

MBTCR7171T: Advanced Cell Biology

Theory:[CIA: 20 Marks; End-Sem: 80 Marks]

No.ofCredits	6
Theory/Composite	Theory
No.ofperiodsassigned	5Theory+1Tutorial

Coursedescription/objective:

In this module the students will be introduced to protein trafficking and cell signaling pathways. Protein trafficking helps in passage of molecules from and to cells and any error in the trafficking pathways can lead to a pathological state. We all are aware of the fact that more than 45% of the marketed drugs are targeted against two major classes of cellular receptors – GPCRs and RTKs. To design more specific drugs against these or other receptors to combat several diseases we need to have a thorough knowledge of the receptors and the downstream signaling pathways. Through these two modules the students will gain sufficient knowledge in this direction.

Module A: Cell Compartmentalization & Protein Trafficking (40 Marks) (3 Classes per Week)

UNIT I: Protein localization based on fluorescence-based techniques.

UNIT II: Translocation of Secretory Proteins across the ER Membrane, Insertion of Membrane Proteins into the ER Membrane, Protein Glycosylation in the ER and Golgi Complex, protein transport in bacteria.

UNIT III: Golgi and Post-Golgi Protein Sorting and Proteolytic Processing, Molecular Mechanisms of Vesicular Traffic, molecular mechanisms. Lysosomes and endocytic pathways.

UNIT IV: Membrane-less organelles (nucleolus, stress granules and P granules: formation and function)

Module B: Cell Signaling (40 Marks)

(3 classes/ Week)

Unit V – General Principles and Mechanisms

Signals and Receptors – Receptors with associated protein kinase activity (RTK), receptors with associated serine-threonine kinase activity; G-protein-coupled receptors (GPCR); TNF receptor family; Cell adhesion receptors and mechano-transducers (Integrins); nuclear receptors (Steroid Hormone Receptors); Gases as signal molecules (NO)

Unit VI – Protein Regulation in Signal Transduction

Post-translational modification and the regulation of protein activity; Regulation of protein-protein interaction – interacting domains; Regulation of protein location; Regulation of protein production or protein degradation

Unit VII – Second Messengers

Cyclic nucleotides (cAMP, cGMP); Lipid derived second messengers (PIP₃ and DAG); Ions (Ca²⁺)

Unit VIII – Signaling Networks – “Bow Tie” or “Hour-Glass” Network

Common signaling pathways –MAP-kinase pathways, PI3K-PKB/Akt Pathway, Calcium Signaling, TGFβ Signaling, JAK/STAT Pathway; EGFR activated signaling network;

Unit IX – Signaling Processes

Signaling by Sensory Receptors – vision; olfaction; gustation;

Signaling involved in Glucose Homeostasis - Insulin and Glucagon Signaling; Insulin Resistance

Immunoreceptor Signaling.

Unit X – Laboratory techniques frequently used in cell signaling study

Teacher involved: Dr. Chandana Barat (Module A), Dr. Uma Siddhanta (Module B)

Texts & Reading/Reference Lists:

1. Molecular Biology of the Cell - Alberts, Johnson, Lewis, Raff, Roberts & Walter (4thed)
2. Leininger Principles of Biochemistry - Nelson & Cox (5th Ed)
3. Signal Transduction – Principles, Pathways & Processes – Cantley, Hunter, Sever & Thorner
4. Molecular Cell Biology Lodish and Darnell et. al (5th edition)
5. Molecular and Cell Biol. (Lodish 6th Ed.)
6. Relevant scientific literature.

Q.PaperStructureforEndSemTheory

Module A (40):

[2 questions of 15 marks (Any 2 from 3);

2 questions of 5 marks (Any 2 from 4)]

Module B (40):

[2 questions of 15 marks (Any 2 from 3);

2 questions of 5 marks (Any 2 from 4)]