ST JOSEPH'SUNIVERSITY

BENGALURU-27

Re-accredited with **'A++' GRADE with 3.79/4 CGPA** by
NAAC Recognized by UGC as College of Excellence

SYLLABUS FOR B.Sc. BIOLOGY

(AS PER SEP 2024)

I and II Semester

2024-2025

Department of Biology
School of Life Sciences
St. Joseph's University
Bengaluru- 560 027

St Joseph's University, Bengaluru- 560 027

School of Life Sciences

Department of Biology

B.Sc. Biology Course Frame Work

Semester	Code number	Title of the paper	No. of hours of teaching per week	No. of credits
I	BY124	Molecular and Cellular basis of Life	3	3
	BYP24	Molecular and Cellular basis of Life	3	2
II	BY224	Systems and Processes in Biology	3	3
	BY2P24	Systems and Processes in Biology	3	2

Semester 1 – B.Sc. Biology

Semester	**I**
Paper Code	**BY124**
Paper Title	**Molecular and Cellular basis of Life**
Number of teaching hours per week	03
Total number of teaching hours of theory per semester	45
Number of theory credits	03
Total number of teaching hours of practical per semester	30
Number of practical's credits	02

Course Outcomes (COs): At the end of the course the student should be able to:

CO1	Knowledge	Demonstrate good knowledge of the founding blocks of life
CO2	Understand	Demonstrate basic chemical and physical concepts underlying the formation of biomolecules.
CO3	Apply	Apply knowledge and understanding of the foundations of life to the study of biological phenomena.
CO4	Analyze	Investigate and solve basic problems and case studies pertaining to the structure and function of biomolecules.
CO5	Evaluate	To critically evaluate their foundational knowledge to biological phenomena and current related research.
CO6	Synthesize	Work in teams to design experiments that would illustrate the concepts they have studied

Learning Outcomes (LOs):

LO1	The students will be able to enumerate and explain the early conditions of life in solar system
LO2	The students will be able to outline and differentiate the volatile compounds and organic molecules that supports the life in comets.
LO 3	The students will be able to identify the evidences of life on earth by understanding the fossils and geological time scale.
LO 4	The students will be able to explain and correlate the importance of surface water for origin of life
LO5	The students will be able to explain, explore and critically analyze evidences of water and life supporting molecules on Mars.
LO6	The students will be able to explore and analyze theories of life on other

	planets in the solar system
LO7	The students will be able to identify, explain and analyze chemical and biological evidences of the evolution of life.
LO8	The students will be able to explain, describe, and analyze the unifying themes in life, from cells to organisms.
LO9	The students will be able to define, explain, and analyze the processes that govern evolution and diversification of life.
LO10	The students will be able to define, describe, and explain the fundamental processes governing the origins of cells and cell survival in different environments.
LO11	The students will be able to define, describe, and analyses energy sources of cells and biosynthesis of molecules in cells.
LO12	The students will be able to describe, explain, and analyze the tree of life
LO13	The students will be able to illustrate and differentiate the cell walls and special cells of different organisms.
LO14	The students will be able to outline, discuss and differentiate the various transportation mechanisms in living organisms.
LO 15	The students will be able to describe and appreciate various types of stem cells and their lineage.
LO 16	The students will be able to describe and animate different stages of programmed cell death.
LO 17	The students will be able to understand, capture and summarize the concepts of cancer and its types with a hold on updated diagnostic and treatment methods.

Semester 1 – B.Sc. Biology
DSC-1:BY124: Molecular and Cellular basis of Life

Topics	**45 Hours**
Unit – I: Astrobiology	**25 h**
Astrobiology: Conditions in the early Solar System,comets as reservoirs of volatiles and organic molecules,concept of habitable zones. Explorations of life in the universe – current evidences /surveys. History of life on earth through evidences. **Prospects for life on Mars**:Evidence for surface water in the past; climate change; Viking results; possible sub-surface life; Martian paleontology. Life on other planets of Solar System, Discovery of planets around other stars. (self-study)	8+2
Unit – II Evolution of cells	
Evolution of life: biological and chemical evolution of life, Unifying themes in life **–** structural and functional processes – evidences from molecules to organisms. Early perspectives and theories regardingdiversity of life, until Darwin-Wallace.	8

Fundamental principles in evolutionary processes – variation, heritability, selection/drift – brief overview.	
Cellular and Genetic basis of life: Origin of cells.Organismal differences in energy source and biosynthetic precursors.Diversification of cells, three distinct domains of Life. Comparison of Bacterial and Archea cells, genomic evolution among three domains, Eukaryotic cells and their origin.Cell survival in different environment (Self-study).	5+2
Unit – III: Cellular Processes	**20h**
Biomolecules: Fundamentals of DNA, RNA, and Proteins. **Basic functions of the cell:**Cell protection – the cell wall(plant, bacteria, fungi). Cells as biochemical factories -special cells fixing nitrogen and carbon-dioxide. **Transport across biological membranes:** Cell permeability, passive transport, Active transport.Phagocytosis, pinocytosis, endocytosis, exocytosis (self-study).	10+2
Cell Birth: Stem cells - types and their differentiation (embryonic stem cells). Cell development and fate. Concept of cell lineage (*C. elegans*as model system*).*Overview of Programmed Cell Death/Apoptosis.	6
Cancer cells: Definition, types and causes (mutation and carcinogens). Formation of tumor cells and malignancy.	2

Note: Underlined topics are for self-study

Recommended Books/References:

1. Handbook of Astrobiology. Edt. Vera M.Kolb (CRC Press, Taylor and Francis gp.)
2. The science of Astrobiology.Julian Chela-Flores (Springer)
3. Cell Biology by P. S Verma
4. Cell Biology by Veer Bala Rastogi.
5. Cell and Molecular Biology by PK Gupta.
6. Fundamentals of Biochemistry: Life at the Molecular Level, Donald Voet, Judith G. Voet, Charlotte W. Pratt 5th Edition Publishers: Wiley
7. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition, John Wiley & Sons. Inc.
8. De Robertis, E. D. P. and De Robertis R. E. 2009. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.
9. Cooper G. M. Hausman R. E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press and Sunderland, Washington D. C.; Sinnauer Academic Press.
10. Becker W. M., Kleinsmith L.J. and Bertni G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Pedagogy: ICT tools, Chalk & Talk, Models & Charts, videos.

Formative Assessment (Internal assessment) Theory	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and mid semester examination	**20**
Seminars/Class work (CIA)	**10**
Assignments/Discussions (CIA)	**10**
Total	**40 + 60 (ESE) = 100**

BLUE PRINT
Code number:**BY124**
Title of the paper:**Molecular and Cellular basis of Life**

Total marks for which the questions are to be asked (including bonus questions)	Number of hours	Unit number
17	9	I
27	14	II
42	22	III
86	**45**	**TOTAL**
Maximum marks for the paper (Excluding bonus question):**60**		

SEMESTER- I: BIOLOGY PRACTICALS

Semester	**I**
Paper Code	**BY1P24**
Paper title	**Molecular and Cellular basis of Life**
Number of teaching hours per week	**3**
Total number of teaching hours per semester	**30**
Number of credits	**2**

1. Using Simple and Compound Microscope, observe Plant cell wall/fungal cell wall.
2. Investigating osmosis/plasmolysis in Animal cell/Plant cells.
3. Study of Blood cells.
4. Cytochemical staining of DNA by Feulgen.
5. Cytochemical staining of proteins by Bromophenol blue.
6. Isolation and culturing of living organisms (yeast, bacteria)
7. Measurement of cell growth by Haemocytometer or UV- Visible spectrophotometer.
8. Vital staining of mitochondria by Janus green B in buccal epithelial cells.
9. Isolation of membranous organelles of eukaryotic cells.
10. Identification and study of types of cancer, cancer cells by permanent slides/photographs OR anatomical observation and study of locally collected leaf galls.

Recommended Books/References

1. Fundamentals of Biochemistry: Life at the Molecular Level, Donald Voet, Judith G. Voet, Charlotte W. Pratt 5th Edition Publishers: Wiley
2. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition, John Wiley & Sons. Inc.
3. De Robertis, E. D. P. and De Robertis R. E. 2009. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.
4. Cooper G. M. Hausman R. E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press and Sunderland, Washington D. C.; Sinnauer Academic Press.
5. Becker W. M., Kleinsmith L.J. and Bertni G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Formative Assessment (Internal assessment) Practical	
Assessment Occasion/ type	**Weightage in Marks**
Pre-lab assignments	**5**
Post-lab assignments	**10**
In-lab performance	**10**
Total	**25 + 25 (ESE) = 50 marks.**

Semester II – B.Sc. Biology

Semester	**II**
Paper Code	**BY224**
Paper Title	**Systems and Processes in Biology**
Number of teaching hours per week	03
Total number of teaching hours of theory per semester	45
Number of theory credits	03
Total number of teaching hours of practicals per semester	30
Number of practicals credits	02

Course Outcomes (COs): At the end of the course the student should be able to:

CO1	Knowledge	Demonstrate basic cellular and tissue organization of organs and their functions.
CO2	Understand	Demonstrate how homeostasis works and how the inter-connected functions of physiological units contribute to homeostasis or organisms. Distinguish between redundant and holistic approaches in biological sciences.
CO3	Apply	Apply foundational knowledge and understanding of homeostasis to health and disease.
CO4	Analyze	Analyze and solve basic problems in physiology of organisms.
CO5	Evaluate	Investigate and critically analyze basic patho-physiology of common human conditions.
CO6	Create	Work in teams to design experiments and/or investigate case studies relevant to current research in plant and animal physiology.

Learning Outcomes (LOs):

LO1	The students will be able to explain, illustrate, and evaluate cellular and tissue organization in different animal organs and plant systems.
LO2	The students will be able to explain, illustrate, and analyze basic functional processes in plants.

LO 3	The students will be able to define, explain, and evaluate plant photosynthesis and its importance to global health.
LO 4	The students will be able to describe, illustrate and evaluate processes underlying plant growth.
LO5	The students will be able to explain, illustrate and examineorgan systems and their functions in animals and humans.
LO6	The students will be able to explore and analyze pathophysiology of organ systems in humans.
LO7	The students will be able to explain, analyze and examine homeostasis in plants and animals.
LO8	The students will be able to explore, analyze and apply thermoregulatory strategies used by plants and animals in the context of climate change.
LO9	The students will be able to explain and analyze fundamental concepts of systems biology.
LO10	The students will be able to explore and analyze the importance of multidisciplinary approaches to studying biological processes.
LO11	The students will be able to explore and analyze the dynamic systems in cells, organs of living organisms.
LO12	The students will be able to explore and analyze network systems approaches in biology.
LO13	The students will be able to explore and analyze the applications of systems approaches in medicine and drug discovery.

Semester II – B.Sc. Biology,
DSC-2: BY224: Systems and Processes inBiology

Topics	45 Hours
Unit – I: Plant physiological processes	15h
Water Relations: Soil and water (Self-study), water absorption, Stomata (structure and mechanism), Transpiration, Ascent of sap. Mineral Nutrition: Essential elements and their role in Hydroponics	4+1
Photosynthesis: Ultrastructure of Chloroplast, Photophosphorylation, Carbon assimilation, Photorespiration, Factors affecting photosynthesis (self-study), Transport of organic solutes and their storage.	4+1
Seed physiology: Definition, structure, chemical composition of seed. physiological changes during seed germination; mobilization of stored resources in seeds for respiration, Ultra structure of Mitochondria and associated respiration.	5
Unit II: Animal physiological processes	23h
Physiological systems and functions: Introduction to physiological systems [respiratory, digestive, excretory, cardiovascular/circulatory, integumentary,	7+2

muscular (self-study)] – related common pathology (one example each).	
Homeostasis. Concept of internal environment, equilibrium and feedback mechanisms, e.g. diabetes, child birth.	4
Osmoregulation: Osmoregulators and osmoconformers. Variation in marine and freshwater fishes. Electrolyte balance in mammals (normal and desert adaptations). Euryhaline and stenohaline animals. Osmoregulative dysfunction in human physiological system (kidney failure).	6
Thermoregulation: Q_{10} and metabolism. Physiological systems adaptations to extreme environments. Strategies in thermal biology - poikilotherms, homeotherms, steno and eurythermal animals. Process of thermoregulation in endotherms, role of hypothalamus in thermoregulation. Adaptations to seasonality and thermal changes – hibernation/ aestivation (self-study), Thermoregulatory dysfunction in physiological systems (heatstroke, cold stress)- Implications of Global warming.	5+1
Unit – III: Introductory Systems Biology	5h
Systems Biology: introduction, History, Scope and importance (Self-study), Fundamental concepts of dynamic systems andnetworks.Concepts of self-organization.	2+1
Fundamental approaches to studying systems biology(Graph theoretic analysis). Overview of Enzyme Kinetic modeling of biochemical reactions.	2

Note: Underlined topics are for self-study

Recommended Books/References

1. Plant Physiology and Biochemistry by H.S. Srivastava.
2. Plant Physiology by L. Taiz and E. Zeiger, Sinauer Associates, USA,2010
3. Introduction to Plant Physiology by W G Hopkins and N P Huner, John Wiley & Sons (Fourth Edition), 2010
4. Animal Physiology by P.S Verma and Aggarwal.
5. Animal Physiology by N. Arumugam.
6. Biochemistry and Physiology by Veer Bala Rastogi.
7. David Randall, Eckert's Animal Physiology, W.H.Freeman and Co.
8. Philips Withers; Comparative Animal Physiology. Books Cole Publishers
9. An Introduction to Systems Biology: Design Principles of Biological Circuits by Uri Alon, Chapman & Hall, ISBN 1-58488-642-0
10. Systems Biology: A Textbook, 2nd Edition (Wiley). Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald.
11. Kitano H. Systems biology: a brief overview. Science. 2002 Mar 1;295(5560):1662-4.
12. Ross J, Arkin AP. Complex systems: from chemistry to systems biology. Proc Natl Acad Sci U S A. 2009 Apr 21;106(16):6433-4. doi: 10.1073/pnas.0903406106. Epub 2009 Apr 20.

Pedagogy: ICT tools, Chalk & Talk, Models & Charts.

Formative Assessment (Internal assessment) Theory	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and mid semester examination	**20**
Seminars/Class work (CIA)	**10**
Assignments/Discussions (CIA)	**10**
Total	**40 + 60 (ESE) = 100**

BLUE PRINT
Code number:**BY224**
Title of the paper:**Systems and Processes in Biology**

Total marks for which the questions are to be asked (including bonus questions)	Number of hours	Unit number
29	15	I
44	23	II
13	7	III
86	**45**	**TOTAL**
Maximum marks for the paper (Excluding bonus question): **60**		

SEMESTER- II: BIOLOGY PRACTICALS

Semester	**II**
Paper Code	**BY2P24**
Paper title	**Systems and Processes in Biology**
Number of teachinghours per week	**3**
Total number of teachinghours per semester	**30**
Number of credits	**2**

1. Calculation of the stomatal index, stomatal frequency in plant samples.
2. Separation of chlorophyll pigments by paperchromatography.
3. Study of the effect of light and temperature on photosynthesisin*Hydrilla*.
4. Effect of temperature on cell permeability.
5. Ganong's Respirometer and photometer.
6. Investigation of salt gain or loss in fish.
7. Determining Q10 effects of temperature – opercular rate variation in fish.
8. Investigation of Oxygen consumption by fish.
9. Qualitative analysis of Nitrogenous wastes.
10. Measurement of blood pressure and blood glucose.

Recommended Books/References

1. Introduction to Plant Physiology by W G Hopkins and N P Huner, John Wiley & Sons (Fourth Edition), 2010
2. Plant Physiology by L. Taiz and E. Zeiger, Sinauer Associates, USA,2010
3. David Randall, Eckert's Animal Physiology, W.H.Freeman and Co.
4. Philips Withers; Comparative Animal Physiology. Books Cole Publishers.
5. An Introduction to Systems Biology: Design Principles of Biological Circuits by Uri Alon, Chapman & Hall, ISBN 1-58488-642-0
6. Systems Biology: A Textbook, 2nd Edition (Wiley). Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald.
7. Kitano H. Systems biology: a brief overview. Science. 2002 Mar 1;295(5560):1662-4.
8. Ross J, Arkin AP. Complex systems: from chemistry to systems biology. Proc Natl Acad Sci U S A. 2009 Apr 21;106(16):6433-4. doi: 10.1073/pnas.0903406106. Epub 2009 Apr 20.

Formative Assessment (Internal assessment) Practical	
Assessment Occasion/ type	**Weightage in Marks**
Pre-lab assignments	**5**
Post-lab assignments	**10**
In-lab performance	**10**
Total	**25 + 25 (ESE) = 50 marks.**

Registration Number:

Date & session:

EXAMINATION PATTERN

STJOSEPH'S UNIVERSITY, BENGALURU -27
I B.Sc. (BIOLOGY) – I SEMESTER
SEMESTER EXAMINATION: OCTOBER 2024
(Examination conducted in November 2024)

BY 124 – Molecular and Cellular basis of Life

Time: 2 Hours **Max Marks: 60**

This paper contains ONE printed page and THREE sections

Part A

Answer any TEN of the following **10 x 2 = 20 marks**

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

Part B

Write notes on any FIVE of the following **5 x 6 = 30 marks**

13.
14.
15.
16.
17.
18.
19.

Part C

Give a comprehensive account of any ONE of the following **1 x 10 = 10 marks**

20.
21.

ST. JOSEPH'S UNIVERSITY, BENGALURU - 5600027
SCHOOL OF LIFE SCIENCES
I B.Sc. (BIOLOGY) - I SEMESTER
BIOLOGY PRACTICAL EXAMINATION

BY 1P24 - Molecular and Cellular basis of Life

MAX. MARKS: 25 **TIME: 3 hours**

1.	Major experiment	**1 X 10 = 10**
2.	Minor experiment	**1 x 6 = 6**
3.	Spotters (A,B,C)	**3 X 3 = 9**