MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Bishop Abraham Memorial College, Thuruthicaud					
Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	GINU JOSEPH					
Contributors	Dr. Ginu Joseph, Mrs. Namita Mary Mathew, Dr. Robi A. J.					
Course Name	SOIL SCIENCE					
Type of Course	DSE					
Specialization title	Applied Plant Science					
Course Code	MG3DSEBOTA08					
Course Level	200					
Course Summary	The course titled “Soil Science” provides a comprehensive exploration about soil. The course describes about the soil formation, classification, structure, properties, soil chemistry, soil fertility, fertilizers nutritional abilities especially in relation with plants.					
Semester	3	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any	NIL					

Course Outcomes (CO)

Number of COs		**5**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Identify different types of rock, minerals, pedological and edaphological concept of soil.	K	PO6, PO10
2	Describe the fundamentals weathering and soil formation.	U	PO6, PO7, PO10
3	Describe soil horizons, structure and physical properties of soil. Explain the characteristic features and functions of Soil water and demonstrate the soil water-plant relationship.	U	PO1, PO3
4	Analyse different types of soil and its chemistry with relation to land types.	AN	PO2, PO9
5	Evaluate Soil chemistry, soil fertility manures and fertilizer. The time and method of application of fertilizers.	E	PO1

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	-	-	-	-	-	3	-	-	-	3
CO 2	-	-	-	-	-	3	3	-	-	3
CO 3	3	-	3	-	-	-	-	-	-	-
CO 4	-	3	-	-	-	-	-	-	-	-
CO 5	3	-	-	-	-	-	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to soil science (15 hours)			
	1.1	Introduction to soil science; Pedological and Edaphological concept of soil. Difference between Pedology and Edaphology. Definition of rocks and minerals- Monomineralanic and polymineralanic rocks- definition and examples, Definition of Petrography and Petrogenesis.	5	["1"]
	1.2	Classification of rocks– Igneous rock- classification of igneous rock, Metamorphic rock and Sedimentary rock- definition, classification, examples.	5	["1"]
	1.3	Secondary and primary minerals: a description with examples.	5	["1"]
2	Weathering and soil formation (15 hours)			
	2.1	Weathering of rocks- definition, types of weathering- physical, chemical & biological weathering with example.	5	["2"]
	2.2	Different processes of soil formation- podzolisation, laterization. Dockuchaiev, Jenny's concept of soil formation.	5	["2"]
	2.3	Factors of soil formation: passive & active factors, age of soil.	5	["2"]
3	Physical properties of soil and soil plant relation (15 hours)			
	3.1	Definition of soil profile, horizon. Different types of horizons with characters.Definition and classification of soil structure. Difference between soil texture and soil structure. Management of soil structure.	5	["2"]
	3.2	Definition of Soil Texture, soil textural classes, alteration of soil textural classes.	5	["3"]
	3.3	Soil water Classification – Physical classification and biological Classification;inRetention of soil water in the field. Water flow in saturated and unsaturated soils. Available water - definition, concept and factors affecting available water. Importance of water in agriculture. Thermal properties of soil – Thermal concepts - heat, temperatures, latent heat, modes of transmission of heat, specific heat, thermal capacity. Importance of soil temperature – effect on microbial activity, germination of seeds, root growth, crop growth and yields of crops.	5	["3"]

Module	Units	Course Description	Hrs	CO No.
4	soil texture and composition (15 hour)			
	4.1	Behavior of soil in water. Poiseuille's law, Darcy's law.	5	["4"]
	4.2	Importance of soil texture in agriculture.	5	["5"]
	4.3	Compost: definition, composition, Classification of compost: rural/urban, aerobic/anaerobic Common composting methods: Indore method, Bangalore method, Enriched Compost: enrichment with N, P, K, bioinoculants. Vermicompost: Definition, classification, vermicasts, Biofertilizers with examples.	5	["5"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Involvement and responses in class room transactions ● Home Assignments ● Oral presentation/ Viva/Quiz/Open book test ● Field study, Group discussion on a recent research or review article(<5 years) related to the course ● Any other method as may be **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written examination Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ One word - (10 out of 12) – 10 × 2 = 20 ◦ PART - B ◦ Short answer - (8 out of 10) – 8 × 5 = 40 ◦ PART - C ◦ Essays - (1 out of 2) – 1 × 10 = 10

References

- A.Rathinasamy & B. Bakiyathu Saliha (2023). Fundamentals of Soil Science, Scientific publishers.
- S.K. Gupta & I.C. Gupta (2022). Soil Physical Properties: Standard Methods of Laboratory and Field Investigations, Scientific publishers.
- Satyanarayana, E. et al. (2023). Glimpse of soil science, Narendra publishing house.
- Naresh, R.K. el al. (2022). Soil Biology and Soil Health, Narendra publishing house.
- Sharma, V. (2024). Textbook on Soil Biology, Narendra publishing house.
- Donahue, R., Miller, R.W. and Shickluna, J.C. (1983) Soils: An Introduction to Soils and Plant Growth. 5th Edition, Prentice-Hall, Englewood Cliffs. http://lib.ugent.be/catalog/rug01:000099533.
- Nyle C. Brady; Ray R. Weil (2016). The Nature and Properties of Soils, Columbus.
- https://www.nextias.com/blog/types-of-soils-in-india/
- https://www.rhs.org.uk/soil-composts-mulches/soil-types

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Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Bishop Abraham Memorial College, Thuruthicaud					
Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	GINU JOSEPH					
Contributors	Namita Mary Mathew, Dr. Ginu Joseph, Dr. Robi A.J.					
Course Name	Artificial Intelligence in Plant Science					
Type of Course	DSE					
Specialization title	Applied Plant Science					
Course Code	MG4DSEBOTA08					
Course Level	200					
Course Summary	This course introduces students to the application of Artificial Intelligence (AI) and Machine Learning (ML) in the field of Plant Science. It covers fundamental AI concepts and explores their roles in plant taxonomy, disease prediction, crop yield forecasting, and stress response modeling. Students will learn about image-based plant identification, smart farming tools, and AI-assisted research in botany. The course emphasizes the ethical, environmental, and data-related aspects of using AI in agriculture and biodiversity conservation.					
Semester	4	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any	Basic understanding of plant biology, data interpretation and computer literacy.					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Identify the core concepts of AI and their relevance to plant biology and agri-tech.	K	PO6
2	Discuss the tools, models, and methods of AI applied in plant identification and disease prediction.	U	PO2
3	Evaluate AI-driven applications in forecasting, crop management, and research.	E	PO2
4	Employ AI methods to solve practical problems in agriculture, plant research, and conservation.	A	PO2, PO3

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	-	-	-	-	-	3	-	-	-	-
CO 2	-	3	-	-	-	-	-	-	-	-
CO 3	-	3	-	-	-	-	-	-	-	-
CO 4	-	3	2	-	-	-	-	-	-	-

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to AI and its Components (15 hours)			
	1.1	Basics of AI: Definition, scope, brief history, types of learning models (supervised, unsupervised, reinforcement learning).	5	["1"]
	1.2	Key components: data, algorithms, training models, cloud computing basics. Tools used in AI: Python, TensorFlow, PlantNet, OpenCV – Introduction and demo.	5	["1"]
	1.3	Relevance to botany: taxonomy, crop classification, stress identification.	5	["1"]
2	AI in Plant Health, Disease Detection, and Classification (15 hours)			
	2.1	AI in plant identification – image analysis and pattern recognition using CNNs. Activity: Hands-on demo of plant ID app.	5	["2"]
	2.2	Disease detection and classification: Case studies (banana leaf spot, rice blast, tomato blight). Activity: Create a simple plant disease identification model using available datasets.	5	["3"]
	2.3	Real-world applications: Mobile apps for farmers, sensor-based detection. Ethical and practical limitations of disease prediction tools.	5	["4"]
3	AI for Crop Yield Prediction and Environmental Interaction (15 hours)			
	3.1	Crop forecasting using AI models: integration of weather, soil, and plant data.	5	["2"]
	3.2	Predictive agriculture: nutrient analysis, irrigation planning, AI + IoT. Activity: Report on existing AI agri-platforms (e.g., Plantix, FarmLogs).	5	["3"]
	3.3	AI and climate resilience: stress tolerance modelling and decision support systems.	5	["3"]
4	Standards, Ethics and Real-world Implementation (15 hours)			
	4.1	Quality standards in AI application in agriculture – ICAR, FAO, IEEE initiatives	5	["2"]
	4.2	Visit/report: An agri-tech startup/research institute using AI for sustainable farming.	5	["3"]
	4.3	AI ethics and data governance: transparency, bias, environmental sustainability.	5	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning,

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Hands on Work **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written Exam Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ∘ PART - A ∘ Short answer - (10 out of 12) – 10 × 2 = 20 ∘ PART - B ∘ Short Essays - (8 out of 10) – 8 × 5 = 40 ∘ PART - C ∘ Essays - (1 out of 2) – 1 × 10 = 10

References

- 1. Artificial Intelligence and IoT-based Technologies for Sustainable Farming and Smart Agriculture. (2021). United States: IGI Global.
- 2. Matt Ginsberg, Essentials of Artificial Intelligence, Morgan Kaufmann (1993), ISBN 9781558602212, https://doi.org/10.1016/B978-1-55860-221-2.50003-0.
- 3. Mohsen Asadnia, Amir Razmjou, Amin Beheshti (2022), In Cognitive Data Science in Sustainable Computing, Artificial Intelligence and Data Science in Environmental Sensing, Academic Press, ISBN 9780323905084, https://doi.org/10.1016/B978-0-323-90508-4.01001-7.
- 4. Wäldchen, J., Mäder, P. (2018) Plant Species Identification Using Computer Vision Techniques: A Systematic Literature Review. Arch Computat Methods Eng 25, 507– 543 https://doi.org/10.1007/s11831-016-9206-z
- 5. Zhou, J., Chen, F. (2023). Artificial Intelligence in Agriculture. In: Zhang, Q. (eds) Encyclopedia of Digital Agricultural Technologies. Springer, Cham. https://doi.org/10.1007/978-3-031-24861-0_183

Suggested Readings

- 1. A Biologist's Guide to Artificial Intelligence: Building the Foundations of Artificial Intelligence and Machine Learning for Achieving Advancements in Life Sciences. (2024). Netherlands: Elsevier Science.
- 2. S. Panigrahi, K. C. Ting, Artificial Intelligence for Biology and Agriculture (2012), Springer Dordrecht, https://doi.org/10.1007/978-94-011-5048-4.

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SIGNATURE COURSE						
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Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	GINU JOSEPH					
Contributors	Dr. Robi A.J., Dr. Ginu Joseph, Ms. Namita Mary Mathew					
Course Name	Forensic botany					
Type of Course	DSE					
Specialization title	Applied Plant Science					
Course Code	MG5DSEBOTA08					
Course Level	300					
Course Summary	Forensic Botany is the application of plant sciences to criminal investigations. This interdisciplinary course integrates botanical knowledge with forensic science to analyze and interpret plant-based evidence in legal contexts. Students learn how plant materials—such as pollen, seeds, leaves, wood, and plant DNA—can help reconstruct crime scenes, estimate time of death, and link suspects to crime locations.					
Semester	5	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any	Basic knowledge about different plant groups, Genetics and Cell biology					

Course Outcomes (CO)

Number of COs		**5**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Summarize the origin, scope and branches of forensic botany	U	PO1, PO2, PO3, PO8
2	Analyze different types of plant evidence.	AN	PO1, PO2, PO3, PO9
3	Create an interdisciplinary approach, integrating botany with other forensic disciplines for comprehensive crime scene analysis.	C	PO1, PO3, PO6
4	Evaluate the reliability, accuracy, and limitations of analytical results, recognizing the potential for error and the importance of quality control.	E	PO1, PO4, PO10
5	Apply the knowledge of Plant Science to real-world forensic scenarios and make valuable contributions to the field of forensic botany.	A	PO1, PO2, PO6, PO9, PO10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	3	3	-	-	-	-	3	-	-
CO 2	3	3	3	-	-	-	-	-	3	-
CO 3	3	-	3	-	-	3	-	-	-	-
CO 4	3	-	-	3	-	-	-	-	-	3
CO 5	3	3	-	-	-	3	-	-	3	3

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to forensic botany (15 hour)			
	1.1	Forensic Science: - Definition, introduction, basic principles & significance. Organizational structure of forensic science laboratory	5	["1"]
	1.2	Forensic Botany: Definition, introduction, basic principles, Nature & Scope. Forensic ethics- the importance of professional ethics in scientific field, professional standards and guidelines for forensic botanists	5	["1"]
	1.3	Forensic Botany: Historical perspective and the evolution of forensic botany, importance and applications in forensic science, branches of forensic botany	5	["1"]
2	Botanical Evidence in Criminal Investigation (15 hour)			
	2.1	Botanical evidence-The use of biological and botanical evidence in criminal investigations and its importance. Classic Forensic Botany Cases: Famous case histories by using different botanical evidence. Activity: Collect articles related to famous forensic case studies. Forensic dendrochronology - Introduction to tree-ring analysis in forensic investigations, collecting and interpreting tree-ring data, application of dendrochronology in aging and dating criminal evidence.	5	["2", "3"]
	2.2	Forensic palynology—Fingerprints of localities, sample preparation for pollen spore and analysis. Techniques for collecting, processing, and analysing pollen and spores. Case studies and real-world applications of forensic palynology. Activity: Collect and submit photographs of different types of pollen grains. Plant fluids- Identification and collection of sap, gum, latex, and volatile oils. Types and identification of microbial organisms of forensic significance, role of fungal spores and algae.	5	["2", "3"]
	2.3	Forensic limnology-Diatom types & morphology, methods of isolation of diatoms from different tissue, methods of identification and comparison, forensic significance in drowning cases. Plant ecology in forensic botany- Geographical distribution of plant species and its forensic relevance	5	["2", "3"]

Module	Units	Course Description	Hrs	CO No.
3	Analyses of Samples (15 hour)			
	3.1	Plant poison: Introduction, classification and their main active constituents. Common types of poisonous plants and their toxins-Abrus precatorius, Cannabis sativa, Claviceps purpuria, Croton tiglium, Atropa belladonna, Gloriosa superba, Jatropha curcas, Nerium oleander, Nicotiana tabacum, Semecarpus anacardium, Strychnos nux-vomica, Thevetia nerifolia. Types of plants yielding drugs of abuse–Opium, Cannabis, Cocoa, Tobacco, Datura, Psilocybe mushrooms. Activity: Collect and submit any five poisonous plants mentioned in the syllabus.	5	["4"]
	3.2	Methods of extraction of plant material from biological sample, Identification by colour test and TLC and UV- Visible spectrophotometer and other instrumental techniques. DNA: Structure of DNA, Polymorphism in DNA, general idea about RFLP and PCR Methods of biological fluid analysis. Merits and demerits of RFLP and PCR, advanced Methods for Forensic DNA Examination, gene mapping and genetic risk assessment etc. Activity: Visit a forensic lab in Kerala to understand various activities and prepare report with geotagged photographs and submit.	5	["4"]
	3.3	Wildlife Forensics - Fundamentals of wildlife forensic, significance. Protected and endangered species of plants. Illegal trading of flowers and plants.	5	["4"]
4	Collection and preservation of botanical evidences (15 hour)			
	4.1	Botanical samples-Collection methods, documentation, preservation and transportation	5	["5"]
	4.2	Forensic photography - Types and importance	5	["5"]
	4.3	Contributions and current trends of forensic botany in crime scene investigation. Role of a forensic botanist in criminal investigations	5	["5"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
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References

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Suggested Readings

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- Boorman, K.E. (1988). Blood Group Serology, Churchill, and Lincolin, P. J.
- Richard Li (2015). Forensic Biology, 2nd edition, CRC Press.
- David, H. & Jason, B. (2012). Forensic Botany: A Practical Guide, John Wiley & Sons Ltd.
- Coyle, H.M. (2025). Forensic Botany Principles and Applications to Criminal Casework, 2nd Edition, CRC Press, Taylor & Francis, New York Washington, D.C.
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Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	GINU JOSEPH					
Contributors	Namita Mary Mathew, Dr. Ginu Joseph, Dr. Robi A.J.					
Course Name	Phytoremediation					
Type of Course	DSE					
Specialization title	Applied Plant Science					
Course Code	MG6DSEBOTA08					
Course Level	300					
Course Summary	This course introduces students to the scientific principles and practical applications of phytoremediation, an eco-friendly and cost-effective approach to mitigating environmental pollution using plants. Students will explore the different types of phytoremediation mechanisms—such as phytoextraction, phytostabilization, phytovolatilization, and rhizodegradation—and the physiological, biochemical, and molecular processes involved. The course highlights the role of hyperaccumulator plants, root-microbe interactions, and environmental factors that influence remediation efficiency.						
Semester	6	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any	Basic understanding of plant anatomy, physiology, and environmental biology.					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Distinguish the types and mechanisms of phytoremediation used to remove contaminants from soil and water	E	PO1, PO2, PO3, PO9
2	Explain the physiological and molecular responses of plants involved in uptake, translocation, and detoxification of pollutants	AN	PO1, PO2, PO3, PO9
3	Estimate the effectiveness of hyperaccumulator plants and their role in ecological restoration and pollution control	E	PO1, PO2, PO3, PO7, PO9
4	Illustrate the interaction of plant-microbe partnerships in enhancing phytoremediation efficiency.	AN	PO1, PO2, PO3, PO7, PO9

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CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
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CO 2	3	3	3	-	-	-	-	-	3	-
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'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Mechanisms of Phytoremediation (15 hours)			
	1.1	Types of phytoremediation – Overview: Definition and scope. Mechanisms: Phytoextraction, Phytostabilization, Phytovolatilization, Phytodegradation. Case studies of applications in real-world settings	5	["1"]
	1.2	Transport and transformation of pollutants in plant systems. Uptake pathways (apoplastic and symplastic). Translocation and sequestration mechanisms. Xylem and phloem transport of metals and organics	5	["1"]
	1.3	Biochemical and physiological mechanisms of uptake and detoxification. Role of antioxidative enzymes (SOD, CAT, POD). Glutathione, phytochelatins, and metallothioneins. Stress-induced signaling pathways (ROS, NO)	5	["1"]
2	Plant Traits and Remediation Efficiency (15 hours)			
	2.1	Role of endophytes and rhizobacteria in phytoremediation enhancement. PGPRs and endophytic fungal symbionts. Genetic modification strategies for enhancement. Role of root exudates and rhizospheric interactions. Organic acids, flavonoids, and chelators. Microbial recruitment and metal solubilization	5	["2"]
	2.2	Hyperaccumulator plants: characteristics and ecological distribution. Criteria for hyperaccumulation. Phytoremediation potential of aquatic plants. Eichhornia, Lemna, Ipomoea aquatica, and Alternanthera.Case studies. Distribution in Indian and global contexts. Heavy metal transporters and chelating agents in plants. ZIP, NRAMP, ABC transporters. Chelation by citrate, histidine, and synthetic agents.	5	["2"]
	2.3	Ecological restoration using phytoremediation. Reclamation of degraded lands. Biodiversity support and succession. Socio-economic and policy perspectives in phytoremediation practices. Cost-effectiveness vs conventional remediation. Community participation and green jobs. National policy initiatives (e.g., Ganga Rejuvenation, Waste Land Reclamation)	5	["2"]
3	Plant–Microbe Interactions and Soil Remediation (15 hours)			
	3.1	Mycorrhizae-assisted phytoremediation. Arbuscular mycorrhizal fungi (AMF) and metal tolerance. Role in nutrient mobilization and root protection. Role of consortia and engineered microbes. Synthetic biology approaches. CRISPR and rhizobacterial engineering	5	["3"]
	3.2	Bacterial-assisted bioremediation: PGPRs and bioaugmentation. Selection of PGPR strains. Biofilm formation, ACC deaminase activity. Use of consortia for enhancing rhizosphere health	5	["4"]
	3.3	Long-term monitoring and ecological safety of phytoremediation sites. Risk assessment protocols. Soil health and contaminant rebound monitoring	5	["4"]

Module	Units	Course Description	Hrs	CO No.
4	Practical (30 hours)			
	4.1	Germination bioassay to test the effect of wastewater or leachate on seed germination. Assessing phytotoxicity of wastewater on seed germination. Data analysis using germination index .	10	["3"]
	4.2	Preparation and maintenance of a basic hydroponic system for observing pollutant uptake. Constructing a basic hydroponic unit. Monitoring pollutant uptake in real time.	5	["3"]
	4.3	Estimation of proline or chlorophyll content under stress using UV-Visible spectrophotometry. Sample preparation, pigment extraction, and spectrophotometric analysis. Interpretation of plant stress indices.	5	["3"]
	4.4	Survey and documentation of local plants growing on polluted or degraded lands. Identifying local plants growing on polluted lands. Preparing a photographic and ecological report.	10	["3"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning,

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Both **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 25 Marks** Involvement and responses in class room transactions ·Home Assignments/preparedness ·Oral presentation/Viva/Quiz/Open book test/written test Field study report /Group discussion on a recent research or review article (≤ 5 years) related the course ·Any **• Practical – 15 Marks** Lab involvement and practical skills ·Record/Any other method as may be required for specific course / student by the course faculty **B. End Semester Evaluation (ESE)** **• Theory – 50 Marks** Assessment Methods – Written exam Duration of Examination – 1.50 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ∘ PART - A ∘ Short answer - (10 out of 12) – 10 × 1 = 10 ∘ PART - B ∘ Short Essays - (6 out of 8) – 6 × 5 = 30 ∘ PART - C ∘ Essays - (1 out of 2) – 1 × 10 = 10 **• Practical – 35 Marks** Assessment Methods – Practical based assessments: 30 marks Record: 5 marks Duration of Examination – 2.00 Hrs

References

- Abbasi, S.A., Nipaney, P.C. (1993). World’s worst weed – control and utilization. International book Distributors, Dehradun, p.226 Pilon-Smits, E. (2005). Phytoremediation. Annual Review of Plant Biology.
- Abbasi, S.A., and Ramasamy, E. (1999). Biotechnological methods of pollution control, universities press (India) Ltd.3-5-819, Hyderguda, Hyderabad.

- Baker, A. J. M., & Brooks, R. R. (1989). Terrestrial Higher Plants which Hyperaccumulate Metallic Elements.
- Prasad, M. N. V. (2004). Heavy Metal Stress in Plants: From Biomolecules to Ecosystems. Springer.
- Raskin, I., & Ensley, B. D. (2000). Phytoremediation of Toxic Metals: Using Plants to Clean Up the Environment. Wiley-Interscience.
- Singh, A., & Ward, O. P. (2004). Biodegradation and Bioremediation. Springer.

Suggested Readings

- Salt, D. E., & Blaylock, M. (1995). Phytoremediation: A Novel Strategy for the Removal of Toxic Metals from the Environment Using Plants.
- Cunningham, S. D., & Ow, D. W. (1996). Promises and Prospects of Phytoremediation.

Affidavit

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- We, Bishop Abraham Memorial College, Thuruthicaud, agree to appoint a new course coordinator for the proposed Applied Plant Science in the event of the unavailability of the currently nominated coordinator. This appointment will ensure the continued coordination of course delivery, assessments, and all related academic responsibilities necessary for the successful implementation of the specialization, for as long as the college offers this programme.
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