## 1. Scheme of Programme

## MSc Neuroscience 2024-25

# (Scheme PG A2: Postgraduate Programmes (Course work + Research)

**Semester 1**

| Course Code | Course Title | Course ID | L | T | P | L | T | P | Total Credits | MARKS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (Hrs) | | | Credits | | | | TI | TE | PI | PE | Total |
| **Core Course(s)** | | | | | | | | | | | | | | |
| CC-A01 | Biochemistry | 241/NEU/CC101 | 3 | | 2 | 3 | | 1 | 4 | 25 | 50 | 5 | 20 | 100 |
| CC-A02 | Cell Biology and Neuron organization | 241/NEU/CC102 | 3 | | 2 | 3 | | 1 | 4 | 25 | 50 | 5 | 20 | 100 |
| CC-A03 | Neuroanatomy | 241/NEU/CC103 | 3 | | 2 | 3 | | 1 | 4 | 25 | 50 | 5 | 20 | 100 |
| **Discipline Specific Elective Courses** | | | | | | | | | | | | | | |
| DSE-01 | Research Methods, Biostatistics and Computer Applications | 241/NEU/DS101 | 3 | | | 3 | | | 3 | 25 | 50 | | | 75 |
| **Multidisciplinary Course(s)** | | | | | | | | | | | | | | |
| MDC-01 | One from Pool | | | | | | | | 3 | | | | | 75 |
| **Ability Enhancement Course(s)** | | | | | | | | | | | | | | |
| AEC-01 | One from Pool | | | | | | | | 2 | | | | | 50 |
| **Value-added Course(s)** | | | | | | | | | | | | | | |
| VAC-01 | One from Pool | | | | | | | | 2 | | | | | 50 |
| **Total Credits** | | | | | | | | | **22** | | | | | **550** |

**Semester 2**

| Course Code | Course Title | Course ID | L | T | P | L | T | P | Total Credits | MARKS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (Hrs) | | | Credits | | | | TI | TE | PI | PE | Total |
| **Core Course(s)** | | | | | | | | | | | | | | |
| CC-A04 | Laboratory Tools and Techniques | 241/NEU/CC201 | 3 | | 2 | 3 | | 1 | 4 | 25 | 50 | 5 | 20 | 100 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC-A05 | Cellular Neurophysiology | 241/NEU/ CC202 | 3 | | 2 | 3 | | 1 | 4 | 25 | 50 | 5 | 20 | 100 |
| | and Biophysics | | | | | | | | | | | | | |
| CC-A06 | Fundamentals of Molecular Biology | 241/NEU/ CC203 | 3 | | 2 | 3 | | 1 | 4 | 25 | 50 | 5 | 20 | 100 |
| **Discipline Specific Elective Courses** | | | | | | | | | | | | | | |
| DSE-02 | Immunology | 241/NEU/ DS201 | 3 | | | 3 | | | 3 | 25 | 50 | | | 75 |
| **Multidisciplinary Course(s)** | | | | | | | | | | | | | | |
| MDC-02 | One from Pool | | | | | | | | 3 | | | | | 75 |
| **Ability Enhancement Course(s)** | | | | | | | | | | | | | | |
| AEC-02 | One from Pool | | | | | | | | 2 | | | | | 50 |
| **Skill Enhancement Course(s)** | | | | | | | | | | | | | | |
| SEC-01 | One from Pool | | | | | | | | 2 | | | | | 50 |
| **Total Credits** | | | | | | | | | **22** | | | | | **550** |

## Multidisciplinary Course from the Neurosciences department for pool of the Courses in the University

## (These courses are to be offered to students of different discipline/Subject)

### Semester 1

| Course Code | Course Title | Course ID | L | T | P | L | T | P | Credits | MARKS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (Hrs) | | | Credits | | | | TI | TE | PI | PE | Total |
| MDC-1 | Introduction to Neuroscience | 241/NEU/MD101 | 3 | | | 3 | | | 3 | 25 | 50 | | | 75 |

### Semester 2

| Course Code | Course Title | Course ID | L | T | P | L | T | P | Credits | MARKS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (Hrs) | | | Credits | | | | TI | TE | PI | PE | Total |
| MDC-2 | Neuropsychology | 241/NEU/MD201 | 3 | | | 3 | | | 3 | 25 | 50 | | | 75 |

## Value Added Course from the Neurosciences department for pool of the Courses in the University

## (All the departments will offer value added course for the students of same or different departments.

**Semester 1**

| Course Code | Course Title | Course ID | L | T | P | L | T | P | Credits | MARKS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (Hrs) | | | Credits | | | | TI | TE | PI | PE | Total |
| VAC-1 | Bioethics and Biosafety | 241/NEU/VA101 | **2** | | | **2** | | | **2** | **15** | **35** | | | **50** |

## Skill Enhancement Course from the Neurosciences department for pool of the Courses in the University

**(These courses are offered by each department for students of other departments/same department and is designed to provide value-based and/or skill-based knowledge and should contain both theory and lab/hands-on/training/field work.)**

**Semester 2**

| Course Code | Course Title | Course ID | L | T | P | L | T | P | Credits | MARKS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (Hrs) | | | Credits | | | | TI | TE | PI | PE | Total |
| | | | | | | | | | | | | | | |
| SEC-1 | Personality and Skill Development | 241/NEU/SE201 | **2** | | | **2** | | | **2** | **15** | **35** | | | **50** |

**Curriculum (2024-26)**

| Semester | CourseID | Title of the Paper (s) | Course type | Credits | | | |
|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total |
| FIRST | 241/NEU/CC 101 | Biochemistry | Core | 3 | 0 | 1 | 4 |
| | 241/NEU/CC 102 | Cell Biology and Neuron organization | Core | 3 | 0 | 1 | 4 |
| | 241/NEU/CC 103 | Neuroanatomy | Core | 3 | 0 | 1 | 4 |
| | 241/NEU/DS 101 | Research Methods, Biostatistics and Computer Applications | DSE | 3 | 0 | 0 | 3 |
| | | One from Pool | MDC | | | | 3 |
| | | One from Pool | AEC | | | | 2 |
| | | One from Pool | VAC | | | | 2 |
| **Total credits for First Semester** | | | | | | | **22** |
| SECOND | 241/NEU/CC 201 | Laboratory Tools and Techniques | Core | 3 | 0 | 1 | 4 |
| | 241/NEU/CC 202 | Cellular Neurophysiology and Biophysics | Core | 3 | 0 | 1 | 4 |
| | 241/NEU/CC 203 | Fundamentals of Molecular Biology | Core | 3 | 0 | 1 | 4 |
| | 241/NEU/DS 201 | Immunology | DSE | 3 | 0 | 0 | 3 |
| | | One from Pool | MDC | | | | 3 |
| | | One from Pool | AEC | | | | 2 |
| | | One from Pool | SEC | | | | 2 |
| **Total credits for Second Semester** | | | | | | | **22** |

**GURUGRAM UNIVERSITY, GURUGRAM**

**MASTER OF SCIENCE (M.Sc.) IN NEUROSCIENCE**

**Goal and Objectives:**

The major goal of introducing a M.Sc. Neuroscience course is for development of trained manpower having a broad overview of the different aspects of neuroscience. It is planned to teach this course at the postgraduate level, imparting the broad perspective of the different disciplines, which comprise neuroscience over a two-year period.

**The Training:**

It is hoped that the M.Sc. Neuroscience programme would offer training in neuroscience to graduates who would then be well equipped to take up their Ph.D. work in specific areas of brain research. The students with a M.Sc. in Neuroscience Degree would have acquired the basic knowledge in major disciplines of neuroscience, such as neuroanatomy, neurophysiology, neurochemistry, molecular neurobiology, neurogenetics, cognitive neuroscience and the knowledge of working of motor, sensory and regulatory systems. The development and regeneration of the brain as well as the knowledge in basics of clinical neuroscience in terms of diseases and diagnostic tools would also be provided. The students would also acquire practical knowledge in the above aspects as well as in research methodology and computational skills.

**SYLLABUS (2024-2026)**

Master of Science in Neuroscience course shall comprise of four semesters of six months duration each. The following is a summary of the course, which is followed by detailed descriptions:

**M.Sc. Neuroscience: Theory and Practical Courses**

| **Semester-I** | | |
|---|---|---|
| **Code** | **Title** | **Credits** |
| 241/NEU/CC101 | Biochemistry | 4 |
| 241/NEU/CC102 | Cell Biology and Neuron Organization | 4 |
| 241/NEU/CC103 | Neuroanatomy | 4 |
| 241/NEU/DS101 | Research Methods, Biostatistics and Computer Applications | 3 |
| | MDC | 3 |
| | AEC | 2 |
| | VAC | 2 |
| | **Total=** | **22** |
| **Semester-II** | | **Credits** |
| **Code** | **Title** | |
| 241/NEU/CC201 | Laboratory Tools and Techniques | 4 |
| 241/NEU/CC202 | Cellular Neurophysiology and Biophysics | 4 |
| 241/NEU/CC203 | Fundamentals of Molecular Biology | 4 |
| 241/NEU/DS201 | Immunology | 3 |
| | MDC | 3 |
| | AEC | 2 |
| | VAC | 2 |
| | **Total=** | **22** |

## Detailed Syllabus (2024-2026)

### Semester-I (Credits 22)

**241/NEU/CC101: *BIOCHEMISTRY***

**Note:** Here we aim to let the students learn the language of biochemistry, get a balance understanding of the physical, chemical and biological properties of biomolecules, their reactivity and pathways in which they operate, get exposed to the themes related to evolution, dynamics, regulation and the biochemical relationship between the structure and function. The topics to be taught in a manner that the opportunity in identifying gaps in our knowledge which can challenge the future generation of neuroscientists in better understanding of the biochemical aspects in relation to brain function and disorders.

| | |
|---|---|
| Core Course (Lectures: 40) | Maximum Theory Marks: 75 |
| Time Allowed: 2 Hrs | External Marks: 50 |
| Credits: 3 | Internal Assessment: 25 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two questions from each section. Q. No. 1 consisting of very short answer type questions and covering the entire syllabus will be compulsory. Each question will be divided into parts and the distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit-I** **Lectures: 10**

1. *Chemical basis of life; Composition of living matter; Water–properties, pH, ionization and hydrophobicity; Biomolecular hierarchy*
2. Macromolecules; Molecular assemblies; Structure-function relationships
3. Amino acids – structure and functional group properties; Peptides and covalent structure of proteins
4. Elucidation of primary and higher order structures; Evolution of protein structure
5. Structure-function relationships in model proteins like ribonuclease A, myoglobin, hemoglobin, chymotrypsin etc.

**Unit-II** **Lectures: 10**

6. *Enzyme catalysis – general principles of catalysis; Quantitation of enzyme activity and efficiency*
7. Enzyme characterization and Michaelis-Menten kinetics; Relevance of enzymes in metabolic regulation, activation, inhibition and covalent modification; single substrate enzymes
8. Sugars - mono, di, and polysaccharides; suitability in the context of their different functions- cellular structure, energy storage, signaling
9. Glycosylation of other biomolecules - glycoproteins and glycolipids

**Unit-III** **Lectures: 10**

10. *Lipids - structure and properties of important members of storage and membrane lipids; lipoproteins*
11. Organization of biomembrane
12. Membrane bound proteins - structure, properties and function; transport phenomena
13. Nucleosides, nucleotides, nucleic acids - structure, diversity and function; Brief overview of central dogma

**Unit-IV** **Lectures: 10**

*14.* Bioenergetics-basic principles; Equilibria and concept of free energy; Coupled processes;

*15. Glycolytic pathway; Kreb's cycle; Oxidative phosphorylation*

*16.* Elucidation of metabolic pathways; Logic and integration of central metabolism

*17.* Entry/ exit of various biomolecules from central pathways

*18.* Principles of metabolic regulation; Regulatory steps; Signals and second messengers

**Suggested Books:**


1. Nelson & Cox, Principles of Biochemistry (5th Edition), Freeman, 2008
2. Voet & Voet, Biochemistry (4th edition), Wiley Press, 2006
3. Stryer, Biochemistry (6th Edition), W.H. Freeman, 2007
4. P.S. Bisen, Laboratory Protocols in Applied Life Sciences, CRC 2014
5. P.S. Bisen & Anjana Sharma, Introduction to Instrumentation in Life Sciences, CRC 2013


**PRACTICAL-*BIOCHEMISTRY***

| | |
|---|---|
| Core Course (Lectures: 10) | Maximum Practical Marks: 25 |
| Time Allowed: 2 Hrs | External Marks: 20 |
| Credits: 1 | Internal Assessment: 5 |

1. Handling of tissue for biochemical analysis
2. Detailed methods for preparation of buffers and solutions with special attention to normality, molarity, etc.
3. Quantitative estimation of proteins, lipids and carbohydrates in brain tissues
4. Demonstration and analysis of biomolecules using TLC/Paper chromatography

**241/NEU/CC102: CELL BIOLOGY AND NEURON ORGANIZATION**

**Note:** Neurons contain the same intracellular components, as do other cells. Understanding of brain function would absolutely need a clear understanding of the cellular and molecular organization of neurons and glia as units. Thus , in this paper the student is expected to learn in greater details the sub- cellular and molecular organization of neurons and glia. In view of the explosion of knowledge in Cell Biology we have tried to detail out theimportant aspects in each topic to easily confine to a limit in teaching.

| | |
|---|---|
| Core Course (Lectures: 40) | Maximum Theory Marks: 75 |
| Time Allowed: 2 Hrs | External Marks: 50 |
| Credits: 3 | Internal Assessment: 25 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two questions from each section. Q. No. 1 consisting of very short answer type questions and covering the entire syllabus will be compulsory. Each question will be divided into parts and the distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit-I** **Lectures: 10**

1. Bio membrane structure and functions; Transport of ions and macromolecules; Pumps, carriers and channels
2. Endo- and exocytosis; Membrane carbohydrates and their significance in cellular recognition; Cellular junctions and adhesions
3. *Nucleus – Structure and function of nuclear envelope, lamina and nucleolus; Macromolecular trafficking; Chromatin organization and packaging*
4. Cell cycle and control mechanisms

**Unit-II** **Lectures: 10**

5. Mitochondria – Structure; Organization of respiratory chain complexes; ATP synthase; Structure-function relationship; Mitochondrial DNA and male sterility
6. *Structure and function of Golgi apparatus, lysosomes and endoplasmic reticulum*
7. *Organization and role of microtubules and microfilaments; Cell shape and motility*
8. Actin-binding proteins and their significance; Muscle organization and function; Molecular motors; Intermediate filaments; Extracellular matrix in animals

**Unit-III** **Lectures: 10**

9. *An overview of the nervous system*
10. Neurons: Introduction to neurons, The Neuron Doctrine, The Nissl and Golgi stains, Components of neurons
11. *Cytology of neurons, Classification and types of neurons*
12. Dendrites structure and function, Axons structure and functional aspects, myelination and synapses

**Unit-IV** **Lectures: 10**

13. *Glial cells: Structure and function of glial cells, Different types of glial cells: astrocytes, oligodendrocytes and Schwann cells*
14. *Types of astrocytes – type I & II astrocytes, fibrous and protoplasmic astrocytes, Importance of astrocytes in glutamate metabolism and blood brain barrier*
15. Functions of other glial cells: oligodendrocyte and microglial cells, Microglial phenotypes,
16. Overview of glial and neuronal relationship in the CNS

**Suggested Books:**

1. Siegel, Basic Neurochemistry (8th Edition) Academic Press,2015
2. Albertes, Molecular Biology of the Cell (6th Edition) Garland Science,2015
3. Kandel, Principles of Neural Science (5th edition), McGraw Hill,2013
4. Verkhratsky, Glial Neurobiology, A Text Book, Wiley, 2007

**PRACTICAL- CELL BIOLOGY**

| | |
|---|---|
| Core Course (Lectures: 10) | Maximum Practical Marks: 25 |
| Time Allowed: 2 Hrs | External Marks: 20 |
| Credits: 1 | Internal Assessment: 5 |

1. Microtomy/Cryotomy/Vibratomy
2. Histology: General methods: Hematoxylin & Eosin staining, Cresyl violet (Nissl) staining
3. Histochemical demonstration of the following in brain tissue:
    i. Lipids
    ii. Proteins
    iii. Carbohydrates
    iv. Enzymes (Acid phosphatase and Alkaline phosphatase)
    v. Nucleic acids
4. Study of permanent slides and electron micrographs

**241/NEU/CC103: NEUROANATOMY**

**Note:** It is expected that a student of M. Sc. Neuroscience should have basic understanding of the anatomical organization of the nervous system during the 1st semester so that he/she is able to correlate the functional aspects in subsequent stages of learning.

| | |
|---|---|
| Core Course (Lectures: 40) | Maximum Theory Marks: 75 |
| Time Allowed: 2 Hrs | External Marks: 50 |
| Credits: 3 | Internal Assessment: 25 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two questions from each section. Q. No. 1 consisting of very short answer type questions and covering the entire syllabus will be compulsory. Each question will be divided into parts and the distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit-I** **Lectures: 10**

1. Gross anatomy of the adult brain; organization of the nervous system
2. Subdivisions of the nervous system; Concept of CNS, ANS & PNS
3. *The scalp, skull and meninges*
4. Cerebrospinal fluid
5. Constitutions of CNS: Overview; Neuronal elements, basic circuit, synaptic action, dendritic properties and functional operation of axons

**Unit-II** **Lectures: 10**

6. Peripheral nervous system: General organization; nerves, roots and ganglia; sensory endings
7. Spinal cord: Gross anatomy, internal structure, tracts of the ascending and descending fibers, spinal reflexes;
8. Brainstem: Medulla oblongata, pons, fourth ventricle, Midbrain, nuclei and tracts, reticular formation
9. Cranial nerves: Functional aspects, classification of cranial and spinal nerve components

**Unit-III** **Lectures: 10**

10. Neuronal elements, basic circuit, synaptic action, dendritic properties and functional operation of Thalamus: Scheme of thalamic organization, nuclei of the thalamus;
11. Neuronal elements, basic circuit, synaptic action, dendritic properties and functional operation of Basal ganglia: Corpus striatum, subthalamic nucleus, substantia nigra

12. Neuronal elements, basic circuit, synaptic action, dendritic properties and functional operation of Cerebellum: Gross anatomy, cerebellar cortex, central nuclei, cerebellar peduncles Functional anatomy of cerebellum
13. Neuronal elements, basic circuit, synaptic action, dendritic properties and functional operation of Cerebralcortex: Histology, general organization, functional localization

**Unit-IV** **Lectures: 10**

14. Ascending sensory pathways; Descending motor pathways
15. Neuronal elements, basic circuit, synaptic action, dendritic properties and functional operation of Auditorysystem
16. Neuronal elements, basic circuit, synaptic action, dendritic properties and functional operation of Visual system;
17. Neuronal elements, basic circuit, synaptic action, dendritic properties and functional operation of olfactorysystem and Limbic system

**Suggested Books:**


1. John A. Kierrnan, Barr's the Human Nervous System (10th Edition), Lippincott-Raven,2014
2. Richard S. Snell, Clinical Neuroanatomy for the Medical Students (7th Edition) Lippincott- Williams & Wilkins, 2010
3. Susan Standring (Editor-in-Chief), Gray's Neuroanatomy: The Anatomical Basis of Clinical Practice (39th Edition), Elsevier, 2005
4. M.J.T. Fitzgerald, Clinical Neuroanatomy & Related Neuroscience (5thEdition) CRC Press, 2007
5. Water, J. Hendelman, Atlas of Functional Neuroanatomy, CRC Press, 2000


**PRACTICAL-NEUROANATOMY**

| | |
|---|---|
| Core Course (Lectures 10) | Maximum Practical Marks: 25 |
| Time Allowed: 2 Hrs | External Marks: 20 |
| Credits: 1 | Internal Assessment: 5 |

1. Dissection of nervous system of rat as experimental model
2. Procedure for removal of various parts of brain in rat and other experimental animals for further study
3. Perfusion techniques
4. Processing and handling of tissue for microanatomy of brain
5. Immunocytochemistry: Tissue processing, Immuno-enzymatic methods
6. Fluorescence microscopy and immunofluorescence methods

**241/NEU/DS101: RESEARCH METHODS, BIOSTATISTICS AND COMPUTER APPLICATIONS**

| | |
|---|---|
| Discipline Specific Elective (Lectures 40) | Maximum Theory Marks: 75 |
| Time Allowed: 2 Hrs | External Marks: 50 |
| Credits: 3 | Internal Assessment: 25 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two questions from each section. Q. No. 1 consisting of very short answer type questions and covering the

entire syllabus will be compulsory. Each question will be divided into parts and the distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit-I** **Lectures: 10**

1. Principle of experimental design; Collection of data, sampling and presentation of data Statistical tables, charts and graphs
2. Centering constants and their measurements: Mean, median and mode; Measurement of variability: like deviation, standard deviation, standard error, etc.

**Unit-II** **Lectures: 10**

3. Tests of significance: Student t-test, Chi-square test; ANOVA- one way and two-way; Coefficient of correlation and regression

**Unit-III** **Lectures: 10**

4. Designing of an experiment for a hypothesis
5. Case studies at a neurology ward
6. Case studies of biological populations
7. Basics of animal handling and maintenance

**Unit-IV** **Lectures: 10**

8. Computer applications: Word, Excel and Power point
9. Image analysis
10. Stereology

**Suggested Books:**

1. Kotz, L., "Biostatistics: A Foundation for Analysis in the Health Sciences, 7th Edition"
2. Buxton, M., "Research Methods for Clinical and Health Sciences, 2nd Edition"
3. Petrie, A., "Medical Statistics at a Glance, 4th Edition"
4. Campbell, M., "Statistics in Medicine, 3rd Edition"
5. Armitage, P., "Statistical Methods in Medical Research, 4th Edition"
6. Altman, D., "Practical Statistics for Medical Research, 2nd Edition"

**Semester-II (Credits=22)**

**241/NEU/CC201: LABORATORY TOOLS AND TECHNIQUES**

**Note:** The prime objective of the course is to develop trained manpower that would take up the challenges of neuroscience research. In view of this selective methods in neurobiology research have been included in this paper so that the student will have a feel of the contemporary techniques and the methods employed in neurobiology research. They will be taught about the principles and applications of such methods. However, extensive details with wide range of examples shall be avoided.

| | |
|---|---|
| Core Course (Lectures 40) | Maximum Theory Marks: 75 |
| Time Allowed: 2 Hrs | External Marks: 50 |
| Credits: 3 | Internal Assessment: 25 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two questions from each section. Q. No. 1 consisting of very short answer type questions and covering the entire syllabus will be compulsory. Each question will be divided into parts and the distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit-I** **Lectures: 10**

1. Principles of fixation and staining of nervous tissue; Methods of tissue processing for microtomy, cryotomy and vibratomy
2. Golgi and other impregnation methods
3. Immunocytochemistry: Principles and applications
4. Basic concepts of microscopy; Principles and applications of confocal microscopy; Principles and applications of fluorescence microscopy, scanning and transmission electron microscopy

**Unit-II** **Lectures: 10**

5. Tools in electrophysiological studies of the brain in animals
6. Spectroscopy Techniques: UV, Visible Spectroscopy; Fluorescence; MS, NMR
7. Chromatography Techniques: Chromatographic methods for macromolecule separation- TLC and Paper chromatography; Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC

**Unit-III** **Lectures: 10**

8. Centrifugation: Principle and types of centrifuges and their applications; Ultracentrifugation, g force
9. Electrophoretic techniques: Theory and application of Polyacrylamide and Agarose gel electrophoresis and brief idea about other types of electrophoresis.
10. Imaging techniques: MRI, PET, SPECT, MRI/FMRI

**Unit-IV** **Lectures: 10**

11. Cell culture techniques; Cell counting, Splitting, Cryopreservation; Primary cell culture, Cell lines, Explants/ Tissue culture
12. Recombinant DNA technology: Preparation of recombinant DNA (Gene cloning)
13. Preparation of genomic and c-DNA libraries, General idea of expression library; screening of gene libraries
14. Methods in gene analysis: Hybridization techniques; Southern, Northern, Western, Dot and slot blots and *in situ*
    i. hybridization

**Suggested Text Books**


1. Williams & Walker, Practical Biochemistry (5th Edition), Cambridge, 2000
2. Plummer, Practical Biochemistry (3rd Edition), Tata-McGraw Hill, 2004
3. Friefelder, Physical Biochemistry (2nd Edition), Freeman, 1982
4. Bancroft, Theory and Practice of Histological Techniques (7th Edition), Churchill Livingstone, 2014
5. Wadhwa & Dinda, Stereology, Image Processing and Quantitative, Image Analysis in Biomedical Research
6. Cohen & Wilkin, Neural Cell Culture, OUP, 1996
7. Kothari, Research Methodology (2nd Edition), New Age, 2005
8. Mahajan, Biostatistics (8th Edition), Jaypee, 2016
9. Rubens, Science & Technical Writing (2nd Edition) Routledge, 2001
10. Renshaw, Immunohistochemistry Scicon, 2007
11. P.S. Bisen, Laboratory Protocols in Applied Life Sciences, CRC 2014
12. P.S. Bisen & Anjana Sharma, Introduction to Instrumentation in Life Science, CRC 2013


**PRACTICAL- LABORATORY TOOLS AND TECHNIQUES**

| | |
|---|---|
| Core Course (Lectures 10) | Maximum Practical Marks: 25 |
| Time Allowed: 2 Hrs | External Marks: 20 |
| Credits: 1 | Internal Assessment: 5 |

1. Microscopy: Prepare slides of biological samples (e.g., blood, tissue); Use light microscopy to observe and identify cellular structures; Use fluorescence microscopy to visualize specific proteins or structures
2. Use HPLC (high-performance liquid chromatography) to analyze biomolecules
3. Enzyme assays: Measure enzyme activity using colorimetric or fluorometric assays; Study enzyme kinetics and inhibition
4. Biochemical assays: Measure protein concentration using Bradford or Lowry assays; Study protein function using enzyme-linked immunosorbent assays (ELISAs)

**241/NEU/CC202: CELLULAR NEUROPHYSIOLOGY AND BIOPHYSICS**

**Note:** This paper is expected to present both the established background and the important developments in brain research. The topics to be covered in a concise enough manners so that the fundamentals are absorbed by a non-specialized student coming from a non-biology or biology background with in the limited term of 90 days teaching, assuming that the student has no prior knowledge of neuroanatomy or neurophysiology. The teaching is to be carried out in a manner that the students understand the solid facts and have an effective brain storming to stimulate ideas in brain research on problems still unsolved.

| | |
|---|---|
| Core Course (Lectures 40) | Maximum Theory Marks: 75 |
| Time Allowed: 2 Hrs | External Marks: 50 |
| Credits: 3 | Internal Assessment: 25 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two questions from each section. Q. No. 1 consisting of very short answer type questions and covering the entire syllabus will be compulsory. Each question will be divided into parts

and the distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit-I** **Lectures: 10**

1. Electrical properties of excitable membranes: Basic electricity and electric circuits,
2. Neurons as conductors of electricity, equivalent circuit representation
3. Electrical properties of excitable membranes: Membrane conductance, linear and nonlinear membrane, ionic conductance, current-voltage relations
4. Ion movement in excitable cells: Physical laws, Nernst-Planck Equation, active transport of ions, movement of ions across biological membranes
5. Membrane potential and role of sodium and potassium pumps

**Unit-II** **Lectures: 10**

6. Neural Signals: Overview of Neurons, Synapses and Networks
7. Stimulus Sensory Perception Motor Action / Higher Brain Function
8. Chemical and Electrical Signaling Within a Circuit; Methods to Record Electrical Activity of a Neuron.
9. Action potential, non-gated ion channels and generation of action potential

**Unit-III** **Lectures: 10**

10. Electrical properties of neurons, quantitative models of simulations, Hodgkin & Huxley's analysis of squid giant axon: Voltage-clamp experiments;
11. Voltage gated channels; Biophysical, biochemical and molecular properties of voltage gated channels.
12. Synaptic vesicles, Principles of synaptic transmission: Electrical and chemical synapses
13. Calcium hypothesis: Control of transmitter release

**Unit-IV** **Lectures: 10**

14. Synthesis and trafficking of neuronal proteins.
15. Synaptic transmission at nerve-muscle synapses
16. Synaptic transmission at central synapses
17. Ligand gated channels
18. Second messengers: cAMP, cGMP, IP3, DAG, PKA, PKC and $Ca^{2+}$ ions; and synaptic transmission

**Suggested books;**


1. Squire, Fundamental Neuroscience (4th Edition), Elsevier, 2013
2. Kandel, Principles of Neural Science (5th edition), McGraw Hill,2013
3. Duchene E. Haines, Fundamental Neuroscience for Basic & Clinical Applications (3rd Edition), Churchill Livingstone,2006
4. Bear, Neuroscience-Exploring the Brain (3rd Edition), Lippincott, 2007


**PRACTICAL-NEUROPHYSIOLOGY**

| | |
|---|---|
| Core Course (Lectures 10) | Maximum Practical Marks: 25 |
| Time Allowed: 2 Hrs | External Marks: 20 |
| Credits: 1 | Internal Assessment: 5 |

1. Acquisition of data for various physiological parameters using Biopac Electrophysiological recording setup:
    a. EEG
    b. ECG
    c. EMG, EOG
    d. Heart rate, respiration, pulse rate, heart sound, etc.
2. To determine pain sensitivity in rat/mice using Tail-Flick Analgesia meter and Paw test apparatus
3. To learn the use of Stereotaxic instrument for neuroscience research
4. Demonstration of basal metabolic rate

**241/NEU/CC203: FUNDAMENTALS OF MOLECULAR BIOLOGY**

**Note:** Current advances in molecular neurobiology have encouraged the neurobiologists to make strides in revealing more about gene expression in nervous system, elucidating nervous system development and understanding the genetic basis of diseases affecting human behaviour. With the belief that there is a molecular basis for memory, behaviour and mental abilities, in about 40 lectures the basics of Molecular Biology shall be taught to the students in this paper.

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|---|---|
| Core Course (Lectures 40) | Maximum Theory Marks: 75 |
| Time Allowed: 2 Hrs | External Marks: 50 |
| Credits: 3 | Internal Assessment: 25 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two questions from each section. Q. No. 1 consisting of very short answer type questions and covering the entire syllabus will be compulsory. Each question will be divided into parts and the distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit-I Structure and Functions of Nucleic Acids** **Lectures: 10**

The beginning of Molecular Biology, DNA: A carrier of genetic information, Chemical structure of DNA and Base composition, biologically important nucleotides, Watson-Crick model, Supercoiled DNA, structure of different types of nucleic acids, hydrolysis of nucleic acids, Conformation of nucleic acids: A-, B-, Z- t-RNA, Stability of nucleic acid structure.

**Unit-II DNA Replication and Repair** **Lectures: 10**

Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, DNA damage and repair mechanisms. Gene editing, Gene targeting.

**Unit-III RNA Synthesis and Processing** **Lectures: 10**

Structure and function of RNA polymerases, Transportation in prokaryotes, Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

**Unit-IV Protein Synthesis and Processing** **Lectures: 10**

Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, posttranslational modification of proteins.

**Suggested Books:**


1. Simmons, Principles of Genetics (7th Edition), Wiley, 2011
2. Strickberger, Genetics (3rd Edition), PHP Press, 2008
3. Albertes, Molecular Biology of the Cell (5th Edition) Garland Science,2008
4. Lewin, Genes X, Jones & Bartlett, 2011
5. Griffiths & Miller, Introduction to Genetic Analysis (8th Edition), Freeman,2005
6. Lodish, Molecular Cell Biology (6th Edition), Freeman, 2008
7. Smith, Elements of Molecular Neurobiology, Wiley, 2002


**PRACTICAL- MOLECULAR BIOLOGY**

| | |
|---|---|
| Core Course (Lectures 10) | Maximum Practical Marks: 25 |
| Time Allowed: 2 Hrs | External Marks: 20 |
| Credits: 1 | Internal Assessment: 5 |

1. Electrophoresis/SDS PAGE
2. Isolation and purification of DNA and/or RNA and estimation of their concentration and purity check using UV- spectrophotometer
3. PCR, RT-PCR
4. Protein purification techniques

**241/NEU/DS201: *IMMUNOLOGY***

Note: This paper has been designed to provide an exposure to fundamental concepts of immunology from anatomy to clinical aspects. The student is expected to have an understanding of the subject to an extend to be able to comprehend the bases of immunological disorders in general and the brain in particular.

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|---|---|
| Discipline Specific Elective (Lectures 40) | Maximum Theory Marks: 75 |
| Time Allowed: 2 Hrs | External Marks: 50 |
| Credits: 3 | Internal Assessment: 25 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two questions from each section. Q. No. 1 consisting of very short answer type questions and covering the entire syllabus will be compulsory. Each question will be divided into parts and the distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit-I** **Lectures: 10**

1. Immunology- fundamental concepts
2. Innate and acquired immunity, components of innate and acquired immunity, Complement system: Classical, Alternative and Lectin pathway
3. Antibody structure, antigen-antibody interactions
4. Cells and organs of the immune system and regulation of immune response
5. Cellular basis of adaptive immunity, B-cell and antibodies

**Unit-II** **Lectures: 10**

6. Generation of antibody diversity
7. T cells; Helper T cells and lymphocytic activation
8. MHC proteins
9. Immunity to infection Bacterial, viral, fungal and parasitic infections (with examples from each group).

**Unit-III** **Lectures: 10**

10. Overview of multiple sclerosis and autoimmune disease
11. Mechanisms of neuroinflammation; Role of astrocytes, Schwann cells and microglia
12. Hypersensitivity,
13. Autoimmunity

**Unit-IV** **Lectures: 10**

14. Transplantation
15. Tumor immunology and Immunodeficiency
16. Neuro-AIDS
17. Immunotechnology: Hybridoma technology, Monoclonal antibodies, Vaccines, DNA vaccines, subunit vaccines
18. Immunochemical techniques antigen-antibody interactions and various cellular techniques

**Suggested Books:**

1. Kuby Immunology (7th Edition), W.H. Freeman,2013
2. Banjamini, Immunology (5th edition), Wiley Liss, 2003
3. M. Roitt, Immunology (7th Edition), Mosby Publication,2006
4. Janeway, Immunobiology (6th Edition), Churchill Livingstone, 2008
5. Verkhratsky, Glial Neurobiology, A Text Book, Wiley, 2007

**(Semester I) MULTIDISCIPLINARY COURSE: 241/NEU/MD101 INTRODUCTION TO NEUROSCIENCE**

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|---|---|
| Multidisciplinary Course (Lectures 40) | Maximum Theory Marks: 75 |
| Time Allowed: 2 Hrs | External Marks: 50 |
| Credits: 3 | Internal Assessment: 25 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two questions from each section. Q. No. 1 consisting of very short answer type questions and covering the entire syllabus will be compulsory. Each question will be divided into parts and the distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit-I** **Lectures: 10**

Introduction to Neuroscience: Definition and scope of neuroscience; Organization of the nervous system (central and peripheral); Neuron structure; Synapses and neural transmission; Neuroglial cells and their roles

**Unit-II** **Lectures: 10**

Brief overview of Sensory and Motor Systems; Reflexes and reflex arcs; Neurotransmitters Types and functions; Neuropharmacology: Drugs and their effects on neural systems

**Unit-III** **Lectures: 10**

Brain Regions and Functions: Cerebral cortex (lobes and areas); Hippocampus and memory; Amygdala and emotions; Brainstem and autonomic functions; Basal ganglia and cerebellum functions

**Unit-IV** **Lectures: 10**

Synaptic plasticity and learning; Neurological and Psychiatric Disorders: Stroke and neurodegenerative diseases (e.g., Alzheimer's, Parkinson's); Anxiety, depression, and other psychiatric conditions

**Suggested books;**

1. Squire, Fundamental Neuroscience (4th Edition), Elsevier, 2013
2. Kandel, Principles of Neural Science (5th edition), McGraw Hill,2013
3. Duchene E. Haines, Fundamental Neuroscience for Basic & Clinical Applications (3rd Edition), Churchill Livingstone,2006
4. Bear, Neuroscience-Exploring the Brain (3rd Edition), Lippincott, 2007

**(Semester II) MULTIDISCIPLINARY COURSE: 241/NEU/MD201 *NEUROPSYCHOLOGY***

Note: This syllabus provides a comprehensive overview of the field of neuropsychology, covering the basics of brain structure and function, cognitive processes, neuropsychological disorders, assessment and diagnosis, rehabilitation, and special topics.

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|---|---|
| Multidisciplinary Course (Lectures 40) | Maximum Theory Marks: 75 |
| Time Allowed: 2 Hrs | External Marks: 50 |
| Credits: 3 | Internal Assessment: 25 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two

questions from each section. Q. No. 1 consisting of very short answer type questions and covering the entire syllabus will be compulsory. Each question will be divided into parts andthe distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit-I** **Lectures: 10**

Introduction to Neuropsychology: Definition and scope of neuropsychology; Historical background and key figures; Relationships between brain, behavior, and cognition; Brain Structure and Function: Overview of brain anatomy and neurophysiology; Cerebral cortex, basal ganglia, limbic system, and brainstem; Neurotransmitters and neural transmission

**Unit-II** **Lectures: 10**

Cognitive Processes: Attention and executive functions; Memory (types, models, and disorders); Language processing and aphasia; Visuospatial perception and spatial cognition; Decision-making and judgment

**Unit-III** **Lectures: 10**

Neuropsychological Disorders: Traumatic brain injury and concussion, stroke and cerebrovascular disorders, Alzheimer's disease and other dementias, Parkinson's disease and movement disorders, Neuropsychiatric conditions (e.g., depression, anxiety); Neurodevelopmental disorders (e.g., ADHD, autism); Neurological disorders (e.g., multiple sclerosis, epilepsy)

**Unit-IV** **Lectures: 10**

Neuropsychological testing and evaluation: Clinical interviews and behavioral observations; Neuroimaging techniques (e.g., MRI, CT, fMRI); Diagnostic criteria and case studies; Rehabilitation and Intervention: Cognitive training and remediation, Behavioral therapy and management, Pharmacological interventions, Neuroplasticity and recovery

**Suggested Books:**

1. "Textbook of Clinical Neuropsychology": Organized around syndromes, disorders, and related clinical phenomena.
2. "Clinical Neuropsychology": Comprehensively reviews the major neurobehavioral disorders associated with brain dysfunction.
3. "Fundamentals of Human Neuropsychology": Gives students access to an extraordinary amount of cutting-edge research.
4. "Diagnostic Clinical Neuropsychology": A handbook for neuropsychological assessment that includes the evaluation of both cognitive and emotional aspects of functioning in the patient.
5. "Neuroanatomy Through Clinical Cases": Brings a pioneering interactive approach to the teaching of neuroanatomy.
6. "APA Handbook of Neuropsychology": Provides foundational information on neuropsychology, identifies pressing research questions related to neuropsychological disorders and conditions.
7. "Encyclopedia of Clinical Neuropsychology": The first and only encyclopedia of clinical neuropsychology covering assessment, treatment, and rehabilitation.

**(Semester I) VALUE ADDED COURSE: 241/NEU/VA101 BIOETHICS AND BIOSAFETY**

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|---|---|
| Value Added Course (Lectures 28) | Maximum Theory Marks: 50 |
| Time Allowed: 2 Hrs | External Marks: 35 |
| Credits: 2 | Internal Assessment: 15 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two questions from each section. Q. No. 1 consisting of very short answer type questions and covering the entire syllabus will be compulsory. Each question will be divided into parts and the distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit I: Animal ethics** **Lectures: 7**

Constitution of institutional ethical committee, CPCSEA and ICMR guidelines, government of India.

**Unit II: Human ethics in research** **Lectures: 7**

Constitution of institutional ethical committee, ICMR guidelines, government of India. Helinsky agreement and guidelines. Permitted and not permitted invasive investigations.

**Unit III: Bio-safety** **Lectures: 7**

Introduction and fundamentals of bio safety and bio hazards. Potential sources of infection, threat and epidemic and pandemic outbreaks.

**Unit IV**: **Good practices in safe bioscience research** **Lectures: 7**

Hygiene, disposal of live tissues and bio materials, Color coding of disposal bags and proper sanitation and disinfection before disposal, Protective methods and treatment in case of hazards.

**(Semester II) SKILL ENHANCEMENT COURSE: 241/NEU/SE201 PERSONALITY AND SKILL DEVELOPMENT**

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|---|---|
| Skill Enhancement Course (Lectures 28) | Maximum Theory Marks: 50 |
| Time Allowed: 2 Hrs | External Marks: 35 |
| Credits: 2 | Internal Assessment: 15 |

**Instructions for Paper Setter**: The examiner will set nine questions in all with two questions from each section. Q. No. 1 consisting of very short answer type questions and covering the entire syllabus will be compulsory. Each question will be divided into parts and the distribution of marks will be indicated part-wise. The candidates will be required to attempt Q. No. 1 & four others, selecting one from each section.

**Unit-I: Communication Skills** **Lectures: 7**

Concept of effective communication- Setting clear goals for communication; Determining outcomes and results; Initiating communication; Avoiding breakdowns while communicating; Creating value in Conversation; Barriers to effective communication; Non-verbal communication- Interpreting non-verbal cues; Importance of body language, Power of effective listening; recognizing cultural differences

**Unit-II: Presentation skills** **Lectures: 7**

Formal presentation skills; Preparing and presenting using Over Head Projector, Power Point; DefendingInterrogation; Scientific poster preparation & presentation; Participating in group discussions

**Unit-III: Computing Skills for Scientific Research** **Lectures: 7**

Web browsing for information search; search engines and their mechanism of searching; Hidden Web and its importance in scientific research; Internet as a medium of interaction between scientists; Effective email strategy using the right toneand conciseness

**Unit-IV: Technical Writing Skills** **Lectures: 7**

Types of reports; Layout of a formal report; Scientific writing skills: Importance of communicating Science; Problems while writing a scientific document; Plagiarism; Scientific Publication Writing: Elements of a Scientific paper including Abstract, Introduction, Materials & Methods, Results, Discussion, References; Drafting titles and framing abstracts