Shiksha Mandal's

Bajaj College of Science, Wardha

(*Formerly known as Jankidevi Bajaj College of Science, Wardha*)

Autonomous College

For Undergraduate Botany (CBS)

Aims and Objectives of the Syllabus

Aims of the syllabus:

(1) To learn the principles, procedures, concepts and historical aspects of botanical fields.

(2) To develop knowledge and understanding of the life structures, processes and functions of plants.

(3) To explore the diversity of plants, their inter-relationship & impact on environment.

(4) To know the technological applications of plant sciences and to introduce them in other technological contexts & investigations.

(5) To develop attitude in students for scientific enquiry, curiosity, self-discovery and evaluation through, individual study, personal initiatives and group work related to plants.

(6) To provide the knowledge, skills and understanding among students in order to pursue further education, training and employment in Botany related fields.

(7) To create interest and excitement among students for appreciation of the nature and word of Plants.

Objectives of the syllabus:

(1) Knowledge, Understanding and Skills:

Students should have a knowledge and understanding of biological facts, terms, principles, concepts, relationships and experimental techniques, including practical laboratory skills.

(2) Application and Interface with Technology:

Students should be able to apply their knowledge and understanding of botany in environmental, industrial, agricultural, medical, waste management and other technological contexts.

(3) Botany in the Personal, Social and Economic Spheres:

Students should be able to apply their knowledge and understanding of botany in personal, social and economic spheres and to make informed evaluations about contemporary botanical issues.

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Programme Outcomes (POs):

The **B.Sc. - Botany** curriculum is designed to equip students with subject domain knowledge and technical skills pertaining to plants in an all-inclusive manner. It aims to train the students in all the areas of plant sciences. Students have exposure to cutting-edge technologies that are currently used in the subject. They are made aware about the social and environmental issues, significance of plants and their relevance to the national economy and environment.

PO1. **Knowledge and understanding**: 1. Understand different branches of Botany such as systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics, and molecular biology of various life-forms. 2. The evaluation and assessment of plant diversity. 3. Plant systematics and classification including flora of Maharashtra. 4. Physiology and metabolism of plants. 5. The role of plants in the functioning of the global ecosystem. 5. Tissue culture techniques. 6. Application of Statistics in biological data. 7. Application of computer and bioinformatics- utilization of biological data in silico.

PO2. **Intellectual skills – able to:** 1. Logical interpretation of ideas and concepts. 2. Amass and unify knowledge and ideas through reading and with the help of internet. 3. Allocation of knowledge-based concepts from one area to another within the subject. 4. Plan hypothesis and test it experimentally. 5. Design and carry out independent survey or research in various topics of the subject.

PO3. **Practical skills:** Giving opportunities to students to conduct experiments practically both in field and laboratory. Hands on practical helps the students to gain proficiency and skills in different topics of modules offered to them. 1. Study of plant morphology and anatomy. 2. Character correlation for Plant identification. 3. Study of structure and composition of vegetations. 4. Phyto-chemical analyses of plant materials to establish the presence of various chemicals with reference to plant physiology and biochemistry. 5. Study of plant

diseases with reference to economic crops. 6. Accumulation and analysis of biological data using statistical methods. 7. Competent enough in various analytical and technical skills related to plant sciences.

PO4. **Transferable skills:** 1. Use of information technology for accumulation and sharing of data. 2. Dissemination of scientific ideas in writing and orally. 3. Access of library resources. 4. Regularity, punctuality, devotion, and career planning.

PO5. **Scientific Knowledge:** Use of principles of basic science, life science and fundamental process to study and analyze the plant forms.

PO6. **Problem analysis:** 1. Identify the taxonomic position of plants, formulate the research literature, and analyze non reported plants with substantiated conclusions using first principles and methods of nomenclature and classification in Botany. 2. Capable to perform short research projects using various tools and techniques in plant sciences and develop scientific temperament and research attitude.

PO7. **Design/development of solutions:** Design solutions from medicinal plants for health problems, disorders and disease of human beings and estimate the phytochemical content of plants which meet the specified needs to appropriate consideration for the public health. Formulate new concepts for a green world, sustainable development, betterment of human health specifically from medicinal plants, new formulation of phytochemical contents to meet specific need and ecofriendly environment.

PO8. **Conduct investigations of complex problems:** Carry out knowledge-based research, use of research methodology including design of experiments, critical analysis of research data, and creation of logical conclusions.

PO9. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern instruments and equipments for Biochemical estimation, Molecular Biology, Biotechnology, Plant Tissue culture experiments, Cytological, Physiological, and Biochemical activities of plants

with an understanding of the application and limitations.

PO10. **The Botanist and society:** Apply reasoning informed by the contextual knowledge to assess plant diversity, its importance for society, health, safety, legal and environmental issues, and the consequent responsibilities relevant to the biodiversity conservation practice.

PO11. **Environment and sustainability:** Understand the impact of the plant diversity in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO12. **Ethics:** Apply ethical principles and commit to environmental ethics and responsibilities and norms of the biodiversity conservation.

PO13. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO14. **Life-long learning:** Diagnose the need for, and have the preparation and capability to engage in self-determining and life-long learning in the broadest framework of continuous change.

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Scheme of Teaching, Evaluation and Examination Credit Based System (CBS)

To be Implemented from Academic Session 2021-22

Department of Botany

No. of Paper : One Max. Marks: 120

(Internal Assessment:20; End Semester Exam: 100)

No. of Practical : One Max. Marks for Practical: 30

(End Semester Exam: 30)

No. of Lectures and Practical's (per week):B.Sc. I, II & III: 6 Theory, 6 Practical's/Batch Scheme

Subject	Credits	Paper	Internal Assessment (Max.)	End Semester Exam (Max.)	Total Marks	Min. Passing Marks	No. of Hours	No. of Lectures
Botany	6	Theory	20	100	120	48	60	75
		Practical	Nil	30	30	12	60	75

Internal Assessment

Theory

S.No.	Evaluation Type	Marks
1.	Seminar	5
2.	Unit Test (s)	5
3.	Assignments	5
4.	Overall Performance (Based on overall conduct as a responsible learner, manners, sincerity, skill inarticulation, leadershipqualities demonstrated through organizing co-curricular activities, active participation in routine)	5

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Grade Awards:

Seven point rating scale is used for the evaluation of the performance of the students to provide letter grade for each course.

Range of percentage of Marks obtained	Grade Points	Grade	Remark (Not to be displayed on the transcripts)
136 - 150	10	O	Outstanding
121 - 135	9	A+	Excellent
106 - 120	8	A	Very Good
91- 105	7	B+	Good
76 - 90	6	B	Fair
61 - 75	5	C	Average
= 60	4	P	Below Average
< 60	0	F	Fail
Absent	0	AB	Fail

(Note: In case, the marks scored by the student fall in multiple grades, higher grade will be considered in the interest of the student)

Computation of Semester Grade Point Average (SGPA) for each semester:

$$\text{SGPA} = \frac{\sum Credits\ \ in\ the\ subject\ \ X\ grade\ \ points\ \ obtained}{Total\ \ credits\ \ in\ the\ semester}$$

Computation of Cumulative Grade Point Average (CGPA) after completion of Program:

Sem-I		Sem-II		Sem-III		Sem-IV		Sem-V		Sem-VI	
Credits	SGPA	Credits	SGPA	Credits	SGPA	Credits	SGPA	Credits	SGPA	Credits	SGPA

$$\text{CGPA} = \frac{\sum(Credits\ \ X\ SGPA)}{Total\ \ credits\ \ in\ the\ program}$$

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Three Year Degree Course (B.Sc.)

(Credit Based System)

(Syllabus Under Autonomy)

SUBJECT – BOTANY

Semester	No. of Units	Course Code	Name of Papers	Allotted Hours
I	I-VI	UG-BOT (06) - S1	Plant Diversity & Applications of Microbes	60
II	I-VI	UG-BOT (06) – S2	Pteridophyta, Palaeobotany,, Gymnosperms, Morphology of Angiosperms & Scientific Report Writing.	60
III	I-VI	UG-BOT (06) – S3	Angiosperms Taxonomy, Cell Biology, Plant Breeding and Plant Micro technique	60
IV	I-VI	UG-BOT (06) – S4	Anatomy, Embryology, Genetics, Molecular Biology & Plant Analytical techniques	60
V	I-VI	UG-BOT (06) – S5	Biochemistry, Plant Physiology-I, Plant Ecology-I and Instrumentation and Phytochemistry	60
VI	I-VI	UG-BOT (06) – S6	Plant Physiology-II, Biotechnology And Utilization Of Plant, Plant Nursery Management	60

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B.Sc. BOTANY - SEMESTER – I

Plant Diversity & Applications of Microbes

Bachelor of Science (Botany)	**Semester I**
Course Code	**UG-BOT (06) - S1**
Title of paper	**Botany- I Plant Diversity & Applications of Microbes**
Course Credit	**6**
Hours	**60 hrs**
Course Structure	**Theory & Practicals**

Course Objectives :

The students should learn about the biology, diversity, reproduction and economic uses of Lower plants and microbes

Course Content :

Unit I	**Viruses and Bacteria**	**10 hrs**

Virus : General Account of Viruses and structure of TMV and HIV

Mycoplasma : Structure, Reproduction.

Bacteria : Cell structure, Reproduction: (Binary fission, Conjugation)

Cyanobacteria : General account, Ultra cell structure, reproduction (e.g. *Nostoc).*

Role of microbes in Agriculture, Medicine and Industries.

Unit II	**Algae**	**10 hrs**

Classification of Algae F. E. Fritsch

General characters of algae with reference to Habitat, Thallus Organization, Pigmentation, Reserve food and Reproduction

Life history of: - *Oedogonium, Vaucheria, Chara, Ectocarpus.*

Economic Importance of Algae with special reference to Food, Industries, Agriculture and Harmful aspects

Unit III	Fungi and Lichens	10 hrs

General characteristics of Fungi,

Classification of Fungi (Alexopoulos 1996),

3.2 Life history of: - *Albugo, Puccinia, Cercospora,*

Economic importance (Industries, Medicine, Food & Agriculture)

Lichens: - Types, Reproduction & Economic importance

Unit IV	Plant Pathology	10 hrs

Host, pathogen, symptoms
Viral diseases-TMV

4.3. Bacteria – Black arm of cotton

4.4 Causes and Control of: Leaf curl of Papaya, Citrus canker and Red rot of Sugarcane

Unit V	Bryophyta	10 hrs

Classification (Proskauer 1957)
General characters (Hepaticopsida, Anthocerotopsida and Bryopsida),

Alteration of generation in life cycles of *Marchantia* and *Funaria*

Economic importance of Bryophyta

Unit VI	Applications of Microbes	10 hrs

(a) Biofertilizers

Concept, importance and types, Vermicomposting

Nitrogen fixing biofertilizers: *Azotobacter* and *Rhizobium*.

Phosphorus degrading and Potash mobilizing bacteria, Vesicular Arbuscular Mycorrhiza (VAM).

(b) Mushroom Cultivation

General Account of Mushroom cultivation. E.g., Cultivation practices of *Pleurotus* (Dhingari oyster mushroom)

Economic Importance of mushrooms. Nutritional and medicinal value of edible mushrooms.

Course Learning Outcomes :

After successful completion of the course

CO1: Students will get familiar with subject Botany in which they learn about Viruses and Bacteria, their ultra-structure, Reproduction, their role in Agriculture, Medicines and In Industry.

CO2: Students learn about types of algae, their classification where they belong to their class/ groups, what kind of habit, thallus structure, organization, pigmentation, form of reserve food present in them and reproduction and their economic importance in reference to food, Industry, Agriculture and also their harmful aspects.

CO3: They learn about different types of plant pathogen / fungi and lichens, their classification, and their economic importance in reference to Industry, Medicines, food and agriculture.

CO4: The students came to know the diseases caused by Viruses and Bacteria, which were the host, types of pathogens and what kind of symptoms occurred on plants and identifying characters with type or name of disease of plants.

CO5: Learn the type of Bryophytes, their classification where they belong to group or classes, their characteristic features, how life cycles occurred and their economic importance.

CO6: Students can understand types of Bio fertilizers, their concept, and importance. They also came to know the types of nitrogen fixing cyanobacteria and Bacteria which are helpful in making the bio fertilizers the, they also learn about Phosphorus degrading and Potash mobilizing bacteria and VAM. Further they also learn the nutritional, medicinal value, cultivation practices of mushrooms and their economic importance.

List of Practicals:

1. Study of Bacterial forms from permanent micro-preparation.
2. Gram staining of Bacteria, Ultrastructure of Bacteriophage from TEM photographs
3. Study of Cyanobacteria: *Nostoc*.
4. Study of Algal genera: *Oedogonium, Chara, Vaucheria, Ectocarpus.*
5. Study of Fungal genera: - *Albugo, Mucor, Puccinia, Cercospora*
6. Study of Lichen: - Thallus structure, Types
7. Plant pathology: – Leaf curl of Papaya, Red rot of Sugarcane, Citrus canker
8. Study of Bryophytes: - *Marchantia & Funaria*
9. To study the bacteria, present in root nodules of leguminous plant.
10. To study the liquid culture/broth culture of *Rhizobium.*
11. To prepare the biofertilizers from broth culture of bacteria (*Rhizobium* / Cyanobacteria)
12. Identification of different types of mushroom.
13. Materials required for Cultivation of Mushrooms.
14. Demonstration of cultivation of Mushroom.
15. Botanical Excursions (One short/Long excursion is compulsory)

Suggested Readings:

- Alexopoulos, C. J. and G. W. Min & M. Blackwell, Introductory Mycology, CBS distributors & publishers, Delhi.
- Bierhorst, D. W. (1971): Morphology of Vascular Plants (Macmillon & Co. N.Y.)
- Bold, H. C. and M. J. Wynne (1978): Introduction of Algae: Structure and Reproduction(Prentice Hall of India, Pvt. Ltd)
- Bold, H.C. C. J Alexopoulos and T Delevoryas (980): Morphology of Plants and Fungi(Harper and Row Publishers, N.Y.)
- Chopra, G. Land D I Yadav (1980): A text Book of Bryophyta (Arihant Press)
- Dube, H. C. (1990): Introduction to Fungi (Vikas Publishing House Pvt. Ltd, Delhi)
- Dubey, R.C., (2005): A Text book of Biotechnology S. Chand & Co, New Delhi.
- Dubey, RC. DK Maheshwari (1999): Text Book of Microbiology, S. Chand & Co.
- Ganguly, Kar: College Botany, Vol II. New Central Book Agency, Calcutta.
- John Jothi Prakash, E. 2004: Outlines of Plant Biotechnology. Emkay Publication, NewDelhi.
- Kumar, H. D. and HN Singh (1982): A text Book of Algae. Affiliate East - West Press, Pvt.

- Kumaresan, V. (2005): Biotechnology, Saras Publications, New Delhi.
- Mehrotra, R. S. and Aneja, K. R. (1990): An Introduction to mycology, Wiley Eastern Ltd.
- Nadiad Marimuthu, T. Krishnamoorthy, A. S. Sivaprakasam, K. and Jayarajan. R (1991): Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University,Coimbatore.
- Prempuri (1980): Bryophyta, Atma Ram & Sons Delhi.
- Prescott *et al*. (1999): Microbiology 3rd ed. Wm C Brown Pub.
- Ram Udar (1970): An Introduction to Bryophyta. Shashidhar Malviya Prakashan, Lucknow
- Sathe, T.V. (2004): Vermiculture and Organic Farming. Daya Publishers,
- Sharma, O.P. (1992): Text Book of Thallophytes (McGraw Hill Publishing Co.) Smith, G. M. (1971): Cryptogamic Botany, Vol. I Algae and Fungi (TMH)
- Sharma, P. D. (1991): The Fungi (Rastogi & Co. Meerut)
- Sharma, P.D. (1993): Microbiology and plant pathology (Rastogi & Co)
- Smith, G. M. (1971): Cryptogamic Botany, vol. I l, Bryophytes and Pteridophytes (THM)
- Smith, K. M.: Plant Viruses (1992) 6th Ed University Book Stall, New Delhi)
- Subha Rao, N.S. (2000): Soil Microbiology, Oxford & IBH Publishers, New Delhi.
- Sullia, S. B. (1998): General Microbiology (Oxford & IBH)
- Swaminathan, M. (1990): Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
- Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
- Nita Bahl (1984-1988): Hand book of Mushrooms, II Edition, Vol. I & Vol. II.
- Tortora, G. E. B. R. Funke, C. L Case U (1997): Microbiology, An Introduction, 6'r'Ed(Addison Neslley Logman, Inc.)
- Vashishtha, B. R. (1992): Bryophyta (S. Chand & Co. New Delhi)
- Vashishtha, B. R. (1990): Algae (S. Chand & Co. New Delhi)
- Vashishtha, B. R. (1990): Fungi (S. Chand and Co. New Delhi)
- Vayas, S. C, Vayas, S. and Modi, H. A. (1998): Bio-fertilizers and organic Farming AktaPrakashan.

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B.Sc. Semester – I Botany

Practical Examination Question Paper

Time: 5 hrs **Marks: 30**

Q.1.	Gram Stain given Bacterial strain / Stain the **Cyanobacterial** material (A), and Identify	**04**
Q.2.	Identify & give characters of the given **Algal** material (B) and make a temporary Mount	**04**
Q.3.	Identify & give characters of the given **Fungal** material (C) and make a temporary Mount	**04**
Q.4.	Identify & give characters of the given **Bryophytic** material (D) and make a temporary mount	**04**
Q.5.	Spotting	**08**
	E. Virus/ Bacteria/ Cyanobacteria F. Algae	
	G. Fungi H. Bryophyte	
	I. Plant Pathology J. Lichen	
	K. Biofertilizer L. Mushroom Cultivation	
Q.6.	Viva - voce	**03**
Q.7.	Practical Record and Excursion Report	**03**

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B.Sc. BOTANY - SEMESTER – II

Pteridophyta, Paleobotany, Gymnosperms, Morphology of Angiosperms & Scientific Report writing

Bachelor of Science (Botany)	**Semester II**
Course Code	**UG-BOT (06)-S2**
Title of paper	**Botany-II Pteridophyta, Palaeobotany,, Gymnosperms, Morphology of Angiosperms & Scientific Report Writing.**
Course Credit	**6**
Hours	**60 hrs**
Course Structure	**Theory & Practicals**

Course Objectives :

The student should gain the knowledge of biology, diversity, evolution from lower to higher plants and acquire the skill of writing scientific report.

Course Content :

Unit I	Pteridophyta	10 hrs

Classification (Smith, 1952)

General characters (Psilopsida, Lycopsida, Sphenopsida and Pteropsida),

Life history of *Selaginella* (Heterospory and seed Habit), *Equisetum*

Apogamy, Apospory and Stelar system in Pteridophytes

Unit II	Paleobotany	10 hrs

Introduction to Paleobotany, Geological time scale

Fossilization: Replacement theory, Infiltration theory

Types of fossils: Impression, Compression, Petrifaction

Fossil plants: Gymnosperms: *Glossopteris* (Leaf, Scutum), *Cycadeoidea* (morphology, anatomy of Stem and flower)

Unit III	Gymnosperms	10 hrs

Classification (Stewart 1982)

General characters

Life cycles of *Pinus* and *Gnetum*

Affinities of Gymnosperms with Pteridophytes and Angiosperms

Economic Importance

Unit IV	Morphology of Angiosperms I	10 hrs

Diversity in Plants habits – Annual, biannual, perennials

Root: Tap, Adventitious &Modifications (Storage, Respiration & Reproduction.

Stem: Shape, surface, texture, nature, Branching (Monopodial,

Sympodial),modifications (Runner, Rhizome, Tuber, Bulb, Cladode).

Leaf: Typical Leaf, Types (Simple, Compound), Phyllotaxy, Venation,

Stipule and modifications of leaf (Tendril, Phyllode)

Unit V	Morphology of Angiosperms II	10 hrs

Inflorescence -Simple (Racemose, Cymose and special types).

Flower: Flower as modified shoot, Insertion of floral whorls,

Structure of Calyx, Corolla, Androecium and Gynoecium.

Placentation; Seed structure; Types of seeds

Fruit: Classification of fruits, Simple, Aggregate, Composite fruit.

Unit VI	Scientific Report writing	10 hrs

(a) Data collection, Documentation and Photography

Maintaining a laboratory record; Tabulation and generation of graphs.

Imaging of tissue specimens and application of scale bars.

The art of field photography.

(b) The art of scientific writing and its presentation

Numbers, units, abbreviations and nomenclature used in scientific writing.

Writing references. Power Point presentation. Poster presentation.

Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

Course Learning Outcomes :

After successful completion of the course

CO1: Students get the knowledge of group of plants from Pteridophyta, their characteristics, classification, life cycles, vascular organization, and reproduction.

CO2: Students came to know about the plants of past which were existed at that time and periods, how they were preserved in nature and their fossil types found today, also students came to know the different examples from gymnosperms fossils group.

CO3: They Know about the group of gymnosperms plants, their classification, life cycle of some examples, their similarity and differences with earlier and later groups/ classes and economic importance.

CO4: Know the plant habit diversity, types of roots and their modification. Stems shapes, surface, texture, nature, branching and modification, Leaf types, arrangements, and their modifications.

CO5: Students will get the knowledge of arrangements of flowers on floral axis/ inflorescence type, their modification, floral insertion on thalamus, structure, arrangements of seed before and after formation, and types of fruits.

CO6: The students will be well acquainted with scientific report writing in which they came to know maintaining laboratory record, tabulation, graph generation, imaging of specimens, application of scale bars and art of field photography. So also, they get the knowledge of numbers, abbreviations, nomenclature. How to write the references, making of power point presentation in scientific writing their ethics, academic misconduct, or plagiarism.

List of Practicals

1. Study of Pteridophytes: *Rhynia, Selaginella, Equisetum.*
2. Study of Gymnosperm: *Pinus, Gnetum, Cycadeoidea, Glossopteris.*
3. Study of Root: Types, Modifications.
4. Study of Stem: shape, surface, texture, nature Branching, Modifications (Ex. *Hibiscus, Ocimum,* any grass).
5. Study of Leaf: Stipules, base, kind, shape, surface, margin, apex, texture, Phyllotaxy, Venation & Modifications.
6. Inflorescence: Types.
7. Flower: Parts, Thalamus, Calyx, Corolla, Androecium, Gynoecium.
8. Fruits: Types of fruits (Simple, Aggregate, Multiple)
9. *To understand and prepare reference list (e.g., Research papers, Reference books, websites,
10. Ph.D./M. Sc. Thesis & research reports)
11. To write and understand units, abbreviations and nomenclature used in scientific writing and prepare presentations in poster and power point template.
12. To prepare scientific paper.

Suggested Readings:

- Bhatnagar, S. P. and Moitra A. (1996) Gymnosperms. New Age International Limited, New Delhi.
- Bierhorst, D. W. (971). Morphology of Vascular Plants. Macmillon & Co. N. R.
- Cambridge University Press.
- Davis, P. H. and Heywood V. H. (1963). Principals of Angiosperm Taxonomy. Oliver and Boyd London.
- Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
- Rashid, A. (1989). An Introduction to Pteridophyta Vikas Publishing House, Pvt. Ltd. New Delhi
- Sharma, O. P. (990). Text Book of Pteridophyta (Macmillan India Ltd.)
- Sporne, K. R. 1965. The Morphology of Gymnosperms. Hutchinson University Library Press, London.
- Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for Agricultural Research Scientists – A training reference manual. West Africa Rice Development Association, Hong Kong.
- Stewart, W. N. and G. W. Rothwell (1993). Paleobotany and the Evolution of Plants, 2nd Ed.
- Vashishtha, B. R. (1992). Gymnosperm (S. Chand & Co. New Delhi)

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B.Sc. Semester – II Botany

Practical Examination Question Paper

Time: 5 hrs **Marks: 30**

Q.1.	Identify and give characters of the given **Pteridophytic** material **(A)** and make temporary mount.	**04**
Q.2.	Identify and give characters of the given **Gymnospermic (B)** material and make temporary mount.	**04**
Q.3.	Describe the given **leaf** material **(C)**	**04**
Q.4.	Describe (Calyx, Corolla, Androecium & Gynoecium) of given **Flower (D)**.	**04**
Q.5.	Spotting	**08**
	E. Pteridophyte F. Fossil	
	G. Gymnosperm H. Vegetative morphology	
	I. Inflorescence/ Flower J. Fruit	
	K. Data collection L. Scientific writing	
Q.6.	Viva-voce	**03**
Q.7.	Practical Record and Excursion Report	**03**

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B.Sc. BOTANY SEMESTER – III

Angiosperms Taxonomy, Cell Biology, Plant Breeding and Plant Micro technique

Bachelor of Science (Botany)	**Semester III**
Course Code	**UG-BOT (06)-S3**
Title of paper	**Botany- III Angiosperms Taxonomy, Cell Biology, Plant Breeding and Plant Micro technique**
Course Credit	**6**
Hours	**60 hrs**
Course Structure	**Theory & Practicals**

Course Objectives :

The students should understand the structure and function of cell and organelles, techniques of plant breeding and learn about the techniques to study cell and tissue structure.

Course Content :

Unit I	**Origin, Systematics and Biodiversity**	**10 hrs**

Origin of Angiosperms (Benettitalean theory) and Gnetales theory

Angiosperm Floras, Herbaria, keys (Indented and Bracketed), Valid publication

Tools in Taxonomy in relation to Cytology, Palynology and Embryology.

Concept and significance of Biodiversity

Unit II	**Classification and Study of Families**	**10 hrs**

Overview of Classification of Angiosperms: Comparative account of Natural, Artificial and Phylogenetic systems of classification.

Systems: Bentham & Hooker and Engler & Prantl (with merits and demerits),

Dicotyledons: Malvaceae, Fabaceae (Papilionoideae, Caesalpinioideae, Mimosoideae) Asteraceae, Asclepiadaceae, Euphorbiaceae Monocotyledons: Liliaceae, Poaceae.

Unit III	Cell Biology I	10 hrs

Characteristics of Prokaryotic and Eukaryotic Plant cell

Ultrastructure and functions of: Cell wall & Cell Membrane (Fluid mosaic model)

Ultrastructure and functions of: Nucleus & Endoplasmic reticulum (RER and SER)

Ultrastructure and functions of: Golgi complex, Ribosomes, lysosomes, Peroxisomes, Mitochondria and Chloroplasts

Unit IV	Cell Biology II	10 hrs

Chromosome structure: Morphology (chromatid, chromomere, centromere, telomere, secondary constriction, satellite, karyotype)

Sex Chromosomes in plants: XY type in *Melandrium*

Cell division in plants: Mitosis, Meiosis and its significance.

Specialized chromosome – Lampbrush, Polytene and B-chromosome

Unit V	Plant Breeding	10 hrs

Plant Breeding- Definition and objectives

Hybridization (emasculation, bagging, tagging, crossing, labelling)

Clonal selection, Heterosis (Definition and scope)

Biostatistics - Mean, Mode, Median, Standard deviation, Standard error, Students' t- test

Unit VI	Plant Micro-techniques	10 hrs

(a) Staining Plant Materials

Staining procedures, classification, principles, and chemistry of stains.

Cytogenetic techniques with squashed and smeared plant materials.

(b) Methods to study plant cell / Tissue Structure

Techniques of microtome

Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives,no coagulant fixatives; tissue dehydration using graded solvent series.

Course Learning Outcomes :

After successful completion of the course

CO1: Students get the knowledge of origin of angiosperms and related theories, floras, herbaria, classification/ separation keys, valid publication, and modern trends of classification with concept and significance of biodiversity.

CO2: Students get familiarize with general and few examples of plant classification, Characteristics, economic and medicinal value, and examples of some mentioned families of plants.

CO3: Students get the knowledge about prokaryotic and eukaryotic plant cell, their typical cell structure and ultra-structure and function of Plant cell wall, Plasma membrane, Nucleus, Endoplasmic reticulum, Golgi complex, Ribosomes, Lysosomes, Peroxisomes, Mitochondria and Chloroplast.

CO4: They know the Morphology, Structure of chromosome, Specialized chromosomes, Sex chromosome in plants with few examples, Mitotic and meiotic division in them and its significance.

CO5: Students will learn about objectives and hybridization techniques of plant breeding, selections, and their biostatistics.

CO6: They learn about stains, classification, staining equipment's and staining procedures and squash and smear preparation. They also get the knowledge about how to prepare the tissues for microtomy through various process of tissue preparation and techniques in microtome.

List of Practicals

1. Study of Families covered in the theory portion.
2. Study of fossil Angiosperms micro-preparation and specimens: *Sahanianthus*,*Enigmocarpon.*
3. Study of Cell organelles with the help of photographs/ Slides.
4. Study of mitosis in plant material (Squash).
5. Study of meiosis in plant material (Smear).
6. Study of hybridization (Emasculation, bagging, tagging, crossing and labelling).

7. To calculate Mean, Mode, Median, standard error from the given data (At least 10 problems to be solved).
8. To calculate the study of t-value from the given data (At least 10 problems to be solved).
9. To prepare different laboratory stains.
10. To study different staining equipment.
11. To study procedure for staining different plant materials.
12. To study methods of fixation preservation and clearing.
13. To study the methods of paraffin infiltration.
14. To study sectioning of infiltrated materials.
15. Botanical Excursions (Two short or One long out of the state is compulsory).

Suggested Readings:

- Bhojwani, S. S. and Bhatnagar, S. P. (2000). The Embryology of Angiosperms. Vikas Publishing House, Delhi.
- Dutta, S. C. (1989). Systematic Botany. Wiley Eastern Co.
- Hartman, H. T. and Kestler D.E. (1976). Plant Propagation: Principles and Practices, 3rd Edition. Prentice- Hall of India Pvt. Ltd. New Delhi.
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- Lavania, U.C., Sharma, A. K. (2017). Practical Manual on Plant Cytogenetics. CRC Press, Boca Raton.
- Naik, V. N. (1989) Taxonomy of Angiosperm. Amrut Prakashan.
- Proctor, M. and Yeo, P. (1973). The Pollination of Flowers. William Collins Son, London.
- Radford, A. E. (1986). Fundamentals of plant systematic. Harper and Row, New York.
- Ruzin, S.E. (1999). Plant micro technique and microscopy. Oxford University Press, New York, U.S.A.
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B.Sc. Semester – III Botany

Practical Examination Question Paper

Time: 5 hrs **Marks: 30**

Q.1.	Describe in technical language the given Angiospermic material (**A**). Classify & Identify the Family giving reasons.	**06**
Q.2.	Write floral formula and Draw Floral Diagram of the given flower (**B**).	**03**
Q.3.	Prepare semi-permanent squash /smear of given material (**C**) & Identify the stage of cell division.	**05**
Q.4.	To solve the given problem of biostatistics (**D**).	**04**
Q.5.	Spotting	**06**
	E. Fossil Angiosperm F. Cytology	
	G. Cell organelles (photocopy) H. Taxonomy	
	I. Plant Micro-technique J. Plant Cell/ Tissue structure	
Q.6.	Viva-voce	**03**
Q.7.	Practical Record and Excursion Report	**03**

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B.Sc. BOTANY - SEMESTER – IV

Anatomy, Embryology, Genetics, Molecular Biology and Plant Analytical techniques

Bachelor of Science (Botany)	**Semester IV**
Course Code	**UG-BOT (06)-S4**
Title of paper	**Botany- IV Anatomy, Embryology, Genetics, Molecular Biology & Plant Analytical techniques**
Course Credit	**6**
Hours	**60 hrs**
Course Structure	**Theory & Practicals**

Course Objectives :

The students should study the internal structure, developmental stages, inheritance, molecular mechanism of the plants and perform techniques for plant analysis.

Course Content :

Unit I	Anatomy	10 hrs

Meristems: Types, Apical cell, Tunica-corpus and Newman theory.

Primary structure of stem and root in Dicot (Sunflower) and Monocot *(Maize*).

Types of vascular bundles in dicots and monocots.;

Secondary growth (Sunflower stem) and anomalous growth in *Bignonia, Boerhaavia* and *Dracaena* stem.

Anatomy of leaf: Dicot (*Nerium*), Monocot (*Maize*).

Unit II	Embryology	10 hrs

Pollination: Types and adaptation, significance

Microsporogenesis, male gametophyte,

Megasporogenesis: Types of ovules, female gametophyte (Polygonum type)

Double fertilization and triple fusion, endosperms and its types,

Structure of dicot (Onagrad) and monocot embryo.

Unit III	Genetics I	10 hrs

Mendel's Laws of Inheritance: Law of Dominance, Law of Segregation and Law of Independent assortment; Monohybrid cross, Dihybrid cross, Test Cross and Back cross) Interaction of genes : Incomplete dominance (1:2:1 ratio in *Mirabilis jalapa*); Complementary (9:7 ratio); Supplementary (9:3:4 ratio) and Dominant epistasis (12:3:1 ratio) Linkage: Definition, Theory of linkage (Coupling and Repulsion theory), types (complete and incomplete), significance Crossing over: Definition, theories (Breakage and reunion), significance.

Unit IV	Genetics II	10 hrs

Extra-nuclear Genome- Mitochondrial DNA and Chloroplast DNA

Variation in chromosome number: Polyploidy (auto- and allo), Aneuploidy (Nullisomy, Monosomy, Trisomy and Tetrasomy), Significance.

Structural changes in chromosome: deficiency, duplication, inversion translocation and their significance.

Concept of gene; Structure of eukaryotic gene, overlapping gene

Unit V	Molecular Biology	10 hrs

DNA Packaging – Nucleosome; DNA damage and repair: Photoreactivation, excision repair. Satellite and repetitive DNA. Gene expression in prokaryotes: Transcription and translation; Regulation of gene expression (Lac operon model). Mutation: Types, Mutagens, Applications of induced mutations in crop improvement. Transposable element in Maize: AC-DS system

Unit VI	Plant Analytical techniques	10 hrs

(a) Analytical Pharmacognosy

Drug adulteration - types, methods of drug evaluation

Instrumentation (Kjeldahl, Soxhlet, Lyophilizer, Clevenger)

(b) Herbal Cosmetics and Medicines

Methods of Herbal extraction: - Maceration, Digestion, Decoction, Extracts and Tinctures Concepts and types of Herbal Preparations

Course Learning Outcomes :

After successful completion of the course

CO1: The students will gain the knowledge of various meristems, primary structure of root and stem in dicots and monocots, types of vascular bundles in dicots and monocots, secondary growth, and anomalous secondary growth in plants.

CO2: The students will get acquainted with the concepts of Embryology which includes pollination, microsporogenesis, megasporogenesis, double fertilization and triple fusion in plants.

CO3: The students will be illuminated with concepts of genetics, gene interaction, Linkage: types and theories and extra-nuclear genome.

CO4: The students will learn about concepts of genetics, crossing over, structural and numerical aberrations in chromosomes and concept of gene.

CO5: The learner will get to know about the concepts of molecular biology, DNA packaging, Gene expression in prokaryotes, Mutations: types, mutagens and applications and transposable elements (AC-DS system) in Maize.

CO6: The pupils will get to know various analytical techniques of drug adulteration and biological testing of herbal drugs, methods of herbal extraction and preparations.

List of Practicals: -

1. Study of simple tissue, complex tissue and secretary tissue from permanent slides.
2. Study of types of vascular bundles (*Zea mays*, *Helianthus*, *Cucurbita*, *Boerhaavia*, etc.)
3. Study of internal structure of dicot and monocot root using hand section and preparetemporary mounts -Sunflower, Maize.
4. Study of internal structure of dicot and monocot stem using hand section and preparetemporary mounts -Sunflower, Maize.
5. Study the growth ring in woods-Teak wood
6. Study of internal structure of secondary growth and anomalous secondary growth using hand section and prepare permanent micro preparations - *Bignonia* stem *Boerhaavia* stem and *Dracaena* stem.

7. Study of internal structure of leaves- *Nerium*, Maize
8. Study of types of ovules, stamens anther structure, pollen grains, adaptations for pollination,
9. To calculate the percent pollen germination in the given specimen
10. To prove the Mendel's law of segregation with the help of coloured beads.
11. To prove the Mendel's law of independent assortment with the help of coloured beads.
12. Problems on gene interaction.
13. *To study different methods of identification of drug adulteration.
14. To study the methods of biological testing of herbal drugs.
15. To study the screening tests for secondary metabolites.
16. Identification of useful herbal plants.
17. To perform herbal preparations
18. Botanical Excursions (One short tour is compulsory).

Suggested Readings:

- Agnes Arber, (1999). Herbal plants and Drugs. Mangal Deep Publications.
- Alberts, B. D. Bray, J Lewis, M. Raff K, Roberts, and J. D. Watson (1999) Molecular Biology of the Cell, Garland Publishing Co. Inc. N.Y.
- Anne Green, (2000). Principles of Ayurveda. Thomsons, London.
- Bhattacharya, Ghosh, Hait (2017) A Textbook of Botany. Vol. I-IV. New Central Book Agency.
- Cooper, G. M. (1997): The Cell. A Molecular Approach (Oxford Univ. Press)
- Cutter, E. G. 1971.Plant Anatomy Experiment and Interpretation. Part II. Organs. Edward Arnold, London.
- Esau, K. 1979 Anatomy of seed Plants, 2nd Edn. John Wiley and Sons New York
- Evans, William C. (2009) Trease and Evans – Pharmacognosy. 16th Edition. W. B. Saunders Co. Ltd.
- Fahn, A. (1995). Plant Anatomy, 4th Edn. Pergamon Press, Oxford.
- Freifelder, D (1990): Essentials of Molecular Biology. Narosa Publishing House, New Delhi, Madras
- Gangulee, Das and Dutta (2011) College Botany, Vol. I, II. New Central Book Agency.
- Gardner, E. J., M. J Simmons, and D. P. Snustad. (1991). Principles of Genetics, 8th ed. John Wiley and Sons, Inc N. Y.
- Gupta P. K. (2007) Genetics: Classical to Modern. Rastogi Publications, Meerut

- Gupta, P.K. (1999): A Text Book of cell and Molecular Biology. Rastogi Publications, Meerut India.
- Hawkins, J. D. (1991): Gene Structure and Expression 2nd edition. Cambridge University Press, Cambridge U.K.
- Kanny, Lal, Dey and Raj Bahadur, (1984). The indigenous drugs of India. International Book Distributors.
- Karp, G (1961): Cell and Molecular Biology- Concepts and Experiments (John Wiley and Sons Inc.)
- Kleinsmith, L. J and V. M. Kish (1995): Principles of cell and Molecular Biology, 2nd ed. Harper Collins College pubs.
- Kokate C. K., Purohit, A. P., Gokhale, S. B. (1999). Pharmacognosy. Nirali Prakashan.
- Kumar and Bendre (2009) A Textbook of Practical Botany Vol. I and II. Rastogi Publications.
- Kumar, H. D. (1991): A Text Book of Cytology, Genetics and Evolution, Kalyani Publisher, New Delhi.
- Lewin, G. (2000): Gene VII (John Wiley and Sons, N. Y.)
- Lodish, H. A. Berk, S. L. Zipursky, P Matudaira, D. Baltimore and J.M. Damell (2000): Molecular Cell Biology (W. H. Freeman and Co. N. Y.)
- Miller, Light and Miller, Bryan, (1998). Ayurveda and Aromatherapy. Banarsidass, Delhi.
- Mondal A. K. (2009). Advanced Plant Taxonomy. New Central Book Agency.
- Mukherjee S. K. (2010) College Botany, Vol. III. New Central Book Agency.
- Pande B. P. (2009) Botany for Degree students. S. Chand Publications.
- Pande B. P. (2011) College Botany Vol. I, II and III. S. Chand Publications.
- R. N. Chopra, S. L. Nayar and I. C. Chopra, (1956). Glossary of Indian Medicinal Plants. C.S.I.R, New Delhi.
- Russel, P. J. (1998): Genetics. The Benjamin/ Cummings publishing Con. Inc. USA
- Snustad, D. P. and M. J. Simmons (2000): Principles of Genetics. John Wiley and sons, USA
- V.V. Sivarajan and Balachandran Indra (1994). Ayurvedic drugs and their plant source. Oxford IBH publishing Co.
- Vyas S. P. and Mehta A. (2011). Cell and Molecular Biology. CBS Publ. and Dist. Pvt. Ltd., New Delhi
- Watson, J. D. Hopkins, Roberts, Steitz, Weiner (1987) Molecular Biology of

Gene. Benjamin Cummings Pub. Co. Sherman

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B.Sc. Semester – IV Botany

Practical Examination Question Paper

Time: 5 hrs **Marks: 30**

Q.1.	Prepare temporary mount of the given material **(A)**(Root/Leaf) and Identify giving diagnostic characters.	**03**
Q.2.	Prepare double stained permanent mounts of the given material (Stem) **(B)** and Identify giving diagnostic characters.	**06**
Q.3.	Calculate percent germination in the given pollen grains **(C)**	**02**
Q.4.	To prove Mendel's Law of Inheritance through coloured beads **(D)**	**04**
Q.5.	To work out the type of gene interaction in the given cross from the given data.	**03**
Q.6.	Spotting	**06**

E. Tissue F. Root anatomy

G. Stem anatomy H. Embryology

I. Analytical Pharmacognosy J. Herbal cosmetics and Medicines

Q.7.	Viva-voce	**03**
Q.8.	Practical Record and Excursion Report	**03**

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B.Sc. BOTANY - SEMESTER – V
Biochemistry, Plant Physiology-I, Plant Ecology and Instrumentation and Phytochemistry

Bachelor of Science (Botany)	**Semester V**
Course Code	**UG-BOT (06)-S5**
Title of paper	**Botany-V Biochemistry, Plant Physiology-I, Plant Ecology and Instrumentation and Phytochemistry**
Course Credit	**6**
Hours	**60 hrs**
Course Structure	**Theory & Practicals**

Course Objectives :

The students should acquire the knowledge of physiological and biochemical mechanisms of the plants, understand the role of plants to sustain ecology and learn working and principles of instruments and chemical composition of plants.

Course Content :

Unit I	Biochemistry	10 hrs

Carbohydrates: Definition, properties and role; Classification: Aldoses and ketoses; monosaccharides, disaccharides and polysaccharides.

Lipids: Definition, properties & role; fatty acids, oils & waxes.

Amino acids and Proteins- Chemistry of amino acids present in proteins: Classification, Structure of Protein.

Basics of Enzymology: Nomenclature & Characteristics of Enzymes, factors affecting enzyme activity, Holoenzyme, Apoenzyme, Co-enzymes and Co-factors, Theories for Mechanism of action of Enzymes

Unit II	Plant-water relations	10 hrs

Properties of water; Diffusion, Osmosis, Imbibition and Plasmolysis: Significance

Water conduction: Root pressure theory, Cohesion-adhesion theory; Transpiration role

Phloem transport: Munch hypothesis Mineral transport: Passive (Donnan equilibrium), Active (Carrier concept)

Unit III	Metabolism	10 hrs

Photosynthesis: Concept, significance, photolysis of water (Hill's reaction), cyclic and noncyclic photophosphorylation, Light independent reactions: C3, C4 and CAM pathways and their significance; factors affecting photosynthesis.

Respiration: Types (aerobic & anaerobic), glycolysis, Kreb's cycle, oxidative phosphorylation (ETS); fermentation (alcohol & lactic acid), photorespiration. Glyoxylate cycle Nitrogen metabolism: Mechanism of biological nitrogen fixation, importance of nitrate reductase

Unit IV	Ecology and Environment	10 hrs

Climatic Factors: Light and Temperature (effect on vegetation).

Edaphic Factor: Pedogenesis, Soil profile, Soil properties (physical and chemical)

Biotic Factor: Interactions between a) plants, animals and human, b) plant community and plants & soil microorganisms.

Plant adaptations: Morphological, Anatomical & Physiological responses of Hydrophytes, Xerophytes, and Halophytes (with one example)

Unit V	Ecosystem and Conservation	10 hrs

Community characteristics: frequency, density, abundance, Life forms, Raunkier's Biological spectrum: Pond and Desert ecosystem Autecology, Ecad, Ecotype, Natality, Mortality, Food chain, Food web, Ecological pyramids Plant succession: Hydrosere, Xerosere Conservation of forest and water resources; Types of pollution.

Unit VI	Instrumentation and Phytochemistry	10 hrs

(a) Instrumentation

Principle, types and application of: microscopy (Light, fluorescent, SEM, TEM), Centrifugation, Electrophoresis (SDS-PAGE and Agarose), Spectroscopy (UV-Vis), Chromatography (Paper chromatography, Thin layer chromatography

(b) Phytochemistry

Active principles of Phytochemistry

Methods of their testing phytochemical substances

Identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron serratum* (anti rheumatic) and *Centella asiatica* (memory booster).

Course Learning Outcomes :

After successful completion of the course

CO1: The students will have the knowledge of definition, properties and roles of Carbohydrates, Lipids and amino acids and will be able to classify them in different classes. They also know the various categories of enzymes and their mechanism of action.

CO2: The students will get acquainted with the concepts of Plant-Water relations, Properties of water like diffusion, osmosis, imbibition and plasmolysis. They also learnt the mechanism and theories of Water conduction, Phloem transport and mineral transport in plants.

CO3: The students will be illuminated with the various aspects involved in the physiological phenomenon of Photosynthesis, Respiration and Nitrogen metabolism. The complete metabolic pathways of the plants will be covered.

CO4: Learners will be familiarized with the various Concepts of Ecology and Environment that will include Climatic factors, edaphic factors, biotic factors and get to know the various Plant adaptations in different environmental conditions.

CO5: The learner will get in-depth information about Ecosystem like Community Characteristics, Autecology, Conservation of resources and plant succession.

CO6: The pupils will know the Principle, Working and Applications of various microscopic techniques, centrifuge and chromatography. Students will also get to learn about various phytochemicals, their structure, distribution in plants and significance.

List of Practical's Major Physiology experiments (Any 10)

1. To study the permeability of plasma membrane using different concentrations of organic solvents.
2. To study the effect of temperature on permeability of membranes.
3. To determine the osmotic potential of vacuolar sap by plasmolytic method.
4. To determine the water potential of any tuber.
5. To compare the rate of transpiration from two surfaces of leaf- a) bell jar method

b) Cobalt chloride method.

6. To determine the path of water (Ascent of sap).
7. To separate chloroplast pigments a) by solvent method and preparation of their absorption spectra, b) paper chromatography.
8. To separate amino acids from plant materials on paper chromatography and their identification by comparison with standards.
9. To measure rate of photosynthesis by Wilmott's bubbler under variable conditions of

   light, temperature and CO_2.
10. To compare rates of respiration of various plant parts.
11. To demonstrate bioassay of auxin, cytokinin, GA, ABA and ethylene using appropriate plant materials.
12. To perform microchemical tests for determination of reducing and non-reducing sugars, starch, cellulose, oils and proteins.
13. To determine osmotic potential of the cell sap by plasmolytic method.
14. To study the activity of enzyme amylase, catalase and peroxidase.

Minor Physiology experiments (Any Seven)

1. To demonstrate the phenomenon of dispersion.
2. To demonstrate the phenomenon of adsorption.
3. To demonstrate the phenomenon of imbibition.
4. To demonstrate the root pressure.
5. To demonstrate that the amount of water absorbed and the amount of water transpired is approximately equal.
6. To demonstrate that the light is necessary for photosynthesis (Ganong's light screen).
7. To demonstrate that the light, chlorophyll and CO_2 are necessary for photosynthesis

   (using Moll's half-leaf experiment).
8. To demonstrate fermentation by Kuhne's tube.
9. To demonstrate aerobic respiration.
10. To demonstrate the evolution of CO_2 in respiration.
11. To demonstrate that the part of energy is released in the form of heat during respiration.
12. To demonstrate the measurement of growth of germination pea seeds.
13. To demonstrate the phenomenon of gravitropism (geotropism), phototropism and hydrotropism.

Ecology Practicals

1. To determine frequency, density, abundance of the community by quadrate method.
2. To determine the homogeneity of vegetation by Raunkier's frequency diagram.
3. To determine the water holding capacity and soil moisture of the given soil samples.
4. To demonstrate capillary action of water in soil samples.
5. To study the morphological and anatomical characteristics of anyone hydrophyte and xerophyte.
6. To study the morphological characteristics of cladode, phylloclade, phyllode and pneumatophores.
7. Principle and working of: spectrophotometer, microscope etc.
8. To determine the DO of water samples different sources.
9. To study the dust holding capacity of leaves.
10. To estimate transparency, pH and temperature of different water bodies.
11. To estimate salinity (chlorides) of different water samples.
12. To determine the percent leaf-area injury of different leaf samples collected around polluted sites.
13. *To separate chlorophyll pigments by paper chromatography.
14. Identification and utilization of the medicinal herbs.
15. To study methods of testing different drugs.
16. To study the active principles of herbal drugs.

Suggested Readings

- Hopkins, W. G. (1995). Introduction to plant physiology. John Wiley & Sons New York, USA
- Old, R. W. and Primrose S.B. (2006) Principles of Gene Manipulation. 7th Edn. Blackwell scientific publications, Oxford U. K. (new edition could be there)
- Dey, P.M. and Harborne, J. B. (1997). Plant Biochemistry. Harcourt Asia Pte Ltd/Academic Press I Printed in India 2000.
- Raghavan, V. 1986 Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, Cambridge.
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- R. N. Chopra, S. L. Nayar and I. C. Chopra, (1956). Glossary of Indian medicinal plants. C.S.I.R, New Delhi.
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- V.V. Sivarajan and Balachandran Indra (1994). Ayurvedic drugs and their plant source. Oxford IBH publishing Co.
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- Kokate C. K., Purohit, A. P., Gokhale, S. B. (1999). Pharmacognosy. Nirali Prakashan.

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B.Sc. Semester – V Botany

Practical Examination Question Paper

Time: 5 hrs **Marks: 30**

Q.1.	To perform given Physiology Experiment **(A)** and report the findings.	**06**
Q.2.	To perform the given Biochemical Experiment **(B)** and report the findings.	**04**
Q.3.	To perform the given Ecological Experiment **(C)** and report the findings.	**05**
Q.4.	To perform the given microchemical test **(D)** and report the findings.	**03**
Q.5.	Spotting	**06**
	E. Plant Physiology (Major) F. Plant Physiology (Minor)	
	G. Ecology (Component of Aquatic ecosystems) H. Ecology (Component of Terrestrial ecosystems)	
	I. Instrumentation J. Phytochemistry	
Q.6.	Viva-voce	**03**
Q.7.	Practical Record and Excursion Report	**03**

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B.Sc. BOTANY - SEMESTER – VI

Plant Physiology-II, Biotechnology And Utilization Of Plant, Plant Nursery Management

Bachelor of Science (Botany)	**Semester VI**
Course Code	**UG-BOT (06)-S6**
Title of paper	**Botany- VI Plant Physiology-II, Biotechnology And Utilization Of Plant, Plant Nursery Management**
Course Credit	**6**
Hours	**60 hrs**
Course Structure	**Theory & Practicals**

Course Objectives :

The student should possess the knowledge of utilization of plants in various aspects, get acquired with the modern techniques in plant biology, learn about managing nursery and production of hybrid seeds.

Course Content :

Unit I	Plant Responses	10 hrs

Growth: Phases, Growth curve; Pr and Pfr forms, their role Circadian rhythms and biological clock.

Growth regulators: Role of auxin, cytokinins, gibberellins, ABA and ethylene

Plant movements: Tropic and nastic movements.

Photoperiodism: photoperiodism and vernalization, role of florigen

Seed dormancy: Causes and role, methods to break seed dormancy.

Stress physiology- Concept, Types of stress, Water and Salinity stress

Unit II	Plant tissue culture	10 hrs

Totipotency, explant, aseptic culture, *in vitro*, micropropagation;

Methods of sterilization (autoclaving, dry heat, chemicals),

Culture media (MS media) hormone requirement and applications of tissue culture.

Callus and organ culture (shoot tip, anther) and its application, cybrid production and its application.

Unit III	Genetic engineering	10 hrs

Tools and techniques of recombinant DNA technology,

Restriction Enzymes – Nomenclature and Types

Cloning vectors – Plasmids, Phages, Cosmids

Gene Source- Genomic and c-DNA library

Transgenic plants, example Bt cotton and golden rice.

Introduction to Protection of Plant Varieties and Farmers Rights Act, 2001.

Unit IV	Phytogeography	10 hrs

Principles of Phytogeography, Distribution (wides, endemics, discontinuous species)

Theories (Land bridge and continental drift),

Climatic & Phytogeographic regions of India.

Ethnobotany: Introduction, definition, branches & importance of ethnobotany

Unit V	Utilization of Plants	10 hrs

Morphology, Utilization and Important chemical constituents of Food: Wheat; Oil: Ground nut; Fibre: Cotton; Spices: Clove; Beverages: Coffee; Rubber.

General account and sources of firewood, timber and Bamboos.

Essential oils – General account, economic importance of Eucalyptus.

General account and uses of medicinal plants: *Aloe vera, Adhatoda vasica, Asparagus racemosus, Azadirachta indica, Catharanthus roseus, Emblica officinalis, Ocimum sanctum.*

Unit VI	Nursery Management	10 hrs

Nursery: Concept, types and infrastructure requirements.

Seed propagation: Germination, Production, Collection, Storage and testing of seeds.

Vegetative Propagation: Natural and Artificial (Cutting, budding, grafting and layering)

Methods of Hybrid production.

Harvesting Techniques.

Course Learning Outcomes :

After successful completion of the course

CO1: The students will gain the knowledge of various physiological aspects of growth and development of plants, plant hormones, plant movements, photoperiodism, seed dormancy and stress physiology.

CO2: The students will get acquainted with the concepts and methodology of Plant Tissue Culture and learn about totipotency, sterilization techniques, culture media, callus, and organ culture, cybrid production and its applications.

CO3: The students will be illuminated with the various tools and techniques of Genetic engineering which will include recombinant DNA technology, restriction enzymes, cloning vectors, etc.

CO4: Learners will be familiarized with principles and theories of Phytogeography, climatic and phytogeographic regions of India and introduction, definition, and importance of Ethnobotany.

CO5: The learner will get to know about morphology, utilization and important chemical constituents of food plants, oil yielding plants, fiber crops, spices, beverages, firewood, timber, essential oils, and medicinal plants.

CO6: The pupils will know the concept, types and infrastructure requirements of nursery, seed propagation techniques, various aspects involved in hybrid seed production, harvesting, and threshing of some local crops.

List of Practicals

1. To determine seed viability by a convenient method.
2. To study instruments and equipments required for plant tissue culture.
3. To study the structure of following vectors on the basis of photographs and diagrams: Plasmid vector, Binary vector.
4. To study the effect of various plant growth regulators on the growth and development of plants.
5. To study steps of genetic engineering from photograph example Bt-cotton and golden rice.

6. Morphology, Utilization and Important chemical constituents of plants mentioned intheory.
7. To study the plants of ethnobotanical importance.
8. Electrophoretic /chromate graphic separation of amino acids carbohydrates
9. To determine proline content of any stress plant.
10. To study different components of M S medium.
11. To study methods of sterilization and Inoculation of explants materials.
12. *To study effect of Abiotic factors on seed germination of tomato and groundnut.
13. To study factors affecting vegetative propagation (rooting and new shoot formation) bycutting of plant species (*Duranta plumieri* and *Hibiscus rosa-sinensis*).
14. To study T-shaped budding of rose plants.

Suggested Readings

- Sharma, O. P. (1996). Hill's Economic Botany (Adapted by O.P. Sharma) Tata Mc Graw -Hill co. Ltd. New Delhi.
- Simpson, B. B. and Corner - Ogorzaly, M. (1986). Economic Botany- Plants in our World.Mc Graw - Hill Book company, New York.
- Shukla, P. S. and Chandel R. S. (2005). A Text Book of Plant Ecology. S Chand and Co. Ltd.,New Delhi.
- Bose T.K. and Mukherjee, D. (1972). Gardening in India. Oxford & IBH Publishing Co.,New Delhi.
- Sandhu, M.K. (1989). Plant Propagation. Wiley Eastern Ltd., Bangalore, Madras.
- Kumar, N. (1997). Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
- Edmond J. B. (1978). Fundamentals of Horticulture. McGraw Hill Book Co., New Delhi.
- Agrawal, P.K. (1993). Hand Book of Seed Technology. Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
- Janick, Jules. (1979). Horticultural Science. 3rd Ed., W.H. Freeman and Co., San Francisco,USA.

Shiksha Mandal's
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Autonomous College

B.Sc. Semester – VI Botany

Practical Examination Question Paper

Time: 5 hrs **Marks: 30**

Q.1.	To determine seed viability **(A)** and report the findings.	**05**
Q.2.	To study the given Plant tissue culture material **(B)** and report the findings.	**05**
Q.3.	Electrophoretic /chromatographic separation of amino acid and carbohydrates **(C)**	**04**
Q.4.	Morphology and utilization of the given plant material **(D)**.	**04**
Q.5.	Spotting	**06**
	E. Ex-plant type F. Instrumentation	
	G. Utilization of Plants - I H. Utilization of Plants - II	
	I. Plant Nursery Technique J. Hybrid Seed Production	
Q.6.	Viva-voce	**03**
Q.7.	Practical Record and Excursion Report	**03**