SOPHIA COLLEGE (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

SOPHIA COLLEGE (AUTONOMOUS)

PROGRAMME SPECIFIC OUTCOMES	
1	Students will able to understand various fundamental concepts of life science and reflect them in their day to day life
2	Student will be able to critical think and analyze any given problem scientifically
3	Students will be proficient with analytical tools and techniques of life sciences

DEPARTMENT OF LIFE SCIENCES

COURSE DETAILS FOR MAJOR:

	SEMESTER I			
	Major Paper	VSC-I	VSC-II	IKS
TITLE	Fundamentals of Cell and Microbial Biology	Principle and Analytical Techniques of Biomolecules	Introductory laboratory skills and techniques in Biology	History of Forests and Agriculture in India
TYPE OF COURSE DSE/DSC	DSC	VSC	VSC	IKS
CREDITS	4	2	2	2

	SEMESTER II			
	Major Paper	SSEC-I	SSEC-II	OE
TITLE	Eukaryotic cell Biology	Science of Genetics	Bioecology	Concepts of Evolution
TYPE OF COURSE DSE/DSC	DSC	SEC1	SEC2	OE
CREDITS	4	2	2	2

SOPHIA COLLEGE (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)		**3**	
Total number of Hours in a Semester		**45**	
Credits		**4**	
Evaluation System	**Summative Assessment**	**2 Hours**	**50 marks**
	Continous Assessment	**--**	**50 marks**

UNIT 1	1	**A Preview of the Cell**	15 hours
	1.1	Visualization of the cell – Microscopy – Principle, Resolving Power and types of microscopy–Brightfield, Fluorescence, Electron microscopy –Transmission and Scanning.	3
	1.2	Types and comparison of cells – Bacteria, Archaea and Eukaryotes.	2
	1.3	Limitation on size and compartmentalization of functions.	1
	1.4	Prokaryotic cell –Structure	

		Cell wall – Gram positive and Gram negative Nucleoid; capsule/glycocalyx; flagella and endospore.	3
	1.5	Fungi – Growth and reproduction – asexual and sexual.	1
	1.6	Algae and Protozoa – Structural organization and Morphological diversity.	2
	1.7	Evolutionary origin of organelles and Endosymbiont Hypothesis.	3
UNIT 2	2	**Introduction to Microbiology**	15 hours
	2.1	History of Microbiology – Spontaneous generation and Germ theory.	1
	2.2	Binary fission and cell growth.	2
	2.3	Biofilm formation.	1
	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.	5
	2.5	Agents of different microbial diseases.	3
	2.6	Role of microorganisms in agriculture, industry, and medicine.	3
UNIT 3	3	**Biomolecules**	15 hours
	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.	4 6

	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. 3. c. Monosaccharide Sugars and Polysaccharide Carbohydrates 4. 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.	5
	3.3	**Macromolecular synthesis** a. DNA synthesis in prokaryotes. b. DNA synthesis in eukaryotes.	

Practicals for Major Paper (SLSC111MJP)

1. Use, care and maintenance of microscopes (discussion on standard operating 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 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.

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

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,2016,12thEdition, *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*

SOPHIA COLLEGE (AUTONOMOUS)

Publication

Programme: Science Life Science VSC I		**Semester – 1**	
Course Title: Principle and Analytical Techniques of Biomolecules		**Course Code: SVSC103**	
COURSE OBJECTIVES: 1. Students will learn the concepts of Molarity and Normality. 2. Students will be acquainted with different qualitative and quantitative based techniques and assays 3. Students will develop the ability of critically learning the concepts of biomolecules			
COURSE OUTCOMES: The learner will be able to : 1. Familiarize oneself with working principle of different instruments used in life science 2. Demonstrate the separation of biomolecules using different techniques. 3. Make calculations related to preparation of different concentration of solutions			
Lectures per week (1 Lecture is 60 minutes)		**1**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Continuos Assessment**	**Theory**	**20 marks**
		Practical	**20 marks**
	Class Participation		**10 marks**

UNIT 1	1	**Fundamentals of Handling/Working of instruments and Analytic Techniques**	15 hours
	1.1	Introduction of instruments, spectroscopy and photometric techniques.	2
	1.2	Concepts of Molarity and Normality.	1
	1.3	Quantitative biochemical measurements.	2
	1.4	Qualitative and quantitative analysis of biomolecules.	2
	1.5	**Extraction techniques** Cell lysis techniques – Physical, chemical Solvent extraction of lipids.	3
	1.6	**Separation and analytical techniques** 1. Precipitation	

		2. Filtration 3. Dialysis 4. Centrifugation 5. Chromatography 6. Electrophoresis Using the above techniques to isolate/ analyze particular molecules using a typical example.	5

Practical of VSCI (SVSC103P)

A. Analytical Techniques

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

B. Separation Techniques

- Separation of biomolecules using a semi permeable membrane (dialysis).
- Isoelectric Precipitation of proteins.
- Separation of the given sample using sucrose gradient.
- Separation of amino acids using paper chromatography technique.

ASSESSMENT DETAILS:

Only Continous Assessment (CA) will be conducted

- It is mandatory for students to attain both CA activities
- CA1: Test: 20 marks (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)
- CA2: Practical/Activity, as applicable: 20 marks
- Class participation (Attendance and Involvement in class activities): 10 marks
- The minimum score to pass for the course is 20 out of 50
- If a student fails to score atleast 20, the student will then appear for 40 marks ATKT CA paper (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)

REFERENCES

1. Nelson D.L. and Cox M.M., Lehninger-Principles of Biochemistry, 2017, 7thEdition, *W H Freeman & Co Publishers.*
2. Plummer M. and Plummer D.T., Introduction to Practical Biochemistry, 1988, 3rdEdition, *McGraw Hill Publication*
3. Taylor D.J., Green N.P.O., Stout G.W., Ed. Soper R., Biological Science, 2005, 3rdEdition, *Cambridge University Press.*

SOPHIA COLLEGE (AUTONOMOUS)

Programme: Science Life Science VSC II		**Semester – 1**	
Course Title: Introductory laboratory skills and techniques in Biology		**Course Code: SVSC104**	
COURSE OBJECTIVES: 1. Students will learn laboratory discipline and good lab practices 2. Students will be able to reflect how microbial growth could be controlled. 3. Students will acquire knowledge of different parameters necessary for optimal microbial growth, culturing and preservation			
COURSE OUTCOMES: The learner will be able to : 1. Gain expertise in laboratory practises and journal writing 2. Elucidate the functioning of microscopes and reason out why specimens must be stained. 3. Perform microbiological techniques under sterile conditions.			
Lectures per week (1 Lecture is 60 minutes)		**1**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Continuous Assessment**	**Theory**	**20 marks**
		Practical	**20 marks**
	Class Participation		**10 marks**

UNIT 1	1	**Fundamentals of Handling/Working of instruments and Analytic Techniques**	15 hours
	1.1	**Laboratory Practices and Basic Microbiology** Laboratory discipline. Good Laboratory Practices. Instrument Safety.	2 5

	1.2	**Fundamental microbial techniques** 1. Micrometry of biological specimen. 2. Sterilization of laboratory material (principle of use of autoclave). 3. Media preparation and pouring plates. 4. Understanding the functioning of common microbiological equipment. 5. Introduction to Stains and Dyes. 6. Staining and culturing of microbial culture.	6
	1.3	**Microbial growth requirements and its control** Requirements for growth– 1. Physical – Temperature, pH, Osmotic pressure 2. Chemical – Carbon, nitrogen, sulphur, phosphorus oxygen, trace elements, growth factors 3. Culture Media 4. Anaerobic growth. 5. Kinetics of growth 6. Growth curve and generation time 7. Batch and continuous cultures 8. Isolation of microorganisms 9. Preservation of microorganisms.	2
	1.4	Control of microbial growth 1. Physical 2. Chemical 3. Antimicrobial.	

Practical of VSCII (SVSC104P)

A. Introduction of Laboratory practices and Journal writing

Good Lab Practices and Writing a Science Lab Report.

B. Microscopy

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

C. 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 cells (onion peel)

b. Differential staining: Gram staining.

- Isolation of Pure Culture of Bacteria by Streak Plate Method.
- Effect of temperature on growth kinetics in yeast.
- Demonstration of AST (by disc diffusion method) and Minimum Inhibitory Concentration (MIC) for a bacterial culture.

ASSESSMENT DETAILS:

Only Continous Assessment (CA) will be conducted

- It is mandatory for students to attain both CA activities
- CA1: Test: 20 marks (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)
- CA2: Practical/Activity, as applicable: 20 marks
- Class participation (Attendance and Involvement in class activities): 10 marks
- The minimum score to pass for the course is 20 out of 50
- If a student fails to score atleast 20, the student will then appear for 40 marks ATKT CA paper (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)

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*
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5. TortoraG.J.,FunkeB.R.,CaseC.L.,Microbiology:An Introduction,2016,12thEdition, *Pearson Publication*
6. Willey J., Sherwood L., Woolverton C., Prescott, Harley and Klein's, Microbiology, 2008, 7th Edition*, McGraw Hill HigherEducation*

SOPHIA COLLEGE (AUTONOMOUS)

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Programme: Science **Life Science IKS**		**Semester – 1**	
Course Title: History of Forests and Agriculture in India		**Course Code: IKS106**	
COURSE OBJECTIVES: **Learner will be acquainted with the understanding of** 1. Indian forest in different historical periods 2. Approaches towards various agriculture techniques and sustainable practices in ancient India			
COURSE OUTCOMES: The learner will be able to : 1. Understand the human activities that led to changes in the forest biodiversity in different historical periods 2. Analyze the wisdom of ancient Indian agricultural practises 3. Undertake socially relevant solutions in the areas of agriculture, and irrigation.			
Lectures per week (1 Lecture is 60 minutes)		**2**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Graded Subject**	**Continous Assesment**	**40 marks**
		Class Participation	**10 marks**

UNIT 1	1	**History of Forests in India**	15 hours
	1.1	Indian Forests in different period 1. Ancient Period, Kautilya classification of forests 2. Gupta Period: history of forestry in the reign of Chandra Gupta Maurya 3. Medieval Period 4. British Period 5. Modern Period	3
	1.2	Establishment of Forest Department in India 1. British Imperial Forestry Service in Colonial India 2. Forest department in colonial India in 1864 and the formulation of Indian Forest Act in 1865	2

	1.3	Forest policies and laws related to Indian Forest Ecology 1. The Indian Forest Act, 1927 2. National Forest Policy 1952 3. The Forest Conservation Act, 1980	3
	1.4	Ecology of Indian Forest 1. Introduction to forest ecosystem 2. India's biodiverse regions	2
	1.5	Effect of environment and socioeconomic status on forests	2
	1.6	Case studies on Indian Forestry 1. Thana Forests in Bombay 2. Impact of British Forestry in Karnataka State 3. The Timberlands of Assam 4. The forests of the Western Himalayas	3
UNIT 2	2	**History of Agriculture in India**	15 hours
	2.1	Beginning of Agriculture in India across ages 1. Vedic period 2. Early Common Era – High Middle Ages 3. Late Middle Ages – Early Modern Era. 4. Colonial British Era 5. Earliest Agrarian Settlements	5
	2.2	Ancient agricultural practices 1. Soil classification and Conservation 2. Water harvesting and irrigation developments during different periods – water storage – distribution and relevance to modern agriculture.	5
	2.3	Farming practices 1. Indus Valley Civilization 2. Harappa and Chanhu-daro, Mohenjo-daro.	3
	2.4	Ancient farming methods of seed storage and pest management practices in India.	2

ASSESSMENT DETAILS:

Only Continous Assessment (CA) will be conducted

- It is mandatory for students to attain both CA activities
- CA1: Test: 20 marks (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)
- CA2: Practical/Activity, as applicable: 20 marks
- Class participation (Attendance and Involvement in class activities): 10 marks
- The minimum score to pass for the course is 20 out of 50
- If a student fails to score atleast 20, the student will then appear for 40 marks ATKT CA paper (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)

REFERENCES

1. Chaubey, O. P., Sharma, A., Prakash, R. (2014). Forest Ecology in India. India: Aavishkar Publishers, Distributors.
2. Forest Environment and Biodiversity Mahesh Prasad Singh, J. K. Singh, Reena Mohanka Daya Books, 2007 - Biodiversity
3. A Forest History of India: Richard P Tucker, Publisher: SAGE Publications Published: November 2011; Copyright: 2012, ISBN: 9788132109280

SOPHIA COLLEGE (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 cell like nucleus, plasma membrane, chloroplast and mitochondria. 2. To make the students learn about protein formation and trafficking through the endomembrane organelle.s 3. To make the students understand processes and mechanisms of cell division.			
COURSE OUTCOMES: The learner will be able to : Students 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 matrix 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)		**3**	
Total number of Hours in a Semester		**45**	
Credits		**4**	
Evaluation System	**Summative Assessment**	**2 Hours**	**50 marks**
	Continuous Assessment	**--**	**50 marks**

UNIT 1	1	**Nucleus and Cell membrane – Structure and function**	15 hours
	1.1	1. Nucleus ● Structure of Interphase nucleus - nuclear membrane, nucleolus, nucleosome model ● Euchromatin and Heterochromatin ● Specialized chromosomes – polytene and lampbrush chromosomes	3
	1.2	Membrane – their structure and function History and models of membrane structure	2

	1.3	Transport across membranes ● Transport processes ● Simple and Facilitated Diffusion ● Active transport – example Na+/K+pump ● Vesicular transport – Endocytosis and exocytosis, Phagocytosis	1 3
	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 2 3
	1.5	Plant cell surface – plant cell wall and plasmodesmata	
UNIT 2	2	**Cell Organelles**	15 hours
	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
	2.2	Golgi Complex ● Structural organization ● Brief introduction to role of Golgi in protein glycosylation and proteasome in protein degradation	2
	2.3	.Lysosomes ● Formation of lysosomes and role in digestion of materials ● Lysosomal storage diseases – silicosis and Tay Sachs disease	2
	2.4	Peroxisomes ● Function in animal and plant cells ● Zellweger syndrome	3
	2.5	Mitochondria ● Structure and role in oxidative phosphorylation	

		in ATP synthesis ● Mitochondrial DNA and associated disease – LHON	3
	2.6	Plastids ● Types of plastids ● Structure of chloroplast and role in Photosynthesis ● Photosynthetic pigments	3
UNIT 3	3	**Cytoskeleton, cell cycle and cell division**	15 hours
	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.	4
	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	6
	3.3	Cell Division ● Mitosis stages and cytokinesis, Metaphase chromosomes: centromere and telomere ● Meiosis – Stages and significance–crossing	5

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 chromosome 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.

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

ASSESSMENT DETAILS:

There are two subheadings namely

Summative Assessment (SA) and Continous 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 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

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.
9. Plopper G, Principles of Cell Biology, 2016, 2ndEdition, Jones and Bartlett Learning Publication.
10. Taylor D.J., Green N.P.O., Stout G.W., Ed. Soper R., Biological Science, 2005, 3rdEdition, Cambridge University Press

SOPHIA COLLEGE (AUTONOMOUS)

Programme: Science **Life Science SSEC I**		**Semester – 2**	
Course Title: Science of Genetics		**Course Code: SSEC203**	
COURSE OBJECTIVES: **Course Objectives** 1. To make the students understand the history and basics of modern genetics. 2. To familiarize the students with the laws of genetics and its modifications. 3. To make the students aware of chromosomal anomalies. 4. To make the students realize the applications of genetics.			
COURSE OUTCOMES: The learner will be able to : 1. Achieve an understanding of classical genetics. 2. Understand the process of gene interactions. 3. Identify genetic disorders.			
Lectures per week (1 Lecture is 60 minutes)		**1**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Continuous Assessment**	**Theory**	**20 marks**
		Practical	**20 marks**

UNIT 1			15 hours
	1.1	Overview and history of Modern Genetics, Chromosome Theory of Inheritance-Sutton-Boveri, Thomas Hunt Morgan's Experiment.	2
	1.2	**Mendelian inheritance** Herman's experiment on X ray induced mutations- Concept of homozygous, heterozygous, phenotype, genotype, alleles; Mendel's Laws and Mono and Dihybrid ratios with problems, chi square - for 3:1 and 1:1 ratio. Use sickle cell anaemia as an example to explain the concept of gene	4

	1.3	**Modification of Mendel's laws -** Gene interactions: incomplete dominance, co-dominance; Multiple genes, Multiple alleles: Blood group, Epistasis, Linkage, Sex limited, sexinfluenced.	4 3
	1.4	**Chromosomal anomalies**– ● Structural: deletion, duplication, inversion, translocation. ● Numerical: euploidy and aneuploidy (e.g. Downs, Turners, Klienfelter's, Cri-du-chat).	2
	1.5	**Applications** - scope of genetics in Healthcare, therapeutics, evolutionary biology, Biotechnology. (dominant and recessive).	

Practical VSC I Paper (SSEC203P)

1. Pairing game to produce a Punnet square.
2. Collection of blood group information from family and construction of pedigree charts.
3. Human Karyotyping- Normal and Abnormal (Numerical and Structural).
4. Observation of Barr body from buccal smear.
5. Study of polyploidy in onion root tip by colchicine treatment.
6. Sex-linked inheritance in Drosophila melanogaster.
7. Identification of adult zebrafish mutants.

ASSESSMENT DETAILS:

Only Continous Assessment (CA) will be conducted

- It is mandatory for students to attain both CA activities
- CA1: Test: 20 marks (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)
- CA2: Practical/Activity, as applicable: 20 marks
- Class participation (Attendance and Involvement in class activities): 10 marks
- The minimum score to pass for the course is 20 out of 50
- If a student fails to score atleast 20, the student will then appear for 40 marks ATKT CA paper (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)

REFERENCES:

1. Brooker, Widmaier, Graham, Stiling, Biology, 2016, 4th edition, *McGraw-Hill Education Publication*
2. Campbell, Reece, Urry, Cain, Wasserman, Minorsky, Jackson, Biology, 2016, 11th Edition, *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. Russelle P., *iGenetics*: A Molecular Approach, 2010, 3rd Edition, *Pearson Benjamin Cummings Publications.*
6. Simon E.J., Biology: The Core, 2016, 2nd Edition, *Pearson Publication*
7. Ward P., Lamarck's Revenge: How Epigenetics Is Revolutionizing Our Understanding of Evolution's Past and Present, 2018, *Bloomsburg publishing.*

SOPHIA COLLEGE (AUTONOMOUS)

Programme: Science **Life Science SSEC II**		**Semester – 2**	
Course Title: Bioecology		**Course Code: SSEC204**	
COURSE OBJECTIVES: **CO 1**:To familiarize the students with the influence of the environment on the survival of organisms **CO 2** :To introduce students with components of ecology. **CO 3:** To acquaint the students with various species interactions.			
COURSE OUTCOMES: The learner will be able to : **LO 1** : achieve an understanding of the functioning of ecosystems. **LO 2 :** identify elements of an ecosystem. **LO 3** : delineate various forms of positive and negative species interactions			
Lectures per week (1 Lecture is 60 minutes)		**1**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Continuous Assessment**	**Theory**	**20 marks**
		Practical	**20 marks**

UNIT 1			15 hours
	1.1	Organism and its environment: Distribution and abundance of Organisms, Importance of carbon-based life. Concept of Ecosystem.	5
	1.2	Biotic Environment: Population, population density, Reproduction, Population growth (Natality, Mortality) Extinction of Population.	5
	1.3	Interspecific and Intraspecific Population Regulation: Competition, Dispersal, Territoriality, Predation. (Lotka-Volterra model), Parasitism, Mutualism.	5

SOPHIA COLLEGE (AUTONOMOUS)

Practical of VSC II SSEC204P

1. Construction of a fold scope and biodiversity analysis.
2. Adaptive radiation using
    a. Darwin finches
    b. Mouthparts in insects- mosquitoes, houseflies and cockroaches.
3. Animal Biodiversity:
    a. Part I: Classification of Animals –Invertebrates.
    b. Part II: Classification of Animals–Vertebrates.
    c. Digital recording and detailed classification of one animal from campus/ local environment
4. To estimate the basal area of trees around Sophia College campus.
5. Study of Ecological Adaptations in Plants.

ASSESSMENT DETAILS:

Only Continous Assessment (CA) will be conducted

- It is mandatory for students to attain both CA activities
- CA1: Test: 20 marks (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)
- CA2: Practical/Activity, as applicable: 20 marks
- Class participation (Attendance and Involvement in class activities): 10 marks
- The minimum score to pass for the course is 20 out of 50
- If a student fails to score atleast 20, the student will then appear for 40 marks ATKT CA paper (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)

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. Russelle P., *iGenetics*: A Molecular Approach, 2010, 3rdEdition, *Pearson Benjamin Cummings Publications.*
6. Simon E.J., Biology: The Core, 2016, 2nd Edition, *Pearson Publication*
7. Ward P., Lamarck's Revenge: How Epigenetics Is Revolutionizing Our Understanding of Evolution's Past and Present, 2018, *Bloomsburg publishing.*

SOPHIA COLLEGE (AUTONOMOUS)

Programme: Science **Life Science Open Elective**		**Semester – 2**	
Course Title: Concepts of Evolution		**Course Code:**	
COURSE OBJECTIVES: 1. To make the students understand the history of evolution. 2. To familiarize the students about the theories of evolution. 3. To introduce students with with evidences of origin of life and evolution.			
COURSE OUTCOMES: The learner will be able to : 1. Achieve an understanding of conceptual arguments for evolution. 2. Understand the process of evolution 3. Delineate the evidences regarding the major events in the evolutionary timescale			
Lectures per week (1 Lecture is 60 minutes)		**1**	
Total number of Hours in a Semester		**30**	
Credits		**2**	
Evaluation System	**Continuous Assessment**	**Theory**	**40 marks**
		Class Participation	**10 marks**

UNIT 1		**Theories of Evolution**	15 hours
	1.1	Theories of Origin of Life a. Spontaneous generation Vs. Biogenesis, other theories (special creation/steady state /Cosmozoan theory) b. Biochemical evolution (Alexander Oparin and Stanley Miller)	4
	1.2	Lamarckian Evolution	4
	1.3	Darwinism- concepts of variation, adaptation, struggle, fitness and natural selection, spontaneity of mutations (Example: Peppered moth evolution)	
	1.4	Conceptual arguments for evolution by Natural Selection given by Charles Darwin and Alfred Wallace	
UNIT 2		**Evidences of Evolution**	15 hours
	2.1	Evidences of evolution- homologous, anatomical, geographical, biochemical, fossil- formation, types of fossils, fossil records and living fossils	7.5

	2.2	Evolutionary history: The evolutionary time scale; eras, periods and epochs; major events in the evolutionary timescale	7.5

ASSESSMENT DETAILS:

Only Continous Assessment (CA) will be conducted

- It is mandatory for students to attain both CA activities
- CA1: Test: 20 marks (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)
- CA2: Practical/Activity, as applicable: 20 marks
- Class participation (Attendance and Involvement in class activities): 10 marks
- The minimum score to pass for the course is 20 out of 50
- If a student fails to score atleast 20, the student will then appear for 40 marks ATKT CA paper (Duration for answering the test between 30 to 45 minutes depending on the type/level of difficulty)

REFERENCES

1. Lamarck’s Revenge: How Epigenetics Is Revolutionizing Our Understanding of Evolution's Past and Present, Ward P. (2018), Bloomsburg Publishing.
2. Strickberger’s Evolution, B. Hall and B. Hallgrimsson. 4th Edition (2008). Jones andBartlett.
3. Remarkable Creatures: Epic Adventures in Search of the Origin of Species, Sean B. Carrol,(2009), MarinerBooks.