SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Affiliated to the University of Mumbai

Programme: Life Sciences

Programme Code: SLSC

FYBSc

Syllabus for the Academic Year 2024-2025

based on the National Education Policy 2020

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Programme Outline:

FYBScLSc (SEMESTER I)

Course Code	Unit No	Name of the Unit	Credits
SLSC111MJ		Fundamentals of Cell and Microbial Biology	2
	1	A Preview of the Cell	
	2	Biomolecules	
SLSC111MJP		Practicals	2

FYBScLSc (SEMESTER II)

Course Code	Unit No	Name of the Unit	Credits
SLSC122MJ		Eukaryotic cell Biology	2
	1	Nucleus and Cell membrane – Structure and function	
	2	Cell Organelles	
SLSC122MJP		Practicals	2

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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 think critically and analyze any problem scientifically.

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

SEMESTER 1

NAME OF THE COURSE	Fundamentals of Cell and Microbial Biology	
CLASS	FYBSCLSC	
COURSE CODE	SLSC111MJ	
NUMBER OF CREDITS	4	
NUMBER OF LECTURES PER WEEK	4	
TOTAL NUMBER OF LECTURES PER SEMESTER	45	
EVALUATION METHOD	CONTINUOUS ASSESSMENT	SUMMATIVE ASSESSMENT
TOTAL MARKS	20	30 + 50
PASSING MARKS	10	30

COURSE OBJECTIVES:

CO 1.	Learn the basic principles of microscopy and microbiology
CO 2.	Learn about types of microscopy to visualize microbial cells
CO 3.	Understand the differences between prokaryotic and eukaryotic cells
CO4.	Understand the composition of molecules within living cells

COURSE LEARNING OUTCOMES:

CLO 1.	Proficiently use the microscope, subsequently associate the appropriate microscopy technique needed to analyse the given sample
CLO 2.	Comprehend the fundamentals of prokaryotic and eukaryotic cells.
CLO 3.	Mindfully embrace the significance of microbes in diseases, agriculture, and industry
CLO 4.	Apply the properties of different functional groups of biomolecules and carry out selective organic reactions.

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Programme: Science Life Science Major	**Semester – 1**
Course Title: Fundamentals of Cell and Microbial Biology	**Course Code: SLSC111MJ**

COURSE OBJECTIVES:

1. Learn the basic principles of microscopy and microbiology
2. Learn about types of microscopy to visualize microbial cells
3. Understand the differences between prokaryotic and eukaryotic cells
4. To understand the composition of molecules within living cells

COURSE OUTCOMES:

The learner will be able to :

1. Proficiently use the microscope, subsequently associate the appropriate microscopy technique needed to analyse the given sample
2. Comprehend the fundamentals of prokaryotic and eukaryotic cells.
3. Mindfully embrace the significance of microbes in diseases, agriculture, and industry
4. Apply the properties of different functional groups of biomolecules and carry out selective organic reactions.

Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**4**	
Evaluation System	**SUMMATIVE ASSESSMENT**	**2 Hours**	**30 marks (SA) + 50 Marks (practical)**
	CONTINUOUS ASSESSMENT	**--**	**20 marks**

A Preview of the Cell		**Structure of Cell**	**15 hours**
	1.1	Prokaryotic cell –Structure Cell wall – Gram positive and Gram negative Nucleoid; capsule / glycocalyx; flagella and endospore.	2
	1.2	Fungi – Growth and reproduction – asexual and sexual. Algae and Protozoa – Structural organization and Morphological diversity.	
	1.3	Evolutionary origin of organelles and Endosymbiont Hypothesis.	2
	1.4	History of Microbiology – Spontaneous generation and Germ theory.	1

	1.5	Binary fission and cell growth. Biofilm formation.	1
		Microorganisms	2
	1.6	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.	1 2
	1.7	Agents of different microbial diseases Role of microorganisms in agriculture, industry and medicine.	2 2
Biomolecules	**2.1**	**Non-carbon-containing molecules in cells:**	**15 hours**
		a. Water- the most abundant component • Molecular structure and physico-chemical properties • Corresponding functions in cells and reasons for being the basis of life. b. Inorganic Ions: • Macro-elements- Na, K, Cl, Ca, P, Mg, S • Micro-elements – Fe, Cu Zn, Mn, I, Ni function in cells.	2 2 1

	2.2	**Carbon-containing compounds in cells:** a. Amino acids and Protein macromolecules • Biological amino acids - general structure and reactions • Classification of amino acids based on – biochemical nature and structure • Structure-function relation in proteins. b. Protein structure and folding, Molecular Chaperones • Primary – Quaternary structures within proteins with typical examples • Protein folding chaperones and disease. c. Monosaccharide Sugars and Polysaccharide Carbohydrates • 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.	2 2 2 2
	2.3	**Macromolecular synthesis** a. DNA synthesis in prokaryotes. b. DNA synthesis in eukaryotes.	2

Practicals for Major Paper (SLSC111MJP)

1. Good Lab Practices and Writing a Science Lab Report.
2. Use, care and maintenance of microscope (discussion on standard operating procedures).
3. A. Observation of permanent slides under light microscope
   B. EM micrographs of bacteria and virus.
4. Demonstration of Fluorescence Microscopy using live biological samples.
5. Study of bacterial motility by hanging drop technique.
6. Slide culture technique for observation of fungi (from pure culture/soil sample).
7. Water molecules and its properties (solvent, density, cohesion and adhesion, colligative properties).
8. Detection and localization of carbohydrates, proteins, lipids and nucleic acids in vitro and in tissues.
9. Origami and modeling of biochemical structures.
10. Extraction of DNA from onion.
11. Analytical Techniques
    A. Colorimetry:
    a. Basic Concept of Solution Preparation:

i. Preparation of Simple Inorganic Salt Solutions: Molarity and Percent Solution
ii. Preparation of dilutions from a stock solution.

b. Determination of Lambda max
c. Verification of Beer-Lambert's law.

B. pH metry:

a. Usage and Calibration of pH meter.
b. Making of own pH indicator papers.

12. Separation Techniques

- Separation of biomolecules using a semi permeable membrane (dialysis).
- Separation of the given sample using sucrose gradient.

Separation of amino acids using paper chromatography technique.

13. Microscopy

- Parts of Microscope
- Micrometry: Measurement of cell size under microscope (concept of mm and μm). Example: measurement of pollen grain from different flowers, starch grains (iodine).

14. Microbiology

- Demonstration of different sterilization techniques used in the laboratory.
- Demonstration of media preparation and pouring plates.
- Microbial staining technique:
  a. Monochrome staining of bacteria, yeast, animal cell (from cheek), plant cell (onion peel)
  b. Differential staining: Gram staining.
- Isolation of Pure Culture of Bacteria by Streak Plate Method.

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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

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

SEMESTER 2

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

COURSE OBJECTIVES:

CO 1.	To make the students learn the structure and function of components of eukaryotic cells like nucleus, plasma membrane, chloroplast and mitochondria.
CO 2.	To make the students learn about protein formation and trafficking through the endomembrane organelles.
CO 3.	To make the students understand the processes and mechanisms of cell division.

COURSE LEARNING OUTCOMES:

CLO 1.	To differentiate between Euchromatin and Heterochromatin, active and passive transport across the membrane in animals and plants.
CLO 2.	To differentiate between different cell-cell junctions and extracellular matrices which contribute stability and elasticity to the cell.
CLO 3.	To gain an insight into the different cell organelles and diseases associated with their malfunctions.

SOPHIA COLLEGE FOR WOMEN (EMPOWERED AUTONOMOUS)

Programme: Science **Life Science Major**		**Semester – 2**	
Course Title: Eukaryotic cell Biology		**Course Code: SLSC122MJ**	
COURSE OBJECTIVES: 1. To make the students learn the structure and function of components of eukaryotic cells like nucleus, plasma membrane, chloroplast and mitochondria. 2. To make the students learn about protein formation and trafficking through the endomembrane organelles. 3. To make the students understand processes and mechanisms of cell division.			
COURSE OUTCOMES: The learner will be able to : 1. To differentiate between Euchromatin and Heterochromatin, active and passive transport across the membrane in animals and plants. 2. To differentiate between different cell-cell junctions and extracellular matrices which contribute stability and elasticity to the cell. 3. To gain an insight into the different cell organelles and diseases associated due to their malfunctions.			
Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**4**	
Evaluation System	**SUMMATIVE ASSESSMENT**	**2 Hours**	**30 marks (SA) + 50 Marks (practical)**
	CONTINUOUS ASSESSMENT	**--**	**20 marks**

UNIT 1	1	**Cell Organelles**	15 hours
	1.1	Cell membrane structure and function, models of membrane structure Transport across membranes ● Transport processes ● Simple and Facilitated Diffusion	
	1.2	Cell adhesion, cell junctions and extracellular structures ● Cell- cell junctions – tight junctions, gap junctions, adhesion junctions ● Extracellular matrix of animal cells –collagen, elastin, laminins	
	1.3	Plant cell surface – plant cell wall and plasmodesmata	

	1.4	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	
	1.5	Golgi Complex ● Structural organization ● Brief introduction to role of Golgi in protein glycosylation and proteasome in protein degradation	
	1.6	.Lysosomes ● Formation of lysosomes and role in digestion of materials ● Lysosomal storage diseases – silicosis and Tay Sachs disease	
	1.7	Peroxisomes ● Function in animal and plant cells ● Zellweger syndrome	
	1.8	Mitochondria ● Structure and role in oxidative phosphorylation in ATP synthesis ● Mitochondrial DNA and associated disease – LHON	
	1.9	Plastids ● Types of plastids ● Structure of chloroplast and role in Photosynthesis ● Photosynthetic pigments	
UNIT 2	2	**Cytoskeleton, Nucleus, cell cycle and cell division**	15 hours
	2.1	Nucleus ● Structure of Interphase nucleus - nuclear membrane, nucleolus, nucleosome model ● Euchromatin and Heterochromatin ● Specialized chromosomes – polytene and lampbrush chromosomes	

	2.2	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.	
	2.3	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	
	2.4	Cell Division ● Mitosis stages and cytokinesis, Metaphase chromosomes: centromere and telomere ● Meiosis – Stages and significance–crossing	

Practicals for Major Paper (SLSC122MJP)

1. Electron micrographs of organelles and cell junctions.
2. Cytogenetic analysis of onion root tip.
3. Chironomous 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.
8. Pairing game to produce a Punnet square.
9. Collection of blood group information from family and construction of pedigree charts.
10. Human Karyotyping- Normal and Abnormal (Numerical and Structural).
11. Barr body from buccal smear.
12. Study of polyploidy in onion root tip by colchicine treatment.
13. Sex-linked inheritance in Drosophila melanogaster.
14. Identification of adult zebrafish mutants.

Note: Students will be continuously monitored for their active participation during lab sessions.

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