

GURU NANAK COLLEGE (AUTONOMOUS)

VELACHERY ROAD, CHENNAI – 600042

(Re-accredited at ‘A-Grade’ by NAAC) Affiliated to University of Madras



B.Sc. (Plant Biology and Plant Biotechnology)

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

SYLLABUS

(For the candidates admitted for the Academic year 2022-23 and thereafter)

PREAMBLE

Plant Biology and Plant Biotechnology Programme main goal in higher education is to get students are prepared for society. At the undergraduate level, the present pattern is intended to provide a focused learning outcome-based curriculum that offers organized teaching-learning experiences that are tailored to the requirements of the students. The courses will provide the students with the basic academic and job-readiness foundation. The Programme instills a variety of qualities at the UG level as well. These qualities include those that promote social justice, emotional stability, creative and critical thinking, wellbeing, and a variety of employable skills, so equipping students for lifelong learning and sustainability. The new curriculum offers knowledge in areas like Plant Diversity I & II, Plant Biotechnology, Herbal Botany, Genetics, Ecology, Microbiology, Physiology and Preservation of Fruits and Vegetables, Plant diseases and management, etc. The course learning outcomes provide the students, the freedom to choose optional areas (NME and IDE) that will enhance their skills in Plant Science. This curricular structure was created in such a way that they are student-centric learning approach, which is wholly outcome and curiosity driven. The curriculum is more leaning toward self-discovery of topics to prevent rote learning and to develop inventiveness. The pragmatic method, which teaches students how to apply theoretical principles in the real world, is the main emphasis of the curricular framework.

LEARNING OUTCOME BASED CURRICULUM

FRAMEWORK

From the Academic Year (2019- 20) and there after

VISION

To establish a viable and conducive environment for the conduct of learning and research in plant sciences and equip the graduate with updated skills to seek their professional pursuits.

MISSION

Earnest endeavors towards imparting fundamental and essential subject knowledge and also to incorporate new emerging frontiers knowledge in the curriculum to keep up with the contemporary academic trends.

PROGRAMME OUTCOME

B.Sc. (PLANT BIOLOGY AND PLANT BIOTECHNOLOGY)

- PO 1:** Provide the needed statistical tools to experience inter disciplinary and cross disciplinary study and to discern the multi- disciplinary scope of biological science.
- PO 2:** Additional skills in multidisciplinary study offer the scope to the demands of recent advances in biological sciences.
- PO 3:** Demonstrable skills in the core discipline enhance the prospects of employment and higher research.
- PO 4:** Encouraging group participation in laboratory work and plant nursery and eco-club activities imparts team spirit and team work amidst students.
- PO 5:** Participation in inter departmental competitions hones communication and subject knowledge and peer gauging.

PROGRAMME SPECIFIC OUTCOMES

B.Sc. (PLANT BIOLOGY AND PLANT BIOTECHNOLOGY)

- PSO 1:** Demonstrable understanding of molecules, cells, systems, organisms, ecosystems and use comparative approach to explain the evolution of organism and understand the genetic diversity of the flora and fauna.
- PSO 2:** The subject knowledge enables to successfully endeavour in the fields like plant explorer, conservationist, ecologist, environment consultant, horticulturist, plant Physiologist, nursery manager, genetics and molecular biologist, taxonomist, plant pathologist, and farming consultant.

**B.Sc. (PLANT BIOLOGY AND PLANT BIOTECHNOLOGY)
COURSE STRUCTURE 2019-20 Batch**

Semester	Part	Course Component	Subject Name	Credit	Hours	Internal	External	Total
I	I	Language	Tamil - I/Hindi - I	3	6	50	50	100
	II	English	English – I	3	4	50	50	100
	III	Core - I	Algae and Bryophytes	4	6	50	50	100
	III	Core III	Practical I: Algae and Bryophytes, Fungi, Plant Pathology and Lichenology	-	2	50	50	100
	III	Allied - I	Zoology – I	3	6	50	50	100
			Allied Zoology Practical	-	2	50	50	100
	IV	1. NME	Nursery and Landscaping /Basic Tamil /Basic Hindi	2	2	50	50	100
IV	Soft Skills - I	Introduction to Study Skills	3	2	50	50	100	
Total Credits - 18, Total Hours/ week- 30								
II	I	Language	Tamil - II /Hindi - II	3	6	50	50	100
	II	English	English – II	3	4	50	50	100
	III	Core - II	Fungi, Plant Pathology and Lichenology	4	6	50	50	100
	III	Core - III	Practical I: Algae and Bryophytes, Fungi, Plant Pathology and Lichenology	4	2	50	50	100
	III	Allied - II	Zoology - II	3	6	50	50	100
			Allied Zoology Practical	4	2	50	50	100
	IV	1.NME	Mushroom Cultivation /Basic Tamil /Basic Hindi	2	2	50	50	100
IV	Soft Skills - II	Life Skills	3	2	50	50	100	
Total Credits - 26, Total Hours/ week- 30								
III	I	Language	Tamil III /Hindi III	3	6	50	50	100
	II	English	English III	3	4	50	50	100
	III	Core IV	Anatomy, Microtechnique and Embryology of Angiosperms	4	6	50	50	100
	III	Core VI	Practical II: Anatomy, Microtechnique and Embryology of Angiosperms, Pteridophytes, Gymnosperms & Paleobotany	-	2	50	50	100
	III	Allied III	Allied Chemistry I	3	6	50	50	100
			Allied Chemistry Practical	-	2	50	50	100
	IV	NME	Environmental Studies	-	2	50	50	100
	Soft Skills - III	Job oriented Skills	3	2	50	50	100	
Total Credits - 16, Total Hours/ week- 30								

**B.Sc. (PLANT BIOLOGY AND PLANT BIOTECHNOLOGY)
COURSE STRUCTURE 2019-20 Batch**

Semester	Part	Course Component	Subject Name	Credit	Hours	Internal	External	Total
IV	I	Language	Tamil IV /Hindi IV	3	6	50	50	100
	II	English	English IV	3	4	50	50	100
	III	Core V	Pteridophytes, Gymnosperms & Paleobotany	4	6	50	50	100
	III	Core VI	Practical II: Anatomy, Microtechnique and Embryology of Angiosperms, Pteridophytes, Gymnosperms & Paleobotany	4	2	50	50	100
	III	Allied IV	Allied Chemistry II	3	6	50	50	100
	III		Allied Chemistry Practical	4	2	50	50	100
	IV	Soft Skills - IV	Computing skills	3	2	50	50	100
	IV	EVS	Environmental studies	2	2	50	50	100
Total Credits - 26, Total Hours/ week- 30								
V	III	Core VII	Morphology, Taxonomy of Angiosperm & Economic Botany	4	4	50	50	100
	III	Core VIII	Cell Biology, Molecular Biology and Evolution	4	4	50	50	100
	III	Core IX	Microbiology	4	4	50	50	100
	III	Core X	Plant Ecology, Phytogeography and Remote sensing	4	4	50	50	100
	III	Core XIV	Practical – III: (Morphology, Taxonomy of Angiosperm & Economic Botany, Cell Biology, Molecular Biology & Evolution, Microbiology, Plant Ecology & Phytogeography)	4	8	50	50	100
	III	Elective I (IDE)	Inter-Disciplinary Elective: Horticulture & Mushroom Cultivation	5	5	50	50	100
	IV		Value Education	2	1	-	100	100
	V		Internship	2	-	-	-	-
Total Credits - 29, Total Hours/ week- 30								
	III	Core XI	Genetics, Plant Breeding & Biostatistics	4	4	50	50	100
	III	Core XII	Plant Physiology & Biochemistry	4	4	50	50	100
	III	Core XIII	Plant Biotechnology	4	4	50	50	100
	III	Core XIV	Practical III – (Morphology, Taxonomy of Angiosperm & Economic Botany, Cell biology, Molecular Biology and Evolution Microbiology, Plant Ecology & Phytogeography)	-	-	50	50	100
	III	Core XV	Practical IV (Genetics, Plant Breeding & Biostatistics, Plant Physiology & Biochemistry, Plant Biotechnology)	4	8	50	50	100
	III	Elective II	Herbal Botany	5	5	50	50	100
	III	Elective III	Preservation of Fruits and Vegetables	5	5	50	50	100
	V		Extension Activities	1	-	50	50	100
	Total Credits - 27, Total Hours/ week- 30							
Grand Total Credits – 142, Grand Total Hours/ week- 180								

SEMESTER -I

CORE I

ALGAE & BRYOPHYTES

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: I	CREDITS: 4	TOTAL HOURS: 90

COURSE FRAMEWORK:

- To study the characters, ecology, distribution, biology and classification, life cycle and economic importance of Algae and Bryophytes.
- To acquire knowledge on database and online resources of Algae and Bryophytes.
- To understand the origin of life and modern concepts, evolutionary scales and events.

COURSE OUTCOME:

1. To explain and identify the basic concepts and life cycle patterns of Algae and Bryophytes
2. Discuss the significances of Algae and Bryophytes in this changing world for future generation.
3. Explain the evidence supporting the evolution of plants from Algae and to acquire knowledge on the morphological and anatomical structure of Bryophytes.
4. Explain the morphological diversity of Bryophytes and to understand the economic importance of the Bryophytes.
5. Familiarize the databases and online resources available for Algae and Bryophytes

ALGAE

UNIT I

(15 Hours)

General characters, ecology and distribution; range of thallus organization; cell structure and components; cell wall, pigment system, reserve food, flagella; methods of reproduction; life cycle patterns, Classification of algae (Fritsch, 1945); Contribution of Indian algologist- Prof. M. O. P. Iyengar, Prof. T.V. Desikachary, Prof. V.S. Sundaralingam, Prof. V. Krishnamurthy.

UNIT II

(20 Hours)

Morphology and life cycle of (i) *Nostoc* (Cyanophyceae) (ii) *Chara* (Chlorophyceae) (iii) *Coleochaete* (Charophyceae) (iv) *Navicula* (Bacillariophyceae) (v) *Sargassum* (Phaeophyceae) (vi) *Kappaphycus* (Rhodophyceae) (No Developmental stages).

BRYOPHYTES

UNIT III

(20 Hours)

General characters of Bryophytes; ecology and distribution of Bryophytes; Classification of Bryophytes (Watson, 1981); alternation of generations; inter-relationship with algae; Evolution of sporophyte within Bryophytes.

UNIT IV

(20 Hours)

Distribution, vegetative characters and reproduction of the following genera: *Riccia* (liverworts), *Anthoceros* (Hornworts), *Polytrichum* (Mosses) (No Developmental stages).

UNIT V

(15 Hours)

Economic importance of algae – Algal database and online resources. Economic importance of Bryophytes - Bryophyte database and online resources.

PRESCRIBED BOOK:

1. Smith, G.M. (1955). Cryptogamic Botany (Vol. I Algae, Fungi, & Lichens). McGraw – Hill Book Co., New York.
2. Vashishta, B.R., Sinha, A.K. and Singh. V.P. (2008). Botany for Degree Students: Algae. S. Chand & company Ltd, New Delhi.
3. Chopra, R. N and Kumar P. K. (1988). Biology of Bryophytes, Wiley Eastern Ltd, New Delhi.
4. Prem, P. (1981). Bryophytes – Morphology Growth and Differentiation. Atma Ram & Sons, Lucknow.
5. Rashid, A. 1998. An Introduction to Bryophyta. Vikas Publishing House (P) Ltd., New Delhi.

SUGGESTED READING**Algae**

1. Fritsch F.E. (1948). The Structure & Reproduction of Algae. Vol 2. Cambridge University Press, Cambridge, U.K.
2. Ian Morris, (1967). An Introduction to the Algae. Hutchinson, London.
3. Kumar, H.D. (1999). Introductory Phycology (2nd edition). Affiliated East West Press Pvt. Ltd. Delhi.
4. Pandey, B.P. (2001). College Botany Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant pathology, Industrial Microbiology and Bryophyta. S. Chand & company Ltd, New Delhi.
5. Sambamurthy, A.V.S.S. (2006). A Textbook of Algae. I.K. International Pvt. Ltd., New Delhi.

Bryophytes

1. Smith, G.M. (1955). Cryptogamic Botany Vol. II Bryophytes and Pteridophytes (2nd edn.). Tata McGraw Hill Publishing Co., New Delhi.
2. Srivastava, N.N. (1996). Bryophyta. Pradeep Prakashan, Meerut.
3. Vashista, B.R. (1983). Botany for Degree Students – Bryophyta. S. Chand and Company Ltd., New Delhi.
4. Watson, E. V. (1974). The structure and life of Bryophytes. B.I. Publications, New Delhi.

QUESTION PAPER PATTERN:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principle Answer any 10 out of 12 Questions	01-12	3	30
Section B	Short Answer - Answer any 5 out of 7 questions	13-19	6	30
Section C	Essay Answer any 4 out of 6 questions	20-25	10	40

DISTRIBUTION OF QUESTIONS:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	3	
	Unit – 3	3	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	2	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	1	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	

**Non Major Elective – I
NURSERY AND LANDSCAPING**

SUBJECT CODE :	THEORY	MARKS: 100
SEMESTER: I	CREDITS: 2	TOTAL HOURS: 30

COURSE FRAMEWORK:

- Explain the principles of vegetative propagation.
- Relate theoretical and practical knowledge to establish home gardens scientifically.
- List and categorize types of soils, chemicals, fertilizers, and Integrated Pest Management.
- Outline a fundamental understanding of plant identification, selection, use, and maintenance of plant material best suited for conventional and sustainable landscapes.
- Relate and familiarize with grafting, layering and seedling culture

COURSE OUTCOME:

1. Explain the principles of vegetative propagation.
2. Relate theoretical and practical knowledge to establish home gardens scientifically.
3. List and categorize types of soils, chemicals, fertilizers, and Integrated Pest Management.
4. Outline a fundamental understanding of plant identification, selection, use, and maintenance of plant material best suited for conventional and sustainable landscapes.
5. Relate and familiarize with grafting, layering and seedling culture

UNIT I

(5 Hours)

Nursery: 1. Definition, objectives, scope and building up of infrastructure for nursery. 2. Planning and seasonal activities – Planting – direct seeding and transplants. 3. Nursery Management and Routine Garden Operations.

UNIT II

(10 Hours)

Gardening: 1. Definition, objectives and scope – different types of gardening. 2. Landscape and home gardening – parks and its components, plant materials and design 3. Computer applications in landscaping. 4. Gardening operations: soil laying, manuring, watering. 5. Landscaping Places of Public Importance: Landscaping highways and Educational Institutions 6. Some Famous gardens of India.

UNIT III

(5 Hours)

Propagation methods: 1 Sowing/raising of seeds and seedlings, transplanting of seedlings. 2. Air – layering, cutting, selection of cutting, propagule collecting season, treatment of cutting rooting medium and planting of cuttings – Hardening of plants. 3. Propagation of ornamental plants by rhizomes, corms tubers, bulbs and bulbils. 4. Green house – mist chamber, shed root, shade house and glass house for propagation.

UNIT IV

(5 Hours)

Gardening: Formal garden, informal garden, vegetable garden, landscaped layout designing – formation and maintenance of lawn. Gardens Operation; Planting and Transplantation, Pinching, Debudding. Defoliation, Staking, Pruning. Mulching and Topiary.

UNIT V**(5 Hours)**

Nursery structures – Green house – shade house, Mist chamber – topiary, Bonsai culture. Manure, composting – Vermicomposting. Terrace garden, Rock Garden, Hydroponics, Terrarium, Arches, Pergolas Bonsai and Lawn. Cut – flowers, flower arrangements commercial floriculture, cultural practices of Rose and Jasmine.

PRESCRIBED BOOKS:

1. Bose, T.K. & Mukherjee, D. 1972. Gardening in India. Oxford & IBH Publishing Co., New Delhi.
2. Chauhan, D.V.S. 1968, Vegetable production in India, Ram Prasad, SMS Agra.
3. Edmund, J.B Senn, T.L Andrews F.S. and Halforce, R.G 1990. Fundamentals of Horticulture 14th ed) Tata McGraw Hill Pvt .Co. London.
4. Gopaldaswami Iyengar, K.S 1970. Complete gardening in India, Kalyan press, Bangalore.
5. Jules J. Janick. J 1982. Horticulture science, 3rd Edition, Surjeet publication, New Delhi.
6. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
7. Kumar, N. 1990, Introduction to Horticulture. Rohini agencies, Nagercoil.
8. Percy Lancaste, 1979. Gardening in India, Mohan Makhijani and Rekhaprinters, New Delhi.

SUGGESTED READING

1. Prasad, 2005. Principles of Horticulture, International book distributors, Dehradun.
2. Randhawa G.S 1973. Ornamental Horticulture in India. Today and Tomorrow printers and publishers, New Delhi.
3. 11.Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.
4. Sandhu, M.K., 1989 Plant Propagation. Wiley Eastern Ltd., Bangalore, Madras

QUESTION PAPER PATTERN:

Section	Question Component	Numbers	Marks	Total
Section A	Essay Answer any 5 out of 10 questions	01-10	20	100

DISTRIBUTION OF QUESTIONS:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	2	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	

Allied I
Allied BOTANY – I

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: I	CREDITS: 3	TOTAL HOURS: 90

COURSE FRAMEWORK:

- To provide knowledge on the structure and reproduction of certain Cryptogams and Gymnosperms forms besides giving an overview.
- To make the student to understand the organization of prokaryotic and eukaryotic cell, structure and function of organelles and cell division.
- To make the student to become familiar and to understand the plant cell, tissues, and internal structures of stem, root and leaves.

COURSE OUTCOME:

1. Explain the structure and reproduction of certain Cryptogams and Gymnosperms
2. Relate the organization of prokaryotic and eukaryotic cell, structure and function of organelles and cell division.
3. Explain the plant cell, tissues, and internal structures of stem, root and leaves.
4. Comparative study of the different plant groups with representative examples including Virus, Bacteria, Algae, Fungi, Lichens, Bryophytes, Pteridophytes and Gymnosperms
5. Demonstrate the simple tissues from fresh plant material and prepare permanent slides. Study of simple and complex tissues (xylem)

UNIT I (20 Hours)
Structure and life history of *Nostoc*, *Chlorella*, *Sargassum*, *Albugo*, *Penicillium* and *Agaricus*.

UNIT II (20 Hours)
Morphology, Anatomy, reproduction and life history of *Funaria*, *Lycopodium* and *Cycas*.

UNIT III (10 Hours)
Viruses: General account of Viruses, structure, replication and transmission of plant diseases Caused by Viruses. Bacteria: Structure, nutrition, reproduction and economic importance. General account of Plant virus (TMV). Outline of plant diseases of important crop plants caused by Bacteria and their control.

UNIT IV (20 Hours)
CELL BIOLOGY – Plant cell envelopes: Ultra structure of cell wall, molecular organization of cell membranes. Nucleus: Ultrastructure. Nucleic acids – Structure and replication of DNA, types and functions of RNA.

CHROMOSOMES AND CELL DIVISION – Chromosomes: Morphology, Organization of DNA in a chromosome, Euchromatin and Heterochromatin, Karyotype. Special types of chromosomes: Polytene, Lampbrush and B – Chromosomes 3. Cell division: Cell cycle and its regulation, Mitosis, Meiosis and their Significance.

UNIT V (20 Hours)
ANATOMY – Meristems: Types, histological organization of shoot and root apices. Tissues: Simple, Complex and special tissues. Leaf – Diversity of internal structure, stomata and epidermal outgrowths. Primary structure of Dicot stem, dicot root and dicot leaf. Structure of monocot root, stem & leaf.

PRESCRIBED BOOKS:

1. Sambamurthy, A.V.S.S 2006. A textbook of Plant Pathology. I.K. International Pvt. Ltd., New Delhi
2. Sharma, O.P 2006. A text book of Thallophyta, McGraw Hill Publishing. Co. New Delhi.
3. Smith, G. M. (1955). Cryptogamic Botany. Vol. II (2nd ed). (Bryophytes and Pteridophytes). Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Thakur, A.K. and S.K. Bassi. 2008. A text book of Botany: Diversity of Microbes and Cryptogams. S. Chand & company Ltd, New Delhi.
5. Vashishta, B.R., A.K. Sinha and V.P.Singh. 2008. Botany for Degree Students: Algae. S. Chand & company Ltd, New Delhi.
6. Vashishta, B.R.1990. Botany for Degree Students: Fungi. S. Chand & company Ltd, New Delhi.
7. Vashista. P.C. (1988) – A Text Book of Plant Anatomy. S.Nagin& Co.

SUGGESTED READINGS:

1. Alexopolous, J. and W.M Charles.1988 introduction to Mycology.Wiley Eastern, New Delhi. Ananthanarayan & Panikers; Microbiology 9th edition.
2. Cutter. E.G (1989) – Plant Anatomy – PartI – Addison – Wesley Publishing Co.
3. Eames, A. J. (1936). Morphology of Vascular Plants (Lower Groups). McGraw Hill,New York.
4. Esau.K. (1985) – Anatomy of Seed Plants –John Willey
5. Fahn, A. (1982). Plant Anatomy (3rd edition).Pergamon Press, Oxford.
6. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
7. Pandey, B.P 2001. College Botany Vol. I: Algae, Fungai, Lichens, Bacteria, Viruses, Plant pathology, Industrial Microbiology and Bryophyta. S. Chand & company Ltd, New Delhi.
8. Pandey, B.P 2007. Botany for Degree students: Diversity of microbes, Cryptograms, Cell biology and Genetics. S. Chand & company Ltd, New Delhi.
9. Parihar, N. S. (1999). An Introduction to Embryophyta. Vol. II. Pteridophyta. Central Book Depot, Allahabad.
10. Sambamurthy, A.V.S.S 2006. A textbook of Algae. I.K. International Pvt. Ltd., New Delhi.

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	Unit – 3	3	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	2	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	1	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	

SEMESTER II

CORE II

FUNGI, PLANT PATHOLOGY AND LICHENOLOGY

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: II	CREDITS: 4	TOTAL HOURS: 90

COURSE FRAMEWORK:

- To acquaint the students about morphology, biology and importance of fungi and lichens.
- To provide knowledge on the structure and reproduction of certain selected fungal and Lichen forms besides giving an overview.
- To impart knowledge on concepts, symptoms and management of various plant diseases.

COURSE OUTCOME

1. Describe the general characteristics of Fungi and Algae and its ultrastructure. Identify advantages and disadvantages of these organisms.
2. Discuss the Biodiversity, Morphological diversity and economic importance of Fungi
3. Explain the prevention and control measures of plant diseases and its effect in agriculture
4. Examine the plant diseases and its pathogens for crop management in agriculture
5. Evaluate the ecological significances of lichens and to gain knowledge on Fruticose lichens

FUNGI

UNIT I

(15 Hours)

General Characteristics of fungi – Habit, diversity in soil, air and water, range of thallus organization, cell wall composition, nutrition, reproduction, homothallism, heterothallism, and phylogeny. Classification of fungi (Alexopoulos and Mims, 1979); fungal culture – isolation, identification.

UNIT II

(20 Hours)

Life cycle of *Pythium* (Oomycetes), *Mucor* (Zygomycetes), *Aspergillus* (Ascomycetes), *Puccinia* (Basidiomycetes), *Cercospora* (Deuteromycetes), coprophilous fungi; Mycorrhizal association with higher plants; Economic importance of Fungi.

PLANT PATHOLOGY

UNIT III

(15 Hours)

Geographical distribution of plant diseases in India; etiology, symptomology; Host – Pathogen relationships; disease control methods (physical, chemical and biological methods); Defence mechanism – Phytoalexin (Allicin and capsidiol).

UNIT IV

(20 Hours)

Symptoms, causal organism, etiology and management of the following plant diseases – Mycoplasmal disease (Little leaf of Brinjal), Bacterial disease (Citrus canker), Viral disease (Bunchy top of Banana), Fungal disease (Red rot of Sugarcane). Plant quarantine – role and functions, regulations in India.

LICHENOLOGY

UNIT V

(20 Hours)

Lichens – occurrence, general characteristics, growth forms and thallus organization, reproduction; Nature of associations of algal and fungal partners; occurrence, structure and reproduction of (*Usnea*). Economic importance of Lichens; Lichens as a pollution indicator.

BOOKS

PRESCRIBED BOOK:

FUNGI

1. Smith, G.M. (1955). Cryptogamic Botany (Vol. I Algae, Fungi, & Lichens). McGraw – Hill Book Co., New York.
2. Vasishta, B.R. and Sinha A.K. (2010). Botany for degree students – Fungi. S. Chand and Company Ltd. New Delhi.
3. Webster, J. (1999). Introduction to Fungi (2nd edition). Cambridge University Press, New York.

PLANT PATHOLOGY

1. Mehrotra, R.S. and Agarwal, A. (2003). Plant Pathology. Tata McGraw Hill, New Delhi.
2. Pandey, B.P. (2001). Plant Pathology. S. Chand & Company Limited, New Delhi.
3. Rangasami, G. and Mahadevan, A. (1998). Diseases of Crop Plants in India. Prentice Hall of India Ltd. New Delhi.
4. Sharma, P.D. (2006). Plant Pathology. Narosa Publishing House, New Delhi.
5. Strange, R.N. (2003). Introduction of Plant pathology. J. Wiley, Chichester/England.

LICHENS

1. Muthukumar, S. and Tarar, J.L. (2006). Lichen Flora of Central India, Eastern book Corporation, New Delhi.
2. Nash, T.H. (1996). Lichen Biology. Cambridge University Press, London.

SUGGESTED READING

FUNGI

1. Dube, H.C. (2005). An Introduction to Fungi. Vikas Publishing House, New Delhi.
2. Pandey, B. P. (2001). College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant. S. Chand and Co., New Delhi.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & their allies. MacMillan Publishers Pvt. Ltd. New Delhi.
4. Singh, R.S. (2002). Principles of Plant Pathology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

PLANT PATHOLOGY

1. Agrios, G.N. (2005). Plant Pathology. Elsevier, Academic Press, New York.
2. Bap Reddy, D. and Joshi, N.C. (1991). Plant Protection in India. Allied Publishers Ltd., New Delhi.
3. Bilgrami, K.S. and Dubey, R.C. (1985). Text book of Modern Plant Pathology. Vikas Publishing House Private Limited, New Delhi.
4. Manners, J.G. (1993). Principles of Plant Pathology. Cambridge University Press

LICHENS

1. Ahamadjian, V. and Hale, M.E. (1973). The Lichens. Academic press, New Delhi.
2. Dharani, D. A. (2000). A Handbook of Lichens. Vedams eBooks (P) Ltd. New Delhi.
3. Hale, M.E. (1983). The Biology of Lichens. Edward Arnold, London.

QUESTION PAPER PATTERN:

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Section A	Definition / Principle Answer any 10 out of 12 Questions	01-12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13-19	6	30
Section C	Essay Answer any 4 out of 6 questions	20-25	10	40

DISTRIBUTION OF QUESTIONS:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	3	
	Unit – 3	3	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	2	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	1	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	

Non Major Elective – II
MUSHROOM CULTIVATION

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: II	CREDITS: 2	TOTAL HOURS: 30

COURSE FRAMEWORK:

- To facilitate self – employment.
- To know the nutrient value of mushroom.
- Get basic information about the business opportunities in plant sciences.
- Inform the students about sustainable agriculture and organic farming.
- Inculcate an enthusiasm and awareness about mushroom cultivation.

COURSE OUTCOME:

1. Explain cultivation of different types of edible Mushrooms
2. Assess Climatic requirement for Mushroom cultivation
3. Complete the requirement of composting for Mushroom cultivation & different methods of composting
4. Examine the diseases affecting the Mushrooms and develop their control measures. Expertise in harvesting methods of Mushrooms for cultivation
5. Describe the grading, packing and storing methods of Mushrooms and to know about preparation of its value-added products

UNIT I

(5 Hours)

History of Mushroom Culture, Mushroom as food. Medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India – *Volvariella*, *Volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus*. General outline of life cycle of Edible mushroom. Tests for identification – Nutritive value of mushrooms.

UNIT II

(5 Hours)

Types of mushrooms – button mushroom, oyster mushroom and milky mushroom, poisonous mushroom – methods of identification. Characteristics of common edible mushrooms .Life cycle of a common mushroom (*Agaricus*).

UNIT III

(10 Hours)

Culture Techniques – Spawn – isolation and preparation. Preparation of compost – Spawn running – Harvest methods. Storage: Short – term storage (Refrigeration – up to 24 hours). Long term storage, drying, storage in salt solutions. Nutritive values– Proteins, amino acids, mineral elements. Nutrition – Carbohydrates, Crude fibre content – Vitamins. Cultivation of milky mushrooms – using paddy straw and saw dust by polybag.

UNIT IV

(5 Hours)

Infrastructure and Inputs – Mushroom Cultivation: Infrastructure and implements – mushroom sheds, design, conditions, materials – Factors influencing mushroom cultivation. Farm design and control of pests and diseases. Preservation and storage of mushrooms. Diseases and pests of mushrooms.

UNIT V

(5 Hours)

Value added products from mushroom – pickles, candies, dried mushrooms. Delicious recipes of mushroom – Economic importance of mushrooms. Cost benefit analysis – Marketing in India and abroad. Research Centres – National level and Regional level.

PRESCRIBED BOOKS:

1. Pandey, R.K. and Ghosh, S.K. 1998. Hand book on mushroom cultivation. Emkay Publications Delhi.
2. Swaminathan, M.S. 1990. Food and Nutrition. The Bangalore Printing and Publishing Co. Ltd. Bangalore.
3. 9. Tewari and Pankaj Kapoor, S.C. 1988. Mushroom cultivation, Mittal Publications. New Delhi.

SUGGESTED BOOK:

1. Nita Bahl, (1984). Handbook on Mushrooms, Oxford and IBH Publishing Company
2. Aneja K. R. 1996. *Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation*. Wishwa Prakasan, Delhi.
3. Nair M.C (eds). *1990 Mushroom Technical Bulletin 17*, Kerala Agricultural University Mannuthy
4. Nita Bahl 2002. *Hand book on Mushrooms*, Oxford & IBH Publishing C. Pvt. Ltd. New Delhi.
5. Hirst, B. 2015. *Mushrooms: A Beginners Guide to Home Cultivation*. Create space Independent Publishing Platform. USA.
6. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan, R. 1991. *Oyster Mushrooms*. Department of Plant Pathology, TNAU, Coimbatore.

QUESTION PAPER PATTERN:

Section	Question Component	Numbers	Marks	Total
Section A	Essay Answer any 5 out of 10 questions	01-10	20	100

DISTRIBUTION OF QUESTIONS:

Sections	Units	No. of Questions	
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	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	

**ALLIED II
ALLIED BOTANY – II**

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: II	CREDITS: 3	TOTAL HOURS: 90

COURSE FRAMEWORK:

- To expose the students to the diagnostic features of selected families.
- To provide an insight into the physico – chemical organization and the functional aspects of plants.
- To give an insight into ecology and microbial processes in the environment.
- To understand the lifecycle of Angiospermic plant development and the various processes that is involved.
- To know the basics in biotechnology.

COURSE OUTCOME:

1. Describe the major groups of vascular plants and their phylogenetic relationships. Understand the basic principles involved in classification, naming and identification of Angiosperms
2. Explain photosynthesis - (apparatus, process, regulation and assimilatory powers), Nitrogen fixation (sites, genetic control and assimilation)
3. Explain interactions of various environmental factors. Describe ecological succession – causes, process and types of succession
4. Explain the embryo types and anatomy of the embryo and structure of ovule
5. Discuss about the characteristics, techniques, principles and application of plant tissue culture

UNIT I **(20 Hours)**

Systematic study and economic importance of plants belonging to the following families Fabaceae, Cucurbitaceae, Asteraceae, Euphorbiaceae and Poaceae.

UNIT II **(15 Hours)**

Absorption and transport of water and ascent of sap. Transpiration –Definition, types of transpiration, structure and opening and closing mechanism of stomata. Photosynthesis – Light reaction and dark reaction (Calvin cycle), Respiration – Glycolysis, Krebs cycle & Electron transport system. Growth Hormones – Auxins, Gibberellins and Cytokinins.

UNIT III **(15 Hours)**

Ecosystem: Concept and components, energy flow, Food chain, Food web, Ecological pyramids. Energy flow in ecosystem – Trophic level, Food Chain, Food web. Productivity of ecosystem – Primary, Secondary and Net productivity. Biogeochemical cycles – Nitrogen.

UNIT IV **(20 Hours)**

Structure and development of Anther. Structure of ovules, Types of ovules. A brief account on pollination, Fertilization, Double fertilization and Triple fusion.

UNIT V **(20 Hours)**

Mendelism and Law (Mono, Dihybrid, test, back), Non – mendelian (Multiple alleles), Introduction to Plant Tissue culture – Historical background, Principle – Totipotency – differentiation – dedifferentiation and re-differentiation; vascular differentiations. Application of tissues and Cell culture – Micropropagation Genetic Engineering – Brief concept of different gene transfer methods, special emphasis on Agrobacterium mediated gene transfer.

PRESCRIBED BOOKS:

1. Pandey S N, Misra S P, 2008. Taxonomy of Angiosperms. Ane Books India, New Delhi.
2. Rendle A B, 1979. Classification of flowering plants, Vols. I & II. Vikas Publishing House, U.P.
3. Sambamurthy A, 2005. Taxonomy of Angiosperms. I.K. International Pvt. Ltd, New Delhi.
4. Sharma O P, 1996. Plant Taxonomy. Tata McGraw Hill, New Delhi.

SUGGESTED READING:

1. Jeffery C, 1968. An Introduction to Plant Taxonomy. J and A Churchill, London.
2. Lawrence G H M, 1951. Taxonomy of Vascular Plants. Macmillan, New York.
3. Maheshwari P and Umaro Singh, 1965. Dictionary of Economic Plants in India. ICAR, New Delhi.
4. Naik V N, 1984. Taxonomy of angiosperms. Tata Mc Graw – Hill Publishing Company, New Delhi.

QUESTION PAPER PATTERN:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principle Answer any 10 out of 12 Questions	01-12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13-19	6	30
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	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	1	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	

CORE III

ALGAE AND BRYOPHYTES, FUNGI, PLANT PATHOLOGY AND LICHENOLOGY

SUBJECT CODE :	PRACTICAL	MARKS:100
SEMESTER: I	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

Outline the classification of Algae and Bryophytes, Fungi, Plant Pathology and Lichenology

- Discuss the biological significance of the given specimen
- Identify the morphology and anatomy of Algae and Bryophytes, Fungi, Plant Pathology and Lichenology
- Investigate their significance and relate structure and function, draw and label diagrams of the specimen
- Identify the morphology and anatomy of Plant Pathology through dissection
- Investigate their significance and relate structure and function, draw and label diagrams of the specimen
- Identify the Plant diseases, sign and symptoms of pathogens and disease, integrated methods of disease management, use of biological and chemicals in disease management.

COURSE OUTCOME:

1. Outline the classification of Algae and Bryophytes upto order
2. Discuss the biological significance of the given specimen
3. Identify the morphology and anatomy of Algae and Bryophytes
4. Investigate their significance and relate structure and function, draw and label diagrams of the specimen
5. Identify and familiarize the specimens during field visit

ALGAE

(15 Hours)

Study of vegetative and reproductive structures of

- *Nostoc*,
- *Chara*,
- *Coleochate*,
- *Navicula*,
- *Sargassum*,
- *Kappaphycus*.

BRYOPHYTES

(15 Hours)

Study of vegetative and reproductive structures of

- *Riccia* (liverworts),
- *Anthoceros* (Hornworts),
- *Polytrichum* (Mosses)

Note: Temporary Preparations / Permanent Slides – Available Materials only

Allied II
Allied BOTANY – II

SUBJECT CODE :	PRACTICAL	MARKS:100
SEMESTER: II	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

- Identify the morphology and anatomy of Algae, Fungi and Bryophytes and to investigate their significance and relate structure and function, draw and label diagrams of the specimen
- To Identify the Pteridophytes - morphology and anatomy of both vegetative and reproductive parts through dissection
- To Identify the Gymnosperm morphology and anatomy of both vegetative and reproductive parts through dissection
- Identify meristems, tissues, stem, root through permanent slides and photographs.
- Identify the Structure and development of dicot and monocot embryos through dissection.
- Identify observe and sketching the floral parts of the plants belonging to different families.

COURSE OUTCOME:

1. Identify the morphology and anatomy of Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperm and to investigate their significance and relate structure and function, draw and label diagrams of the specimen
2. Identify meristems, tissues, stem, root through permanent slides and photographs.
3. Identify the Structure and development of dicot and monocot embryos through dissection.
4. Identify observe and sketching the floral parts of the plants belonging to different families.
5. Discuss the application of vital and physical forces theories on plant physiology most preferably ascent of sap, transpiration, mineral nutrition in plants and phloem transport through experiment

Allied Botany Practical

(60 Hours)

1. Describe and to make suitable micro – preparations: Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms prescribed in the theory.
2. To describe in technical terms plants belonging to the families prescribed.
3. To describe experimental setup in plant physiology
4. Microphotographs of cell biology
5. Study of internal structure of dicot & monocot stem, root and leaf.
6. Structure of Mature anther and Ovule types (Permanent slides only).

BOOKS

1. Ganguly A.K. 1971, General Botany, Vol. I. The New Book Stall, Calcutta.
2. Rao. K.N. Krishnamurthy K.V. and Rao. G., 1979, Ancillary Botany, Viswanathan Private Ltd.
3. Dutta A.C., College Botany, Vol. I & II.
4. Gupta P.K., Elements of Biotechnology Rastogi and Company

SEMESTER III

CORE IV

PAPER TITLE: ANATOMY, MICROTÉCHNIQUE AND EMBRYOLOGY OF ANGIOSPERMS

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: III	CREDITS: 4	TOTAL HOURS: 90

COURSE FRAMEWORK:

- To understand the anatomical theories and structures of plants
- To provide knowledge on the Microtechniques involved in botanical sciences
- To impart knowledge on embryological changes in plants

COURSE OUTCOME:

1. Discuss the classification of tissues on the basis of structure and function and to gain knowledge in the Primary and secondary anatomical characters and development of Root, Stem, Leaf (Dicot and Monocot).
2. Explain the techniques of microscopic slides making, microscopic measurements and methods of identification of some organic compounds in plant cells.
3. Explain the making of temporary microscopic slides, using different cutting techniques and permanent microscopic slides using paraffin method.
4. To Prepare large plant Material through Dry, Wet, and Pressing method detect the presence of different groups of organic compounds in plant
5. Outline on double fertilization and their significance and to know about the Structure and development of dicot and monocot embryos.

ANATOMY

UNIT I

(15 Hours)

Meristems – definition, characteristic features, classification (position, origin, function, plane of division); various theories of meristems (apical cell, histogen, Tunica – Corpus, Korper Kappe, quiescent centre). Permanent tissues – simple tissue and complex tissues. Cell wall – structure and composition. Pits and plasmodesmata; secretory structures, stomatal types; hydathodes; Tissue system (epidermal, ground and vascular), ergastic substances.

UNIT II

(20 Hours)

Vascular cambium – cork cambium – cell types – its activity and function – Normal secondary growth in stem and root – annual rings, heart wood, sapwood; periderm formation; anomalous secondary growth in dicot stems (*Nyctanthes*, *Boerhavia*, *Bougainvillea*) and monocot stem (*Dracaena*); Nodal anatomy.

PLANT MICROTÉCHNIQUE

UNIT III

(20 Hours)

Methods to study plant cell/tissue structure:

Compound microscope – Staining, staining methods, fixation, fixative, preparation of permanent slides – Sectioning – Free hand, Microtomes – types. Squash and smears – Histochemistry.

EMBRYOLOGY OF ANGIOSPERMS

UNIT IV

(15 Hours)

Development of anther – Microsporangium – Microsporogenesis, Microspores, male gametophyte. Development of ovule – Megasporogenesis, female gametophyte (Monosporic – *Polygonum*, Bisporic – *Allium*, Tetrasporic – *Peperomia*).

UNIT V

(20 Hours)

Fertilization – Double fertilization, triple fusion, Endosperm and its types (Cellular, Nuclear and Helobial), development of dicot embryo (*Capsella*), development of monocot embryo (*Najas*), polyembryony, apomixis – definition and types.

PRESCRIBED BOOKS:

ANATOMY

1. Krishnamurthy, K.V. (1980). Wood. Tetrahedron Publications, Tiruchirappalli.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
3. Vasishta, P.C. (1977). A Text Book of Plant Anatomy. S. Nagin and Co., New Delhi.

MICROTECHNIQUES

1. Johnson, D.A. (1940). Plant Microtechnique. Mac – Graw Hill, New Delhi.
2. MC Clung, C.L. (1961). Hand book of Microscopical Technique. New York, U.S.A.
3. Patki, L.R. (1992). An Introduction to Microtechnique. S. Chand & Company, New Delhi.

EMBRYOLOGY OF ANGIOSPERMS

1. Raghavan, V. (1997). Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
2. Rogland, A. (2000). Developmental Botany (Embryology of Angiosperms). Saras Publications, Nagercoil.
3. Swamy, B.G.L. and Krishnamoorthy, K.V. (1980). From Flower to Fruit. Tata McGraw Hill Publishing Co. Ltd., New Delhi.

SUGGESTED READING

ANATOMY

1. Cutter, E.G. (1978). Plant Anatomy Part– I: Cells and Tissues (2nd Edn.), Plant Anatomy Part– II: Experiments and Interpretations. Edward Arnold, London.
2. Esau, K. (1965). Vascular Differentiation in Plants. Holt, Rinehart and Winston, New York.
3. Esau, K. (1980). Plant Anatomy (2nd Edition). Wiley Eastern Ltd., New Delhi.
4. Fahn, A. (1997). Plant Anatomy. Pergamon Press, Oxford.
5. Foster, A.S. (1960). Practical Plant Anatomy. Van Nostrand and East–West Press, New Delhi.

MICROTECHNIQUES

1. Alan peacock, H. (1966). Elementary Microtechnique Edward Arnold (Pub) Ltd.
2. Gray P. (1908). Hand Book of Basic Microtechnique. Mac – Graw Hill, New Delhi.
3. Duddington, C.L. (1960). Practical Microscopy, Pitinan.
4. Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New Delhi.

EMBRYOLOGY OF ANGIOSPERMS

1. Bhojwani, S.S. and Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Johri, B.M. (1982). Experimental Embryology of Vascular Plants. Springer – Verlag, Heidelberg.
3. Maheswari, P. (1985). An Introduction to the Embryology of Angiosperms. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Maheswari, P. (1963). Recent Advances in the Embryology of Angiosperms. International Society of Plant Morphologists, University of Delhi.
5. Maheswari, P. (1991). An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd.,

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	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	1	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	

SEMESTER IV

CORE V

PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: IV	CREDITS: 4	TOTAL HOURS: 90

COURSE FRAMEWORK:

- To acquaint the students about the latest trends in classification, vegetative morphology and reproductive biology of Pteridophytes and gymnosperms.
- To provide knowledge on the detailed study of plant fossils.
- Open the window to Paleobotany

COURSE OUTCOME:

1. To describe the morphological, reproductive and anatomical structure of Pteridophytes and Gymnosperms.
2. Outline the salient features of stellar evolution and relate the latest trends in classification, vegetative morphology and reproductive biology of Gymnosperms.
3. Describe the features and reproductive adaptations of conifers and other gymnosperms.
4. To explain about fossils and fossilization and to understand about geological time scale.
5. After getting through this paleobotany, students would be able to know about Palynology, its branches and their importance, they would be able to isolate Palynomorphs from Sedimentary Rock samples through different maceration techniques.

PTERIDOPHYTES

UNIT – I (15 Hours)

General characteristics and distribution of Pteridophytes and classification by Reimer (1954). Stellar evolution in Pteridophytes – Heterospory and seed habit. Apogamy and Apospory. Indian Pteridologists – S.S. Bir, V.S. Manickam. Economic importance of ferns.

UNIT – II (20 Hours)

Detailed study of vegetative and reproductive structures in the following genera (no developmental aspects) a) *Lycopodium* b) *Equisetum* c) *Adiantum* d) *Marsilea*

GYMNOSPERMS

UNIT III (15 Hours)

General Characters and distribution of Gymnosperms – Classification of Sporne (1965). Economic importance of Gymnosperms.

UNIT IV (20 Hours)

Detailed study of vegetative and reproductive structures of the following genera (no developmental aspects) a) *Cycas* b) *Pinus* c) *Gnetum*

PALEOBOTANY

UNIT V (20 Hours)

History and scope of Paleobotany; Fossils – types – methods of fossilization – Carbon Dating – Uses. Study of the fossil forms – *Lepidodendron*, *Lepidocarpon* and *Calamites*.

BOOKS

PRESCRIBED BOOK:

PTERIDOPHYTES

1. Smith, G. M. (1955). Cryptogamic Botany (Bryophytes and Pteridophytes). Vol. II (2nd ed). Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Sporne, K. R. (1970). The Morphology of Pteridophytes (The structure of Ferns and Allied Plants). Hutchinson University Library, London.
3. SundaraRajan, S. (1994). Introduction to Pteridophyta. New Age International Publishers Ltd., New Delhi.
4. Vashista, P. C. (1997). Botany for Degree Students – Pteridophyta. S. Chand & Co.Ltd., New Delhi.

GYMNOSPERMS

1. Sharma, O. P. (1997). Gymnosperms. Pragati Prakashan, Meerut, India.
2. Sporne, K. R. (1971). The Morphology of Gymnosperms (The Structure and Evolution of Primitive Seed Plants). Hutchinson University Library, London.
3. Srivastava, H. N. (1998) Gymnosperms. Pradeep Publications, Jalandhar, India.
4. Vashista, P. C. (1996). Botany for Degree Students – Gymnosperms. (2nd ed) S. Chand & Co. Ltd., New Delhi.

PALEOBOTANY

1. Shukla, A. C. and Misra, S P. (1975). Essentials of Paleobotany. Vikas Publishing House (P) Ltd., New Delhi.
2. Stewart, W. N. (1983). Paleobotany and the Evolution of Plants. Cambridge University Press, London.
3. Venkatachala, B. S., Shukla, M. and Sharma, M. (1992). Plant Fossils: A link with the past (A Birbal Sahni Birth Centenary Tribute). Birbal Sahni Institute of Paleobotany, Lucknow, India.

Suggested Reading:

PTERIDOPHYTES

1. Bierhorst, D. W. (1971). Morphology of Vascular Plants. The MacMillan Co., New York, London.
2. Eames, A. J. (1936). Morphology of Vascular Plants (Lower Groups). McGraw Hill, New York.
3. Parihar, N. S. (1999). An Introduction to Embryophyta – Pteridophyta. Vol. II. Central Book Depot, Allahabad.
4. Rashhed, A. (1999). An Introduction to Pteridophyta. Vikas Publishing Co., New Delhi.
5. Sharma, O. P. (1990). Textbook of Pteridophytes. MacMillan India Ltd., Delhi.

GYMNOSPERMS

1. Bhatnagar, S. P. and Alok Moitra (1997) Gymnosperms. New Age International (P) (Ltd.) Publisher, New Delhi.
2. Chopra, G. W. and Verma, Y. (1988). Gymnosperms. Pradeep Publications, Jalandhar.
3. Coulter, J. M. and Chamberlain, C. J. (1964). Morphology of Gymnosperms. Central Book Depot, Allahabad.
4. Datta, S. C. (1984). An introduction to Gymnosperms. Kalyani Publishers, New Delhi.

PALEOBOTANY

1. Arnold, C. A. (1947). An Introduction to Paleobotany. McGraw Hill, New York.
2. Seward, A. C. (1959). Plant Life through the ages. Hafner Publishing Co., New York.
3. Scott, D. H. (1962). Studies in Fossil Botany. (Vol. I and II). Hafner Publishing Co., New York. 17
4. Delavoryas, T. (1962). Morphology and evolution of Fossil Plants. Holt, Rinehart & Winston, New York.

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	Unit – 4	2	
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CORE VI
PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY
ANATOMY, MICROTECHNIQUE AND EMBRYOLOGY OF ANGIOSPERMS

SUBJECT CODE :	PRACTICAL	MARKS:100
SEMESTER: IV	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

- Identify meristems, tissues, stem, root through permanent slides and photographs.
- Identify the Structure and development of dicot and monocot embryos through dissection.
- Examine the steps involved in Smear/Squash Method and from Prepared Slides.
- Identify the ovule types and developmental stages of embryo sac using permanent slides
- Identify the types of endosperm and seed dispersal mechanisms by specimen

COURSE OUTCOME:

1. To identify the Pteridophytes morphology and anatomy of both vegetative and reproductive parts through dissection
2. To identify the fossil genera of Pteridophytes and Gymnosperms
3. To Identify and familiarize the lower vascular Plants distributed in any ecosystem
4. Familiarize with the Smear and Squash method
5. Examine the structure of Anomalous secondary growth of the Higher plants

ANATOMY

10 Hours

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Anomalous secondary structure of dicot stems (*Nyctanthes*, *Boerhavia*, and *Bougainvillea*) and monocot stem (*Dracaena*)
7. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).

EMBRYOLOGY OF ANGIOSPERMS

10 Hours

8. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides / Photographs).
9. Types of ovules slides / photographs.
10. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides /photographs).
11. Ultrastructure of mature egg apparatus cells through electron micrographs.
12. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
13. Dissection of embryo/endosperm from developing seeds. Structure of pollen grains using whole
Mounts (*Catharanthus* / *Hibiscus* / *Tridax* / *Acacia* / Grass).
14. Study of ovule types and developmental stages of embryo sac using permanent slides

/Photographs.

15. Structure of endosperm (nuclear and cellular); Developmental stages of dicot and monocot Embryos using permanent slides / Photographs

DEMONSTRATION

MICROTECHNIQUE

(10 Hours)

1. Microscopic preparation of semi – permanent and permanent slides.
2. Special techniques: smear, squash & maceration.

PTERIDOPHYTA:

(10 Hours)

Lycopodium, Equisetum, Adiantum and Marsilea.

GYMNOSPERMS:

(10 Hours)

Cycas, Pinus and Gnetum

PALEOBOTANY:

(10 Hours)

A study of the morphology and anatomy of both vegetative and reproductive parts of the living genera and fossil forms.

Fossils – *Lepidodendron, Lepidocarpon and Calamites* (spotters / photographs only)

SEMESTER V

CORE VII
MORPHOLOGY, TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: V	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

- To study the morphological features of vegetative, inflorescence, fruits characters.
- To impart knowledge on botanical nomenclature, classifications, merits and demerits of various systems of classifications.
- To understand the systematics of the selected families of the flowering plants with their economic importance.
- To have knowledge on the economically important plants with their systematic treatment.

COURSE OUTCOME:

1. Describe the major groups of vascular plants and their phylogenetic relationships.
2. List the basic principles involved in classification, naming and identification of angiospermic plants.
3. To Find the unknown plants to species level with help of Taxonomical tools such as Keys and Monographs
4. Describe morphological and floral characters in technical terms of given Families.
5. To recognize the diverse aspects of human cultural endeavors to plant resources, and to gain a better understanding and perspective of the origins, histories, and roles of important plants and plant products to the development of human culture

Morphology

UNIT I **(10 Hours)**

Morphology: vegetative, floral; Root, stem and leaf modifications. Inflorescence types – racemose, cymose, mixed and special types. Fruit (parts, types).

Taxonomy of Angiosperms

UNIT II **(10 Hours)**

Taxonomy: Definition, scope and Importance; Binomial nomenclature; ICN rules; nomenclatural types. Types of classification with merits & demerits – Artificial (Linnaeus), Natural (Bentham & Hooker), Phylogeny (APG). Taxonomic tools: Herbarium (techniques, importance), Botanical gardens, Flora, Identification Keys (single access and multi – access), online database and resources in Taxonomy.

UNIT III **(15 Hours)**

Systematic study and economic importance of the following families – Annonaceae, Capparidaceae, Caesalpiaceae, Anacardiaceae, Curcubitaceae, and Rubiaceae.

UNIT IV **(15 Hours)**

Systematic study and economic importance of the following families – Asteraceae, Asclepiadaceae, Euphorbiaceae, Orchidaceae and Poaceae.

Economic Botany

UNIT V **(10 Hours)**

Study the following groups of plants with special reference to the botanical name, family and morphology of the useful Partand uses: Food – Cereals (*Oryza sativa*, *Eleusine coracana*); Pulses – Black gram (*Phaseolus mungo*), Spices – Pepper (*Piper nigrum*); Edible – Gingelly

oil (*Sesamum indicum*); Root tubers – Tapioca (*Manihot esculenta*); Sugar – Sugarcane (*Saccharum officinarum*). Fibres – Textiles (*Gossypium hirsutum*); Timber – Teak wood (*Tectona grandis*); Latex – Rubber (*Hevea brasiliensis*); Medicine – *Ocimum tenuiflorum*, *Phyllanthus amarus*, *Solanum trilobatum*

PRESCRIBED BOOKS

TAXONOMY OF ANGIOSPERMS

1. Gurcharan Singh (1999). Plant Systematics – Theory & Practice. Oxford & IBH Publishing Co. (P) Ltd., New Delhi.
2. Jaques, H.E. (1999). Plant Families – How to know them?. Agro Botanical Publishers (India), Bikaner.
3. Jefferey, C. (1968). An Introduction to Plant Taxonomy. J.A. Churchill, London.
4. Lawrence, G.H.M. (1953). Taxonomy of Vascular Plants. Oxford & IBH Publishers, New Delhi.
5. Lawrence, G.H.M. (1955). An Introduction to Plant Taxonomy. The Central Book Depot, Allahabad.
6. Mathews, K.M. (1987 – 90). Flora of Tamilnadu Carnatic (1 – 4vols.) Rapinat Herbarium, Trichy.

ECONOMIC BOTANY

1. Ashok Bendre and Ashok Kumar (1998 – 99). Economic Botany. Rastogi Publications, Meerut.
2. Govinda Praksh and Sharma, S.K. (1975). Introductory Economic Botany. Jai Prakash Nath, Meerut.
3. Gupta, S.K. and Kaushik, M.P. (1973). An Introduction to Economic Botany. K. Nath & Co., Meerut.
4. Hill, A.W. (1952). Economic Botany. Tata McGraw–Hill Publishing Co., New Delhi.
5. Jain, S. K. 1981. Glimpses of Indian Ethnobotany. Oxford and IBH, New Delhi.
6. Jain, S. K. 1987. A Manual of Ethnobotany. Scientific Publishers, Jodhpur.

SUGGESTED READING:

TAXONOMY OF ANGIOSPERMS

1. Mathur, R.C. (1970). Systematic Botany (Angiosperms). Agra Book Stores, Lucknow.
2. Mitra, J.N. (1964). An Introduction to Systematic Botany & Ecology. The World Press (P) Ltd., Calcutta.
3. Naik, V.N. (1996). Taxonomy of Angiosperms (9th Ed.). Tata McGraw – Hill Publishing Co., (P) Ltd., New Delhi.
4. Narayanaswamy, R.V. and Rao, K.N. (1976). Outlines of Botany. S. Viswanathan Printers & Publishers, Chennai.
5. Palaniyappan, S. (2000). AngiospermgalinVagaippadu (Taxonomy of Angiosperms). V.K. Publishing House, Chennai.
6. Pandey, B.P. (1997). Taxonomy of Angiosperms. S. Chand & Company Pvt. Ltd., New Delhi.
7. Porter, C.L. (1967). Taxonomy of flowering Plants. Eurasia Publishing House, New Delhi.
8. Ramaswami, S.N., Lakshminarayana, S. and Venkateswaralu, V. (1976). Taxonomy (Systematic Botany) for Degree Course. Maruthi Book Depot, Guntur, Hyderabad.
9. Sharma. O.P. (2007). Plant Taxonomy. Tata McGraw–Hill Publishing Co., New Delhi.
10. Singh, V. and Singh, D.K. (1983). Taxonomy of Angiosperms. Rastogi Publications, Meerut.
11. Sivarajan V.V. (1993). Introduction to the Principles of Plant Taxonomy (2nd Edn.). N.K.P. Robson (Ed.). Oxford & IBH Publishing Co. (P) Ltd., New Delhi.

12. Subramanian, N.S. (1999). Laboratory Manual of Plant Taxonomy (2nd Ed.). Tata McGraw – Hill Publishing Co., New Delhi.
13. Vashista, P.C. (1997). Taxonomy of Angiosperms. S. Chand & Company Pvt. Ltd., New Delhi.

ECONOMIC BOTANY

1. Maheshwari, P. and Umarm Singh, (1965). Dictionary of Economic Plants in India. ICAR, New Delhi.
2. Pandey, B.P. (2000). Economic Botany. S. Chand & Company Ltd., New Delhi.
3. Sambamurthy, A.V.V.S. and Subrahmanyan, N.S. (1989). A Text Book of Economic Botany. Wiley Eastern Ltd., Madras.
4. Sen, S. (1992). Economic Botany. New Central Book Agency, Calcutta.
5. Verma, V. (1974). A Text Book of Economic Botany. Emkay Publications, New Delhi.
6. Sreemali, J. L. (1979). Economic Botany. Kitab Mahal, Allahabad.

QUESTION PAPER PATTERN:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principle Answer any 10 out of 12 Questions	01-12	3	30
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Section C	Essay Answer any 4 out of 6 questions	20-25	10	40

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CORE VIII

CELL BIOLOGY, MOLECULAR BIOLOGY AND EVOLUTION

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: V	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

- To acquaint the student about the anatomical and cytological studies of various plant groups.
- To make the student understand the organization of prokaryotic and eukaryotic cell, structure and function of cell organelles including cell division.
- Apply the knowledge gained from plant molecular biology in agriculture.

COURSE OUTCOME:

1. Describe the level of molecules, cells, systems, organisms and ecosystems
2. Explain structure and function of cell and cell organelles, using Compound Microscope and elucidation of Ultra structure from Electron Microphotographs and to learn the measurement of Cell Size
3. Compare the organization of prokaryotic and eukaryotic cell, structure and function of cell organelles including cell division.
4. Discuss the molecular mechanisms by which DNA controls development, growth or morphological characteristics of organisms and relate gene regulation
5. Describe the Theory of Evolution considering Darwinism and Modern Synthetic Theory and Geological Time Scale and describe phytogeographical Realms.

Cell Biology

UNIT I

(10 Hours)

Introduction to Cell Biology; Cell Theory; Cell Dimensions; Types of cell – Prokaryotic and Eukaryotic. Cell Boundaries; Cell Wall – Introduction, Occurrence, Gross structure – Layers (Primary wall, Secondary wall, Tertiary wall, Middle lamella, Plasmodesmata and Pits (Simple and Bordered), Ultra structure; chemistry and function. Plasma membrane – Occurrence, Molecular organization, Models, Chemistry and Functions.

UNIT II

(15 Hours)

Occurrence, Structure and functions of Endoplasmic Reticulum, Golgi bodies, Sphaerosomes; Glyoxisomes; Ribosomes; Mitochondria and Chloroplast. Autonomy of organelles. Occurrence, Structure and functions of Nucleus; Nucleolus; Organization of Chromosomes – Euchromatin; Heterochromatin Special types of chromosomes – Giant Chromosomes (Polytene, Lamp brush and β Chromosomes). Cell cycle, Interphase (G1, S, G2) Mitotic Phase (M – Phase), Cytokinesis phase (C – phase) and Mitosis.

Molecular Biology

UNIT III

(15 Hours)

Central dogma in Molecular Biology; Structure and functions of genetic material; DNA as Genetic material, DNA Replication and DNA Repair. RNA as Genetic material, RNA structure types and function. Protein synthesis – Transcription & Translation of Prokaryotes & Eukaryotes.

UNIT IV**(10 Hours)**

Gene regulation in Prokaryotes – LAC and TRP – Operon; Positive and negative regulation. Genetic engineering – Vectors; Restriction enzymes; Recombinant DNA Synthesis, Transformation of host selection & Screening of recombinants.

Evolution**UNIT V****(10 Hours)**

Origin of life, Theories of evolution - Lamarckism, Darwinism, Neo-Darwinism, De Vries; Modern concepts of Evolution; Geological Time Scale (GTS); Evolution of plants in evolutionary time scale; Role of RNA in origin and evolution.

PRESCRIBED BOOKS:

De Robertis, E.D.P. and De Robertis, E.M.F. Jr. (1980). Cell and Molecular Biology (7th Ed). Saunders College/Holt, Rinehart and Winson, Philadelphia.

1. Grierson, D. and Convey, S.N. (1989). Plant Molecular Biology. Blackie Publishers, New York.
2. Lea, P.J. and Leegood, R.C. (1999). Plant Biochemistry and Molecular Biology. John Wiley and Sons, London.

SUGGESTED READING:

1. Old, R.W. and Primrose, S.B. (1994). Principles of Gene Manipulation. Blackwell Science, London.
2. Power, C.B. (1984). Cell Biology. Himalaya Publishing Co., Mumbai.
3. Sharma, N.S. (2005). Molecular Cell Biology. International Book distributors, Dehradun.
4. Verma, P.S. and Agarwal, V.K. (1986). Cell Biology and Molecular Biology (Cytology). S. Chand and Company Ltd., New Delhi.

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	Unit – 3	2	
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	Unit – 5	1	
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	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	

CORE IX
MICROBIOLOGY

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: V	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

- To study the micro – organisms and their activities.
- To exploit their potentialities in agriculture, industry and other environmental aspects.
- To understand the mechanism of bacteria and virus Multiplication & Transmission system.
- To understand the sources and importance of Microorganisms.

COURSE OUTCOME:

1. To describe diversity of microorganisms, bacterial cell structure and function, microbial growth and metabolism, and the ways to control their growth by physical and chemical means
2. Explain the practical skills in fundamental microbiological techniques and to gain knowledge on microbial growth and sterilization techniques
3. Classify and apply the scientific method of investigation and hypothesis testing and perform inoculating bacteria with different cultivation technique
4. Investigate the role of microorganisms in production of industrial enzymes, antibiotics, biopolymer
5. Explain the role of microorganisms in food production and preservation, and their ability to cause food-borne infections

UNIT I **(10 Hours)**
Microbiology – history and scope, branches, theory of biogenesis and abiogenesis, contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner and Paul Ehrlich in microbiology; Sterilization – principles, types and equipment's.

UNIT II **(15 Hours)**
Bacteria – discovery, general characteristic features, cell structure, nutritional types; classification of Bacteria (Bergey's, 1984 – outline only); reproduction – vegetative, asexual and recombination (conjugation, transformation, transduction) and growth curve; identification (catalase, oxidase and urease tests), isolation of bacteria from bacterial culture and staining methods; economic importance.

UNIT III **(15 Hours)**
Viruses – discovery, structure, general characteristic features; virus classification (ICTV, Baltimore); symptoms of virus infection in plants; transmission of plant viruses; viral genome organization, replication of plant virus (tobacco mosaic virus); structure and multiplication of bacteriophages; virion, virusoids, prion, viroid.

UNIT IV **(10 Hours)**
Food Microbiology – principles and methods of food preservation; food spoilage– vegetables and fruits, canned food, eggs, milk and milk products, meat and meat products, fish and seas foods; fermented foods – bread, role of yeast & vinegar in fermentation; fermented vegetables.

UNIT V**(10 Hours)**

Industrial microbiology – Production of enzymes (Amylase), Alcohol (Ethanol) amino acids (Glutamic acid), vitamins (Riboflavin), antibiotics (Penicillin). Aerobiology – scope and Importance. Soil microbiology – role of microbes in soil fertility, soil reclamation and waste water management. Recycling of bio-degradable municipal, agricultural and Industrial wastes.

PRESCRIBED BOOKS:

1. Adams, M.R. and Moss. M.O. (1995). Food Microbiology. New International (P) Ltd. Publishers.
2. Alexander. (1997). Introduction to soil Microbiology. John Wiley and Sons. N.Y.
3. Banwart, G.J., (1989). Basic Food Microbiology, 2nd Edition CBS Publishers and Distributors, New Delhi.
4. David, B.D., Delbecco, R., Eisen, H.N. and Ginsburg, H.S. (1990). Microbiology. 5th Edition. Harper & Row, New York.
5. Dubey, R.C. and Maheswari, D.K. (2005). A Text book of microbiology. S. Chand & Company Ltd. New Delhi.
6. Frazier, W.C and Westhoff, D.C. (1988). Food microbiology, 4th edition, Tata Mac Graw Hill, New Delhi.
7. Gardner, E.J., Simmons, M. J. and Snustad, D. P. (2005). Principles of genetics, 8th Edition. Wiley India Pvt India, New Delhi.
8. Hobbs, B.C. and Roberts, D. (1993). Food Poisoning and Food Hygiene Edward Arnold, London.
9. Denyer, S.P., Hodges, N.A., Gorman, S.P. and Gilmore, B.F. (2011). Hugo&Russell's Pharmaceutical Microbiology.8th edition. Blackwell scientific publications / Oxford.

SUGGESTED READING:

1. Prescott., L.M., Harley, J.P. and Klein, D.A. (2005). Microbiology. Mc Graw Hill Inc. New York.
2. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. (2000). Molecular Cell Biology – 4th edition, W. H. Freeman, New York.
3. Maloy, S.R., Cronan JE Jr., and Freitfelder, D. (2006). Microbial Genetics, Jones Bartlett Publishers, Sudbury, Massachusetts.
4. Pelczar Jr. M.J. Chan. E.C.S and Kreig. N.R (2006). Microbiology – 5th Edition Mc Graw Hill Inc. New York.
5. Robinson R.K (1990). Dairy Microbiology, Elsevier Applied science, London.
6. Sale, A.J. (1992). Fundamentals Principles of Bacteriology. 7th Edition. McGraw Hill Publishing Co. Ltd., New York.
7. Stainer, R.Y., Ingraham, J.L., Wheelis, M.L and Painter, P.R. (1986). General Microbiology. MacMilan Education Ltd. London.
8. Subba Rao, N.S. (1995). Soil Microorganisms and plant growth. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.

CORE X
PLANT ECOLOGY, PHYTOGEOGRAPHY AND REMOTE SENSING

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: V	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

- To understand the role and importance of biotic and abiotic environmental factors in the sustenance of plant life.
- To understand causes consequences, prevention, remediation of pollution and efforts taken in reducing or controlling the pollution causing factor.
- To understand the importance of phytogeography and forestry for man and the legal enforcements imposed by government in preventing the loss to the natural regional flora.

COURSE OUTCOME:

1. Discuss the morphological and anatomical adaptations of hydrophytes, mesophytes and xerophytes.
2. Explain interactions of various environmental factors. Describe ecological succession – causes, process and types of succession
3. Explain biodiversity – threat, cause and conservation of biodiversity (In-situ and Ex – situ) Field visit to familiarize students with ecology of different sites.
4. Describe pollution, types, causes symptoms and remedial measures and to describe the phytogeographical region of India.
5. Compare the natural patterns and relationships between plants and their environment by organizing groups of plant species into functional vegetation categories.

Ecology

UNIT I **(10 Hours)**

Plant Ecology – definition, scope, branches; ecological factors – climatic factor, light, temperature, precipitation and Atmospheric humidity. Edaphic factors – soil profile, types of soil, soil humus, soil water, soil pH, soil organisms and soil temp. Biotic factors – positive and negative interactions.

UNIT II **(10 Hours)**

Ecosystem – structure, biotic, abiotic components; food chain; food web; ecological pyramids; energy flow; biogeochemical cycles. Methods of study of vegetation (Quadrat and transect).

UNIT III **(15 Hours)**

Plant communities – General characters, forms and structure, Raunkier's life forms. Plant succession – hydrosere and xerosere. Ecological Adaptations – hydrophytes, xerophytes, halophytes, epiphytes and parasites. Ecotone and edge effect.

Phytogeography

UNIT IV **(15 Hours)**

Principles of phytogeography, continental drift, phytogeographic regions of India; phytogeographic regions of world; Endemism – types and causes; endemic plants of India.

Remote Sensing

UNIT V

(10 Hours)

Remote sensing: Definition and data acquisition techniques. Application of remote sensing in vegetation classification, understanding the key environmental issues and ecosystem management, Study of satellite maps, vegetation mapping. Role of remote sensing in Forest Management.

PRESCRIBED BOOKS:

PLANT ECOLOGY

1. Agrawal, K.C. (1987). Environmental Biology. Agro Botanical Publisher, India.
2. Arumugam, N. (1994). Concepts of Ecology (Environmental Biology). Saras Publications, Nagercoil, Tamil Nadu.
3. Kumar, H.D. (1992). Modern Concepts of Ecology (7th Edn.). Vikas Publishing Co., New Delhi.

PHYTOGEOGRAPHY

1. Cain, S.A. (1944). Foundations of Plant Geography. Harper & Brothers, New York.
2. Good, R. (1997). The Geography of flowering Plants (2nd Edn.). Longmans, Green & Co., Inc., London & Allied Science Publishers, New Delhi.

SUGGESTED READING:

PLANT ECOLOGY

1. Odum, E.P. (1971). Fundamentals of Ecology (2nd Edn.). Saunders & Co., Philadelphia & Natraj Publishers, Dehradun.
2. Sharma, P.D. (2000). Ecology & Environment. Rastogi Publications, Meerut, India.
3. Vashishta, P.C. (1990). Plant Ecology. Vishal Publications, Delhi, Jalandhar.

PHYTOGEOGRAPHY

1. Verma, P.S. and Agarwal, V.K. (1999). Concept of Ecology (Environmental Biology). S. Chand & Co., New Delhi.
2. Mani, M.S. (1974). Ecology & Biogeography of India. Dr. W. Junk Publishers, The Haque.

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ELECTIVE I - INTER DISCIPLINARY ELECTIVE (IDE)

HORTICULTURE & MUSHROOM CULTIVATION

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: V	CREDITS: 5	TOTAL HOURS: 75

COURSE FRAMEWORK:

- Provide the knowledge to establish home gardens scientifically.
- Help the students to learn horticulture, mushroom cultivation, bio – composting and bio-fertilizer production.
- Enable the students to become self – employment / entrepreneur.

COURSE OUTCOME:

1. To list the horticultural practices and activities of large-scale plant production.
2. Explain horticultural skills and knowledge to operate various business entities found in the horticultural industry
3. List a fundamental understanding of landscape construction, irrigation design and constructing conventional and sustainable landscapes
4. List the requirement of composting for Mushroom cultivation & different methods of composting
5. Determine the most important species of mushrooms and knows the basic ways of the cultivation of each of them

HORTICULTURE

UNIT – I (15 Hours)

Brief history of horticulture, horticultural classification, horticultural crops, Economic importance; Essentials of nursery Management; Soil management: Garden soil, Physical and chemical properties of soil, Organic matter, Compost, Cultural practices.

UNIT – II (15 Hours)

Water management: Water quality, Irrigation, Mulching. Nursery structures: Protected cultivation (Greenhouses), environment controls. Hydroponic culture – types of container. Uses of manures and fertilizers in Horticultural crop production. Organic farming.

UNIT – III (15 Hours)

Horticultural crops protection; Environment factors influencing vegetable and fruit production, Physical control – pruning. Chemical control – pesticides, fungicides. Plant propagation – cutting, layering, grafting. Indoor gardening. Floriculture, ornamental gardening and landscaping.

UNIT – IV (15 Hours)

Post harvesting processes –packaging, transport and storage; Chemical treatment. Food processing – freezing, bottling, canning, drying and chemical preservation. Horticultural crops marketing.

MUSHROOM CULTIVATION

UNIT – V

(15 Hours)

Prospects and scope of Mushroom cultivation – paddy straw – oyster mushroom. Life cycle of *Pleurotus* species. Nutritional value and control of pests and pathogens. Post harvesting techniques and storage methods of mushroom. Marketing.

PRESCRIBED BOOKS:

1. Bose, T.K. and Yadav, L.P. 1989. Commercial flowers. Naya Prakash, Calcutta.
2. Bose, T.K., Mitra, S.K. and Sadhu, M.K. 1991. Propagation of tropical and subtropical horticultural crops. Naya Prakash.
3. Chadha, K.L. 1986. Ornamental horticulture in India ICAR. Krishi Bhavan, New Delhi.
4. Hartmann, H.T., Kester, D. E., Davies, F.T., Robert L. and Geneve, R.L. 2011. Hartmann and Kester's Plant propagation: principles and practice. 8th ed. Pearson Education, Inc., Publishing as Prentice Hall, One Lake Street, Upper Saddle River, NJ.
5. Kumar, N. 1986. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil.

SUGGESTED READING:

1. Larsen, R.A. 1981. Introduction to Floriculture. Academic Press, New York.
2. Manibushan Rao, K. 1990. Text book of Horticulture. Macmillan India Limited, New Delhi.
3. Rangaswami, G. and Mahadevan, A. 1999. Diseases of Crop Plants in India (4th edition). Prentice Hall Pvt. Ltd., New Delhi.
4. Singh, R. and Singh, U.C. 2005. Modern Mushroom Cultivation. International Book Distributors, Dehradun.
5. Singh, S.P. 1989. Mist propagation. Metropolitan Book Co., New Delhi.
6. Suman, B.C. and Sharma, V. P. 2006. Mushroom: Cultivation, Processing and Uses. Agrobios, India.
7. Trivedi, P.P. 1983. Home gardening. ICAR, New Delhi.

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CORE XIV
MORPHOLOGY, TAXONOMY OF ANGIOSPERM & ECONOMIC BOTANY,
CELL BIOLOGY, MOLECULAR BIOLOGY AND EVOLUTION MICROBIOLOGY,
PLANT ECOLOGY & PHYTOGEOGRAPHY

SUBJECT CODE :	PRACTICAL	MARKS:100
SEMESTER: V	CREDITS: 4	TOTAL HOURS: 120

COURSE FRAMEWORK:

- Identify the anatomical feature of root, stem and leaf in addition to variation or anomalies. To provide knowledge on the structure of anther and ovule
- Identify observe and sketching the floral parts of the plants belonging to different families.
- To Find the Economic uses of plants and plant parts.
- Explain the steps involved in Smear/Squash Method and from Prepared Slides.
- Identify and familiarize the specimens during field visit
- Describe the Theory of Evolution considering Darwinism and Modern Synthetic Theory, evolutionary scientists and Geological time scale
- Demonstrate the process in remote Sensing, types of satellite mapping and vegetation mapping.

COURSE OUTCOME:

1. Identify the anatomical feature of root, stem and leaf in addition to variation or anomalies. To provide knowledge on the structure of anther and ovule
2. Identify observe and sketching the floral parts of the plants belonging to different families.
3. Explain the steps involved in Smear/Squash Method and from Prepared Slides.
4. Identify Describe the Theory of Evolution considering Darwinism and Modern Synthetic Theory, evolutionary scientists and Geological time scale
5. Demonstrate the process in remote Sensing, types of satellite mapping and vegetation mapping and familiarize the specimens during field visit.

MORPHOLOGY, TAXONOMY OF ANGIOSPERM & ECONOMIC BOTANY
(20 Hours)

1. Morphology of root, stem, leaves and modifications, types of inflorescence and fruits.
2. Plants of local flora included under theory syllabus and family identification and derivation based on reasoning.
3. Dissection, identification, observation and sketching the floral parts of the plants belonging to the families included in the syllabus.
4. Ten (10) Herbarium sheets and field note book to be submitted.
5. Economic uses of plants and plant parts included under theory syllabus.
6. Botanical tour to places for observation, study and collection of plants prescribed in the syllabus for 2 to 5 days under the guidance of faculties.

CELL BIOLOGY**(20 Hours)**

Squash and Smear techniques.

Ultrastructure of Plant cell and cell organelles with the help of ultra – microphotograph.

Photograph of evolutionary scientists, and Geological time scale.

Demonstration:

Isolation and identification of Cell Organelles

Molecular Biology – Photographs**(10 Hours)**

1. DNA Structure

2. t RNA

3. DNA – Replication

4. DNA – Repair

5. Genetic code

6. Vectors – PBR 322, BAC & YAC vectors, Lac and TRP operon

Microbiology Practical**(20 Hours)****Demonstration / Photographs:**

1. Sterilization techniques (Physical, Chemical and Biological)
2. Dilution plate techniques for isolation of bacteria
3. Dilution of plate techniques for isolation of fungi
4. Staining of bacteria – Simple, Gram, Capsule, Spore staining
5. Isolation of pure culture – streak, spread and pour plate methods.
6. Wet mount method, hanging drop method
7. Catalase test, oxidase test, urease test
8. Identification of morphological types and diseases caused by Viruses and bacteria on the basis of the external symptoms (Photographs)
9. Study the quality of milk by methylene blue reductase test.
10. Fermentation of food by yeast.

ECOLOGY, PHYTOGEOGRAPHY AND REMOTE SENSING**(20 Hours)**

1 Study the morphological and anatomical adaptations of the hydrophytes, xerophytes, halophytes, epiphytes and parasites.

2. Find out the density, frequency & abundance of plant species by quadrat and Transect methods (Demonstration only).

3. Plant adaptive modifications. Specimens /slides / Photographs.

A) *Opuntia* B) *Euphorbia* C) *Hydrilla* D) *Eichornia* E) *Typha* and F) *Rhizophora*

4. Demonstration – Remote Sensing – study of satellite maps, vegetation mapping.

QUESTION PAPER PATTERN:

Section	Question Component	Numbers	Marks	Total
Section A	Definition / Principle Answer any 10 out of 12 Questions	01-12	3	30
Section B	Short Answer Answer any 5 out of 7 questions	13-19	6	30
Section C	Essay Answer any 4 out of 6 questions	20-25	10	40

DISTRIBUTION OF QUESTIONS:

Sections	Units	No. of Questions	
		Theory	Problems
Section A	Unit – 1	2	
	Unit – 2	3	
	Unit – 3	3	
	Unit – 4	2	
	Unit – 5	2	
Section B	Unit – 1	1	
	Unit – 2	2	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	1	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	

SEMESTER V

CORE XI

GENETICS, PLANT BREEDING & BIOSTATISTICS

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: VI	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

- Understand the basic principles of heredity and variations in life
- Understand the inheritance pattern of nuclear and extra nuclear genes
- Understand the objectives of plant breeding and the methods of crop improvement
- To understand the various applications of statistics with reference to biological sciences.

COURSE OUTCOME:

1. To compare the classical Mendelian genetics, modified Mendelian theories like allelic and gene interactions including epistasis, complementary genes, multiple alleles, quantitative inheritance.
2. Explain the mechanism of linkage and crossing over, chromosome mapping, sex determination in various organisms, sex linked inheritance, nuclear inheritance, population genetics
3. Outline different breeding techniques and the application of modern amenities for the process like the use of genetic engineering, mutation breeding, heterosis breeding and breeding for resistance
4. Find the plant adaptation that is applicable to agricultural and natural systems.
5. Recognize the importance of data collection and its role in determining scope of inference.

GENETICS

UNIT I

10 Hours

History, branches and application, Mendelian genetics – Mendel's experiment, Mendel's laws, monohybrid, dihybrid, back and test cross. Incomplete dominance and co – dominance;

UNIT II

15 Hours

Gene interactions – complementary, supplementary, epistasis, duplicate factors. Chromosome theory of linkage, methods and significance of crossing over, recombinations and mapping of genes on chromosomes. Inheritance patterns in Human (Sex – linked, Autosomal, Mitochondrial, Unifactorial, Multi – factorial).

UNIT III

15 Hours

Polygenic inheritance, Multiple alleles. Extra nuclear inheritance and its significance. Chromosomal aberrations – deletion, duplication, translocation, inversion and sex linkage; sex determination in plants. Mutation – types, mutagenic agents (physical and chemical) and significance.

PLANT BREEDING

UNIT IV

10 Hours

Principles involved in plant breeding, methods of crop improvement – selection (pure line, mass and clonal). Hybridization techniques – interspecific and Intergeneric hybridization, Heterosis – types, causes and effects. Mutation breeding; types of polyploidy and its application in plant breeding.

BIOSTATISTICS

UNIT V

10 Hours

Measures of central tendency – Mean, median and mode. Measures of dispersion – range, variance, Standard Deviation and Standard Error. Small sample testing: t – Test, Chi – square test. Computer application with special reference to SPSS software. Data – types of data. Presentation of data – Graphical methods: Histogram, Bar and Pie diagrams.

PRESCRIBED BOOKS:

Genetics

1. John, R. (2004). Fundamental Genetics. Cambridge University Press India Pvt. Ltd., New Delhi.
2. Jain, H.K. (1999). Genetics – Principles, Concepts & Implications. Oxford & IBH Publishing Co., (P) Ltd., New Delhi.
3. Lewin, B. (1990). Genes IV. Oxford University Press, Oxford.
4. Meyyan, R.P. (2000). Genetics & Evolution. Saras Publication, Nagercoil.
5. Palaniyappan, S. (1987). Marabiyal (Genetics – In Tamil). V.K. Publishing House, Madras.
6. Pandey, B.P. (2012). Cytology, Genetics and Molecular Genetics. Tata McGraw – Hill Education Private Ltd., New Delhi.

Plant Breeding

1. Chandrasekaran, S.N. and Parathasarathy, S.V. (1965). Cytogenetics and Plant Breeding. P. Varadhachari & Co., Madras.

Genetics

7. Adrin, M.S.R.B., Owen, R.D. and Edger, R.S. (1979). General Genetics. In: Mendelism. Eurasia Publishing House (P) Ltd., New Delhi.
8. Agarwal, V.K. (2000). Simplified course in Genetics (B.Sc., Zoology). S. Chand & Company Ltd., New Delhi.
9. Ahluwalia, K.B. (1990). Genetics. Wiley Eastern Ltd., Madras.
10. Gardner, E.J. and Snusted, D.P. (1984). Principles of Genetics (7th edition). John Wiley & Sons, New York.
11. Gupta, P.K. (2000). Genetics. Rastogi Publishers, Meerut.
12. Herskowitz, I.H. (1977). Principles of Genetics (2nd Ed.). MacMillan Publishing Co. Inc., New York.
13. Hexter, W. and Yost, H.T. Jr. (1977). The Science of Genetics. Prentice Hall of India (P) Ltd., New Delhi.
14. Renganathan, T.K. and Shanmugavel, S. (1996). Genetics & Genetic Engineering. Commercial Offset Printers, Sivakasi.
15. Sandhya, M. (1994). Genetics – A Blue Print of Life. Tata McGraw – Hill Education Private Ltd., New Delhi.
16. Sarin, C. (1994). Genetics. Tata McGraw – Hill Education Private Ltd., New Delhi.
17. Singleton, R. (1963). Elementary Genetics. D. Van Nostrand Co., Ltd. Inc., New York.
18. Sinnott, E.W., Dunn, L.C. and Dobshansky, J. (1958). Principles of Genetics (5th Edition) McGraw Hill Publishing Co., New York.
19. Strickberger, M.W. (1976). Genetics (2nd Ed.). MacMillan Publishing Co. Inc., New York.
20. Watson, J.D. (1977). Molecular Biology of the Gene. W.A. Benjamin Inc., California.
21. Winchester, A.M. (1958). Genetics (3rd Ed.). Oxford & IBH Publishing House, Calcutta.

22. Winter, P.C., Hickey, G.I. and Fletcher, H.L. (1999). Instant Notes in Genetics. Viva Books (P) Ltd., New Delhi, Mumbai, Chennai.

Plant Breeding

1. Chandrasekaran, S.N. and Parathasarathy, S.V. (1965). Cytogenetics and Plant Breeding. P. Varadhachari & Co., Madras.
2. Daniel Sundararaj, D. and Thulsidas, G. (1972). Introduction to Cytogenetics & Plant Breeding (3rd Ed.). Popular Book Depot, Madras.
3. Sinha, U. and Sinha, S. (1989). Cytogenetics, Plant Breeding & Evolution. Vikas Publishing House, New Delhi.

CORE XII

PLANT PHYSIOLOGY AND BIOCHEMISTRY

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: VI	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

- To learn the underlying principles of the various metabolic activities of plants.
- To understand the role of enzymes in various metabolic activities of plants
- To understand the structure and properties of the biomolecules.
- To study the reactions performed by the biological macromolecules.

COURSE OUTCOME:

1. Describe the characteristic features of water which helps in the biological systems, transpiration types, features and mechanisms.
2. Explain the processes related to the ascent of sap, uptake of nutrients and translocation of sugars.
3. Examine photosynthesis- (apparatus, process, regulation and assimilatory powers), Nitrogen fixation- (sites, genetic control and assimilation)
4. List the role of phytohormones in plant growth, development, movement (types and feature), photomorphogenesis, seed germination and seed dormancy.
5. Explain the plant metabolic reactions, components and functioning of Plant chemicals.

Plant Physiology

UNIT I

(10 Hours)

Plant – Water relationship: structure and properties and significance of water – osmotic and non – osmotic uptake of water. Ascent of sap – cohesion theory: root pressure, transpiration, physiology of stomatal action, Translocation of solutes and assimilates. Mass flow, Membrane permeability mineral uptake: Passive and active. Role of major and Minor elements, mineral deficiency symptoms.

UNIT II

(10 Hours)

Photosynthesis – history of discovery, absorption spectrum, action spectrum, role of pigments, enhancement effect, photosystems I & II, photophosphorylation; carbon assimilation – Calvin cycle, Hatch & Slack pathway, CAM pathway; photorespiration. Respiration – aerobic and anaerobic; Glycolysis, Krebs' cycle and oxidative phosphorylation, energetics of respiration.

UNIT III

(15 Hours)

Nitrogen Metabolism: Importance of nitrogen in plant life, Nitrogen fixation – abiological and biological (symbiotic and asymbiotic), nitrogen cycle and nitrogen metabolism. Plant growth regulatory substances – auxin, gibberellin, cytokinin, ethylene and abscisic acid (chemical nature, physiological effects and function). Role of hormones in flowering, senescence and abscission. Photoperiodism, vernalization and seed dormancy.

Biochemistry

UNIT IV

(10 Hours)

Biochemistry: definition and scope. Biomolecules and Biomacromolecules (Brief account). Carbohydrates – Classification – structure and properties of mono, di, tri saccharides. Starch and cellulose – structure and function. Lipids – Classification – Properties – saturated and unsaturated fatty acids. Pigments: structure of chlorophyll, carotenoids, phycobilins and anthocyanin

UNIT V

(15 Hours)

Properties of Enzymes – Mechanism of Enzyme action – Factors affecting Enzyme activity, Michaelis constant. Coenzymes: Introduction, salient features of coenzymes, mechanism of coenzyme action and Classification of coenzymes (NAD, FAD, CoA, ATP and TPP).

PRESCRIBED BOOKS:

Plant Physiology

1. Pandey, B. P. (2007). Botany for Degree Students: Plant Physiology, Biochemistry, Biotechnology, Ecology and Utilization of Plants. S. Chand & Company Ltd., New Delhi.
2. Pandey, S.N. (1991). Plant Physiology. Vikas Publishing House (P) Ltd., New Delhi.
3. Periyasamy, K. (1978). Cell IyakkaViyal (Cell Physiology). Tamilnadu text Book Society, Chennai.
4. Salisbury, F.B. and Ross, C.W. (1999). Plant Physiology. CBS Publishers and Printers, New Delhi.
5. Srivastava H.S. (2005). Plant Physiology. Rastogi Publications, Meerut.
6. Taiz, L. and Zeiger, E. (1998). Plant Physiology (2nd Ed.). Sinauer Associates, Inc., Publishers, Massachusetts, USA.

Biochemistry

1. Plummer, D.T. (1988). An Introduction to Practical Biochemistry (3rd Edn.). Tata McGraw Hill Publishing Co., Ltd., New Delhi.
2. Sadasivam, S and Manickam, A. 1996. Biochemical Methods. New Age International (P) Ltd. New Delhi.
3. Srivastava, H.S. (1990). Elements of Biochemistry. Rastogi Publications, Meerut, India.
4. Stryer, L. (1989). Biochemistry. W.H. Freeman & Co., New York, San Francisco.
5. Wilson, K. and Walker, J. (1994). Principles and Techniques of Practical Biochemistry (4th Edition). Cambridge University Press, U.K.

SUGGESTED READING

Plant Physiology

1. Datta, S.C. 1989. *Plant Physiology*, Central Book Depot, Allahabad.
2. Dayananda, B. (1999). *Experiments in Plant Physiology*, Narosa Publishing House, New Delhi.
3. Devlin, R.M. (1969). *Plant Physiology*. Holt, Rinehart & Winston & Affiliated East West Press (P) Ltd., New Delhi.
4. Hopkins, W. G. 1995. *Introduction to Plant Physiology*. John Wiley & Sons Inc., New York, USA.
5. Jain, V.K. (1996). *Fundamentals of Plant Physiology*. S. Chand & Co., New Delhi.
6. Kochar, P.L. 1964. *A Text Book of Plant Physiology*, Atmaram & Sons, Delhi.
7. Leopald, A.C. and Kriedemann, P.E. (1979). *Plant Growth and Development*. Tata McGraw Hill, New Delhi.
8. Malik, P.C. 1980. *Plant Physiology*, Kalyani Publishers, New Delhi.
9. Noggle, R. and Fritz (1989). *Introductory Plant Physiology*. Prentice Hall of India.

Biochemistry

1. Day, P.M. and Harborne, J.B. (2000). Plant Biochemistry. Harcourt Asia (P) Ltd., India & Academic Press, Singapore.
2. De Robertis, E.D.P. and De Robertis, E.M.F.Jr. 2002. Cell and Molecular Biology, Lipponcott Williams and Wilkins. USA.
3. Jain, J.L. (1998). Fundamentals of Biochemistry. S. Chand & Co., New Delhi.
4. Jain, J.L., Jain, S. and Jain, N. (2008). Fundamentals of Biochemistry. S. Chand & Company Ltd., New Delhi.
5. Jayaraman, J. (1981). Laboratory Manual of Biochemistry. Wiley Eastern Ltd., New Delhi.
6. Lehninger, A.L. (1984). Biochemistry (2nd Edition). Kalyani Publishers, Ludhiana, New Delhi.
7. Lewin, B. (2002). Genes VIII. Oxford University Press., Oxford.
8. Nelson, D.L. and Cox, M.M. 1(993). Principles of Biochemistry. MacMillan Worth Publications.

QUESTION PAPER PATTERN:

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	Unit – 3	2	
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	Unit – 5	1	
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	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	

CORE XIII

PLANT BIOTECHNOLOGY

SUBJECT CODE :	THEORY	MARK:100
SEMESTER: VI	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

- To understand the fundamental aspects of plant tissue culture and molecular biology of plants for the production of transgenics.
- To understand the concepts of modern technology pertaining to large scale production of agricultural products.

COURSE OUTCOME:

1. Describe the isolation and cultivation of economically important microbes plant cells.
2. Explain tissue culture methods and study the suitable culture media and its composition.
3. Relate the mechanisms of plant cell signalling and gene regulation.
4. Discuss the different methods for transformation of plants or plant cells, including their specific advantages and applications.
5. Relate plant biotechnology applications within forestry, agriculture, and production of bio products, in pharmaceuticals, tanneries, dairy and bio-fuels

UNIT I

(10 Hours)

Biotechnology – definition, history and scope. Isolation and cultivation of economically important microbes (a) Fresh Water Alga (*Scenedesmus*) (b) Fungus (*Aspergillus*).

UNIT II

(15 Hours)

Plant Tissue Culture – micropropagation, Sterilization Methods, Culture Media – Composition and types of medium, inoculation, incubation and acclimatization. Organ culture: Anther, Embryo & Meristem culture. Organogenesis, somatic embryogenesis and artificial seeds. Somatic Hybridization: Isolation, fusion and protoplast culture. Somoclonal Variation & cryopreservation.

UNIT III

(15 Hours)

Single cell protein (SCP) – Microorganism used in SCP (*Scenedesmus* and *Spirulina*). Nutritional value of SCP. Algal Biomass production and maintenance. Biofertilizers – Blue green algae, *Azolla*, Fungi – *Mycorrhiza* (VAM and Ectomycorrhiza), Bacterium – *Azospirillum* and *Rhizobium*.

UNIT IV

(10 Hours)

Biotechnology-introduction and application in various fields. Genetic engineering tools: restriction endo nuclease, DNA ligase, reverse transcriptase, alkaline phosphatase. Vectors- Plasmid vectors, lambda bacteriophage vectors, methods of transferring desired gene into vectors – transformation techniques, Screening for selection of clones – replica plating method, colony hybridization.

UNIT V

(10 Hours)

Transgenic plants: Insect resistance, Herbicide resistant plants, golden rice, agar production, alginate production, cultivation of sea weeds. Gene delivery system: Plant Viruses, *Agrobacterium* mediated gene transfer (biological), Particle gun bombardment, microinjection, electroporation. Production of transgenics: disease resistant plant (*Bt* gene).

PRESCRIBED BOOKS

1. Kumar, H.D. (1991). A Textbook on Biotechnology. East west press, New Delhi.
2. Parihar, P. (2014). A Textbook of Biotechnology. Argobios Publications, Jodhpur
3. Purohit, S.S. (2003). Agricultural Biotechnology. Agrobios Publications, Joshpur.
4. Trevan, M.D., Boffey, S., Goulding, K.H. and Stanbury, P. (1988). Biotechnology – The Biological Principles. Tata Mc Graw Hill Publishing Co., New Delhi.

SUGGESTED READING:

1. Chatterji, A.K. (2011). Introduction to Environmental Biotechnology. Prentice Hall India Pvt., Ltd., New Delhi.
2. Dubey, R.C. (2013). A Textbook of Biotechnology. S. Chand & Company Ltd., New Delhi.
3. Gupta, P.K. (1994). Elements of Biotechnology. Rastogi Publications, Meerut.
4. Ignacimuthu, S. (1997). Plant Biotechnology. Oxford & IBM Publishing Co., New Delhi.
5. Kalyan Kumar De. (1997). Plant Tissue culture. New central Book Agency, Calcutta.

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	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	1	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	

ELECTIVE – I
HERBAL BOTANY

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: VI	CREDITS: 5	TOTAL HOURS: 75

COURSE FRAMEWORK:

- To understand the role of medicinal plants in Traditional medicine for health care
- To understand the active principles, biological effects of medicinal plants.
- To realize the standardization, quality control and
- To know about the role of Medicinal Plants Board and Herbal drug regulations in India

COURSE OUTCOME:

1. Explain method for identification and authentication of herbal drugs
2. Explain basic principles of traditional medicinal systems with method of preparation and standardization of Ayurvedic, Siddha, Unani formulations
3. Describe benefits of various plants as nutraceuticals in ailments and also the herb-food interaction of various plant drugs
4. Describe about herbs or natural origin drugs as raw materials for preparation of cosmetics, excipients, conventional herbal formulation and novel dosage forms like phytosomes
5. Explain methods for selection, processing of herbal drugs as raw materials for herbal drug preparation

UNIT I

(15 Hours)

Herbal medicines: history and scope – definition of medical terms – role of medicinal plants in Traditional Medicine (Ayurveda, Siddha, Unani, Homeopathy and Folk); cultivation – harvesting – processing – storage – marketing and utilization of medicinal plants.

UNIT II

(15 Hours)

PHYTOCHEMISTRY – active principles and methods of their testing – identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomidoides* (anti – rheumatic) and *Centella asiatica* (memory booster).

UNIT III

(15 Hours)

Pharmacognosy – definition, history, scope and development of Pharmacognosy; Classification of drugs – Alphabetical, morphological, taxonomical, chemical and pharmacological classification of drugs

UNIT IV

(15 Hours)

Analytical pharmacognosy: Drug adulteration – types, methods of drug evaluation – Biological testing of herbal drugs – Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).

UNIT V

(15 Hours)

Standardization and quality control methods of herbal drugs; WHO Guidelines for Herbal medicines. National Medicinal Plants Board of India – Aim & objectives, functions. Herbal drug regulations in India.

PRESCRIBED BOOKS:

1. Agnes Arber (1999). Herbal plants and Drugs. Mangal Deep Publications.
2. Anne Green (2000). Principles of Ayurveda, Thomsons, London.
3. Chopra, R.N., Nayar S.L. and Chopra, I.C. (1956). Glossary of Indian medicinal plants. C.S.I.R, New Delhi.
4. Kanny, Lall, Dey and Raj Bahadur (1984). The indigenous drugs of India, International Book Distributors.
5. Miller, L. and Miller, B. (1998). Ayurveda and Aromatherapy. Motilal Banarsidass, Delhi.
6. Kokate, C. K., Purohit, A. P., and Gokhale, S.B. (2004). Pharmacognosy, Nirali Prakashan, Pune.
7. Sivarajan, V.V. and Indra Balachandran (1994). Ayurvedic drugs and their plant source. Oxford IBH publishing Co.

SUGGESTED READING:

1. WHO. (1992). Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva.
2. WHO. (1993). Guidelines for the Assessment of Herbal Medicines. WHO Technical Report Series, World Health Organization, Geneva.
3. WHO. (2002). General Guidelines for Methodologies on Research and Evaluation of Traditional Medicine. World Health Organization, Geneva.

WEBSITE:

1. <https://www.nmpb.nic.in/>

Question Paper Pattern:

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	Unit – 4	2	
	Unit – 5	2	
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	Unit – 2	2	
	Unit – 3	2	
	Unit – 4	1	
	Unit – 5	1	
Section C	Unit – 1	1	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	

ELECTIVE – II

PRESERVATION OF FRUITS AND VEGETABLES

SUBJECT CODE :	THEORY	MARKS:100
SEMESTER: VI	CREDITS: 5	TOTAL HOURS: 75

COURSE FRAMEWORK:

- To acquaint with properties and role of various constituents in foods, interaction and changes during processing.
- Discuss the proper handling technologies of fruits and vegetables to reduce post-harvest losses
- List the principles and methods of preservation of fruits and vegetables into various products
- To acquaint with principles of different techniques used in processing and preservation of foods
- Explain the essentials of Intellectual Property Rights, nutritional security, standard protocol for food quality parameters and control systems, food standards, regulations, specifications.

COURSE OUTCOME:

1. To acquaint with properties and role of various constituents in foods, interaction and changes during processing.
2. Discuss the proper handling technologies of fruits and vegetables to reduce post-harvest losses
3. List the principles and methods of preservation of fruits and vegetables into various products
4. To acquaint with principles of different techniques used in processing and preservation of foods
5. Explain the essentials of Intellectual Property Rights, nutritional security, standard protocol for food quality parameters and control systems, food standards, regulations, specifications.

UNIT I

(15 Hours)

Preservation Technology – Nature of the fruits & vegetables in respect of their preservation. Different terms used in processing. Classification of fruits and vegetables (basis of p^H, physiology). Principles & techniques involved for different fruit & vegetable preservation.

UNIT II

(15 Hours)

Canning operations on fruits and vegetables. Process flow diagram for canning. Canning machineries. Pre – treatment's before canning operations. Fruits and vegetable drying/dehydration: General methods of fruits & vegetable drying/dehydration, sun drying, mechanical drying. Types of dryers, characteristics of dried fruits and vegetables, treatments prior.

UNIT III

(15 Hours)

Principle of making jam and jellies as per availability of the fruits. Process flow diagram for jam and jellies. Test of pectin for jam and jelly preparation. Glazed fruits, candy, fruit bar. Principle and methods of production. Pickles – principles of pickle production, different types of pickles from fruits and vegetables.

UNIT IV**(15 Hours)**

Purpose and Scope of Preservation; Objectives of preservation and processing; Principles and Methods of Preservation – Asepsis, Low temperature, High temperature, Removal of moisture, Removal of air; Use of chemical preservatives, Fermentation, Irradiation, Newer methods. Scope of preservation industry in India.

UNIT V**(15 Hours)**

Food Safety Regulations; Key terms, factors affecting food safety, recent concerns, standards and regulations, *Food Safety and Standards Authority of India (FSSAI)*, FSS acts, FPO mark, International Food Standards (Codex Alimentarius), HACCP.

PRESCRIBED BOOKS:

1. Avantina Sharma, (2006). Text Book of Food Science and Technology, International Book Distributing Co, Lucknow, UP.
2. Dauthy, M.E. (1995). Fruit and Vegetable processing, FAO Agricultural Services Bulletin, 119, Rome.
3. Desrosier, N.W. (1973). The technology of food preservation. The Av Publishing Co., Inc West Poet, Connecticut.
4. Fellows, P.J. (2002). Food Processing Technology. Principles and Practices, Second Edition, Woodland Publishing Ltd, Cambridge, England.
5. Lal G., Siddhappa G., and Tondon G. L. (1986). Preservation of fruits and vegetables, ICAR, New Delhi.
6. NIIR Board, (2005). The complete Technology book on processing, dehydration, canning, preservation of fruits and vegetables, National Institute of Industrial Research, Delhi.

SUGGESTED READING:

1. Peter Zeuthen and Leif Bogh – Sorenson (2005). Food Preservation Techniques, Woodland Publishing Ltd, Cambridge, England.
2. Salunkhe, D.K. and Kadam S.S. (1995). Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York.
3. Shrivastava, R. P. and Kumar. S. (1998). Fruit and Vegetable Preservation: Principles and Practices, 2nd Edition, International Book Distribution Co., Lucknow.
4. Sivasankar, B. (2005). Food Processing and Preservation, Prentice hall of India Pvt Ltd, New Delhi.
5. Suman Bhatti and Uma Varma, (1995). Fruit and vegetable processing organizations and institutions, CBS Publishing, New Delhi.
6. Virag Gupta, (2018). [The Food Safety and Standards Act 2006 Along with Rules and Regulations](#). Jain book Depot, New Delhi.

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	Unit – 5	1	
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	Unit – 3	1	
	Unit – 4	2	
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CORE XV

GENETICS, PLANT BREEDING & BIostatISTICS, PLANT PHYSIOLOGY & BIOCHEMISTRY, PLANT BIOTECHNOLOGY

SUBJECT CODE:	PRACTICAL	MARKS:100
SEMESTER: VI	CREDITS: 4	TOTAL HOURS: 120

COURSE FRAMEWORK:

- Discuss the basic principles of genetics, Law of Mendel, Gene interaction, Allelic and non- allelic genes.
- List Genetic Problems related to Transmission and Distribution of Genetic Material.
- Describe linkage and crossing over of genes, solving gene mapping problems. Identification of DNA in Plant Material
- Construct a histogram, pie chart and line diagram of plants within the plants.
- Describe more about the characteristics, techniques, principles and application of plant tissue culture
- Explain the main techniques of in vitro culture of plant cells & tissues.
- Discuss the application of vital and physical forces theories on plant physiology most preferably ascent of sap, transpiration, mineral nutrition in plants and phloem transport
- Identify Glucose and Protein Estimation
- Find the methods used for the bio-production of plant secondary metabolites.

COURSE OUTCOME:

1. Discuss the basic principles of genetics, Law of Mendel, Gene interaction, Allelic and non- allelic genes.
2. Construct a histogram, pie chart and line diagram of plants within the plants.
3. Describe more about the characteristics, techniques, principles and application of plant tissue culture
4. Discuss the application of vital and physical forces theories on plant physiology most preferably ascent of sap, transpiration, mineral nutrition in plants and phloem transport
5. Identify Glucose and Protein Estimation and the bio-production of plant secondary metabolites.

A. Genetics

(40 Hours)

a. Students are expected to work out and record the problems in:

1. Monohybrid, dihybrid cross and back crosses.
2. All types of modified Mendelian ratios mentioned in the syllabus.

b. Study of human karyotype and study of characteristic karyotypes and symptoms of the syndromes mentioned in the syllabus and record it.

B. Plant breeding

(10 Hours)

1. Emasculation and bagging (Demonstration / Photographs)

Biostatistics

(10 Hours)

1. To study the standard deviation with reference to leaf length in plants (mean, medium and mode).
2. Construct a histogram, pie chart and line diagram of plants within the plants.

PRACTICAL – Plant Biotechnology

(30 Hours)

Demonstration and photographs:

M. S. Medium preparation,

Sterilization techniques in plant tissue culture.

Explant sterilization.

Callus induction.

Plantlet.

Hardening.

Embryo culture.

Meristem culture and Anther culture, study of algal biofertilizers,

VAM fungi, Bacteria – Azospirillum

Sterilization techniques in plant tissue culture

Preparation of MS Medium, Embryo culture, Meristem culture and Anther culture

Study of algal biofertilizers, VAM fungi, Bacteria – Azospirillum.