ST JOSEPH'S UNIVERSITY
BENGALURU-27

BOTANY

SYLLABUS

FOR UNDERGRADUATE PROGRAMME BCBBT (BIOCHEMISTRY, BOTANY, AND BIOTECHNOLOGY) (AS PER SEP 2026-29)

Semester	**I (BCBBT)**
Paper Code	**BO 1226**
Paper Title	**Plant Physiology and metabolism**
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	33
Number of practical credits	02

COURSE OBJECTIVES (CO)	This course aims to: 1. Provide an understanding of water and nutrient transport in plants, including mechanisms like transpiration and phloem loading. 2. Introduce the structure and function of the photosynthetic and respiratory systems in plants. 3. Explain the physiological processes regulating plant growth, development, and flowering. 4. Explore the biochemical and structural basis of plant defense and immunity. 5. Highlight the significance of plant-microbe interactions in enhancing plant productivity and health
LEARNING OUTCOMES (LO)	After completion of this course, students will be able to 1. Analyze the mechanisms involved in plant-water relations and nutrient transport. 2. Explain the major biochemical pathways of photosynthesis and respiration in plants. 3. Assess the role of hormones in regulating plant growth, development, and movement. 4. Describe various plant defense strategies and the role of secondary metabolites in immunity. 5. Evaluate the contribution of beneficial microbes to plant nutrition and disease resistance.

BO 1226: Plant Physiology and Metabolism

Unit No.	Title of Contents	Hrs (45)
UNIT I	Plant water relations Plant - water relations - Diffusion, osmosis, imbibition, water potential and its components. Absorption of water: The mechanism of water absorption - active and passive (in brief). Ascent of sap – Transpiration pull theory Transpiration in plants – Introduction, Thermo-diffusion in Transpiration (2024), Maximum Transpiration Hypothesis (2007–Present), Mechanism of opening and closing of stomata – K+ ion pump theory. Anti-transpirants and their types.	**5**
	Phloem transport Source and sink concept, vein loading and unloading; transport mechanism (protoplasmic streaming hypothesis, Mass flow hypothesis). Factors affecting phloem transport (Self-study).	**3**
	Mineral nutrition *Deficiency symptoms of macronutrients and micronutrients in plants. Ion antagonism*.	***2***
UNIT II	**Photosynthesis** Structure of chloroplast and ultrastructure of thylakoid membrane, photosystems I and II. Principles of light absorption (Self-study). Photosynthetic electron transfer and photophosphorylation, mechanism of ATP synthesis (Chemiosmotic hypothesis). Mechanisms of carbon fixation and carbohydrate synthesis - C3 cycle, C4 pathway, CAM pathway, note on evolutionary significance Photorespiration: Mechanism, Organelles Involved, and Significance.	**9**
UNIT III	**Respiration** Glycolysis, TCA cycle, ETS and Oxidative phosphorylation. Brief account of anaerobic respiration (alcohol and lactic acid fermentation), *Respiratory quotient and its significance (Self-study)*	**5 + *1***
UNIT IV	**Flowering in plants** Photoperiodism: Types of plants based on photoperiod – Long day plants, short day plants, day neutral plants. Role of phytochromes in flowering, *Vernalization (Self-study.)* ABCDE Model of development of flower	**5+*1***
UNIT	**Plant growth and plant movements**	**5 +*2***

V	Physiological roles and horticultural applications of Auxins, Gibberellins, Cytokinins, Abscisic acid and Ethylene *(Any two hormones self-study).* Brief role of Strigolactones, Phytomelatonin (Melatonin), Brassinosteroids, Jasmonic Acid, and Salicylic Acid in plant growth and development Plant movements – Tropic & Nastic movements & their types	
UNIT VI	**Defense Mechanism and plant immunity** Introduction - Innate and induced plant defence, structural and biochemical defence. A brief outline on secondary metabolites–terpenes, phenolics, alkaloids in plants, their types and role in plant immunity. A brief account on biotic and abiotic stress and tolerance mechanism in plants.	**4**
UNIT VII	**Plant-microbe interaction** Symbiotic nitrogen fixation in legumes by *Rhizobium*–Mechanism of nodulation and nitrogen fixation. Role of Nitrogenase. A brief introduction to endophytes (fungal and bacterial). Role of endophytes in enhancing plant productivity and defence responses	**3**

NOTE: Portions that are underlined are meant for self-study

BO 1P2 26: Plant Physiology and Metabolism

11 Sessions – 3 hours/ Week

	LIST OF EXPERIMENTS
Practical 1	Observation of plasmolysis and determination of osmotic potential by plasmolytic method in plant cells.
Practical 2	Study of stomatal types and determination of Stomatal Index in monocot and dicot leaves.
Practical 3	Study of the effect of temperature on membrane permeability using a spectrophotometer
Practical 4	To study the effect of deficiency of essential mineral nutrients on plant growth using hydroponic culture
Practical 5	To estimate the amount of fructose present in different fruit samples using the resorcinol (Seliwanoff's) method.
Practical 6	Separation of photosynthetic pigments by paper chromatography and estimation of their Rf values.
Practical 7	Spectrophotometric estimation of total chlorophyll
Practical 8	Qualitative estimation of secondary metabolites in plant samples
Practical 9	Instruments as spotters (Clinostat, Phototropic chamber, Set-up for hydrotropism)
Practical 10	Instruments as spotters (Ganong's potometer, Ganong's respirometer, Suction force by thistle funnel)
Practical 11	Revision and attestation of records

References

1. Srivastava, H. N, (2007). Plant Physiology, Rastogi Publications
2. Mukherji, S. and Gupta A. K. (2005). Plant physiology. New Central Book Agency, New Delhi.
3. Salisbury F.B. and Ross C.W. 1986. Plant Physiology. CBS Pub. New Delhi.
4. Dey, P.M., and Harborne, J.N., 1977. Plant Biochemistry, Academic Press, New York
5. Hall, D.O & Rao, K.K., 1999. Photosynthesis 6th ed., Published in association with the Institute of Biology, Cambridge University Press.
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7. Singh, B.N. & Mengel, K., 1995. Plant physiology and biochemistry, Panima Pub. Corporation, New Delhi.
8. Singal, G.S., Genger, G.C., Sopory, S.K., Irrgang, K.D. & Govindjee, 1999. Concepts in photobiology, photosynthesis and photomorphogenesis, Narosa Pub. House, New Delhi.
9. Meyer B.S. and Anderson D.B., 2017, Plant Physiology, Agri-biovet Press, New Delhi.

10. L.Taiz and E.Zeiger, I.M.Moller and A. Murphy, 2015, Plant Physiology 6th Ed., Sinauer Associates, Inc, USA.
11. W.G.Hopkins and N.P.A.Huner, 2009, Introduction of plant physiology, 4th Edition, John Wiley and Sons, Inc.
12. Stumpf, PK, and Conn, EE (eds.) 1988. The Biochemistry of Plants - A comprehensive treatise, Academic Press, New York.
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BLUEPRINT OF THEORY EXAMINATION QUESTION PAPER

Unit number	**Number of hours**	**Total marks for which the questions are to be asked (including bonus questions)**
I	10	19
II	9	17
III	6	11
IV	6	11
V	7	14
VI	4	8
VII	3	6
TOTAL	**45**	**86**
Note: Maximum marks for the paper (Excluding bonus question): 60		

PRACTICAL QUESTION PAPER PATTERN

ST JOSEPH'S UNIVERISTY, BENGALURU – 560027
SCHOOL OF LIFE SCIENCES, DEPARTMENT OF BOTANY
I B.Sc. I SEMESTER (BCBBT)
BO 1P2 26 – PLANT PHYSIOLOGY AND METABOLISM
BOTANY PRACTICAL EXAMINATION

MAX MARKS – 25 **TIME – 3 HOURS**

I	Separate the photosynthetic pigment mixture **A** by paper	6

	chromatography and calculate the Rf for each constituent	
II	Conduct the experiment **B** and write a note on the requirements, principle and calculations. Report your result and discuss the same	6
III	Conduct the experiment **C** and write a note on the requirements, principle and calculations. Report your result and discuss the same	6
III	Identify the spotters **D**, write your comments.	4
IV	Answer the questions **E** and **F**	2 × 1.5=3

KEY
A – Photosynthetic pigment mixture
B - Observation of plasmolysis and determination of osmotic potential by plasmolytic method.
Or
Study of stomatal types and determination of Stomatal Index in monocot and dicot leaves.
Or
Study of the effect of temperature on membrane permeability using spectrophotometer
C - Estimation of total chlorophyll by spectrophotometer method.
Or
Qualitative estimation of secondary metabolites
Or
Estimation of fructose in different fruits by resorcinol method.
D - Spotters
E & F – Questions of hydroponics and mineral nutrition or any other experiment from the syllabus

THEORY QUESTION PAPER PATTERN

ST JOSEPH'S UNIVERISTY, BENGALURU – 560027
B.Sc. (BOTANY) I SEMESTER
BO 1226 – PLANT PHYSIOLOGY AND METABOLISM
(Only for current BCBBT students)

TIME: 2 HOURS **MAX. MARKS :60**

The paper contains ONE printed page and THREE parts
Draw diagrams and provide examples wherever necessary

A. Answer ANY TEN of the following in 2 to 3 sentences 10 × 2= 20

1.
2.
3.
4.
5.
6.
7.

8.
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10.
11.
12.

B. Answer ANY FIVE of the following in brief **5 × 6= 30**

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

C. Answer ANY ONE of the following in detail **1 × 10 = 10**

20.
21.

Semester	**II**
Paper Code	**BO 2226 (BCBBT)**
Paper Title	**Ecology and Conservation 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	33
Number of practical credits	02

COURSE OBJECTIVES (CO)	This course aims to: **CO1:** Understand and explain fundamental ecological concepts including ecosystem structure, function, energy flow, succession, and adaptations in plants. **CO2:** Apply quantitative and qualitative methods for vegetation analysis, biodiversity estimation, and ecological indices (e.g., Shannon, Simpson, IVI). **CO3:** Critically analyze the impact of invasive species, global environmental issues, and biogeochemical cycles in the context of ecological resilience and sustainability. **CO4:** Demonstrate practical skills in biodiversity monitoring, habitat mapping, remote sensing, and carbon estimation using standard ecological tools and geospatial technologies. **CO5:** Develop an ethical and environmentally responsible approach to conservation challenges in line with national policies and the United Nations Sustainable Development Goals (SDGs).

LEARNING OUTCOMES (LO)	**After completion of the course, students will be able to:** **LO1:** Explain key ecological principles, including niche, succession, trophic interactions, and plant adaptations across ecosystems and biomes. **LO2:** Demonstrate field-based skills in vegetation analysis and biodiversity assessment using parameters like DBH, basal area, IVI, and diversity indices. **LO3:** Apply geospatial tools and remote sensing indices (NDVI, EVI, SAVI) to monitor vegetation health, assess ecological changes, and support conservation research. **LO4:** Evaluate biodiversity threats and conservation strategies, including in-situ/ex-situ methods, and IUCN classifications. **LO5:** Estimate carbon storage, and promote sustainability through environmental impact assessment and eco-friendly practices.

BO2226: Ecology and Conservation Biology

Unit No.	Title of Contents	45 Hrs
UNIT I	**Fundamentals of Ecology**	**15 Hrs**
	Introduction to Ecology: Definition, scope, and relevance to Biotechnology	**1**
	Levels of organization in Ecology: Population, community, and ecosystem	**1**
	Ecosystem concept and structure: Biotic components and abiotic factors - Climatic factors - Light and Temperature; *Soil profile; Edaphic factors affecting vegetation (soil water, soil microbes, and pH – (Self-study))*.	**3+1**
	Energy Flow and Productivity: Food chains, food webs and trophic levels; Ecological pyramids.	**2**
	Productivity: NPP and GPP**; Energy flow:** 10% rule; **Biogeochemical Cycles** -Gaseous cycles - (Nitrogen cycle) and Sedimentary cycles (Phosphorous cycle). Microbial role in nutrient cycling. Interspecific interactions.	**3**
	Ecological Niches and Adaptations: Habitat vs niche, Ecological Niche Modeling. Plant evolution and types of adaptations.	**2**
	Ecological successions: Process and examples; hydrosere and xerosere - *(Self-study)*.	**1+1**
UNIT II	**Ecological Assessment and Geospatial Tools**	**15 Hrs**
	Population Ecology - Characteristics of Population: size, density, abundance, natality, mortality, age structure, dispersal.	**3**
	Community Ecology: Quantitative estimation of vegetation; DBH, Shannon Diversity Index, Simpson Index, density, frequency, basal area, and IVI	**3**
	The world's biomes: *Desert (Self-Study)*, Forest, Grassland, and *Tundra biomes (Self-Study)*	**2+1**
	Invasive Alien Species (IAS): Issues and Prospects with suitable examples	**1**
	Fundamentals of Remote Sensing and GIS: Concept of Remote Sensing and GIS **Vegetation Indices and Applications:** NDVI, EVI, SAVI, principles and uses; Applications in vegetation health, biomass, and phenology monitoring; case studies on the application of remote sensing in forestry, crop monitoring and precision agriculture; Mapping medicinal plant resources.	**3**
	Contemporary Environmental Issues and SDGs: Climate Change, Global Warming, Ozone Layer Depletion *(Self-Study)* and SDGs	**1+1**
UNIT III	**Biodiversity and Conservation Biology**	**15 Hrs**
	Biodiversity: Definition, Convention on Biological Diversity (CBD); threats to biodiversity; *IUCN Red List categories and criteria, Biodiversity hotspots in India (Self-Study)*.	**3+1**

	Conservation terminologies: Keystone species, flagship species, umbrella species, indicator species	**2**
	Conservation strategies: *in-situ:* Medicinal Plant Conservation Areas (MPCAs), Protected Areas (PAs), and *ex-situ*: Botanical Gardens, Seed banks and Gene banks. Role of biotechnology in conservation.	**3**
	Conservation Genetics: Genetic diversity and population viability; Molecular markers in conservation; DNA barcoding and species identification.	**3**
	Carbon sequestration and carbon trading, carbon footprint (Self-Study), Environmental Impact Assessment (EIA); Biodiversity Impact Assessment (BIA).	**2+1**

NOTE: Portions that are underlined are meant for self-study

BO 2P226 - ECOLOGY AND CONSERVATION BIOLOGY (BCBBT)
Total: 33 Hours (11 Sessions and 3 hours per week)

	LIST OF EXPERIMENTS
Practical 1	Vegetation assessment tools and techniques - GPS, Quadrat, Clinometer, Compass, Vernier Calipers, Densiometer, DBH & measuring tapes, Ropes, etc.
Practical 2	Enumeration of campus flora and IVI Calculation
Practical 3	Calculation of Shannon Diversity Index
Practical 4	Estimation of Carbon storage in a given tree species
Practical 5	Ecological Adaptations – Set 1 (Xerophytes, Hydrophytes)
Practical 6	Ecological Adaptations – Set 2 (Halophytes, Epiphytes, Parasitic plants)
Practical 7	Field identification of local IAS and recording ecological impacts
Practical 8	Questionnaire survey to address conservation issues
Practical 9	Vegetation Indices Analysis - Calculation and interpretation of NDVI, EVI, SAVI
Practical 10	Waste to wealth; paper-making from dry leaves/seedball making using paper pulp/dried leaf art and eco-greeting cards/seed jewellery/used plastic bottle art and crafts
Practical 11	Revision and attestation of records

References:

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12. Cohen, M., Wohlmuth, H., Williams, C., & Clarke, P. (2023). The evolutionary pathways and ecological adaptations of plants: A comprehensive analysis of survival strategies over geological timescales. Australian Herbal Insight, 1(5), 1-5. https://doi.org/10.25163/ahi.619966
13. Wilson EO (ed.) (1988) Biodiversity. National Academy Press, Washington, D.C.
14. Stephen, A., Suresh, R., & Livingstone, C. (2015). Indian biodiversity: Past, present and future. International Journal of Environment and Natural Sciences, 7, 13-28.

BLUEPRINT OF THEORY EXAMINATION QUESTION PAPER

Unit number	**Number of hours**	**Total marks for which the questions are to be asked (including bonus questions)**
I	15	28
II	15	29
III	15	29
TOTAL	**45**	**86**
Note: Maximum marks for the paper (Excluding bonus question): 60		

PRACTICAL EXAMINATION QUESTION PAPER PATTERN

ST. JOSEPH'S UNIVERSITY, BENGALURU - 560027
SCHOOL OF LIFE SCIENCES, DEPARTMENT OF BOTANY
I B.Sc. II SEMESTER - BOTANY PRACTICAL EXAMINATION
BO 2P226 – ECOLOGY AND CONSERVATION BIOLOGY

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

1.	Determine the Importance Value Index (IVI) of the given vegetation **A** through the quadrat sampling method, and calculate the Shannon Diversity Index	4 M+2M
2.	Identify, draw and comment on the ecological adaptations of **B, C, and D**	3 X 3 = 9 M
3.	Identify and comment on **E** with a labelled diagram	2.5 M
4.	Calculation and Interpretation of Vegetation Indices problem **F**	2.5 M
5.	Submission of survey report	3 M
6	Submission of Waste to Wealth	2 M

THEORY EXAMINATION QUESTION PAPER PATTERN

ST JOSEPH'S UNIVERSITY, BENGALURU – 560027
SCHOOL OF LIFE SCIENCES, DEPARTMENT OF BOTANY
B.Sc. (BOTANY) II SEMESTER
BO2226 - ECOLOGY AND CONSERVATION BIOLOGY
END SEMESTER EXAMINATION

(Only for current BCBBT students only)

TIME:2 HOURS **MAX. MARKS: 60**

The paper contains ONE printed page and THREE parts
Draw diagrams and provide examples wherever necessary

A. Answer any TEN of the following: **10 × 2= 20**

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