SOPHIA COLLEGE FOR WOMEN

(EMPOWERED AUTONOMOUS)

Affiliated to the University of Mumbai

Programme: BSc

Course: Life Sciences

Syllabus for the Academic Year 2023-2024

based on the National Education Policy 2020

Programme Outline: FYBScLSc SEMESTER I

Course Code	Unit No	Name of the Unit	Credits
SLSC111MJ		Fundamentals of Cell and Microbial Biology	4
	1.	A Preview of the Cell	
	2.	Introduction to Microbiology	
	3.	Biomolecules	
SLSC111MJ		Practicals	

Programme Outline: FYBScLSc SEMESTER II

Course Code	Unit No	Name of the Unit	Credits
SLSC122MJ		Eukaryotic cell Biology	4
	1.	Nucleus and Cell membrane – Structure and function	
	2.	Cell Organelles	
	3.	Cytoskeleton, cell cycle and cell division	
SLSC122MJ		Practicals	

Preamble: The Broad-Based Integrated Biology Undergraduate Program in Life Sciences, which offers the BSc Life Sciences, is a cutting-edge integrated approach to biological sciences. The course is dedicated to the expansion of knowledge, innovation, and ethical practice in the field of life sciences, in recognition of the profound importance of these fields in understanding the complexity of living beings and ecosystems. Beyond theory, this program provides students with real laboratory activities that will help them hone their skills and obtain invaluable experience in a scientific setting. The student will be prepared to apply state-of-the-art tools and methods, which will reinforce their comprehension of the subjects taught in class. Through encouraging scientific inquiry, interdisciplinary collaboration, and the pursuit of excellence, our program aims to create a community of scholars and researchers who are ready to take on the most important problems facing both humanity and the natural world, regardless of their career goals—research, industry, environmental science, or a combination of these.

PROGRAMME OBJECTIVES

PO1	Understand and analyze fundamental biological concepts while merging perspectives from several domains related to modern biology
PO2	Expand professional studies and research in disciplines such as neurology, genetics, cell biology, physiology, biochemistry, immunology, developmental biology, ecology, and biotechnology.
PO3	Understand and apply information from a variety of scientific resources; assess and interpret graphical data; develop reliable hypotheses, plan experiments, and observational techniques in a laboratory setting; demonstrate problem-solving abilities; and present results from science in verbal and written form.
PO4	Demonstrate expertise in scientific subjects such as biostatistics, bioinformatics, and analytical procedures required for productive biological research; understand biotechnological processes utilized in business; and anticipate need-based entrepreneurial opportunities in all areas of biology.
PO5	Engage as a team, establish interpersonal communication skills, and get the confidence to pursue a career in any field of choice.

PROGRAMME SPECIFIC OUTCOMES

PSO1	The learner will be able to understand various fundamental concepts of life science and reflect them in their day-to-day life.
PSO2	The learner will be proficient with analytical tools and techniques of life sciences
PSO3	The learner will be able to critically think and analyse any given problem scientifically.

SEMESTER 1

NAME OF THE COURSE	Cell and Microbial Biology	
CLASS	FYBSCLSC	
COURSE CODE	SLSC111MJ	
NUMBER OF CREDITS	4	
NUMBER OF LECTURES PER WEEK	3	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD	CONTINUOUS ASSESSMENT	SUMMATIVE ASSESSMENT
TOTAL MARKS	50	50
PASSING MARKS	20	20

COURSE OBJECTIVES:

CO1	Identify and describe the structure and function of major cellular organelles.
CO2	Classify microorganisms into different groups (bacteria, archaea, fungi, protozoa, viruses) based on their structural and functional characteristics.
CO3	Evaluate different physical and chemical methods used to control microbial growth, including sterilization techniques, disinfectants, and antimicrobial agents.

COURSE LEARNING OUTCOMES:

CLO1	The Learner will be able to understand the basics of microscopy, types of microscopes to visualize microbial cells, microorganisms.
CLO2	The Learner will be able to Compare and contrast the diverse microbes, Microbial diversity, the cell wall structure and its propagation.
CLO3	The Learner will be able to Gain knowledge about parameters of microbial growth and conditions for their control.

UNIT 1	A PREVIEW OF THE CELL
1.1	Visualization of the cell – Microscopy – Principle, Resolving Power and types of microscopy–Brightfield, Fluorescence, Electron microscopy –Transmission and Scanning.
1.2	Types and comparison of cells – Bacteria, Archaea and Eukaryotes.
1.3	Limitation on size and compartmentalization of functions.
1.4	Prokaryotic cell –Structure Cell wall – Gram positive and Gram negative Nucleoid; capsule/glycocalyx; flagella and endospore.
1.5	Fungi – Growth and reproduction – asexual and sexual.
1.6	Algae and Protozoa – Structural organization and Morphological diversity.
1.7	Evolutionary origin of organelles and Endosymbiont Hypothesis.
UNIT 2	**INTRODUCTION TO MICROBIOLOGY**
2.1	History of Microbiology – Spontaneous generation and Germ theory.
2.2	Binary fission and cell growth.
2.3	Biofilm formation.
2.4	Viruses, Viroids and Prions: Virus–structure and life cycle of a bacterial virus (lytic and lysogenic), animal virus – DNA virus (ex. Herpes virus) RNA virus (plus and minus stranded), Retrovirus and plant virus (TMV), Viroids, Prions – e.g. scrapie.
2.5	Agents of different microbial diseases.
2.6	Role of microorganisms in agriculture, industry, and medicine.
UNIT 3	**BIOMOLECULES**
3.1	**Non-carbon-containing molecules in cells:** a. Water- the most abundant component 1. Molecular structure and physico-chemical properties 2. Corresponding functions in cells and reasons for being the basis of life. b. Inorganic Ions: 1. Macro-elements- Na, K, Cl, Ca, P, Mg, S 2. Micro-elements – Fe, Cu Zn, Mn, I, Ni function in cells.
3.2	**Carbon-containing compounds in cells:** a. Amino acids and Protein macromolecules

	1. Biological amino acids - general structure and reactions 2. Classification of amino acids based on – biochemical nature and structure 3. Structure-function relation in proteins. b. Protein structure and folding, Molecular Chaperones 1. Primary – Quaternary structures within proteins with typical examples 2. Protein folding chaperones and disease. c. Monosaccharide Sugars and Polysaccharide Carbohydrates 1. Nomenclature, structure of common sugars and reactions. d. Fatty Acids and Lipids Nomenclature and structure of common lipids. e. Nucleotides and Nucleic Acid Nomenclature and structure.
3.3	**Macromolecular synthesis** a. DNA synthesis in prokaryotes. b. DNA synthesis in eukaryotes.
SLSC111MJP	1. Use, care and maintenance of microscopes (discussion on standard oper procedures). 2. A. Observation of permanent slides under light microscope B. EM micrographs of bacteria and virus. 3. Demonstration of Fluorescence Microscopy using live biological samples 4. Microbial analysis from pond water/ curd/or any other sample. 5. Study of bacterial motility by hanging drop technique. 6. Slide culture technique for observation of fungi (from pure cultur sample). 7. Water molecules and its properties (solvent, density, cohesion and adhe colligative properties). 8. Detection and localization of carbohydrates, proteins, lipids and nucleic in vitro and in tissues. 9. Origami and modeling of biochemical structures. 10. Extraction of DNA from onion.

REFERENCES:

1. Aneja K.R., Experiments in Microbiology, Plant Pathology and Biotechnology, 2017,5th Edition, *New Age InternationalPublishers.*
2. Hardin J., Bertoni J.P., Kleinsmith L.J., Becker's World of the Cell: International Edition, 2011, 8th Edition, *PearsonPublisher*.
3. Madigan M, Martinko J., Bender K., Buckley D., Stahl D., Brock Biology of Microorganisms, 2017, 14th Edition, *Pearson Publishers*
4. TortoraG.J.,FunkeB.R.,CaseC.L.,Microbiology:AnIntroduction,20 16,12thEdition, *Pearson Publication*
5. Willey J., Sherwood L., Woolverton C., Prescott, Harley and Klein's, Microbiology, 2008, 7th Edition*, McGraw Hill HigherEducation*

6. Nelson D.L. and Cox M.M., Lehninger-Principles of Biochemistry, 2017, 7thEdition, *W H Freeman & Co Publishers.*
7. Plummer M. and Plummer D.T., Introduction to Practical Biochemistry, 1988, 3rdEdition, *McGraw Hill Publication*
8. Taylor D.J., Green N.P.O., Stout G.W., Ed. Soper R., Biological Science, 2005, 3rdEdition, *Cambridge University Press.*
9. Karp G, Cell Biology, 2013, 7thEdition- International Student Edition, *Wiley Publication.*
10. LodishH.,BerkA.,KaiserC.A.,MolecularCellBiology,2012,7thEdition, *Macmillan Learning Publications.*
11. Plopper G, Principles of Cell Biology, 2016, 2ndEdition*, Jones and Bartlett Learning Publication.*

ASSESSMENT DETAILS:
There are two subheadings namely

Summative Assessment (SA) and Continuous Assessment (CA)

- It is mandatory for students to attain both SA and CA
- No minimum marks requirement for passing individually in either SA or CA
- However, the passing marks out of 100 will be mandatorily be calculated from SA (50 marks) and CA (50 marks)
- Students will be declared fail if the score is less than 40 out of 100
- If a student fails, the student will have to appear for a 100 marks ATKT SA paper covering the entire semester syllabus
- If a student fails to appear in the semester end SA, the student will then appear for 50 marks Additional SA paper
- Format of CA: Two CA activities, 25 marks each

SEMESTER 2

NAME OF THE COURSE	Eukaryotic cell Biology	
CLASS	FYBSCLSC	
COURSE CODE	**SLSC122MJ**	
NUMBER OF CREDITS	4	
NUMBER OF LECTURES PER WEEK	3	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD TOTAL MARKS PASSING MARKS	CONTINUOUS ASSESSMENT 20 10	SUMMATIVE ASSESSMENT 30 + 50 30

COURSE OBJECTIVES:

CO1	To make the students learn the structure and function of components of eukaryotic cells like nucleus, plasma membrane, chloroplast and mitochondria.
CO2	To make the students learn about protein formation and trafficking through the endomembrane organelles.
CO3	To make the students understand processes and mechanisms of cell division.

COURSE LEARNING OUTCOMES:

CLO1	To differentiate between Euchromatin and Heterochromatin, active and passive transport across the membrane in animals and plants
CLO2	To differentiate between different cell-cell junctions and extracellular matrices which contribute stability and elasticity to the cell.
CLO3	To gain an insight into the different cell organelles and diseases associated due to their malfunctions.

UNIT 1	**NUCLEUS AND CELL MEMBRANE – STRUCTURE AND FUNCTION**
1.1	1. Nucleus ● Structure of Interphase nucleus - nuclear membrane, nucleolus, nucleosome model ● Euchromatin and Heterochromatin ● Specialized chromosomes – polytene and lampbrush chromosomes
1.2	Membrane – their structure and function History and models of membrane structure
1.3	Transport across membranes ● Transport processes ● Simple and Facilitated Diffusion ● Active transport – example Na+/K+pump ● Vesicular transport – Endocytosis and exocytosis, Phagocytosis
1.4	Cell adhesion, cell junctions and extracellular structures ● Cell- cell junctions – tight junctions, gap junctions, adhesion junctions ● Extracellular matrix of animal cells –collagen, elastin, laminins
1.5	Plant cell surface – plant cell wall and plasmodesmata
UNIT 2	**CELL ORGANELLES**
2.1	Endoplasmic reticulum and ribosomes ● Ribosomes – structure of prokaryotic and eukaryotic ribosomes and role in protein synthesis ● Rough ER – structure and role in protein synthesis – signal peptide hypothesis ● Smooth ER – structure and functions (also function as sarcoplasmic reticulum ● ER role in biosynthesis of membranes
2.2	Golgi Complex ● Structural organization ● Brief introduction to role of Golgi in protein glycosylation and proteasome in protein degradation
2.3	Lysosomes ● Formation of lysosomes and role in digestion of materials ● Lysosomal storage diseases – silicosis and Tay Sachs disease

2.4	Peroxisomes ● Function in animal and plant cells ● Zellweger syndrome
2.5	Mitochondria ● Structure and role in oxidative phosphorylation in ATP synthesis ● Mitochondrial DNA and associated disease – LHON
2.6	Plastids ● Types of plastids ● Structure of chloroplast and role in Photosynthesis ● Photosynthetic pigments
UNIT 3	**CYTOSKELETON, CELL CYCLE AND CELL DIVISION**
3.1	Cytoskeleton ● Types of cytoskeletal elements ● Microtubules – Structure and role in spindle formation and cilia/ flagella; microtubule motor proteins ● Microfilaments – Structure and role in muscle contraction and motility (migration via lamellipodia/amoeboid movement/cytoplasmic streaming) ● Intermediate filament – Structure and functions.
3.2	Cell cycle ● Cell cycle stages ● Regulation of Cell cycle (in brief–role of cyclins and Cdks) ● Cancer as an example of dysregulation of cell cycle
3.3	Cell Division ● Mitosis stages and cytokinesis, Metaphase chromosomes: centromere and telomere ● Meiosis – Stages and significance–crossing
SLSC122MJP	1. Electron micrographs of organelles and cell junctions. 2. Cytogenetic analysis of onion root tip. 3. Chironomus Larvae- study of giant chromosomes from salivary glands. 4. Permanent slides of meiotic stages. 5. Staining of striated muscle. 6. Plasmolysis using Tradescantia leaf. 7. Methyl green pyronin staining for localization of nucleic acids.

REFERENCES:

1. Brooker, Widmaier, Graham, Stiling, Biology, 2016, 4th edition, *McGraw-Hill Education Publication*
2. Campbell, Reece, Urry, Cain, Wasserman, Minorsky, Jackson,

Biology, 2016, 11thEdition, *Pearson Publication*
3. Freeman S., Biological Science, 2004, Benjamin Cummings Publishing Company.
4. Hyde D. R., Genetics and Molecular Biology: With Fundamentals of Biostatistics, 2010, 1st Edition, *McGraw Hill Education Publication*
5. Alberts B., Johnson A., Lewis J., Morgan D., Raff M., Roberts K., Walter P., Molecular Biology of the Cell, 2007 or 2014,Science Publications th th Edition or6 Edition,Garland
6. Hardin J., Bertoni J.P., Kleinsmith L.J., Becker's World of the Cell: International Edition, 2011, 8thEdition, Pearson Publisher
7. Karp G, Cell Biology, 2013, 7thEdition- International Student Edition, Wiley Publication
8. LodishH.,BerkA.,KaiserC.A.,MolecularCellBiology,2012,7thEdition, Macmillan Learning Publications.
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