YENEPOYA
(DEEMED TO BE UNIVERSITY)
Recognized under Sec 3(A) of the UGC Act 1956

Neuroscience

Core course for Pre-PhD: 4 credits

Yenepoya Research Centre
Yenepoya (Deemed to be University)
University Road, Deralakatte
Mangalore – 575018

Course Name: Neuroscience

1.	Course Type	:Core
2.	Level	: Ph.D. (Pre-PhD course work)
3.	Credit Value	: 4 Credits
4.	Total Hours	: 60 (L:P:S: 10:25:25)
5.	Total Marks	: 100 (IA= 40 + Final exam= 60)

6. Course Objectives

- To brief the research scholars about the basics of cellular and molecular neuroscience, protein mass spectrometry, and bioinformatics tools
- To train in different analytical and biological techniques relevant for the research/study of neurological disorders
- To train the students on the design and execution of experiments on pre-clinical models of different neurological disorders
- To train the students on the application of protein mass spectrometry and down-stream bioinformatics tools to solve research questions relevant to neurological disorders

7. Learning Outcome

- This course will prepare the research scholars to design and execute projects in the area of neuroscience using bio-analytical, biological, and proteomics techniques.

8. Competencies

On completion of the course, the scholars will be able to perform activities as follows

1. Demonstrate analytical, spectroscopic, biological techniques used in neuroscience research
2. Apply appropriate analytical, spectroscopic, biological Techniques/ procedures for a given research problem
3. Perform research experiments involving preclinical models of neurological disorders such as……
4. Outline study design for neuro-proteomics experiments for given set of research problem

5. Analyze proteomics data using bioinformatics tools such as
6. Practice ethics and maintain privacy, confidentiality and integrity of the data
7. Practice biological/hazardous waste management protocols appropriately during sample collection, storage, analysis and disposal as per prescribed guidelines.

9. Content of the Course

Module 1: Bio-Analytical Methods

1.1 Microscopy- Image formation, resolution, Types (Light, Fluorescence, Confocal, SEM and TEM) techniques and applications
1.2 Spectroscopy-Different types of spectroscopies (UV-Vis, Fluorescence, NMR) and their applications
1.3 Separation Methods: Centrifugation-Sedimentation principle, differential centrifugation, different types of centrifuges, Chromatography- types (adsorption, partition, affinity, ion exchange and size exclusion) and applications
1.4 Biological techniques-PCR, qRT-PCR, Electrophoresis, blotting techniques, ELISA, Cell biology techniques: Assessment of cellular viability, cell proliferation and migration assays, Histopathology and immune cyto chemistry, Flow cytometry
1.5 Physical and chemical methods of sterilization, Media and buffers, Mammalian and Microbial culture techniques

Module 2: Cell and Molecular Biology

2.1 Biological macromolecules – lipids, proteins and nucleic acids– structure and function, Central Dogma, Viral, Prokaryotic and eukaryotic cells and their genomes, membranes and cell architecture
2.2 Cell cycle regulation- cellular differentiation, proliferation, apoptosis
2.3 Basic principles of Pharmacology/toxicology– Agonist, Antagonist, Receptors, Dose-response relationships, Cellular communication, signaling mediated transport of ions and molecules across cell membrane
2.4 Enzymes- DNA polymerase, restriction endonucleases, reverse transcriptase, kinase, Cloning vector (characteristics applications) Plasmids Vectors, Gene cloning, Cloning Strategies
2.5 Stem Cells and Stemness basics, Types of stem cells

Module 3: Applied Proteomics

3.1 Introduction to Mass spectrometry – ionization methods (MALDI, electrospray), types of mass analyzers, detectors
3.2 Protein identification - protease digestion, peptide mass fingerprinting, tandem mass spectrometry, de-novo sequencing, search engines

3.3 Protein quantification –various approaches, analysis of post translational modifications, database searching

3.4 Bioinformatics tools – web-based and open-source – Gene Ontology and enrichment analysis, network analysis (STRING, Cytoscape), sequence analysis (BLAST, alignment tools)

Module 4: Basic Neurobiology

4.1 Organization of nervous system: different parts of the brain and their functions

4.2 Cells and connection of the nervous system: neurons (types, structure, and functions), synapse, glial cells (astrocyte, microglia, oligodendrocyte), neuro-glial cross-talk

4.3 Neurotransmitters (glutamate, dopamine, acetyl choline, GABA) and their receptors and Signal transduction

4.4 *In vitro* and *in vivo* models used in neurobiology research

Module 5: Neurological Disorders

5.1 Acute neurological disorder – Stroke (classification, epidemiology, pathophysiology, emerging concepts and research trends)

5.2 Chronic neurological disorders – Parkinson's disease and Alzheimer's disease (classification, epidemiology, pathophysiology, emerging concepts and research trends)

Teaching-Learning methods.

Modules	Teaching-learning		
	Lecture	Practical/Hands on/Problem based learning (PBL)/Group Discussions	Self-study
Module 1: Bio-Analytical Methods	1.1		1.1
	1.2		1.2
	1.3	1.3 (PBL)	1.3(Seminar)
	1.4	1.4	1.4
	1.5		1.5
Module 2: Cell and Molecular Biology	2.1		2.1
	2.2		2.2
	2.3	2.3 (PBL)	
	2.4	2.3 (PBL)	2.4
	2.5	2.5 (Group Discussions)	
Module 3: Applied Proteomics	3.1	3.1	
	3.2		3.2 (Seminar)
	3.3	3.3(Hands-on)	
		3.4 (Hands-on)	
Module 4: Basic Neurobiology			4.1 (Seminar)
			4.2 (Seminar)
		4.3	4.3
	4.4	4.4 (Hands-on)	
Module 5: Neurological Disorders	5.1	5.1 (Group discussion)	5.1
	5.2	5.2 (Group discussion)	5.1

10. Assessments

Formative assessments: (40 Marks)

1	Internal Exams - 40 marks each (2)	20 M
2	Seminar (2)	8 M
3	Group discussion/hands on (2 Including ethical and regulatory issues)	6 M
4	Problem based learning (PBL) (2)	6 M

Summative Assessment: (60 Marks)

Table: Assessment pattern – Multiple choice questions, problem-based questions will be included along with essay-type questions. A question bank will be maintained.

S. No.	Details	Q X M
1	Objective type questions	20 X 1= 20 M
2	Problem-based Questions	5 x 4 = 20 M
3	Essay-type Questions	5 X 4 = 20 M

Learning Resources

Text Books

1. Alan Longstaff (2011). BIOS Instant notes in Neuroscience. Taylor and Francis, London.
2. Bruce Albert, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter (2007). Molecular Biology of the cell- 5th edition. Garland Science, NewYork.
3. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, Karen Hopkin, Alexander Johnson, Peter Walter (2015). Essential Cell Biology- 4th edition. Garland Science, NewYork.
4. George Siegel, Donald Price, R. Wayne Albers, Scott Brady (2006). Basic NeurochemistryMolecular, Cellular and Medical Aspects – 7th edition. Elsevier.
5. Gross JH (2011). Mass Spectrometry – A Textbook. Springer.
6. Karp G (2009). Cell and Molecular Biology: Concepts and Experiments- 7th edition. John Wiley & Sons.
7. Larry Squire, Darwin Berg, Anirvan Ghosh, Sascha du Lac, Nicholas Spitzer, Floyd E. Bloom

(2008). Fundamental Neuroscience - 3rd edition. Elsevier.
8. Lodish H, Berk A, Zipursky SL, Matsudaira P, Baltimore D, Darnell J (2008). Molecular Cell Biology. W.H. Freeman
9. Miller K, Levine J (2010). Biology. Pearson.
10. Primrose SB, Twyman RM (2006). Principles of gene manipulation and genomics. Blackwell Publishing.
11. Simpson R (2002). Proteins and Proteomics: A laboratory manual. Cold Spring Harbor Laboratory Press.
12. Wilson K, Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology, 7th edition. Cambridge University Press.
13. Baxevanis AD, Ouellette BFF (2005). Bioinformatics – A Practical Guide to the analysis of Genes and Proteins- 3rd edition. John Wiley & Sons, Inc.
14. Brown TA (2010). Gene cloning and DNA analysis: An introduction.Wiley-Blackwell.
15. Green MR, Sambrook J (2012). Molecular cloning – A laboratory manual. Cold Spring Harbor Laboratory Press.
16. Leung H-CE (2012). Integrative proteomics. In Tech, Croatia.
17. Reece RJ (2004). Analysis of Genes and Genomes. John Wiley & Sons Ltd.
18. National Ethical Guidelines for Biomedical and Health Research involving Human Participants", 2017, Indian Medical Research.

Other Resources

1. Gallien S and Domon B (2015). Advances in high-resolution quantitative proteomics: implications for clinical applications. Expert Rev Proteomics, 12, (5): 489-98.
2. Harsha HC, Molina H and Pandey A (2008). Quantitative proteomics using stable isotope labeling with amino acids in cell culture. Nat Protoc, 3, (3): 505-16.
3. Harsha HC, Pinto SM and Pandey A (2013). Proteomic strategies to characterize signaling pathways. Methods Mol Biol, 1007, 359-77.

Journals: e.g., Annual Review of Neuroscience, Nature Neuroscience, Trends in Neurosciences, Expert Reviews in Proteomics, Molecular and Cellular Proteomics, Journal of Proteome Research, Neuron, Cell, Molecular Cell, Science, Nature, Journal of Neuroscience etc.

URLs:

http://www.ionsource.com/
https://www.ebi.ac.uk/pride/archive/
https://www.ncbi.nlm.nih.gov/
https://www.ncbi.nlm.nih.gov/pmc/
https://shodhganga.inflibnet.ac.in/