Faculty of Allied Health Sciences

Department of Paramedical Sciences

SGT UNIVERSITY

Shree Guru Gobind Singh Tricentenary University (SGTU)
Gurugram, Haryana, India-122505

M.Sc. Neuroscience and Neurotechnology (MNNT)

Duration: 2 years (4 Semesters)
(2021-23)

Brochure and Course Content

Total credits: 96

In full compliance of the New Education Policy (NEP) of the Govt. of India as implemented by the SGTU

M. Sc. in Neuroscience and Neurotechnology (MNNT)

Goal: Rapid advancements in neuroscience have opened unprecedented possibilities for its application to various aspects of human life. Neuroscience and Neurotechnology course aims to equip students in advancing the basic and technical knowledge of brain functions. The course has a high potential in career advancement in research and applied fields in academia, health and pharmaceutical industries.

Preamble: Neuroscience research has greatly benefitted from advancements in related technologies. These benefits come in several ways, in academic as well as applied domains. Neurophysiology research is a key domain dealing with brain and nervous system. This novel course of masters in Neuroscience and Neurotechnology is most probably one of its own kind of program in the current scenario for developing a human resource for academic and research needs in the fields of physiology of the neural systems. This course is of 4 semesters and is being aimed to operate at a phase, spanning basic and applied sciences and technology. The students passing from this course should be able to find high valued positions in academic as well as industrial ecosystems as they will know the core as well as the crust.

PROGRAM EDUCATION OBJECTIVES:

1. To provide students with basic and broad knowledge of the field of neuroscience.
2. To enable students to develop qualitative, analytical, and laboratory technical skill related to molecular neuroscience and diagnostic neurophysiology.
3. To acquaint students with the basic and advanced biochemistry and immunology of neurons and glia.
4. To provide students with an understanding of the fundamentals of molecular biology. The students would learn the basic principles of DNA replication and repair; RNA synthesis and processing; and protein synthesis and processing.
5. To provide students with the know-how of scientific research, like the various methodological approaches used to conduct research and how data is collected and analyzed while answering a research problem. Students will also learn how to apply biostatistics on the scientific data. They would be acquainted with the various statistical tools and tests.
6. To educate them about the bioethical and biosafety measures that need to be taken care of while doing biomedical research.
7. To enable them to contribute towards developing mathematical tools for studying brain functions using computational neuroscience.
8. To foster and nurture a talent for thinking towards innovation in biomedical technology.
9. To develop students' ability to be critical and independent thinkers.
10. To enable students to develop their ability to communicate scientific findings clearly.

Career Opportunities:

1. Academic pursuits leading to M. Phil and Doctorate programs.
2. Teaching in various colleges and universities.

3. Research and development related career opportunities in national/ international and industrial environments and set ups.
4. Start-up opportunities.

Support and Sensitivity: A special provision of scholarship/ financial support will be developed by the SGT University supplementing the existing scholarship scheme for meritorious, however, deprived students. Equal opportunity and gender equality will be promoted from admission to passing out.

MASTERS DEGREE PROGRAMME IN ALLIED HEALTH SCIENCES

ORDINANCE

1. **Scope of the Ordinance:**
   This ordinance will be applicable to the M.Sc. Neuroscience and Neurotechnology (MNNT) programme.

2. **Duration of the Programme:**
   The duration of the MNNT programme shall be of two academic years consisting of four semesters. On successful completion of all the four semesters, the student will be awarded M.Sc. degree with the nomenclature given under Clause (1) above. The student shall complete the programme within a maximum period of 4 years from the date of admission to the first semester, failing which he/she will be disqualified from the programme.

3. **Admission to the Programme:**
   Admission into M.Sc. Neuroscience and Neurotechnology program of SGT University is governed by SGT University admission regulations.

   Number of Seats: 10 (session 2021-2022)

   i) Eligibility for Admission:

   - Any graduate degree in fields of basic, applied or allied sciences/ vocational course with atleast one life sciences or related subject, and having studied biology at 10+2 level.
   - Admission into M.Sc. Neuroscience and Neurotechnology (Master of Science in Neuroscience and Neurotechnology) will be based on a merit system and the rule of reservation (as per rules of the SGT University and the Haryana Govt. rules), wherever applicable.
   - Lateral entry may be offered to selected students fulfilling the initial eligibility criteria and additional educational qualifications as decided by the SGTU in compliance to NEP. A direct enquiry with the admission office is advised.

   ii) Schedule of admission and payment of fees:

   The admission schedule, along with last date for submission of admission forms and payment of fees, shall be fixed by the Vice-Chancellor from time to time.

4. **Mode of Selection of Candidates for Admission:**
   The admissions will be made as per the following criteria:

Sr. No.	Criteria	Condition
1	On the Basis of the Merit of the qualifying Examination.	If the no. of applicants is up to 3 times of the intake
2	On the Basis of the Merit of the Entrance Examination.	If the no. of applicants is more than 3 times of the intake

5. **Scheme of Examinations, distribution of marks, credit system and syllabus:**

The Scheme of Examinations, distribution of marks in various papers along with the credit system and the syllabi of the M.Sc. programmes shall be as approved the by Board of Studies/ Academic Council from time to time. (Scheme of Examination attached)

6. **Medium of Instruction:**
The medium of instruction and examination shall be English for all the programmes.

7. **Attendance Requirements and Eligibility to Appear in Examination:**
The student should fulfill the following criteria to be eligible for appearing in the End Term Semester Examination:

(i) He/She should bear a good moral character.
(ii) He/She should be on the rolls of the Faculty during the semester.
(iii) He/She should have 75% of the attendance during the respective semester.
(iv) The deficiency in the attendance, both in theory and practicals may be condoned by the Dean/ Director of the Faculty up to 5%.
(v) The deficiency may be further condoned by the Vice Chancellor in cases of exigencies/ extreme circumstances.
(vi) The student, who does not fulfil the condition laid down under (iii) to (v) above taken in aggregate may be allowed to appear only in the subject in which he/she fulfils the condition as per the sub clause (iii) to (v) above.
(vii) He/she should not be a defaulter in payment of any dues of the SGT University and no disciplinary action is pending against the student.
(viii) He/she should not be a defaulter in payment of any dues of the SGT University and no disciplinary action is pending against the student.

8. **Exemption from Attendance / Shortage of attendance to be condoned:**
The relaxation in shortage of attendance shall be given as per the following rules:

Sr. No	Exemptible No. of Lecture	Ground of Exemption	Competent Authority
1	All periods of the day of donation	Voluntarily blood donation to the Blood Bank.	Dean of the Faculty
2	All periods of the day of Examination	For appearing in the supplementary examinations (Theory/ Practical/ Viva-voce)	-do-
3	10 days attendance during a semester	For participation in University programmes/ University or Inter-Collegiate Sports Tournaments/ Youth Festivals, Cultural events/NCC/ NSS Camps/ University Educational Excursions/ Mountaineering Programmes	-do-
4	15 days attendance during a semester	For participation in Inter-University Sports Tournaments/ Youth Festivals	-do-

Provided:
I. that he/she has obtained prior approval of the Dean, Faculty of Allied Health Sciences;
II. that credit may be given only for the days on which lectures were delivered or tutorials

or practical work done during the period of participation in the aforesaid events.

9. **Attendance Shortage Warning:**
Attendance shortage warning will be displayed on the Faculty's Notice Board and/or University Website regularly.

10. **Detained students:**
If a student does not fulfill the condition of 75% attendance in any semester as per clauses 7-8, he/she will not be eligible for appearing in the End Term Examination accordingly and will be deemed to have been detained in the concerned paper(s). Such students will attend the classes with the regular students of the subsequent batch or he/she will make up the deficiency in attendance in accordance with the arrangement made by the Dean of the faculty to fulfill prescribed conditions to appear in the concerned examination of the programme/ paper as per clause 7 and clause 17.

11. **Submission of Examination Forms and Payment of Examination Fee:**
The Dean, Faculty of Allied Health Sciences shall submit the examination admission forms of those students who satisfy the eligibility criteria to appear in the examinations along with the prescribed examination fee to the Controller of Examinations as per schedule of examination circulated by the Controller of examinations from time to time.

12. **University Examinations:**

(i) End Term Semester Examinations:
The examination for the 1st and 3rd semesters (Odd Semesters) shall ordinarily be held in the month of December and of the 2nd and 4thsemesters (Even Semesters) in the month of May/June.

(ii) Fail/ Reappear Candidates:
Fail / re-appear candidate of the odd semesters (1st& 3rd) will take re-appear exams as an ex-student in the subsequent exams of the odd semesters (1st & 3rd). Similarly, for the even semesters (2nd & 4th), he/she will take re-appear exams in the subsequent exams of the even semesters (2nd&4th). However, a candidate appearing in the 4thsemester examination (Regular) may appear simultaneously in his/her re-appear paper(s) of lower semesters. The student who fails in the 4th semester examination may appear in the subsequent examination along with the previous papers, if any, whether of odd/even semester.

(iii) Improvement Examination:
After passing all the semesters, a student may appear as an ex-student for improvement of his CGPA for the following purpose:
(i) Improvement of CGPA equal to 2nd division.
(ii) Improvement of the CGPA equal to 55% (aggregate of all the semester)
(iii) Improvement of CGPA equal to 1st division.

(a) For improvement, only one chance for each semester will be given within a period of two years of initially passing of the final examination.
(b) If a candidate appears for improvement and the status/nature of his/her final result does not improve his/her improvement result will be declared "PRS" (Previous Result Stands).

(c) The candidate shall be allowed to appear in the improvement examination(s) along with regular candidates as and when the programme is offered. No separate examination will be held for improvement of division/grade. In case of change of syllabi, the student shall have to appear for improvement in accordance with the changed syllabi of the concerned programme applicable to the regular students of that exam.

13. Distribution of Marks:

The distribution of marks shall be as prescribed in the Scheme of Examinations approved by the Board of Studies/Academic Council of the University.

14. Setting of Question Papers:

(i) The Dean of the Faculty shall supply the panel of internal and external examiners duly approved by the Board of Studies to the Controller of Examinations. The paper(s) will be set by the examiner(s) nominated by the Vice-Chancellor from the panel of examiners. Internal question bank will also be created and submitted to the controller of examination sticking to the domain of syllabus for use in regular and supplementary examination.

(ii) The question paper will be moderated by committee who are proficient in the subject in the office of controller of examination. The moderation will be done to see the difficulty level and that no question is out of syllabus & there is no mistake in the questions and the committee will amend/correct the paper accordingly.

(iii) The examiner(s) will set the question papers as per criteria laid down in the Scheme of Examinations as approved by the Board of Studies/Academic Council of the University.

(iv) The examiner(s) will set the question papers as per criteria laid down in the Scheme of Examinations as approved by the Board of Studies/Academic Council of the University.

15. Appointment of Examiners:

The examiners will be appointed as per the following guidelines with the approval of the Vice-Chancellor:

(i) An internal/external examiner should be of the level of an Assistant Professor/consultant/equivalent or above in the respective subject in a University/Institute/College/hospitals with a minimum experience of 02 years.

(ii) One external and one internal examiner will jointly conduct the practical examination.

(iii) External examiners shall not be from the same University and should preferably be from outside the State/University.

(iv) External examiners shall rotate at an interval of 3 years.

16. Evaluation Process – Theory, Practical, project & Internal Assessment Exams:

(A) Evaluation of Answer Books:

The answer books may be evaluated either by the paper setter or any other internal or external examiner to be nominated by the Controller of Examiners with the approval of the Vice-Chancellor from the panel of examiners approved by the Board of Studies.

(B) Re-evaluation of Answer Books:

Re-evaluation/ rechecking of any paper is allowed. The students can apply for Re-evaluation/ Re-checking of any paper through the HoD/ Dean of the Faculty within 10 days of the declaration of the result by paying prescribed fee.

(C) Internal Assessment: (as per university guidelines)

(i) Theory Paper: The internal assessment marks shall be assigned to each theory paper as per scheme of examination which shall be awarded as per the criteria given below:

Distribution of marks (e.g. 40)**:**

1	**Assignment**	**5 marks**
2	**Mid Term Test(10 Marks Each)**	**20 Marks**
3	**Synergy/Project**	**10 marks**
4	**Attendance**	**5 marks**
	Marks distribution for Attendance in % age	
	95<= attendance=100	**5 Marks**
	90<= Attendance<=95	**4 Marks**
	85<= Attendance<=90	**3 Marks**
	80<= Attendance<=85	**2 Marks**
	75<= Attendance<=80	**1 Marks**

(ii) Practical paper: The Internal Assessment for practical paper shall be awarded as per the criteria given below:

Distribution of marks (e.g. 30)**:**

1	**Attendance**	**5 marks**
2	**Practical/Project File/Dissertation**	**10 Marks**
3	**Internal Viva-Voce**	**15 marks**
4	**Marks Distribution for Attendance in % age**	
	95<= attendance=100	**5 Marks**
	90<= Attendance<=95	**4 Marks**
	85<= Attendance<=90	**3 Marks**
	80<= Attendance<=85	**2 Marks**
	75<= Attendance<=80	**1 Marks**

(iii) Project/ Dissertation The Internal Assessment for project/ dissertation shall be awarded as per the criteria given below:

Distribution of marks (e.g. 50)**:**

(a) Attendance = 25% marks (e.g. 12.5 out of total 50 marks)

(b) Project file/ Dissertation = 25% marks (e.g. 12.5 out of total 50 marks)

(c) Internal Viva Voce = 50 % marks (e.g. 25 out of total 50 marks)

(iv) In case of ex-students, those appearing for re-appear/ improvement examination, their previous Internal Assessment marks will be counted or they may be reassessed if they so desire, but this relief will be for one time only and he will be **assessed for the marks on account of Mid Term Test and Assignment and his assessment on account of Attendance/Synergy etc**. will stand same as before. If his internal assessment does not improve, previous internal assessment will be counted.

(v) The concerned teacher shall preserve records on the basis of which the Internal Assessment has been awarded and shall make the same available to the Controller of Examinations whenever required.

(vi) The Head of the Department/ Dean of the Faculty shall ensure that the internal assessment marks are submitted to the Controller of Examinations as per schedule circulated by Controller of Examination.

(D) Practical Examinations:

(i) Appointment of Examiner:

(1) The practical examinations shall be conducted by a Board of two Examiners consisting of one internal and one external examiner to be nominated by the Vice-Chancellor from the panel of examiners recommended by the Board of Studies.

(2) **Distribution of marks in examination of the practical paper will be as per the criteria given below:**

(a) Practical Examination (Conduction/Demonstration)/ Project file/Dissertation = 50% marks (e.g.10 marks out of total 20 marks)

(b) Viva-Voce in End Term Examination by External Experts = 50% marks (e.g. 10 marks out of total 20 marks)

(ii) Comprehensive Viva-Voce:

The comprehensive Viva-Voce for Project/dissertation shall be conducted by a Board of Two Examiners consisting of one internal and one external examiner to be nominated by the Vice-Chancellor from the panel of examiners recommended by the Board of Studies. Evaluation of the Project Report /Dissertation will be done by the External examiner.

(E) Evaluation of Project:

(i) **Topic and Appointment of Guide/Supervisor**

Each student who opts for a Research Paper /Project Report etc. will be assigned a Teacher as Guide/ Supervisor from the Faculty of Allied Health Sciences. Topic of the Research Paper/ Project Report will be as approved by the Dean of the Faculty on the recommendation of the Teacher Guide/Supervisor.

(ii) **Evaluation /Viva Voce:**

The student will submit the Project Report in the form of Dissertation on completion of the 4th semester but 15 days before the commencement of examination failing which it will be acceptable only with late fee of Rs. 1000/-. It will be got evaluated in accordance with above mentioned 16D (iii).

17. Criteria for Promotion to Higher Semester:

(i) **The student will be promoted to the next semesters irrespective of the no. of papers cleared/passed in the lower semesters.** But he/she will not be allowed to appear in the examination of the 4th Semester unless he/she has cleared 50% subjects of 1st and 2nd Semester taken together.

(ii) If the student fails in either theory or practical papers, he/she will have to re-appear only

for the papers in which he/she has failed.

18. Credit Based Grading System:

(i) Grading Method

The grading system will be adopted on a 10 point scale. The grades will be awarded based on marks out of 100 and will be converted into grades as under:

	Range of Percentage of Marks	Letter Grade Value (Corresponding performance)	Range of Grade Points	Classification
	90% and above	O (Outstanding)	9-10	Outstanding
	80% or above but less than 90%	A+ (Excellent)	8<9	Excellent
	70% or above but less than 80%	A (Very Good)	7<8	1st Div. with Distinction
	60% or above but less than 70%	B+ (Good)	6<7	1st Division
	50% or above but less than 60%	B (Above Average)	5<6	2nd Division
	40% or above but less than 50%	C (Average)	Above 4<6	3rd Division
	40%	P (Pass)	4	Pass
	Below 40%	F (Fail)	-	-

Grade 'F' student may re-appear in that paper in the subsequent examination for that semester

(ii) Calculation of SGPA & CGPA

The performance of a student shall be evaluated in terms of two indices, viz. the Semester Grade Point Average (SGPA) for a semester and Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time. The SGPA is calculated on the basis of grades obtained in pass grades in the semester:

$$SGPA = \frac{\Sigma\square\ (C \times G) \text{ for programme with at-least pass grade in a particular semester.}}{\Sigma\square\ (C) \text{ for each semester}}$$

Where C is number of credits of a programme as per study scheme of the program
G is Grade point obtained in that particular programme

The CGPA is calculated on the basis of all pass grades, except audit programmes, obtained in all completed semesters.

$$CGPA = \frac{\Sigma\square\ (C \times G) \text{ for programme with minimum pass grade in all completed semesters.}}{\Sigma\square\ (C) \text{ for all completed semesters}}$$

Where C and G shall have the meanings as given above

19. Pass criteria and grading system:

The minimum percentage of marks to pass the examination will be 40% in theory examination and practical examination separately (including internal assessment).

20. Declaration of Results:

(i) As soon as possible, after the semester examinations are over, the Controller of Examinations shall publish the results of those students who had appeared in the examinations.

(ii) Each successful student/ student placed in reappear shall receive a copy of the Detailed Marks Certificate/ Grade Card Sheet of each semester examination.

(iii) The student whose result is declared late without any fault on his/her part may attend classes for the next higher semester provisionally at his /her own risk and responsibility, subject to his /her passing the concerned semester examination. In case, the student fails to pass the concerned semester examination, he/she will be governed by the clause 16 & 17 of these regulations.

21. Classification of Performance:

The successful students after the 4th semester examination shall be placed classified in five divisions on the basis of final CGPA obtained by him / her in the 1st to 4thsemester examinations as under:

CGPA	Classification of Performance
Those who obtain CGPA of 8.25 or more	First Division with Distinction
Those who obtain CGPA of 6.75 or more but less than 8.25	First Division
Those who obtain CGPA of 5.75 or more but less than 6.75	Second Division
Those who obtain CGPA above Pass Grade but less than 5.75	Third Division
Those who obtain CGPA less than Pass Grade	Fail

22. Grace Marks:

Maximum 1% of total marks excluding internal assessment marks can be awarded to a student in one academic year.

23. Clinical Training:

All the candidates shall complete the recommended hours (Given in scheme of examination) in Clinical Training during the programme. All the students shall go for the compulsory rotatory hospital training each year as approved by the Board of Studies in parent Institution/Hospital. Internship, wherever applicable, will be carried out at the parent Faculty/hospital of Shree Guru Govind Singh Tricentenary (*SGT)* University. The students may be permitted to undergo internship training for not more than six months (50% of total period of internship) in the hospitals empaneled by the SGT University for this purpose or the hospitals approved by MCI/DNB.

24. Other Provisions:

i) Nothing in the Ordinance shall debar the University from amending the Ordinance and the same shall be applicable to all the students whether old or new.

ii) Any other provision not contained in the Ordinance shall be governed by the rules and regulations framed by the University from time to time.

iii) In case of any interpretation, The Vice-Chancellor is empowered in this regard and his interpretation shall be the final.

iv) Notwithstanding the integrated nature of this programme which is spread over more than one academic year, the Ordinance in force at the time a student joins the programme shall hold good only for the examination held during or at the end of the academic year.

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COURSE CONTENT

M. Sc. NEUROSCIENCE AND NEUROTECHNOLOGY (MNNT)								
Semester I								
Paper	**Subject**	**Paper Code**	**Theory Examination**		**Practical Examination**		**Total Marks**	**Credits**
			Univ. Exam	**Int. Assess- ment**	**Univ Exam**	**Int. Assess-ment**		
1	Anatomy and Physiology of Nervous System	05480101	60	40	NA	NA	100	4
2	Basics of Neurobiochemistry and Neuroimmunology	05480102	60	40	NA	NA	100	4
3	Fundamentals of Molecular biology	05480103	60	40	NA	NA	100	4
4	Research Methodology and Biostatistics	05480104	60	40	NA	NA	100	4
5	Tools and Techniques in Molecular Neuroscience	05480105	60	40	NA	NA	100	4
6	Critical Research Appraisal - practical	05480106	NA	NA	NA	50	50	2
7	Practical-I (Anatomy and Physiology of Nervous System)	05480107	NA	NA	20	30	50	2
8	Practical-II (Basics of Neurobiochemistry and Neuroimmunology, Fundamentals of Molecular biology, Tools and Techniques in Molecular Neuroscience)	05480108	NA	NA	20	30	50	2
	Total		**300**	**200**	**40**	**110**	**650**	**26**

Semester II								
1	Biophysics and Neurophysiology	05480201	60	40	NA	NA	100	4
2	Neurological Diseases and Neuropharmacology	05480202	60	40	NA	NA	100	4
3	Behavioural and Cognitive Neurosystems	05480203	60	40	NA	NA	100	4
4	Tools and Techniques of Diagnostic Neurophysiology	05480204	60	40	NA	NA	100	4
5	Bioethics and Biosafety	05480205	60	40	NA	NA	100	4
6	Project Development and Seminar	05480206	NA	NA	NA	50	50	2
7	Practical-III (Biophysics and Neurophysiology, Neurological Diseases and Neuropharmacology)	05480207	NA	NA	20	30	50	2
8	Practical-IV (Behvioural and Cognitive Neurosystems, Tools and Techniques of Diagnostic Neurophysiology)	05480208	NA	NA	20	30	50	2
	Total		**300**	**200**	**40**	**110**	**650**	**26**
Semester III								
1	Neuroendocrinology and Biorhythm	05480301	60	40	NA	NA	100	4
2	Advanced Neurobiochemistry and Neuroimmunology	05480302	60	40	NA	NA	100	4
3	Biomedical Techniques	05480303	60	40	NA	NA	100	4
4	Computational Neuroscience	05480304	60	40	NA	NA	100	4
5	Evaluative Laboratory Training	05480305	NA	NA	40	60	100	4
6	Technical Writing and Seminar-practical	05480306	NA	NA	NA	100	100	4

7	Practical-V (Advanced Neurobiochemistry and Neuroimmunology, Neuroendocrinology and Biorhythm)	05480307	NA	NA	20	30	50	2
8	Practical-VI (Computational Neuroscience and Biomedical Techniques)	05480308	NA	NA	20	30	50	2
	Total		**240**	**160**	**80**	**220**	**700**	**28**
Semester IV								
1	Dissertation (Clinical Research Based) - Practical	05480401	NA	NA	160	240	400	16
2	Dissertation (Laboratory Research Based) - Practical	05480402	NA	NA	160	240	400	16
	Total				**160**	**240**	**400**	**16**

Total Credits : 96
Total credits (Theory) : 60
Total credits (Practical) : 36

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER I

Anatomy and Physiology of Nervous system

PAPER CODE – 05480101

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: the basic knowledge about the anatomy and physiology of the nervous system.
CO2: the overall anatomy of the nervous system in the human body and introduced to the functional cells of the nervous system, viz, the neurons and glia.
CO3: the physiological properties of the neurons and their functions with respect to pain and posture pathways.

Unit I: Neuroanatomy

Gross anatomy of the adult brain, organization of the nervous system, subdivisions of the nervous system, concepts of CNS, ANS and PNS, meninges and cerebral spinal fluid, anatomy of the pituitary gland (normal and enlarged), vertebral column, cutaneous nerve supply of head and neck, limb and trunk, brain, spinal cord, cranial nerve, spinal nerve,

Unit II: Overview of the Brain Cells

Neuron and glia and its properties, Components of neurons, Cytology of neurons, Classification and types of neurons, Dendrite structure and function, Axon structure, functional aspects, and myelination, Electrical property of neurons, Action potential, Propagation of action potential, Synapse, Synaptic and neuro-muscular transmission

Unit III: Neurophysiology

Degeneration and regeneration/repair of nerve fibers, Nerve growth factors, Muscle tone, posture, equilibrium and their regulation, Vestibular apparatus and motion sickness, Pain production, pathways and analgesics, headache and referred pain, Integrative functions of thalamus, cerebellum, basal ganglia and Cerebral cortex, Blood brain barrier, Blood CSF, Split Brain.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER I

Basic Neurobiochemistry and Neuroimmunology

PAPER CODE – 05480102

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: the basic biochemistry of the neurons and glia.
CO2: the different types of cytoskeletal proteins present in the neurons and glia which give both structural and functional properties to these cells.
CO3: the constituents and metabolism of the biomolecules of the neurons which are characteristic of the brain cells.
CO4: about the immune system of the body and how its neural regulation takes place.

Unit I: Neurocellular Biochemistry

Cell biology of the nervous system, Cell membrane, structure and functions, Membrane proteins, Membrane transport, Ion channels, Cytoskeleton of neurons and glia, Intracellular Trafficking, Types of Neurotransmitters, Neurotransmitter release, SNARE proteins, Neuroreceptors- its types and mechanism of action

Unit II: Neurocellular Metabolism

Overview of carbohydrates, lipids and proteins, Glycolysis, TCA cycle, Structure of fatty acids, Classification of lipids, essential fatty acids, Fatty acids: oxidation, synthesis and regulation, Amino acids as building blocks of proteins, Protein structure and Functions, Glutamate-Gutamine cycle

Unit III: Overview of the Immune System

Humoral and Cellular Immunity, Antigens, Immune response to antigens, Innate and adaptive immunity, Hematopoietic stem cells, Lymphatic system, Primary and secondary immune response, B lymphocytes, T lymphocytes, Antibodies

Unit IV: Neural Regulation of the Immune System

Signaling between the immune system and central nervous system, role of sympathetic and parasympathetic nervous system in peripheral immune response, role of cytokines in glucocorticoid release

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER I

Fundamentals of Molecular Biology

PAPER CODE – 05480103

L	T	P	Credits		
4	-	-	4	Examination:	60 Marks
				Int. Assessment:	40 Marks
				Total:	100 Marks
				Duration of Examination:	3 Hours

Course Outcome:

On successful completion of this course, students will learn:

CO1: the fundamentals of molecular biology and develop an understanding of how all biological processes taking place in the body involve one or more of these biomolecules for their functioning.
CO2: the genomics and proteomics of the cells.
CO3: the basic structure and functions of nucleic acids i.e. DNA and RNA.
CO4: the basic principles of DNA replication and repair; RNA synthesis and processing; and protein synthesis and processing.

Unit I: Structure and Functions of Nucleic Acids

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.

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Unit II: DNA Replication and Repair

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

Unit III: RNA Synthesis and Processing

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

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.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER I

Research methodology and Biostatistics

PAPER CODE – 05480104

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: how scientific research is conducted and what are the various methodological approaches used to conduct these researches.
CO2: how data is generated while answering a research problem and all topics related to research methodology, data management and evaluation.
CO3: biostatistics and acquainted with the various statistical tools and tests applied on the scientific data gathered.

UNIT 1: **Introduction of Research Methodology**

Research – Definition, concept, purpose and approaches, Variable in research, reliability & validity in research. Scales of measurement. Steps in the Research Process, Identifying interest areas and prioritizing. Selection of the topic and considerations in selection. Review of related literature and research: Reference management, Concepts, hypotheses and theories. Research Design Research questions, objectives and assumptions (with examples to be brought by students as exercise).

UNIT 2: Detailed Research Methodology

Basic and applied research, Qualitative and Quantitative research (brief review of differences). Descriptive research methods – survey, case study, correlation study, causal-comparative research. Analytic studies- pre-experimental, experimental research, quasi experimental research, Evaluative research- general characteristics, use of qualitative methods in inquiry (Exercise to be based on actual research papers published in accredited journals). Components of a scientific manuscript: Results, Discussion, Conclusion, Summary, Abstract, Bibliography and Appendices.

UNIT 3: Introduction of Biostatistics

Definition, concept and scope in neuroscience and neurotechnology, Collection & presentation of data, Methods of scaling: nominal, ordinal, ratio and interval scale. Measures of central tendency-mean, median, mode and its uses, measures of dispersion /variability- range, variance, standard deviation, standard error, coefficient of variation, Kurtosis, Skewness (practical aspects of grouped data-frequency distribution, histogram, frequency polygons, percentiles

UNIT 4: Data Management, Analysis and Evaluation

Concept of population and sample. Types of sampling methods. General consideration in determination of sample size. Correlation and regression, its interpretation and practical approach, goodness of fit. Concept of probability distribution. ANOVA and Chi-square tests, Parametric and non- parametric tests- t, z and f tests, Mann-Whitney U test, Wilcoxon signed rank test, Friedman test, kruskal Wallis test, Software used in Statistical Analysis and research.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER I

Tools and Techniques in Molecular Neuroscience

PAPER CODE – 05480105

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: the various tools and techniques used in molecular neuroscience.
CO2: how to isolate DNA and RNA and do its quantitative and qualitative estimation.
CO3: various techniques used for purification of proteins.
CO4: the principle and procedure of various spectroscopic techniques, electrophoresis and blotting.
CO5: how tissue culturing is done in the laboratory.

Unit I: Nucleic Acid Extraction

Isolation of nucleic acids, Extraction of genomic DNA & plasmid DNA by boiling lysis method, alkaline lysis method, by Kit methods, RNA extraction, Qualitative and quantitative estimation of DNA & RNA.

Unit II: Polymerase Chain Reaction

Polymerase chain reaction, Nested PCR, Colony PCR, Assembly PCR, touchdown PCR, multiplex PCR, Hot start PCR, Methylation specific PCR, LAMP Assay, Methods for synthesis of double strand cDNA, RT PCR and Real Time PCR, DNA sequencing by Maxum Gilbert method and Sanger's dideoxynucleotide method, RFLP, RAPD

Unit III: Protein Purification Techniques

Salting in, Sating out, Dialysis, Ultrafiltration and precipitation, Chromatography: Principles of chromatography, Paper chromatography, Thin Layer Chromatography, Gel filtration Chromatography, Ion exchange Chromatography, Affinity chromatography, Hydrophobic interaction, Reverse-phase chromatography, HPLC, Gas chromatography

Unit IV: Spectroscopic Techniques, Electrophoresis and Blotting

Lambert Beer's Law, Analysis of biomolecules using UV/visible spectrophotometer, fluorescence, circular dichroism, Electrophoresis, types of electrophoresis, Polyacrylamide and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Isoelectric focusing, Southern Blotting, Northern Blotting and Western Blotting

Unit V: Tissue Culture Techniques

Animal cell culture, Cell lines, Primary cells, Culture media and environment, Subculturing, Sub-culturing adherent cells, Sub-culturing suspension cells, Freezing cells, Thawing frozen cells, Transfection

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER I

Critical Research Appraisal

PAPER CODE – 05480106

L	T	P	Credits		
-	-	2	2	**Examination:**	**NA**
				Int. Assessment:	**50 Marks**
				Total:	**50 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: how to search for research papers related to a topic.
CO2: how to analyze and evaluate the research papers critically.
CO3: how to prepare a comparative report of a few related research articles.
CO4: how to present the critically evaluated papers.

Students must be acquainted with the recent advancements in neuroscience and neurotechnology. Therefore, research seminar is an essential and integral part of this master's program. The student must read and critically evaluate a minimum of five recent research articles published in reputed and high impact journals (Impact Factor > 5) on a particular chosen topic. The article must be taken from PubMed. Each student has to present these five papers in a precise manner. He/She has to submit a report put together on the chosen topic and finally present it in form of a seminar at the end of the semester. The student will be evaluated based on their research aptitude, data analysis, and presentation and writing skills.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER I

Practical I

PAPER CODE – 05480107

L	T	P	Credits		
-	-	2	2	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: the anatomical localization of important human brain areas.
CO2: how to identify various EEG recordings.
CO3: develop laboratory skills.

[Pertaining to the subject Anatomy and Physiology of Nervous System (05480101)]

- Measurement of skull size: Conventional methods.
- Measurement of temperature, blood pressure and heart rate in human subjects. Comparison with other animal models.
- Demonstration of recorded brain waves. Identification of vigilant states in the recorded brain waves. Identification of alpha, beta, delta, theta and gamma brain waves in recorded EEG.
- Cryosectioning of brain
- Identification of some important brain areas such as Thalamus, Anterior and Posterior Hypothalamus, Hippocampus, Amygdala, Locus Coeruleus, Dorsal Raphe etc. in histological slides of the brain under normal microscope.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER I

Practical II

PAPER CODE – 05480108

L	T	P	Credits		
-	-	2	2	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: biochemical tests pertaining to carbohydrates, lipids and fats.
CO2: extraction and quantitative estimation of DNA.
CO3: how to separate proteins by electrophoresis and chromatography.

[Pertaining to subjects Basic Neurobiochemistry and Neuroimmunology (05480102); Fundamentals of Molecular Biology (05480103) and Tools and Techniques in Molecular Neuroscience (05480105)]

- Test for Carbohydrates
- Test for proteins
- Test for lipids
- Validation of Lambert's and Beer's law and derivation of standard curve in colorimetry
- Determination of unknown concentration of colored solutions by photometric method
- Assay of acid phosphatase in crude potato extract
- Effect of pH on phosphatase activity
- Effect of temperature on phosphatase activity
- Effect of substrate concentration on phosphatase activity and determination of Michaelis – Menton constant
- Quantitative estimation of DNA and protein by using spectrophotometry
- Separation of analytes by performing paper & thin layer chromatography
- Extraction of DNA by Boiling Lysis methods
- Extraction of DNA by Alkaline Lysis methods
- Extraction of DNA by kit methods
- Quantitative estimation of DNA and Quality check of DNA by agarose gel electrophoresis
- Polyacrylamide gel electrophoresis of serum proteins.
- Determination of molecular weight of a protein by SDS-PAGE.
- Separation of compounds/ proteins based on specificity - Affinity Chromatography.
- Separation of compounds based on charge - Ion-exchange Chromatography.
- Separation of compounds based on size - Gel permeation Chromatography

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER II

Biophysics and Neurophysiology

PAPER CODE – 05480201

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: what are the electrical properties that make the neurons excitable cells.
CO2: how neural signals are generated and transmitted across the axons.
CO3: what are the various types of channels that govern the inflow and outflow of ions across the neuronal membrane.
CO4: what happens at the neuromuscular junction and how nerves and muscles interact.

Unit I: **Electrical properties of excitable membranes**

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

Unit II: Neural signals

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

Unit III: Properties of neurons

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

Unit IV: Neuromuscular synapse

Synthesis and trafficking of neuronal proteins. Synaptic transmission at nerve-muscle synapses Synaptic transmission at central synapses, Ligand gated channels, Second messengers and synaptic transmission

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER II

Neurological Diseases and Neuropharmacology

PAPER CODE - 05480202

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: about the various genetic and degenerative diseases related to the nervous system.
CO2: about the various neurodegenerative diseases of the aging brain.
CO3: about the neuropharmacology of the neurotransmitters and their receptors.

Unit I: **Neurological diseases**

Autosomal (recessive and dominant) and X-linked neurological diseases –Neurodegenerative diseases, unstable mutation (repeat expansion) causing spinocerebellar ataxias, Huntington's disease, Myotonic dystrophy, Friedreich's ataxia, Fragile-X syndrome, etc., and molecular pathology. Metabolic defects causing neurological diseases (Tay-Sach's, Gaucher's diseases, etc). Complex genetic diseases, gene environment interactions, Pathogenetics of migraine, epilepsy, autism and schizophrenia.

Unit II: Disorders of the aging brain

Clinical presentation, History, genetic & molecular risk factors, pathological mechanisms of Alzheimer's disease, Parkinson's disease, Amyotrophic lateral sclerosis, Stroke, Spinal cord injury & regeneration

Unit III: Neuropharmacology

Chemistry of the brain, chemical architecture, environment, Fundamentals of Organic Chemistry - recent concepts for understanding the drug action. Cellular foundation of Neuropharmacology - the chemical approach; Molecular foundation of Neuropharmacology, Fundamental molecular interactions, Molecular strategies in neuropharmacology, Metabolism in Central Nervous System, Receptors, Modulation of Synaptic transmission, amino acid transmitters – GABA / GABA receptors, Pharmacology of GABA-ergic Neurons, excitatory amino acid receptors; Acetylcholine / Cholinergic pathways / Cholinergic receptors, ACTH in disease states, Norepinephrine and Epinephrine, Morphology of Adrenergic Neuron, Life Cycle of the Catecholamines, Pharmacology of Noradrenergic Neuron, CNS Catecholamine Neurons, Systems of Catecholamine pathways in the CNS, Epinephrine Neurons, Biochemical organization, Pharmacology of Central Catecholamine containing neurons, Catecholamine. Theory of Affective Disorder; Dopamine / Dopaminergic systems, Postsynaptic dopamine receptors, Parkinson's disease, Dopamine hypothesis or Schizophrenia; Serotonin and Histamine - biosynthesis and metabolism, Pineal Body, localization of Brain Serotonin to Nerve Cells, 5-HT Receptors, Neuroactive peptides.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER II

Behavioural and Cognitive Neurosystems

PAPER CODE - 05480203

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: how the central nervous system evolved over time in mammals and its organization with respect to cognitive ability in humans.
CO2: the neural basis of visual perception and spatial cognition.
CO3: how memories are formed and which brain areas play an important role in their formation.
CO4: how language is used to communicate and how we pay attention.

Unit I: Cognitive Neuroscience

A brief history of cognitive neuroscience, Organization of central nervous system in relation to cognition, Evolutionary and comparative principles, mammalian evolution, Human Brain Evolution, Brain and cognitive development

Unit II: Brain and Cognition

Aging and cognition, Pathological processes in cognitive development and aging, Cognitive functions of the motor system, Visual perception of objects: Neuronal basis of object recognition, Perception and recognition of specific classes of objects, Spatial cognition: Neural system of spatial cognition- Parietal cortex, Frontal cortex, Hippocampus and adjacent cortex

Unit III: Learning and Memory

Theories of learning and memory: Models and mechanisms of short-term and long-term memory, Learning and Memory: Basic Systems: Basic mechanisms of learning, key insights from invertebrate studies, Classical conditioning in vertebrates, Long-term potentiation and long-term depression, Learning and memory: Brain systems, Major memory systems in mammalian brain, Multiple memory systems and behaviour

Unit IV: Attention

Attention: Varieties of attention and Neglect syndrome, Visual system and attention, Language and communication: Animal communication, Human language, Neuronal organization for language, Executive brain functions: Role of prefrontal cortex, Neurophysiology of prefrontal cortex, Theories of prefrontal cortex function, Consciousness

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER II

Tools and techniques of Diagnostic Neurophysiology

PAPER CODE - 05480204

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: the principle and methodology of various electrophysiological techniques.
CO2: the fundamentals of electroencephalography.
CO3: what electrodes are and how unit activity can be recorded using single and multi-electrode system.

Unit I: In-Vitro Electrophysiology

In-Vitro Electrophysiology: Bilayer membrane: structure, composition and functionality, Patch Clamp technique: fundamentals: whole cell patch, ion channel punching and methodology.

Unit II: Fundamentals of EEG

Fundamentals of Electroencephalography: EEG, its acquisition, and interpretation, Types of electrodes, references, Types of filters: low pass, high pass, band pass and band stop, EEG in sleep and awake states.

Unit III: Methodology of various techniques

Principles and methodology: EMG, NCV, MEG, MRI, fMRI, PET, CT-SCAN.

Unit IV: Electrode and electrode recordings

Single electrode and Multi-Electrode Array Electrophysiology: Principles, use and methodology, Introduction to electrode making and concept of tetrode recordings.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER II

Bioethics and Biosafety

PAPER CODE-05480205

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: the rules and guidelines for doing research in animal models.
CO2: the rules and guidelines which must be followed for doing research in humans.
CO3: the fundamentals of biosafety and precautions to be taken while dealing with biohazardous or radioactive material.
CO4: what are the good practices to be followed while doing laboratory research.

Unit I: Animal ethics

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

Unit II: Human ethics in research

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

Unit III: Bio-safety

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**

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.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER II

Project development and Seminar
PAPER CODE - 05480206

L	T	P	Credits		
-	-	2	2	**Examination:**	**20 Marks**
				Int. Assessment:	**30 Marks**
				Total:	**50 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: how to design a problem related to their area of interest.
CO2: how to develop a project proposal.
CO3: how to present the developed proposal as a seminar.

In this semester the student is expected to work on finalizing the topic and methodology with a detailed review of literature work to be submitted in the form of a synopsis along with a seminar to be held. Allotment of guide will also be carried out. It will involve a comprehensive literature survey of the chosen research area. Through regular meetings, the student and advisor discuss this literature in detail and the topic for research project.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER II

Practical III

PAPER CODE - 05480207

L	T	P	Credits		
-	-	2	2	**Examination:**	**20 Marks**
				Int. Assessment:	**30 Marks**
				Total:	**50 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: how to handle laboratory rats for doing experiments.
CO2: how electrophysiological recordings are done in the laboratory.

[Pertaining to subjects Biophysics and Neurophysiology (05480201) and Neurological Diseases and Neuropharmacology (05480202)]

- Animal Training- (1 week- may be certified)
- EEG, MEG etc
- Behavioural exposure, cognitive exposure

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER II

Practical IV

PAPER CODE - 05480208

L	T	P	Credits		
-	-	2	2	**Examination:**	**20 Marks**
				Int. Assessment:	**30 Marks**
				Total:	**50 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: experiments related to research in learning and memory.
CO2: about spatial and temporal memory and development of cognitive ability.

[Pertaining to the subject Behvioural and Cognitive Neurosystems (05480203) and Tools and Techniques of Diagnostic Neurophysiology (05480204)]

1. Morris water maze test

2. Y-Maze test

3. Cognitive measurement of spatial memory

4. Biomechanics of human wailing pattern

5. Eye gaze and saccade patterns in human subjects. Attentive control and distractions.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER III

Neuroendocrinology and Biorhythm

PAPER CODE - 05480301

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: how the nervous system controls the endocrine system of the body.
CO2: the important role hypothalamus plays in control of various bodily functions.
CO3: what is circadian biorhythm, how it is generated and what is its molecular mechanism.
CO4: the basics of sleep-wakefulness and the various neural and circadian factors regulating it.

UNIT 1: Neuroendocrine organs

Hypothalamus as a central neuroendocrine organ: Historical perspectives, Hypothalamic control of anterior pituitary hormones and their regulatory functions, Neural, glial and hormonal inputs to the hypothalamus, Hormones, brain and behavior

UNIT II: Hypothalamus and neuroendocrine functions

Hypothalamic control of stress, Hypothalamic control of basal metabolism, Hypothalamic control of growth, Hypothalamic control of reproduction, Hypothalamic control of lactation, Hypothalamic control of posterior pituitary hormones

UNIT III: Introduction to biorhythms

Overview of the mammalian circadian timing system, Suprachiasmatic nucleus as the primary circadian pacemaker, Circadian Oscillators, Neural control of circadian behavior in Drosophila, Molecular basis for circadian oscillation

UNIT IV: Sleep-wakefulness

Circadian regulation of sleep and wakefulness: Sleep architecture, NREM and REM sleep, Different stages of human sleep, Neural control of sleep and wakefulness, homeostatic and circadian factors associated with sleep-wake mechanism

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER III

Advanced Neurobiochemistry and Neuroimmunology

PAPER CODE - 05480302

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: how adult neurogenesis and programmed cell death of neurons takes place.
CO2: the bio-metabolism happening in the brain for generation of energy used in various neuronal activities.
CO3: in more detail the mechanism of immune system of the brain.
CO4: the various neuroimmune disorders.

Unit I: Advanced Neurocellular Biochemistry

Cellular determination, Adult Neurogenesis, Neural stem cells, Neural and glial markers associated with neurogenesis, neuronal growth, Neurotropic factors, Programmed cell death

Unit II: Neurocellular Metabolism

Energy metabolism of the brain, Substrates for cerebral energy metabolism, Hypoxia, Ischemia and Brain infarction, Generation of free radicals and oxidative stress, ROS, Neuroprotective strategies and heat shock responses

Unit III: Brain and Immune System

B lymphocytes and B-cell receptors, T lymphocytes and T-cell receptors, NK Cells, Antibodies: types, structures and functions, Cytokines and Interleukins, Immune cells of the brain, Role of microglia and astrocytes in neuroimmune responses

Unit IV: Neuroimmune Disorders

Cerebral Malaria, Optic Neuritis, acute disseminated encephalomyelitis (ADEM)

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER III

Biomedical Techniques

PAPER CODE - 05480303

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: the basics of intra-operative neurophysiological monitoring.
CO2: how the knowledge of these biomedical techniques can be used in hospitals and other medical care clinics.
CO3: the principles and applications of various neuro-imaging techniques.
CO4: the principle and working of fMRI

UNIT I: IONM Basics

IONM Basics and Common Modalities, Introduction to IONM and Basics of Recording Somatosensory Evoked Potentials (SSEPs) Electromyograms (EMGs) and Transcranial Electrical Motor Evoked Potentials (TceMEPs) Brainstem Auditory Evoked Responses (BAERs) Electroencephalograms (EEGs) and Other IONM Modalities, Factors Affecting Daily Job Performance of IONM Personnel.

UNIT II: Fundamentals and principles of IONM

Requirements for IONM in a Hospital Organization: Challenges & Integration in Medical Care, Programs, Financing, Education programs and Credentialing, Features and Limitations.

UNIT III: Neuro- imaging techniques

Introduction to neuro- imaging techniques, Principles, Advantages & Disadvantages, Recent advances.
Introduction to Emission Computed Tomography (ECT) systems. Principles and applications of SPECT, Principles and applications of PET, Principles and applications of CT, System components of CT, Contrast Scale for different neuro- imaging techniques.
Introduction to MRI system, Principles of MRI and fMRI, Basic MR components, Biological Effect on MR Imaging, Advantage of MR Imaging system.
Introduction to BCI, Applications of BCI, Introduction to MEG, Applications of MEG, Advantage and disadvantage of MEG.

UNIT IV: fMRI
Functional Magnetic Resonance Imaging (fMRI) Basic principles of fMRI, Blood oxygenation dependent contrast (BOLD) and its application in fMRI; Analysis of BOLD Pulse sequence of and optimization.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER III

Computational Neuroscience

PAPER CODE - 05480304

L	T	P	Credits		
4	-	-	4	**Examination:**	**60 Marks**
				Int. Assessment:	**40 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: the basics of computer programming.
CO2: how to apply the computational knowledge in neuroscience in terms of neuroinformatics.
CO3: the basics of artificial neural networks.
CO4: Matlab and its applications

Unit I: Computer applications

Basics of Computer applications-introduction to structural organization and types of digital computers, operating systems, word processing, Computer programs in the analysis of statistical methods and preparation of graphs. Application of Programs to solve - Algebric and matrix equations - Differential equations -Dynamical systems Models – Linear Regression, Handling Files - Containing Numerical and /orcharacter data -Files from sequence and structural data banks.

Unit II: Neuroinformatics

Biophysics & Theoretical Neuroscience with Computational application; Elements of Neural network and computation, complexity and learning. Non-linear elements and networks, linear and polynomial threshold elements, network capacity, learning theory, the sample complexity of learning, perception training, learning complexity, the intractability of learning, model selection. Brain as electrical machine; Neuron & Nervous system Modeling; Essential Bioinformatics related to Neuroinformatics; Application of Neuroinformatics; Neuroinformatics related to Brain Disease/Disorder.

Unit III: Neural Networks

Single Neuron Modeling Ion flux in membranes, Nernst Planck Equation, Ion-Channels, Excitable membranes, Spiking, Hodgkin Huxley models, Integrate and Fire Neurons, Neural Encoding and Decoding Spike train statistics, Receptive fields, Linear and Nonlinear models of Receptive fields, Applications of Information Theory in neural coding and decoding. Overview of neural networks, Architecture, Types of NN, Commonly used activation functions

Unit IV: Matlab

Matlab and Data Analysis: Vectors, scalars, scripts and functions in matlab. Basic matlab programming and toolboxes. Array manipulations and data visualizations. Introduction to neuroscience related toolboxes of matlab. Signal and systems, Signal and image processing, linear systems, Time and space invariance, convolution functions, frequency domain analysis, corelation (Auto and cross) function, Fourier and Laplace transform

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER III

Evaluative Laboratory Training

PAPER CODE - 05480305

L	T	P	Credits		
4	-	-	4	**Examination:**	**40 Marks**
				Int. Assessment:	**60 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will get:

CO1: hands-on training in well-established research labs or hospital set-ups.
CO2: knowledge of how to do report-writing and presentation.

In this semester the student will be evaluated on the basis of knowledge and hands-on training carried out during their posting of 45 days to various institutes/hospitals. Each student must submit to the University, the work report carried out by him/ her during the posting.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER III

Technical writing and seminar

PAPER CODE- 05480306

L	T	P	Credits		
4	-	-	4	**Examination:**	**40 Marks**
				Int. Assessment:	**60 Marks**
				Total:	**100 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: how to write a research proposal.
CO2: how to present and defend the research proposal.
CO3: how to write a research article on the topic of interest chosen.

In this semester the student will start working on their research proposal and evaluate the outcome of the project along with a detailed seminar presentation on progress made. Each student must submit to the university with the signed approval of the advisor, a thesis proposal defining the thesis project, the methods and design of the experiments needed for completion, the progress to date and plans for completion in the fourth semester.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER III

Practical V

PAPER CODE - 05480307

L	T	P	Credits		
-	-	2	2	**Examination:**	**20 Marks**
				Int. Assessment:	**30 Marks**
				Total:	**50 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: how to assess the various hormonal changes taking place according to the diurnal rhythm.
CO2: how to do sleep scoring in the recorded EEGs.
CO3: how to do immunological assays.

[Pertaining to subjects Neuroendocrinology and Biorhythm (05480301) and Advanced Neurobiochemistry and Neuroimmunology (05480302)]

- Hormonal Assays
- Study of Sleep-wake architecture using PSG
- Ag-Ab assays using ELISA

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER III

Practical VI

PAPER CODE - 05480308

L	T	P	Credits		
-	-	2	2	**Examination:**	**20 Marks**
				Int. Assessment:	**30 Marks**
				Total:	**50 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will learn:

CO1: the basics of Matlab.
CO2: advanced analysis of EEG, EMG and NCV using Matlab.

[Pertaining to subjects Biomedical Techniques (05480303) and Computational Neuroscience (05480304)]

- Random number generation using Matlab/ Octave
- Writing scripts and functions for making n -dimensional arrays in Matlab/ Octave.
- Plotting and Analyzing theta to alpha wave ratio of EEG from human subjects in Matlab/ Octave.
- Analysis of NCV and EMG data traces in Matlab/ Octave using Signal Processing toolbox.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER IV

Dissertation Practical (Clinical Research Based)

PAPER CODE - 05480401

L	T	P	Credits		
-	-	16	16	**Examination:**	**160 Marks**
				Int. Assessment:	**240 Marks**
				Total:	**400 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will:

CO1: learn how to conduct research experiments.
CO2: become proficient in using various techniques related to their research methodology.
CO3: learn how to analyze real time research data obtained after doing experiments.
CO4: get an understanding of how to present and defend their experimental data.
CO5: learn how to prepare a manuscript for publication from the data obtained after research experiments.

After completion of dissertation in clinical lab work, this involves preparation of the thesis. The thesis must include a cover page, abstract, table of contents, introduction of the thesis topic with a comprehensive review of literature, appropriately organized methods, results and discussion section for the experiment performed and final conclusions section summarizing the outcome of the project. The student should submit a draft of the thesis along with a manuscript draft (submitted or prepared for publication in Scopus indexed Journal) to the advisor by the end of the fourth semester. Also, a draft of the review/research paper (submitted or prepared to be submitted) must be submitted to respective guide before seminar presentation.

M.Sc. NEUROSCIENCE AND NEUROTECHOLOGY
SEMESTER IV

Dissertation Practical (Laboratory Research Based)

PAPER CODE - 05480402

L	T	P	Credits		
-	-	16	16	**Examination:**	**160 Marks**
				Int. Assessment:	**240 Marks**
				Total:	**400 Marks**
				Duration of Examination:	**3 Hours**

Course Outcome:

On successful completion of this course, students will:

CO1: learn how to conduct research experiments.
CO2: become proficient in using various techniques related to their research methodology.
CO3: learn how to analyze real time research data obtained after doing experiments.
CO4: get an understanding of how to present and defend their experimental data.
CO5: learn how to prepare a manuscript for publication from the data obtained after research experiments.

After completion of dissertation in laboratory research work, this involves preparation of the thesis. The thesis must include a cover page, abstract, table of contents, introduction of the thesis topic with a comprehensive review of literature, appropriately organized methods, results and discussion section for the experiment performed and final conclusions section summarizing the outcome of the project. The student should submit a draft of the thesis along with a manuscript draft (submitted or prepared for publication in Scopus indexed Journal) to the advisor by the end of the fourth semester. Also, a draft of the review/research paper (submitted or prepared to be submitted) must be submitted to respective guide before seminar presentation.