

LS 402—CELL BIOLOGY [3 credits]

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S No	Topic	Faculty	No. of lectures
1.	Introduction to the Cell: The evolution of the cell, From molecules to first cell, From Prokaryotes to eukaryotes, From single cells to multicellular organisms	AB	1
2.	How cells are studied: Microscopy: light microscopy; fluorescence microscopy; Phase contrast microscopy; Electron microscopy, Purification of cells and their parts Cell separation and culture, flow cytometry, Fractionation of cell contents, Tracing cellular molecular with radioactive isotopes and antibodies	AB	3
3.	Membrane structure: The Lipid bilayer, Fluidity of a Lipid Bilayer, Phospholipids, Sphingolipids, Cholesterol, glycolipids, Lipid Rafts, Asymmetry of the Lipid Bilayer; Membrane Proteins, Association with the Lipid Bilayer by various ways, Transmembrane Proteins, RBC ghost cells, Proton pump; Membrane Proteins Diffusion and confinement	NM	3
4	Membrane transport of small molecules, Membrane transport of macromolecules and particles: Principles of Membrane Transport, Two Main Classes of Membrane Transport Proteins: Carriers and Channels; Active and passive transport; Asymmetric Distribution of Carrier Proteins in the membrane; Ionophores; Na ⁺ -K ⁺ Ca ²⁺ and H ⁺ Pumps are ATPases Pumps; Regulation of cytosolic pH, Maintenance of osmotic balance and cell volume; ABC transporters	NM	2
5	The cytoskeleton: Nature of cytoskeleton, Intermediate filaments, Microtubules, Actin filaments; Nucleation, Treadmilling and Dynamic Instability; Accessory proteins, cross-linking and assembly; Organization in response to signaling and cell behaviour	NM	4
6	Cell Junction and Adhesion: Anchoring Junctions, Cell-cell & Cell-matrix junctions; cadherins, integrins, selectins, immunoglobulin superfamily, catenins, desmosomes, hemidesmosomes; Occluding Junctions; gap junctions	NM	2
7	Extracellular Matrix: Glycosaminoglycan (GAG) chains, Hyaluronan, Proteoglycans, Collagens, Elastin, Fibronectin, Basal Laminae	NM	2
8	Cell-Cell Communication: General principle; Ligands and receptors; same signal different response and vice-versa, cell surface and nuclear receptor; intercellular signaling complexes; adaptation to signaling molecules; Receptor Guanylyl Cyclases; signaling through GPCR, secondary messenger- cAMP and Ca ²⁺ ; cAMP dependent protein kinase (PKA), Ca ²⁺ /Calmodulin-	NM	4

	dependent Protein Kinases (CaM-Kinases); Phospholipase C- β ; phosphatases; Smell and vision signaling-GPCR-cyclic-nucleotide-gated Ion Channels; signaling through enzyme coupled cell surface receptors; RTK; Ras; MAP kinase cascade; PI-3 kinase; Tyrosine-kinase-linked receptors; Jak-STAT signaling; Receptor Guanylyl Cyclases; Signaling regulated by proteolysis		
9	The Cell nucleus, Morphology and functional elements of eukaryotic chromosomes, Chromosomal DNA and its packaging and organization: The complex global structure of chromosomes and functions implications lampbrush Chromosomes, Polytene chromosomes, heterochromatin, centromeres	AB	3
10	Cell Cycle: Overview of the Cell cycle and components of control system: Checkpoints, cyclins and cyclin dependent kinases (CDKs); The molecular mechanisms for regulating mitotic events: Origin licensing DNA replication once per cell cycle, regulation by G1 phase cyclin-CDK, G1/S phase cyclin-CDK, S phase cyclin-CDK and M phase-CDK complexes. APC/C and SCF complexes, Cohesins and Condensins, Sister chromatid separation; regulation by mitogens, Rb and p53	NM	4
12	Organelles to the eukaryotic cell: The lysosomes, The peroxisomes, The Golgi apparatus, The endoplasmic reticulum	AB	1
13	Mitochondria and chloroplast, Structure of the mitochondria and chloroplast, Oxidation of glucose and fatty acids, Electron transport and oxidative phosphorylation, Chloroplast and photosynthesis	AB	4
14	Protein sorting: organelle biogenesis and protein secretion, synthesis and targeting, of mitochondria, chloroplast, peroxisomal proteins, translational modification in the ER. Intracellular traffic, vesicular traffic in the secretory pathway, protein sorting in the Golgi, traffic in the endocytic pathway, exocytosis	AB	5
	Neural Cell Biology	B.N. Mallick	
15	Excitable Cell/Tissue? Neuron and Muscle Neuronal Type and Properties	BNM	1
16	Basis of transmembrane potential and excitability channels? Types? Active and Passive, Gated, Non-gated, voltage gated, chemical gated, and their biology	BNM	4
17	Neuronal receptor and its Biology	BNM	2
18	Action Potential, Receptor Potential, Synaptic potential Propagation of Nerve Impulse conduction Synapse-Communication between neurons, fast propagation of signals Types of synapses? Mechanism of Action, Properties of synapses	BNM	4

19	Neurotransmitters – synthesis, release, mechanism of action Pre- Post-	2	
20	synaptic actions and their physiology; excitatory- inhibitory	2	
21	Glia – types, functions	1	
22	Axoplasmic flow, Growth of neurons, Degeneration and Regeneration Cellular Basis of Memory	3	
23	Basic Techniques to study Neural Cell-Biology	1	
		20+1	
Exams	2 quiz, one mid-term and one end term		

References:

1. Molecular Biology of The Cell: Bruce Alberts et. al.
2. The Cell: Geoffrey M Cooper
3. Molecular Cell Biology: Harvey Lodish et. al.
4. Principles of Neural Science Eds: E. Kandel et al.
5. Fundamental Neuroscience Eds : L. Squire et al.
6. Biology: Life on Earth with Physiology: Eds G. Audesirk et al.