations.

11. Hands on sessions with Bio-Medical Engineering department to familiarize with Amplifiers, Filters, Resistance and Capacitance, EEG and ENMG recording system, their electrical safety and maintenance.

II. <u>ACADEMIC SESSION</u>

1. Exposure to Basic Biology:

Basic human anatomy and physiology as relevant to Neurotechnology is taught in collaboration with the Anatomy and Physiology Departments of Medical College, Thiruvananthapuram in the first six months of their training, so that candidates acquire a scientific and logical foundation for their electrophysiological studies.

2. Theory Classes and Teaching Sessions

270 days of teaching and training are imparted to the students every year

Theory – Seminars and Journal clubs - 260 hours

Practical – in various labs - 1900 hours

(EEG, ENMG, EP, Video-EEG labs, Intra-operative monitoring in surgical theaters, Emergent EEG in Intensive care units, Sleep lab and Transcranial Magnetic Stimulation labs)

First year rotations

Orientation in all the labs – 1 month

EEG – 3 months

EMG and EP – 4 months

VEEG and sleep – 4 months

Second year rotations

EEG – 3 months

EMG, EP and TMS – 4 months

VEEG and sleep – 4 months

Intraoperative monitoring (OT) – 1 month

3. Clinico-electrophysiological project

A topic is allocated to each candidate at the beginning of their tenure; candidate dedicatedly performs electrophysiological study in those patients, collects and analyses the data and critically evaluates the yield, sensitivity, specificity and prognostic significance of these parameters in comparison with other laboratory values and clinical parameters. The study is compiled as dissertation and submitted for internal evaluation before final examination.

4. Resource Persons

From each area of electrophysiology, consultants are given charge for the supervision of the conduct of the academic program.

Electroencephalography and Evoked potentials

1. Dr. Sanjeev V. Thomas, Professor (Senior Grade) and Head of Neurology
2. Dr. Ashalatha R., Professor of Neurology
3. Dr. Ramshekhar N. Menon, Additional Professor of Neurology
4. Dr Ajith Cherian, Associate Professor of Neurology

Nerve conduction studies and Electromyography

1. Dr. Sruthi S. Nair, Associate Professor of Neurology

Sleep studies

1. Dr. Ashalatha R., Professor of Neurology
2. Dr. Sapna E. S., Additional Professor of Neurology

Intraoperative brain mapping

1. Dr. Ashalatha R., Professor of Neurology
2. Dr. Ramshekhar N. Menon, Additional Professor of Neurology

III. EXAMINATION AND EVALUATION

1. Internal evaluation is done at six-month intervals with stipulated syllabus by theory examinations. The marks of these evaluations are considered for credit-scoring at the end of the 2-year course.
2. Final examination at the end of two years consists of Theory paper based on electrophysiological and disease-based situations followed by Practical and Viva voce by Neurologists and a Biomedical Engineering expert.

Theory examination	- 100 marks
Practical and Viva voce	- 75 marks.
Internal Assessment score	- 25 marks

Total	- 200 marks