

Course contents for Advance Technologies in Cell and Animal Physiology

1. Faculty: FLSB

2. Course Code: LSB702

3. Course Title: Advanced Technologies in Cell and Animal Physiology

4. Number of Credits: 6 (3L, 3P)

5. Course objectives:

Current research in health sciences involves use of cell and animal models for various diseases ranging from infectious (bacterial and viral) to non-infectious (cancer, metabolic disorders and neurodegenerative disorders) ones. Cellular responses to these stresses and methods to study the same are studied in this course at the organelle, cellular, tissue and animal levels. A range of techniques measuring mitochondrial function will be covered integrating with overall cellular metabolic changes and overall viability and cell proliferation. At the tissue level, specimen collection and imaging would be studied in detail. Further, this course would expose students to various animal models commonly used in research with specific emphasis on rodent handling, behaviour and use in research. Current research papers applying these techniques would be discussed. In addition, hands-on training of a few essential techniques would also be included as part of the course.

6. Minimum prerequisites for taking this course, if any: Master-level Chemistry or any branch of biology.

7. Course structure with units, if applicable:

The following topics will be covered as part of the course:

- a. Cell Biology Techniques: principles of mammalian cell culture, aseptic techniques, assessing viability of cells in culture, assays for cell cycle, cell proliferation and cell death including assays to distinguish various types of cell death (assays measuring apoptosis, necrosis and autophagy); cell fractionation and studying nucleus, lysosomes and other organelles; experimental methods such as MTT assay, colony formation assay and spheroid assay
- b. Mitochondrial Techniques: role of mitochondria in health and disease; organelle separation and specific staining methods; techniques to measure mitochondrial activity (respiration, membrane permeability transition, oxidative stress, calcium homeostasis, and measuring Warburg effect); experimental methods such as PI-annexin V assay and measuring oxidative stress
- c. Histological Techniques: anatomical terminology; tissue fixation and perfusion; tissue sectioning methods; dye-based and antibody-based tissue staining methods, neuroanatomical tracing techniques; principles of imaging and microscopy; confocal microscopy, limitations of optical microscopy
- d. In vivo Techniques: humane handling of animals, CCSEA and the role of IAEC, animal husbandry, rodent identification methods, blood injection and collection techniques, surgery and postoperative care of animals, methods for anesthesia and euthanasia, rodent behavior analysis, small animal imaging methods, optogenetics
- e. Transcriptomics: transfection and gene silencing techniques, RNA sequencing and its applications; experimental methods such as transfection and its confirmation through fluorescence microscopy and Western blot.
- f. Transgenics: Principle of knockout and knockin strategies, cre-lox technology, use of CRISPR-Cas and other gene editing methods in research

8. Experiments:

- a. Maintenance and passaging of mammalian cell-lines
- b. Assessing cell viability using MTT assay
- c. Assessing cell proliferation using colony formation and spheroid assays
- d. Assessing apoptosis using PI-Annexin flow cytometry
- e. Assessing cell cycle using propidium iodide
- f. Assessing oxidative stress using fluorescence microscopy
- g. Transfection of cells using lipofectamine
- h. Confirmation of transfection using Western blotting
- i. Confirmation of transfection using fluorescence microscopy

9. Reading suggestions: Text Books/Web-resources/other:

- a. Original papers and reviews as provided during the class
- b. Current Protocols Series in Cell Biology, Immunology and Neuroscience

10. Evaluation:

Theory:	Written Examination	: 50% Marks
	Paper Presentation	: 25% Marks
	Practicals/Assignments	: 25% Marks