SYLLABUS

for courses affiliated to the

Kerala University of Health Sciences

Thrissur 680596

BACHELOR OF SCIENCE IN NEUROTECHNOLOGY

(BSc Neurotechnology)

Course Code: 027

(w.e.f. 2023 admission onwards)

2.COURSE CONTENT

2.1 Name of the course

Bachelor of Science in Neurotechnology - Abbreviated as **BSc Neurotechnology**

2.2 Objectives of the course

a) To acquire knowledge in basic neurosciences, neurological disease and neurological investigations.
b) To acquire the skill of handling, operating and maintaining the medical instruments used in the Neurotechnology lab
c) To acquire the skill of interpreting the normal and abnormal electro technological investigations
d) To acquire the skill of managing medical emergencies arising in the Neurophysiology lab
e) To acquire the skill in advanced Neurotechnology to assist the surgical and medical management of neurological conditions

2.3 Medium of instruction:

The medium of instruction and examination shall be in English.

2.4 Course outline

The course is designed as a vocational course aimed at equipping students with practical skills in Neurotechnology. The course's design is in such a way that the candidates are trainees as well as residents in the Neurotechnology lab from the beginning of the course and are totally under the Neurology department's supervision. The academic programs, including theory classes, will be arranged by the department of neurology with other departments' help as and when required. A candidate who has successfully completed the course will be able to perform the electro technological investigations and will have the ability to interpret the common abnormalities.

2.5 Duration of the course

Duration shall be for four years including one year of Training

2.6 Subjects

First year

Paper1. Neuroanatomy -1 (70 hours)

Brain, spinal cord, meninges, CSF, skull and spine

Paper2. Neuroanatomy - 2 (70 hours)

Cranial nerves, Radicles, Peripheral nerves, muscles and major bones of limbs including pelvic and pectoral girdles.

Paper 3. Neurophysiology and Neurotechnology instrumentation (70 hours)

Second year

Paper 1. **Neurological disease 1.** (70 hours)

Epilepsy, Sleep disorders, Diseases of Brain, spinal cord and cranial nerves

Paper 2. **Neurological disease 2**. (70 hours)

Diseases of peripheral nerves, muscles, and myoneural junction

Paper3.**Neurocritical care.** (70 hours)

Neuro ICU, Stroke ICU, Monitors, ventilators, Plasmapheresis, ECG and defibrillators

Third year

Paper1. Neurotechnology - 1 (70 hours)

EEG and VEEG, Surgical workup of epilepsy

Paper2. Neurotechnology - 2 (70 hours)

Electrophysiology. NCS, Proximal conduction, Evoked potential –VEP ABER, NMJ studies, ENMG

Paper3. Advanced Neurotechnology(70 hours)

Polysomnogram, SSPE, motor evoked potential, Single-fiber electromyography (SFEMG), Invasive EEG monitoring, Cognitive potential

Fourth year

Training after completion of course:

Duration of training: One year

During training, candidate will be posted in rotation in Electrophysiology lab, neuro ICU, Ward and OP.

Duty time 8.00am to 8.00pm

Night duties in sleep lab and electrophysiology lab in - rotation, if required by the department.

2.7 Detailed Syllabus and Curriculum

First year

Paper1. Neuroanatomy - 1

A. Introduction to Nervous System

- Introduction to CNS PNS and ANS
- Structure of a neuron , glial cells
- Anatomical terms (e.g. , anterior/ posterior)

B. Brain

1. **Cerebrum**:
    - Gross structure,
    - Lobes,
    - Important sulci and gyri,
    - Motor cortex,
    - Sensory cortex,
    - Language areas,
    - Hippocampus and medial temporal lobe,
    - Auditory and visual cortex.
    - Cerebral white matter,
    - Basal Ganglia: Components and functions

2. A brief account of:
    - **Cerebellum** : Gross anatomy and functions
    - **Brain stem** : Structure and function
    - **Diencephalon** : Thalamus and Hypothalamus – structure and functions
    - **Blood supply** of the brain and spinal cord

C. Spinal cord

- Functions
- structure,
- tracts – formation and function

D. Meninges and CSF

- Layers of meninges
- Subarachnoid space and subdural space
- CSF

E. Skull and spine

- Name and location of skull bones,
- foramen of skull
- Structure of a typical vertebra,
- atlas,
- axis

Paper 2. **Neuroanatomy – 2**

A. Peripheral nerves

1. Introduction to peripheral Nervous System
    - Structure of a peripheral nerve
    - Schwan cell and myelin
    - Types of nerve fibres and their function
    - sensory axons and formation of sensory tracts
    - motor axons and the concept of LMN
2. Brachial plexus and cervical plexus
3. nerves of upper limbs
4. Lumbar and sacral plexus
5. Nerves of lower limbs

B. Cranial nerves

1. Name and functions
2. Visual pathway
3. Auditory pathway

C. Radicles

1. Dorsal and ventral roots
2. Dorsal root ganglia
3. Cauda equina

D. Muscles

1.Gross and microscopic structure of muscle

2. Clinically important muscles of upper limbs
3. Clinically important muscles of lower limbs

4.Muscles of the tongue, face, neck (Trapezes and sternomastoid), abdominal muscles

E. Bones

Identification of bones of the pectoral girdle, pelvic girdle, upper limbs (humerus, ulna and radius) and lower limbs (femur, tibia, fibula, calcaneus)

Paper 3. Basic Neurophysiology and Neurotechnology instrumentation

A. Neurophysiology

1. Cells / organelle / functions / intracellular and extracellular fluids
2. Body fluids and their composition – Blood / blood elements / plasma and serum / CSF / Lymph.
3. Neuron / Synapse / Neurotransmitters/ wallerian degeneration
4. RMP/ Action potential / conduction of action potential / myelin / myelinated nerve fibre / unmyelinated nerve fiber / difference in conduction between myelinated and unmyelinated nerve fibers
5. Neuromuscular junction (NMJ) and neuromuscular transmission
6. Muscle fiber : muscle fiber structure / myofibril / sarcomere / contractile proteins / muscle contraction.
7. Muscle enzymes, glucose metabolism : Brief account of glycolysis, glycogenolysis, glycogen synthess and gluconeogenesis.
8. Reflexes

   Classification of reflexes, Monosynaptic reflex- Stretch reflex , muscle spindle ,inverse stretch reflex. Polysynaptic reflex-Withdrawal reflex
9. Motor and sensory Tracts : Pyramidal tract // sensory tracts/ Concept of UMN and LMN ,
10. Motor unit
11. Physiology of Sleep
12. Genesis of EEG
13. Genesis of EKG
14. Genesis of Evoked potentials
13. Sense organs and receptors
    - Eye ,
    - Ear,
    - taste receptors smell ,
    - Proproopceptive and exroceptive receptors

14.Intracranial pressure

B) Neurotechnology instrumentation

a**) EEG**

1.Principles of analogue and digital EEG

2. Basic elements of EEG machine

3. Electrodes / Amplifiers / Filters / Paper / Writing units

4. Electrical Principles – Concept of Dipole, Common Mode rejection,

5. Inphase and out of phase signals

b**) NCS machine**

1. Basic elements of NCS machine
2. EMG needle

c) **Ventillators :**

Mode of operation – CMV, SIMV, CPAP, PEEP

Humidifier

Nebulizer

d) **Infusion pump / Pulse oxymeter / Defibrillator / ECG**

e**) Central oxygen plant / Central suction / Compressed air**

f**) Evoked Potentials - Basics of Instrumentation**

1. Definition
2. Principles of averaging/recording techniques
3. Evoked potential Instrumentation

- General

- Analogue

- Digital Signal to noise ratio
- Frequency response

Internal noise

Second-year

Paper1. Neurological disease 1

1. Epilepsy
2. Sleep disorders

3.Diseases of Brain

- CNS infections : Encephalitis / Meningitis / Slow virus diseases
- Metabolic encephalopathies

- Multiple sclerosis and demyelinating illnesses
- Stroke

A brief account of:

a. Dementia

b. Parkinsonism

c. Cerebral palsy

d. Head ache

e. Brain tumor and head injury

4. Diseases of spinal cord

- Transverse myelitis
- Compressive myelopathy
- Syringomyelia
- CV junction anomaly
- Cervical spondylitis myelopathy
- Lumbar disc disease and radiculoparhies

5. Diseases of cranial nerves

a) Anosmia

b) Optic neuritis, hemianopia and field defects

c) Ophthalmoplegia

d) Bells palsy ,UNM facial palsy

e) Deafness-conductive, sensorineural

f) Dysphagia

g) Dysarthria

Paper 2. **Neurological disease - 2**

1.Diseases of peripheral nerves,

a) Concept of Mononeuropathy / Mono neuritis multiplex and Polyneuropathy

b) Inflammatory neuropathies

- Guillian Barre syndrome
- AMAN and AMSAN
- SIDP ,
- CIDP and
- MADSAM

c) Diabetic and metabolic neuropathies

d) Hansen's neuropathy and other infective neuropathies

e) Hereditary Neuropathy

f) Deficiency neuropathies and toxic neuropathies

g) Nerve injuries entrapment neuropathies and pressure palsy

2.Diseases of specific nerves

a) Median Nerve

- CTS ,
- Anterior interosseous nerve syndrome,

b) Ulnar Nerve:

- Cubital tunnel syndrome,
- Tardive ulnar nerve palsy,
- Guyon's cannel ulnar neuropathy,
- Claw hand

c) Radial Nerve:

- Radial tunnel syndrome,
- Saturday night palsy,
- PIN syndrome

d) Peroneal Nerve:

- Foot drop

e) Tibail Nerve:

- Tarsal tunnel syndrome,

3. Plexopathy

4. Radiculopathy

5. MND and Anterior Horn cell disease

6. Ganglionopathy

7 .Muscle disease :

a) Muscular dystrophy

b) Inflammatory muscle disease

c) Metabolic muscle disease

d) Congenital myopathies.

8. Neuromuscular junction disorders

a) Myasthenia gravis

b) Congital myasthenia

c) LEMS and Botulism

Paper 3. Neurocritical care

1.Stroke

a. Intracerebral haemorrhage
b. Subarachnoid haemorrage
c. Ischemic stroke
d. Thromolysis- iv, mechanical
e. Decompressive craniotomy

2. Coma

3. Mechanical ventilation

4. Myasthenic crisis

5.DVTPulmonry embolism

6.Cardiac arrhythmia

7. Plasmapheresis

8. EEG monitoring in ICU

9. Monitoring in ICU

10. ICU psychosis

11. Nursing care in ICU

12. Raised ICP management

13.Fluid and electrolyte management

14. Trauma care –TBI

15. Critical illness neuropathy

16.Vitals

- Blood pressure
- body temperature,
- respiration
- pulse,
- Auscultation for Heart Sounds

17.CPR

18. Simple aseptic techniques

19.Shock –

- Definition
- Types of shock with examples: Hypovolemic, cardiogenic and septic shock

- Stages of shock: Nonprogressive, progressive and irreversible.

Third year

Paper1. Neurotechnology -1

1 Technical aspects

- Electrode placement
- Special electrodes
- Derivations and Montages
- Machine calibration (biological and mechanical)

2.Normal EEG waves

3.Benign EEG variants

4.Neonatal EEG and EEG changes with age

5. Localization techniques and Phase reversal

6.Artifacts

7. Sleep and EEG

8. EEG activation procedures

9.Abnormal EEG

a) EEG abnormalities in epilepsies and epileptic syndromes – ictal and interictal
b) Periodic complexes
c) Encephalitis
d) Metabolic encephalopathies

10. Ambulatory EEG

11.Video EEG

12.EEG / VEEG Reporting

Paper2. Neurotechnology – 2

A) NCS

1)motor conduction studies

- Distal latency and its clinical significance
- CMAP and its clinical significance
- Conduction velocity
- Conduction block

2) Sensory conduction studies

3)NCS pattern in demyelinating neuropathy

4)NCS pattern in axonal neuropathy

4)NCS pattern in neuronopathy

5**) NCS pattern** in ganglionopathy

6) NCS pattern in root lesions and the Concept of preganglionic and postganglionic lesion

7) Brachial plexeus studies

B) Proximal conduction

- F Wave
- H reflex Introduction
- Pathway
- Patient preparation
- Materials required
- Procedure
- Factors affecting
- Normal values and waveforms
- Limitations
- Clinical uses

C) Evoked potential - VEP

- Introduction
- Visual pathway
- Types of VEP
- Patient preparation Materials required
- Procedures
- Factors affecting
- Limitations
- Normal values
- Clinical conditions
- Pediatric VEP
- Responses and values

D) Evoked potential- B.A.E.R

- Introduction
- Auditory pathway

- Patient preparation
- Materials required
- Procedure
- Factors affecting
- Normal values and waveforms
- Limitations
- Clinical uses

E) Blink reflex

F) Sympathetic skin response

G) Quantitative sensory testing

H) NMJ studies RNS

- RNS at low rate of stimulation
- RNS at high rate of stimulation
- decremental response
- Incremental response
- MNJ protocols
- Presynaptic electrophysiological abnormalities

I) **EMG**

- Basics
- Recording techniques
- Types of needles
- Muscles and localization
- Insertional activity
- Spontaneous activity
- Motor units
- Neurogenic patterns
- Myopathic patterns
- Macro EMG
- Quantitative EMG QEMG
- Surface electromyography (**sEMG**

Paper3. Advanced Neurotechnology

A) SSEP

- Introduction
- Patient preparation
- Technique
- Anatomical and physiological basis of SEP
- Upper limbs - Median SSEP
- Lower limbs – Tibial Motor SSEP
- Cortical somatosensory evoked potentials
- Reproducibility of SEP andPatient related factors of SEP
- Clinical applications of SEP
- Surgical monitoring of SSEP

B) Motor evoked potentials

- Magnetic and Electrical Stimulators
- Generation of motor evoked potentials
- Facilitation of motor evoked potentials
- Safety issues
- TMS Methodology-StimulationResponse recording
- MEP parameters-*Threshold of stimulation , Response latency,Amplitude*
- Contraindications
- Clinical Applications

C) Single-fiber electromyography (SFEMG)

- Introduction
- jitter
- Indications
- Contraindications
- Technique
- SFEMG studies in myasthenia gravis

D)Cognitive potentials and polygraph

- Introduction
- Technique
- Anatomical and physiological basis
- Clinical applications

- **E) Invasive EEG recordings**
- Subdural EEG electrodes
- Depth EEG electrodes
- Cortical stimulation
- Complications
- Contraindications
- Clinical applications

F) Polysomnogram

- Introduction
- Normal adult PSG
- Paediatric PSG
- Stages of sleep
- Waveform
  - K complex
  - POST
  - Sleep sprindles
  - VST
  - BETS
- Clinical condition
  - Apnea
    (a) Central
    (b) OSA
    (c) Mixed
  - Hypopnea
  - Parasomnias

G) Intra-operative brain and spinal cord monitoring.

- Intraoperative monitoring of Facial nerve
- Intraoperative monitoring of spinal cord
- Intraoperative monitoring of the brainstem
- Intraoperative monitoring for tethered cord syndrome

3. EXAMINATIONS

3.1 Eligibility for appearing for the examination:

First year and second year

Every candidate should have attended at least 80% of the total number of theory classes conducted in an academic year in each of the subjects prescribed for that year separately and availed only 20 leave from practical classes from the date of commencement of the term to the last working day as notified by University.

Third year

1. The candidate should produce a certificate from the Head of the Department certifying satisfactory completion of the course.
2. They shall produce a completed log book duly approved by the HOD.
3. Attendance**.** Every candidate should have attended at least 80% of the total number of theory classes and availed 20 only leave conducted in the academic year from the date of commencement of the term to the last working day as notified by University in each of the subjects. Only such candidates are eligible to appear for the university examinations in their first attempt.

3.2 Schedule of examination:

The University shall conduct one examination annually for first year and second year and two examinations annually for final year at an interval of not less than 6 months as notified by the University from time to time. A candidate who satisfies the criteria for eligibility for appearing for the examination as stipulated by the university shall appear for the University examination. Certificate of eligibility from the Head of the institution and the application for examination and the prescribed fee shall be submitted to the University.

3.3 Scheme of Examination

There shall be three examinations, one each at the end of I, II and III year

First and second year examination:

The University examination for first and second year shall consist only of theory examination and there shall be no university practical examination.

Third year examination:

The University examination for 3rd year shall consist of Written Examination, Practical and viva.

Written Examinations consists of

03 papers in the 1st year

03papers in the 2nd year

03 papers in the 3rd year

Practical examination:

Three practical examinations and viva at the end of the 3rd year

Practical 1. EEG VEEG Polysomnogram

Practical 2. NCS, proximal conduction studies, EMG.

Practical 3. Evoked potentials, NMJ studies

Internal Assessment:

To be conducted by the Institutions concerned at the end of each year

3.4 Distribution of marks

Theory (Each paper)

University exam - 100

Internal assessment – 20

Practicals (Each practical)

University exam - 100

Internal assessment – 20

Viva (Final year)

University exam - 80

log book - 20

Internal assessment – 20

Total marks

First year – 360

Second year – 360

Third year –

Theory 360

Practical and viva – 480

3.5 Training after completion of course:

- Duration of training - : one year
- During training, candidate will be posted in rotation in
- Electrophysiology lab, neuro ICU, Ward and OP.
- Duty time 8.00am to 8.00pm
- Night duties in sleep lab and electrophysiology lab in - rotation, if required by the department.