SYLLABUS FOR FYUGP

IN

BOTANY

DEPARTMENT OF BOTANY

MADHABDEV UNIVERSITY, NARAYANPUR

ASSAM

(Approved in the BoS Botany, Held in 13.07.2026)

FOUR YEAR UNDER GRADUATE PROGRAMME (FYUGP) IN BOTANY

MADHABDEV UNIVERSITY

1. Programme Learning Outcome

P.O. 1: Knowledge on diversity of plant resources their importance.

P.O. 2: Scientific approach to address problems in plant science and use of plant based products for human welfare.

P.O. 3: Application of knowledge and skills in entrepreneurship.

P.O. 4: Develop new techniques/methods for solving the problems of the allied disciplines.

2. Teaching Learning Process

The programme allows to use varied pedagogical methods and techniques both within classroom and beyond.

(i) Lecture

(ii) Practical

(iii) Tutorial

(iv) Documentary on related topic

(v) Project Work/Dissertation

(vi) Group Discussion

(vii) Seminars/workshops/conferences

(viii) Field visits and Report/Excursions

(ix) Mentor/Mentee

3. Assessment

(i) Home assignment

(ii) Project Report

(iii) Seminars

(iv) Group Discussions

(v) In semester examinations

(vi) End Semester examinations

(vii) Dissertation

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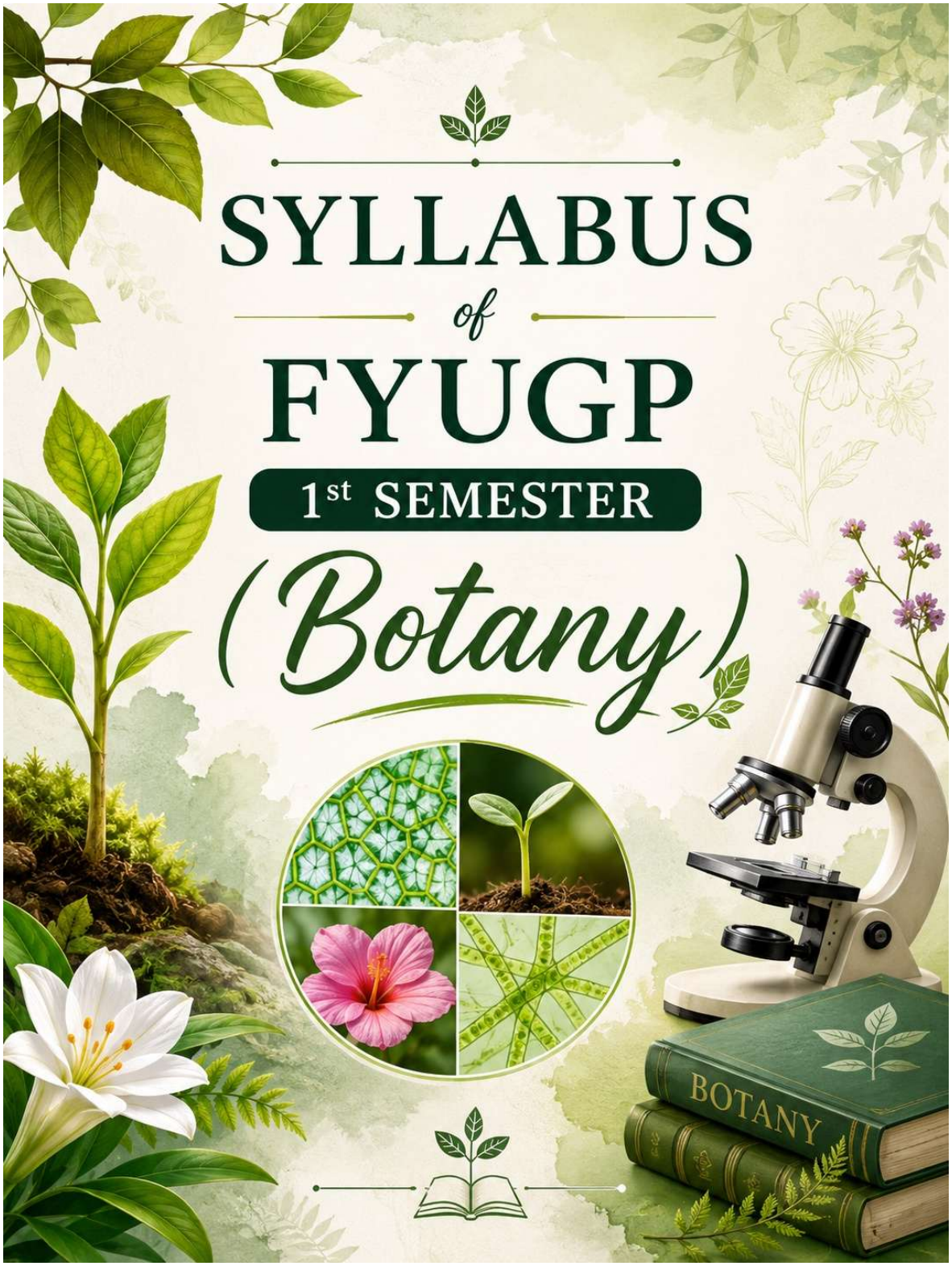
FYUGP Structure as per UGC Credit Framework of December, 2022

YEAR	SEMESTER	MAJOR/ MINOR	COURSE/ PAPER	CREDITS	TITLE OF THE COURSE/PAPER	TOTAL CREDITS
Year – 1	I	MAJOR	BOTM 101	3+1	Algae, Fungi, Bryophyte & Pteridophyte	20
		MINOR	BOTN 101	3+1	Algae, Fungi, Bryophyte & Pteridophyte	
		MDC	MDCN 101	3	Natural Resource Management	
		AEC	AEC-	4	×	
		VAC	VAC-	2	×	
		SEC	SEC 101	2+1	Mushroom Cultivation	
	II	MAJOR	BOTM 201	3+1	Morphology and Reproduction of Spermatophytes	20
		MINOR	BOTN 201	3+1	Morphology and Reproduction of Spermatophytes	
		MDC	MDC 201	3	Plant Diversity and Human Welfare	
		AEC	AEC 201	4	Madhabdev Studies	
		VAC	VAC-	2	×	
		SEC	SEC-	3	×	
Year - 2	III	MAJOR	BOTM 301	3+1	Cell Biology	22
		MAJOR	BOTM 302	3+1	Plant Biochemistry & Molecular Biology	
		MINOR	BOTN 301	3+1	Cell Biology, Plant Anatomy & Genetics	
		MDC	MDC-	3	×	
		VAC	VAC 301	3	Environmental Studies	
		SEC	SEC-	4	×	
	IV	MAJOR	BOTM 401	3+1	Microbiology & Plant pathology	22
		MAJOR	BOTM 402	3+1	Anatomy of Angiosperms	
		MAJOR	BOTM 403	3+1	Angiosperm Systematics	
		MAJOR	BOTM 404	3+1	Economic Botany	
		MINOR	BOTN 401	3+1	Plant Ecology & Taxonomy	
		INTERN-SHIP	×	2	(Minimum Duration: 60 Hrs)	
Year – 3	V	MAJOR	BOTM 501	3+1	Genetics	22
		MAJOR	BOTM 502	3+1	Plant Ecology & Phytogeography	
		MAJOR	BOTM 503	3+1	Natural Resource Management	
		MAJOR	BOTM 504	3+1	Plant Physiology	
		MINOR	BOTN 501	3+1	Plant Physiology	
		INTERN-				

		SHIP	×	2	(Minimum Duration: 60 Hrs)	
Year - 3	VI	MAJOR	BOTM 601	3+1	Plant Metabolism	22
		MAJOR	BOTM 602	3+1	Plant Breeding & Crop Improvements	
		MAJOR	BOTM 603	3+1	Plant Biotechnology	
		MAJOR	BOTM 604	3+1	Agropreneurship	
		MINOR	BOTN 601	3+1	Agropreneurship	
		PROJECT	×	2	-	
Year - 4	VII	MAJOR	BOTM 701	3+1	Research Methodology	22
		MAJOR	BOTM 702	3+1	Cellular Bioenergetics & Cell Signalling	
		MAJOR	BOTM 703	3+1	Functional Genomics & Chromosomal Architecture	
		MAJOR	BOTM 704	3+1	Bioethics, IKS & IPR	
		MINOR	BOTN 701	3+1	Bioethics, IKS & IPR	
		FIELD REPORT/ EXCURSION		2	-	
	VIII	MAJOR	BOTM 801 (i)	3+1	Reproductive & Developmental Biology	24
		MAJOR	BOTM 802 (ii)	3+1	Organismal Ecology and Environmental Interactions	
		MAJOR	BOTM 803 (iii)	3+1	Pharmacognosy & Ethnobotany	
		MINOR	BOTN 801	3+1	Pharmacognosy & Ethnobotany	
		UG Degree With HONOURS (i+ii+iii+ iv+v)	BOTM 804 (iv)	3+1	Immunology & Translational Pathobiology	
			Field Work / Project (v)	4	-	
		UG Degree With RESEARCH (i+ii+iii+ vi)	Research Project (vi)	8	-	

Abbreviations: **MDC**: Multi Disciplinary Course; **AEC**: Ability Enhancement Course;
VAC: Value Added Course; **SEC**: Skill Enhancement Course.


SYLLABUS
of
FYUGP
1st SEMESTER
(Botany)
BOTANY

SEMESTER: FYUGP 1st SEMESTER				
Course Code	BOTM 101			
Course Title	Algae, Fungi, Bryophyte & Pteridophyte			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52(ES) + 18 (PR) +30 (IA) = 100			
Course Objectives	The course will provide a comprehensive understanding of the diversity, structure, reproduction, and classification of microbes, algae, fungi, bryophytes, and pteridophytes; It also aims to explore their ecological roles, economic significance, and applications in agriculture, industry, and biotechnology. The course is also thought to develop skills in comparative study, observation, and analysis of plant and microbial life cycles and evolutionary trends.			

	Course Content	
	THEORY	
UNITS	**CONTENTS**	**Teaching Hours/Marks Allotted**
I	**Introduction:** A general account on microbes (Bacteria and Virus) **Introduction to Algae** Classification system of Fritsch, and Basic concept of evolutionary classification viz. Lee; General characteristics; range of thallus organization; cell structure; pigment system, reserve food, methods of reproduction. Role of algae in the environment, agriculture, biotechnology and industry. Study of major divisions of Algae; Comparative study of Characteristics; Occurrence; Mode of reproduction; Morphology and life cycles of *Anabaena, Chara, Ectocarpus*, and *Polysiphonia*. Diatoms and its importance.	**15 H/17 M**
II	**Introduction to Fungi** Salient features; Classification; Thallus organization; Cell wall composition; Nutrition; Classification. Mycorrhiza (Ectomycorrhiza, Endomycorrhiza and their significance); Lichen: Classification & Economic Importance. Study of major divisions of Fungi: General characteristics of *Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota, Oomycota*: asexual and sexual fruiting bodies; Life cycle of *Phytophthora, Saccharomyces, Penicillium, Puccinia, Agaricus*. Economic importance of fungi.	**10 H/15 M**
III	**Bryophytes** General features; classification; thallus organization; morphology, anatomy and reproduction of *Marchantia*, *Anthoceros, Sphagnum*; Reproduction and evolutionary trends in bryophytes. Ecological and economic importance of Bryophytes, Adaptation to land habits.	**10 H/10 M**
IV	**Pteridophytes** Classification, morphology, anatomy and reproduction of *Psilotum, Selaginella, Equisetum* and *Ophioglossum, Marsilea*. Heterospory and seed habit, stelar evolution; Ecological and economic importance.	**10 H/10 M**
	TOTAL	**45 H/ 52 M**

<table>
<tr><th colspan="3">PRACTICAL</th></tr>
<tr><th>Experiment No.</th><th>Name of the Experiment</th><th>Teaching Hours/Marks Allotted</th></tr>
<tr><td></td><td>1. Study of vegetative and reproductive structures of Nostoc, Volvox,
2. Chara, Vaucheria, Ectocarpus and Polysiphonia, through electron micrographs, temporary preparations and permanent slides.
3. Study of vegetative and reproductive structures of Phytophthora, Saccharomyces, Aspergillus, Penicillium, Alternaria, Puccinia.
4. Study of vegetative and reproductive structures of Riccia, Marchantia, Anthoceros, Sphagnum/Polytrichum.
5. Study of vegetative and reproductive structures of Selaginella, Equisetum, Ophioglossum, and Marsilea</td><td>30 H/18 M</td></tr>
<tr><td>Course/ Learning outcomes</td><td colspan="2">Upon successful completion of the course, the student should be able to:

1. Identify and classify microbes, algae, fungi, bryophytes, and pteridophytes based on morphology, structure, and reproduction.
2. Explain their evolutionary relationships, ecological roles, and economic importance in agriculture, industry, and biotechnology.
3. Analyze life cycles, thallus organization, and reproductive strategies of major plant and microbial groups.
4. Apply observational and analytical skills to study diversity, adaptations, and environmental significance of lower plants and fungi.</td></tr>
<tr><td>Text/References</td><td colspan="2">1. “Fundamentals of Microbiology” – Pelczar, Chan & Krieg
2. Introductory Phycology” – C. S. Parker
3. “Introduction to Fungi” – Webster & Weber
4. “Textbook of Mycology” – Alexopoulos, Mims & Blackwell
5. “Bryophytes” – R. S. Chopra & A. K. Chopra
6. “Pteridophyta” – B. P. Pandey & R. C. Dubey
7. “Cryptogamic Botany (Vol. 1 & 2)” – A. C. Gangulee
8. “Cryptogamic Botany” – Vashishta, Sinha & Kumar (includes algae, fungi, bryophytes, pteridophytes)
9. “Botany for Degree Students – Algae, Fungi, Bryophytes, Pteridophytes” – B. P. Pandey</td></tr>
<tr><td colspan="3">MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations 20Marks
Attendance 5 Marks
Assignment/Seminar/Activity 5 Marks</td></tr>
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SEMESTER: FYUGP 1st SEMESTER				
Course Code	BOTN 101			
Course Title	Algae, Fungi, Bryophyte & Pteridophyte			
Category of Course	Minor			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52(ES) + 18 (PR) +30 (IA) = 100			
Course Objectives	The course will provide a comprehensive understanding of the diversity, structure, reproduction, and classification of microbes, algae, fungi, bryophytes, and pteridophytes; It also aims to explore their ecological roles, economic significance, and applications in agriculture, industry, and biotechnology. The course is also thought to develop skills in comparative study, observation, and analysis of plant and microbial life cycles and evolutionary trends.			

	Course Content	
	THEORY	
UNITS	**CONTENTS**	**Teaching Hours/Marks Allotted**
I	**Introduction:** A general account on microbes (Bacteria and Virus) **Introduction to Algae** Classification system of Fritsch, and Basic concept of evolutionary classification viz. Lee; General characteristics; range of thallus organization; cell structure; pigment system, reserve food, methods of reproduction. Role of algae in the environment, agriculture, biotechnology and industry. Study of major divisions of Algae; Comparative study of Characteristics; Occurrence; Mode of reproduction; Morphology and life cycles of *Anabaena, Chara, Ectocarpus*, and *Polysiphonia*. Diatoms and its importance.	**15 H/17 M**
II	**Introduction to Fungi** Salient features; Classification; Thallus organization; Cell wall composition; Nutrition; Classification. Mycorrhiza (Ectomycorrhiza, Endomycorrhiza and their significance); Lichen:Classification & Economic Importance. Study of major divisions of Fungi: General characteristics of *Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota, Oomycota*: asexual and sexual fruiting bodies; Life cycle of *Phytophthora, Saccharomyces, Penicillium, Puccinia, Agaricus*. Economic importance of fungi.	**10 H/15 M**
III	**Bryophytes** General features; classification; thallus organization; morphology, anatomy and reproduction of *Marchantia*, *Anthoceros, Sphagnum*; Reproduction and evolutionary trends in bryophytes. Ecological and economic importance of Bryophytes, Adaptation to land habits.	**10 H/10 M**
IV	**Pteridophytes** Classification, morphology, anatomy and reproduction of *Psilotum, Selaginella, Equisetum* and *Ophioglossum, Marsilea*. Heterospory and seed habit, stelar evolution; Ecological and economic importance.	**10 H/10 M**
	TOTAL	**45 H/ 52 M**

PRACTICAL		
Experiment No.	**Name of the Experiment**	**Teaching Hours/Marks Allotted**
	1. Study of vegetative and reproductive structures of *Nostoc, Volvox,* 2. *Chara, Vaucheria, Ectocarpus* and *Polysiphonia*, through electron micrographs, temporary preparations and permanent slides. 3. Study of vegetative and reproductive structures of *Phytophthora*, *Saccharomyces*, *Aspergillus*, *Penicillium*, *Alternaria*, *Puccinia*. 4. Study of vegetative and reproductive structures of *Riccia, Marchantia, Anthoceros, Sphagnum/Polytrichum.* 5. Study of vegetative and reproductive structures of *Selaginella, Equisetum*, *Ophioglossum,* and *Marsilea*	**30H / 18M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Identify and classify microbes, algae, fungi, bryophytes, and pteridophytes based on morphology, structure, and reproduction. 2. Explain their evolutionary relationships, ecological roles, and economic importance in agriculture, industry, and biotechnology. 3. Analyze life cycles, thallus organization, and reproductive strategies of major plant and microbial groups. 4. Apply observational and analytical skills to study diversity, adaptations, and environmental significance of lower plants and fungi.	
Text/References	1. **"**Fundamentals of Microbiology" – Pelczar, Chan & Krieg 2. Introductory Phycology" – C. S. Parker 3. "Introduction to Fungi" – Webster & Weber 4. "Textbook of Mycology" – Alexopoulos, Mims & Blackwell 5. "Bryophytes" – R. S. Chopra & A. K. Chopra 6. "Pteridophyta" – B. P. Pandey & R. C. Dubey 7. "Cryptogamic Botany (Vol. 1 & 2)" – A. C. Gangulee 8. "Cryptogamic Botany" – Vashishta, Sinha & Kumar (includes algae, fungi, bryophytes, pteridophytes) 9. "Botany for Degree Students – Algae, Fungi, Bryophytes, Pteridophytes" – B. P. Pandey	
MODES OF IN-SEMESTER ASSESSMENT: (30 Marks) Two Sessional Examinations 20Marks Attendance 5 Marks Assignment/Seminar/Activity 5 Marks		

SEMESTER: FYUGP 1st SEMESTER				
Course Code	MDCN 101			
Course Title	Natural Resource Management			
Category of Course	MDC			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	0	3
	Hours of Teaching	45	0	45
Total Marks	70 (ES) + 30 (IA)=100			
Course Objectives	The objective of this course is to provide knowledge to the students onimportance, sustainable utilization, conservation and management of natural resources.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	Natural Resources: Definition and types. Natural resources of NE India.	9 H / 15 M
II	Sustainable utilization of land and water resources; Soil degradation and management; water resources and their management. Rivers and Wetlands of Assam and their management. Renewable and non-renewable sources of energy. River dams.	13 H / 20 M
III	Forests: Definition, Significance; Types of vegetationin India; NTFP-Depletion and Management, JFM. Forest of Assam.	10 H / 15 M
IV	Contemporary practices in resource management: EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management. National and international efforts in resource management and conservation**.** IKS.	13 H / 20 M
TOTAL		45 H / 70 M

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours & Allotted Marks
1	NIL	NA
2		
3		
4		
5		
6		
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Know about the natural resources, its types, sustainable utilization and management practices 2. Understand natural resources and their management by explaining the definition, types, distribution of natural resources in North-East India, and the significance of forests, land, water, and energy resources.	

Texts / References	1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, NewDelhi 2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and ResourceConservation. Anamaya Publications, New Delhi. 3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi. 4. Bora A., Borah H., Das U., Kakoti D. and Dutta R. **প্ৰাকৃতিক সম্পদ ব্যৱস্থাপনা** (Natural Resource Management) মাধৱদেৱ বিশ্ববিদ্যালয়ৰ চাৰিবছৰীয়া স্নাতক পাঠ্যক্ৰমৰ**)** FYUGP) প্ৰথম ষাণ্মাসিকৰ বাধ্যতামূলক বহুমুখী পাঠ্যক্ৰমৰ **(**Multi Disciplinary Courses**)** আধাৰত প্ৰস্তুত**,** Kaustabh Prakashan, Dibrugarh, Assam.

MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 1st SEMESTER				
Course Code	SEC 101			
Course Title	Mushroom Cultivation			
Category of Course	SEC			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	2	1	3
	Hours of Teaching	30	30	60
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The course is designed to impart students with practical skills in mushroom production, enabling self-employment, startup development, and sustainable livelihood generation using locally available substrate material.			

Course Content

THEORY

Units	CONTENT	Teaching hours / Allotted Marks
I	**Introduction to Mushroom Cultivation** Introduction and scope of mushroom cultivation; Characterization of edible and poisonous Mushrooms; Nutritional and medicinal value of mushrooms.	**5 H/10 M**
II	**Principle of Mushroom Cultivation** Structure and construction of mushroom house; Concept, types and production of spawn; Sterilization and preparation of substrates; Composting techniques; Mushroom bed preparation; Harvesting.	**5 H/10 M**
III	**Cultivation of Common Edible Mushrooms** Cultivation process of *Agaricus bisporus* (Button mushroom), *Pleurotus spp.* (Oyster mushroom), *Volvariella volvacea* (Paddy straw mushroom).	**5 H/10 M**
IV	**Crop Management** Common pests and diseases; Preventive and control measures; Hygiene and sanitation practices; Yield improvement techniques.	**7 H/11 M**
V	**Post-Harvest, Value Addition and Marketing** Preservation of mushrooms- freezing, drying, and packaging of harvested mushrooms; Quality assurance; Value added products of mushrooms; Cost analysis and marketing strategies; Government schemes and entrepreneurship opportunities.	**8 H/11 M**
TOTAL		**30 H/52 M**

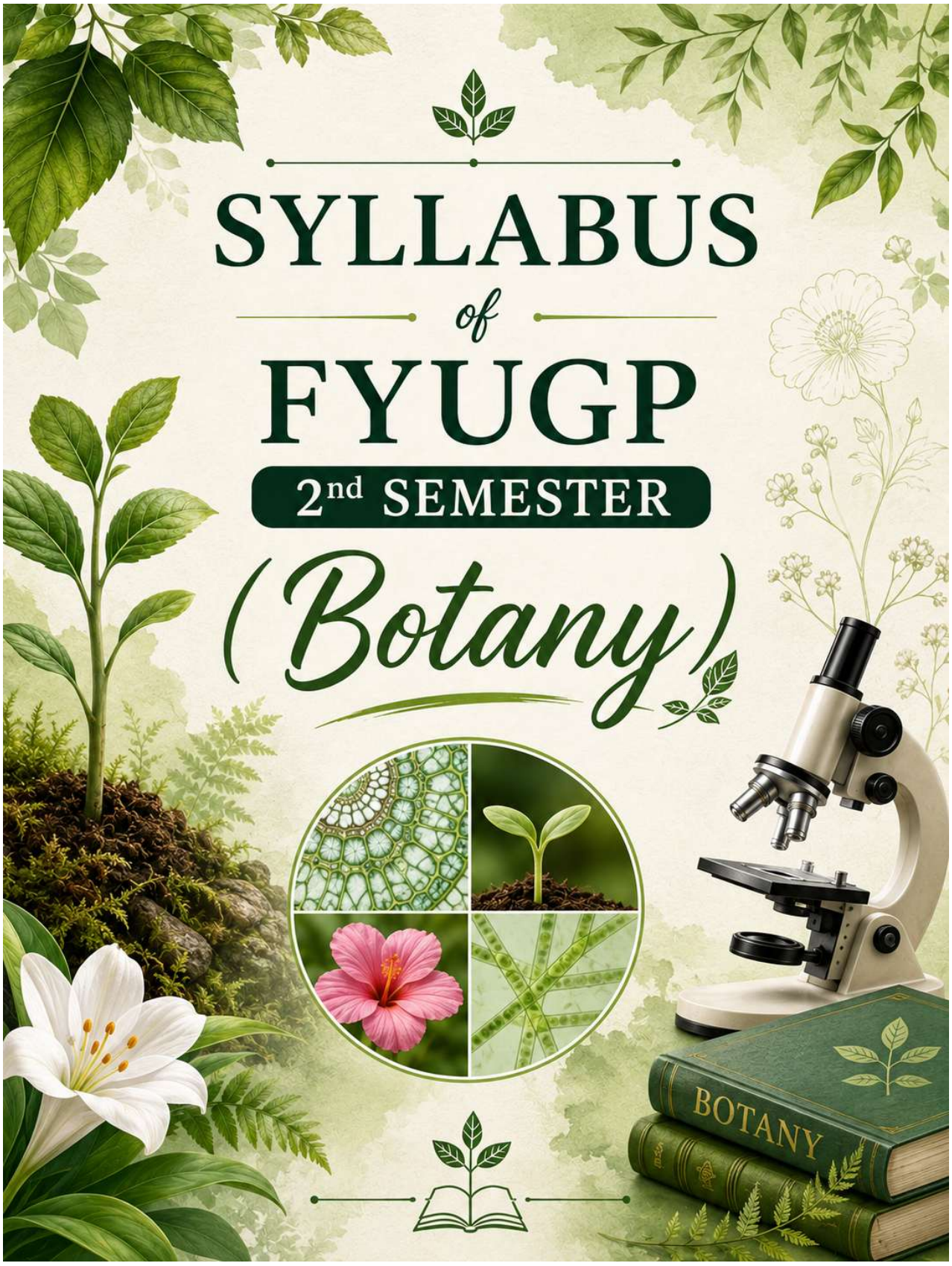
PRACTICAL

Exp. No.	Name of the experiment	Teaching hours & Allotted Marks
1 2 3 4	Substrate preparation Culture media preparation Spawn preparation Field visit to a mushroom production unit to study cultivation methods, environmental requirements, harvesting techniques, and post-harvest management of edible mushrooms	**30H / 18M**

	Once the course is completed the students will: ➢ Have the basic knowledge of how to identify edible and poisonous mushrooms.

Course/ Learning outcomes	➢ Gain the knowledge on cultivation method of commonly grown edible mushrooms ➢ Know the nutritional value of the edible mushrooms. ➢ Open the opportunity of self-employment and income generation.
Texts / References	1. Purkayastha, R.P. and Chandra, A. (1985). Manual of Indian edible Mushrooms, 1st Edition. Today and Tomorrows Printers and Publishers, New Delhi. 2. Pathak, V.N, Yadav, N. (1998). Mushroom Production and Processing Technology, 1st Edition. Agrobios, Jodhpur. 3. Tripathi, D.P. (2005) Mushroom Cultivation, 1st Edition. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. 4. Pandey, R.K. and Ghosh, S.K. (1996). A Hand Book on Mushroom Cultivation, 1st edition. Emkey Publications. 5. Pathak, V.N., Yadav, N. and Gaur, M. (2000). Mushroom Production and Processing Technology, Indian Edition. Vedams Ebooks Pvt. Ltd., New Delhi. 6. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. (1991). Oyster Mushroom, 1st Edition. Department of Plant Pathology, Tamil Nadu, Agricultural University, Coimbatore. 7. Bhal, N. (2000). Handbook of Mushrooms. 2nd edition, Vol. I and II. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi. 8. Tiwari Pankaj Kapoor, S. C. (1998). Mushroom cultivation, 1st Edition. Mittal Publication, New Delhi. 9. Kaul, T.N. (2001). Biology and Conservation of Mushrooms, 1st edition. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. 10. Dhar, B.L. and Sharma, S.R. (2009). Advances in Mushroom Production, 1st edition. National Research Centre for Mushroom, Solan, Himachal Pradesh, India. 11. Chang, S.T. and Miles, P.G. (2004). Mushrooms: Cultivation, Nutritional Value, Medicinal Effect and Environmental Impact, 2nd edition. CRC Press, Boca Raton, Florida, USA.

MODES OF IN-SEMESTER ASSESSMENT	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment Seminar	5 Marks


SYLLABUS
of
FYUGP
2nd SEMESTER
(Botany)
BOTANY

SEMESTER: FYUGP 2nd SEMESTER				
Course Code	BOTM 201			
Course Title	Morphology and Reproduction of Spermatophytes			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52(ES) + 18 (PR) +30 (IA) = 100			
Course Objectives	The course is designed to understand the diversity, structure, reproduction, evolution, and economic importance of gymnosperms, fossil plants, and angiosperms. It will also help students to study the morphology and reproductive biology of flowering plants, including pollination, fertilization, embryology, and seed development. Apart from that, the course is thought to develop knowledge of evolutionary theories, plant fossil records, and the significance of plant reproductive processes in taxonomy, ecology, and agriculture.			

Course Content

THEORY

UNITS	CONTENTS	Teaching Hours/Marks Allotted
I	**Gymnosperms:** General characteristics, classification, morphology, anatomy and reproduction of *Cycas, Pinus, Gnetum*; Patterns of embryo development in gymnosperms. Ecological and economic importance. **Fossil plants:** Process of fossilization; early land plants; *Rhynia, Cycadeoidea, Sphenophyllum*; importance of fossil study. Geological time scale **Evolution**: Theories of evolution(Lamarckism, Darwinism,Neo-Darwinism, Modern synthetic theory)	**15 H /17M**
II	**Morphology of Angiosperms** Morphology and types of root, stem, and leaves; phyllotaxy and venation, hairs and trichomes, inflorescence and its types; aestivation. Arrangement and types of reproductive parts of flower, placentation and its types.	**10 H / 15M**
III	**Anther and Pollen Biology** Anther wall: structure and functions, microsporogenesis, callose deposition and its significance; microgametogenesis; pollen wall structure, MGU (Male Germ Unit) structure, NPC classification; palynology and scope (a brief account); pollen wall proteins; pollen viability, storage and germination, pollen allergy, melissopalynology. Ovule: Structure and types of ovule; female gametophyte – megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis.	**10H /10M**
IV	**Pollination, Fertilization and Post fertilization developments** Pollination types and significance; adaptations for pollination; Double fertilization; Structure and types; general pattern of development of dicot and monocot embryo and endosperm; suspensor: structure and functions; embryo-endosperm relationship; nutrition of embryo; Polyembryony-causes & importance, apomixis, parthenocarpy and self- incompatibility.	**10H /10M**
	TOTAL	**45 H/ 52 M**

PRACTICAL		
Experiment No.	**Name of the Experiment**	**Teaching Hours/Marks Allotted**
	1. Study of morphology and reproductive parts of *Cycas, Pinus* & *Gnetum.* 2. Study of Fossil plants (Photographs/specimen). 3. Study of different types of roots (Morphology only). 4. Types of leaves, venation, hairs and trichomes, 5. Phyllotaxy, inflorescence and aestivation. 6. Types of placentation and ovule (Preparation of temporary slides/photographs) 7. Study of pollen morphology (Malvaceae & Solanaceae) and pollen germination. 8. Study of anther, different types of ovules, embryo sacs, embryos (dicot and monocot) and endosperms (Permanent slides/ photographs).	**30H /18M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the morphology, anatomy, reproduction, and evolutionary significance of gymnosperms, fossil plants, and angiosperms. 2. Identify and classify various plant structures, reproductive organs, and developmental patterns in flowering plants. 3. Describe processes such as pollination, fertilization, embryogenesis, and seed formation, including their biological significance. 4. Evaluate evolutionary theories and apply knowledge of plant reproductive biology to ecological, agricultural, and taxonomic studies.	
Text/References	1. "Botany for Degree Students: Gymnosperms, Plant Embryology and Palynology"- B. P. Pandey (S. Chand Publishing) 2. "Plant Anatomy"- B. P. Pandey (S. Chand Publishing) 3. "An Introduction to Embryology of Angiosperms"- P. Maheshwari (McGraw Hill Education India) 4. "Plant Systematics: Theory and Practice"- Gurcharan Singh (Oxford & IBH Publishing Co. Pvt. Ltd.) 5. "Paleobotany: The Biology and Evolution of Fossil Plants"- Thomas N. Taylor, Edith L. Taylor & Michael Krings (Academic Press)	

MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
Two Sessional Examinations	20Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 2nd SEMESTER				
Course Code	BOTN 201			
Course Title	Morphology and Reproduction of Spermatophytes			
Category of Course	Minor			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52(ES) + 18 (PR) +30 (IA) = 100			
Course Objectives	The course is designed to understand the diversity, structure, reproduction, evolution, and economic importance of gymnosperms, fossil plants, and angiosperms. It will also help students to study the morphology and reproductive biology of flowering plants, including pollination, fertilization, embryology, and seed development. Apart from that, the course is thought to develop knowledge of evolutionary theories, plant fossil records, and the significance of plant reproductive processes in taxonomy, ecology, and agriculture.			
	Course Content			
	THEORY			

UNITS	CONTENTS	Teaching Hours/Marks Allotted
I	**Gymnosperms:** General characteristics, classification, morphology, anatomy and reproduction of *Cycas, Pinus, Gnetum*; Patterns of embryo development in gymnosperms. Ecological and economic importance. **Fossil plants:** Process of fossilization; early land plants; *Rhynia, Cycadeoidea, Sphenophyllum*; importance of fossil study. Geological time scale **Evolution**: Theories of evolution(Lamarkism, Darwinism,Neo-Darwinism, Modern synthetic theory)	**15H /17M**
II	**Morphology of Angiosperms** Morphology and types of root, stem, and leaves; phyllotaxy and venation, hairs and trichomes, inflorescence and its types; aestivation. Arrangement and types of reproductive parts of flower, placentation and its types.	**10H /15M**
III	**Anther and Pollen Biology** Anther wall: structure and functions, microsporogenesis, callose deposition and its significance; microgametogenesis; pollen wall structure, MGU (Male Germ Unit) structure, NPC classification; palynology and scope (a brief account); pollen wall proteins; pollen viability, storage and germination, pollen allergy, melissopalynology. Ovule: Structure and types of ovule; female gametophyte – megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis.	**10H /10M**
IV	**Pollination, Fertilization and Post fertilization developments** Pollination types and significance; adaptations for pollination; Double fertilization; Structure and types; general pattern of development of dicot and monocot embryo and endosperm; suspensor: structure and functions; embryo-endosperm relationship; nutrition of embryo; Polyembryony-causes & importance, apomixes, parthenocarpy and self- incompatibility.	**10H /10M**
	TOTAL	**45 H/ 52 M**

PRACTICAL		
Experiment No.	**Name of the Experiment**	**Teaching Hours/Marks Allotted**
	1. Study of morphology and reproductive parts of *Cycas, Pinus* & *Gnetum.* 2. Study of Fossil plants (Photographs/specimen). 3. Study of different types of roots (Morphology only). 4. Types of leaves, venation, hairs and trichomes, 5. Phyllotaxy, inflorescence and aestivation. 6. Types of placentation and ovule (Preparation of temporary slides/photographs) 7. Study of pollen morphology (Malvaceae & Solanaceae) and pollen germination. 8. Study of anther, different types of ovules, embryo sacs, embryos (dicot and monocot) and endosperms (Permanent slides/ photographs).	**30H /18M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the morphology, anatomy, reproduction, and evolutionary significance of gymnosperms, fossil plants, and angiosperms. 2. Identify and classify various plant structures, reproductive organs, and developmental patterns in flowering plants. 3. Describe processes such as pollination, fertilization, embryogenesis, and seed formation, including their biological significance. 4. Evaluate evolutionary theories and apply knowledge of plant reproductive biology to ecological, agricultural, and taxonomic studies.	
Text/References	1. "Botany for Degree Students: Gymnosperms, Plant Embryology and Palynology"- B. P. Pandey (S. Chand Publishing) 2. "Plant Anatomy"- B. P. Pandey (S. Chand Publishing) 3. "An Introduction to Embryology of Angiosperms"- P. Maheshwari (McGraw Hill Education India) 4. "Plant Systematics: Theory and Practice"- Gurcharan Singh (Oxford & IBH Publishing Co. Pvt. Ltd.) 5. "Paleobotany: The Biology and Evolution of Fossil Plants"- Thomas N. Taylor, Edith L. Taylor & Michael Krings (Academic Press)	

MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
Two Sessional Examinations	20Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 2nd SEMESTER				
Course Code	MDC 201			
Course Title	Plant Diversity and Human Welfare			
Category of Course	MDC			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	0	3
	Hours of Teaching	45	0	45
Total Marks	70 (ES) + 30 (IA)=100			
Course Objectives	The objective of this course is to provide knowledge to the students on plant diversity and its importance for human welfare.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Plant diversity and its scope**: Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Uses of plants, Uses of microbes.	**10 H / 15 M**
II	**Loss of Biodiversity**: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss, Management of Plant Biodiversity: Organizations associated with biodiversity management Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conventions.	**15 H / 20 M**
III	**Conservation of Biodiversity**: Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.	**8 H / 15 M**
IV	**Role of plants in relation to Human Welfare**: a) Importance of forestry, their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. e) Fruits and nuts: Important fruit crops their commercial importance. f) Wood and its uses.	**12 H / 20 M**
TOTAL		**45 H 70 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours & Allotted Marks
	NIL	**NA**
Course/ Learning	1. Know the scope, dimension and importance and threats to plant diversity. 2. Conservation ways of biodiversity and its Sustainable utilization.	

outcomes	3. Acquire knowledge of biodiversity for human welfare.
Texts / References	1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi. 2. Dutta R., Bora A., Borah H., Das U. **বৈচিত্র্যময় উদ্ভিদ জগত আৰু মানৱ কল্যাণ** (**Plant Diversity and Human Welfare),** মাধৱদেৱ বিশ্ববিদ্যালয়ৰ চাৰিবছৰীয়া স্নাতক পাঠ্যক্রমৰ)FYUGP) প্রথম ষাণ্মাসিকৰ বাধ্যতামূলক বহুমুখী পাঠ্যক্রমৰ (Multi Disciplinary Courses) আধাৰত প্রস্তুত, Kaustabh Prakashan, Dibrugarh, Assam.

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar	5 Marks

SEMESTER: FYUGP 2nd SEMESTER				
Course Code	AEC 201			
Course Title	Madhabdev Studies (Syllabus prepared by Assamese Department, MDU)			
Category of Course	AEC			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	4	0	4
	Hours of Teaching	60	0	60
Total Marks	70 (ES) + 30 (IA)=100			
Course Objectives	The objective of this course is to acquaint the students with the philosophy and literary achievement of Sri Sri Madhabdeva who enriched the spiritual &socio-cultural sphere of Assam through Neo-Vaishnavism.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Neo-Vaishnavite Movement in Assam:** a) Vaishnavism -A brief introduction b) Bhakti Movement in Indian-Origin and general feature c) Neo-Vaishnavismin Assam Origin, development and characteristics	**20 H / 30 M**
II	**Life and Works of Sri Sri Madhabdeva:** a) Biography of Sri Sri Madhahdeva b) Vision and Philosophy of Madhabdeva c) Literary Works of Sri Sri Madhabdeva and his Contribution (Suggested Topics: Ancestors of Madhabdeva, his meeting with his guru Sankardeva, his new vision towards spiritualism, literary works performing art)	**20 H / 30 M**
III	**Successors of Sri Sri Madhabdeva:** a) Division of Sanghatis and followers Satras of Sanghatis b) Notable saints of Assam viz. Damodardeva, Harideva, Gopalata, Anirudhadeva	**20 H / 10 M**
TOTAL		**60 H / 70 M**

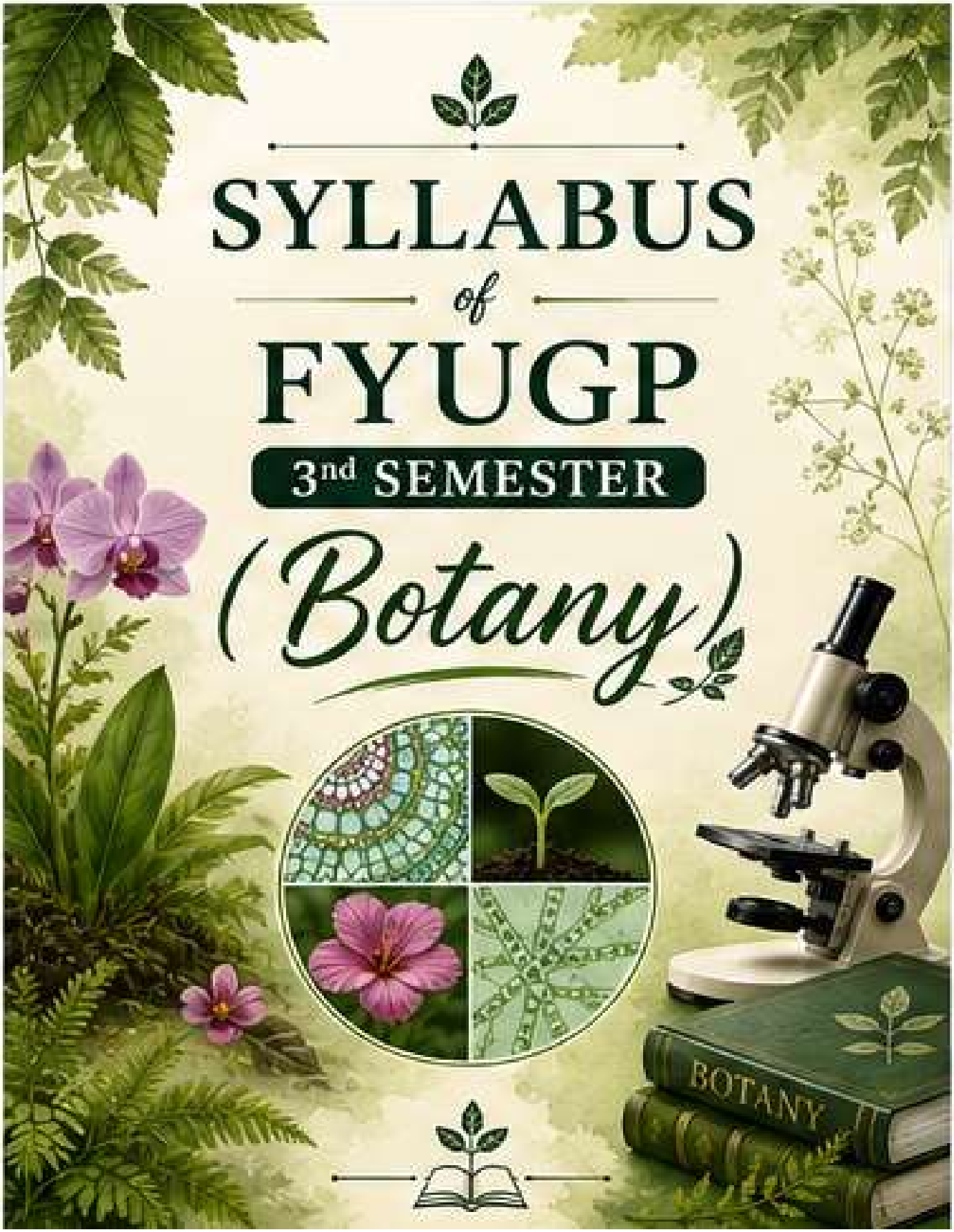
PRACTICAL

Exp. No.	Name of the experiment	Teaching hours & Allotted Marks
	NIL	**NA**
Course/	1. The course aims to provide a clear idea of Neo-Vaishnavism religious believes	

Learning outcomes	2. To know about Assam Vaishnavite Sanghatis. 3. To know about Madhabdevas life and philosophy. 4. To Know about successors of Vashinavite saints of Assam
Texts / References	1. Birinchi Kumar Baruah: History of Assamese Literature (Chapter-3) 2. Kaliram Medhi: Studies in the Vaisnavite Literature and Culture of Assam 3. Dr. Dayananda Pathak: Sri Sri Madhabdev 4. Suvira Jaiswal: The Origin and Development of Vaisnavism 5. T.C. Rastogi: Assam Vaisnavism 6. P J Mahanta: Glimpses of the Vaisnavite Heritage of Assam

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar	5 Marks


SYLLABUS
of
FYUGP
3nd SEMESTER
(Botany)
BOTANY

SEMESTER: FYUGP 3rd SEMESTER				
Course Code	BOTM 301			
Course Title	Cell Biology			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52(ES) + 18 (PR) +30 (IA) = 100			
Course Objectives	The objective of this course is to provide students the concept of cell as functional unit of life, structure of plant cell and functions of cellular components.			

Course Content

THEORY

UNITS	CONTENTS	Teaching Hours/Marks Allotted
I	**The cell** Cell as a unit of structure and function; cell theory, Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).	**8 H / 8M**
II	**Cell wall and plasma membrane** Chemistry, structure and function of Plant cell wall; Overview of fluid mosaic model; Chemical composition of membranes; membrane function.	**10 H /12 M**
III	**Cell organelles** Nucleus & its Structure. Microtubules, microfilaments and intermediary filament. Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Mitochondria and Chloroplast: structure, functions & semiautonomous nature; Ribosomes- types, components and function; Lysosomes, Endoplasmic Reticulum, Golgi apparatus: structure, functions & protein sorting.	**12 H /15 M**
IV	**Membrane transport and Protein sorting & targeting** Membrane transport – Passive, active and facilitated transport, membrane channels, gates and pores; endocytosis and exocytosis; protein glycosylation, protein sorting and export from Golgi apparatus; protein folding& processing; Smooth endoplasmic reticulum and lipid synthesis, export of proteins and lipids.	**7 H /10 M**
V	**Cell division** Types of cell division, stages of mitosis and meiosis; Phases of eukaryotic cell cycle, Regulation of cell cycle-checkpoints, Interphase, role of protein kinases, significance.	**8 H / 7 M**
	TOTAL	**45 H / 52 M**

PRACTICAL

Experiment No.	Name of the Experiment	Teaching Hours/Marks Allotted
	1. Study of plant cell structure with the help of epidermal peel mount of Onion/Crinum/Rheo. 2. Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf, Vallisnaria. 3. Measurement of cell size by of micrometric method. 4. Cell counting using Haemocytometer (Yeast/pollen grains).	**30 H /18 M**

	5. Study the phenomenon of plasmolysis and deplasmolysis. 6. Study of cell and its organelles with the help of electron micrographs. 7. Cytochemical staining of: DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique. 8. Study of different stages of mitosis and meiosis.	
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the cell as the basic structural and functional unit of life and differentiate between prokaryotic and eukaryotic cells. 2. Describe the structure, composition, and functions of the plant cell wall and plasma membrane based on the fluid mosaic model. 3. Identify and explain the structure and functions of major cell organelles. 4. Illustrate the mechanisms of membrane transport, protein sorting, targeting, folding, processing and lipid synthesis within the cell. 5. Analyze the stages and significance of mitosis, meiosis and the eukaryotic cell cycle.	
Text/References	1. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition. 2. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson EducationInc. U.S.A. 8th edition. 3. Cooper, G.M. and Hausman, R.E. (2009): The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 3rd SEMESTER				
Course Code	BOTM 302			
Course Title	Plant Biochemistry & Molecular Biology			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The given course will provide a comprehensive understanding of the biochemical composition and metabolic processes of plants. It will give an introduction of the structure, organization and function of genetic material in plants. Furthermore, it will explain the molecular mechanisms governing gene expression and regulation. It will familiarize the learners with modern molecular techniques used in plant sciences and will help them to develop practical skills in biochemical and molecular analyses of plant materials.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Biomolecules and Plant Cell Organization** Introduction to plant biochemistry and molecular biology; Chemical composition of plant cells; Structure, properties, and functions of carbohydrates, lipids, proteins and nucleic acids; Organization and functions of cellular organelles involved in metabolism; Water and mineral nutrition in relation to plant metabolism.	**9 H/10 M**
II	**Enzymes and Plant Metabolism** Nature, classification and properties of enzymes; Enzyme kinetics and factors affecting enzyme activity; Coenzymes and cofactors; Bioenergetics: ATP and biological oxidation; Overview of carbohydrate metabolism: glycolysis, TCA cycle, and pentose phosphate pathway.	**9 H/11 M**
III	**Photosynthesis and Nitrogen Metabolism** Photosynthetic pigments and photosystems; Light reactions and photophosphorylation; Carbon fixation pathways: C3, C4, and CAM metabolism; Nitrogen assimilation and biological nitrogen fixation; Amino acid and protein biosynthesis in plants.	**9 H/11 M**
IV	**Molecular Biology of the Gene** Structure and organization of DNA and RNA; DNA replication in prokaryotes and eukaryotes; Transcription and RNA processing; Genetic code and translation; Regulation of gene expression in plants.	**9 H/10 M**
V	**Recombinant DNA Technology and Plant Biotechnology** Principles and tools of recombinant DNA technology; Restriction enzymes, vectors, and cloning strategies; Polymerase Chain Reaction (PCR) and DNA sequencing; Gene transfer methods in plants and Applications of molecular biology in crop improvement, disease diagnosis and plant biotechnology.	**9 H/10 M**
TOTAL		**45H/ 52 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours & Allotted Marks
	1. Qualitative tests for carbohydrates, proteins, amino acids, and lipids. 2. Determination of reducing sugars by Benedict's method. 3. Estimation of plant proteins by Biuret/Lowrymethod. 4. DNA estimation by diphenylamine reagent/UVSpectrophotometry. 5. Extraction and estimation of chlorophyll from plant leaves. 6. Demonstration of the qualitative analysis of DNA using agarose gel electrophoresis 7. Demonstration of the isolation of RNA from plant material (demonstration). 8. Demonstration of Polymerase Chain Reaction (PCR). 9. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication). 10. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II, through photographs.	**30 H / 18 M**
Course/ Learning outcomes	Upon successful completion of the course, students will be able to: ➢ Explain the structure and functions of major biomolecules in plants. ➢ Describe enzymatic reactions and metabolic pathways occurring in plant cells. ➢ Understand the molecular basis of inheritance and gene expression. ➢ Apply basic molecular biology techniques for nucleic acid analysis. ➢ Interpret biochemical and molecular data relevant to plant sciences.	
Texts / References	1. Nelson, D.L. and Cox, M.M. (2021). Lehninger Principles of Biochemistry. 8th Edition. W.H. Freeman and Company, New York. 2. Buchanan, B.B., Gruissem, W. and Jones, R.L. (2015). Biochemistry and Molecular Biology of Plants. 2nd Edition. Wiley Blackwell, Oxford. 3. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A. (2018). Plant Physiology and Development. 6th Edition. Sinauer Associates, Massachusetts. 4. Voet, D., Voet, J.G. and Pratt, C.W. (2019). Fundamentals of Biochemistry: Life at the Molecular Level. 6th Edition. Wiley, New York. 5. Brown, T.A. (2020). Gene Cloning and DNA Analysis: An Introduction. 8th Edition. Wiley-Blackwell, Oxford. 6. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2014). Molecular Biology of the Gene. 7th Edition. Pearson Education, New York. 7. Glick, B.R., Pasternak, J.J. and Patten, C.L. (2017). Molecular Biotechnology: Principles and Applications of Recombinant DNA. 5th Edition. ASM Press, Washington, D.C. 8. Plummer, D.T. (2017). An Introduction to Practical Biochemistry. 6th Edition. McGraw-Hill Education, New Delhi. 9. Berg, J.M., Tymoczko, J.L., Gatto, G.J. and Stryer, L. (2019). Biochemistry. 9th Edition. W.H. Freeman and Company, New York. 10. Deb, A.C. (2011). Fundamentals of Biochemistry. 9th Edition. New Central Book Agency (P) Ltd., Kolkata.	

MODES OF IN-SEMESTER ASSESSMENT	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment Seminar	5 Marks

SEMESTER: FYUGP 3rd SEMESTER				
Course Code	BOTN 301			
Course Title	Cell Biology, Plant Anatomy & Genetics			
Category of Course	Minor			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	This course provides knowledge of cell biology, plant anatomy and genetic with emphasis on processes and their significance. The course also develops practical skills in anatomical, cellular and genetical studies through microscopic observations.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	Cell theory; prokaryotic and eukaryotic cells; general organization of the plant cell; differences between plant and animal cells. Cell wall—structure, chemical composition, primary and secondary cell walls, middle lamella, pits, and plasmodesmata. Plasma membrane—structure, fluid mosaic model, membrane transport.	8 H 10 M
II	Cell organelles—structure and functions of nucleus, nucleolus, chloroplast, mitochondria, endoplasmic reticulum, Golgi apparatus, ribosomes, lysosomes, vacuoles, peroxisomes. Cell cycle—phases of the cell cycle, mitosis and cytokinesis in plant cells; significance of mitosis; basic concept of meiosis and its significance.	9 H 10 M
III	**Meristematic and permanent tissues:** Characters of meristematic tissues, Root and shoot apical meristems; Simple and complex tissues.	4 H 5 M
IV	**Organs:** Structure of dicot and monocot root, stem and leaf. **Secondary Growth:** Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood). **Adaptive and protective systems:** Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.	5 H 8 M
V	**Structural organization of flower:** Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac. **Pollination and fertilization:** Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms. **Embryo and endosperm:** Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm relationship. **Apomixis and polyembryony:** Definition, types and Practical applications.	10 H 10 M
VI	**Genetics: C**oncepts of heredity, variation, genes, alleles, genotype, phenotype, chromosomes, Mendel's laws of inheritance. Linkage and crossing over (basic concepts). Sex determination in plants (brief introduction). Mutations—types, causes, and significance in plant evolution and crop improvement.	9 H 9 M
TOTAL		**45H 52M**

PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
1	Study of meristems through permanent slides and photographs	**30 hours 18 Marks**
2	Tissues (parenchyma, collenchyma and sclerenchyma); Maceratedxylem elements, Phloem (Permanent slides, photographs).	
3	Stem: Monocot: *Zea mays*; Dicot: *Helianthus;*Secondary: *Helianthus* (only Permanent slides).	
4	Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).	
5	Study of mitosis and meiosis from fresh specimens and permanent slides	
6	Study of plant cells using temporary mounts (onion epidermis and leaf epidermis)	
7	Study of plastids and stomata from fresh specimens.	
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the structure and organization of plant cell, tissues and organs. 2. Describe the processes of basic plant genetics. **3.** Identify anatomical and cellular structures along with the basic genetics using permanent slides and laboratory specimens.	
Texts / References	1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA. 2. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA. 3. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA. 4. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.	

MODES OF IN-SEMESTER ASSESSMENT **(30 Marks)**

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment Seminar	5 Marks

SEMESTER: FYUGP 3rd SEMESTER				
Course Code	VAC 301			
Course Title	Environmental Studies			
Category of Course	VAC/EVS (COMPULSORY FOR ALL)			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	0	3
	Hours of Teaching	45	0	45
Total Marks	70 (ES) + 30 (IA)=100			
Course Objectives	To emphasize sustainability of the society through equitable maintenance of natural resources; To illustrate about environment & biodiversity that raises an appreciation and deeper understanding of species, ecosystems and also the interconnectedness of the living world and thereby avoids the mismanagement, misuse and destruction of biodiversity; To familiarize sustainable development that aims to meet raising human needs of the present and future generations through preserving the environment and natural resources.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	The Environment: The Atmosphere, Hydrosphere, Lithosphere, Biosphere, Ecology, Ecosystem, Biogeochemical Cycle (Carbon Cycle, Nitrogen Cycle), Water cycle, Environmental Pollution: Air Pollution, Water Pollution, Soil Pollution, Radiation Pollution, Plastic Pollution. Arsenic pollution in Assam.	12 H / 20 M
II	Population Ecology: Individuals, Species, Population, Community, Control Methods of Population, Urbanization and its effects on Society, Communicable Diseases and its Transmission, Non-Communicable Diseases.	10 H / 15 M
III	Environmental Movements in India: Grass root Environmental movements in India, Role of women, Environmental Movements in Assam, River Dams: Its negative impact on environment & society with special reference to Assam. Dam induced flood in Assam. Assam Pollution Control Board, Central Pollution Control Board.	10 H / 15 M
IV	Natural Resources: Conservation of Natural Resources, Management and Conservation of Wildlife, Soil Erosion and Conservation, Water Resources of Northeast India. Environmental Laws: Water Act, 1974, Air Act, 1981, The Wildlife (Protection) Act, 1972, Environment Protection, 1986, Natural Disasters and their Management. Floods in Assam.	13 H / 20 M
TOTAL		**45 H / 70 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours & Allotted Marks
1		

2	**NIL**	**NA**
3		
4		
5		
6		
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. To know about the environment and its components. 2. Identify the natural resources and understand resource management. 3. Critique the Importance of biodiversity and its conservation. 4. Analyze the problems related to environmental pollution and management.	
Texts / References	1. Singh, J.S., Singh, S.P. & Gupta, S.R. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications. 2. Asthana, D. K. (2006).Text Book of Environmental Studies. S. Chand Publishing. 3. Basu, M., Xavier, S. (2016). Fundamentals of Environmental Studies, Cambridge University Press, India. 4. Sharma, P.D., 2015-16. Ecology and Environment.12th edition. Rastogi Publications, Meerut. 5. Miller, G.T. and Spoolman, S.E., 2013. Environmental Science. 14th edition. Environmental Science. Brooks/Cole Cengage Learning, USA.	
MODES OF IN-SEMESTER ASSESSMENT:		**(30 Marks)**
Two Sessional Examinations		20 Marks
Attendance		5 Marks
Assignment/Seminar		5 Marks

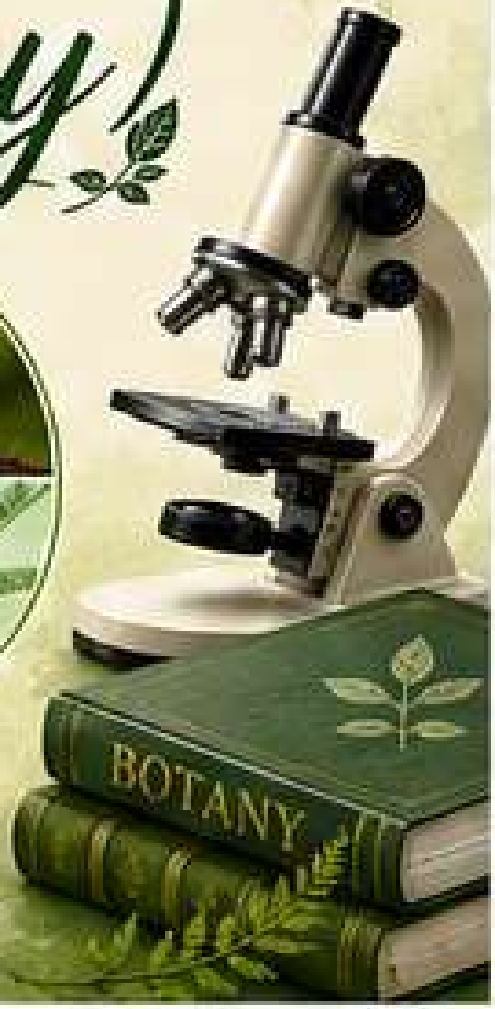
SYLLABUS

of

FYUGP

4th SEMESTER

(Botany)



SEMESTER: FYUGP 4th SEMESTER				
Course Code	BOTM 401			
Course Title	Microbiology & Plant Pathology			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The given syllabus will introduce learners to the fundamental concepts of microbiology and plant pathology. It will also help to understand the diversity, structure, physiology, and significance of microorganisms. The course will help the learners to study plant pathogens, the mechanisms of disease development in plants and develop skills in the isolation, identification, and management of plant diseases. The learners will be provided the practical exposure to microbiological and plant pathological technique.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Introduction to Microbiology and Microbial World** History and scope of microbiology; Contributions of major microbiologists: Antonie van Leeuwenhoek, Louis Pasteur, Robert Koch; Classification and diversity of microorganisms; General characteristics of Bacteria, Archaea, Fungi, Algae, Protozoa, and Viruses; Economic importance of microorganisms in agriculture and industry.	**9 H/10 M**
II	**Microbial Structure, Nutrition and Growth** Cell structure of prokaryotes and eukaryotes; Bacterial cell wall, capsule, flagella, pili, endospore; Microbial nutrition and nutritional types; Microbial growth curve and factors affecting microbial growth; Sterilization, disinfection, and culture media.	**9 H/10 M**
III	**Introduction to Plant Pathology and Plant Diseases** History, scope, and importance of plant pathology; Concept of plant disease and disease triangle; Classification of plant diseases; Symptoms and signs of plant diseases; Major groups of plant pathogens: Fungi, Bacteria, Viruses, Phytoplasma, Nematodes, and Parasitic flowering plants.	**9 H/11 M**
IV	**Host–Pathogen Interaction and Disease Development** Pathogenesis and infection process; Penetration and colonization of host tissues; Disease cycle and epidemiology; Environmental factors influencing disease development; Plant defence mechanisms: structural and biochemical defences.	**9 H/10 M**
V	**Plant Disease Diagnosis and Management** Principles of disease diagnosis; Conventional and modern diagnostic techniques; Principles of plant disease management; Cultural, physical, biological, and chemical control methods; Integrated Disease Management (IDM); Brief account of important diseases of rice, wheat, potato, and citrus.	**9 H/11 M**
TOTAL		**45 H/ 52 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours & Allotted Marks

	1. Preparation and sterilization of culture media. 2. Isolation of microorganisms by serial dilution and spread plate techniques. 3. Gram staining. 4. Types of Bacteria to be observed from temporary/permanent slides/photographs. 5. Observation of fungal structures using temporary mounts. 6. Collection and identification of plant disease symptoms in field specimens. 7. Field visit to crop fields, plant clinic, or plant pathology laboratory and submission of report. 8. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle. 9. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Viral diseases: TMV, Vein clearing, Fungal diseases: Blight of potato. *Puccinia*. 10. Demonstration of Koch's postulates.	**30 H/ 18 M**
Course/ Learning outcomes	Upon successful completion of the course, students will be able to: ➢ Explain the diversity and importance of microorganisms. ➢ Describe microbial structure, growth, metabolism, and reproduction. ➢ Identify major groups of plant pathogens and symptoms caused by them. ➢ Understand host-pathogen interactions and disease epidemiology. ➢ Apply laboratory techniques for microbial culture, disease diagnosis, and pathogen observation.	
Texts / References	1. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996). Introductory Mycology. 4th Edition. John Wiley & Sons (Asia) Singapore. 2. Webster, J. and Weber, R. (2007). Introduction to Fungi. 3rd Edition. Cambridge University Press, Cambridge. 3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies. 1st edition. Macmillan Publishers India Ltd. 4. Sharma, P.D. (2011). Plant Pathology. 1st Edition. Rastogi Publication, Meerut, India. 5. Agrios, G.N. (2005). Plant Pathology. 5th Edition. Elsevier Academic Press, Burlington, USA. 6. Rangaswami, G. and Mahadevan, A. (2006). Diseases of Crop Plants in India. 4th Edition. Prentice Hall of India, New Delhi. 7. Singh, R.S. (2017). Introduction to Principles of Plant Pathology. 5th Edition. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. 8. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. (2005). Microbiology. 5th Edition. Tata McGraw-Hill, New Delhi. 9. Prescott, L.M., Harley, J.P. and Klein, D.A. (2017). Microbiology. 10th Edition. McGraw-Hill Education, New York. 10. Tortora, G.J., Funke, B.R. and Case, C.L. (2021). Microbiology: An Introduction. 13th Edition. Pearson Education. 11. Aneja, K.R. (2012). Experiments in Microbiology, Plant Pathology and Biotechnology. 4th Edition. New Age International Publishers, New Delhi. 12. Mehrotra, R.S. and Aggarwal, A. (2017). Plant Pathology. 3rd Edition. McGraw Hill Education, New Delhi.	

MODES OF IN-SEMESTER ASSESSMENT	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 4th SEMESTER				
Course Code	BOTM 402			
Course Title	Anatomy of Angiosperms			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	This course familiarizes students with a comprehensive understanding of the internal structure of different parts of angiospermic plants. It introduces the organization and development of plant tissues, meristems, vascular systems, and adaptive structures.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
/ I	**Introduction and scope of Plant Anatomy:** Importance of plant anatomy in systematics, forensics and pharmacognosy.	3H / 4M
/ II	**Structure and Development of Plant Body:** Internal organization of plant body: The three tissue systems, types of cells and tissues. Development of plant body: Polarity, Organogenesis during embryogenic development.	6H / 7M
III	**Tissues:** Classification of tissues; Simple and complex tissues; cyto-differentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers, Structure of dicot and monocot leaf, stem & root, Endodermis, Kranz anatomy.	12 H /14M
IV	**Apical meristems:** Organization of shoot apex (Apical cell theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Origin of leaves; Organization of root apex (Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap.	13 H/14 M
V	**Vascular Cambium and Wood:** Structure, function and seasonal activity of cambium; Secondary growth in root and stem, Anomalous Secondary Growth in stem & root. Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; tyloses; Dendrochronology. Periderm, rhytidome and lenticels.	8H / 9 M
VI	**Adaptive and Protective Systems: S**tomata (classification);anatomical adaptations of xerophytes, hydrophytes and epiphytes.	3 H / 4 M
TOTAL		45 H/ 52M

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours/Allotted Marks

	1. Study of anatomical details through permanent slides and temporary stained mounts with suitable examples of dicot and monocot stems showing anomalous secondary growth. 2. Apical meristem of root, shoot and vascular cambium (through photographs/permanent slides). 3. Distribution and types of parenchyma, collenchyma and sclerenchyma (through photographs/permanent slides). 4. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres (through photographs/permanent slides). 5. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres. (through photographs/permanent slides) 6. Leaf anatomy: isobilateral, dorsiventral, C_4 leaves (Kranz anatomy) (Photographs). 7. Adaptive Anatomy: xerophytes, hydrophytes, epiphytes (Temporary preparation of slides).	**30 H / 18 M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the structure, development, and functions of plant tissues and organs. 2. Differentiate various anatomical features of roots, stems, leaves, and vascular tissues. 3. Interpret the role of meristems, cambium, and secondary growth in plant development. 4. Identify anatomical adaptations and analyse plant structures using microscopic techniques	
Texts / References	1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA. 2. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA. 3. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA. 4. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.	

MODES OF IN-SEMESTER ASSESSMENT: (30Marks)

Two Sessional Examinations:	20 Marks
Attendance:	5 Marks
Assignment/Seminar/Activity:	5 Marks

SEMESTER: FYUGP 4th SEMESTER				
Course Code	BOTM 403			
Course Title	Angiosperm Systematics			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The objective of this course is to provide students the concept of plant Classification and identification.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Significance of Plant systematic:** Introduction to taxonomy & systematics; Plant identification, Classification, Nomenclature, Importance of systematics. Evidences from palynology, cytology, phytochemistry and molecular data. Field inventory; Herbarium & Botanical Garden: Importance and Functions, herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora.	**9 H /10 M**
II	**Taxonomic hierarchy:** Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).	**2H /5 M**
III	**Morphology and Botanical nomenclature:** Angiosperm morphology, Principles and rules (ICN= International Code of Nomenclature of Algae, fungi & Plants); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.	**5H / 5M**
IV	**Systems of classification:** History of Plant Taxonomy: Linnaeus, Bentham and Hooker, Hutchinson, Engler and Prantl and Takhtajan (up to series), APG.	**10H /10M**
V	Biometrics, numerical taxonomy and cladistics: Characters; Variations; OTUs, Cluster analysis; Phenograms, cladograms (definitions and differences).	**4H / 4M**
VI	**Phylogeny of Angiosperms**: Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals.	**5H / 8M**
VII	**Major families of Angiosperms**: Study of morphological characters of some major families of Angiosperms: Magnoliaceae, Orchidaceae, Zingiberaceae, Poaceae, Fabaceae, Cucurbitaceae, Euphorbiaceae, Lamiaceae, Solanaceae, Asteraceae.	**10H /10M**
	TOTAL	**45 H/ 52M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours/Allotted Marks
	1. Taxonomic studies of locally available species. 2. Preparation and submission of locally available specimens in the form of herbarium sheets. 3. Specimen of any wild plant with herbarium label (to be submitted in the record book). 4. Field visit / visit to any Taxonomy research center / BSI/ Botanical Garden.	**30 H / 18 M**
	Upon successful completion of the course, the student should be able to:	

Course/ Learning outcomes	1. Explain and apply the principles of plant systematics, including taxonomy, nomenclature, classification systems, species concepts, and the role of modern systematic evidence derived from palynology, cytology, phytochemistry, and molecular studies. 2. Demonstrate proficiency in plant identification and taxonomic practices through the use of taxonomic keys, herbarium techniques, botanical nomenclature (ICN), field inventory methods, and digital resources 3. Analyze evolutionary relationships and classify angiosperms by interpreting phylogenetic concepts, numerical taxonomy, cladistics, and diagnostic morphological characters of major angiosperm families.
Texts / References	1. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition. 2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge. 3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics. 4. Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition. 5. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi. 6. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York.

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations:	20 Marks
Attendance:	5 Marks
Assignment/Seminar/Activity:	5 Marks

SEMESTER: FYUGP 4th SEMESTER				
Course Code	BOTM 404			
Course Title	Economic Botany			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (TH) + 18 (PR) + 30 (IA)=100			
Course Objective	The objective of this course is to expose the students on various economically important plants and plant products.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Origin of Cultivated Plants:** Concept of Centres of Origin, Indigenous Knowledge System (IKS). Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity	**6 H / 8 M**
II	**Cereals:** Wheat and Rice (origin, morphology, processing & uses); Brief account of wheat. **Legumes:** Morphology and economic importance of Chick pea, Pigeon pea and fodder legumes. **Sources of sugars and starches**: Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.	**8 H / 8 M**
III	**Spices:** Listing of important spices, their family and part used & economic importance with special reference to saffron, clove, cinnamommum, cardamom and black pepper **Beverages:** Tea, Coffee (morphology, processing & uses)	**7 H / 9 M**
IV	**Sources of oils and fats:** General description, classification, extraction, their uses and health implications groundnut, mustard and coconut (Botanical name, family & uses). Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.	**8 H / 7 M**
V	**Natural Rubber:** Para-rubber: tapping, processing and uses. **Drug-yielding plants:** Study of drug yielding plants with special reference to *Cinchona, Rawolfia* and *Phyllanthus* (Morphology, processing, uses and health hazards), Pharmacognosy. **Timber plants:** General account with special reference to teak, sal, pine & sisu.	**8H / 8 M**
VI	**Fibers:** Classification based on the origin of fibers; Cotton & Jute (morphology, extraction and uses). **Aromatics and Petrocrops:** General account with special reference to *Aquilaria, Vetiveria, Jatropha* and *Ricinus.*	**9H / 5 M**
TOTAL		**45 H / 52 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours/Allotted Marks

	1. **Cereals:** Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests). 2. **Legumes:** Soybean (habit, fruit, seed structure, micro-chemical tests). 3. **Sources of sugars and starches:** Sugarcane (habit sketch; cane juice- micro-chemical tests). 4. **Beverages:** Tea (plant specimen, tea leaves), Coffee (plant specimen, beans). 5. **Sources of oils and fats:** Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds. 6. **Essential oil-yielding plants:** Habit sketch of Rosa, Vetiveria (specimens/photographs). 7. **Rubber:** specimen, photograph/model of tapping, samples of rubber products. 8. **Woods:** Tectona: Specimen, Section of young stem. 9. **Fiber-yielding plants:** Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose).	**30 H / 18 M**
Course/ Learning outcomes	After completion of the course, students will be able to: 1. Explain the origin, domestication, diversity and economic significance of cultivated plants and plant genetic resources. 2. Identify major economic plants and describe their morphology, processing methods, products and uses in agriculture, industry and daily life. 3. Distinguish between different categories of plant-derived products such as cereals, legumes, spices, beverages, oils, fibers, timber, drugs and aromatic plants. 4. Analyse the extraction, processing and utilization of economically important plant products, including essential oils, natural rubber, fibers and medicinal compounds. 5. Evaluate the role of economically important plants in sustainable development, biodiversity conservation, healthcare, food security and industrial applications.	
Texts / References	1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India. 2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands. 3. Chrispeels, M.J. and Sadava, D.E. 1994: Plants, Genes and Agriculture. Jones & Bartlett Publishers.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 4th SEMESTER				
Course Code	BOTN 401			
Course Title	Plant Ecology & Taxonomy			
Category of Course	Minor			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (TH) + 18 (PR) + 30 (IA)=100			
Course Objective	The objective of this course is to expose the students to interaction of plant life with the surroundings and also to identification, classification and nomenclature of plants.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Introduction**: Ecology, branches of ecology, Scope of Ecology	**2 H / 4 M**
II	**Ecological factors**: Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.	**10 H / 10 M**
III	**Plant population:** Characteristics, Ecological Speciation. **Plant communities:** Characters; Ecotone and edge effect; Succession; Processes and types.	**4 H / 9 M**
IV	**Ecosystem**: Structure; energy flow, trophic organization; Food chains and food webs, Ecological pyramids, production and productivity; Biogeochemical cycling; Cycling of carbon & nitrogen.	**7 H / 10 M**
V	**Phytogeography**: Principle biogeographical zones; Endemism.	**5 H / 4 M**
VI	**Introduction to plant taxonomy:** Identification, Classification, Nomenclature.	**7 H / 3 M**
VII	**Identification**: Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora.	**4 H / 5 M**
VIII	**Botanical nomenclature**: Principles and rules (IUCN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.	**6 H / 7 M**
TOTAL		**45 H / 52 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours /Allotted Marks

	1. Study of morphological adaptations of hydrophytes and xerophytes. 2. Determination of minimal quadrat size for the study of herbaceous vegetation in the University campus by species area curve method (species to be listed). *3.* Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): *Asteraceae, Solanaceae, Lamiaceae, Musaceae.* 4. 4. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).	**30 H / 18 M**
Course/ Learning outcomes	Upon successful completion of this course, students will be able to: 1. Explain fundamental ecological concepts and environmental factors, including soil, water, light, temperature, ecological tolerance, and adaptive strategies of plants in different habitats. 2. Analyze the structure and functioning of ecosystems by interpreting ecological processes such as succession, energy flow, trophic interactions, ecological pyramids, productivity, and biogeochemical cycles. 3. Apply basic taxonomic principles and phytogeographical concepts to identify plants, utilize herbaria and floras for documentation	
Texts / References	1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition. 2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition. 3. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A. 4. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.	

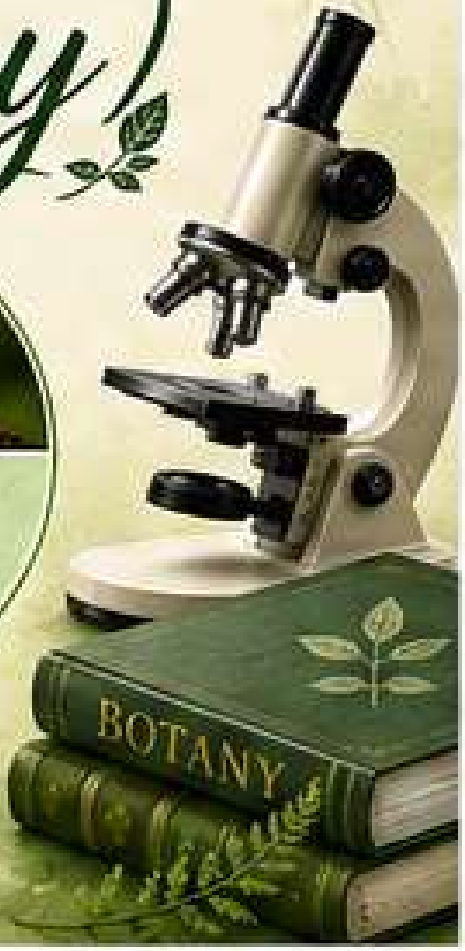
MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SYLLABUS of FYUGP

5th SEMESTER

(Botany)



SEMESTER: FYUGP 5th SEMESTER				
Course Code	BOTM 501			
Course Title	Genetics			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (TH) + 18 (PR) + 30 (IA)=100			
Course Objective	The objective of this course is to provide basic idea about plant genetics and its associated principles, tools and techniques			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Genes, Genomes, and Genetic Analysis:** DNA as a genetic material: Historical perspective DNA structure and basics of DNA replication	**2 H / 5 M**
II	Organization of eukaryotic and prokaryotic genomes, Genome size and complexity, Polytene chromosomes, Repetitive elements Molecular structure of centromeres and telomeres; Molecular genetics of Mitosis and meiosis	**10 H / 9 M**
III	Changes in chromosome number and structure: Karyotyping, Polyploidy, Aneuploidy, Deletion, Inversion, Duplication, Translocation, and their consequences in plants and animals	**4 H / 8 M**
IV	Allelic and non-allelic interactions: Concept of alleles, types of dominance, lethal alleles, multiple alleles, test of allelism, complementation, epistasis	**7 H / 7 M**
V	Linkage and recombination, gene mapping, Two-point and three-point crossing in Drosophila Chi-Square test for linkage, Genetic mapping in human pedigrees Mapping by tetrad analysis	**5 H / 6 M**
VI	Mutation: Types, mechanisms, and role in creating genetic variation/evolution, DNA repair; **Human Genetics**: Organization of the human genome; Genetic basis of human diseases- Dominant, Recessive, autosomal, Trinucleotide repeat disorders, Genomic imprinting; Basics of gene therapy, Non-Mendelian/quantitative genetics: Genes and environment, heritability, penetrance, and expressivity	**7 H / 8 M**
VII	Molecular markers, development of mapping populations, genome mapping, Mapping of QTLs to identify genes governing important traits, Genome-wide association studies in Plants, and Comparative genetics and synteny analysis.	**4 H / 5 M**
VIII	Population Genetics, Hardy-Weinberg law, calculation of gene and genotypic frequencies, forces influencing gene and genotypic frequencies in a population.	**6 H / 4 M**
TOTAL		**45 H / 52 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours/Allotted Marks

	1. Meiosis through temporary squash preparation. 2. Mendel's laws through seed ratios. 3. Pedigree analysis for dominant and recessive autosomal and sex linked traits. 4. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4). 5. Study of aneuploidy: Down's and Turner's syndromes. 6. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge. 7. Study of human genetic traits: Sickle cell anemia, red-green colour blindness, Rolling of tongue.	**30 H /18 M**
Course/ Learning outcomes	Upon successful completion of this course, students will be able to: 1. Explain the molecular basis of heredity and genome organization, including DNA structure and replication, chromosome architecture, genome complexity, and the genetic mechanisms underlying mitosis and meiosis. 2. Analyze patterns of inheritance and genetic variation through the study of gene interactions, linkage and recombination, chromosomal alterations, mutations, population genetics, and the genetic basis of human diseases. 3. Apply modern genetic and genomic tools such as molecular markers, gene mapping, QTL analysis, genome-wide association studies (GWAS), comparative genomics, and pedigree analysis to investigate biological traits and evolutionary processes.	
Texts / References	1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition. 2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition. 3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition. 4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition .	

MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 5th SEMESTER				
Course Code	BOTM 502			
Course Title	Plant Ecology & Phytogeography			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (TH) + 18 (PR) + 30 (IA)=100			
Course Objective	The objective of this course is to expose the students to interaction of plant life with the surroundings.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Introduction**: Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis.	**3 H / 6 M**
II	**Soil & Water**: Importance, Origin, Formation, Composition, Physical, Chemical and Biological components, Soil profile, Role of climate in soil development; Water: Importance, States of water in the environment, Atmospheric moisture, Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle, Water in soil, Water table.	**10 H / 6 M**
III	**Biotic interactions**: Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis, commensalism, parasitism;	**5 H / 5 M**
IV	**Population ecology**: Characteristics and Dynamics. Ecological Speciation.	**5 H / 6 M**
V	**Plant communities**: Concept of ecological amplitude; habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.	**6 H / 10 M**
VI	**Ecosystems:** Structure and Function, Ecological pyramids. Principles and models of energy flow; Production and productivity; Ecological Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.	**7 H / 9 M**
VII	**Phytogeography**: Principles; static and dynamic phytogeography, Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical regions of India with special reference of Assam.	**9 H / 10 M**
TOTAL		**45 H / 52 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours/Allotted Marks

	1. Determination of pH of various soil and water samples (pH meter). 2. Determination of organic matter of different soil samples by Walkley & Black rapid titration method. 3. Determination of dissolved oxygen of water samples from polluted and unpolluted sources. 4. Study of morphological adaptations of hydrophytes and xerophytes. 5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed). 6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law. 7. Quantitative analysis of herbaceous vegetation for density and abundance in the University campus. 8. Field visit to familiarize students with ecology of different sites.	**30 H /18 M**
Course/ Learning outcomes	Upon successful completion of this course, students will be able to: 1. Explain the fundamental principles of ecology and evaluate the influence of abiotic and biotic factors, including soil, water, climate, and species interactions, on the distribution and survival of organisms. 2. Analyze ecological processes and ecosystem functioning by interpreting population dynamics, community structure, ecological succession, energy flow, productivity, and biogeochemical cycles. 3. Assess patterns of plant distribution and biodiversity through the application of phytogeographical principles, concepts of endemism, biome classification, and the phytogeographical regions of India with special reference to Assam.	
Texts / References	1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition. 2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India. 3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition. 4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A. 5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 5th SEMESTER				
Course Code	BOTM 503			
Course Title	Natural Resource Management			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The objective of this course is to expose students to the interaction between our natural resource and their management.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Natural resources:** Definition and types.	**2 H / 5 M**
II	**Sustainable utilization:** Concept, approaches (economic, ecological and socio-cultural).	**5 H / 5 M**
III	**Land:** Utilization (agricultural, pastoral, horticultural, silvicultural); Soil degradation and management. Land resources of Assam; **Water:** Fresh water (rivers, lakes, groundwater, aquifers, watershed); Marine; Estuarine; Wetlands; Threats and management strategies. Water resources of Northeast India. Rivers and Wetlands of Assam. General outline of Rain Water Harvesting.	**10 H / 10 M**
IV	**Biological Resources:** Biodiversity-definition and types; Significance; Threats; Management strategies; Biodiversity Hot Spot (Terrestrial & Marine), IUCN Species categories, In situ & Ex situ conservation, Bio-prospecting; IPR; CBD; National Biodiversity Action Plan). Sustainable development. **Forests:** Definition, Cover and its significance (with special reference to India); Major and minor forest products; Depletion; Management. Forest resources of Assam. National Parks of Assam.	**10 H / 15 M**
V	**Energy:** Renewable and non-renewable sources of energy.	**3 H / 5 M**
VI	**Contemporary practices in resource management:** EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management.	**10 H / 7 M**
VII	**National and international efforts in resource management and conservation:** National and international efforts in natural resource management and their conservation approaches.	**5 H / 5 M**
TOTAL		**45 H / 52 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours/Allotted Marks

	1. Estimation of solid waste generated by a domestic system (biodegradable and non-biodegradable) and its impact on land degradation. 2. Collection of data on forest cover of specific area (Lakhimpur district). 3. Measurement of dominance of woody species by DBH (diameter at breast height) method. 4. Calculation and analysis of ecological footprint. 5. Ecological modeling. 6. Field Visit to any National Parks of Northeast India.	**30 H / 18 M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Develop a comprehensive understanding of natural resources and their sustainable utilization through economic, ecological, and socio-cultural approaches, with special reference to land, water, forest, biological, and energy resources of India and Northeast India. 2. Analyze the causes, impacts, and management strategies of environmental degradation, including soil degradation, biodiversity loss, deforestation, water resource depletion, waste generation, and unsustainable resource use. 3. Apply contemporary tools and practices in natural resource management, including EIA, GIS, Participatory Resource Appraisal, Ecological Footprint, Carbon Footprint, Resource Accounting, and waste management for sustainable environmental planning and conservation.	
Texts / References	1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi. 2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi. 3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi. 4. Sharma, P.D., 2015-16. Ecology and Environment.12th edition. Rastogi Publications, Meerut. 5. Miller, G.T. and Spoolman, S.E., 2013. Environmental Science. 14th edition. Environmental Science. Brooks/Cole Cengage Learning, USA.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 5th SEMESTER				
Course Code	BOTM 504			
Course Title	Plant Physiology			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The objective of this course is to expose the students to different physiological processes in plant life.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Plant-water relations:** Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure. Ascent of sap– cohesion-tension theory. Transpiration and factors affecting transpiration, anti-transpirants, mechanism of stomatal movement. Guttation.	**3 H / 8 M**
II	**Mineral nutrition**: Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements.	**5 H / 7 M**
III	**Nutrient Uptake**: Transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.	**8 H / 7 M**
IV	**Translocation in the phloem**: Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model.	**6H / 6 M**
V	**Plant Growth Regulators**: Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Concept of plant movement: tropic and nastic.	**9 H /8 M**
VI	**Physiology of flowering**: Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.	**8 H / 7 M**
VII	**Phytochrome, cryptochromes and phototropins:** Discovery, chemical nature, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.	**7 H / 9 M**
TOTAL		**45 H / 52 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours/Allotted Marks

	1. Determination of osmotic potential of plant cell sap by plasmolytic method. 2. Determination of water potential of given tissue (potato tuber) by weight method. 3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf. 4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves. 5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces). 6. To study the phenomenon of seed germination (effect of light). 7. To study the induction of amylase activity in germinating barley grains. **Demonstration experiments** 1. To demonstrate suction due to transpiration. 2. Fruit ripening/Rooting from cuttings	**30 H / 18 M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the physiological mechanisms governing plant growth and development, including water relations, mineral nutrition, ion transport, translocation of assimilates, and the regulation of plant responses to environmental cues. 2. Analyze the roles of plant growth regulators and photoreceptors in controlling plant growth, movement, flowering, seed dormancy, photomorphogenesis, and adaptation to changing environmental conditions. 3. Apply principles of plant physiology to interpret physiological processes and experimental observations, including nutrient uptake, stomatal regulation, phloem transport, photoperiodism, vernalization, and hormonal regulation of plant growth and development	
Texts / References	1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition. 2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition. 3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.	

MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 5th SEMESTER				
Course Code	BOTN 501			
Course Title	Plant Physiology			
Category of Course	Minor			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The objective of this course is to expose the students to different physiological processes in plant life.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Plant-water relations:** Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure. Ascent of sap– cohesion-tension theory. Transpiration and factors affecting transpiration, anti-transpirants, mechanism of stomatal movement. Guttation.	**3 H / 8 M**
II	**Mineral nutrition**: Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements.	**5 H / 7 M**
III	**Nutrient Uptake**: Transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.	**8 H / 7 M**
IV	**Translocation in the phloem**: Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model.	**6H / 6 M**
V	**Plant Growth Regulators**: Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Concept of plant movement: tropic and nastic.	**9 H /8 M**
VI	**Physiology of flowering**: Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.	**8 H / 7 M**
VII	**Phytochrome, cryptochromes and phototropins:** Discovery, chemical nature, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.	**7 H / 9 M**
TOTAL		**45 H / 52 M**

PRACTICAL

Exp. No.	Name of the experiment	Teaching hours/Allotted Marks

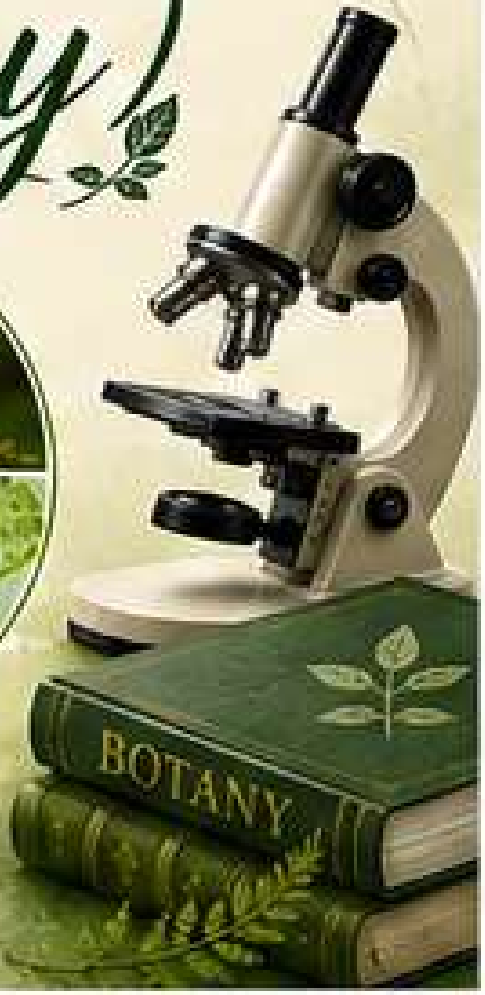
	8. Determination of osmotic potential of plant cell sap by plasmolytic method. 9. Determination of water potential of given tissue (potato tuber) by weight method. 10. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf. 11. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves. 12. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces). 13. To study the phenomenon of seed germination (effect of light). 14. To study the induction of amylase activity in germinating barley grains. **Demonstration experiments** 1. To demonstrate suction due to transpiration. 2. Fruit ripening/Rooting from cuttings	**30 H / 18 M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 4. Explain the physiological mechanisms governing plant growth and development, including water relations, mineral nutrition, ion transport, translocation of assimilates, and the regulation of plant responses to environmental cues. 5. Analyze the roles of plant growth regulators and photoreceptors in controlling plant growth, movement, flowering, seed dormancy, photomorphogenesis, and adaptation to changing environmental conditions. 6. Apply principles of plant physiology to interpret physiological processes and experimental observations, including nutrient uptake, stomatal regulation, phloem transport, photoperiodism, vernalization, and hormonal regulation of plant growth and development	
Texts / References	4. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition. 5. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition. 6. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.	

MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SYLLABUS of FYUGP

6th SEMESTER

(Botany)



SEMESTER: FYUGP 6th SEMESTER				
Course Code	BOTM 601			
Course Title	Plant Metabolism			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The objective of this course is to expose the students to various metabolic processes involved with plant life.			

Course Content

THEORY

Units	Course Content	Teaching hours/Allotted Marks
I	**Concept of metabolism**: Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and Isozymes).	**3 H / 8 M**
II	**Carbon assimilation:** Definition, Photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron / transport, PSI, PSII, Q cycle, CO_2 reduction, photorespiration, C_4 pathways; Crassulacean acid metabolism; Factors affecting CO_2 reduction.	**8 H / 10 M**
III	**Carbohydrate metabolism:** Synthesis and catabolism of sucrose and starch.	**5 H / 7 M**
IV	**Carbon Oxidation**: Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle, amphibolic role, anaplerotic reactions, mitochondrial electron transport, oxidative phosphorylation, cyanide resistant respiration, factors affecting respiration.	**10 H / 10 M**
V	**ATP-Synthesis**: Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers.	**7 H / 8 M**
VI	**Lipid metabolism**: Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation.	**6 H / 4 M**
VII	**Nitrogen metabolism**: Nitrate assimilation, biological nitrogen fixation (examples of legumes and nonlegumes); Physiology and biochemistry of	**6 H / 5 M**

	nitrogen fixation.	
TOTAL		**45 H / 52 M**
PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours/Allotted Marks**
	1. Chemical separation of photosynthetic pigments. 2. Experimental demonstration of Hill's reaction. 3. To study the effect of light intensity on the rate of photosynthesis. 4. Effect of carbon dioxide on the rate of photosynthesis. 5. To compare the rate of respiration in different parts of a plant. 6. To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources. 7. Demonstration of absorption spectrum of photosynthetic pigments.	**30 H / 18 M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the fundamental principles of plant metabolism, including the regulation of anabolic and catabolic pathways, enzyme-mediated metabolic control, and the integration of major metabolic processes in plants. 2. Analyze the biochemical pathways involved in energy production and carbon assimilation, including photosynthesis, respiration, ATP synthesis, carbohydrate metabolism, and their regulation under varying physiological conditions. 3. Apply knowledge of lipid and nitrogen metabolism to interpret plant growth, development, nutrient utilization, biological nitrogen fixation, and metabolic adaptations associated with seed germination and environmental responses.	
Texts / References	1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition. 2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition. 3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi. 4. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 6th SEMESTER				
Course Code	BOTM 602			
Course Title	Plant Breeding and Crop Improvement			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The course provides fundamental knowledge of plant breeding principles and crop improvement methods. It will help to understand the genetic basis of variation and its utilization in crop improvement. It will familiarize learners with conventional and modern breeding techniques and will develop skills in crop improvement strategies for enhancing yield, quality, and stress tolerance. It will also introduce learners to the role of biotechnology in plant breeding.			

Course Content

THEORY

Units	Course Content	Teaching hours & Allotted Marks
I	**Introduction to Plant Breeding and Genetic Resources:** History, objectives, and scope of plant breeding; Centres of origin and diversity of cultivated plants; Germplasm resources: collection, conservation, evaluation, and utilization; Plant genetic resources and gene banks; Modes of reproduction in crop plants; Self-pollinated, cross-pollinated and vegetatively propagated crops	9H/11M
II	**Genetic Basis of Plant Breeding:** Genetic variation and its importance in crop improvement; Qualitative and quantitative traits; Heritability and genetic advance; Hardy-Weinberg principle; Inbreeding and inbreeding depression; Heterosis and its genetic basis; Combining ability and breeding value.	9H/10M
III	**Conventional Plant Breeding Methods** Selection methods: mass selection, pure-line selection, clonal selection; Hybridization techniques and breeding procedures; Pedigree, bulk, and single-seed descent methods; Backcross breeding; Breeding for disease and pest resistance; Hybrid seed production.	9H/11M
IV	**Crop Improvement Strategies** Mutation breeding; Polyploidy breeding; Breeding for abiotic stress tolerance; Breeding for quality improvement and biofortification; Breeding of major cereals, pulses, oilseeds, and horticultural crops; Seed production and varietal release procedures.	9H/10M

V	**Modern Approaches in Plant Breeding** Molecular markers and marker-assisted selection; Genomics and plant breeding; Tissue culture in crop improvement; Genetic engineering and transgenic crops; Genome editing (CRISPR-Cas systems); Future prospects of plant breeding under climate change.	**9H/10M**
TOTAL		**45 H/ 52 M**
PRACTICALS		
Exp. No.	**Name of the experiment**	**Teaching hours/Allotted Marks**
	1. Study of floral biology and pollination mechanisms in crop plants. 2. Emasculation and controlled pollination techniques. 3. Study of pollen morphology and viability 4. Hybrid seed production techniques. 5. Estimation of Heterosis 6. Demonstration of mutation breeding and polyploidy induction. 7. Demonstration of molecular markers used in plant breeding. 8. Visit to a plant breeding research station/seed production unit.	**30 hours 18 Marks**
Course/ Learning outcomes	Upon successful completion of the course, students will be able to: 1. Explain the principles, objectives, and significance of plant breeding and crop improvement. 2. Describe genetic mechanisms underlying crop improvement programmes. 3. Apply conventional breeding methods for the development of improved crop varieties. 4. Analyse breeding strategies for enhancing yield, quality, and resistance to biotic and abiotic stresses. 5. Evaluate the applications of biotechnology and molecular tools in modern plant breeding.	
Texts / References	1. Singh, B. D. (2026). Plant Breeding: Principles and Methods, 12th edition. MedTech Science Press, New Delhi. 2. Chaudhari, H. K. (1984). Elementary Principles of Plant Breeding, 2nd edition. Oxford – IBH. 3. Acquaah, G. (2007). Principles of Plant Genetics & Breeding, 1st edition. Blackwell Publishing. 4. Poehlman, J. M. and Sleper, D. (1999). Breeding Field Crops, 4th edition. Wiley-Blackwell. 5. Singh, P. (2025). Essential of Plant Breeding, 1st edition. Kalyani Publisher. 6. Salgotra, R. K. and Gupta, B. B. (2015). Plant Genetic Resources and Traditional Knowledge for Food Security, 1st edition. Springer. 7. Lynch, M. and Walsh, B. (1998). Genetics and Analysis of Quantitative Traits, 1st edition. Sinauer Associates Inc. 8. Fehr, W. R. (1998). Principles of Cultivar Development: Theory and Technique, 1st Edition, Vol. 1. Macmillan USA.	
MODES OF IN-SEMESTER ASSESSMENT		**(30 Marks)**
	Two Sessional Examinations Attendance Assignment Seminar	20 Marks 5 Marks 5 Marks

SEMESTER: FYUGP 6th SEMESTER				
Course Code	BOTM 603			
Course Title	Plant Biotechnology			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The objective of this course is to expose the students to application of modern tools and techniques in Biology..			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Plant Tissue Culture**: Historical perspective; Composition & types of media, instruments; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation.	**9H/11M**
II	**Recombinant DNA technology**: Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19), Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector.	**9H/10M**
III	**Gene Cloning**: Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning; Gene Construct; construction of genomic and cDNA libraries, complementation, colony hybridization.	**9H/11M**
IV	**Methods of gene transfer**: Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (GUS, GFP).	**9H/10M**
V	**Applications of Biotechnology**: Pest resistant (BT cotton); herbicide resistant plants (Round Up Ready soybean); Transgenic crops with improved quality traits (Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.	**9H/10M**
TOTAL		**45 H/ 52 M**

PRACTICALS

Exp. No.	Name of the experiment	Teaching hours /Allotted Marks
	1. Preparation of MS medium. 2. Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of *Tobacco, Datura, Brassica* etc. 3. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs. 4. Isolation of protoplasts. 5. Construction of restriction map of circular and linear DNA from the data provided. 6. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment. 7. Isolation of plasmid DNA (photographs).	**30 H /18 M**
Course/ Learning outcomes	Upon successful completion of the course, students will be able to: 1. Explain the principles and methodologies of plant tissue culture and recombinant DNA technology, including media preparation, organogenesis, embryogenesis, gene cloning, vector systems, and genetic transformation techniques. 2. Analyze the applications of plant biotechnology in crop improvement and conservation, including micropropagation, germplasm preservation, production of haploids and hybrids, development of transgenic plants, and enhancement of agricultural productivity and quality traits. 3. Apply biotechnological tools and molecular techniques for gene transfer, selection of transgenics, recombinant product development, and evaluation of biosafety issues associated with genetically engineered organisms and products.	
Texts / References	1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science, Amsterdam. The Netherlands. 2. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington. 3. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition. 4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition. 5. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.	

MODES OF IN-SEMESTER ASSESSMENT	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment Seminar	5 Marks

SEMESTER: FYUGP 6th SEMESTER				
Course Code	BOTM 604			
Course Title	Agropreneurship			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The objective of this course is to develop entrepreneurial skills related to medicinal plants, floriculture, horticulture, food processing, and agro-based industries. It is a sincere approach to familiarize students with market analysis, value addition, branding, business planning, and quality control.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Horticulture, Floriculture & Agro-based Industries**: Introduction to horticulture and floriculture industries in India; Fruits: types, nutritional value, processing, preservation and storage; Lemon and Litchi: cultivation practices, agro-technology and commercial importance; Flowers and floriculture industries; Bougainvillea and Marigold cultivation techniques; Vegetable oils: Mustard: composition, extraction and industrial applications; Sugar industry and economic importance.	**15H/17M**
II	**Food, Nutrition & Fodder Crops:** Balanced diet and nutrition; Nutritional deficiency disorders; Rabi and Kharif crops; Rice and wheat cultivation; Legumes: pea and soybean; Fodder crops and storage; Value-added food products and agri-business opportunities.	**10H/15M**
III	**Industrial Entrepreneurship & Economic Botany**: Medicinal and aromatic plants (MAPs); Quality control and standardization; Cultivation of Ashwagandha, Safed Musli, Lemon grass and Rose; Extraction of essential oils; Plant fibres and natural dyes; Paper industry; Herbal cosmetics, nutraceuticals and plant-based startups; IPR and patent awareness in plant industries.	**10H/10M**
IV	**Entrepreneurship Development & Startup Ecosystem**: Concept and scope of entrepreneurship; Industrial incubation and startup ecosystem; Product development, branding and quality control; FSSAI registration and licensing; Government schemes and startup funding; Project proposal preparation; Digital marketing, e-commerce and SWOT analysis.	**10H/10M**
TOTAL		**45 H/ 52 M**

PRACTICALS

Exp. No.	Name of the experiment	Teaching

		hours/Allotted Marks
	1. Visit to herbal gardens, nurseries, or agro-industrial units. 2. Preparation of herbarium and market survey reports. 3. Demonstration of essential oil extraction techniques. 4. Preparation of natural dyes and value-added botanical products. 5. Preparation of a mini business plan for a plant-based enterprise. 6. Awareness on startup registration and entrepreneurship schemes.	**30 H/18 M**
Course/ Learning outcomes	Upon successful completion of the course, students will be able to: 1. Understand entrepreneurial opportunities in economic botany and agro-industries. 2. Develop basic skills in agro-technology, cultivation practices, and product development. 3. Acquire knowledge regarding medicinal and aromatic plants, essential oils, and natural products. 4. Learn preparation of business proposals, licensing procedures, and marketing strategies. 5. Develop an entrepreneurial mindset for sustainable botanical enterprises.	
Texts / References	1. Charantimath, P.M. Entrepreneurship Development and Small Business Enterprises. 2. Verma, V. Textbook of Economic Botany. 3. Judd, W.S. Plant Systematics and Economic Botany. 4. Maiti, R.K. An Introduction to Modern Economic Botany. 5. Kumar, N. Medicinal and Aromatic Plants. 6. Odum, E.P. Fundamentals of Ecology and Sustainable Resource Management	

MODES OF IN-SEMESTER ASSESSMENT	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment Seminar	5 Marks

SEMESTER: FYUGP 6th SEMESTER				
Course Code	BOTN 601			
Course Title	Agropreneurship			
Category of Course	Minor			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The objective of this course is to develop entrepreneurial skills related to medicinal plants, floriculture, horticulture, food processing, and agro-based industries. It is a sincere approach to familiarize students with market analysis, value addition, branding, business planning, and quality control.			

Course Content

THEORY

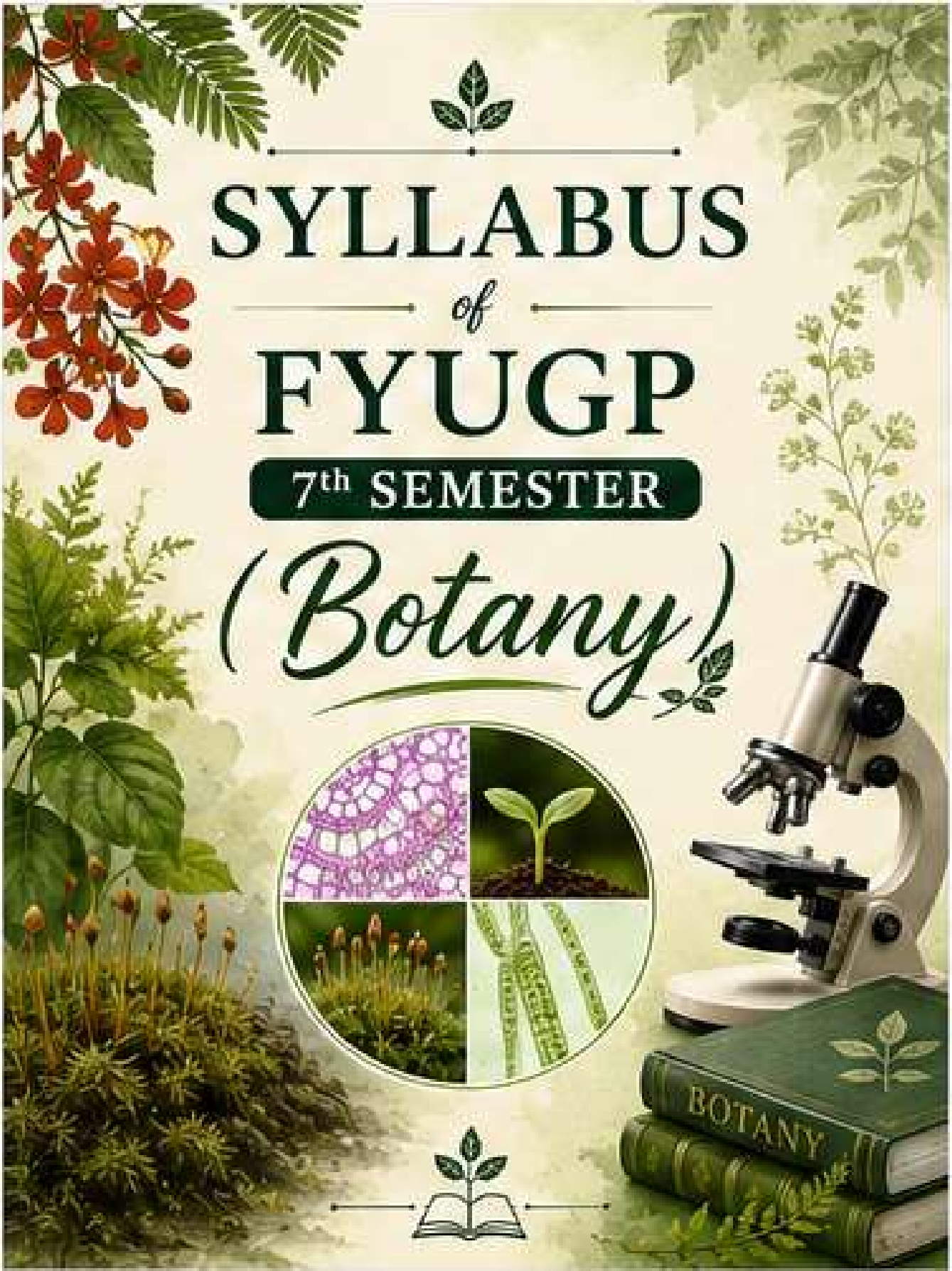
Units	CONTENTS	Teaching hours/Allotted Marks
I	**Horticulture, Floriculture & Agro-based Industries**: Introduction to horticulture and floriculture industries in India; Fruits: types, nutritional value, processing, preservation and storage; Lemon and Litchi: cultivation practices, agro-technology and commercial importance; Flowers and floriculture industries; Bougainvillea and Marigold cultivation techniques; Vegetable oils: Mustard: composition, extraction and industrial applications; Sugar industry and economic importance.	**15H/17M**
II	**Food, Nutrition & Fodder Crops:** Balanced diet and nutrition; Nutritional deficiency disorders; Rabi and Kharif crops; Rice and wheat cultivation; Legumes: pea and soybean; Fodder crops and storage; Value-added food products and agri-business opportunities.	**10H/15M**
III	**Industrial Entrepreneurship & Economic Botany**: Medicinal and aromatic plants (MAPs); Quality control and standardization; Cultivation of Ashwagandha, Safed Musli, Lemon grass and Rose; Extraction of essential oils; Plant fibres and natural dyes; Paper industry; Herbal cosmetics, nutraceuticals and plant-based startups; IPR and patent awareness in plant industries.	**10H/10M**
IV	**Entrepreneurship Development & Startup Ecosystem**: Concept and scope of entrepreneurship; Industrial incubation and startup ecosystem; Product development, branding and quality control; FSSAI registration and licensing; Government schemes and startup funding; Project proposal preparation; Digital marketing, e-commerce and SWOT analysis.	**10H/10M**
TOTAL		**45 H/ 52 M**

PRACTICALS

Exp. No.	Name of the experiment	Teaching

		hours/Allotted Marks
	7. Visit to herbal gardens, nurseries, or agro-industrial units. 8. Preparation of herbarium and market survey reports. 9. Demonstration of essential oil extraction techniques. 10. Preparation of natural dyes and value-added botanical products. 11. Preparation of a mini business plan for a plant-based enterprise. 12. Awareness on startup registration and entrepreneurship schemes.	**30 H/18 M**
Course/ Learning outcomes	Upon successful completion of the course, students will be able to: 6. Understand entrepreneurial opportunities in economic botany and agro-industries. 7. Develop basic skills in agro-technology, cultivation practices, and product development. 8. Acquire knowledge regarding medicinal and aromatic plants, essential oils, and natural products. 9. Learn preparation of business proposals, licensing procedures, and marketing strategies. 10. Develop an entrepreneurial mindset for sustainable botanical enterprises.	
Texts / References	7. Charantimath, P.M. Entrepreneurship Development and Small Business Enterprises. 8. Verma, V. Textbook of Economic Botany. 9. Judd, W.S. Plant Systematics and Economic Botany. 10. Maiti, R.K. An Introduction to Modern Economic Botany. 11. Kumar, N. Medicinal and Aromatic Plants. 12. Odum, E.P. Fundamentals of Ecology and Sustainable Resource Management	

MODES OF IN-SEMESTER ASSESSMENT	**(30 Marks)**
Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment Seminar	5 Marks


SYLLABUS
of
FYUGP
7th SEMESTER
(Botany)
BOTANY

SEMESTER: FYUGP 7th SEMESTER				
Course Code	BOTM 701			
Course Title	Research Methodology			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	The objective of this course is to develop an understanding of the basic concepts, principles and significance of research in different disciplines and also to familiarize students with various types, approaches, and methods of research.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Marks Allotted
I	**Research methodology**: Research concept, types. Identification of research gap, Understanding the scientific question(s), Novelty of research in support of existing literatures, setting hypothesis and objectives, writing research proposal/synopsis. Experimental designs: Formulation of research problem, sampling technique, methods selection, experimental set up, data generation/acquiring, Coding/decoding and reproducibility of data.	**11 H / 12M**
II	**Scientific writing**: Different forms of scientific writing – article, notes, reports, review article, monographs. Dissertation/Thesis writing: format, content and chapterization, writing style, drafting titles & sub-titles, captions and legends. Proper description of methodology and research design, compilation and presentation of data with statistical analysis; Writing results, discussion and conclusions. Bibliography and references, referencing style. Appendices, Plagiarism.	**12 H / 15M**
III	**Computer application**: Basics of MS word; Manuscript editing; Foot note and end note; Reference manager. MS Excel: tabulation, calculation and data analysis, preparation of graphs, histograms and charts. Statistical tools: MS Excel, SPSS, R, Python, STATA. Power Point: preparation of presentations and scientific poster designing. Bioinformatics tools and its applications in biological sciences, Plagiarism detection software. AI in research.	**12 H / 15M**
IV	**Biostatistics**: Biostatistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean,	**10 H /10M**

	mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.	
TOTAL		**45 H /52M**
PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	1. Identify a research problem and prepare a short research proposal/synopsis. 2. Data Tabulation and Statistical Analysis Using MS Excel. 3. Poster presentation on defined topics. 4. Prepare a scientific report with proper citation and referencing style. 5. Bio-statistical problems.	**30 H/ 18M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Design and conduct scientific experiments using appropriate sampling techniques, research methods, experimental setups, and data collection procedures. 2. Design and conduct scientific experiments using appropriate sampling techniques. 3. Apply computer applications and statistical tools such as MS Word, MS Excel, SPSS, R, Python, STATA, reference managers, and bioinformatics tools for data analysis, visualization, manuscript preparation, and scientific presentations. 4. Analyze and interpret biological and statistical data using biostatistical methods.	
Texts / References	1. Kothari, C. R. 2004. *Research methodology: Methods and techniques* (2nd ed.). New Age International Publishers. 2. Gurumani, N. 2007. Research methodology for biological sciences. MJP Publishers, Chennai. 3. Katz, MJ. 2009. From research to manuscript: A guide to scientific writing. Springer. 4. DePoy, E, Gitlin, L. 2015. Introduction to Research: Understanding and Applying Multiple Strategies. Elsevier. 5. Dawson, C. 2002. Practical research methods. UBS Publishers, New Delhi. 6. Zar, J.H. 2012. Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 7th SEMESTER				
Course Code	BOTM 702			
Course Title	Cellular Bioenergetics & Cell Signalling			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	This course aims to provide students with a comprehensive understanding of the physicochemical principles, bioenergetics, molecular structure, and enzymatic processes that govern cellular functions. It also seeks to develop an understanding of cellular communication and signal transduction mechanisms underlying the regulation and coordination of biological systems.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Cellular interactions**: Van der Waals, electrostatic, hydrogen bonding, hydrophobic interactions; pH, buffer, reaction kinetics, thermodynamics, colligative properties	**7 H / 10 M**
II	**Bioenergetics:** Energy calculations of glycolysis and oxidative phosphorylation, coupled reactions, group transfer, biological energy transducers.	**8 H / 9 M**
III	**Enzyme catalysis**: Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes; Enzyme linked metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins	**10 H / 10 M**
IV	**Conformation Biology**: Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds); Conformation of nucleic acids (Structural characteristics of A, B and Z DNA; RNA conformation); Stability of Proteins and Nucleic acids	**9 H / 11 M**
V	**Cellular communications:** General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation, regulation of haematopoiesis.	**6H /6 M**
VI	**Cell signaling**: Hormones and their receptors, cell surface receptors, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-	**5H / 6 M**

	component systems, light-signaling in plants, bacterial chemotaxis and quorum sensing.	
TOTAL		**45 H /52 M**
PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours/Allotted Marks**
	1. Estimation of amylase, catalase, or invertase activity and determination of the effect of substrate concentration, pH, and temperature on enzyme activity 2. Study of protein denaturation and renaturation under different physical and chemical conditions 3. Retrieval and visualization of protein and DNA structures from databases (e.g., PDB), identification of secondary structures, domains, motifs, and analysis of Ramachandran plots using online tools. 4. Demonstration of the effects of pH and temperature on protein structure. 5. Observation and interpretation of signaling pathways using animations/software tools, including G-protein coupled receptors (GPCRs), second messenger systems, and plant light-signaling pathways.	**30 H / 18M**
Course/ Learning outcomes	Upon successful completion of the course, the student should be able to: 1. Explain the physicochemical and bioenergetic principles underlying biological systems, including molecular interactions, thermodynamics, reaction kinetics, enzyme catalysis, and cellular energy transformations. 2. Analyze the structure–function relationships of biomolecules by interpreting the conformational properties and stability of proteins and nucleic acids, and their roles in cellular metabolism and regulation. 3. Apply concepts of cellular communication and signal transduction to understand receptor-mediated signaling, intracellular regulatory pathways, plant and bacterial signaling systems, and the coordination of physiological responses in living organisms.	
Texts / References	1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). Molecular biology of the cell (7th ed.). Garland Science. 2. Berg, J. M., Tymoczko, J. L., Gatto, G. J., Jr., & Stryer, L. (2023). Biochemistry (10th ed.). W. H. Freeman and Company. 3. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Scott, M. P. (2021). Molecular cell biology (9th ed.). W. H. Freeman and Company. 4. Nelson, D. L., & Cox, M. M. (2021). Lehninger principles of biochemistry (8th ed.). W. H. Freeman and Company. 5. Voet, D., Voet, J. G., & Pratt, C. W. (2019). Fundamentals of biochemistry: Life at the molecular level (6th ed.). John Wiley & Sons.	

MODES OF IN-SEMESTER ASSESSMENT: **(30 Marks)**

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 7th SEMESTER				
Course Code	BOTM 703			
Course Title	Functional Genomics & Chromosomal Architecture			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objective	To provide students with advanced knowledge of gene and chromosome organization, cell division and cell cycle regulation, DNA replication and repair, RNA biology, protein synthesis and degradation, and the molecular mechanisms controlling gene expression and epigenetic regulation in prokaryotic and eukaryotic systems.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	Organization of genes and chromosomes: Nucleus and its organization and dynamics, Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons	6 H / 7 M
II	Cell division and cell cycle regulation: Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle, apoptosis, necrosis and autophagy.	8 H / 8 M
III	Advanced DNA Biology: Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.	7 H / 10 M
IV	Advanced RNA Biology: Mechanism and regulation of transcription, transcriptional inhibitors, transcription factors and machinery, transcription activators and repressors, RNA polymerases, capping, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport, ribozyme, riboswitches, non-coding RNA	8 H / 9 M
V	Protein synthesis, processing and degradation: Ribosome, mechanism of translation and its regulation, translational inhibitors, post- translational modification of proteins, protein trafficking and transport, protein degradation.	8 H / 10 M
VI	Control of gene expression at transcription and translation level: Regulation of gene expression in phages, viruses, prokaryotes and eukaryotes, role of chromatin in gene expression and gene silencing, epigenetic regulation.	8 H / 8 M
TOTAL		45 H / 52 M

PRACTICAL

	Sl. No. and Name of the experiment	Teaching hours & Allotted

		Marks
	1. Preparation and observation of onion root tip squash to identify stages of mitosis. 2. Observation of meiotic stages preparing temporary slides of flower buds (e.g., *Tradescantia* or onion flower buds). 3. Demonstration of chromosome structure by preparation of charts or models showing chromosome organization, chromatin, euchromatin, and heterochromatin. 4. DNA isolation from plant material such as extraction of DNA from banana, onion, or pea. 5. Demonstration of DNA replication and transcription by use of paper models or clay models with explain of replication fork, transcription, and RNA synthesis. 6. Demonstration of ribosome structure, translation process, and genetic code using teaching models. 7. Comparative study of Prokaryotic and Eukaryotic gene organization by preparation of diagrams or charts showing operon system and eukaryotic gene structure. 8. Seminar and Assignment on gene regulation and epigenetics such as gene expression, gene silencing, and epigenetic modifications.	**30 hours / 18 Marks**
Course/ Learning outcomes	**After successful completion of the course, students will be able to**: 1. Understand the organization and regulation of genes, chromosomes, chromatin, and the cell cycle. 2. Explain the mechanisms of DNA replication, repair, recombination, and transcription. 3. Describe RNA processing, protein synthesis, post-translational modification, and protein degradation. 4. Analyse gene expression and epigenetic regulation in prokaryotic and eukaryotic systems.	
Texts / References	1. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). Molecular Biology of the Gene (7th ed.). Pearson Education, USA. 2. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). Molecular Biology of the Cell (7th ed.). Garland Science, Taylor & Francis Group, New York. 3. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., & Scott, M. P. (2021). Molecular Cell Biology (9th ed.). W. H. Freeman and Company, New York. 4. Lewin, B., Krebs, J. E., Kilpatrick, S. T., & Goldstein, E. S. (2017). Lewin's Genes XII. Jones & Bartlett Learning, Burlington, Massachusetts. 5. Karp, G. (2019). Cell and Molecular Biology: Concepts and Experiments (9th ed.). Wiley, USA. 6. Snustad, D. P., & Simmons, M. J. (2015). Principles of Genetics (7th ed.). John Wiley & Sons, USA.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 7th SEMESTER				
Course Code	BOTM 704			
Course Title	Bioethics, Indian Knowledge System (IKS) and Intellectual Property Rights (IPR)			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objective	To provide students with advanced knowledge of fundamental concepts and principles of bioethics in biological sciences and research. It will familiarize students with the Indian Knowledge System (IKS) and its relevance in biological sciences, traditional healthcare, and sustainable practices. It will create ethical awareness and professional responsibility among students.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Fundamentals of Bioethics:** Definition, scope, and importance of bioethics; Historical development of bioethics; Ethical principles: autonomy, beneficence, non-maleficence, justice; Research ethics and scientific misconduct; Ethics in human and animal experimentation; Environmental ethics and sustainability.	**10 H / 13 M**
II	**Bioethics in Modern Biological Sciences:** Ethical issues in biotechnology and genetic engineering; Ethics of stem cell research and cloning; Ethical concerns in assisted reproductive technologies; Bioethics in public health and epidemiology; Biosafety and biosecurity regulations; Case studies related to ethical dilemmas in biological sciences.	**8 H / 10 M**
III	**Indian Knowledge System (IKS):** Concept and evolution of Indian Knowledge System; Traditional Indian knowledge related to plants, medicine, and agriculture; Ayurveda, ethnobotany, and indigenous healthcare practices; Traditional ecological knowledge and biodiversity conservation; Role of IKS in sustainable development; Documentation and preservation of indigenous knowledge with reference to NE India.	**10 H / 10 M**
IV	**Intellectual Property Rights (IPR):** Concept, importance, and types of IPR; Patents, copyrights, trademarks, geographical indications, and trade secrets; Patent filing procedures and patentability criteria; Plant variety protection and farmers' rights; IPR issues related to biological resources and traditional knowledge; National and international organizations related to IPR.	**10 H / 11 M**
V	**Biodiversity, Legal Frameworks & Contemporary Issues:** Convention on Biological Diversity (CBD); Nagoya Protocol and Access & Benefit Sharing (ABS); Biopiracy and protection of traditional knowledge; Indian Biological Diversity Act and related regulations; Ethical and legal issues in biodiversity utilization; Contemporary issues and emerging challenges in bioethics and IPR.	**7 H / 8 M**
TOTAL		**45 H / 52M**

PRACTICAL		
	Name of the experiment	**Teaching hours/Allotted Marks**
	1. Preparation of assignments and seminar presentations on bioethical issues. 2. Case study analysis on ethical dilemmas in biological sciences. 3. Survey and documentation of indigenous traditional knowledge. 4. Demonstration of patent search using online databases. 5. Preparation of a model patent draft. 6. Group discussion on biopiracy and biodiversity laws. 7. Field visit/report related to traditional medicinal knowledge or biodiversity conservation.	**30 H / 18 M**
Course/ Learning outcomes	**After successful completion of the course, students will be able to**: 1. Understand the ethical principles governing biological research and applications. 2. Explain the significance of Indian traditional knowledge systems in modern science and sustainability. 3. Demonstrate knowledge of various forms of Intellectual Property Rights (IPRs). 4. Analyze ethical and legal issues related to biotechnology, biodiversity, and indigenous knowledge. 5. Develop awareness regarding research integrity, biosafety, and biosecurity	
Texts / References	1. Beauchamp, T.L. & Childress, J.F. Principles of Biomedical Ethics. Oxford University Press. 2. Sateesh, M.K. Bioethics and Biosafety. I.K. International Publishing House. 3. Nambisan, P. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology. Academic Press. 4. Subbarayappa, B.V. The Roots of Ancient Medicine: An Historical Outline. 5. Jha, A.K. Intellectual Property Rights and Globalization. 6. Singh, K. Intellectual Property Rights in India. 7. Gupta, A.K. Traditional Knowledge and Intellectual Property. 8. Government of India. National Education Policy (NEP) 2020. 9. The Biological Diversity Act, Government of India. 10. WIPO Publications on Intellectual Property Rights.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 7th SEMESTER				
Course Code	BOTN 701			
Course Title	Bioethics, Indian Knowledge System (IKS) and Intellectual Property Rights (IPR)			
Category of Course	Minor			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objective	To provide students with advanced knowledge of fundamental concepts and principles of bioethics in biological sciences and research. It will familiarize students with the Indian Knowledge System (IKS) and its relevance in biological sciences, traditional healthcare, and sustainable practices. It will create ethical awareness and professional responsibility among students.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Fundamentals of Bioethics:** Definition, scope, and importance of bioethics; Historical development of bioethics; Ethical principles: autonomy, beneficence, non-maleficence, justice; Research ethics and scientific misconduct; Ethics in human and animal experimentation; Environmental ethics and sustainability.	**10 H / 13 M**
II	**Bioethics in Modern Biological Sciences:** Ethical issues in biotechnology and genetic engineering; Ethics of stem cell research and cloning; Ethical concerns in assisted reproductive technologies; Bioethics in public health and epidemiology; Biosafety and biosecurity regulations; Case studies related to ethical dilemmas in biological sciences.	**8 H / 10 M**
III	**Indian Knowledge System (IKS):** Concept and evolution of Indian Knowledge System; Traditional Indian knowledge related to plants, medicine, and agriculture; Ayurveda, ethnobotany, and indigenous healthcare practices; Traditional ecological knowledge and biodiversity conservation; Role of IKS in sustainable development; Documentation and preservation of indigenous knowledge with reference to NE India.	**10 H / 10 M**
IV	**Intellectual Property Rights (IPR):** Concept, importance, and types of IPR; Patents, copyrights, trademarks, geographical indications, and trade secrets; Patent filing procedures and patentability criteria; Plant variety protection and farmers' rights; IPR issues related to biological resources and traditional knowledge; National and international organizations related to IPR.	**10 H / 11 M**
V	**Biodiversity, Legal Frameworks & Contemporary Issues:** Convention on Biological Diversity (CBD); Nagoya Protocol and Access & Benefit Sharing (ABS); Biopiracy and protection of traditional knowledge; Indian Biological Diversity Act and related regulations; Ethical and legal issues in biodiversity utilization; Contemporary issues and emerging challenges in bioethics and IPR.	**7 H / 8 M**
TOTAL		**45 H /52M**

PRACTICAL

	Name of the experiment	Teaching hours/Allotted Marks
	8. Preparation of assignments and seminar presentations on bioethical issues. 9. Case study analysis on ethical dilemmas in biological sciences. 10. Survey and documentation of indigenous traditional knowledge. 11. Demonstration of patent search using online databases. 12. Preparation of a model patent draft. 13. Group discussion on biopiracy and biodiversity laws. 14. Field visit/report related to traditional medicinal knowledge or biodiversity conservation.	**30 H / 18 M**
Course/ Learning outcomes	**After successful completion of the course, students will be able to**: 6. Understand the ethical principles governing biological research and applications. 7. Explain the significance of Indian traditional knowledge systems in modern science and sustainability. 8. Demonstrate knowledge of various forms of Intellectual Property Rights (IPRs). 9. Analyze ethical and legal issues related to biotechnology, biodiversity, and indigenous knowledge. 10. Develop awareness regarding research integrity, biosafety, and biosecurity	
Texts / References	11. Beauchamp, T.L. & Childress, J.F. Principles of Biomedical Ethics. Oxford University Press. 12. Sateesh, M.K. Bioethics and Biosafety. I.K. International Publishing House. 13. Nambisan, P. An Introduction to Ethical, Safety and Intellectual Property Rights Issues in Biotechnology. Academic Press. 14. Subbarayappa, B.V. The Roots of Ancient Medicine: An Historical Outline. 15. Jha, A.K. Intellectual Property Rights and Globalization. 16. Singh, K. Intellectual Property Rights in India. 17. Gupta, A.K. Traditional Knowledge and Intellectual Property. 18. Government of India. National Education Policy (NEP) 2020. 19. The Biological Diversity Act, Government of India. 20. WIPO Publications on Intellectual Property Rights.	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SYLLABUS of FYUGP

8th SEMESTER

(Botany)

SEMESTER: FYUGP 8th SEMESTER				
Course Code	BOTM 801			
Course Title	Reproductive & Developmental Biology			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	This course aims to provide knowledge of the fundamental principles of developmental biology, including cell differentiation, embryogenesis, morphogenesis, and organogenesis in plants and animals. It also focuses on plant anatomy, secondary growth, and palynology, along with their practical applications in agriculture, biotechnology, environmental studies, and forensic science. The course helps students understand developmental mechanisms and develop analytical and observational skills in biological sciences			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation, morphogenetic gradients, cell fate and cell lineages, stem cells, genomic equivalence and the cytoplasmic determinants, imprinting, mutants and transgenics in analysis of development.	6 H / 10 M
II	Gametogenesis, fertilization and early development: Male gametophyte development, embryo sac development and double fertilization in plants, embryogenesis, establishment of symmetry in plants, seed formation, embryo and endosperm developmental dynamics and germination.	8 H / 8 M
III	Morphogenesis and organogenesis in model organisms: Cell aggregation and differentiation in Dictyostelium, axes and pattern formation in Drosophila; organogenesis - vulva formation in *Caenorhabditis elegans*, eye lens induction, post embryonic development - larval formation, metamorphosis; environmental regulation of normal development; sex determination.	10 H / 10 M
IV	Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem, shoot and root development, leaf development and phyllotaxy, transition to flowering, floral meristems, organogenesis and floral development.	6 H / 10 M
V	Periderm: Origin and activity, Rhytidome, protective tissue in Monocotyledons, bark and cork; Cambium- Origin, function, behavior, Secondary growth in dicot stem.	7 H / 6 M
VI	Applications Palynology: Pollen morphology, ultrastructure, pollen chemistry, viability, storage and adaptation of palynology: aeropalynology and pollen allergy, melissopalynology, forensic palynology, palaeopalynology and hydrocarbon exploration.	8 H / 8 M
TOTAL		**45 H / 52 M**

PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours & Allotted Marks**
	1. Study of different stages of mitosis and meiosis using temporary slides. 2. Observation of embryonic developmental stages in plants and animals through prepared slides/charts/models. 3. Study of pollen morphology (by acetolysis method), pollen viability, and pollen germination by staining techniques. 4. Identification and study of male gametophyte and embryo sac development in flowering plants. 5. Study of seed structure, stages of seed germination, and embryogenesis in dicot and monocot plants. 6. Observation of morphogenesis and organogenesis in model organisms through charts, specimens, and virtual demonstrations. 7. Study of shoot apical meristem, root apical meristem, and leaf arrangement (phyllotaxy). 8. Preparation and identification of transverse sections of dicot stem showing secondary growth and cambial activity. 9. Study of periderm, bark, cork, and protective tissues in monocot and dicot plants. 10. Analysis of pollen grains for applications in palynology including aeropalynology, melissopalynology, and forensic palynology. 11. Demonstration of tissue culture, stem cells, mutants, and transgenic techniques through laboratory visits/videos/models. 12. Submission of practical records, diagrams, and field/laboratory reports	**30 hours/ 18 Marks**
Course/ Learning outcomes	After completing this course, students will be able to- 1. Explain the basic concepts and mechanisms of development in plants and animals, including embryogenesis, differentiation, and organogenesis. 2. Understand plant anatomical structures, secondary growth, and the role of cambium and periderm. 3. Gain knowledge of pollen biology and applications of palynology in various scientific fields. 4. Enhance their analytical, observational, and practical skills in developmental biology and plant sciences.	
Texts / References	1. Gilbert, S. F., & Barresi, M. J. F. (2020). Developmental biology (12th ed.). Sinauer Associates/Oxford University Press. 2. Wolpert, L., Tickle, C., & Arias, A. M. (2019). Principles of development (6th ed.). Oxford University Press. 3. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2018). Plant physiology and development (6th ed.). Sinauer Associates.	

4. Evert, R. F. (2006). Esau's plant anatomy: Meristems, cells, and tissues of the plant body—Their structure, function, and development (3rd ed.). John Wiley & Sons.
5. Hesse, M., Halbritter, H., Zetter, R., Weber, M., Buchner, R., Frosch-Radivo, A., & Ulrich, S. (2009). Pollen terminology: An illustrated handbook. Springer.
6. Erdtman, G. (1969). Handbook of palynology: Morphology, taxonomy, ecology. Hafner Publishing Company.

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 8th SEMESTER				
Course Code	BOTM 802			
Course Title	Organismal Ecology and Environmental Interactions			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objectives	This course aims to provide students with a comprehensive understanding of ecological principles governing the interactions between organisms and their environment across different levels of biological organization. It introduces the concepts of population, community, and ecosystem ecology, emphasizing ecological processes such as population dynamics, species interactions, energy flow, and nutrient cycling. The course further explores the impacts of human activities on natural ecosystems, including climate change, habitat fragmentation, pollution, and biological invasions.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	**Introduction:** Levels of organization- individual, population, community, ecosystem, biosphere; Abiotic and biotic ecological factors, Ecological adaptations. /	**6 H / 6 M**
II	**Population Ecology:** Population growth models- Exponential growth, logistic growth, density-dependent and density-independent factors, life tables, survivorship curves; Population dynamics- Age structure, sex ratio, life history strategies (r-selected vs. K-selected); Metapopulations- Habitat fragmentation, connectivity, and extinction risk.	**8 H / 8 M**
III	**Community Ecology**: Community structure - Food webs, trophic levels, keystone species; Species interactions - Competition, predation, mutualism, parasitism; Succession- Primary and secondary succession, community stability.	**10 H/10M**
IV	**Ecosystem Ecology**: Energy flow in ecosystems- Primary production, trophic levels, energy pyramids; Biogeochemical cycles- Carbon, nitrogen, phosphorus, water cycles; Ecosystem services and human impacts.	**6 H / 10M**
V	**Human Impacts on Ecosystems**: Anthropogenic pressures: Land use and land-cover change; Climate change, pollution, invasive species.	**7 H / 6 M**
VI	**Ecological Calculations:** Mark Capture Recapture, Population measurement, Biomass prediction, indices of plant community, Island Biogeography	**8 H / 5 M**
TOTAL		**45 H / 52 M**

PRACTICAL		
Exp. No.	**Name of the experiment**	**Teaching hours/Allotted Marks**
	1. Estimation of Population Density and Frequency of Plant Species for calculating IVI 2. Determination of Species Diversity and Community Structure 3. Population Estimation by Mark–Capture–Recapture Method 4. Measurement of above-ground biomass and estimation of primary productivity in a selected ecosystem. 5. Analysis of primary and secondary succession using case studies, models, photographs, or digital simulations. 6. Computer-assisted or model-based demonstration of species–area relationships, habitat fragmentation, connectivity, and extinction–colonization dynamics.	**30H / 18 M**
Course/ Learning outcomes	After completing this course, students will be able to- 1. Explain the fundamental principles of organismal ecology and evaluate the influence of abiotic and biotic factors on the distribution, adaptation, and survival of organisms 2. Analyze population, community, and ecosystem dynamics by interpreting population growth models, species interactions, ecological succession, energy flow, biogeochemical cycles, and ecosystem services. 3. Apply quantitative ecological methods and ecological indices to assess biodiversity, population structure, biomass, island biogeography, and the impacts of anthropogenic activities on ecosystem stability and conservation.	
Texts / References	1. Begon, M., Townsend, C. R., & Harper, J. L. (2021). Ecology: From individuals to ecosystems (5th ed.). Wiley-Blackwell. 2. Cain, M. L., Bowman, W. D., & Hacker, S. D. (2022). Ecology (6th ed.). Oxford University Press. 3. Molles, M. C., Jr., & Sher, A. A. (2019). Ecology: Concepts and applications (8th ed.). McGraw-Hill Education. 4. Ricklefs, R. E., & Relyea, R. A. (2019). The economy of nature (8th ed.). W. H. Freeman and Company. 5. Smith, T. M., & Smith, R. L. (2015). Elements of ecology (9th ed.). Pearson Education	

MODES OF IN-SEMESTER ASSESSMENT: (30 Marks)

Two Sessional Examinations	20 Marks
Attendance	5 Marks
Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 8TH SEMESTER				
Course Code	BOTM 803			
Course Title	Pharmacognosy and Ethnobotany			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52(ES) + 18 (PR) +30 (IA) = 100			
Course Objective	This course will introduce students to the principles, history, scope, and importance of Pharmacognosy and Ethnobotany. It will provide comprehensive knowledge regarding medicinal plants, crude drugs, and bioactive phytochemicals. It will familiarize students with indigenous knowledge systems and traditional healthcare practices of India. This may helps to develop practical skills in identification, collection, preservation, and processing of medicinal plant materials and promote awareness regarding biodiversity conservation, sustainable utilization of medicinal plants, and intellectual property rights.			

COURSE CONTENTS

THEORY

Units	CONTENTS	Teaching Hours/Marks allotted
I	**Introduction to Pharmacognosy** Definition, history, scope, and importance of Pharmacognosy; Classification of crude drugs based on morphology, taxonomy, and chemical nature; Sources of crude drugs: plant, animal, mineral, marine, and microbial origin; Collection, cultivation, processing, storage, and preservation of crude drugs; Adulteration and evaluation of crude drugs.	**10H/15M**
II	**Medicinal Plants and Phytochemistry** Study of important medicinal plants and their therapeutic uses; Primary and secondary metabolites; Classification and significance of alkaloids, glycosides, flavonoids, tannins, terpenoids, and essential oils; Methods of extraction, isolation, and identification of phytochemicals.; Role of medicinal plants in pharmaceutical and herbal industries.	**8H/10M**
III	**Ethnobotany and Traditional Knowledge** Definition, history, scope, and objectives of Ethnobotany; Ethnobotanical studies among tribal and rural communities of India; Traditional systems of medicine: Ayurveda, Siddha, Unani, Folk Medicine, and Homeopathy; Documentation and preservation of indigenous knowledge; Role of ethnobotany in healthcare and community development	**9H/10M**
IV	**Applied and Economic Ethnobotany** Ethnobotanical uses of plants in food, beverages, fibre, dyes, gums, resins, oils, and rituals; Medicinal plants used in common ailments and traditional therapies; Economic importance of medicinal and aromatic plants; Bioprospecting, biopiracy, biodiversity laws, and Intellectual Property Rights (IPR); Ethnobotany in sustainable rural development.	**10H/10M**

V	**Conservation and Sustainable Utilization** Threats to medicinal plant diversity; Conservation strategies: in situ and ex situ conservation; Sustainable harvesting and cultivation practices; Herbal drug standardization and quality control; Recent advances and future prospects in Pharmacognosy and Ethnobotany.	**8H/7M**
TOTAL		**45H / 52M**
Exp. No.	**Name of the Experiment**	**Teaching Hours/Allotted Marks**
	1. Identification and study of locally available medicinal plants. 2. Preparation of herbarium specimens of medicinal plants. 3. Microscopic examination of crude drugs. 4. Extraction of phytochemicals using different methods. 5. Detection of alkaloids, tannins, flavonoids, and essential oils. 6. Preparation of ethnobotanical survey reports. 7. Field visit to herbal gardens, medicinal plant conservation centres, or local communities.	30H /18M
Course/ Learning outcomes	Upon successful completion of the course, the students be should able to- 1. Explain the concepts, scope, and applications of Pharmacognosy and Ethnobotany. 2. Identify important medicinal plants and evaluate their therapeutic importance. 3. Describe major phytochemical groups and their medicinal significance. 4. Understand the role of traditional medicine and indigenous knowledge systems in healthcare. 5. Demonstrate practical knowledge in herbarium preparation, crude drug identification, and phytochemical extraction. 6. Analyze issues related to conservation, bioprospecting, and intellectual property rights associated with medicinal plants.	
Texts / References	1. Trease, G.E. and Evans, W.C. Pharmacognosy. Saunders Elsevier. 2. Kokate, C.K., Purohit, A.P. and Gokhale, S.B. Pharmacognosy. Nirali Prakashan. 3. Jain, S.K. Manual of Ethnobotany. Scientific Publishers. 4. Harborne, J.B. Phytochemical Methods. Chapman and Hall. 5. Shah, B. and Seth, A.K. Textbook of Pharmacognosy and Phytochemistry. Elsevier. 6. Cotton, C.M. Ethnobotany: Principles and Applications. John Wiley & Sons. 7. Sofowora, A. Medicinal Plants and Traditional Medicine in Africa. Spectrum Books	
	MODES OF IN-SEMESTER ASSESSMENT:	**(30 Marks)**
	Two Sessional Examinations	20 Marks
	Attendance	5 Marks
	Assignment/Seminar/Activity	5 Marks

SEMESTER: FYUGP 8TH SEMESTER				
Course Code	BOTN 801			
Course Title	Pharmacognosy and Ethnobotany			
Category of Course	Minor			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52(ES) + 18 (PR) +30 (IA) = 100			
Course Objective	This course will introduce students to the principles, history, scope, and importance of Pharmacognosy and Ethnobotany. It will provide comprehensive knowledge regarding medicinal plants, crude drugs, and bioactive phytochemicals. It will familiarize students with indigenous knowledge systems and traditional healthcare practices of India. This may helps to develop practical skills in identification, collection, preservation, and processing of medicinal plant materials and promote awareness regarding biodiversity conservation, sustainable utilization of medicinal plants, and intellectual property rights.			

COURSE CONTENTS

THEORY

Units	CONTENTS	Teaching Hours/Marks allotted
I	**Introduction to Pharmacognosy** Definition, history, scope, and importance of Pharmacognosy; Classification of crude drugs based on morphology, taxonomy, and chemical nature; Sources of crude drugs: plant, animal, mineral, marine, and microbial origin; Collection, cultivation, processing, storage, and preservation of crude drugs; Adulteration and evaluation of crude drugs.	**10H/15M**
II	**Medicinal Plants and Phytochemistry** Study of important medicinal plants and their therapeutic uses; Primary and secondary metabolites; Classification and significance of alkaloids, glycosides, flavonoids, tannins, terpenoids, and essential oils; Methods of extraction, isolation, and identification of phytochemicals.; Role of medicinal plants in pharmaceutical and herbal industries.	**8H/10M**
III	**Ethnobotany and Traditional Knowledge** Definition, history, scope, and objectives of Ethnobotany; Ethnobotanical studies among tribal and rural communities of India; Traditional systems of medicine: Ayurveda, Siddha, Unani, Folk Medicine, and Homeopathy; Documentation and preservation of indigenous knowledge; Role of ethnobotany in healthcare and community development	**9H/10M**
IV	**Applied and Economic Ethnobotany** Ethnobotanical uses of plants in food, beverages, fibre, dyes, gums, resins, oils, and rituals; Medicinal plants used in common ailments and traditional therapies; Economic importance of medicinal and aromatic plants; Bioprospecting, biopiracy, biodiversity laws, and Intellectual Property Rights (IPR); Ethnobotany in sustainable rural development.	**10H/10M**
	Conservation and Sustainable Utilization Threats to medicinal plant diversity; Conservation strategies: in situ and ex	**8H/7M**

V	situ conservation; Sustainable harvesting and cultivation practices; Herbal drug standardization and quality control; Recent advances and future prospects in Pharmacognosy and Ethnobotany.	
TOTAL		**45H / 52M**
Exp. No.	**Name of the Experiment**	**Teaching Hours/Allotted Marks**
	1. Identification and study of locally available medicinal plants. 2. Preparation of herbarium specimens of medicinal plants. 3. Microscopic examination of crude drugs. 4. Extraction of phytochemicals using different methods. 5. Detection of alkaloids, tannins, flavonoids, and essential oils. 6. Preparation of ethnobotanical survey reports. 7. Field visit to herbal gardens, medicinal plant conservation centres, or local communities.	**30H /18M**
Course/ Learning outcomes	Upon successful completion of the course, the students should be able to- 1. Explain the concepts, scope, and applications of Pharmacognosy and Ethnobotany. 2. Identify important medicinal plants and evaluate their therapeutic importance. 3. Describe major phytochemical groups and their medicinal significance. 4. Understand the role of traditional medicine and indigenous knowledge systems in healthcare. 5. Demonstrate practical knowledge in herbarium preparation, crude drug identification, and phytochemical extraction. 6. Analyze issues related to conservation, bioprospecting, and intellectual property rights associated with medicinal plants.	
Texts / References	1. Trease, G.E. and Evans, W.C. Pharmacognosy. Saunders Elsevier. 2. Kokate, C.K., Purohit, A.P. and Gokhale, S.B. Pharmacognosy. Nirali Prakashan. 3. Jain, S.K. Manual of Ethnobotany. Scientific Publishers. 4. Harborne, J.B. Phytochemical Methods. Chapman and Hall. 5. Shah, B. and Seth, A.K. Textbook of Pharmacognosy and Phytochemistry. Elsevier. 6. Cotton, C.M. Ethnobotany: Principles and Applications. John Wiley & Sons. 7. Sofowora, A. Medicinal Plants and Traditional Medicine in Africa. Spectrum Books	
MODES OF IN-SEMESTER ASSESSMENT:		**(30 Marks)**
Two Sessional Examinations		20 Marks
Attendance		5 Marks
Assignment/Seminar/Activity		5 Marks

SEMESTER: FYUGP 8th SEMESTER				
Course Code	BOTM 804			
Course Title	Immunology & Translational Pathobiology			
Category of Course	Major			
Credits & Hours of Teaching		Theory	Practical	Total
	Credits	3	1	4
	Hours of Teaching	45	30	75
Total Marks	52 (ES) + 18 (PR) + 30 (IA)=100			
Course Objective	Understand the fundamentals of immunity, host–pathogen interactions, cancer biology, microbial physiology, antimicrobial resistance and membrane structure and transport mechanisms.			

Course Content

THEORY

Units	CONTENTS	Teaching hours/Allotted Marks
I	Innate and adaptive immune system: Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity, B and T cell epitopes, structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antibody engineering.	6 H / 8 M
II	Antigen antibody interactions: MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial, parasitic and viral infections, congenital and acquired immunodeficiencies, vaccines.	8 H / 10 M
III	Host pathogen interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behaviour by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.	7 H / 8 M
IV	Cancer Biology: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, therapeutic interventions of uncontrolled cell growth. Programmed cell death, aging and senescence in plants	7 H / 10 M
V	Microbial physiology: Growth kinetics, strategies of cell division, stress response, antimicrobial resistance (AMR), Mechanism of actions of antibiotics, Culture media for growing pathogenic and non pathogenic microbes	9 H / 8 M
VI	Microbial membrane physiology: Cell wall, physical structure of model membranes in prokaryotes, lipid bilayer, membrane proteins, diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.	8 H /8 M
TOTAL		**45 H /52 M**

PRACTICAL

Exp. No.	Name of the	Teaching hours/Allotted

	experiment	Marks
	1. Differential Staining of Human Blood Cells (Innate and Adaptive Immunity) 2. Antigen–Antibody Agglutination Test 3. Study of Microbial Growth Curve 4. Effect of Antibiotics on Bacterial Growth (Antimicrobial Resistance) 5. Observation of Osmosis Using Dialysis Membrane (Membrane Physiology) 6. Detection of Programmed Cell Death in Plant Tissues	**30 H /18 M**
Course/ Learning outcomes	After completion of the course, students will be able to: 1. Differentiate between innate and adaptive immunity and explain the role of immune cells, antibodies and epitopes in immune responses. 2. Interpret antigen–antibody interactions and explain the mechanisms of immune regulation, hypersensitivity, autoimmunity, immunodeficiency and vaccination. 3. Evaluate the interaction between hosts and pathogens and describe pathogen-induced diseases in plants and animals. 4. Explain the genetic and cellular basis of cancer, including carcinogenesis, metastasis, programmed cell death, aging and senescence. 5. Demonstrate knowledge of microbial growth, antimicrobial resistance mechanisms and the preparation and use of microbial culture media. 6. Describe membrane organization, transport systems, membrane proteins and intracellular transport processes in microbial cells.	
Texts / References	1. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2017). Janeway's Immunobiology (9th ed.). Garland Science, New York. 2. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2021). Cellular and Molecular Immunology (10th ed.). Elsevier, Philadelphia. 3. Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2021). Brock Biology of Microorganisms (16th ed.). Pearson Education, USA. 4. Weinberg, R. A. (2014). The Biology of Cancer (2nd ed.). Garland Science, New York. 5. Indian Authors 6. Dubey, R. C., & Maheshwari, D. K. (2018). A Textbook of Microbiology (5th ed.). S. Chand Publishing, New Delhi. 7. Verma, P. S., & Agarwal, V. K. (2019). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand Publishing, New Delhi. 8. Arora, M. P. (2019). Cell Biology, Genetics, Molecular Biology and Evolution. Himalaya Publishing House, Mumbai.	