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 to IV Semesters

2024-2026

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
	BY1P24	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
III	BY325	Biology of Development and Growth	3	3
	BY3P25	Biology of Development and Growth	3	2
IV	BY425	Diversity of Flora and Fauna	3	3
	BY4P25	Diversity of Flora and Fauna	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	8+2

of Solar System, Discovery of planets around other stars. (self-study)	
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 regarding diversity of life, until Darwin-Wallace. Fundamental principles in evolutionary processes – variation, heritability, selection/drift – brief overview.	8
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**
Bio-molecules: 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 / Acetocarmine.
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 examine organ 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 in Biology

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, muscular (self-study)] – related common pathology (one example each).	7+2
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 and networks. 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 teaching hours per week	**3**
Total number of teaching hours per semester	**30**
Number of credits	**2**

1. Calculation of the stomatal index, stomatal frequency in plant samples.
2. Separation of chlorophyll pigments by paper chromatography.
3. Study of the effect of light and temperature on photosynthesis in *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**

Semester III – B.Sc. Biology

Semester	**III**
Paper Code	**BY325**
Paper Title	**Biology of Development and Growth.**
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	**36**
Number of practical credits	**02**

Course description: This course explores fundamental and applied aspects of plant and animal development and growth from the molecular to organism level. The course will also explore the mechanisms that govern the growth and development of organisms, exploring changes that occur from fertilization, development of the zygote, various embryological stages to the formation of entire organisms and the factors that influence their growth. Students will gain an understanding of the genetic, hormonal, and environmental factors influencing growth and development in plants, animals, and humans, with an emphasis on comparative biology. Topics will include cell division, differentiation, tissue growth, morphogenesis, and the regulation of development across various taxa.

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

CO1	Knowledge	Explain historical and current theories of developmental biology.
CO2	Understand	Describe and explain the relationship between reproduction, fertilization, and early embryonic development, including cell differentiation and pattern formation.
CO3	Apply	Apply fundamental principles of developmental biology to identify similarities and differences between plant and animal growth, and the factors that influence diversity of growth patterns across major groups.
CO4	Analyze	Evaluate and determine how intrinsic and extrinsic factors influence embryonic development and growth of organisms. Explore and analyze human embryonic development.
CO5	Evaluate	Critically evaluate and relate concepts in developmental biology to the generation of biodiversity and also extend their knowledge and understanding to applications, such as agriculture and animal

		husbandry.
CO6	Create	Design experiments that would illustrate and/or extend concepts of plant and animal development in laboratory settings.

Learning Outcomes (LOs): At the end of the course the students will be able to:

LO1	Define and describe fundamental principles of developmental biology
LO2	Define and differentiate between the kinds of reproduction that occur in plants and animals
LO3	Explain and illustrate how gametes are formed in plants and animals
LO4	Explain the processes of fertilization in plants and animals
LO5	Identify and enumerate the types of eggs or ovules that are formed in different plants and animals.
LO6	Define, explain and illustrate how egg/ovule structure and content influences various cleavage patterns in different animals
LO7	Identify, examine, and describe the various stages of early embryonic development in plants and animals.
LO8	Explain, describe, and analyze unifying themes or differences underlying early embryonic development in plants and animals.
LO9	Define, explain, and analyze the processes that govern embryonic development at the molecular and cellular levels.
LO10	Define, describe, and analyze the process by which tissues and organs are formed in plants and animals.
LO11	Examine, describe, and illustrate various stages of plant and animal development in model organisms.
LO12	Define, describe, and analyze the difference between development and growth in plants and animals.
LO13	Examine, describe, and explain intrinsic and extrinsic influence on plant and animal growth.
LO14	Examine and apply concepts in development and growth to real life phenomena.
LO 15	Investigate and design experiments to analyze growth of plants and animals.
LO 16	Describe and explain early human development.

SEMESTER III – B.Sc. Biology,
DSC-3: BY325: BIOLOGY OF DEVELOPMENT AND GROWTH

	45 Hours
Unit-1: History and philosophy of developmental biology	
Theories of animal development - preformation, epigenesis, Von Baer's theory. Definition and importance of growth and development, Overview of development, differentiation, and growth at the cellular and organismal levels.	4

Unit-2: Developmental stages and patterns	
Types of reproduction, introduction to gametogenesis: Formation of male and female gametes in plants and animals, types of eggs/ovules, and fertilization in plants and animals. Embryogenesis in plant and animals - Patterns of cell division in plants and cleavage patterns based on yolk in animals. Embryology of chick.	10 + 2
Unit-3: Molecular regulation during development	
Introduction to inducers, organizers, and pattern formation. Spemann-Mangold experiment. Brief overview of Homeotic genes and genetic control of early development in animals. Examples of homeotic mutations. Conservation of homeotic genes across animals. Genes involved in development and differentiation of Shoot apical meristem; Root apical meristem and flower.	9 + 1
Unit-4: Hormonal and environmental influences on growth and development	
Endocrine regulation, relationship between hormone and environment in regulating animal growth, thyroxine and frog development, temperature and sex determination in reptiles, Allen's and Bergmann's rule of morphology and climate. Role of Plant hormones in plant growth and development: auxins, gibberellins, cytokinins, abscisic acid, ethylene. Photoperiodism.	11 + 2
Unit-5: Human development	
Brief overview of ovulation cycle, implantation and zygote development, development during trimesters and hormonal regulation of development.	5 + 1

Note: Underlined topics are for self-study

Recommended Books/References

1. Gilbert, S. F., & Barresi, M. J. F. (2016). *Developmental biology* (11th ed.). Sunderland, MA: Sinauer Associates.
2. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). *Molecular biology of the cell* (6th ed.). New York, NY: Garland Science.
3. Wolpert, L., Tickle, C., & Martinez Arias, A. (2015). *Principles of development* (5th ed.). Oxford, UK: Oxford University Press.
4. Tyler, M. S. (1994). *Developmental biology: A guide for experimental study* (2nd ed.). Sunderland, MA: Sinauer Associates.
5. Sankar, B. G. (Year). *Cell and molecular biology of the eye*. Publisher.

6. Cronk, Q. C. B., Bateman, R. M., & Hawkins, J. A. (Eds.). (2002). *Developmental genetics and plant evolution*. London, UK: Taylor & Francis.
7. Slack, J. M. W. (2013). *Essential developmental biology* (3rd ed.). Hoboken, NJ: Wiley-Blackwell.
8. Sanes, D. H., Reh, T. A., & Harris, W. A. (2019). *Development of the nervous system* (4th ed.). London, UK: Academic Press.
9. Maheshwari, P. (1950). *An introduction to the embryology of angiosperms*. New York, NY: McGraw-Hill.
10. Pua, E. C., & Davey, M. R. (Eds.). (2010). *Plant developmental biology - biotechnological perspectives: Volume 1*. Berlin, Germany: Springer.
11. Pandey, S. N., & Chadha, A. (2009). *Plant anatomy and embryology*. New Delhi, India: Vikas Publishing House.
12. Raghavan, V. (1999). *Developmental biology of flowering plants*. New York, NY: Springer.
13. Jangid, P. (2018). *Plant embryology: Biology of plants*. [Kindle version]. Retrieved from Amazon.com.
14. Krishnamurthy, K. V. (2015). *Growth and development in plants*. Jodhpur, India: Scientific Publishers.
15. Bhojwani, S. S., Bhatnagar, S. P., &Dantu, P. K. (2015). *The embryology of angiosperms* (6th ed.). New Delhi, India: Vikas Publishing House.

Pedagogy: ICT tools, Chalk & Talk, Models & Charts, presentations, project-based learning.

Formative Assessment (Internal assessment) Theory	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and mid semester examination	**20**
CIA 1 and 2 Total	**20**
Assessments:	
Presentations	**5**
Quiz/Test	**5**
Science Writing	**5**
Case study/ Group projects	**5**

BLUE PRINT
Code number: **BY325**
Title of the paper: **Biology of Development and Growth**

Total marks for which the questions are to be asked (including bonus questions)	Number of hours	Unit number
8	4	I
23	12	II
19	10	III
25	13	IV
11	6	V
86	**45**	**TOTAL**
Maximum marks for the paper (Excluding bonus question):**60**		

SEMESTER- III: BIOLOGY PRACTICALS

Semester	III
Paper Code	**BY 3P25**
Paper title	**Biology of Development and Growth**
Number of teaching hours per week	**3**
Total number of teaching hours per semester	**36**
Number of credits	**2**

1. Frog embryology.
2. Chick embryology I
3. Chick embryology II
4. Study of segment formation in Drosophila.
5. Study of drosophila developmental stages and growth Part I.
6. Screening for drosophila mutants.
7. Study of anther anatomy in *Dhatura*.
8. Pollen tube germination.
9. Types of ovule and their arrangement within the ovary.

10. Different stages of embryo development in monocots/dicots.
11. Effect of Auxin on Root and Shoot Growth.
12. Revision

Recommended Books/References

1. Sastry, K. V., & Shukla, V. (2018). *Developmental Biology* (2nd ed.). Meerut, India: Rastogi Publications.
2. Arora, R., & Mehta, A. (2019). *Developmental Biology: Principles and Concepts*. R. Chand & Company.
3. Tyler, M. S. (1994). Developmental biology: A guide for experimental study (2nd ed.). Sunderland, MA: Sinauer Associates.
4. Experiments with Drosophila for biology courses (2001) Eds. Lahkotia, S. C. and Ranganath, H. A. Indian Academy of Sciences Press.
5. A. Bendre& A. Kumar (1984) A Textbook of Practical Botany, Volume 2, Rastogi Publications.
6. B. P. Pandey, Practical Botany for Degree Students, S. Chand Publishing.
7. Katherine Esau (1977) Anatomy of Seed Plants**,** John Wiley & Sons.
8. S. S. Bhojwani & S. P. Bhatnagar (2015) Embryology of Angiosperms**,** Vikas Publishing House.
9. A. K. Sharma (2019) Practical Manual on Plant Developmental Biology, Scientific Publishers.
10. D. K. Pandey (2020) Laboratory Manual for Plant Development and Physiology, Rastogi Publications.

Formative Assessment (Internal assessment) Practical	
Assessment Occasion/ type	**Weightage in Marks**
Pre- Lab assignment	**5**
In-lab performance	**8**
Post - Lab assignments	**5**
Lab Record	**7**
Total	**25 + 25 (ESE) = 50 marks.**

Semester IV – B.Sc. Biology

Semester	**IV**
Paper Code	**BY425**
Paper Title	**Diversity of Flora and Fauna**
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	**36**
Number of credits for practicals	**02**

Course description: This course explores the vast diversity of plant and animal life on Earth, examining the evolutionary and ecological aspects that shape the characteristics of various organisms. Students will gain an understanding of the major plant and animal groups, their evolutionary relationships, classification, adaptations, and ecological roles within ecosystems. Emphasis will be placed on understanding the fundamental principles of taxonomy, the diversity of life forms and the importance of biodiversity for ecosystem stability and human welfare.

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

CO1	Knowledge	Explain and describe basic principles taxonomy and classification of plants and animals.
CO2	Understand	Demonstrate the basis of classifications of plants and animals up to genus level.
CO3	Apply	Apply taxonomic principles to Identify and classify major plant and animal groups.
CO4	Analyze	Evaluate and identify general and unique features of different plant and animal groups.
CO5	Evaluate	Critically evaluate how form and structure are related to organismal function and their roles in ecosystems.
CO6	Create	Design experiments or surveys to document plant and animal diversity.

Learning Outcomes: At the end of the course the students will be able to:

LO1	Define and describe fundamental principles of how life can be organized.
LO2	Define and differentiate taxonomy, phylogeny, and systematic of life.
LO 3	Explain and describe fundamental concepts that influence biodiversity.

LO 4	Examine and identify key differences that differentiate plants and animals at different levels.
LO5	Identify, define and apply the meaning of taxonomic and systematic terminologies to the classification of plants and animals.
LO6	Examine and describe the relationship between major groups of plants and animals.
LO7	Identify and describe the unifying and unique features of different groups of plants and animals.
LO8	Examine and identify unique features in different groups of plants and animals.
LO9	Examine and apply principles of systematics to classify plants and animals up to the class level.
LO10	Examine and analyze the life history of different groups of plants and animals.
LO11	Examine, describe, and analyze the ecological importance of plants and animals.
LO12	Define, describe, and analyze the economic importance of key plants and animals.
LO13	Examine, describe, and explain intrinsic and extrinsic influence on plant and animal growth.
LO14	Critically evaluate how systematic has changed in the last few decades.
LO 15	Identify and classify major groups of plants and animals in the field.

Semester IV – B.Sc. Biology,
DSC- 4: BY 425: Diversity of Flora and Fauna

	45 Hours
Unit – I: Biodiversity	3h
Biodiversity: Definition, Components of Biodiversity, importance, levels of biodiversity, Impact of climate change. Bioprospecting of diverse organisms. India as mega biodiversity Nation. Hot spots and biodiversity in India.	2+1h
Unit – II: Diversity of Flora	19h
Phycology: Classification of algae by Fritsch (1935), general characteristics of different classes of Algae, types of life cycles. **Mycology**: General characteristics, thallus organization and nutrition in fungi. Ecological significance (Mycorrhizae, Lichens). Economic and ecological importance of algae and fungi.	4+1

Bryology: Classification and general characteristics of Bryophytes. Morphology, anatomy and reproduction in *Marchantia*. **Pteridology:** General characteristics of pteridophytes, fossil pteridophytes - *Rhynia*. Morphology and reproduction in *Pteris.* Ecological and economic importance of Bryophytes and Pteridophytes.	6+1
Phanerogams: General characteristics of gymnosperm, salient features of the classes and life cycle of *Pinus*. Description, classification, Family characters of Malvaceae, Fabaceae, Compositae and Liliaceae.	7
Unit III: Diversity of Fauna	23
Brief introduction to the organization of life –Taxonomy, classification, and systematics. **DIVERSITY OF INVERTEBRATES** **Non-Bilateria: Parazoans** as the basal animals, distinguishing features, including rudimentary immune 'system'. **EUMETAZOANS** **Non-Bilateria (Diploblasts):** Systematics and distinguishing characteristics of Cnidarians. **BILATERIA (Triploblasts).** Importance of bilateral symmetry. **Protostomia, Lophotrochozoans:** The lophophore and trochophore larva as a connecting link. Systematics and distinguishing features of Platyhelminths, Annelids, and Molluscs. Special adaptations in cephalopods - bioluminescence and camouflage.	7 + 2
PROTOSTOMIA **Ecdysozoans** and the origin of ecdysis. Systematics and distinguishing features of **Nematodes**. Parasitic and free living worms. **Pan Arthropoda And Euarthropoda*:*** *Tardigrada and Onychophora*– discovery, brief features. Systematics and distinguishing features of Euarthropod classes. Brief note on significance of **Deuterostomes**. Systematics and distinguishing features of **Echinodermata**. **Brief overview of diversity, ecological and economic importance of*	7

Invertebrates included.	
DIVERSITY OF THE CHORDATES Brief overview of the **Protochordates, Agnatha and Gnathostomata** with examples. Systematics and general features of **Vertebrata**. Brief exploration of major adaptations -amphibious life, terrestrialization, and flight. **Brief overview of diversity, ecological and economic importance of chordates*.	6 + 1

Note: Underlined topics are for self-study.

Recommended Books/References

1. Singh V., Pande P.C and Jain D.K. (2019). A Text Book of Botany (5th Edition). Rastogi Publication, Meerut.
2. Sundarajan S. 1997. College Botany Vol. I and Vol II. S Chand & Co. Ltd., New Delhi.
3. MehrotraR.S.andAnejaK.R(1990). AnintroductiontoMycology.NewAgeInternational Publications, New Delhi.
4. Rashid, A. (1998). An Introduction to Bryophyta. Vikas Publishing House, New Delhi.
5. Vashista, B.R. 1978. Bryophytes. S Chand & Co. Ltd., New Delhi.
6. Rashid, A. 1998. An Introduction to Pteridophyta. II ed., Vikas Publishing House, New
7. Vashishta, P.C.,2014. Pteridophyta.S Chand and Company,Pvt.Ltd.New Delhi.
8. Sundararajan, S. 1994.Introduction to Pteridophyta. New Age International Publishers.
9. Bhatnagar, S.P. and Moitra, A. 1997. Gymnosperms. New Age International Ltd.,New Delhi.
10. Alexepoulos CJ and Mims CW. 1989. Introductory Mycology, Wiley Eastern Ltd., New Delhi.
11. Smith, G.M. 1971. Cryptogamic Botany. Vol.I Algae & Fungi. Tata McGraw Hill Publishing. New Delhi.
12. Smith, G.M. 1971. Cryptogamic Botany. Vol. II. Bryophytes & Pteridophytes. Tata McGraw Hill Publishing, New Delhi.
13. Animal Diversity by Cleveland P. Hickman, Larry S. Roberts, and David J. K. Barnett
14. Invertebrates by Richard C. Brusca and Gary J. Brusca
15. The Animal Kingdom: A Class-Action Approach by Jeffrey E. Miller
16. Zoology by Stephen A. Miller and John P. Harley
17. Principles of Animal Diversity by George J. Bartholomew and Thomas R. McFadden
18. Biology of Animals by Cleveland P. Hickman, Larry S. Roberts, and David J. K. Barnett

Pedagogy: ICT tools, Chalk & Talk, Models & Charts, presentations, project-based learning.

Formative Assessment (Internal assessment) Theory	
Assessment Occasion/ type	**Weightage in Marks**
Continuous evaluation and mid semester examination	**20**
CIA 1 and 2 Total **<u>Assessments:</u>** **Presentations** **Quiz/Test** **Science Writing** **Case study/ Group projects**	**20** **5** **5** **5** **5**
Total	**40 + 60 (ESE) = 100**

BLUE PRINT
Code number: **BY425**
Title of the paper: **Diversity of Flora and Fauna**

Total marks for which the questions are to be asked (including bonus questions)	Number of hours	Unit number
6	3	I
36	19	II
44	23	III
86	**45**	**TOTAL**
Maximum marks for the paper (Excluding bonus question):**60**		

SEMESTER- IV: BIOLOGY PRACTICALS

Semester	**IV**
Paper Code	**BY4P25**
Paper title	**Diversity of Flora and Fauna**
Number of teaching hours per week	**3**
Total number of teaching hours per	**36**
semester Number of credits	**2**

1. Study of *Rhizopus*, *Agaricus*, Mycorrhiza and Lichens.
2. Study of *Anabaena, Spirogyra, Chara, Sargassum* and *Batrachospermum*
3. Study of *Marchantia, Anthoceros* and *Funaria*.
4. Study of *Psilotum, Selaginella, Equisetum, Pteris*
5. Study of *Pinus*
6. Study of Malvaceae, Asteraceae, and Muscaceae
7. Study of Parazoans and Eumetazoans: diversity of sponges and Cnidarians, sea anemone, Physalia, and coral types.
8. Study of Lophotrochozoans: Platyhelminths - Tapeworm, Annelids - *Trochophore* larva, examination of annelid body plans. **Molluscans –***Octopus, sepia.* Examination of molluscan body plans*.*
9. **Study of Ecdysozoans and Deuterostomes:** Nematodes **-** Round worm, Panarthropods- *Peripatus*, *Tardigrades. Euarthropods - Nauplius* and *Mysis* larvae. Collection and classification of local insects. Classification of echinoderms based on taxonomic features, study of *Pedicellaria*.
10. **Protochordates and Vertebrates I:** observation of *Balanoglossus, Amphioxus*, ascidian larva, *Petromyzon*.Amphibia – *Hyla, Axolotl*. Reptiles – *Draco, Phyrnosoma*, Turtle, Tortoise, Viper, Krait, Sand Boa. Report on venomous and non-venomous snakes.
11. **Vertebrates II:** Exploration of vertebrate skeleton types. Project based report of Aves and Mammals –local diversity surveys. Revision

Recommended Books/References:

1. A. Bendre & A. Kumar(2009)A Textbook of Practical Botany, Volume 1, Rastogi Publications.
2. A. Bendre & A. Kumar (1984) A Textbook of Practical Botany, Volume 2, Rastogi Publications.
3. K. N. Bhatia & S. K. Gupta (2003) A Laboratory Guide to FungiKalyani Publishers.
4. C. J. Alexopoulos & C. W. Mims (1996 - 4th Edition) Introductory Mycology, John Wiley & Sons.

5. A. Rashid (1998) A Laboratory Manual of Bryophytes, Vikas Publishing House.
6. C. A. Agrawal (2209) Practical Botany: Pteridophytes, Gymnosperms & Angiosperms, Meerut College Publications.
7. P. C. Vashistha (2010) A Laboratory Manual for Pteridophytes & Gymnosperms, S. Chand Publishing.
8. B. P. Pandey, Practical Botany for Degree Students, S. Chand Publishing.
9. Lal, S. S. (2009). Practical Zoology: Invertebrate.
10. Lal, S. S. (2012). Practical Zoology Invertebrate: For Undergraduate Students.
11. Verma, P. S. (2010). A Manual of Practical Zoology: INVERTEBRATES. S. Chand Publishing.
12. Wallace, R. L., & Taylor, W. K. (1997). Invertebrate Zoology: A Laboratory Manual. Benjamin Cummings.
13. Hyman, L. H. (1938). A Laboratory Manual for Comparative Vertebrate Anatomy.
14. Jordan, D. S. (1894). Manual of the Vertebrate Animals of the Northern U.S. Inclusive of the Marine Species.
15. Jordan, D. S. (2023). Manual of the Vertebrates of the Northern United States. Legare Street Press.

Formative Assessment (Internal assessment) Practical	
Assessment Occasion/ type	**Weightage in Marks**
Pre- Lab assignments	**5**
In-lab performance	**8**
Post - Lab assignments	**5**
Lab Record	**7**
Total	**25 + 25 (ESE) = 50 marks.**

Registration Number:

Date & session:

EXAMINATION PATTERN

STJOSEPH'S UNIVERSITY, BENGALURU -27

II B.Sc. (BIOLOGY) – III SEMESTER

SEMESTER EXAMINATION: OCTOBER 2025

(Examination conducted in November 2025)

BY 325 – BIOLOGY OF DEVELOPMENT AND GROWTH

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
II B.Sc. (BIOLOGY) - III SEMESTER
END SEMESTER PRACTICAL EXAMINATION: OCTOBER 2025

BY 3P25 – BIOLOGY OF DEVELOPMENT AND GROWTH

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**