MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Manipal Institute of Regenerative Medicine, Bengaluru

M.Sc. By Research in Translational Neuroscience

Course Description:

M.Sc. By Research in Translational Neuroscience is first of its kind. First semester is designed to have theory and practical sessions wherein students will understand the fundamentals of cell biology, molecular biology, biochemistry, neuroscience, CNS diseases, application of stem cells and tissue engineering in neuroscience and various techniques. Semester II-IV will be research project based wherein the students will be working on neuroscience projects leading to conference presentations and publications in peer-reviewed national/international journals.

Focus of the program:

- To educate students about the fundamentals of neuroscience and its clinical applications
- To provide hands-on training in various basic science techniques including neuroscience techniques
- To encourage students in neuroscience research and to develop novel diagnostics and treatment strategies for neurological/psychiatric illnesses and neurodegenerative diseases
- To develop communication skills for paper/project presentations and publications
- To develop in-depth knowledge on bioethics, clinical trials, animal ethics, recombinant DNA technology, genetic engineering, animals handling, intellectual property rights, biosafety, research and publication integrity

Career Prospectus:

- As neuroscientist in pharma companies involved in novel drug development for neurological/psychiatric/neurodegenerative diseases
- As a research scholar in national and international research institutes/universities working towards Ph.D. and Post-doctoral fellowships
- As entrepreneurs to start companies involved in drug development, screening, and patenting
- As clinical neuro-technicians assisting doctors, psychologist in developing neuro-feedback therapies for neurological/psychiatric/neurodegenerative diseases
- As a professor/lecturer/teacher in reputed institutes/universities
- As a scientific journal editor and scientific writer

Program Highlights

- Translational Neuroscience will be a unique course offered by MAHE covering the fundamentals of Neuroscience to translational neuroscience.
- The theory classes would be of 90 minutes duration comprising 1 hour of formal lecture followed by 30-minute discussion/tutorial session that shall comprise clarifications and questions from the students and evaluation of the students by faculty through short tests, quizzes, and group discussions.
- Student's performance in the discussion/tutorial sessions shall be used for their internal assessments and grading.
- The afternoon practical/skills sessions, in each module would be in line with the topics covered during the theory classes in the morning sessions.

- All key fundamental concepts and practical/skills, related to cell biology, molecular biology, biochemistry, neuroscience, CNS diseases, application of stem cells and tissue engineering in neuroscience shall be covered during Semester-I consisting of Module 1,2,3, &4.
- Lectures in Semester II, III & IV would be on advanced elective topics. Students shall opt for their elective subject and their allotment would be done based upon their performance in the previous semester.
- During Semester II & III students would have only 10 lectures/seminars/Journal club on advanced topics in the field and would do practical/skills related to elective topics.
- Students will be highly encouraged to submit manuscripts /publish original and review articles in peer reviewed high impact journals before the dissertation submission in forth semester.
- Observerships /internships in hospitals (Neuro departments) and/or labs/industry will be highly encouraged.

Minimum Qualification for Admission:

Admission is open to candidates who possess a MBBS, BDS, BE (Biotechnology) B.Sc., B.Pharm., Allied Health Professionals-or equivalent level of education from a recognized University.

Selection Process: Manipal entrance test. Shortlisted candidates will be called for interview. The research aptitude of the candidate will be assessed during interview.

Duration of Program: It is a 2-year program with 4 semesters.

PROGRAM STRUCTURE
M.SC. by Research in TRANSLATIONAL NEUROSCIENCE
SEMESTER-I

Code	Course Title	Hours per week			C	Maximum marks		
		L	T	P		IA	*UNI EXAM	TOTAL
TN 401	Biomolecules	3	1	-	4	30	70	100
TN 403	Laboratory Methodologies.	3	1	-	4	30	70	100
TN 405	Fundamentals of Neuroscience	3	1	-	4	30	70	100
TN 407	Neurodevelopment and CNS Diseases	3	1	-	4	30	70	100
TN 409	Biomolecules Lab	-	-	4	2	40	60	100
TN 411	Laboratory Practices	-	-	6	3	40	60	100
TN 413	Fundamentals of Neuroscience Lab	-	-	6	3	40	60	100
TN 415	Development and Diseases Lab	-	-	4	2	40	60	100
	TOTAL	12	4	18	26	-	-	800

*Minimum marks for all University Examinations for a pass credit = 50%

SEMESTER-II

Code	Course Title	Hours per week	C	Maximum marks

		L	T	P		IA	UNI EXAM	TOTAL
TN 5XX	Elective 1	4	-	-	4	100	-	100
TN 501	Elective 1 Lab	-	-	10	5	100	-	100
TN 503	Research Project**	-	-	-	8	100	-	100
	TOTAL	-	-	-	17	-	-	300

L= Lecture, T= Tutorial, P= Practical, C= Credit, IA= Internal assessment, UNI Exam= University examination. ** Evaluation by subject experts.

SEMESTER-III

Code	Course Title	Hours per week			C	Maximum marks		
		L	T	P		IA	UNI EXAM	TOTAL
TN 6XX	Elective 2	4	-	-	4	100	-	100
TN 601	Elective 2 Lab	-	-	10	5	100	-	100
TN 503	Research Project**	-	-	-	8	100	-	100
	TOTAL	-	-	-	17	-	-	300

L= Lecture, T= Tutorial, P= Practical, C= Credit, IA= Internal assessment, UNI Exam= University examination. ** Evaluation by subject experts.

SEMESTER-IV

Code	Course Title	Hours per week			C	Maximum marks TOTAL
		L	T	P		300
TN 503	Research Project work and dissertation**	-	-	-	20	

L= Lecture, T= Tutorial, P= Practical, C= Credit, IA= Internal assessment, UNI Exam= University examination. ** Evaluation by subject experts.

DETAILED SYLLABUS FOR M.SC. BY RESEARCH IN TRANSLATIONAL NEUROSCIENCE

Module 1 Biomolecules (Lectures: 35)

Primary Secondary and Tertiary structures of Proteins: (a) amino acids- names etc. (b) peptide bond and modifications (c) acetylation (d) secondary structures S-S bonds (e) tertiary structure, Proteins as Enzymes, categories, nomenclature etc., Proteins as structural complexes Supra Molecular Organization, Secretory Proteins: synthesis, protein transport, functions, Proteins as hormones, Proteins as Neurotransmitters, Proteins and immune regulation-cytokines, Membrane protein: introduction, types, Association with lipids, Biological role of membrane associated proteins, Pathological conditions related to Membrane associated proteins, Translational Regulation and Post-translational Modifications, Protein folding and diseases, Protein Engineering, Classification of Carbohydrates; Primary and secondary structure, Monosaccharides, Glycosidic bond - Reducing & Non reducing sugars; Composition & linkage Polysaccharides, Lectins, Conjugated Carbohydrate: Glycoproteins; proteoglycans and glycolipids; Sialation, Carbohydrate metabolism-synthesis and breakdown, Metabolic Disorders, Fatty acids and Triacylglycerol: Nomenclature, Classification and structures, Phospholipids and Sphingolipids: structure and biological roles; Cerebroside, Sterols: Structural aspects in different membranes, lipid rafts, Metabolism of Lipids: Biogenesis of fatty acids and Cholesterol, ketone biosynthesis, degradation of lipids, beta oxidation and association with diseases, Lipids in mitochondrial and chloroplast membranes, Steroids and prostaglandins as signaling molecules, Primary, secondary and tertiary

structural organization and modification of DNA, Primary, secondary and tertiary structural organization and modification of RNA, Nucleotide Metabolism: Synthesis and degradation of Nucleotides, Gene regulation through DNA modifications and RNA molecules, Non-coding RNA, LncRNA, SnRNA, PiRNA, miRNA, Prokaryotic and Eukaryotic Genome Evolution, Genome organization and whole genome analysis, Genome Analysis- Tools behind genomics , Advanced Genomics tools.

Module 2 Laboratory Methodologies (Total Lectures: 35)

Chromatography: Gel Filtration chromatography, TLC/Gas chromatography, Ion exchange and Affinity chromatography, Principles ,Methods & Applications of Spectroscopy, UV visible spectroscopy Fluorescence spectroscopy, Mass Spectrophotometry, Circular dichroism, Chromatography: Gel Filtration chromatography, TLC/Gas chromatography, Ion exchange and Affinity chromatography, Spectroscopy: Principles and Methods of UV visible spectroscopy (Nanodrop), Fluorescence spectroscopy, Mass Spectrophotometry, Circular dichroism, Nuclear magnetic resonance, Electrophoresis: Brief Introduction to types of electrophoresis Paper, Starch and Gel, Nucleic Acid Analysis: Brief Introduction to Northern, Southern and Western Blotting, PCR- Types of PCR: Hot-Start PCR, Touch Down, RACE, Long and Accurate PCR (LA), Inverse PCR; Nested PCR; Real Time PCR. Genome Analysis: NGS; DNA methylation Studies; Chromatin immunoprecipitation. RNA Analysis: RNA Sequencing, In situ RNA hybridization; Karyotyping, FISH, Microarrays, RNAZyme, RNA-protein Technology, Bimolecular Interaction Studies: Protein-Protein- Yeast two hybrid system systems. Protein DNA: DNA foot printing/ EMSA, Proximity Ligation assay, SILAC, Biacore, Microscopy: Types of Microscopy Light, Phase Contrast, Fluorescence, FRET (fluorescent anisotropy); FRAP and FLIP; Confocal, Electron Microscopy-Transmission and Scanning; Differential Interference Contrast Microscopy, Single and Dual Photon Microscopy, Cryo-EM, Flow Cytometry: Principles, methods and applications of flow Cytometry, Fluorescence activated Cell sorting, BrdU Incorporation, Immuno phenotyping, Cells cycle analysis, Cell Sorting, Immunological analysis: Immunofluorescence, ELISA, Magnetic sorting, Embedding and Sectioning and Staining - Paraffin Sectioning, Cryosectioning, Histological Staining; IHC, Cell Culture Techniques: Isolation of Primary Cultures; Organoid Cultures, Hybridoma Technology, Gene Editing (Homologous Recombination –Cre/loxP system; CRISPR Cas9 system, RNA Interference using siRNA, miRNA, Selection of Recombinants), Parthenoid stem cells, Animal Models - Types of Models (Spontaneous, Experimental, Humanized) Breeding Systems (Inbreed/outbreed). Transgenic Models: (Knock in, Knock Out). Mouse Handling Techniques. Immunocompromised mice model (NSG mice model, SCID). Biostatistics (8 Lectures), Bioinformatics (7 Lectures) , Clinical Research, Bioethics & Regulatory Guidance (5 Lectures).

Module 3 Fundamentals of Neuroscience (Total Lectures: 35)

General Introduction to Neuroanatomy , Neurons and Glia, Human Nervous system: Central Nervous system, Peripheral Nervous system, Autonomic Nervous system, Resting Membrane potential, Action Potential, Action Potential Propagation, Cytoskeletons and Axonal transports, Synaptic Transmission, Synaptic plasticity, Cholinergic transmission: Synthesis, distribution, receptors and function, Dopaminergic transmission: Synthesis, distribution, receptors and function, Glutamatergic transmission: Synthesis, distribution, receptors and function, GAbAergic transmission: Synthesis, distribution, receptors and function, Serotonergic transmission: Synthesis, distribution, receptors and function, Neurotransmitters: Neuropeptides, Fundamentals of Motor Systems, Motor function: Reference to Basal Ganglia, Visual System: Retina, Auditory System, Vestibular System, Olfactory system, Gustatory System: Sense of taste, Role of Nutrition in Neurodevelopment and functioning, Learning and Memory , Neurobiology of Emotion, Neurobiology of Stress, Neural substrate controlling Sleep-Wakefulness cycle, Neuroimmunology, Brain Imaging Techniques: Computed Tomography, Brain Imaging Techniques: Magnetic

Resonance Imaging [structural and functional MRI], Brain Imaging Techniques: Local Field Potential, Brain Imaging Techniques: Electroencephalogram.

Module 4 Neurodevelopment and CNS diseases (Total Lectures: 35)

Developmental Neurobiology: Developmental Nutritional Neuroscience, Neural induction, pattern formation, cell specification, neuronal and axonal growth, neurogenesis, synaptogenesis, role of neurotropic factors, refinement of synaptic connections, development and functions of astrocyte, oligodendrocyte and microglia, development and functions of astrocyte, oligodendrocyte and microglia, Adult neurogenesis, [Alterations in neural plasticity-synaptic & neurogenesis by neurotherapy/ biofeedback mechanisms], Multiple Sclerosis, Amyotrophic lateral sclerosis, Alzheimer's disease, Parkinson's Disease, Neurobiology of Epilepsy, Stroke, Sleep Disorders, Psychiatric disorders [attention-deficit/hyperactivity disorder (ADHD), autism spectrum disorder, and learning disorders, Bipolar disorder, Anxiety and depression, Schizophrenia Animal models of Neurodegenerative disease, In vitro model of neurodegenerative disease ,Embryonic stem cells, Adult Stem Cells, Induced pluripotent stem cells and its application in neuroscience, Neural stem cells , Application of stem cells in neuroscience, Brain Organoids and its application, Application of Tissue Engineering in Neuroscience, Application of neurotherapies /biofeedback therapies in neurological disorders.

QUESTION PAPER PATTERN:

The question paper will be divided into 2 parts.
Part 1: Multiple Choice Questions.
Part 2: Subjective Questions.

M.Sc. in Translational Neuroscience, Theory Examination, Month, Year Course Code. Course Title. Part 1: Multiple Choice Questions Date: dd-mm-yyyy Duration: 15 minutes Max Mark: 20	
Instructions: Answer the following: Each question carries 1 mark. A negative mark of – ¼ will be given for a wrong answer.	
1. 2. 3. 4. 5. 6. 7. 8. 9. 10.	11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

M.Sc. in Translational Neuroscience, Theory Examination, Month, Year Course Code. Course Title. Part 2: Subjective Questions Date: dd-mm-yyyy Duration: 2 Hours 30 Minutes Max Mark: 80 Marks	
Instructions: Answer all Questions	
Answer the following:	
TYPE OF QUESTION	PROPOSED PATTERN
Essay Answer:	10 marks x 3 = 30 marks

Short Answer: Brief Answer:	5 marks x 6 = 30 marks 2 marks x 10 = 20 marks

EVALUATION:

Performance grades:

The marks obtained in the Internal Assessment and Final Examination are added together and converted to a 12-point relative letter grading scheme used to allot a Grade to a student's performance in that course. The letter grades and grade points are specified in the table below.

Grade Letter	Performance	Grade point	Absolute grading
A+	OUTSTANDING	10	≥ 90
A	EXCELLENT	9	80-89
B	VERY GOOD	8	70-79
C	GOOD	7	60-69
D	AVERAGE	6	55-59
E	MARGINAL	5	50-54
F	FAIL	0	< 50
I	INCOMPLETE	0	-
DT	DETAINED	0	-
AP	AUDIT PASS	-	-
S	SATISFACTORY	-	-
NS	NOT SATISFACTORY	-	-

TENTATIVE ELECTIVE TITLES FOR SEMESTER II-IV

- Role of exosome in glioblastoma metastasis
- EEG Microstate as a biomarker for diagnosis and prognosis of Parkinson's disease
- Microstate analysis in schizophrenia
- Blood Brain Barrier integrity in diabetes mellitus
- Blood Brain Damage following chemotherapy and its implications on neurological and cognitive functions
- Assessment of neurogenesis following dental pulp stem cell treatment in animal model of hippocampal damaged
- Immunomodulatory function of mesenchymal stem cells in Parkinson's disease
- Extracellular vesicles derivation from dental pulp stem cells and its anti-epileptogenic effects in animal model of temporal lobe epilepsy
- Study to evaluate the neurogenic and cognition enhancing properties of Nano-curcumin
- Role of extracellular vesicles in health and diseases.

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