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

Cell Signaling and Cancer Biology

Core course for Pre-PhD: 4 credits

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

Course Name: Cell Signaling and Cancer Biology

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

- Develop knowledge on important techniques used in cancer research.
- Enable research scholars to address and come up with new problems in cell based research.
- To develop skill in handling of cells and related methodologies to reveal the cross-talks of biomolecules.
- To sensitise the research scholars in managing biohazards, biosafety and ethical issues in cell based research.

7. Learning Outcomes

- This course will enable the students to work independently and to design detailed methodology using appropriate techniques for understanding molecular mechanisms in cell signaling and cancer research

8. Competencies

1. Demonstrate different *in vitro* and *in vivo* models used in cancer research and research problems related to cancer biology to cell signaling.
2. Distinguish the major cancer types based on molecular and cellular characteristics
3. Analyse the databases used in cancer research for outlining relevant research questions and hypothesis.
4. Describe experimental approaches used for understanding Signal Transduction pathways.
5. Choose appropriate experimental test systems for macromolecular research for generating new data
6. Perform laboratory techniques for deriving mechanistic insights based on selected biomarkers in cancer biology research.
7. Practice biological/hazardous waste management protocols appropriately during sample collection, storage, analysis and disposal as per prescribed guidelines.
8. Practice safety and research ethics while performing research using samples from biological origin.

9. Contents of the Course

Module 1: Bio-Analytical Methods (12 h)

1.1. Approaches to maintain aseptic environment in cell culture facility. Different sources of contamination and its implications.

1.2. Good laboratory practices- Principles and protocols and handling the storage facilities.

1.3. Different types of imaging techniques-Digital photography and its applications in recording data, Microscopy and its applications (Live cell imaging, Optical, Fluorescence, phase contrast and Confocal), image resolution and representation of images in manuscripts and reports.

1.4. Different types of bio analytical instrumentation and their application-Spectroscopy (UV-Vis, Fluorescence, IR, NMR), different types of centrifuges, Chromatographic techniques (TLC, HPTLC, GPC, LC, GC/MS).

1.5. Software- adobe illustrators, origin, end note, Image J, Photoshop, coral draw, sigma plot, excel for data analysis, Graph pad prism.

Module 2: Cell and Molecular Biology techniques in biomedical research and its application (14 h)

2.1. Cell propagation, maintenance and storage, Cell viability assays, isolation of macromolecules from cells, transformation, transfection, cell proliferation and migration assays commonly used in biomedical research.

2.2. Gene and protein expression analysis - PCR, qRT-PCR, IP, ChIP, Microarray, RNA sequencing, NGS, FISH, blotting techniques, ELISA, IF, IHC).

2.3. Application of Flow cytometry in biomedical research – Cell cycle analysis, apoptosis detection, MACS, FACS, cell surface marker detection and immuno- phenotyping.

Module 3: Cell Signaling (10 h)

3.1. Signal Transduction pathways, use of EMSA assays, northwestern assays, southwestern assays, eastern blotting, gel imaging, blot imaging.

3.2. Aberrant DNA synthesis, damage recognition and Repair pathways.

3.3. Aberrant signaling leading to EMT and MET and angiogenesis.

3.4. Cell signaling mechanisms associated with cell cycle, membrane vesicle trafficking, JAK-STAT signaling.

Module 4: Biological models in Cancer research and its management (14 h)

4.1. *In-vitro* models (knock-down and over-expression studies).

4.2. Animal models (induced, transgenic and xenograft models), Tissues preservation and processing techniques and applications.

4.3. Ethics and regulations in cancer research (IAEC, IEC, IBSC, ISCC, IPR).

4.4. Management of Bio-Waste generated from experiments using different model systems, Bio- medical waste (Hazardous and non-hazardous), tissues and body fluids. Steps for waste management-segregation, collection and storage, transportation and treatment and disposal.

Module 5: Major areas of Cancer research (14 h)

5.1. Cancer Surveillance, Genomic Epidemiology, Nutrition and Metabolism, Environmental exposure.

5.2. Systemic anticancer therapy (Chemo/Radiotherapy), Targeted therapy (Immunotherapy, Hormone Therapy).

5.3. Genetic resources databases (NCBI, EMBL, KEGG, DDBJ, TCGA Atlas, C-Bioportal, UCSC-Xena, Cosmic, GitHub and other related databases).

5.4. Molecular pathology- Specific to the disease of interest of the scholar, stages of the disease, disease manifestation, major molecular players, major pathways.

Teaching-learning methods

Modules	**Teaching-learning**		
	Lecture	Practical/Hands on	Self study
Module 1: Bio-Analytical Methods	1.1		
			1.2 (Seminar)
	1.3	1.3 (Group discussion)	
	1.4	1.4	
		1.5	1.5
Module 2: Cell and Molecular Biology techniques in biomedical research and its application		2.1	2.1
	2.2	2.2	
	2.3	2.3	
Module 3: Cell Signaling		3.1	3.1
		3.2	3.2 (Seminar)
		3.3	3.3
			3.4
Module 4: Biological models in Cancer research and its management		4.1(Group discussion)	4.1
		4.2(Group discussion)	4.2 (Seminar)
			4.3
			4.4
Module 5: Major areas of Cancer research		5.1 (Group discussion)	
	5.2		5.2
			5.3
		5.4 (Group discussion)	5.4

10. Assessments

Formative assessments: (40 Marks)

1	Internal Exams - 40 marks each (2)	20 M
2	Seminar (2)	8 M
3	Group discussion (2 Including ethical and regulatory issues)	6 M
4	Case studies (2)	6 M

Summative Assessment: (60 marks)

Sl. No.	Details	Q X M
Two Questions to assess the knowledge and problem solving abilities in the given context		4X10M= 40 M
1	Knowledge on application of any of the major instruments used in the In vitro and in vivo cancer research for generating data (e.g. use of spectrophotometer for cytotoxicity analysis, protein estimation etc.)	
2	Problem solving ability: Designing experimental protocol for a given research problem and interpretation of data (e.g. RT-PCR / Design a primer from given sequence/ Western blot)	
Two questions to assess the analytical skills to solve a given hypothetical research problem		
3	Write the methodology for solving a given research problem (example; differential expression of a particular gene in normal and cancer cells/ in vitro condition with respect to exposure to an inducer etc.)	
4	Question based on the field of interest of the researcher from Module 5 (example Describe the molecular pathology of a Cancer of your interest)	
5	Descriptive questions from module 3 and 4	4X5=20 M

*****A question bank will be maintained with multiple scenarios.

Learning Resources

Reference Books / Resources

1. Alberts B, et al. (2014). Essential Cell Biology. Garland Science
2. Arthur M. Lesk (2012), Introduction to Genomics, Oxford University Press, 2nd edition
3. Benjamin Lewin& Nelson Cox. (2001) Gene VII. Oxford University Press,
4. Brown TA (2010). Gene cloning and DNA analysis: An introduction. Wiley-Blackwell.
5. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. (2002) Molecular biology of the Cell. 4th ed. Garland publishing Inc,
6. Chadwick D, Goode J (1997). Antibiotic resistance: Origins, evolution, selection and spread. Wiley.
7. Dale & Schartz, (2003) From Genes to Genomes. Wiley
8. Darnell, Lodish and Baltimore.(2000) Molecular Cell Biology, W. H. Freeman, Macmillan Learning, New York
9. David L. Nelson, Michael Cox (2009) Lehninger's Principles of Biochemistry, W. H. Freeman, Macmillan Learning, New York
10. Domingo E, Parrish CR, Holland JJ (2008). Origin and evolution of viruses, 2nd edition. Elsevier.
11. Gibbs AJ, Calisher CH, García-Arenal F (2005). Molecular basis of virus evolution. Cambridge UniversityPress.
12. Green MR, Sambrook J (2012). Molecular cloning – A laboratory manual. Cold Spring Harbor Laboratory Press.
13. Heinz Peter Nasheuer, (2010) Genome Stability and Human Diseases. Springer,
14. Karp G (2009). Cell and molecular biology: Concepts and experiments, 7th edition. John Wiley & Sons.
15. Lodish H, et al. (2008). Molecular Cell Biology. W. H. Freeman, Macmillan Learning, New York
16. Michael A. Palladino, Benjamin Cummings (2005) Understanding the Human Genome Project, Pearson Education (US); 2nd edition
17. Miller K, Levine J (2010). Biology. Pearson Education, Inc.
18. Primrose & Twyman Blackwell (2003) Principles of Genome Analysis & Genomics. Wiley-Blackwell; 3rd edition
19. Stella Pelengaris and Michael Khan, (2006) The Molecular Biology of Cancer. Wiley-Blackwell2nd edition
20. Tortora GJ, et al. (2010). Microbiology: An introduction. Pearson Education, Inc.
21. Watson. J. D, Baker. T. A, Bell. S. P, Gann. A, Levine. M, Losick. R. (2008) Molecular Biology of Gene.6th The Benjamin / Cummings Pub. Co. Inc,
22. Wilson K, Walker J (2010). Principles and techniques of Biochemistry and Molecular Biology, 7th edition. Cambridge University Press.
23. National Ethical Guidelines for Biomedical and Health Research involving Human Participants", 2017, Indian Medical Research, 2017.

Online resources

https://www.ncbi.nlm.nih.gov/

https://www.ncbi.nlm.nih.gov/pmc/
https://www.nature.com/scitable/
https://doi.org/10.3389/fonc.2020.00499