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| Semester: 7 | |
| Course: Major IV | |
| Paper Title: Applied Plant Biology | |
| Paper code: | Credits: 4 (3+1) |
| Hours/week: 3 + 3 | |
| Category: Core/MDC/SEC/VAC: Core | |
| Theory / Practical / Composite: Composite | |
| No of Modules: Theory – 2, Practical 1 | |
| <p>Course Overview: This course provides an advanced understanding of contemporary concepts in plant sciences with translational relevance to agriculture, medicine, and sustainability. Module A focuses on fundamental and applied aspects of plant embryology, plant pathology, plant immunity, and cellular regulation, emphasizing, disease processes, defense mechanisms, and programmed cell death. Students will explore how developmental pathways such as embryogeny, polyembryony, and apomixis contribute to plant reproduction. The module also examines plant–pathogen interactions across stages of infection, modern immunity models (gene-for-gene and zig-zag), systemic resistance mechanisms, and integrated disease management strategies. Molecular regulation of senescence and programmed cell death is discussed in the context of plant development and biotic stress adaptation. Module B integrates traditional knowledge systems with modern technological approaches. It introduces ethnomedicine, quality evaluation of crude plant drugs, and the role of natural products in drug discovery using network pharmacology and computer-aided drug design approaches. The module further addresses plants as agents of climate action and sustainable agriculture, covering plant phenomics, precision agriculture tools (hyperspectral imaging, IoT, swarm robotics), GIS-based crop monitoring, NDVI-based health assessment, rhizosphere engineering, holobiont concepts, biomass economy, yield stability, and carbon biosequestration strategies. The practical component develops hands-on skills in pharmacognostic evaluation of plant-derived crude drugs using organoleptic and biochemical methods, including antioxidant assays and Computer Aided Drug Discovery (CADD). Overall, the course bridges classical botany with modern biotechnology, digital agriculture, and sustainability science, preparing students for research, industry, and policy roles in plant-based solutions to global challenges.</p> | |
| <p>COURSE OUTCOME:</p> <ol style="list-style-type: none"> 1. CO1. Understand plant embryological processes and their applications in crop improvement and reproduction biology. 2. CO2. Analyze plant disease dynamics, host–pathogen interactions, and modern concepts of plant immunity. 3. CO3. Evaluate plant defense mechanisms and design appropriate disease management strategies. 4. CO4. Interpret molecular mechanisms underlying plant senescence and programmed cell death. 5. CO5. Assess the role of ethnomedicine and natural products in drug discovery, including | |

quality evaluation of crude drugs and in the practical component evaluate crude drugs using organoleptic and biochemical methods.

6. **CO6.** Apply modern technological tools (phenomics, precision agriculture, GIS, NDVI, IoT) for sustainable crop management and climate action with insights and integration of concepts such as holobiont interactions, rhizosphere engineering, biomass economy, and carbon sequestration in sustainable agriculture.

Syllabus

| Unit/Module | CONTENT | Hours / Number of Classes | Co Mapping | Cognitive Level |
|-----------------------------------|--|---------------------------|--------------------|-----------------|
| Theory [30 Marks] MODULE A | <p>UNIT I:</p> <ol style="list-style-type: none"> 1. Plant Embryology and its applications. Endosperm types, Embryogeny, Polyembryony and Apomixis <p>UNIT II:</p> <ol style="list-style-type: none"> 1. Plant Pathology: Concept of Disease cycle; Symptoms; Etiology and causal complex; Endemic, Epidemic, Pandemic and Sporadic disease: concepts with examples. 2. Host pathogen interaction: Pre-penetration, Penetration and Post Penetration; Plant Immunity: Concept of gene for gene concept and Zig Zag model. <p>UNIT III:</p> <ol style="list-style-type: none"> 1. Defense mechanisms; Systemic acquired resistance and Induced systemic resistance; Plant disease management - Quarantine, Chemical, Biological and Integrated Methods | 24 hours | CO 1 to CO6 | K1 to K6 |
| Module B: 15 marks | <p>UNIT V: Ethnomedicine and Natural Compound based Drug Discovery:</p> <ol style="list-style-type: none"> 1. Ethnomedicine; Drug adulteration. Methods for Evaluation. 2. Natural compound based drug discovery with insights from network pharmacology and | 12 hours | CO 1 to CO6 | K1 to K6 |

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| | <p>Computer Aided Drug discovery (CADD).</p> <p>UNIT VI: Plants for Climate action and Sustainable Agriculture:</p> <ol style="list-style-type: none"> 1. Introductory idea on plant phenomics and precision agriculture; applications of hyperspectral imaging, Swarm robotics and Internet of Things (IoT). Census Techniques and GIS based methods; Normalized Difference Vegetation Index (NDVI) to assess crop health. 2. Holobiont and Hologenome Concepts, Basics of soil types, Rhizosphere Engineering, Yield stability index (YSI); Carbon biosequestration strategies. | | | |
| Practical [40 marks] | <ol style="list-style-type: none"> 1. Evaluation of plant-derived crude drugs – Organoleptic and Biochemical (Evaluation of Antioxidant Potential and Alkaloid content) 2. Identifying pharmacologically important ethnomedicinal plants and important plant derived natural compounds from databases such as TKDL, IMPPAT and COCONUT and evaluating their druggability. (Computer Lab required). 3. Field trip to a different agro - ecological region to study different plant, soil and other agro ecological parameters in situ. | 30 hours | CO 1 to CO6 | |
| Text and Reference books: | <ol style="list-style-type: none"> 1. The embryology of angiosperms S.S. Bhojwani, S.P. Bhatnagar, and P.K. Dantu; Vikas Publishing House (5th Edition) 2. Plant Pathology, 6th Ed. by George N. Agrios (Elsevier, 2024 - <i>Updated 6th Ed.</i>) 3. Plant Pathology, 2nd Ed. by R.S. Mehrotra & Ashok Aggarwal (Academic/Arya Publications, 2023) 4. Plant Diseases by R.S. Singh (Oxford & IBH, 11th Ed., 2024) 5. The Ayurvedic Pharmacopoeia of India , Ministry of Health and Family Welfare 6. Ethnomedicine: Ancestral Legacy and Use of Medicinal Plants José L. Martínez, José Mostacero-León, Ina Aneva, ISBN 9781032803210 7. Bochtis, D., et al. (2023). <i>Unmanned Aerial Systems in Agriculture</i>. 8. Precision Agriculture Evolution, Insights and Emerging Trends (2023) Editor: Qamar Zaman | | | |

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| | <p>9. Naeem, M., & Ansari, A. A. (Eds.). (2026). <i>Phenotyping crop plants for physiological and biochemical traits</i> (1st ed.). Academic Press/Elsevier.</p> <p>10. Rebetzke, G. J., & Chenu, K. (Eds.). (2022). <i>Plant phenotyping: A special issue of plant phenomics</i>. Springer.</p> | |
| Evaluation | <p>Theory CIA- 10; Assignment – 02; Attendance – 03; Semester Exam- 45</p> | <p>Practical CA (38 marks); Attendance (2 marks)</p> |
| <p>Question Paper Structure: Module A (30 Marks):</p> <ul style="list-style-type: none"> Any 1 out of 2 Questions (15 marks each with suitable subparts, no subpart can be less than 1 Mark) Any 3 out of 5 questions (5 marks each with subparts not less than 1 Mark) <p>Module B (15 Marks):</p> <ul style="list-style-type: none"> Any 3 out of 5 questions (5 marks each with subparts not less than 1 Mark) | | |

COURSE OUTCOMES (COs) AND COGNITIVE LEVEL MAPPING

| COs | CO Description | Cognitive levels |
|------------|---|-------------------------|
| CO1 | Explain plant embryological processes and their applications in crop improvement and reproduction biology. | K1 to K6 |
| CO2 | Analyze plant disease dynamics, host–pathogen interactions, and modern concepts of plant immunity. | K1 to K6 |
| CO3 | Evaluate plant defense mechanisms and design appropriate disease management strategies. | K 1 to K6 |
| CO4 | Interpret molecular mechanisms underlying plant senescence and programmed cell death. | K1 to K6 |
| CO5 | Assess the role of ethnomedicine and natural products in drug discovery, including quality evaluation of crude drugs. | K1 to K6 |
| CO6 | Apply modern technological tools (phenomics, precision agriculture, GIS, NDVI, IoT, rhizosphere engineering) and carbon biosequestration strategies for sustainable crop management and climate action. | K1 to K6 |