## CONTEMPORARY CONCEPTS AND METHODS IN CELL BIOLOGY

**Bot.Sp-25** **Credit Hours 3(2+1)**

**Theory:**

**Introduction of the Course:**

This course focuses on the structure, molecular biology, and physiology of eukaryotic cells. It also provides knowledge about the structure and function of macromolecules DNA, RNA, proteins and modern approaches in genomics.

**Course Objectives:**

1. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
2. Students will understand how these cellular components are used to generate and utilize energy in cells.
3. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function.

**Course Detail:**

1. **Infective particles and life forms:**
   - 1.1. Prions, viroids, origin and evolution of various life forms
   - 1.2.Cell theory vs. cell body concept
   - 1.3.Multicellularity vs. supracellularity.
2. **Cell Wall:**
   - 2.1.Temporal and spatial dynamism in structure, structural and functional roles
   - 2.2.In planta and explanta uses
   - 2.3.Cell wall biotechnology
3. **Biological membranes:**
   - 3.1.From PLP model to Dynamically Structured Mosaic Model
   - 3.2.Transport through membranes
   - 3.3. Membranes as sties and routes of intra- and inter-organism and environment interactions
4. **Cytoplasmic components:**
   - 4.1.Endomembranes
   - 4.2.rganellar architecture
   - 4.3.Protein sorting and vesicular traffic
5. **Biopolymers:**
   - 5.1.Structural and functional aspects of cytoskeleton and associated motore molecular, their role in cell organization and movement
   - 5.2. Interaction among cytoskeletal elements, genomics, proteomics and bioinformatics of plant cytoskeleton
   - 5.3.Cytoskeleton in agro-biotechnolgy
6. **Nucleus:**
   - 6.1.Detailed structure of nuclear pore complex and nuclear Lamina, nuclear transport
   - 6.2.Chromatin subunit structure: from DNA to metaphase chromosome, histone code, states of chromatin during replication and transcription heterochromatization as a method of gene regulation

7. **Cell turnover:**
   7.1. Cell division, cell cycle controls, breakdown of cell cycle control: cancer vs. Plant tumors, programmed cell death.
8. **Cells to tissues:**
   8.1. Cell polarity, cell fate determination, integration of plant cells in tissues.
9. **Introduction to methods in plant cell biology:**
   9.1. Optical and electron microscopy
   9.2. Fluorescent probes
   9.3. Flow cytometry
   9.4. Transient expression
   9.5. Microinjection and micromanipulation
   9.6. Electrophysiological methods
   9.7. Plant histology
   9.8. Immunocytochemistry
   9.9. In-situ hybridization
   9.10. Cell fractionation and organelle isolation

**PRACTICALS:**

1. Would be based on the above topics. These could be in real time if facilities are available or could be virtual experiments.

**Teaching-learning Strategies**

1. Lectures
2. Group Discussion
3. Laboratory work
4. Seminar/ Workshop

**Learning Outcome**:

Students will be able to:

1. Illustrate that fundamental structural units define the function of all living things.
2. Explain that the growth, development, and behavior of organisms are activated through the expression of genetic information.
3. Summarize those biological systems grow and change by processes based upon chemical transformation pathways.
4. Communicate biological concepts and understanding to members of a diverse scientific community as well as to the general public.

**Assessment Strategies**:

1. Lecture Based Examination (Objective and Subjective)
2. Assignments
3. Class discussion
4. Quiz
5. Tests

**Recommended Readings:**


1. Alberts B, Johnson A, Lewis J, Raff Marin, Roberts K and Walter P. (2007). Molecular Biology of the Cell. Garland Publ., New York.
2. Bonifacino JS, Dasso M, Harford Jb, liipincott-Schwartz J and Yamada KM. (2004). Short Protocols in Cell Biology. John Wiley & Sons, New Jersey.
3. Bregman AA. (1987). Laboratory Investigations in Cell Biology. John Wiley & Sons, New York.
4. Buchanan et al. 2002. Biochemistry & Molecular Biology of Plants 1st edition, American Society of Plant Physiologists: Chapter 4, pp. 160-201 7 Chapter 5. pp. 202-256.
5. Hawes C and Satiat-Jeunernaitre B. (2001). Plant Cell Biology: Practical Approach. Oxford University Press, Oxford.
6. Karp G. (2008). Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons.
7. Lodish H, Berk A, Kaiser Ca, Krieger M, Scott Mp, Bretscher A, Ploegh H and Matsudaire P (2008). Molecular Cell Biology. WH Freeman & co., New York.
8. Ruzin SE (1999). Plant Microtechnique and microscopy. Oxford Univ. Press, Oxford.
9. Wischnitzer S. (1989). Introduction of Electron Microscopy. Pergamon Press, New York.

**Research papers / Reviews:**

1. Aguzzi, A. et al. (2007) Molecular mechanisms of prion pathogenesis, Ann. Rev. Path.: Mech. Dis. 3: 11-40.
2. Baluska F. et Al. (2004) Eukaryotic cells and cell bodies : cell theory revised. Ann. Bot. 94: 9-32.
3. Boxma, B. et al. (2005) An anerobic mitochondtion that prduces hydrogen. Nature 434:74-79.
4. Delwiche Cf (1999). Tracing the thread of plastid diversity through taperstry of life. Amer. Nat. 154: S164-177.
5. Dobson CM (2005). Structural biology: prying the prions. Nature 435:747—749.
6. Gruenbaum Y. et al. (2003). The nuclear lamina and its functions in the nucleus. Int. Rev. Cytol. 226:1-62.
7. Meagher, B. et al. (1999) "The evolution of new structures: clues from plant cytoskeletal genes. TIG, 15:7, 278-284.
8. Moerschbacher B. (2002). The plant cell wall – structural aspects and biotechnological developments. Pp. 445-477. In: Oksman-Caldentey, K-M. and Barz, W.H. Plant. Biotechnology and transgenic Plants. Marcel Dekkher, Inc. New York.
9. Raven JA and Allen JF (2003). Genomics and chloroplast evolution: what did cyanobacteria do for plants? Genome Biol.4(3):Art No. 209.
10. Rose A. et al. (2003). The plant nuclear envelope. Planta. 218:327-336.
11. Smith and Raikhel (1999). Protein targeting to the nuclear pore: what can we learn from plants?" Plant Physiol. 119:1157-1163
12. van der Giezen et al. (2005) "Mitochondrion-derived organelles in protists and fungi". Int. Rev. Cytol. 244:175-225.
13. Vereb, G.et al. (2003) Dynamic, yet structured: the cell membrane three decades after the Singer-Nicolson model. Proc. Nat. Acad. Sci. USA 100: 8053-8058
14. Wasteneys GO and Yang Z (2004) New views on plant cytoskeleton. Plant Physiol. 136: 3884-3891.


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