Jawaharlal Institute of Postgraduate Medical Education & Research

(JIPMER)

Puducherry

BSc Neurotechnology

CURRICULUM

2021

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This curriculum was approved at the 16th meeting of the Standing Academic Committee held on September 21, 2021 and will be applicable for students joining BSc (Allied Health Sciences) – Neurotechnology from the academic year 2021-22. The curriculum document was prepared based on the model curricula for allied health sciences courses issued by the Ministry of Health and Family Welfare, Government of India.

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About JIPMER

Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry (JIPMER) under Government of India since the year 1956, is one of the leading Medical Institutions of India. Spread over a sprawling 195-acre campus in an urban locale of Puducherry (formerly Pondicherry), JIPMER is 170 kms by road from Chennai.

JIPMER has been declared as an "Institution of National Importance" by an Act of Parliament, JIPMER, Puducherry, Act, 2008. A copy of the Act was Gazette notified on 14-7-2008 to enforce this Act. Prior to this, the Institute was functioning under the administrative control of Directorate General of Health Services, Ministry of Health and Family Welfare, New Delhi. The Institution is now empowered to award Medical Degrees under the clauses 23 & 24 of the said Act. Such Degrees shall be deemed to be included in the schedules to the respective Acts governing Medical Council of India/National Medical Commission, Indian Nursing Council, and Dental Council of India, entitling the holders to the same privileges as those attached to the equivalent awards from the recognized Universities of India.

JIPMER imparts Undergraduate (UG), Postgraduate (PG) and Super Specialty Medical Training through a large hospital complex (JIPMER Hospital) and a Nursing College. Some of the courses offered are MBBS, BSc, MSc, MD, MS, DM, and MCh courses. Full-time Ph.D. programs are available in several disciplines.

About the Department of Neurology

Neurology department which was started in 1986 moved to its current premises in Super Specialty block in 2009. Department conducts DM Neurology, PDF in comprehensive epilepsy care, stroke management BSc Neurotechnology, MSc Neurotechnology and PhD courses. Apart from general Neurology/degenerative disease clinics the department runs subspecialty clinics such as Stroke, Epilepsy, and Neuromuscular clinic.

These clinics have the highest patient attendance in JIPMER. Department has a stroke and acute neurology intensive Care Unit with 6 beds, a 20 bedded general ward, and 3 special ward beds. In addition we have a stroke recovery ward with rehabilitation facilities and an epilepsy monitoring unit, each with 4 beds. The department of Neurology is spearheading acute stroke care offering thrombolysis (so far 151 patients) and carotid intervention programs including stenting (so far 12 patients), and an epilepsy surgery program in collaboration with departments of Neurosurgery and Radiology (30 patients to date). State of the art equipment such as Cerebrovascular Dopplers, EEG, Video-EEG, Polysomnography, ENMG-EP, Tilt-table/Autonomic Nervous system lab, Computerized Cognitive battery, VNG and basic clinical Neurobiology lab facilities like Microscope, Centrifuge, Deep freezer, ELISA reader, immunoblot, Autoclave, Laminar Air flow (Bio safety cabinet) and Nano Spectrophotometer are available in the department for patient care services and research. In addition to these we also have a Neurobionics facility with neurostimulation equipment (TMS and tDCS), and Functional Electrical stimulation.

Other special neurorehabilitation services are also available like Robotic Motomed physiotherapy, Motomed arm rehabilitation system, Tyromotion balance system, Action Research arm training, Music therapy and mirror therapy. Recently a state-of-the-art Clinical clinical Neurobiology lab has also been established with Neuronal and Stemcell culture facility, with biosafety cabinet, Laminar Air flow, CO2 incubator and Phase contrast Microscope; basic Genetic and Proteomics lab with Millipore water purification system, Cooling Centrifuge, PCR, Gel Electrophoresis, Gel documentation system, Spectrophotometer, Western blot, ELISA reader and Deep freezers, refrigerator, microwave oven, water baths, shakers and mixers, centrifuges, precision weighing system, autoclave, and an immunoblot, with SERB, DBT and JIPMER funding for advanced research. In the ICU, we have a point-of-care INR and a Blood gas analyser as well.

The Department uniquely provides a blend of mutually enriching clinical and basic sciences training in Neurosciences through a comprehensive teaching courses and research programmes including post doctoral clinical fellowship and research opportunities, under the umbrella of Department of Neurology, which a unique model in the country, spearheaded by faculty trained in national and international centres of excellence.

COURSE DETAILS

Nomenclature: BSc (Allied Health Sciences) – Neurotechnology

Introduction:

Modern neurological practice is increasingly dependent on an array of technological investigations that requires meticulous technical expertise and sound theoretical knowledge. From electroencephalography to nerve conduction studies and polysomnography these techniques are highly labour intensive and versatile. Neurobionics is a closely linked subspecialty of Neurology which aims to develop technology involving electronic man-machine interfaces in neuro-therapeutics.

The manpower demand is mostly met by personnel trained on ad hoc basis with neither the theoretical grounding nor the technical precision demanded by these tests. This makes these investigations variable in their results and substandard about their investigational value. Also, lack of proper certification courses in these disciplines makes the technicians unable to keep abreast with rapid expansion in the knowledge and techniques. This also curtails the scope of local research and technological innovation. While most technologically developed nations have instituted certification courses in each of these disciplines and have special board of studies such as American Bard of EEG and EMG technology, in India very few institutions like JIPMER provide BSc program with rigorous and dedicated training in the field of neurotechnology.

Learning Objectives of the course:

BSc Neurotechnology course is developed to impart comprehensive knowledge and technological expertise in the field by using the varied and rich resources available in JIPMER

Course Overview:

BSc (Allied Health Sciences) – Neurotechnology is a four-year course with three-year academic program divided into three phases of one year each and one year compulsory internship period.

First phase: one year

In addition to the subjects of foundation course, Anatomy, and Physiology, students will learn the basic concepts in areas such as Biochemistry, Biomedical sciences, and introductory concepts of neurotechnology

Second phase: one year

In the Second phase, the students will learn basic neurosciences and clinical neurophysiology. The students will also be trained in biomedical instrumentation and neuroimaging.

Third phase: one year

In the Third phase, the students will learn advanced and therapeutic neurophysiology and they will be trained in various neurotechniques. They will also assist the technologists in neurotechnological procedures. In addition, the students will also get trained in neurophysiology in special situations.

Internship: one year

Internship of one year is compulsory. The interns will be given hands-on training in various neurotechnology procedures in various clinical labs. They will also be trained to do independently neurophysiological investigations

Expectation from the future graduate

After completion of the course, the graduates will be able to meet all the demands for neurophysiological investigations in a neurological practice. It is designed not only to impart technical know-how with the theoretical background, but also as a basic degree that could qualify for further master's and doctoral degrees in these fields.

Available postgraduate programmes in India

MSc Neurotechnology is offered only by JIPMER. However our graduates are welcomed in various post graduate programmes in allied areas such as cognitive neurosciences, basic neurosciences, physiology etc. Such programmes are offered in various universities in India and abroad. In addition there are post graduate diploma and certificate courses available in areas like intra-operative monitoring.

Job profile

On completion of the programme, graduates independently manage neurophysiology lab performing a wide variety of neurophysiological investigations like EEG, Nerve conduction studies, evoked potentials, Transcranial Doppler, Long term EEG monitoring etc.

Job opportunities India and abroad (for internal discussion only)

Job opportunities on completion of graduation are mainly in centres where they cater to neurological or neurosurgical patients. Most of these investigations abroad require certification except in middle east where they can work in this area.

Eligibility for the course:

- The Applicant should be an **Indian National.**
- He/she should have completed **17 years** at the time of application cut-off date.
- There is **no upper age limit.**

The applicants should have passed the qualifying examinations in the manner mentioned below:

- The Higher / Senior Secondary Examination or the Indian School Certificate Examination which is equivalent to 10+2 Higher/Senior Secondary Examination after a period of 12 years study, the last two years of such study comprising Physics, Chemistry, Biology/ Botany & Zoology (which shall include practical tests in these subjects) and with English as a subject.
- The applicant must have passed in the subjects of Physics, Chemistry, Biology/Botany & Zoology and English individually and must have obtained a minimum of 50% marks taken together in Physics, Chemistry, Biology/Botany & Zoology at the qualifying examination
- Candidates belonging to the Scheduled Castes/Scheduled Tribe or Other Backward Classes must have obtained a minimum of 40% marks in the subjects of Physics, Chemistry, Biology / Botany & Zoology taken together in the qualifying examination.
- For PwD candidates in general and EWS categories, the minimum marks in Physics, Chemistry, Biology/ Botany & Zoology taken together in the qualifying examination is 45%.

Candidates intake per year:

Five candidates will be admitted to the course every year. There is no provision for sponsored / nominated candidates.

Duration of the course

4 years (48 months) duration including 3 years of classes and one year of compulsory internship.

Medium of instruction:

English

Vacation:

Students will be eligible for 4 weeks of vacation in summer and 2 weeks in winter.

Subject details:

Phase	Paper	Title of the paper
I	I	Foundation Course (T & P)
	II	Anatomy and Physiology (T & P)
	III	Pathology and Microbiology (T)
	IV	Introduction to Neurotechnology (T & P)
II	I	Basic neurosciences (T & P)
	II	Biomedical instrumentation and Neuroimaging (T & P)
	III	Clinical Neurophysiology (T & P)
III	I	Advanced Neurophysiology (T & P)
	II	Neurophysiology in special situations (T & P)
	III	Therapeutic Neurophysiology (T & P)
IV	**Internship period**	

T- Theory, P- Practical

Teaching hours:

Phase	Subject	Theory	Practical	Others
I	Foundation course	80	40	
	Anatomy	60	180	
	Physiology	60	180	
	Pathology	40		
	Microbiology	40		
	Introduction to Neurotechnology	60	280	
	Self-study/Library			60
	Total			**1080**
II	Basic neurosciences	60	280	
	Biomedical instrumentation and Neuroimaging	60	280	
	Clinical Neurophysiology	60	280	
	Self-study/Library			60
	Total			**1080**
III	Clinical Neurophysiology	60	280	
	Neurophysiology in special situations	60	280	
	Therapeutic Neurophysiology	60	280	
	Self-study/Library			60
	Total			**1080**
IV	Internship			

SYLLABUS

Phase I

Paper I: Foundation course

Theory:

Introduction to National Healthcare System

The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world. Topics to be covered under the subject are as follows:

1. Introduction to healthcare delivery system

   a. Healthcare delivery system in India at primary, secondary and tertiary care
   b. Community participation in healthcare delivery system
   c. Health system in developed countries.
   d. Private Sector
   e. National Health Mission
   f. National Health Policy
   g. Issues in Health Care Delivery System in India

2. National Health Programme- Background objectives, action plan, targets, operations, achievements, and constraints in various National Heath Programme.

3. Introduction to AYUSH system of medicine

   a. Introduction to Ayurveda.
   b. Yoga and Naturopathy
   c. Unani
   d. Siddha
   e. Homeopathy
   f. Need for integration of various system of medicine

4. Health scenario of India- past, present, and future

5. Demography & Vital Statistics-

   a. Demography – its concept
   b. Vital events of life & its impact on demography
   c. Significance and recording of vital statistics
   d. Census & its impact on health policy

6. Epidemiology

   a. Principles of Epidemiology
   b. Natural History of disease
   c. Methods of Epidemiological studies

d. Epidemiology of communicable & non-communicable diseases, disease transmission, host defence immunizing agents, cold chain, immunization, disease monitoring and surveillance.

Medical terminologies and record keeping

This course introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes, and suffixes. Topics include origin, word building, abbreviations and symbols, terminology related to the human anatomy, reading medical orders and reports, and terminology specific to the student's field of study. Spelling is critical and will be counted when grading tests.25 Topics to be covered under the subject are as follows:

1. Derivation of medical terms.
2. Define word roots, prefixes, and suffixes.
3. Conventions for combined morphemes and the formation of plurals.
4. Basic medical terms.
5. Form medical terms utilizing roots, suffixes, prefixes, and combining roots.
6. Interpret basic medical abbreviations/symbols.
7. Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.
8. Interpret medical orders/reports.
9. Data entry and management on electronic health record system.

Basic computers and information science

The students will be able to appreciate the role of computer technology. The course has focus on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation. Topics to be covered under the subject are as follows:

1. Introduction to computer: Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages.

2. Input output devices: Input devices (keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices (monitors, pointers, plotters, screen image projector, voice response systems).

3. Processor and memory: The Central Processing Unit (CPU), main memory.

4. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.

5. Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing, and maximizing, etc.).

6. Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.

7. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.

8. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.

9. Introduction of Operating System: introduction, operating system concepts, types of operating system.

10. Computer networks: introduction, types of networks (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.

11. Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.

12. Application of Computers in clinical settings.

Medical law and ethics

Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical sciences, growing sophistication of the modern society’s legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice.26

Medical ethics has developed into a well based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analysing, and attempting to resolve the ethical problems that arise in practice".26 Doctors are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice across the whole spectrum. Few of the important and relevant topics that need to focus on are as follows:

1. Medical ethics - Definition - Goal - Scope

2. Introduction to Code of conduct

3. Basic principles of medical ethics – Confidentiality

4. Malpractice and negligence - Rational and irrational drug therapy

5. Autonomy and informed consent - Right of patients

6. Care of the terminally ill- Euthanasia

7. Organ transplantation

8. Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege

communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.

9. Professional Indemnity insurance policy

10. Development of standardized protocol to avoid near miss or sentinel events

11. Obtaining an informed consent.

Communication and soft skills

Major topics to be covered under Communication course –

1. Basic Language Skills: Grammar and Usage.

2. Business Communication Skills. With focus on speaking - Conversations, discussions, dialogues, short presentations, pronunciation.

3. Teaching the different methods of writing like letters, E-mails, report, case study, collecting the patient data etc. Basic compositions, journals, with a focus on paragraph form and organization.

4. Basic concepts & principles of good communication

5. Special characteristics of health communication

6. Types & process of communication

7. Barriers of communication & how to overcome

Introduction to Quality and patient safety

1. Quality assurance and management - The objective of the course is to help students understand the basic concepts of quality in health Care and develop skills to implement sustainable quality assurance program in the health system.

a. Concepts of Quality of Care

b. Quality Improvement Approaches

c. Standards and Norms

d. Quality Improvement Tools

e. Introduction to NABH guidelines

2. Basics of emergency care and life support skills - Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA) and activation of the emergency

response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED). Initial recognition and response to heart attack and stroke are also considered part of BLS. The student is also expected to learn about basic emergency care including first aid and triage. Topics to be covered under the subject are as follows:

a. Vital signs and primary assessment

b. Basic emergency care – first aid and triage

c. Ventilations including use of bag-valve-masks (BVMs)

d. Choking, rescue breathing methods

e. One- and Two-rescuer CPR

f. Using an AED (Automated external defibrillator).

g. Managing an emergency including moving a patient

At the end of this topic, focus should be to teach the students to perform the manoeuvres in simulation lab and to test their skills with focus on airways management and chest compressions. At the end of the foundation course, each student should be able to perform and execute/operate on the above-mentioned modalities.

3. Bio medical waste management and environment safety- The aim of this section will be to help prevent harm to workers, property, the environment, and the general public. Topics to be covered under the subject are as follows:

a. Definition of Biomedical Waste

b. Waste minimization

c. BMW – Segregation, collection, transportation, treatment, and disposal (including colour coding)

d. Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste

e. BMW Management & methods of disinfection

f. Modern technology for handling BMW

g. Use of Personal protective equipment (PPE)

h. Monitoring & controlling of cross infection (Protective devices)

4. Infection prevention and control - The objective of this section will be to provide a broad understanding of the core subject areas of infection prevention and control and to equip AHPs with the fundamental skills required to reduce the incidence of hospital acquired infections and improve health outcomes. Concepts taught should include –

a. Evidence-based infection control principles and practices [such as sterilization, disinfection, effective hand hygiene and use of Personal protective equipment (PPE)],

b. Prevention & control of common healthcare associated infections,

c. Components of an effective infection control program, and

d. Guidelines (NABH and JCI) for Hospital Infection Control

5. Antibiotic Resistance-

a. History of Antibiotics

b. How Resistance Happens and Spreads

c. Types of resistance- Intrinsic, Acquired, Passive

d. Trends in Drug Resistance

e. Actions to Fight Resistance

f. Bacterial persistence

g. Antibiotic sensitivity

h. Consequences of antibiotic resistance

i. Antimicrobial Stewardship- Barriers and opportunities, Tools and models in hospitals

6. Disaster preparedness and management- The objective of this section will be to provide knowledge on the principles of on-site disaster management. Concepts to be taught should include-

a. Fundamentals of emergency management,

b. Psychological impact management,

c. Resource management,

d. Preparedness and risk reduction,

e. Key response functions (including public health, logistics and governance, recovery, rehabilitation, and reconstruction), information management, incident command and institutional mechanisms.

Professionalism and values

The module on professionalism will deliver the concept of what it means to be a professional and how a specialized profession is different from a usual vocation. It also explains how relevant professionalism in terms of healthcare system is and how it affects the overall patient environment.

1. Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality

2. Personal values- ethical or moral values

3. Attitude and behaviour- professional behaviour, treating people equally

4. Code of conduct, professional accountability and responsibility, misconduct

5. Differences between professions and importance of team efforts

6. Cultural issues in the healthcare environment

Research Methodology and Biostatistics

The objective of this module is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings.

1. Introduction to research methods
2. Identifying research problem
3. Ethical issues in research
4. Research design
5. Basic Concepts of Biostatistics
6. Types of Data
7. Research tools and Data collection methods
8. Sampling methods
9. Developing a research proposal

Principles of Management

The course is intended to provide a knowledge about the basic principles of Management.

1. Introduction to management
2. Strategic Management
3. Foundations of Planning
4. Planning Tools and Techniques
5. Decision Making, conflict and stress management
6. Managing Change and Innovation
7. Understanding Groups and Teams
8. Leadership
9. Time Management
10. Cost and efficiency

Community orientation and clinical visit

The objective of this section of the foundation course is to sensitize potential learners with essential knowledge; this will lay a sound foundation for their learning across the under-graduate program and across their career. Innovative teaching methods should be used to

ensure the attention of a student and make them more receptive such as group activities, interactive fora, role plays, and clinical bed-side demonstrations.

1. The community orientation and clinical visit will include visit to the entire chain of healthcare delivery system -Sub centre, PHC, CHC, SDH, DH and Medical College, private hospitals, dispensaries, and clinics.

2. The student will also be briefed regarding governance at village level including interaction and group discussion with village panchayat and front-line health workers.

3. Clinical visit to their respective professional department within the hospital.

Practical:

Fundamentals of computers

1. Learning to use MS office: MS word, MS PowerPoint, MS Excel

2. To install different software.

3. Data entry efficiency

Paper II: Anatomy and Physiology

Gross anatomy and Histology

Theory:

General Anatomy:

Introduction – Anatomical terms, position, movements; epithelium – classification, structure & examples; Tissues – classification and structure; skin – structure, thick and thin skin; cartilage – types, structure, hyaline, elastic, and white fibrocartilage; bones – classification, structure, growth; muscles - classification & structure; glands - classification & structure.

Musculoskeletal system:

Axial and appendicular skeleton – muscle groups and regions muscles with action.

Cardiovascular and lymphatic system:

Structure of pericardium, heart & major blood vessels – arteries, veins, and lymphatic system – classification and structure of lymphoid organs – thymus, spleen, lymph node, tonsil, and major lymphatic vessels.

Respiratory system:

Parts of respiratory system, structure of external nose, paranasal air sinuses, nasal cavity, nasopharynx, larynx, trachea, pleura, lungs & diaphragm.

Gastrointestinal system:

Parts of gastrointestinal system, salivary glands, oral cavity, oropharynx and laryngopharynx, esophagus, stomach, small intestine, large intestine, liver, gallbladder, extrahepatic biliary apparatus, and pancreas.

Excretory system:

Parts of excretory system – structure of kidney, ureter, urinary bladder & urethra.

Male and female reproductive systems:

Structure & parts of male reproductive system, external genitalia, testis, epididymis, vasdeferens, seminal vesicle and prostate.

Structure & parts of female reproductive system, uterus, ovary, fallopian tubes, and mammary gland

Endocrine system:

Location & structure of thyroid, parathyroid, pituitary, adrenal glands.

Special senses:

Structure of eyeball, external, middle & internal ear, and papillae of tongue.

Nervous system:

Neuron, neuroglia, classification, autonomic nervous system, meninges, parts of

brain, cerebrum, cerebellum, basal nuclei, limbic system, thalamus, hypothalamus, spinal cord, circulation of cerebrospinal fluid.

Histology:

General histology:

Microscopy – Types of microscopes, parts of microscope, cleaning, and maintenance of microscope.

Microscopic features of

1. Cartilages
   1.1 Hyaline,
   1.2 Elastic
   1.3 White fibro cartilages
2. Bones
   2.1 Longitudinal section of compact bone
   2.2 Cross section of compact bone
3. Muscles
   3.1 Skeletal muscle
   3.2 Cardiac muscle
4. Glands
   4.1 Serous gland
   4.2 Mucous gland
   4.3 Mixed gland
5. Blood vessels
   5.1 Medium sized artery
   5.2 Large sized artery
   5.3 Medium sized vein
   5.4 Large sized vein
6. Nervous tissue
   6.1 Peripheral nerve H & E stain
   6.2 Peripheral nerve Osmic acid stain
   6.3 Dorsal root (spinal) ganglia
   6.4 Autonomic ganglia
7. Lymphoid organs
   7.1 Thymus
   7.2 Lymph node
   7.3 Spleen
   7.4 Tonsil
8. Skin
   8.1 Thick skin
   8.2 Thin skin

Practical: Anatomy (Gross anatomy and Histology)

1. Demonstration of bones

2. Demonstration of various parts of body
3. Demonstration of parts of digestive system
4. Demonstration of parts of respiratory system
5. Demonstration of parts of reproductive system
6. Demonstration of parts of excretory system
7. Demonstration of various parts of circulatory system
8. Demonstration of various parts of nervous system
9. General histology slides

Textbooks Recommended (Latest edition):

General anatomy:

1. Handbook of General Anatomy – B.D. Chaurasia - CBS Publishers

Systemic Anatomy:

1. Textbook of Anatomy – Vishram Singh – Elsevier
2. B.D. Chaurasia's Human Anatomy – CBS Publishers
3. Manipal Manual of Anatomy for Allied Health Science Courses

Histology:

1. Textbook of Human Histology: With Color Atlas 3D Illustrations – Dr. Yogesh Sontakke
2. Textbook of Histology - A Practical guide – Dr. J. P Gunasegaran
3. Di Fiore's Atlas of Histology – Eroschenko – Lippincott Williams & Wilkins

Reference textbook:

Gray's Anatomy: The Anatomical Basis of Clinical Practice – Susan Standring – Elsevier

Physiology

Theory:

1. **General Physiology**
   a. Principle of homeostasis
   b. Cell membrane, cell organelles, intercellular junctions
   c. Transport across cell membrane
   d. Body fluids: Classification of body fluid compartments, ionic composition, measurement
   e. Resting membrane potential

2. **Blood**
   a. Composition of blood
   b. Plasma proteins: classification and functions
   c. RBC: development, morphology, counts, functions and dysfunctions

d. Hemoglobin: types, structure, synthesis, function, degradation, anemia
e. WBC: development, classification, morphology, counts, functions and dysfunctions
f. Immunity: definition, classification, Innate, Cellular and Humoral Immunity
g. Platelets: morphology, counts, development, functions and dysfunctions
h. Blood coagulation: clotting factors, mechanism, dysfunctions
i. Anticoagulants
j. Blood grouping: classification, cross matching, blood transfusion, Rh factor and incompatibility

3. Nerve

a. Structure, function, classification of neurons
b. Neuronal action potential: ionic basis and properties
c. Conduction of nerve impulses
d. Nerve Injuries
e. Neuromuscular junction: structure, mechanism of transmission & applied aspects

4. Muscle

a. Structure of skeletal muscle & sarcotubular system
b. Mechanism of contraction and relaxation of skeletal muscle
c. Isotonic and isometric contraction
d. Properties of skeletal muscle
e. Smooth muscle: structure, properties, and mechanism of contraction
f. Differences between skeletal, smooth, and cardiac muscles

5. Autonomic nervous system

a. Divisions and functions

6. Gastrointestinal (GI) system

a. Functional anatomy of GIT
b. Gastrointestinal hormones
c. Principles & Functions of GI secretions, applied aspects
d. Movements of GIT, applied aspects

7. Endocrine system

Hormones, actions, and dysfunctions of various endocrine glands:

a. Hypothalamus
b. Pituitary
c. Thyroid
d. Parathyroid and hormones involved in calcium homeostasis
e. Adrenal gland
f. Endocrine pancreas

8. Reproductive System

a. Male and female gametogenesis
b. Structure and function of male reproductive system
c. Structure of female reproductive system, menstrual cycle, pregnancy, parturition, lactation
d. Contraceptives

9. Kidney

a. Structure & function of kidney, structure of nephron, composition of urine
b. Glomerular filtration rate: definition, values, regulation and measurement
c. Mechanism of urine formation: tubular functions, concentration of urine, acidification of urine
d. Micturition reflex
e. Diuretics
f. Dialysis

10. Cardiovascular system

a. Functional anatomy of heart
b. Circulatory system: arterial, venous, capillary circulation
c. Structure and properties of cardiac muscle
d. Electrophysiology of heart and conduction of impulse
e. ECG: waveforms and physiological basis
f. Cardiac cycle, heart sounds, Jugular venous pulse
g. Stroke volume, heart rate, cardiac output – definition, normal values and their regulation
h. Blood pressure and regulation
i. Coronary circulation
j. Lymphatic circulation
k. Applied aspects: shock, hypertension, hypotension, tachycardia, bradycardia, heart failure

11. Respiratory system

a. Functional anatomy of respiratory system
b. Mechanics of breathing, lung volumes and capacities, compliance, surfactant
c. Alveolar ventilation, dead space, pulmonary circulation, ventilation-perfusion ratio
d. Diffusion and gas exchange
e. Transport of oxygen and carbon dioxide
f. Brief account of respiratory regulation
g. Acclimatization, definition & types of hypoxia, oxygen therapy, cyanosis, asphyxia.
h. Methods of artificial respiration

12. Central nervous system

a. Parts and functions of brain and spinal cord
b. Sensory system: receptors and ascending pathways
c. Motor system: motor neurons, motor units, muscle spindle, stretch reflex, and descending tracts with emphasis on corticospinal tract
d. Cerebellum- functional anatomy, functions, and dysfunctions
e. Basal ganglia- functional anatomy, functions, and dysfunctions
f. Functions of hypothalamus
g. Functions of Thalamus
h. Types of sleep and EEG

i. Cerebrospinal fluid
j. Higher functions: types of memory, centers of speech, types of aphasia in brief, Cerebral cortex-lobes and functions
k. Blood-brain barrier

13. Special senses

a. Vision: Components of visual apparatus, visual acuity, color vision, accommodation, errors of refraction, visual pathway, pupillary reflexes
b. Hearing: External, middle ear, inner ear and their functions, auditory pathway, hearing tests.
c. Taste – receptors and pathway
d. smell: receptors and pathway

14. Integrative Physiology

a. Structure and functions of skin
b. Regulation of temperature

Practical: Physiology

1. Hematology

a. Methods of collection of blood
b. Microscopy
c. Haemocytometry
d. Total RBC count
e. Estimation of haemoglobin
f. Calculation of blood indices
g. Demonstration of osmotic fragility of red blood cells
h. Determination of ESR
i. Total leucocyte count
j. Absolute eosinophil count
k. Peripheral blood smear
l. Differential leukocyte count
m. Arneth count
n. Determination of blood group
o. Bleeding time, Clotting time
p. Demonstration of reticulocyte count
q. Demonstration of platelet count
r. Demonstration of PCV

2. Clinical

a. General physical examination
b. Clinical examination of Radial pulse
c. Determination of blood pressure
d. Recording of Electrocardiogram
e. Examination of cardiovascular system

f. Examination of respiratory system
g. Demonstration of spirometry
h. Determination of vital capacity and effect of posture of vital capacity
i. Examination of sensory system
j. Examination of motor system
k. Visual acuity
l. Color vision
m. Pupillary reflexes
n. Perimetry
o. Tests of hearing
p. Mosso'sergography

Textbooks recommended: (Latest edition)

1. Textbook of Medical Physiology by G.K. Pal (Theory)
2. Textbook of Practical Physiology by G.K. Pal & Pravati Pal (Practical)

Teaching learning methodology:

The course content in Physiology will be covered by:

1. Interactive Lectures
2. Group Discussions
3. Practical classes & demonstrations
4. Seminars
5. Assignments

Paper III: Pathology and Microbiology

Pathology

The Pathology syllabus introduces the principles of **Pathology** with emphasis on applied aspects of Pathology particularly in the following areas:

1. Collection and dispatch of specimens for routine pathological investigations
2. Common routine pathology tests
3. General concepts of Pathology
4. Laboratory diagnosis of common pathological conditions
5. Systemic Pathology
6. Applied Surgical Pathology, cytopathology, hematopathology, renal pathology and neuropathology

Theory:

1. Adaptations, cell injury and repair

a. Hyperplasia,
b. hypertrophy,
c. atrophy,
d. metaplasia,
e. Necrosis and
f. Apoptosis

2. Acute and chronic inflammation

a. Cardinal signs of inflammation
b. Outcomes of acute inflammation
c. Chronic inflammation
d. Granulomatous inflammation
e. Acute phase proteins

3. Tissue repair, regeneration, and hemodynamic disorders

a. Cutaneous wound healing
b. Pathological aspects of repair
c. Hyperaemia and congestion
d. Thrombosis and Virchow triad
e. Embolism, infarction, and shock

4. Disorders of immune system

a. Types of hypersensitivity reactions
b. Autoimmune diseases

5. Neoplasia

a. Definition of neoplasia.
b. Differences between benign and malignant tumours
c. Metastasis

d. Carcinogenesis – causes

6. Applied general pathology related to transfusion medicine

a. ABO blood group & Rh system (terminologies)
b. Principles of blood grouping and cross matching
c. Shelf life of stored blood
d. Anticoagulants used for storing blood and temperature for storage

7. RBC, WBC, and bleeding disorders

a. Anaemia – definition and classification
b. Iron deficiency anaemia and haemolytic anaemia
c. Leukocytosis and leukaemia
d. Causes of splenomegaly
e. Thrombocytopenia and coagulation disorders
f. Phlebotomy, haemoglobin estimation, peripheral smear examination, bleeding time, PT and APTT

8. Disorders of GI tract, liver, biliary tract, and pancreas

a. Causes of peptic ulcer, carcinoma stomach, intestinal obstruction, acute appendicitis, and colonic carcinoma
b. Jaundice – classification based on pathophysiology
c. Cirrhosis – definition and causes
d. Hepatitis – types and mode of transmission
e. Portal hypertension and hepatic failure

9. Blood vessels, heart, and lung diseases

a. Risk factors for atherosclerosis and their classification
b. Hypertension – definition and causes
c. Varicose veins, thrombophlebitis and phlebothrombosis
d. Congenital heart disease and heart failure
e. Myocardial infarction and cor-pulmonale
f. Rheumatic heart disease
g. Chronic obstructive airway disease
h. Asthma, pneumonia, and lung carcinoma

10. The kidney and lower urinary tract, male and female genital tract

a. Acute and chronic renal failure
b. Nephrotic and nephritis syndrome
c. Acute tubular necrosis and urolithiasis
d. Carcinoma penis, testicular tumours, and prostatic hyperplasia
e. Endometriosis, adenomyosis and leiomyoma

11. Endocrine and nervous system

a. Diagnostic criteria, types, and complications of diabetic mellitus
b. Intracerebral, subarachnoid, and subdural haemorrhage

c. Meningitis and encephalitis
d. Epilepsy and CNS tumours

12. Applied Surgical Pathology & Cytopathology, renal pathology, and neuropathology

a. Histopathology techniques
b. Fine needle aspiration cytology and imprint cytology
c. Basic terminologies of surgical specimens
d. Urine analysis and renal biopsy
e. CSF cytology, nerve and muscle biopsy, squash cytology

Textbooks recommended (latest edition)**:**

1. Illustrated Pathology – McFarlen
2. Essentials of Rubin's Pathology
3. Basic Pathology by Robbins
4. General and systemic Pathology – Underwood and Cross

Teaching and Learning methodology

Mostly will be didactic lectures with tutorials.

Microbiology

The Microbiology syllabus introduces the principles of **Microbiology** with emphasis on applied aspects of Microbiology of infectious diseases particularly in the following areas

1. Universal and Standard precaution.
2. Collection and dispatch of specimens for routine microbiological investigations.
3. Common routine serological tests
4. General concept of infection
5. Common Bacteriological, Viral, Fungal, Parasitic infection and Laboratory diagnosis
6. Nosocomial infection
7. Biomedical waste management
8. Vaccine

Theory:

Introduction and Morphology

Introduction of microbiology, Classification of microorganisms, size, shape and structure of bacteria. Use of microscope in the study of bacteria.

Growth and Nutrition

Nutrition, Culture media, Types of medium with example and uses of culture media in diagnostic bacteriology, antimicrobial sensitivity test.

Sterilisation and Disinfection

Principles and use of equipment of sterilization namely Hot Air oven, Autoclave and serum inspissator. Pasteurization, Anti septic and disinfectants.

Immunology

Immunity, Types of Immunity, Vaccines, Types of Vaccine and immunization schedule. Principles and interpretation of commonly done serological tests namely Widal, VDRL, ASLO, ELISA, Rapid tests for HIV and HbsAg

Systematic Bacteriology

Morphology, diseases caused, laboratory diagnosis including specimen collection of the following bacteria (the classification, antigenic structure and pathogenicity are not to be taught) Staphylococci, Streptococci, Pneumococci, Gonococci, Meningococci, C. diphtheriae, Mycobacterium tuberculosis, Clostridium spp., Bacillus spp., Shigella spp., Salmonella spp., Escherichia coli, Klebsiella spp., Proteus spp., Vibrio cholera, Pseudomonas spp. & Spirochaetes

Parasitology

Morphology, life cycle, laboratory diagnosis of following parasites E. histolytica, Plasmodium spp., Tapeworms, Intestinal nematodes, Filariasis

Mycology

Morphology, diseases caused, laboratory diagnosis of following fungi. Candida, Cryptococcus, opportunistic fungi

Virology

General properties of viruses, diseases caused, lab diagnosis and prevention of following viruses, Herpes, Hepatitis, HIV, Rabies and Poliomyelitis

Hospital Infection

Causative agents, transmission methods, investigation, prevention and control Hospital infection, Universal precaution, Standard precaution

Principles And Practice Biomedical Waste Management

Applied Microbiology

Causative agents, Sample collection and Laboratory diagnosis

Gastrointestinal infections, Nosocomial infections, Urinary tract infections, Respiratory tract infections, Pyogenic Meningitis, Food borne infections, Vector borne infections, Blood borne infections, Aerosol borne infections.

Textbooks recommended (latest editions):

1. CP. Baveja. Textbook of Microbiology for nurses. Arya Publishing Company.
2. RL Ichhpujani, Rajesh Bhatia. Essentials of Medical Microbiology. Jaypee Brothers Medical Pub (p) Ltd.
3. Seema Sood. Microbiology for Nursing Students & Nurses. Elsevier India Pvt.Ltd.
4. Satish Gupte. Short Textbook of Medical Microbiology. Jaypee Brothers Medical Pub (p) Ltd.
5. CK Jayaram Paniker, Ananthanarayan R. Textbook of Microbiology for nurses. Publisher Universities Press (India) Limited.
6. B.S.Nagoba. Clinical Microbiology. Bi Publications Pvt Ltd.
7. Clint E Carter, Burton J Bogitsh, Thomas N Oeltmann. Human Parasitology. Publisher Elsevier India Pvt. Ltd.

Paper IV: Introduction to Neurotechnology

Section A: Introduction to Neurotechnology

- History of neurosciences
- Introduction of neurotechniques
- Introduction to various imaging technologies
- Principle of Electroencephalogram (EEG)
- Concepts of Electroneurography
- Concepts of Electromyography (EMG)
- Principle of Transcranial Doppler (TCD) ultrasonography
- Transducers
- Introductory concepts of therapeutic neurotechnology
- Fundamental aspects of Evoked potentials, Repetitive Nerve Stimulation Test (RNST)

Textbooks recommended (Latest editions):

1. Evoked potentials in clinical medicine by Keith H. Chiappa
2. Principles of Transcranial Doppler and Carotid Duplex: A. Alexandriov
3. Atlas of Video-EEG Monitoring by Joseph Sirven and John
4. Electromyography and Neuromuscular Disorders by Preston and Shapiro
5. Clinical Neurophysiology by Misra and Kalita
6. Evoked potentials in clinical medicine by Keith H. Chiappa
7. Clinical Electroencephalography-UK Misra, J Kalita
8. Electroencephalography: Basic Principles, Clinical Applications, and Related Fields - Ernst Niedermeyer , Fernando Lopes da Silva
9. EEG in clinical practice: John Hughes

   Current Practice of Clinical Electroencephalography John S. Ebersole , Timothy A. Pedley

Phase II

Paper I: Basic neurosciences

Theory: Applied Neuroanatomy, Neurochemistry, Neuropathology and Neurogenetics

1. **Applied neuroanatomy**:

- Brain and its environment, Development of the nervous system, Neuron and Neuroglia,
- Cranial Nerves.
- Somatic sensory system.
- Motor pathways.
- Central autonomic pathways, Hypothalamo-hypophyseal system.
- Spinal cord.
- Peripheral nerves, Neuromuscular Junction and Muscles

2. **Neurochemistry:**

- Basics of carbohydrate, protein, lipid, and nucleic acid metabolism
- Methods of collection and storage of different specimens of Neurological importance.
- Basics of ELISA, blotting methods, PCR.

3. **Neuropathology:**

- Basic understanding pathology of diseases affecting central and peripheral nervous systems like atherosclerosis, motor neuron diseases (MND), Alzheimer's etc
- CSF evaluation
- Types of muscles and nerves including physiological importance
- Muscle and nerve metabolism
- Indications of Muscle and nerve biopsy
- Techniques of Muscle and nerve biopsy and preservation and transport of specimen
- Normal appearance of muscle and nerve biopsy & abnormalities
- Different types of Nerve injuries and properties of Regeneration; Denervation and Reinnervation.

4. **Neurogenetics:**

- Basic concepts of Molecular biology
- Clinical neurogenetics including pedigree charting
- Mendelian and non-mendelian inheritance.

Practical:

- Demonstration of pedigree charts
- Muscle and nerve biopsy, CSF extraction and evaluation

Textbooks recommended (Latest editions):

1. Grays anatomy: The anatomical basis of clinical practice.
2. BD Chaurasia's Human Anatomy
3. Snells Clinical Neuroanatomy
4. Inderbir Singh: Textbook of Human Neuroanatomy
5. Modern Techniques in Neuroscience Research by Uwe Windhorst and Hakan Johansson
6. Atlas of Neuromuscular Diseases: A Practical Guideline by Eva L. Feldman, Wolfgang Grisold, James W. Russell, and Udo A. Zifko
7. Neurochemistry: Segal
8. Practical guide to neurogenetics. Thomas T Warner; Simon R Hammans. Publisher:Philadelphia : Saunders/Elsevier,
9. Catherine, M.D. Haberland "Clinical Neuropathology: Text and Color Atlas"
10. Textbook of Neuropathology Richard L. Davis , David M. Robertson
11. Escourolle and Poirier's Manual of Basic Neuropathology-Francoise Gray , Jacques Poirier , Umberto De Girolami
12. Localization in Clinical Neurology by Paul Brazis
13. Harrison's principles of internal medicine relevant chapters on genetics and Neurological disorders
14. Bradleys Neurology in clinical practice relevant chapters

Paper II: Biomedical instrumentation and Neuro imaging

1. Biomedical Instrumentation:

- Basics medical physics
- Biomedical signals
- Instrumentation and electronics in EEG, ENMG, Polysomnography, ultrasound and evoked responses
- Instrumentation of commonly used equipment, Trouble shooting, electrical safety, care of equipment
- Amplifiers, filters, resistance, and capacitance
- Amplification, Signal processing, Analog – digital conversion, Sampling rate, Filters (High frequency, Low frequency) Time constant, Data acquisition & storage, Impedance, Averaging, Calibration, Electrode Paste, Common Mode Rejection Ratio, Triggering – Principles and applications, Signal Delay, Troubleshooting and analysis of medical instrumentation
- Interfacing the Computer with Medical instruments and other equipment
- Biomedical computer applications
- Electrical safety and maintenance Electrical hazards
- Patient electrical safety; types of hazards patient isolation, physiological effects of currents, let to current micro shocks

2. Neuroimaging:

- Neuroimaging methods with particular emphasis on sonography, radiation safety
- Imaging techniques involved in Computed Tomography (CT) & Magentic Resonance Imaging (MRI)
- Patient preparation for various diagnostic procedures; contrast agents
- Normal imaging of central nervous system and peripheral nervous system; Ultrasound including principles of neuromuscular ultrasound; functional imaging methods; Functional neuroimaging

Practical:

- Demonstration of filters, gain etc for various procedures, parts of instruments, care of equipment, electrical safety, basic trouble shooting.

Textbooks recommended (Latest editions):

1. Khandpur R. S., Handbook of Biomedical Instrumentation.
2. Webb. A., Introduction to Biomedical Imaging
3. Gaikwad R. Operational Amplifier and Linear Integrated Circuits.

4. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer., Biomedical Instrumentation and Measurements
5. Electrical science, Gupta and Vandana Singhal, Wheeler publishing
6. Biomedical Instrumentation, MR Arumugam
7. A text book of biomedical Instrumentation, S Ananthi, New Age International (2006)
8. Electric circuits and electronic devices, K Padmanabhan, P Swaminathan, S Ananthi, Laxmi publications (2010)
9. MRI and CT of the Brain by James E. Gillespie and Alan Jackson
10. Diagnostic Radiology of the Brain: CT, DSA, NMR: Advanced Exercises in Diagnostic
    Radiology Series by Ruth G. Ramsey
11. Spect Imaging of the Brain by R. Duncan
12. Functional Cerebral SPECT and PET Imaging by Ronald L Van Heertum, Ronald S Tikofsky, and Masanori Ichise
13. Radiation protection in Medical radiography — Mary Alice
14. An introduction to Radiation Protection — Allen Martin & Samuel.
15. Technological aspects in CT, Mammography, MRI, DR and other modern imaging devices
16. Procedures involved in CT, MRI, Interventional Radiography, SPECT
17. Clinical electroencephalography and Topographic Brain Mapping: Technology and Practice by Frank H. Duffy, Vasudeva G. Iyer, and Walter W. Surwillo
18. Electromyography and Neuromuscular Disorders by Preston and Shapiro
19. Bradleys Neurology in clinical practice relevant chapters (part II section C)

Paper III: Clinical Neurophysiology

Theory and practical aspects of Electroencephalogram (EEG), Nerve conduction study (NCS) and Transcranial doppler (TCD)/ Brain perfusion single-photon emission computed tomography (ECD) acquisition

Review of basic neuronal and muscular physiology including action potential and signal transmission Nerve action potential, motor units, nerve signal transmission, Excitatory-contractile coupling, Physiology of different types of muscles; Modularity of brain function, physiological basis of brain signal transmission; Pyramidal and extrapyramidal system and control of motor functions.

1. EEG:

- Physiological basis of EEG
- Principles, methodology, interpretation and clinical applications
- Historical aspects of EEG and EP recording- conventions and procedures
- Terminology, waveforms, frequencies and artifacts Polarity and montages
- Technical specification of the international 10-20 system of EEG
- Minimal technical requirements for EEG, Normal EEG and benign variants
- Activation procedures; Normal EEG-- resting, sleep, activation procedures
- Artifacts and rectification

2. ENMG:

- Physiological basis of EMG and NCS
- Principles, methodology, interpretation and clinical applications of Nerve conduction studies and Electromyography
- Historical aspects of NCS and EMG recording- conventions and procedures
- Terminology, waveforms, frequencies, and artifacts
- Technical specification of the NCS and EMG
- Normal NCS and EMG
- Artifacts and rectification
- Neuropathies, Myopathies and other conditions requiring NCS and EMG.
-

3. Ultrasound:

- Principles of vascular ultrasound
- Continuous versus pulse wave Doppler
- Transcranial doppler, TCCD
- TCD machine, main parts, probes, headframe, maintenance, technique of TCD, normal flow velocities, pulsatility and resistance index, power Doppler, Normal spectrum, Carotid colour duplex, 2D imaging, Doppler imaging, Colour Doppler, power Doppler, Tissue harmonic imaging

- Transient ischemic attacks
- Terminology, waveforms, frequencies, and artifacts
- Technical specifications
- Normal TCD and ECD
- Artefacts and rectifications
- Stroke and other conditions requiring TCD/ECD.

Practical:

- Demonstration of different components and connections of ENMG, EEG and USG machine
- Checking and setting of different parameters like room temperature, impedance, filters, sensitivity, power etc. before different tests
- Electrode placement, connections, basic parameter settings, recording adult NCS, EEG, TCD and ECD.

Textbooks recommended (Latest editions):

1. Review of Medical Physiology by Ganong
2. Textbook of Medical Physiology by Guyton
3. Electromyography and Neuromuscular Disorders by Preston and Shapiro
4. Clinical Electroencephalography-UK Misra, J Kalita
5. Electroencephalography: Basic Principles, Clinical Applications, and Related Fields - Ernst Niedermeyer, Fernando Lopes da Silva
6. EEG in clinical practice: John Hughes
7. Current Practice of Clinical electroencephalography John S. Ebersole , Timothy A. Pedley

Phase III

Paper I: Advanced Neurophysiology

Theory and practical aspects of Evoked potentials, Repetitive nerve stimulation (RNS), Electromyography (EMG), Electroneuromyography (ENMG), Single-fiber EMG (SfEMG), neuromuscular ultrasound, plexus protocols, collision protocols etc.

1. Evoked responses:

- Physiology and principles behind evoked response both sensory and motor
- Technical specifications, procedure, settings, artefacts, waveforms, and terminology of evoked responses
- Multiple sclerosis and other conditions requiring study of evoked potentials.

2. EEG:

- Seizures
- EEG pattern, classification, clinical Pattern and nonconvulsive status
- Other abnormal patterns
- Encephalopathies, drug effects, Periodic Lateralized Epileptiform Discharges (PLEDS), periodic complexes, Frontal intermittent rhythmic delta activity (FIRDA), polymorphic delta activity (PDA)
- Paediatric and neonatal EEG
- High-definition EEG.

3. ENMG:

- Physiological basis,
- principles, methodology, interpretation and clinical applications
- Repetitive nerve stimulation tests, Long loop reflexes, blink reflex
- Basics of planning and performing evaluation of brachial and lumbosacral plexus
- SfEMG.

4. Ultrasound:

- Pathological spectrum in stenosis, occlusion, spasm, brain death
- Diagnosis of Right-to-left shunts,
- high intensity transient signal (HITS)
- Neuromuscular ultrasound.

Practical:

Performance of RNST, visual evoked potential (VEP), Brain stem evoked response audiometry (BERA), SSEP, long loop reflexes, blink reflex, pediatric and neonatal EEG.

Textbooks recommended (Latest editions):

1. Evoked potentials in clinical medicine by Keith H. Chiappa
2. Principles of Transcranial Doppler and Carotid Duplex: A. Alexandriov
3. Atlas of Video-EEG Monitoring by Joseph Sirven and John
4. Electromyography and Neuromuscular Disorders by Preston and Shapiro
5. Clinical Neurophysiology by Misra and Kalita
6. Evoked potentials in clinical medicine by Keith H. Chiappa
7. Clinical Electroencephalography-UK Misra, J Kalita
8. Electroencephalography: Basic Principles, Clinical Applications, and Related Fields - Ernst Niedermeyer , Fernando Lopes da Silva
9. EEG in clinical practice : John Hughes
10. Current Practice of Clinical Electroencephalography John S. Ebersole , Timothy A. Pedley

Paper II: Neurophysiology in special situations

Theory and practical aspects of Intensive care unit (ICU) and Operation Theatre (OT) neurophysiology, long term EEG monitoring

OT electrophysiology:

- Understanding the principles and need for intraoperative monitoring
- Pre-op evaluation,
- Intraoperative EEG monitoring during epilepsy surgery
- Invasive EEG recording
- Cortical stimulation studies for epilepsy surgery
- Intraoperative evoked potential recording
- Peripheral nerve injuries

ICU electrophysiology:

- Continuous EEG monitoring in Status epilepticus patients
- Continuous EEG monitoring in suspected NCSE
- Continuous EEG monitoring in comatose patients
- Continuous EEG monitoring in encephalitis/encephalopathy
- NCS in acute flaccid paralysis
- RNST in Neuromuscular paralysis
- TCD studies in acute stroke/SAH
- ECD studies in acute stroke/SAH
- Intracranial pressure (ICP) monitoring
- Brain death

Long term EEG monitoring:

- Need for Long term monitoring, procedure, presurgical evaluation.

Practical

- Performance of Bedside RNST,
- EEG,
- TCD,
- NCS and
- Connection of Long-term EEG monitoring, editing and storing same.

Textbooks recommended (Latest editions):

1. EEG in clinical practice : John Hughes
2. Review of Medical Physiology by Ganong
3. Electromyography and Neuromuscular Disorders by Preston and Shapiro
4. Clinical Electroencephalography and Topographic Brain Mapping: Technology and Practice by Frank H. Duffy, Vasudeva G. Iyer, and Walter W. Surwillo
5. Clinical Neurophysiology by Misra and Kalita
6. Clinical ElectroencephalographyG-UK Misra, J Kalita
7. Current Practice of Clinical Electroencephalography John S. Ebersole , Timothy A. Pedley

Paper III: Therapeutic neurophysiology

Theory and practical applications of neuromodulation techniques, neurorehabilitation approaches including Functional electrical stimulation (FES), Vagus nerve stimulation (VNS), Deep brain stimulation (DBS), sonothrombolysis, neuropace etc

- Neuroplasticity principles, Long-term potentiation (LTP), Long-term depression (LTD), Neuromodulation techniques—Transcranial magnetic and electrical stimulation, Electroconvulsive therapy (ECT), p-300,
- Brain computer interface
- Basic principles of neurorehabilitation
- Intrathecal baclofen,
- Botulinum toxin

Neurobionics:

- Deep brain stimulation (DBS)
- Vagus nerve stimulation (VNS)
- Electrotherapy: Electrical Muscle Stimulation, Transcutaneous Electrical Nerve Stimulation, Functional Electrical Stimulation
- Neuropace.

Practical:

Performance of Functional electrical stimulation (FES), Transcranial direct current stimulation (tDCS).

Textbooks recommended (Latest editions):

1. Oxford Handbook of Transcranial Stimulation (Oxford Handbooks) by Eric Wassermann, Charles Epstein, and Ulf Ziemann
2. Clinical Manual of Electroconvulsive Therapy by Mehul V. Mankad, John L. Beyer, Richard D. Weiner, and Andrew Krystal
3. Clinical Magnetoencephalography and Magnetic Source Imaging by Andrew C. Papanicolaou
4. Neurobionics - an interdisciplinary approach to substitute impaired functions of the human nervous system, Elsevier, Amsterdam, 1993, ISBN 0-444-89958-8
5. Deep Brain Stimulation Programming: Principles and Practice. Erwin B. Montgomery Jr. MD
6. Vagus Nerve Stimulation by Steven C. Schachter and Dieter Schmidt
7. Electrotherapy: Electrical Muscle Stimulation, Transcutaneous Electrical Nerve Stimulation, Functional Electrical Stimulation by Books LLC
8. Neuroengineering by Daniel J. DiLorenzo and Joseph D. Bronzino

COURSE AND EXAMINATION REGULATIONS

Attendance:

- Students are required to attend 75% or more of all theory classes held, and 75% or more of practical in each subject to be eligible to appear in the final examination. Under no condition will a student with less than the prescribed attendance in any subject in theory and practical separately shall be allowed to appear in the Annual examination of that subject.
- Students with less than 75% attendance in theory and practical separately at the end of any year must start afresh by joining the junior batch of students. No extra classes will be arranged to make such students eligible for the final annual examinations. The attendance accrued in the previous academic year in those subject(s) will not be transferred. The student will need to secure 75% attendance afresh in theory and practical/laboratory postings after joining the junior batch to become eligible to appear in the final summative examination.
- The 25% leverage in attendance includes all types of leaves (including leave on medical grounds). For absence because of illness or any medical condition, a duly approved medical leave from Dean (Academic) with medical and fitness certificate issued/verified by authorized JIPMER clinical faculty member is mandatory. Certificate must be submitted before or within 10 days after availing medical leave.
- Students who are detained in all the subjects of a year due to lack of attendance should join the classes with junior batch within 7 days of declaration of the eligibility/detention list or when classes commence, whichever is earlier.
- Students who are detained in one or more subject(s) because of lack of attendance but are eligible to appear for final Annual examination in at least one subject of the year should join classes with junior batch within 7 days of completion of the last final theory/practical examination or when classes, whichever is earlier. Attendance will be calculated from the date of joining.
- A show cause notice will be issued to students on continuous unauthorized absence without prior permission for two weeks or more. If such absence extends to a period more than one month for any reason, the student is liable for termination for the course. The decision of the competent authority is final.
- There is **no condonation permissible** for shortage of attendance.

Internal Assessment (IA)

- A minimum of three notified internal assessments will be held periodically in each year (in a one-year period) and one model examination before the final annual examination.

- Each of the notified IA tests will carry 20% weightage and the model examination will carry 40% weightage. The sum of notified IA tests and model examination will decide the eligibility to appear in the examination and for contribution to aggregate marks.
- A student must secure at least 30% of the maximum marks fixed for internal assessment in theory and practical/clinical separately in a particular subject to be eligible to appear for the final annual examination in that subject.
- Of the final total aggregate marks in each subject, internal assessment marks will contribute 40% and annual examination marks will contribute the remaining 60%. This will apply to both theory and practical/clinical papers separately.
- If a student misses up to one notified test because of illness, marks of the remaining notified tests can be considered for calculating the internal assessment, ignoring the absence on medical grounds. To avail this concession, the student should submit a valid medical certificate signed by the treating clinical faculty member of JIPMER before or within 10 days after the missed test. This exemption will not apply to model examination. This is applicable only up to one missed notified internal assessment test.
- No repeat/additional notified internal assessment or model examination will be conducted.
- Students who are detained in all the subjects of a year because of lack of sufficient internal assessment marks should join the classes with junior batch within 7 days of declaration of the eligibility/detention list or when classes of the year commence, whichever is earlier.
- Students who are detained in one or more subject(s) due to lack of sufficient internal assessment marks but are eligible to appear in the annual examination in at least one subject of the year should join classes with junior batch within 7 days of completion of the last annual theory/practical examination or when classes of the year commence, whichever is earlier.
- The internal assessment marks accrued in the previous year will not be transferred to the next year.

Annual Examinations

Number and timing of examinations

- Annual examinations will be held at the end of each academic year. The Institute shall conduct not more than two annual examinations in an academic year, a regular annual and a supplementary examination in each subject. The supplementary examinations will be held within 6 weeks after publication of the result of the regular annual examination.
- Practical Examinations shall be jointly conducted by one internal and one external examiner duly appointed by the Professor of Examinations.
- Students should obtain a minimum of 40% in the annual examination and a minimum of 50% in the final total aggregate (total of internal assessment and annual examination marks) in a subject (theory and practical separately) to be declared as pass in that subject.

Marks scheme:

	Maximum marks
Theory	200
Practical	100
Total	**300**

Theory

	Maximum marks
Internal Assessment test 1 (weighted)	16
Internal Assessment test 2 (weighted)	16
Internal Assessment test 3 (weighted)	16
Model Examination	32
Annual Theory Examination	100
Viva-voce Examination	20
Total Theory marks	**200**

Practical

	Maximum marks
Internal Assessment test 1 (weighted)	7
Internal Assessment test 2 (weighted)	7
Internal Assessment test 3 (weighted)	7
Model Examination	14
Record marks	5
Annual Practical Examination	60
Total Practical marks	**100**

Question paper pattern

	Maximum marks
Section A	50
Section B	50
Total	**100**

Each section

		Marks
Answer in detail	1 X 10	10
Short notes	5 X 5	25
Brief answers	5 X 3	15
		50

Number of attempts and Training Period

- The academic program of the BSc Allied Health Sciences courses must be completed within 6 years from the date of joining (excluding internship). Maximum permissible duration for each year shall be four years and a maximum four attempts (including the annual and supplementary examinations) in any subject will be permitted.
- If a student does not appear in both theory and practical final examination, it will NOT be considered as an attempt for the purpose of calculation of maximum number of attempts in a subject.
- If a student appears for theory in the Annual Examination but does not appear for Practical Examination or vice-versa, his/her theory or practical appearance shall be counted as an attempt. In the next attempt, the student will have to appear for both Theory and Practical Examinations. Mere submission of application form for examination will not be considered as an attempt.
- Passing in the exams of all the previous year subjects is compulsory before proceeding to the classes of next phase.
- A student who fails in theory and/or practical papers of one or more subjects in the regular annual examinations at the end of each year can appear in the supplementary examination (to be held within 6 weeks of announcement of the regular annual examination results) in those subjects.
- If he/she passes these subjects in the supplementary examination, he/she should join the regular batch within 7 days of declaration of supplementary examination results or when classes commence, whichever is earlier. Attendance calculation for students who join after passing supplementary examination will begin from their date of joining of that year.
- Students who fail in theory and/or practical in one or more subjects in the supplementary examination and those who do not appear in the supplementary examination should join classes with the junior batch within 7 days of declaration of supplementary examination results or when classes, whichever is earlier. These students should secure 75% attendance and 30% internal assessment afresh to be eligible to appear in the final regular annual examination of that year along with the junior batch. Attendance calculation for students who join after failing in supplementary examination will begin from their date of joining the year with junior batch.
- A maximum of four attempts in any subject is allowed. If a student fails even in the 4^{th} attempt, no further chances will be given, and his/her name will be struck off the rolls of JIPMER.
- No grace marks will be awarded for either theory or practical examinations under any circumstances.

Model Question paper

Phase I - Paper I: Foundation course

Maximum marks: 100 Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A

1. Answer the following question in detail: 1 x 10 = 10

a. Describe in detail healthcare delivery system in India at the primary, secondary, and tertiary levels.

2. Write short notes on the following: 5 x 5 = 25

a. What is the role of processor and RAM in a computer?
b. Describe the types of networks in computing.
c. Write a short note on right to healthcare.
d. What is medical negligence? What are the laws governing medical negligence in India?
e. Write in brief about the importance of informed consent and the process.

3. Answer the following questions briefly: 5 x 3 = 15

a. What are the components of a medical term?
b. What are the input and output devices of a computer?
c. What is paralanguage? What are its implications?
d. Describe the characteristics of good communicator.
e. What are the alternative medicine systems recognised by the Government of India?

Section B

4. Answer the following question in detail: 1 x 10 = 10

a. Explain the concepts of quality of care. Describe various approaches to quality improvement.

5. Write short notes on the following: 5 x 5 = 25

a. Describe the principles of management with suitable examples.
b. Describe the methods of disinfection in biomedical waste management.
c. Describe the methods of prevention & control of common healthcare associated infections.
d. Classify the types of antibiotic resistance and describe each of them.
e. Write a short note on research study designs.

6. Answer the following questions briefly: 5 x 3 = 15

a. What are the components of cardiopulmonary resuscitation?
b. What is integrity and what is its importance of integrity in healthcare practice?
c. What are the qualities of a good leader?
d. What are the different types of data?
e. Describe the concept of ethics and its relevance in healthcare practice.

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Model Question paper

Phase I - Paper II: Anatomy and Physiology

Maximum marks: 100 Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A - Anatomy

1. Answer the following question in detail: 1 x 10 = 10

a. Describe the position, parts, structure, blood supply and supports of uterus.

2. Write short notes on the following: 5 x 5 = 25

a. Parts and blood supply of stomach
b. Simple epithelium
c. Histology of lymph node
d. Chambers and valves of heart
e. Surfaces and lobes of lung

3. Answer the following questions briefly: 5 x 3 = 15

a. Name three major salivary glands.
b. Mention two contents of spermatic cord
c. Name two paranasal air sinuses
d. Name the parts of small intestine
e. Name two upper limb muscles

Section – B - Physiology

4. Write essay answer on the following: 1 x 10 = 10

a. Define immunity. Mention the different types of immunity. Write briefly about the different types of immunity. (2+2+6)

5. Write short notes on the following: 5 x 5 = 25

a. Active transport
b. Movements of small intestine
c. Factors affecting glomerular filtration rate
d. Oxygen haemoglobin (Oxy-Hb) dissociation curve
e. Factors regulating cardiac output

6. Answer the following questions briefly: 5 x 3 = 15

a. Name the hormones secreted from Adrenal gland
b. Mention the Indicators of ovulation
c. Define tidal volume. Mention its normal value.
d. Draw a labelled diagram of lead II ECG.
e. List four functions of hypothalamus.

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Model Question paper

Phase I - Paper III: Pathology and Microbiology

Maximum marks: 100 Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A - Pathology

1. Answer the following question in detail: 1 x 10 = 10

a. What is inflammation? What are the cardinal signs of inflammation? Mention the difference between acute and chronic inflammation. Add a note on granuloma with example. (1+2+4+3)

2. Write short notes on the following: 5 x 5 = 25

a. Define necrosis. Give examples of different types of necrosis. Differences between necrosis and apoptosis.
b. What is thrombosis? Explain Virchow's triad.
c. Define neoplasia. What are the differences between benign and malignant tumours? List the different routes of metastasis.
d. Mention the differences between wound healing by primary and secondary intention.
e. Principles and procedures of blood grouping and cross-matching.

3. Answer the following questions briefly: 5 x 3 = 15

a. Define anaemia. Give any two causes of anaemia.
b. What is jaundice? Give the classification based on pathophysiology.
c. What is atherosclerosis? Give some of its risk factors.
d. What is nephrotic syndrome? Give any two examples.
e. How will you do urine analysis?

Section – B - Microbiology

4. Write essay answer on the following: 1 x 10 = 10

a. Define sterilization. Draw a labelled diagram of autoclave. Write principle of autoclave and its application in hospital. (1+3+3+3)

5. Write short notes on the following: 5 x 5 = 25

a. Enumerate vector borne diseases. Add a note on the laboratory diagnosis of malaria
b. What do you understand by segregation of biomedical waste? How is it done in your hospital?
c. Describe in detail about various method of urine sample collection
d. Enumerate sexually transmitted microorganisms. Write laboratory diagnosis of HIV
e. Describe laboratory diagnosis of Mucormycosis.

6. Answer the following questions briefly: 5 x 3 = 15

a. Name two transport media
b. Name two foodborne pathogens
c. Enumerate four Personal Protective Equipment (PPE)
d. Name two nosocomial pathogens
e. List two opportunistic fungal infection

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Model Question paper

Phase I - Paper IV: Introduction to Neurotechnology

Maximum marks: 100 Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A

1. Answer the following question in detail: 1 x 10 = 10

a. What are electrodes? How do you classify them? Explain with examples

2. Write short notes on the following: 5 x 5 = 25

a. Pre procedure preparation for electroencephalogram
b. Pre procedure preparation for nerve conduction study
c. Electromyography
d. Transducers
e. Name the software used for NCS, OPD-EEG, VEEG, TCD and ECD machines in the lab

3. Answer the following questions briefly: 5 x 3 = 15

a. Types of synapses
b. Artefacts in electroencephalogram
c. Neurotransmitters
d. Components of central nervous system
e. Action potential

Section B

4. Write essay answer on the following: 1 x 10 = 10

a. How are EEG waves classified? Explain any two normal activities on EEG.

5. Write short notes on the following: 5 x 5 = 25

a. Types of electrophysiology
b. Draw a labelled diagram of a neuron
c. Nerve conduction in a myelinated neuron
d. Excitation-contraction coupling in Muscle
e. Monosynaptic reflex

6. Answer the following questions briefly: 5 x 3 = 15

a. Neuroimaging modalities
b. Components of basal nuclei
c. Types of nerve fibres
d. Nerves studied in nerve conduction study (NCS)
e. Evoked potentials.

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Model Question paper

Phase II - Paper I: Basic Neurosciences

Maximum marks: 100 Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A

1. Answer the following question in detail: 1 x 10 = 10

a. Give detailed description of Brachial Plexus with reference to brachial plexopathies.

2. Write short notes on the following: 5 x 5 = 25

a. Erb's paralysis
b. Anatomy of Mid Brain
c. Lobes of Brain
d. Anatomy of Visual pathway
e. Klumpke's Paralysis

3. Answer the following questions briefly: 5 x 3 = 15

a. Neuropathy
b. Wallerian degeneration
c. Mendelian inheritance
d. Ascending pathways
e. Neuroglia

Section B

4. Write essay answer on the following: 1 x 10 = 10

a. Describe in detail the formation and circulation of Cerebrospinal fluid.

5. Write short notes on the following: 5 x 5 = 25

a. Proteomics
b. ELISA
c. Polymerase chain reaction
d. Short note on muscle biopsy
e. CSF findings in meningitis

6. Answer the following questions briefly: 5 x 3 = 15

a. What is carotid intima media thickness?
b. Parts of internal capsule
c. Neural metabolism
d. Myelination
e. Syringomyelia

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Model Question paper

Phase II - Paper II: Biomedical instrumentation and neuroimaging

Maximum marks: 100 Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A

1. Answer the following question in detail: 1 x 10 = 10

a. Describe in detail about artefacts in electrophysiology. What are the steps taken to reduce the artefacts?

2. Write short notes on the following: 5 x 5 = 25

a. Short note on carotid Doppler
b. Contrasts in radiology
c. Transcranial Doppler
d. Neuroimaging in Stroke
e. Functional neuroimaging

3. Answer the following questions briefly: 5 x 3 = 15

a. Define piezoelectric transducer.
b. Differentiate AC and DC voltage.
c. What is the role of amplifier in EEG instrumentation?
d. Name the materials used in piezoelectric transducers.
e. What are the types of electrodes?

Section B

4. Write essay answer on the following: 1 x 10 = 10

a. Describe the process of calibration in electrophysiology. Write about the types and its importance.

5. Write short notes on the following: 5 x 5 = 25

a. Short note on Notch Filter
b. Short note on EEG montages
c. Short note on parameters of nerve conduction studies
d. Parts of VEP machine
e. Repetitive nerve stimulation tests

6. Answer the following questions briefly: 5 x 3 = 15

a. Explain Multimeter.
b. From what alternating current is generated.
c. Draw and label an electrical receptacle.
d. Why dedicated earthing is required for EEG instrument.
e. What is CMRR?

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Model Question paper

Phase II - Paper III: Clinical neurophysiology

Maximum marks: 100 Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A

1. Answer the following question in detail: 1 x 10 = 10

a. Write principles, indications, and descriptive notes on Nerve Conduction studies

2. Write short notes on the following: 5 x 5 = 25

a. Normal CMAP
b. Motor unit potential
c. Draw a labelled diagram of the circle of Willis
d. EMG artefacts
e. Doppler effect and its application in neurosonography

3. Answer the following questions briefly: 5 x 3 = 15

a. HITS in TCD
b. Blink reflex
c. Sympathetic skin response
d. Sonothrombolysis
e. Aliasing in EEG

Section B

4. Write essay answer on the following: 1 x 10 = 10

a. Describe the process of calibration in electrophysiology. Write about the types and its importance.

5. Write short notes on the following: 5 x 5 = 25

a. Extracranial duplex studies
b. EEG procedure
c. Parts of EEG machine
d. Sleep spindles
e. Lead placement and 10-20 system

6. Answer the following questions briefly: 5 x 3 = 15

a. Neuropathy in EMG
b. Origin of Wave I and II in BERA
c. Materials used in EEG electrodes
d. Types of VEP
e. Photomyoclonic response

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Model Question paper

Phase III - Paper I: Advanced neurophysiology

Maximum marks: 100 Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A

1. Answer the following question in detail: 1 x 10 = 10

a. Write principles, indications, and descriptive notes on Transcranial Doppler (TCD) with special reference to normal cerebrovascular anatomy. How does TCD aid in diagnosis of patent foramen ovale?

2. Write short notes on the following: 5 x 5 = 25

a. Parameters that can be measured using TCD and explain any two
b. HITS.
c. Ictal EEG patterns and describe any two.
d. Nerve ultrasound
e. High frequency RNST

3. Answer the following questions briefly: 5 x 3 = 15

a. What is Monro-Kellie doctrine?
b. What is local field potential?
c. Name two shunt surgeries.
d. What is an implantable pulse generator?
e. What is awake cranial surgery?

Section B

4. Write essay answer on the following: 1 x 10 = 10

a. Draw a labelled diagram of the neuromuscular junction and explain its physiology.

5. Write short notes on the following: 5 x 5 = 25

a. High-definition EEG
b. PLEDS
c. H reflex
d. SfEMG
e. Blink reflex

6. Answer the following questions briefly: 5 x 3 = 15

a. Name the stages of sleep?
b. Name two drugs given for epilepsy.
c. What are the filter settings for recording EMG?
d. What is cerebrovascular reactivity??
e. Neural regeneration

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Model Question paper

Phase III - Paper II: Neurophysiology in special situations

Maximum marks: 100 Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A

1. Answer the following question in detail: 1 x 10 = 10

a. Write in detail about indications and procedure for long term EEG monitoring and its role in pre-surgical evaluation for epilepsy surgery.

2. Write short notes on the following: 5 x 5 = 25

a. Myasthenic crisis
b. Electrophysiology of GBS
c. Non convulsive status epilepticus
d. Sonothrombolysis
e. SSEP in prognosis of comatose patients

3. Answer the following questions briefly: 5 x 3 = 15

a. Write a short note on invasive EEG electrodes.
b. Write briefly about the utility of EEG in the OT.
c. Explain briefly about BERA in CP angle surgeries.
d. Write a short note on hydrocephalus.
e. Write a short note on long term EEG monitoring.

Section B

4. Write essay answer on the following: 1 x 10 = 10

a. Evaluation of suspected Brain death

5. Write short notes on the following: 5 x 5 = 25

a. Neuronavigation
b. Mesial Temporal Lobe Sclerosis
c. Brain death
d. Principles of intra operative neuromonitoring
e. Classification of peripheral nerve injuries

6. Answer the following questions briefly: 5 x 3 = 15

a. Write a short note on Motor Evoked Potentials for intra-operative monitoring.
b. What is hemicraniectomy? Name one indication. Explain.
c. Write a short note on pre-surgical evaluation of patient with drug refractory epilepsy.
d. Classify the types of anaesthesia used during surgery.
e. Intraoperative testing of facial nerve function

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Model Question paper

Phase III - Paper III: Therapeutic electrophysiology

Maximum marks: 100 Maximum duration: 3 hours

Answer all the questions. Draw suitable diagrams where necessary

Section A

1. Answer the following question in detail: 1 x 10 = 10

a. Describe in detail about Transcranial magnetic Stimulation

2. Write short notes on the following: 5 x 5 = 25

a. Central Motor conduction time
b. Silent period in Trans cranial magnetic stimulation
c. Types of coils used in TMS
d. Principles of Vagal nerve stimulation (VNS)
e. Counselling and preparation process in ECT

3. Answer the following questions briefly: 5 x 3 = 15

a. Name two nerves studied during RNST.
b. Name two features of demyelinating Neuropathy.
c. Name two features of axonal neuropathy.
d. Name two antiseizure drugs which can be given intravenously.
e. Name two types of EMG needles.

Section B

4. Write essay answer on the following: 1 x 10 = 10

a. Describe in detail about Electroconvulsive Therapy.

5. Write short notes on the following: 5 x 5 = 25

a. Complications of Vagus nerve stimulation
b. Short note on Neuroplasticity
c. Short note on principles of tDCS
d. Write a short note on Transcutaneous electrical nerve stimulation
e. Write a short note on p-300

6. Answer the following questions briefly: 5 x 3 = 15

a. Name two complications for Deep brain stimulation.
b. What is artificial vision?
c. Name two parameters measured during autonomic function tests in your lab.
d. What is magnetic resonance spectroscopy?
e. Acute flaccid quadriparesis

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