

Examination Scheme for EoSE for Semester III

CA – Continuous Assessment
EoSE – End of Semester Examination

Regular Students –

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-63T-201 Microbiology and Plant Pathology	CA	1 Hrs	CA	20 Marks	CA	8 Marks
		EoSE	3 Hrs	EoSE	80 Marks	EoSE	32 Marks
Practical	BOT-63P-202 Practical-III Microbiology and Plant Pathology	CA	1 Hrs	CA	10 Marks	CA	4 Marks
		EoSE	4 Hrs	EoSE	40 Marks	EoSE	16 Marks

The theory question paper will consist of **two** parts A&B.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 60 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

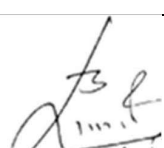
Non-Collegiate Students –

Type	Course Code and Nomenclature	Duration of Examination	Maximum Marks (EoSE)	Minimum Marks (EoSE)
Theory	BOT-63T-201 Microbiology and Plant Pathology	3 Hrs	100 Marks	40 Marks
Practical	BOT-63P-202 Practical-III Microbiology and Plant Pathology	4 Hrs	50 Marks	20 Marks

The theory question paper will consist of **two** parts A&B.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

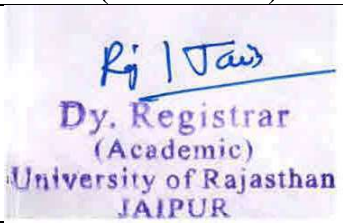
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PART-B: 80 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 20 marks.

Syllabus**UG0802 – Three/Four Year Bachelor of Science (Bio Group)****III-Semester- Botany****BOT-63T-201-Microbiology and Plant Pathology**

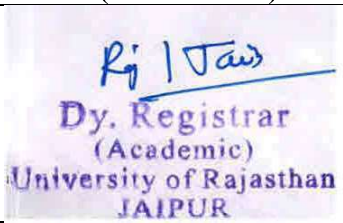
Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
III	BOT-63T-201	Microbiology and Plant Pathology			6	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method
		Theory	Practical	Total		
Intermediate	Major/Minor	4	2	6	Yes	60 lectures with diagrammatic presentations and informative assessments during lecture hours
List of Programme Codes in which Offered as Minor Discipline		UG0806, UG0812				
Prerequisites		Botany course of Foundation/Introductory level				
Objectives of the Course:		➤ To gain in-depth knowledge about bacteria, viruses and other microorganisms, including their structure, function, genetics, and role in ecosystems, ➤ To learn about the interactions between plants and microorganisms, ➤ To understand the beneficial relationships (e.g., symbiosis) and harmful interactions (e.g., plant diseases) between plants and microorganisms				

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COURSE OUTCOMES

On completion of the course the student would be able to develop the following

Understanding	• To gain in-depth knowledge about bacteria, viruses and other microorganisms, including their structure, function, genetics, and role in ecosystems. • To learn about the interactions between plants and microorganisms, • To understand the beneficial relationships (e.g., symbiosis) and harmful interactions (e.g., plant diseases) between plants and microorganisms.
Memorizing	• Different types of microbes with structure, function and their economic importance. • Host pathogen interaction and its effects on plants. • Symptomology, disease cycle and control of different pathogens causing diseases.
Applying	• Acquire proficiency in various laboratory techniques, such as culturing microorganisms, gram staining, microscopy, and biochemical assays. • Will be helpful for students in further developing interest in agricultural research, crop protection, and pest management to improve crop yield and quality. • Work in disease prevention and control, focusing on plant diseases that impact food safety and public health.

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Detailed Syllabus

BOT-63T-201 - [Microbiology and Plant Pathology]

Unit – I

Microbiology	Introduction to microbial world: History and Development in the field of microbiology, Systemic position of Micro-organism (R.H. Whittaker's five kingdom concept, Carl Woese's Domain System), Origin of Life, contribution of Louis Pasteur and Robert Koch, Germ theory of disease.	(7 Lectures)
Virus	Discovery, General account, structure with special reference to TMV, Pox virus, Bacteriophage; Replication of T4 phage (Lytic and Lysogenic).	(6 Lectures)
Mycoplasma	General Characteristics, Morphology and Reproduction.	(2 Lectures)

Unit –II

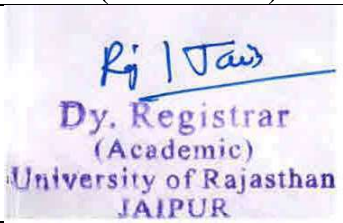
Bacteria	General Characteristics, Classification, Cell structure, endospore formation, Reproduction- asexual and recombination (Conjugation, Transformation and Transduction).	(10 Lectures)
Applied Microbiology	Economic importance of viruses, Economic importance of Bacteria with reference to their role in agriculture and food industry, Biofilms	(5 Lectures)

Unit –III

Phyto-pathology	Terminology and basic concepts (Primary and Secondary inoculum; infection, Pathogenicity, Pathogenesis, Disease Cycle); Biotic and abiotic diseases, General symptoms caused by Viruses, Bacteria, Fungi, Mycoplasma, Nematodes, Insects (smut, rust, mildews, canker, mosaic, vein clearing, spots, lesion, knot, galls).	(8 Lectures)
Diseases	Viral, Mycoplasmal and Bacterial diseases: Brief account, Symptomology and control of the following plant diseases:- Tobacco Mosaic, Little leaf of Brinjal, Citrus canker and Angular leaf spot of Cotton.	(7 Lectures)

Unit-IV

Fungal Diseases	Symptomology, disease cycle and control of the following plant diseases with special reference to Rajasthan: White rust of crucifers, Downy mildew/green ear disease of Bajra, Black/stem rust of Wheat, Loose and covered smut of Barley, Early blight of Potato	(10 Lectures)
Diseases	Disease caused by insects and nematodes: General account of diseases caused by insects and nematodes, Brief account and histopathology of root knot of vegetables, leaf gall of <i>Pongamia</i> .	(5 Lectures)

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Suggested Books and References –

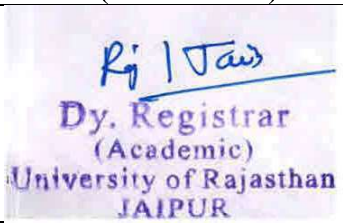
1. Pelczar, M.J. (2001) Microbiology, 5th edition. New Delhi, Delhi: Tata Mc-Graw- Hill Co.
2. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, 6th edition: McGraw Hill, New Delhi.
3. Agrios G.N. (2004) Plant Pathology, 5th Edition, Academic Press
4. Pandey B.P. (2001) Plant Pathology (Pathogen and Plant Disease), S. Chand Publishing
5. Mehrotra RS and Aggarwal A. (2003) Plant Pathology, 2nd Edition. Delhi: Tata Mc-Graw-Hill Co.
6. Sharma P.D. (2013). *Plant pathology*. Deep and Deep Publications.

Suggested E-resources:

1. <https://archive.nptel.ac.in/courses/102/103/102103015/>
2. https://onlinecourses.swayam2.ac.in/cec21_bt16/preview
3. <https://www.pdfdrive.com/plant-pathology-concepts-and-laboratory-exercises-e179105354.html>

University of Rajasthan
B.Sc. Semester – III (Microbiology and Plant Pathology)
BOT-63P-202 Botany Practical-III

- I** Microscopic techniques- handling of light microscope, general idea of SEM and TEM.
Write major contribution of leading scientists of Microbiology
Study of TMV, Bacteriophage and Pox virus, Mycorrhiza (Photographs/3D Models)
- II** Study of Bacteria by Gram Staining and Negative staining
Preparation of Liquid and solid media for culturing microbes
Pure culture techniques- pour plate, spread plate, streaking
- III** Study of symptoms of plant diseases (specimen/permanent slide)-
Downy mildew/green ear disease of Bajra,
Tobacco Mosaic, Citrus canker, Little leaf of Brinjal,
Study of spores of *Alternaria* from Early blight of Potato
- IV** Study and identification of spores from temporary slide preparation from infected plant material:- white rust of crucifers (conidia stage), Black/ stem rust of Wheat (all stages).
Study of histopathology using temporary slide preparation of infected part of root knot of tomato, Leaf gall of *Pongamia*

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UNIVERSITY OF RAJASTHAN
B.Sc. Semester- III (Bio Group) Botany Practical-III
Microbiology and Plant Pathology
Scheme of Practical Examination and Distribution of marks

BOT-63P-202

Maximum Marks 10*+40 Marks

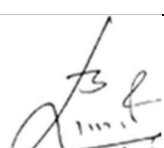
Duration: 4 Hrs

Minimum marks 4*+16 Marks

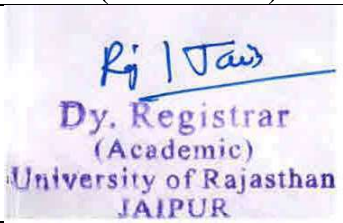
S.No.	Exercise	Regular	Ex./N.C. Students
1.	Perform exercise of Microbiology Gram'/negative staining of bacteria or Identification of virus/mycoplasma	4	5
2.	Perform the exercise based on the microbiology – media preparation/any pure culture technique	6	10
3.	Study the material “A” carefully, prepare a suitable stained preparation, and identify the casual organism associated with the disease giving reasons (Fungal disease)	6	10
4.	Identify the material “B” carefully, prepare a suitable stained preparation, and identify the casual organism associated with the disease giving reasons (Insect/Nematode disease)	4	5
5.	Spotting (5 spots)	10	15
6.	Viva voce	5	5
7.	Record	5	-
	TOTAL	10*+40=50	50
	*Internal marks for regular students only		
	Regular Candidates must keep a record of all work done in the practical classes and submit the same for inspection at the time of practical examination.		

Course Learning Outcomes: Upon completion of course, students will be able to

1. Understand about morphology and function diverse microbes.
2. Understand about diagnosing plant diseases, understanding their causes, and implementing management strategies to control or prevent them.
3. Understand and perform different laboratory exercise to further understand about microorganisms.
4. Acquire knowledge about different types of microbes with structure, function and their economic importance, Host pathogen interaction and its effects on plants.

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5. Apply control and management strategies for plant diseases caused by fungi, bacteria, nematodes, insects etc.
6. Acquire proficiency in various laboratory techniques, such as culturing microorganisms, gram staining, microscopy, and biochemical assays.
7. Develop interest among students in agricultural research, crop protection, and pest management to improve crop yield and quality.
8. Work in disease prevention and control, focusing on plant diseases that impact food safety and public health

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Examination Scheme for EoSE for Semester IV

CA – Continuous Assessment

EoSE – End of Semester Examination

Regular Students –

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-64T-203 – Plant Taxonomy and Economic Botany	CA	1 Hrs	CA	20 Marks	CA	8 Marks
		EoSE	3 Hrs	EoSE	80 Marks	EoSE	32 Marks
Practical	BOT-64P-204 – Practical IV Plant Taxonomy and Economic Botany	CA	1 Hrs	CA	10 Marks	CA	4 Marks
		EoSE	4 Hrs	EoSE	40 Marks	EoSE	16 Marks

The theory question paper will consist of **two** parts A&B.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 60 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

Non-Collegiate Students –

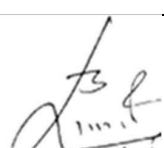
Type	Course Code and Nomenclature	Duration of Examination	Maximum Marks (EoSE)	Minimum Marks (EoSE)
Theory	BOT-63T-201 Microbiology and Plant Pathology	3 Hrs	100 Marks	40 Marks
Practical	BOT-64P-204 – Practical IV Plant Taxonomy and Economic Botany	4 Hrs	50 Marks	20 Marks

The theory question paper will consist of **two** parts A&B.

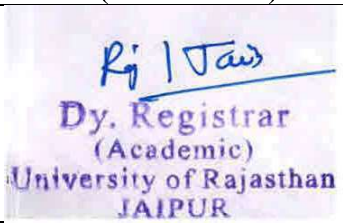
PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 80 Marks

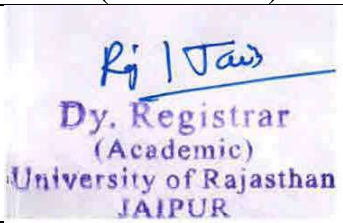
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Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 20 marks.

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Syllabus
UG0802 -BOT-64T-203
Plant Taxonomy and Economic Botany
IV-Semester- B.Sc. (Bio Group)
Botany

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
IV	BOT-64T-203	Plant Taxonomy and Economic Botany			6	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method
		Theory	Practical	Total		
Intermediate	Major/Minor	4	2	6	Yes	60 lectures with diagrammatic presentations and informative assessments during lecture hours
List of Programme Codes in which Offered as Minor Discipline		UG0806, UG0812				
Prerequisites		Botany course of Foundation/Introductory level				
Objectives of the Course:		➤ To gain in-depth knowledge about plant taxonomy and economic botany. ➤ To learn about the various aspects of taxonomy like nomenclature, classification and identification ➤ To understand the benefits of plants with their products in various field. ➤ To learn about plant collection and preservation of plants in lab (herbarium).				

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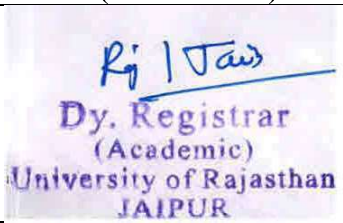
COURSE OUTCOMES

On completion of the course the student would be able to develop the following

- Understanding**
- To Understand the historical development and modern approaches to plant classification systems, including the principles and criteria used for categorizing plants
 - Understand the evolutionary relationships among different plant groups and how phylogenetic trees represent these relationships.
 - Understand the key morphological features that are used to identify and classify plants at various taxonomic levels (family, genus, species).

- Memorizing**
- Memorize the hierarchical classification of plants, including ranks such as domain, kingdom, phylum, class, order, family, genus, and species.
 - Memorize the characteristics and representative species of major plant families, including their economic and ecological significance.

- Applying**
- Apply knowledge to identify plant species in the field using keys, guides, and floras, demonstrating proficiency in using diagnostic features.
 - Apply techniques for collecting, preserving, and preparing plant specimens for herbarium collections, ensuring accurate labeling and documentation.
 - Conduct independent or group research projects involving the collection, identification, and classification of local plant species, integrating field and laboratory work.

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Detailed Syllabus

BOT-64T-203 - Plant Taxonomy and Economic Botany

UNIT-I

Classification	Artificial (Linneaus), Natural (Bentham&Hooker) and Phylogenetic (Engler and Prantle's) System.	5 lectures
Nomenclature	Angiosperm Phylogeny Group (APG). International Code of Botanical Nomenclature. Introduction, principles, rules (Name of Taxon, Priority & publication) and Recommendations. Introduction to International code of Nomenclature for algae, fungi and plants (ICNafp),	5 lectures
Herbarium	Equipments, herbarium sheet preparation & preservation and significances. Introduction to Botanical Survey of India (BSI).	5 lectures

UNIT-II

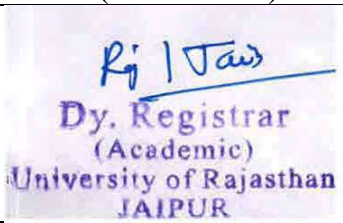
Taxonomic literature	Floras, Monographs, Icons.	3 lectures
Modern Trends	Cytotaxonomy, Chemotaxonomy, Palynology, Embryology Anatomy and Numerical taxonomy.	5 lectures
Study of Families	Diagnostic characters and economic importance of Ranunculaceae, Brassicaceae, Malvaceae, Fabaceae, Apiaceae, Rubiaceae and Asteraceae.	7 lectures

UNIT-III

Study of Families	Diagnostic characters and economic importance of Apocynaceae, Asclepiadaceae, Convolvulaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae and Poaceae.	8 lectures
Economic Botany	Vavilov concept of centre of origin. Primary and secondary centres. Cereals (General account): Rice, Wheat, Maize. Millets (General account): Ragi (finger millet), Jowar (Sorghum), Sama (Little millet), Bajra (pearl millet), Variga (Porso millet).	7 lectures

UNIT-IV

Economic Botany of	Vegetable oil : Ground nut and Mustard Spices : General account of turmeric, asafoetida, Cumin, Coriander & Red Chilli. Beverages : Tea and Coffee. Medicinal plants : General account (Tulsi, Isabgol, Ashwgandha, Neem and Ephedra). Fibres : Cotton&Jute.Processing of Rubber & Sugarcane	15 lectures
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Suggested Books and References –

- Principles of Angiosperm Taxonomy by Davis & Heywood. Publisher: Oliver & Boyd
- Taxonomy of Vascular Plants by Lawrence H M George. Publisher : Scientific Publishers
- Plant Systematics: An Integrated Approach. by Gurcharan Singh. Publisher : CRC Press
- Plant Taxonomy by O. P. Sharma. Publisher : McGraw Hill Education
- Taxonomy of Angiosperms by A.V.S.S. Sambamurty. Publisher : Dreamtech Press
- Modern Plant Taxonomy by N.S. Subrahmanyam. Publisher : S Chand
- Economic Botany by B.P. Pandey. Publisher : S Chand & Company
- Economic botany: a comprehensive study by S.L.Kochhar. Publisher : Cambridge University Press
- Economic Botany by Singh, Pandey & Jain. Publisher -S. Chand Publishing

Suggested E-resources:

1. https://www.google.co.in/books/edition/The_Flowering_Plants_Handbook/yoLaBAAQBAJ?hl=en&gbpv=1&dq=james+byng+taxonomy&printsec=frontcover
2. <https://www.pdfdrive.com>

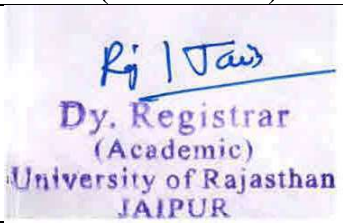
University of Rajasthan
B.Sc. Semester – IV (2024-25)
BOT-64P-204 Botany Practical-IV
Plant Taxonomy and Economic Botany

Exercises based on Plant Taxonomy: -

- Plant description and identification of following families: Ranunculaceae, Brassicaceae, Malvaceae, Fabaceae, Apiaceae, Rubiaceae, Asteraceae Apocynaceae, Asclepiadaceae, Convolvulaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae and Poaceae
- Exercise based on using taxonomic modern tools
- Preparation of Herbarium sheets
- Campus Flora writing/ Excursion/Field study
- Herbarium tools

Exercises based on Plant Taxonomy

- Biochemical test for Starch, Protein, Oil, Cellulose, lignin and tannin
- Medicinal plant-identification and collection
- Study of specimens with reference to economic use of Cereals, millets, Pulses, Oil, Fibres, Spices, and Beverages (common name, Botanical name, Family, Parts used, Economic uses)
- Collection of specimens of locally available medicinal/ wild plants
- Any other exercise based on theory syllabus

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UNIVERSITY OF RAJASTHAN

B.Sc. Semester- IV (Bio Group) Botany Practical-IV Plant Taxonomy and Economic Botany

Scheme of Practical Examination and Distribution of marks

BOT-64P-204

Duration: 4Hrs

Maximum Marks 10*+40 Marks

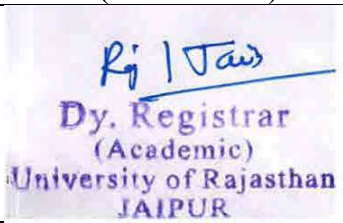
Minimum marks 4*+16 Marks

S.No.	Exercises	Regular	Ex./N.C. Students
1.	Identify the family of the given flower and describe floral characters in semi-technical language, draw floral diagram and write floral formula.	7	10
2.	Identify and describe the given herbarium tool	4	6
3.	Perform the biochemical test of given material.	3	4
4.	Identify the given material (economic botany), write botanical characters and economic importance	6	10
5.	Spotting (5)	10	15
6.	Viva voce	5	5
7.	Record	5	-
	TOTAL	10*+40=50	50
*Internal marks for regular students only			
Regular Candidates must keep a record of all work done in the practical classes and submit the same for inspection at the time of practical examination.			

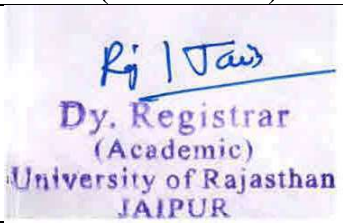
Course Learning Outcomes:

On completion of the course the student will be able to:

- Learn the types of classifications- artificial, Natural and phylogenetic.
- Gain knowledge about Botanical Survey of India (BSI).
- Briefly study herbarium techniques.
- Learn the taxonomic evidences from molecular, numerical and chemicals.
- Brief study the economic products with special reference to the Botanical name, family, morphology of useful part and the uses
- Acquire an increased awareness and recognition of economical important plants.
- Learn diverse human uses of plants and plant products.
- Apply the knowledge gained in seeking employment to reputed institutions and organizations known in the field of plant taxonomy, diversity, conservation, agro-industry, pharmaceuticals etc.
- Memorize the various classification with the botanical names, distinctions, distribution, habit, characteristics and affinities of various taxon.

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- Learn the perspective of origin, history and role of important plants and plant products for the development of human culture.
- Acknowledge the economic uses of plants in modern society.
- Acquire an increased awareness and appreciation of plants & plant products encountered in everyday life.
- Develop scientific insights into the development of many plant products that have shaped our society.
- Appreciate the diversity of plants and the plant products in human use.

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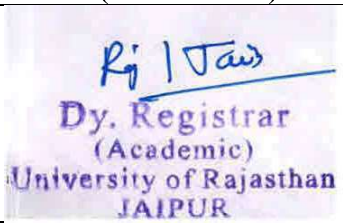
To create potential and competent professionals in Botany through the courses with practical training and advanced technical skills; equipped with knowledge and aptitude for higher education and research.

Mission:

- Dissemination of global demand based knowledge through teaching with technical professionalism.
- Creation of individuals with social and environmental concern.
- Training the students to create economically and environmentally viable solutions in the field of plant science.

Programme Outcomes

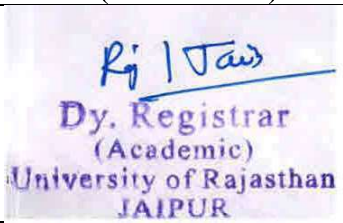
- PO1. Developing the potential for vertical career growth in plant sciences, academic and service sectors and related fields.
- PO2. Development of in-depth analytical and critical thinking, so that students would be able to identify and solve the problems with the help of botany.
- PO3. Proficient knowledge in the major domains of plant sciences including plant identification, plant diseases, microbiology, Plant biotechnology etc.
- PO4. Students can successfully learn tools and techniques related to plant research.
- PO5. After completion of course students would be able to execute their professional roles in society as botanist, plant taxonomist, plant pathologist, etc.
- PO6. Students will be able to learn skills to work as a team with the people from multidisciplinary environment.
- PO7. To design and develop sustainable solutions to major biological problems by applying appropriate tools.
- PO8. Develop skills, attitude and values required for self-directed, lifelong learning and professional development.
- PO9. Acquire knowledge and understanding of norms and ethics in the field of botany.

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Name of University	University of Rajasthan, Jaipur
Name of Faculty	Science
Name of Discipline	Botany
Type of Discipline	Major/Minor
List of Programme where offered as Minor Discipline	UG0806, UG0812
Offered to Non-Collegiate Students	Yes

SEMESTER-WISE PAPER TITLES WITH DETAILS

UG0802–Three/Four Year Bachelor of Science (Bio Group)								
#	Level	Semester	Type	Botany	Credits			
				Title	L	T	P	Total
1.	5	I	MJR	UG0802 - BOT-51T-101 -Cell Biology and Diversity of Plant Kingdom-I	4	0	0	4
2.	5	I	MJR	UG0802 - BOT-51P-102 – Practical-I	0	0	2	2
3.	5	II	MJR	UG0802 - BOT-52T- 103 - Molecular Biology, Genetics and Diversity of Plant Kingdom-II	4	0	0	4
4.	5	II	MJR	UG0802 - BOT-52P-104 – Practical-II	0	0	2	2
5.	6	III	MJR	UG0802- BOT-63T-201 – Microbiology and Plant Pathology	4	0	0	4
6.	6	III	MJR	UG0802- BOT-63P-202 – Practical –III	0	0	2	2
7.	6	IV	MJR	UG0802 - BOT-64T-203 Plant Taxonomy and Economic Botany	4	0	0	4
8.	6	IV	MJR	UG0802 BOT-64P-204 Practical-IV	0	0	2	2
9.	7	V	MJR	UG0802 BOT-75T-301 Plant Biochemistry and Physiology	4	0	0	4
10.	7	V	MJR	UG0802 BOT-75P-302 Practical-V	0	0	2	2
11.	7	VI	MJR	UG0802 BOT-76T-303 Plant Morphology, Anatomy and Embryology	4	0	0	4
12.	7	VI	MJR	UG0802 BOT-76P-304 Practical VI	0	0	2	2
13.	8	VII	MJR	UG0802	4	0	0	4
14.	8	VII	MJR	UG0802	0	0	2	2
15.	8	VIII	MJR	UG0802	4	0	0	4
16.	8	VIII	MJR	UG0802	0	0	2	2

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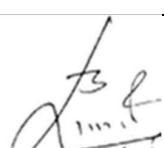
Examination Scheme

- 1 credit = 25 marks for examination/evaluation
- For Regular Students there will be Continuous assessment, in which sessional work and the terminal examination will contribute to the final grade. Each course in Semester Grade Point Average (SGPA) has two components- Continuous assessment (20% weightage) and (End of end-semester examination) EoSE (80% weightage).
- For Regular Students, 75% Attendance is mandatory for appearing in the EoSE.
- To appear in the EoSE examination of a course/subject a regular student must appear in the mid-semester examination and obtain at least a C grade in the course/subject.
- Credit points in a Course/Subject will be assigned only if, the regular student obtains at least a C grade in the CA and EoSE examination of a Course/Subject.
- In the case of Non-Collegiate Students there will be no Continuous assessment and credit points in a course/subject will be assigned only if, the non-collegiate student obtains at least a C grade in the EoSE examination of a Course/Subject.

Examination Scheme for Continuous Assessment (CA)

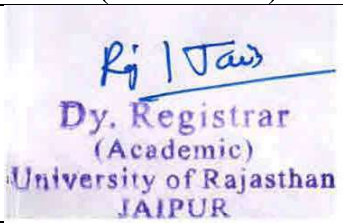
DISTRIBUTION OF CONTINUOUS ASSESSMENT (CA) MARKS

S. No.	CATEGORY	Weightage (out of total internal marks)	THEORY					PRACTICAL		
	Max Internal Marks		CORE (Only Theory)	CORE (Theory + Practical)	AEC	SEC	VAC	CORE (Theory +Practical)	SEC	VAC
			30	20	20	10	10	10	10	10
1	Mid-term Exam	50%	15	10	10	5	5	5	5	5
2	Assignment	25%	7.5	5	5	2.5	2.5	2.5	2.5	2.5
3	Attendance	25%	7.5	5	5	2.5	2.5	2.5	2.5	2.5
		Regular Class Attendance	= 75%	3	2	2	1	1	1	1
			75-80%	4	3	3	1.5	1.5	1.5	1.5
			80-85%	5	4	4	2	2	2	2
			> 85%	7.5	5	5	2.5	2.5	2.5	2.5

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Note:

1. Continuous assessment will be the sole responsibility (Paper setting and Evaluation) of the teacher concerned.
2. For continuous assessment no remuneration will be paid for paper setting, Evaluation, Invigilation etc.
3. For continuous assessment no Answer sheets/question papers etc. will be provided by the University.
4. Colleges are advised to keep records of continuous assessment, attendance etc.

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Examination Scheme for EoSE for Semester V

CA – Continuous Assessment

EoSE – End of Semester Examination

For Regular Students –

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-75T-301 - Plant Biochemistry and Physiology	CA	01 Hr	CA	20 Marks	CA	08 Marks
		EoSE	03 Hrs	EoSE	80 Marks	EoSE	32 Marks
Practical	BOT-75P-302 – Practical-V (Based on Plant Biochemistry and Physiology)	CA	1 Hr	CA	10 Marks	CA	04 Marks
		EoSE	04 Hrs	EoSE	40 Marks	EoSE	16 Marks

The theory question paper will consist of two parts A&B.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 60 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

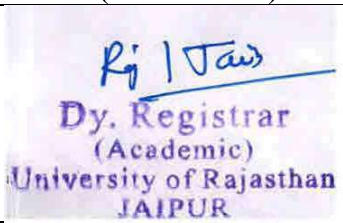
For Non-Collegiate Students –

Type	Course Code and Nomenclature	Duration of Examination	Maximum Marks (EoSE)	Minimum Marks (EoSE)
Theory	BOT-75T-301 - Plant Biochemistry and Physiology	03 Hrs	100 Marks	40 Marks
Practical	BOT-75P-302 – Practical-V (Based on Plant Biochemistry and Physiology)	04 Hrs	50 Marks	20 Marks

The question paper will consist of two parts A&B.

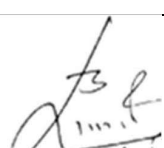
PART-A: 20 Marks: Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 80 Marks: Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 20 marks.

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UG0802 – Three/Four Year Bachelor of Science (Bio Group)
V-Semester - Botany
BOT-75T-301 - Plant Biochemistry and Physiology

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
V	BOT-75T-301	Plant Biochemistry and Physiology			7	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method
		Theory	Practical	Total		
Intermediate	Major/Minor	4	2	6	Yes	60 lectures with diagrammatic and informative assessments during lecture hours
List of Programme Codes in which Offered as Minor Discipline		UG0806, UG0812				
Prerequisites		Botany course of Introductory/intermediate level				
Course Objectives:		✓ Understand the classification, structure, and function of major biomolecules (proteins, carbohydrates, lipids, nucleic acids). ✓ Explain the nature and types of biological bonds such as glycosidic, peptide, and phosphodiester bonds. ✓ Describe enzyme classification, structure, and factors affecting their activity. ✓ Illustrate mechanisms of water and nutrient transport in plants, including osmosis, transpiration, and pressure flow. ✓ Identify essential macro- and micronutrients in plants and symptoms of their deficiencies. ✓ Analyze key processes of photosynthesis and respiration, including electron transport and energy pathways. ✓ Interpret plant growth and development stages, hormonal regulation, and responses to environmental cues like photoperiodism and vernalisation.				

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Detailed Syllabus

BOT-75T-301 - Plant Biochemistry and Physiology

Unit – I

Biomolecules: Nomenclature, classification, importance, molecular structure and function of Proteins (primary, secondary, tertiary, conjugated), Carbohydrates (monosaccharides, disaccharides, polysaccharides), Lipids (saturated and unsaturated), General account of Secondary Metabolites in plants.

Nature of Bond: Glycosidic linkage, Peptide bond, Phosphodiester bonds, Alpha and Beta oxidation.

Enzymes: Nomenclature, classification, Structure, mechanism of action, factors affecting enzyme activity
(15 lectures)

Unit –II

Transport in Plants: Facilitated diffusion, active absorption, Passive and Active Transport (uniport, co-transport, symport, antiport), Concept and Mechanism of Water Potential, Osmosis, Plasmolysis, Ascent of Sap, Root Pressure, Guttation, Transpiration (Pressure Flow Hypothesis).

Mineral Nutrition and translocation: Macro- and Micro nutrients in Plants and deficiency symptoms, Translocation of Solutes, Phloem transport, Source-sink relationship, Factors affecting translocation of nutrients, Nitrogen Metabolism, Biological Nitrogen Fixation, Nodule formation. (15 lectures)

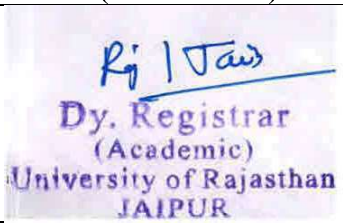
Unit –III

Photosynthesis: Pigments, Photosynthetic apparatus, Light reaction, PSI, PSII, Cyclic and Non-cyclic Photo-phosphorylation, Calvin cycle, C4 and CAM Pathway, Photorespiration, Factors affecting Photosynthesis.

Respiration: Aerobic and Anaerobic respiration, Glycolysis, Tricarboxylic Acid Cycle, Electron Transport System (ETS) and Oxidative Phosphorylation, Pentose Phosphate Pathway, Respiratory Quotient (RQ).
(15 lectures)

Unit-IV

Growth and Development: Phases of Growth, Differentiation, Dedifferentiation and Redifferentiation, Characteristics, discovery and Physiological effects of Plant Growth Regulators: Auxins, Gibberellins, Cytokinins, Ethylene, Absciscic Acid. Concept, Physiology and mechanism of Photoperiodism and Vernalisation. Florigen concept, Seed Dormancy.
(15 lectures)

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Suggested Books and References –

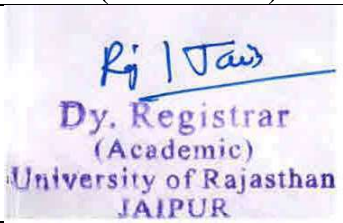
1. Cox, M.M. and Nelson DL (2004) Lehniger Principle of Biochemistry (Third Edition) MacMillan Worth Publishers.
2. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
3. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
4. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.
5. Srivastava, L. M. 2002. Plant Growth and Development: Hormones and Environment (1st edition). Academic Press, USA.
6. Verma, S. K., Textbook of Plant Physiology, S.Chand & Company.

Suggested E-resources:

1. https://docs.google.com/file/d/0B_FBTJyzk2ZNLVNuZFp6S3E2YU0/edit?resourcekey=0-NxnSCZjwDln3VDCh0rfgSQ
2. https://onlinecourses.swayam2.ac.in/cec19_bt09/preview
3. <https://archive.org/details/plant-physiology-and-bio-chemistry/page/18/mode/2up>

B.Sc. Semester- V (Bio Group) BOT-75P-302 – Practical-V (Based on Plant Biochemistry and Physiology) Syllabus

1. To study the effect of temperature on permeability of Plasma Membrane
2. To determine osmotic potential of Vascular Sap using Plasmolytic method.
3. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
4. To separate chlorophyll pigments using paper chromatography.
5. To separate chlorophyll pigments using solvent method.
6. Separation of amino acids by paper chromatography.
7. To demonstrate enzyme activity- Catalase, amylase.
8. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
9. Mohl's Half Leaf experiment
10. To study the effect of light intensity and bicarbonate on O₂ evolution in photosynthesis.
11. Calculate Respiration Quotient (RQ) of different substrates by Ganong's Respirometer.
12. To study the phenomenon of seed germination (effect of light).
13. Demonstration of Potato osmoscope, Aerobic and Anaerobic respiration, Rate of Transpiration, Arc Auxanometer.

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UNIVERSITY OF RAJASTHAN

B.Sc. Semester- V (Bio Group) Botany Practical-V (Based on Plant Biochemistry and Physiology)

Scheme of Practical Examination and Distribution of marks

BOT-75P-302

Duration- 4 hrs

Max. Marks: 10*+40

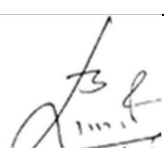
Min. Marks: 4*+16

S.No.	Exercise	Regular	NC/Ex students
1.	Exercise-based on Unit I	5	7
2.	Exercise-based on Unit II	5	7
3.	Exercise-based on Unit III	5	8
4.	Exercise-based on Unit IV	5	8
5.	Comment upon the spots- identify giving reasons. (1 to 5)	10	15
6.	Viva-voce	5	5
7.	Record	5	-
	Total	10*+40= 50	50
	*Internal marks for regular students only		
	Regular Candidates must keep a record of all work done in the practical classes and submit the same for inspection at the time of practical examination.		

Course Learning Outcomes:

At the completion of the course, the student would be able to:

1. Identify and classify major biomolecules such as carbohydrates, proteins, lipids, and nucleic acids, and explain their structure and function in biological systems.
2. Explain the nature and significance of biochemical bonds (glycosidic, peptide, phosphodiester) and key metabolic processes like alpha and beta oxidation.
3. Demonstrate an understanding of enzymes, including their classification, structure, mechanism of action, and the factors influencing their activity.
4. Describe the mechanisms of water and nutrient transport in plants and relate them to physiological processes like osmosis, transpiration, and root pressure.
5. Interpret the role of macro- and micronutrients in plant growth and diagnose common nutrient deficiency symptoms.
6. Explain the processes of nitrogen metabolism and biological nitrogen fixation, and evaluate their importance in plant productivity and sustainable agriculture.
7. Illustrate the light and dark reactions of photosynthesis and compare cyclic and non-cyclic photophosphorylation, including factors affecting the process.
8. Describe the pathways of respiration (aerobic and anaerobic), glycolysis, TCA cycle, ETS, and pentose phosphate pathway, and assess their role in energy production.
9. Apply the concepts of photoperiodism and vernalization in understanding flowering responses and seasonal adaptations in plants.

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Examination Scheme for EoSE for Semester VI

CA – Continuous Assessment

EoSE – End of Semester Examination

Regular Students:

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-76T-303 Plant Morphology, Anatomy and Embryology	CA	01 Hr	CA	20 Marks	CA	08 Marks
		EoSE	03 Hrs	EoSE	80 Marks	EoSE	32 Marks
Practical	BOT-76P-304 Plant Morphology, Anatomy and Embryology- Practical	CA	1 Hr	CA	10 Marks	CA	04 Marks
		EoSE	04 Hrs	EoSE	40 Marks	EoSE	16 Marks

The theory question paper (EoSE) will consist of two parts A&B.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 60 Marks

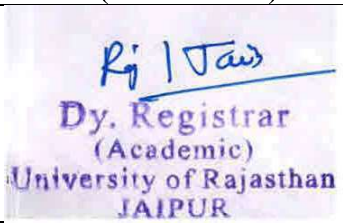
Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

Non-Collegiate Students:

Type	Course Code and Nomenclature	Duration of Examination	Maximum Marks(EoSE)	Minimum Marks(EoSE)
Theory	BOT-76T-303 Plant Morphology, Anatomy and Embryology	03 Hrs	100 Marks	40 Marks
Practical	BOT-76P-304 (Based on Plant Morphology, Anatomy and Embryology) - Practical	04 Hrs	50 Marks	20 Marks

The theory question paper (EoSE) will consist of two parts A&B.

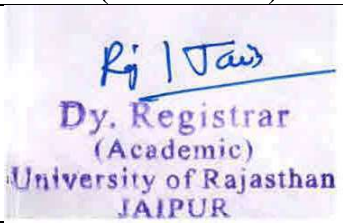
PART-A: 20 Marks

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Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

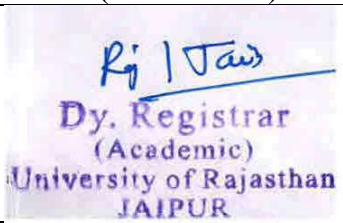
PART-B: 80 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 20 marks.

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UG0802 – Three/Four Year Bachelor of Science (Bio Group)
Semester VI - Botany
UG0802 BOT-76T-303 Plant Morphology, Anatomy and Embryology

Semester	Code of the Course	Title of the Course/Paper			NHEQF Level	Credits
VI	BOT-76T-303	Plant Morphology, Anatomy and Embryology			7	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method
		Theory	Practical	Total		
Intermediate	Major/Minor	4	2	6	Yes	60 lectures with diagrammatic and informative assessments during lecture hours
List of Programme Codes in which Offered as Minor Discipline		UG0806, UG0812				
Prerequisites		Botany course of Introductory/intermediate level				
Course Objectives:		This course will enable the students: To understand morphology and anatomy of flowering plants and its practical and experimental aspects. To understand the modifications of root, stem, leaves and their significance in plant life. To make the students learn about the concepts of secondary growth, abnormal secondary growth and wood formation. To provide knowledge of the internal structure and functional organization of higher plants To provide basic knowledge of male and female plant reproductive structures To provide detailed understanding of plant embryology and seed structure				

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UG0802 BOT-76T-303
Detailed Syllabus
Plant Morphology, Anatomy and Embryology

Unit 1: Morphology and the Tissue System

Basic body plan of a typical dicot and a monocot plant; diversity of plants on the basis of habit, habitat, longevity, and body forms

Tissues: Structure and function- Meristematic Tissues, Permanent Tissues: Simple Tissues and Complex Tissues; Tissue systems: Epidermal Tissue System, Ground Tissue System and Vascular Tissue System

Organizational theories of Shoot apical meristem (SAM) and Root apical meristem (RAM)
(15 hours)

Unit 2: Growth in plants

Anatomy of primary structures of root, stem and leaf of dicot and monocot plants

Secondary Growth: Structure and function of vascular cambium, secondary growth in stem and roots; Annual Rings: Spring wood and autumn wood, Heartwood and sapwood, tyloses, Porous and non-porous wood

Structure and function of cork cambium, Periderm

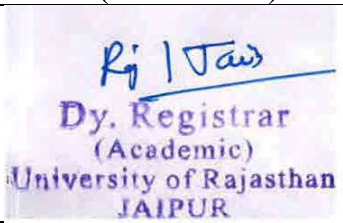
Anomalous growth in *Nyctanthus*, *Boerhaavia*, *Bignonia*, *Salvadora*, *Dracaena* and *Leptadenia*
(15 hours)

Unit 3: Embryology I

Angiosperm flower, Structure of anther, microsporogenesis, development of male gametophyte, Structure of pistil, structure of ovule and its types, megasporogenesis, development and types of female gametophyte
(15 hours)

Unit 4: Embryology II

Pollination and double fertilization. Endosperm: structure and types, embryo development in dicotyledons and monocotyledons, Seed structure (monocot and dicot), specialized structures related to seed, seed dispersal mechanisms. Polyembryony, apomixes
(15 hours)

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Suggested Books and References –

1. Cutter E.G. 1971. Plant Anatomy: Experiment and Interpretation. Part II Organs. Edward Arnold, London.
2. Esau K. 1977. Anatomy of seed plants, 2nd edition, John Wiley and Sons New York.
3. Fahn, A. 1974. Plant anatomy 2nd edition. Pergamon press. Oxford.
4. Crang, R. et al, 2018. Plant anatomy: a concept-based approach to the structure of seed plants.
5. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
6. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
7. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
8. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
9. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
10. Johri, B.M. I (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands

Suggested E-resources:

1. <https://nptel.ac.in/courses/102107075>

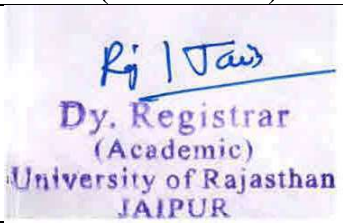
B.Sc. Semester- VI (Bio Group)

BOT-76P-304 – Practical-VI

(Based on Plant Morphology, Anatomy and Embryology)

Syllabus

1. Study of Tissue organization in root and shoot apices using permanent slides
2. Study of Anatomy of dicot and monocot root
3. Study of Anatomy of dicot and monocot stem
4. Study of Anatomy of dicot and monocot leaf
5. Study of Anomalous secondary growth in stems of *Nyctanthus*, *Boerhaavia*, *Bignonia*, *Salvadora*, *Dracaena* and *Leptadenia*
6. Study of ovule using temporary/ permanent slides/photographs
7. Study of T. S. of anther, to study the wall layers and pollen sac with pollen grains
8. Study of pollen germination and pollen viability
9. Measurement of pollen size using micrometry
10. Study of types of placentation in angiosperms
11. Study of structure of endosperm (nuclear and cellular) using permanent slides / Photographs.
12. Study of developmental stages of dicot and monocot embryos using permanent slides / photographs
13. Study of seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens)
14. Any other exercise related to syllabus

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UNIVERSITY OF RAJASTHAN
B.Sc. Semester- VI (Bio Group) Botany
Plant Morphology, Anatomy and Embryology Practical

Scheme of Practical Examination and Distribution of Marks

BOT-76P-304

Duration- 4 hrs

Max. Marks: 10*+40

Min. Marks: 4*+16

S.No.	Exercise	Regular	NC/Ex students
1.	Anatomical exercise on plant stem/ root/ leaf. Draw a labelled diagram and comment.	5	8
2.	Anatomical exercise on anomalous secondary growth. Draw a labelled diagram and comment.	5	8
3.	Study of the given reproductive part of plant. Draw a labelled diagram and comment.	5	7
4.	Comment on the given embryological exercise.	5	7
5.	Comment upon the spots- identify giving reasons. (1 to 5)	10	15
6.	Viva-voce	5	5
7.	Record	5	-
	Total	40 (10*+40=50)	50
*Internal marks for regular students only			
Regular Candidates must keep a record of all work done in the practical classes and submit the same for inspection at the time of practical examination.			

Course Learning Outcomes:

On successful completion of this course, the students will be able to:

- Apply knowledge of plant anatomy to identify plant samples and interpret their adaptive significance
- Understand on the organization of tissues and tissue systems in plants.
- Analyze and compare vascular bundles and secondary growth in monocot and dicot plants
- Identify and analyze anomalous patterns of secondary growth in various plants.
- Understand, evaluate and analyze the wood anatomy and climate studies
- Identify and compare the different reproductive organs of angiosperms and analyze the diversity of their structures.
- Understand the process of double fertilization and its significance in flowering plants
- Illustrate and interpret various aspects of embryology.

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