ST JOSEPH'S UNIVERSITY

BENGALURU-27

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

BOTANY SYLLABUS

FOR UNDERGRADUATE PROGRAMME - CBZ

(AS PER SEP 2024-25)

ST JOSEPH'S UNIVERSITY
SCHOOL OF LIFE SCIENCES
DEPARTMENT OF BOTANY
BENGALURU 560 027

Semester	I- CBZ
Paper Code	BO 1124
Paper Title	Microbiology, Mycology and Plant Pathology
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)	The course aims to: 1. Provide a basic understanding of contributions of key microbiologists in shaping the field. 2. Explain the components, working principles, and applications of light and electron microscopes. 3. Explain the preparation and application of basal, enriched, selective, indicator, transport, and storage media. 4. Appreciate the diversity and significance of viruses in biological systems. 5. Evaluate the economic importance of bacteria in industry, agriculture, and medicine. 6. Appreciate the significance of plant pathology in agriculture and food security.
LEARNING OUTCOMES (LO)	After completion of the course, the students will be able to 1. Analyze the impact of historical discoveries on the advancement of microbiology. 2. Identify the components and working principles of simple, compound, and electron microscopes (SEM and TEM). 3. Compare various sterilization techniques, including dry heat, moist heat, UV light, ionizing radiation, and filtration. 4. Understand the role of viruses in disease and biotechnology. 5. Assess the economic importance of bacteria and fungi in industry, agriculture, and medicine. 6. Explain the impact of plant diseases on agriculture and food security.

BO1124: Microbiology, Mycology and Plant Pathology

Units	Title of Contents	Hrs (45)
UNIT 1	**History and developments of microbiology -** Microbiologists and their contributions (Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner and Alexander Fleming).	**2**
UNIT 2	**Microscopy –** *History of microscopy (self study).* Components, working principle and applications of light *(simple and compound) (self study)* and electron microscopes(SEM and TEM).	**3+*2***
UNIT 3	Culture media for Microbes - *Natural and synthetic media, Routine media -basal media, enriched media, selective media, indicator media, transport media, and storage media (Self study)*	***2***
UNIT 4	**Sterilization methods -** Principle of disinfection, antiseptic and Pasteurization, Sterilization - Sterilization by dry heat, moist heat, UV light, ionization radiation, filtration. Chemical methods of sterilization - phenolic compounds, anionic and cationic detergents.	**4**
UNIT 5	**Viruses** - General structure and classification based on Nucleic acids (ssDNA, dsDNA, ssRNA, and dsRNA). Structure and multiplication of TMV.	**3**
UNIT 6	**Bacteria** – General account on Archaebacteria and Eubacteria. General characteristics and classification of bacteria based on shape and flagellation. Ultrastructure of Bacteria - Structure of capsule, flagella, pili and endospore. (Ultrastructure of flagella and endospore only), Physical and chemical structure of Gram positive and Gram-negative bacterial cell walls. Reproduction by binary fission. Genetic recombination by conjugation (F+ and F-, Hfr types), Transduction (generalized and specialized types) and Transformation. *Economic importance of Bacteria (Industry, agriculture and Medicine) – (Self study)*	**13+*1***
UNIT 7	**Fungi** - General characteristics and thallus organization and nutrition in fungi. Reproduction in fungi (asexual and sexual). Type study of; *Pythium*, *Rhizopus*, *Puccinia* and *Penicillium*. *Economic importance of fungi (Industry, agriculture and medicine) – Self study* **Lichens** – Structure, types and reproduction.	**9+*1***
UNIT 8	**Plant Pathology** – Brief account of the following diseases: Tomato Leaf Curl, Citrus Canker, Sandal Spike, Club Root of Crucifer, Smut of Jowar, Blast of Rice, Red Rot of Sugarcane.	**5**

BO 11P24: Microbiology, Mycology and Plant Pathology

11 Sessions – 3 Hours/ Week

Sl. No.	Experiments	Units/ Sessions
1	Safety measures in microbiology laboratory and study of equipment/appliancesused for microbiological studies (Microscopes, Hot air oven, Autoclave/Pressure Cooker, Inoculation needles/loop, Petri plates, Incubator, Laminar flow hood, Colony counter).	1
2	Preparation of culture media (NA/PDA) sterilization, inoculation. Enumeration of soil/water microorganisms by serial dilution technique.	1
3	Gram's staining of bacteria	1
4	Determination of cell count by using Haemocytometer.	1
5	Determination of microbial cell dimension by using Micrometer.	1
6	Study of vegetative structures and reproductive structures – *Stemonitis, Pythium, Rhizopus*	1
7	Study of vegetative structures and reproductive structures- *Puccinia, Penicillium*	1
8	Study of vegetative structures and reproductive structures- *Trichoderma* and *Agaricus*	1
9	Study of Tomato Leaf Curl, Citrus Canker, Sandal Spike, Club Root of Crucifer.	1
10	Study of Smut of Jowar, Blast of Rice, Red Rot of Sugarcane and Tikka disease of Groundnut. Revision.	2

References

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2. Arora DR. 2004. Textbook of Microbiology, CBS, New Delhi.
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19. Sullia SB and Shantharam S. 1998. General Microbiology. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.
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PRACTICAL EXAMINATION QUESTION PAPER PATTERN

ST. JOSEPH'S UNIVERSITY, BENGALURU - 560027
SCHOOL OF LIFE SCIENCES, DEPARTMENT OF BOTANY
I B.Sc. I SEMESTER - CBZ
BO11P24- MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY
BOTANY PRACTICAL EXAMINATION

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

I	Perform the Gram's staining for **A.** Write the principle, identify with reasons and leave the preparation for evaluation	2+2=4
II	Calculate the population of yeast cells using haemocytometer/ measure cell dimensions using micrometer in the given sample **B**. Briefly describe the instrument and tabulate the result.	2+2=4
III	Identify and classify the specimens **C** and **D** with reasons.	2X2.5=5
IV	Identify the slides **E** and **F** with labeled diagrams and reasons.	2X3=6
V	Comment on spotters **G, H** and **I**	2X3=6

KEY

A – Curd sample/Root nodule extract

B – Haemocytometry - Yeast cells. Micrometry - Pollen or Epidermal cells or Fungal spores

C & D – Fungal specimens

E & F – Fungal slides

G, H and I – Plant pathology specimen/ slide, Microbiological instrument, Serial dilution/ Culture plate

THEORY QUESTION PAPER PATTERN

ST JOSEPH'S UNIVERSITY, BENGALURU - 560027
I B.Sc. BOTANY – I SEMESTER, CBZ
SEMESTER EXAMINATION
BO 1124: MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY

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

The paper contains TWO printed pages and THREE parts
Draw diagrams and provide examples wherever necessary

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

1.
2.
3.
4.
5.
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9.
10.
11.
12.

B. Write critical notes on ANY FIVE of the following **5 × 6 = 30**

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

C. Give a comprehensive account on ANY ONE of the following **1 × 10 = 10**

20.
21.

BLUEPRINT OF THEORY EXAMINATION QUESTION PAPER PATTERN

Unit number	Number of hrs.	Total marks for which the questions are to be asked (including bonus questions)
I	02	04
II	05	10
III	02	04
IV	04	08
V	03	06
VI	14	24
VII	10	20
VIII	05	10
TOTAL	**45**	**86**
Note: Maximum marks for the paper (Excluding bonus question): **60**		

ST JOSEPH'S UNIVERSITY
SCHOOL OF LIFE SCIENCES
DEPARTMENT OF BOTANY
BENGALURU – 560027

Semester	II – CBZ
Paper Code	BO 2124
Paper Title	Phycology and Bryology
Number of teaching hours per week	03
Total number of teaching hours 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)	The course aims to 1. Describe the diversity, classification, and reproduction of algae, with reference to their habitat and thallus organization. 2. Analyze the systematic position, structure, and reproductive methods of selected algae species. 3. Evaluate the economic importance of algae in ecosystems, identifying both their harmful and beneficial effects. 4. Understand the general characteristics, distribution, and classification of bryophytes, with specific reference to Proskauer's classification system. 5. Discuss the ecological role of bryophytes, including their response to environmental changes, pollution, and conservation efforts
LEARNING OUTCOMES (LO)	After completion of the course, the students will be able to 1. Identify different types of algae and describe their life cycle types, including haplontic, diplontic, haplodiplontic, haplobiontic, and diplobiontic cycles. 2. Describe the morphology, anatomy, and reproduction of key bryophyte species belonging to the liverworts, hornworts and true mosses. 3. Examine the phylogenetic relationships between algae and bryophytes, recognizing their evolutionary connections. 4. Assess the impact of pollution on bryophytes and explore their role in bioindication and ecological adaptation. 5. Explore the practical applications of bryophytes and algae, including their use in conservation biology and their role in sustainable agriculture and environmental monitoring.

BO 2124 – Phycology and Bryology

Units	Title of Contents	Hours (45)
UNIT 1	**Algae – General concepts** Diversity of Algae with respect to habitat, thallus organization and reproduction. *Classification of algae (upto classes) by Fritsch (self study).* Life cycle types in algae: Haplontic, diplontic, haplodiplontic, haplobiontic and diplobiontic types.	10 + *2*
UNIT 2	**Algae – Type study** Systematic position, structure and reproduction of the following forms: *Anabaena, Volvox, Spirogyra, Chara, Vaucheria, Sargassum, Batrachospermum*.	9
UNIT 3	*Economic importance of algae including harmful and useful effects in ecosystems.* *(self study).*	*2*
UNIT 4	**Bryophytes – General concepts** Bryophytes: Distribution, general characters, alternation of generation and classification of Bryophytes by Proskauer (1957).	4
UNIT 5	**Bryophytes – Type study** Morphology, anatomy and reproduction of *Marchantia, Anthoceros and Sphagnum* (developmental details not required).	7
UNIT 6	Origin and phylogenetic relationships between algae and bryophytes.	2
UNIT 7	Ecology of Bryophytes. Bryophytes in a changing world – impact of pollution on bryophytes, application to bioindication, adaptation to a changing environment. Conservation biology for algae and bryophytes – threats, need for conservation and conservation strategies. Role of peat in soil less plant growth.	7
UNIT 8	*Economic importance of Bryophytes (self-study).*	*2*

BO 2P1: Phycology and Bryology

11 Sessions – 3 Hours/ Week

Sl. No.	Experiments	Units/ Sessions
1	Type study of *Anabaena, Scytonema, Spirulina*	1
2	Type study of *Volvox, Hydrodictyon*	1
3	Type study of *Spirogyra*, *Chara*, *Vaucheria*	1
4	Type study of *Sargassum*, *Batrachospermum*	1
5	Type study of *Marchantia*	2
6	Type study of *Anthoceros*	1
7	Type study of *Funaria*	1
8	Type study of *Sphagnum*	1
9	Type study of Isolation of algae from water samples by serial dilution method	1
10	Institutional visit to study culturing of microalgae	1

References:

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ST. JOSEPH'S UNIVERSITY, BENGALURU - 560027
SCHOOL OF LIFE SCIENCES, DEPARTMENT OF BOTANY
I B.Sc. II SEMESTER - CBZ
BO2P124 – PHYCOLOGY AND BRYOLOGY
BOTANY PRACTICAL EXAMINATION

MAX. MARKS: 25 TIME: 3 HOURS

I	Identify specimens A, B and C with classification and reasons	3 × 3 = 9
II	Prepare a temporary slide of D, identify, comment and leave the preparation for evaluation	4
III	Identify the slides E, F and G with labeled diagrams and reasons	4 × 3 = 12

KEY

A, B, C – Algae and Bryophyte specimens

D – Algae specimen

E, F, G – Algae and Bryophyte slides

THEORY QUESTION PAPER PATTERN

ST JOSEPH'S UNIVERSITY, BENGALURU - 560027

I B.Sc. BOTANY – I SEMESTER, CBBT

SEMESTER EXAMINATION

BO 2124: PHYCOLOGY AND BRYOLOGY

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

The paper contains TWO printed pages and THREE parts

Draw diagrams and provide examples wherever necessary

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

1.
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11.
12.

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

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

C. Give a comprehensive account on ANY ONE of the following **1 × 10 = 10**

20.
21.

BLUEPRINT OF THEORY EXAMINATION QUESTION PAPER PATTERN

Unit number	Number of hours	Total marks for which the questions are to be asked (including bonus questions)
I	11	21
II	9	17
III	2	4
IV	4	8
V	7	14
VI	2	4
VII	7	14
VIII	2	4
TOTAL	45	86
Note: Maximum marks for the paper (Excluding bonus question): 60		

ST JOSEPH'S UNIVERSITY
BENGALURU-27

BOTANY - SYLLABUS

FOR UNDERGRADUATE PROGRAMME - CBZ
(AS PER SEP 2025-26)

3rd Semester B.Sc. Botany syllabus (SEP)

BO 3125: Pteridophytes, Gymnosperms and Plant Anatomy (for CBZ course)

Course Outcomes and Course Content

Semester	III
Paper Code	BO 3125
Paper Title	Pteridophytes, Gymnosperms and Plant Anatomy
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)**	CO1: Understanding the basic concepts of classical botany through different life forms and life cycles in Pteridophytes and Gymnosperms. CO2: Understanding interrelationship and evolutionary aspects among life forms of Pteridophytes and Gymnosperms. CO3: Understanding economic uses and bioprospecting of Pteridophytes and Gymnosperms. CO4: Understanding the internal structure of various parts of a plant as well as among different plant groups in support for the evolutionary concept. CO5: Understanding the primary, secondary and anomalous secondary growth in different plant groups and their significance in structural organization. learn
LEARNING OUTCOMES **(LO)**	After completion of the course, the students will be able to - LO1: Remember and apply the learnt knowledge on Pteridophytes and Gymnosperms especially on characteristic features, distribution, and affinities of these plant groups. LO2: Understand and differentiate between gametophytes, sporophytes, reproduction and life cycle of selected Pteridophyte and Gymnosperm

	plants. LO3: Understand and analyze the stelar evolution, the phenomenon of heterospory and seed habit in Pteridophytes. LO4: Demonstrate and develop skills on the internal structural (primary, secondary and abnormal) organization in different plant groups and their relevance with plant evolution. LO5: Demonstrate and develop skills on the internal structural organization of different plant groups based on primary, secondary and abnormal growth conditions and its significance in plant growth and development.

BO 3125: PTERIDOPHYTES, GYMNOSPERMS AND PLANT ANATOMY - 45 Hours		
	Unit 1: Pteridophytes	**15 hrs**
Chapter 1	A general account of characteristic features, distribution, and affinities of Pteridophytes with Bryophytes and Gymnosperms. Classification of Pteridophytes (Smith, 1955).	2+1
Chapter 2	Systematic position, sporophytic structure (morphology and anatomy), reproduction (developmental stages not required) and life cycle of *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum*, and *Marsilea*.	8+1
Chapter 3	Stelar evolution in Pteridophytes. Heterospory and seed habit. Allergic Ferns and Invasive Ferns (*Pteridium aquilinum*).	3
	Unit 2: Gymnosperms	**15 hrs**
Chapter 4	A general account of characteristic features, distribution, and affinities of Gymnosperms with Angiosperms. Classification of Gymnosperms (Sporne, 1965). Salient features of Cycadales, Coniferales and Gnetales.	4+1
Chapter 5	Systematic position, sporophytic structure (morphology and anatomy), reproduction (developmental stages not required) and life cycle of *Pinus* and *Gnetum*. Economic importance of Gymnosperms.	9+1
	Unit 3: Plant Anatomy	**15 hrs**
Chapter 6	**Plant cell**: Ultra-structural organization of plant cell wall (primary and secondary) and functions.	2

Chapter 7	Meristematic tissue and its classification, Simple and complex permanent tissues. Structural organization of Shoot Apical Meristem (SAM) - Theories of organization (Apical cell, Histogen, Tunica-Corpus); Root Apical Meristem (Korper-Kappe theory), and Quiescent centre concept.	5 + 1
Chapter 8	**Leaf**, **Stem and Root anatomy**: Primary (internal) structure of leaf, root and stem (Dicot and Monocot). Types of vascular bundles. Secondary growth of dicot stem (*Helianthus*) and dicot root (*Cicer*); Anomalous secondary growth in the stem of *Boerhaavia* and *Dracaena*.	6 + 1 hrs

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

REFERENCES

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Tayal, M.S. (2004). Plant Anatomy, Rastogi Publication

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BLUEPRINT

Unit/ Chapter number	Number of hrs.	Total marks for which the questions are to be asked (including bonus questions)
1	03	06
2	09	18
3	03	06
4	05	10
5	10	18
6	02	04
7	06	11
8	07	13
TOTAL	**45**	**86**
Note: Maximum marks for the paper (Excluding bonus question): **60**		

BO3P1: PTERIDOPHYTES, GYMNOSPERMS AND PLANT ANATOMY **Total: 33 Hours (11 Sessions and 3 hrs per week)**	
LIST OF EXPERIMENTS	
Practical 1	Study of morphology, anatomy, and reproductive structures of *Psilotum* and *Lycopodium.*
Practical 2	Study of morphology, anatomy, and reproductive structures of *Selaginella* and *Equisetum.*
Practical 3	Study of morphology, anatomy, and reproductive structures of *Marsilea.*
Practical 4	Study of morphology and anatomy of *Pinus.*
Practical 5	Study of reproductive structures of *Pinus* and morphology of *Gnetum.*
Practical 6	Study of anatomy and reproductive structures of *Gnetum.*

Practical 7	T.S. of dicot and monocot leaf.
Practical 8	T.S. of dicot and monocot stem.
Practical 9	T.S. of dicot and monocot root.
Practical 10	Anomalous secondary growth in *Boerhaavia* and *Dracaena*.
Practical 11	Revision/Makeup lab/Attestation of records.

PRACTICAL QUESTION PAPER PATTERN

ST JOSEPH'S UNIVERISTY, BENGALURU – 560027
SCHOOL OF LIFE SCIENCES, DEPARTMENT OF BOTANY
2ND B.Sc., 3rdSEMESTER (CBZ)
BO 3P1: PTERIDOPHYTES, GYMNOSPERMS AND PLANT ANATOMY

MAX. MARKS: 25 **TIME: 2 HOURS 40 MINUTES**

1. Prepare a temporary section of the sample **A**, identify and comment ……..... **5x1=5**
2. Prepare a temporary section of the sample **B**, identify and comment…..... **5x1=5**
3. Identify and classify the specimens **C** and **D** and comment……..... **3x2=6**
4. Identifyand comment on the permanent slide/specimens**E, F**and**G** ..... **3x3=9**

Key

1. **A:***Equisetum* stem/ *Pinus* needle
2. **B:** Stem/Root/Leaf of Dicot or Monocot
3. **C** and **D:** Specimens fromPteridophyte/ Gymnosperm
4. **E, F** and **G:** Permanent slides from Pteridophyte /Gymnosperm/ Anatomy (Anomalous Sec. growth/ Sec. growth)

THEORY QUESTION PAPER PATTERN

ST JOSEPH'S UNIVERSITY, BENGALURU - 560027
II B.Sc. BOTANY – III SEMESTER, CBZ
END SEMESTER EXAMINATION
BO 3125: PTERIDOPHYTES, GYMNOSPERMS AND PLANT ANATOMY

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

The paper contains _____ printed pages and THREE parts
Draw diagrams and provide examples wherever necessary

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

1.
2.
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10.
11.
12.

B. Write critical notes on ANY FIVE of the following **5 × 6 = 30**

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

C. Give a comprehensive account on ANY ONE of the following **1 × 10 = 10**

20.
21.

Course Outcomes and Course Content

Semester	**IV-CBZ**
Paper Code	**BO 4125**
Paper Title	**Palynology and Embryology of Angiosperms (For CBZ)**
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's per semester	33
Number of practicals credits	02

COURSE OBJECTIVES **(CO)**	The main objectives of this course are to: CO1: **Introduce students to the foundational concepts of palynology**, its history, development, and scope, enabling an understanding of its interdisciplinary applications across various scientific fields. CO2: **Explore the morphology of pollen grains**, providing students with the ability to identify and classify different pollen types based on their characteristics such as symmetry, shape, size, apertures, and ornamentation. CO3: **Investigate the factors affecting pollen viability and storage**, equipping students with knowledge on how to assess and preserve pollen for both short-term and long-term usage, contributing to fields like plant breeding and conservation. CO4: **Examine the role of palynology in biotechnology**, especially in optimizing crop yield, overcoming pollination barriers, and facilitating the production of hybrid seeds, thus enhancing agricultural productivity. CO5: **Apply palynology in forensic science**, enabling students to understand how pollen analysis aids in criminal investigations and its role in determining geographic origin and environmental context at crime scenes. CO6: **Study paleopalynology**, linking the study of ancient pollen to understand historical climates, ecosystems, and the role of plant life in past geologic eras, contributing to biostratigraphy and paleoecology. CO7: **Introduce students to the embryology of angiosperms**,

	covering the development of both male and female reproductive structures, pollination mechanisms, and the unique process of double fertilization in flowering plants. CO8: **Analyze the structure and development of embryos** in dicots and monocots, exploring endosperm formation, polyembryony, and parthenogenesis, while understanding their applications in plant breeding and agriculture. CO9: **Develop practical skills in experimental embryology**, focusing on tissue culture techniques, protoplast fusion, and organogenesis, to foster innovation in plant biotechnology and genetic modification.
LEARNING OUTCOMES **(LO)**	Upon successful completion of this course, students will be able to: LO1: **Demonstrate a comprehensive understanding of palynology**, including its history, development, key branches, and wide range of applications in fields such as agriculture, forensics, and archaeology. LO2: **Identify and classify different types of pollen grains** based on their morphology, including their shape, size, symmetry, apertures, and ornamentation, and explain the significance of these features in plant reproduction. LO3: **Evaluate pollen viability and vigor**, understanding the factors that influence pollen longevity, and apply various techniques for short-term and long-term pollen storage, ensuring effective use in research and agriculture. LO4: **Apply palynology in biotechnology**, particularly in overcoming pollination constraints, optimizing crop yield, and facilitating hybrid seed production, enhancing students' ability to contribute to agricultural innovation. LO5: **Utilize forensic palynology methods** to assist in criminal investigations, understanding how pollen evidence can be used to determine the geographic origin of samples and place suspects at specific locations or time periods. LO6: **Interpret paleopalynological data**, relating ancient pollen records to historical climate changes, past ecosystems, and the study of biostratigraphy, thus contributing to the understanding of

	Earth's past environments. LO7: **Understand the structural and developmental processes in angiosperm embryology**, including the development of microsporangium, megasporangium, and male and female gametophytes, as well as the significance of double fertilization. LO8: **Differentiate between the structure and development of dicot and monocot embryos**, and analyze the formation and function of endosperm, along with understanding polyembryony and its applications in plant breeding. LO9: **Analyze and apply experimental embryology techniques**, such as anther culture, ovary culture, protoplast fusion, and organogenesis, to innovate and solve challenges in plant biotechnology and genetic improvement.

Palynology		
Unit I		
Chapter No. 1	**Palynology**: Introduction to Palynology; *History and development of Palynology; Basic branches and their scope* ***(self study).*** Applications of palynology.	**1+2 (self study)**
Chapter No. 2	**Pollen morphology:** Pollen units, polarity, symmetry, shape, size, apertures - NPC classification, apertural types, edges of apertures, views of grains concerning apertures; exine stratification and ornamentation.	**5**
Chapter No. 3	**Pollen Viability and Vigour -** Variations in the longevity of pollen, factors affecting pollen viability. ***Pollen Storage*** *– Short-term and long-term storage and its significance (self Study).*	**1+1 (self study)**
Unit II		
Chapter No. 4	**Pollen Biotechnology:** Introduction, overcoming pollination constraints for optimization of crop yield; Developing effective pollination control system for commercial production of hybrid seeds; Overcoming crossability barriers to transfer of useful genes to crop species.	**6**
Unit III		
Chapter No.5	**Forensic Palynology:** Introduction, methodology in forensic study, forensic palynology as an aid in criminology, limitations of forensic palynology. **Paleopalynology:** Definition, history, Biostratigraphy and geochronology; Palaeoecology and climate change; Archaeological palynology.	**2** **2**
Embryology of Angiosperms		
Unit IV		
Chapter No. 6	**Introduction**: Development and structure of Microsporangium - Anther wall, sporogenous tissue. **Microsporogenesis**: Development of male gametophyte. Types of microspore tetrads, pollinia.	**3**
Chapter No. 7	Structure of megasporangium, Ovule and its types (based on (a) position of chalaza, micropyle and funicle, (b) nucellus, (c) number of integuments); Variations in ovule structure- Aril, integumentary tapetum, caruncle.	**3**

Chapter No. 8	**Types of Embryo sac development:** (Monosporic-*Polygonum* type; Bisporic-*Allium* type and Tetrasporic-*Fritillaria* type. Pollination, Self and cross-pollination, their advantages and limitations. Pollen-pistil interaction and self-incompatibility. **Double Fertilization** - Definition, process, importance and uniqueness in angiosperms	**5**
Unit V		
Chapter No. 9	*Structure of dicot and monocot embryos (Capsella bursa-pastoris, Oryza sativa).* *Differences between mature Dicot and Monocot embryos (Self study)* **Endosperm**: Development and Function. ***Types of Endosperm:*** *i) Nuclear ii) Cellular iii) Helobial (self study).*	**2 (self study) +1**
Chapter No. 10	**Polyembryony:** Introduction, Classification of Polyembryony - Simple, Multiple, Nucellar, Integumentary, Endothelial, Zygotic and Suspensor, Synergid - Twins and Triplets; Polyembryony in Hybrids; Causes of Polyembryony; Induction of Polyembryony; Utilization of PluraI Embryos. *Parthenogenesis – Introduction, types and significance (self study).*	**2+1 (self study)**
Unit VI		
Chapter No. 11	**Experimental Embryology**: Introduction; procedure and nutritional requirements, and applications of anther and pollen Culture; Ovary, Ovule, and Nucellus Culture; Endosperm Culture; Embryo Culture; Protoplast Culture - Embryogenesis and Regeneration, Protoplast Fusion and Somatic Hybridization, "Pomatoes" and "Topatoes" **Organogenesis in Plants**: Transformation of vegetative apex to floral apex, Development of floral organs in *Arabidopsis*. Role of MADS box genes in flower development	**8**

Note: 6 hours of self-study can be given

Text Books and Further Readings:

1. Agashe, S.N. 2006. Palynology and its application, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Agashe, S.N. and Caulton, E. 2009. Pollen and Spores: Applications with Special Emphasis on Aerobiology and Allergy. CRC Press.
3. Alotaibi, S.A., Sayed, S.M., Alosaimi, M., Alharthi, R., Banjar, A., Abdulqader, N. and Alhamed, R. 2020. Pollen molecular biology: Applications in the forensic palynology and future prospects: A review. Saudi Journal of Biological Sciences 27: 1185-1190.
4. Asif, M. 2013. Parthenogenesis. In: Progress and Opportunities of Doubled Haploid Production. SpringerBriefs in Plant Science, vol 6. Springer, Heidelberg.
5. Bhattacharya, K., Majumdar, M.R. and Bhattacharya, S.W. 2006. A Textbook of Palynology [Basic and Applied]. New Central Book Agency (P) Ltd., London.
6. Bhojwani, S.S., Bhatnagar, S.P. and Dantu, P.K. 2014. An Embryology of Angiosperms (6th Ed.). Vikas Publishing House
7. Birks, H.J.B. and Birks, H.H. 1980. Quaternary Palaeoecology. Arnold. London.
8. Blackmore, S. and Ferguson, I.K. 1986 (eds). Pollen and spores: Form and Function. Academic Press, London.
9. Bryant, V.M. Jr., Mildenhall, D. and Jones, J. 1990. Forensic palynology in the United States of America. Palynology 14:193-208.
10. Dijk, P.V. 2009. Apomixis: Basics for Non-botanists. In: Schön, I., Martens, K. and Dijk, P.V. (eds) Lost Sex: The Evolutionary Biology of Parthenogenesis, Springer.
11. Dutta, A.C. 1997. Botany for Degree Students (6th Ed.), Oxford University Press.

12. Erdtman, G. 1957 "Pollen & spore Morphology / plant taxonomy Vol. 1 - V. Hafner Pub. Co. New York.
13. Faergri, K. and Iversen, J. 1988. Textbook of pollen analysis IV Edit. John Wiley and Sons. New York.
14. Halbritter, H., Ulrich, S., Grímsson, F., Weber, M., Zetter, R., Hesse, M., Buchner, R., Svojtka, M. and Frosch-Radivo, A. 2018. Illustrated Pollen Terminology (2nd Ed), Springer Open.
15. Hojsgaard, D. and Pullaiah, T. 2022. Apomixis in Angiosperms: Mechanisms, Occurrences, and Biotechnology. CRC Press.
16. Johri, B.M. 1984. Embryology of Angiosperms, Springer-Verlag.
17. Johri, B.M. and Srivastava, P.S. 2001. Reproductive Biology of Plants, Springer-Verlag.
18. Maheshwari, P. 1950. An Introduction to Embryology of Angiosperms, McGraw Hill Publication.
19. Mildenhall, D. 2009. Forensic palynology: an increasingly used tool in forensic science. European Journal of Aerobiology and Environmental Medicine, 2: 7-11.
20. Nair, P.K.K. 1970. Pollen Morphology of Angiosperms : a historical and phylogenetic study. Scholar publishing house, Lucknow.
21. Naumova, T.N. 1993. Apomixis in Angiosperms: Nucelar and Integumentary Embryony. CRC Press.
22. Ogden, E.C. Rayner, G.S. Manual for sampling Airborne Pollen. Hafner Press, Macmillan Publishing Co., Inc, New York.
23. Punt, W., Hoen, P.P., Blackmore, S., Nilsson, S. and Le Thomas, A. 2007. Glossary of pollen and spore terminology. Review of Palaeobotany and Palynology, 143: 1-81.
24. Raghavan, V.R. 2000. Developmental biology of flowering plants. Springer publications.
25. Sandiford, A. 2012. Palynology, pollen, and spores, partners in crime: what, why, and how. In: Hall, D.W. and Byrd, J.H. (eds) Forensic Botany: A Practical Guide, First Edition. John Wiley & Sons, Ltd.
26. Shivanna, K. R. and Tandon, R. 2014. Reproductive Ecology of Flowering Plants: A Manual. Springer.
27. Singh, V., Pande, P.C. and Jain, D.K. 2018. Anatomy and Embryology of Angiosperms, Rastogi Publication.
28. Sinnot E.W. 1960. Plant morphogenesis. Mc Graw Hill Book Company, INC, New York.
29. Stephen, A. 2014. Pollen – A microscopic wonder of plant kingdom. International Journal of Advanced Research in Biological Sciences, 1 (09): 45-62.
30. Traverse, A. 2008. Paleopalynology, 2nd edn. Springer, Dordrecht.
31. Tilak, S.T. 1982 Aerobiology. Vaijayanti Prakashan, Aurangabad.
32. Wardlaw, C.W. 1968. Morphogenesis in Plants. A Contemporary Study. Methuen and Company, London.
33. Wodehouse, R. P. 1935. "Pollen grains" their structure, identification and significance in Science and Medicine. McGraw-Hill, New York.

BLUE PRINT

Code number: **BO - 4125**

Title of the paper: **Palynology and Embryology of Angiosperms**

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Unit number
20	10	I

11	6	II
8	4	III
21	11	IV
11	6	V
15	8	VI
86	**45**	**TOTAL**
Maximum marks for the paper (Excluding bonus question): **60**		

A. 2-mark questions: Answer any 10 out of 12. | 2x10 = **20 marks**

B. 6-mark questions: Answer any 5 out of 7. | 6x5= **30 marks**

C. 10-mark questions: Answer any 10 out of 2. | 10x1= **10 marks**

BO 4P1: List of Experiments to be conducted

Practical 1: L.S. of flower; T.S of young and mature anther

Practical 2: Permanent slide preparation of pollen grains (Erdtman acetolysis method)

Practical 3: Preparation of permanent slides and Study of Pollen morphology of Monocotyledons – *Canna, Commelina, Chloris, Cocos nucifera, Cyperus* and determine the shape of the pollen grains

Practical 4: Preparation of permanent slides and Study of Pollen morphology of Dicotyledons *Hibiscus, Mimosa, Acacia, Tridax, Eucalyptus*, Pollinia of *Calotropis* and determine the shape of the pollen grains

Practical 5: Germination of Pollen grains of *Catharanthus roseus* – Hanging Drop method

Practical 6: Types of placentation & ovules

Practical 7: Mounting of endosperm of *Cucumis*

Practical 8: Mounting of embryo of *Tridax*

Practical 9: Pollen viability by histo-chemical (acetocarmine) test

Practical 10: Pollen viability by TTC test

Practical 11: Revision/Makeup lab - Submission to the batch teacher: Permanent slides of pollen grain from Monocots (1 slide) and Dicots (1 slide).

PRACTICAL EXAMINATION QUESTION PAPER PATTERN

St Joseph's University, Bengaluru - 560027
III Semester, B.Sc. Botany Practical Examination
BO4125: Palynology and Embryology of Angiosperms

Time: 3hrs Max. Marks: 25

1. Identify specimens/slides **A, B, C** and comment.	3x3=9 Marks
2. Mount Embryo / Endosperm of **D**, draw neat labeled diagrams and comment.	1x6=6 Marks
3. Perform pollen germination experiment **E** and calculate percentage of germination.	1x6=6 Marks
4. Submission of permanent slides of pollen grains from Monocots (1 slide) and Dicots (1 slide).	2x2=4 Marks

Scheme

- **A.** Pollen slide – 3 marks
- **B.** Types of Placentation – 3 marks
- **C.** TS of Young/Mature anther / Types of Ovules – 3 marks
- **D.** Embryo / endosperm mounting – 6 marks
- **E.** Pollen germination experiment – 6 marks