

# **AMERICAN BOARD OF CLINICAL NEUROPHYSIOLOGY**

## **Part I Content Outline**

### **I. Physiology and Instrumentation 30%**

- A. Physiology
  1. Anatomy of neural generation
  2. Mechanisms of EEG and evoked potential generation
  3. Pathophysiology of abnormal waveforms
  4. Basic mechanisms of epileptogenesis
- B. Instrumentation and Recording
  1. Basic electricity and electronics
  2. Amplifiers and their characteristics
  3. Calibration
  4. Filters
  5. Localization and polarity
  6. Artifacts
  7. Electrical safety
  8. Computers and principles of averaging
  9. Electrodes and their application
  10. Techniques of ECS determination
  11. Statistics
  12. Long term monitoring
  13. Instrumentation and safety in the operating room
  14. Principles of EEG digitalization

### **II. Clinical EEG 30%**

- A. Normal EEG
  1. Maturational changes (neonatal, etc.)
  2. Normal adult patterns-wake
  3. Normal sleep patterns
    - a. Neonatal
    - b. Child
    - c. Adult
  4. Normal variants
  5. Activation procedures
- B. Abnormal EEG
  1. Neonatal disorders
  2. Epileptiform abnormalities
  3. Seizures
    - a. Childhood

- b. Adulthood
- 4. Spells
- 5. Focal lesions of the CNS
- 6. Encephalopathy
- 7. Brain death and Electroencephalographic Inactivity
- 8. Drug and treatment effects

**III. EEG Recording Techniques** 10%

- A. Ambulatory EEG monitoring
- B. Video/EEG monitoring
- C. Critical Care EEG
  - 1. Coma
  - 2. Periodic Patterns
  - 3. Non-clinical seizures
  - d. Status Epilepticus
- D. EEG during surgery
  - 1. Indications and considerations
  - 2. Carotid endarterectomy
  - 3. Epilepsy
- E. Quantitative EEG

**V. Clinical Evoked Potentials** 10%

- A. Visual
  - 1. Criteria of abnormality
  - 2. Clinical correlation
- B. Auditory
  - 1. Criteria of abnormality
  - 2. Clinical correlation
- C. Somatosensory
  - 1. Criteria of abnormality
  - 2. Clinical correlation
- D. Event related
  - 1. Criteria of abnormality
  - 2. Clinical correlation
- E. Clinical Application in Demyelinating Disease
- F. Other monitoring

**VI. Basic Principals of Intraoperative Monitoring** 10%

- A. SEP monitoring of the spinal cord
- B. BAEP monitoring during brainstem surgery

- C. Motor evoked potential monitoring for spinal cord surgery
- D. Cranial nerve monitoring
  - a. Acoustic Neuromas
  - b. Facial nerve reconstruction

V. **Clinical Sleep** 10%

- A. Indications for PSG/MSLT
- B. Scoring of sleep stages and arousals
- C. Scoring of apneas and hypopneas
- D. Scoring of periodic leg movements
- E. Clinical significance of apnea-hypopnea index
- F. Clinical significance in MSLT of mean sleep latency and sleep-onset REM

## PART II EXAMINATION

### Epilepsy Monitoring Track Content Outline

The Epilepsy Monitoring Track will contain more case-based items and will incorporate video segments.

- I. **Correlation of interictal EEG with seizure type** 10%
  - A. Partial onset
  - B. Secondarily generalized
  - C. Primary generalized
    - 1. Convulsive
    - 2. Nonconvulsive
  
- II. **Identification of various patterns of ictal onset, propagation, and resolution along with their localizing significance in scalp recordings** 25%
  - A. Focal onset seizure
  - B. Generalized convulsive seizure
  - C. Generalized nonconvulsive seizure
  - D. Syndromes
    - 1. Hypsarrhythmia – electrodecremental seizures
    - 2. Lennox Gastaut syndrome
    - 3. Electrical SE during slow sleep
    - 4. Landau-Kleffner syndrome
  - E. Recognition of non-ictal events & patterns
    - 1. Artifacts
    - 2. Nonepileptic paroxysmal patterns

- F. Technical aspects
  - 1. Appropriate recording montages
  - 2. Use of additional electrodes (T1, T2, subtemporal chain, sphenoidals, etc.)
  - 2. Activation techniques
  - 3. Other approaches that may assist in event interpretation
  
- III. **Recognition of clinical manifestations of various seizure types, and their appropriate classification** 20%
  - A. Simple partial
  - B. Complex partial
    - 1. Automatism
    - 2. Lateralizing signs
    - 3. Localizing signs
  - C. Secondarily generalized
    - 1. Lateralizing signs
    - 2. Localizing signs
  - D. Primary generalized
    - 1. Convulsive
    - 2. Absence
  - E. Myoclonic
  - F. Atonic
  
- IV. **Identification and localization of neonatal seizures** 6%
  - A. Interictal EEG patterns
  - B. Ictal EEG patterns
    - 1. Focal
    - 2. Multifocal
  - C. Clinical manifestations
  
- V. **Recognition of behavioral features suggestive of non-epileptic events** 15%
  - A. Psychogenic
  - B. Syncope/Arrhythmia
  - C. Parasomnia
  - D. Other
  
- VI. **Planning and Interpretation of Intracranial Monitoring** 2%
  - A. Indications for intracranial monitoring
  - B. Choice of intracranial electrodes
    - 1. Subdural strips
    - 2. Grids
    - 3. Depth electrodes
    - 4. Stereo EEG
  - C. Interictal epileptiform activity
  - D. Ictal activity

1. Identification of seizure onset
2. Localization
3. Functional mapping with cortical stimulation
  - a. Intra-operative
  - b. Extra-operative

**VII. Evaluation of patients for epilepsy surgery** 12%

- A. EEG findings leading to
  1. Temporal lobectomy
  2. Corpus callosotomy
  3. Multiple subpial transection
  4. Neurostimulators
  5. Stereotactic ablation and other techniques
- B. EEG and the intracarotid amobarbital test (Wada)
- C. Intraoperative electrocorticography
  1. Uses
  2. Limitations
- D. Other diagnostic modalities
  1. ictal SPECT
  2. MEG
  3. EEG-fMRI
  4. PET-EEG

## **Neurophysiologic Intraoperative Monitoring Track Content Outline**

The NIOM Track will contain more complex multiple-choice questions focused on all aspects of Neurophysiologic Monitoring. Candidates will have three hours to complete 120 items.

**I. Basic NIOM techniques** 25%

- A. SEP
- B. MEP
- C. BAEP
- D. EEG
- E. ECoG
- F. EMG/NCS
- G. VEP
- H. Others

**II. Anatomy and physiology** 15%

- A. Cerebral cortex
- B. Subcortical structures
- C. Brainstem and cerebellum
- D. Ascending and descending pathways
- E. Cranial nerves

- F. Spinal cord
- G. Peripheral nerves, neuromuscular junction, muscles
- H. Vascular anatomy
- I. Head and neck
- J. Spine and other bones
- K. Cellular physiology
- L. Others

**III. Surgical procedures and NIOM (to include surgical technique and NIOM questions) 25%**

- A. Vertebral column surgery
- B. Spinal cord surgery
- C. Lumbosacral surgery
- D. Tethered cord surgery
- E. Peripheral nerve surgery
- F. CPA surgery
- G. Vascular surgery
- H. Cardiac and aortic surgery
- I. Epilepsy surgery
- J. Brain tumor surgery
- K. Posterior fossa decompression surgery
- L. Selective dorsal rhizotomy
- M. Pain surgery
- N. Movement disorders surgery
- O. Cranial nerve surgery
- P. Pelvic floor surgery
- Q. Hip surgery
- R. ENT surgery
- S. Other surgery

**IV. Anesthetic considerations 15%**

- A. SEP
- B. MEP
- C. BAEP
- D. EEG
- E. ECoG
- F. EMG/NCS
- G. VEP
- H. Anesthesia not modality related
- I. Others

**V. Operating room procedures 5%**

- A. Sterilization techniques
- B. OR equipment
- C. Anesthesia equipment
- D. Aseptic techniques/sterile field
- E. Imaging
- F. Communication

- VI. Equipment/Networking issues** 10%
- A. Electrodes
  - B. NIOM machines (incl. amplifiers, filters, averaging, electrical issues, etc)
  - C. Networking, remote access
  - D. Other/Ancillary equipment

- VII. Ethical and medicolegal issues** 5%
- A. ACNS guidelines
  - B. AANEM guidelines
  - C. AAN guidelines
  - D. Medicare rules for interpretation
  - E. Real time review issues
  - F. Other

## **Critical Care EEG Monitoring Content Outline**

- I. Terminology** 15%
- A. Standardized critical care EEG nomenclature
  - B. Periodic discharges and modifiers
  - C. Rhythmic delta activity and modifiers
  - D. Clinical correlation

- II. Technical aspects of recording** 5%
- A. Electrodes
  - B. Montages
  - C. Troubleshooting

- III. Background patterns** 15%
- A. EEG correlates of different types of encephalopathy
  - B. EEG continuity and reactivity
  - C. Medication effects

- IV. Artifacts** 10%
- A. Physiological
  - B. Non-physiological

- V. Quantitative EEG** 25%
- A. Basic principles of qEEG and trending
  - B. Clinical application
    - 1. Identification of seizures
    - 2. Identification of ischemia
    - 3. Recognition of artifacts

- VI. Indications for long term ICU EEG monitoring** 5%
- A. Seizures

- B. Cerebrovascular disease
  - C. Coma and altered consciousness
- VII. Seizures and status epilepticus** 15%
- D. Non-convulsive seizures
  - E. Status epilepticus
  - F. Ictal-interictal continuum
- VII. Hypoxic-ischemic brain injury** 10%
- A. Dynamic EEG changes
  - B. Prognosis

## **General Clinical Neurophysiology Content Outline**

The **General CNP track** will include short segments of neurophysiologic studies (EEG, evoked potentials, etc.), with one or more multiple-choice questions for each sample. Additional multiple choice questions will cover technical aspects of recording and clinical correlation.

- I. Electroencephalography** 50%
- A. Physiology of normal and abnormal waveforms
  - B. Instrumentation and acquisition procedures (include quantitative EEG)
  - C. Normal patterns of various ages in wake, drowsy, and sleep states
  - D. Neonatal normal and abnormal patterns
  - E. Activating procedures (hyperventilation, photic stimulation)
  - F. Drug effects
  - G. Focal abnormalities
  - H. Diffuse abnormalities
  - I. Coma and brain death
  - J. Epileptiform abnormalities
  - K. Benign EEG variants and patterns of unknown significance
  - L. Artifacts
- II. Epilepsy Monitoring** 25%
- A. Correlate interictal EEG with seizure type / epilepsy syndrome
  - B. Localization and propagation of epileptogenic foci (children, adults)
  - C. Correlation of behavioral and electrographic changes
  - D. Identify and localize neonatal seizures
  - E. Nonpileptic events (physiologic and psychogenic)
  - F. Plan and interpret intracranial monitoring
  - G. Evaluate patients for epilepsy surgery
- III. Evoked Potentials** 5%
- A. Visual evoked potentials (pattern reversal)
  - B. Brain stem auditory evoked potentials
  - C. Short latency somatosensory evoked potentials
    - a. Stimulus and recording techniques



- b. Criteria for identification of major waveform components
- c. Criteria for normal and abnormal evoked potentials for adults and children
- d. Presumed generator sources of major waveform components
- e. Clinical significance of various evoked potential abnormalities
- f. Technical and non-pathologic factors that influence evoked potentials and affect interpretation

**IV. Sleep** 10%

- A. Recognition of sleep stages
- B. Identification of examples showing the effects of age, physiological and environmental variables, and disease on sleep architecture
- C. Interpretation of multiple sleep latency studies
- D. Identification of polysomnographic findings in sleep-related disorders
- E. Montages, special instrumentation and other technological aspects of sleep studies

**V. Intraoperative Monitoring** 10%

- A. SEP monitoring for spinal cord, brainstem and cerebral surgery
- B. BAEP monitoring techniques for eighth nerve and brainstem surgery
- C. EEG monitoring for cerebral surgery
- D. Motor evoked potential monitoring for spinal cord surgery
- E. Cranial nerve monitoring
- F. Criteria for decision making

**American Board of Clinical Neurophysiology  
Recertification Content Outline**

**I. EEG** 45%

- A. Epileptiform
- B. Normal awake
- C. Normal sleep
- D. Artifacts
- E. Focal (non epileptiform) abnormalities
- F. Encephalopathy or coma
- G. Pediatric and neonate

**II. LTM** 15%

- A. Semiology
  - 1. Epileptic
  - 2. Non-epileptic
- B. Ictal EEG
  - 1. Epileptic
  - 2. Non-epileptic
- C. Intracranial EEG
- D. Presurgical Correlation
- E. Neonatal seizures

**III. Evoked Potentials** 15%

- A. VEP
  - 1. Normal
  - 2. Abnormal
- B. SSEP
  - 1. Normal
  - 2. Abnormal
- C. BAEP
  - 1. Normal
  - 2. Abnormal

**IV. Sleep** 15%

- A. PSG
  - 1. Normal / Staging
  - 2. Apneas
    - a. central
    - b. obstructive
    - c. mixed
  - 3. PLM
  - 4. Other
- B. MSLT

**V. Intraoperative Monitoring** 10%

- A. Spine
- B. Carotid
- C. Intracranial vascular
- D. Functional surgery, mapping
- E. CP angle cases
- F. IOM Anesthesia
- G. Billing/ethics/involvement