MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	B.C.M. College, Kottayam					
Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Antu Mariya Jose					
Contributors	Dr. Peter K Mani					
Course Name	Agriculture and Floriculture Allied Startups					
Type of Course	DSE					
Specialization title	Plant Based Startups					
Course Code	MG3DSEBOTA04					
Course Level	200					
Course Summary	This course introduces students to the entrepreneurial potential in agriculture and floriculture with a plant science perspective. It emphasizes the fundamentals of plant propagation, cultivation techniques, structures for optimized growth, and the commercial viability of important plant species. The course blends botanical knowledge with startup frameworks to prepare students for plant-based enterprise development					
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		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand the types and biological significance of plant propagules and propagation techniques in agriculture and floriculture	U	PO1, PO2, PO3, PO4, PO6, PO7, PO8, PO10
2	Apply knowledge of pots, potting mixtures, and growing structures to plan optimal plant cultivation setups	A	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10
3	Identify and analyze the commercial potential of selected ornamental and edible plants	AN	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10
4	Evaluate modern agricultural practices and marketing strategies suitable for small-scale plant-based startups.	E	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, 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	2	3	2	1	-	2	3	1	-	2
CO 2	2	3	2	1	1	2	3	1	1	3
CO 3	3	2	2	2	2	2	2	1	2	3
CO 4	3	2	2	2	3	3	3	2	2	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	Propagules and Propagation Techniques of Plants			
	1.1	Propagules and Their Types: • Definition and importance of propagules in agriculture and floriculture • Types of propagules: Seeds, bulbs, tubers, rhizomes, corms, suckers, offsets, runners, stem cuttings, leaf cuttings, root cuttings	5	["1"]
	1.2	Propagation Techniques: • Sexual vs asexual propagation • Techniques: seed sowing, stem cutting, grafting, layering, budding, tissue culture	5	["1"]
	1.3	Factors affecting propagation • Factors affecting propagation success: temperature, humidity, medium, and hormonal treatment • Dormancy and viability	5	["1"]
2	Pots, Potting Mixtures, and Growing Structures			
	2.1	Containers Types of pots: clay, plastic, fabric grow bags, biodegradable pots Features and selection of pots for different plant types	5	["2"]
	2.2	Growing Media Potting mixtures: soil, sand, compost, cocopeat, perlite, vermiculite, biochar Formulation of potting media for different crops (vegetables, orchids, Anthuriums and indoor plants)	5	["2"]
	2.3	Growing Structures • Open field vs protected cultivation • Greenhouses, polyhouses, shade nets, hydroponic systems (advantages) • Temperature, light, and humidity control in growing structures Cost-benefit analysis for small-scale setups	5	["2"]

Module	Units	Course Description	Hrs	CO No.
3	Commercially Important Plants			
	3.1	Commercially Valuable Plants • Classification of ornamental Plants based on their uses: Foliage Plants (Podocarpus, Asparagus, Cypress, Thuja), Indoor plants (Snake Plant, ZZ Plant, Money Plant, Luckey Bamboo), Flowering Plants (Orchids, Anthurium, Chrysanthemum, Rose) • Cultivation of orchids and Anthurium	5	["3"]
	3.2	Commercially Valuable Edible Plants Cultivation, harvesting and post-harvesting processes of • Vegetables- Amaranth, Chilly, Cephalandra (Coccinia) • Fruits- Banana, Jackfruit, Mango • Plantation crops- Coconut, Nutmeg, Pepper	5	["3"]
	3.3	Packaging and transport of plants • Packaging and transport of cut flowers, potted plants, seedlings and seeds. • Precautions and limitations in transporting live plants	5	["3"]
4	Modern Agricultural Practices			
	4.1	Modern Farming • Precision farming, organic farming, vertical farming • Crop Rotation and Intercropping • Genetically Modified Crops (GMOs)	5	["4"]
	4.2	Irrigation • Definition, Factors affecting irrigation, Frequency of irrigation • Types of irrigation: Surface irrigation, Sub irrigation, Special irrigation methods -Advantages and disadvantages • Fertigation	5	["4"]
	4.3	Pest Management and Marketing • Biological Control Agents • Integrated pest management (IPM) • Marketing strategies for plant-based startups	5	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lectures, Group discussion, Field trip and report, Brainstorming sessions, specimen observation, student-led presentations, Hands-on demo of potting mixture formulation, visual aids

Assessment Types

MODE OF ASSESSMENT
Mode of Assessment: Theory

A. Continuous Comprehensive Assessment (CCA)
• Theory – 30 Marks
• Test/Quiz • Assignment • Group Discussions, • Project/Field Visit Report • Class Participation

B. End Semester Evaluation (ESE)
• Theory – 70 Marks
Assessment Methods – 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
◦ 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. Bose, T. K., Maiti, R. G., Dhua, R. S., & Das, P. (1999). Floriculture and landscaping (2nd ed.). Naya Udyog. 2. Chadha, K. L. (Ed.). (2001). Handbook of horticulture (2nd ed.). Indian Council of Agricultural Research (ICAR). 3. Sadhu, M. K. (1989). Plant propagation. New Age International Publishers. 4. Kumar, N. (2015). Introduction to horticulture (7th ed.). Oxford & IBH Publishing. 5. Sharma, A. K. (2001). A handbook of organic farming. Agrobios (India). 6. Bhattacharjee, S. K. (2006). Advanced commercial floriculture (Vol. 1 & 2). Avishkar Publishers. 7. Peter, K. V. (Ed.). (2008). Basics of horticulture (2nd ed.). New India Publishing Agency. 8. Rai, M. M. (2012). Principles of soil science (6th ed.). Prentice Hall of India..

Suggested Readings

- 9. ICAR – Indian Horticulture Magazine https://icar.org.in/publications/horticulture 10. Krishi Vigyan Kendra – Kerala https://kvkkerala.org/ 11. National Horticulture Board (NHB) http://nhb.gov.in 12. Kerala Agricultural University (KAU) https://kau.in 13. AgriStartups – Startup India https://www.startupindia.gov.in 14. YouTube Channels (for visual learners): Farming India, AgriTech Kerala, Garden Tips Malayalam

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Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Antu Mariya Jose					
Contributors	Dr. Peter K Mani					
Course Name	Value-Added Plant Products					
Type of Course	DSE					
Specialization title	Plant Based Startups					
Course Code	MG4DSEBOTA04					
Course Level	200					
Course Summary	This course explores how plant-based raw materials can be sustainably transformed into high-value products. Emphasis is placed on scientific principles, traditional knowledge, and modern technological interventions in the domains of food, cosmetics, health, crafts, and rural entrepreneurship. The course also addresses processing methods, regulatory norms, and entrepreneurial potential in the plant value-addition sector.					
Semester	4	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Explain the fundamentals of plant-based value addition and describe traditional and biological sources relevant to the field.	U	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10
2	Apply scientific and traditional processing and preservation techniques for plant-based value-added products.	A	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10
3	Analyze the components, formulation, and cultural relevance of personal care, lifestyle, and eco-friendly plant-based products.	AN	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10
4	Evaluate entrepreneurial opportunities and policy frameworks for the commercialization of value-added plant products.	E	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, 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
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CO 2	2	3	2	2	2	3	3	2	2	3
CO 3	3	2	3	2	2	3	3	2	2	3
CO 4	3	3	3	3	3	3	3	3	3	3

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Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Fundamentals of Plant-Based Value Addition			
	1.1	Introduction and Scope • Concept and definition of value addition • Importance in sustainable development and rural economy • Sector-wise applications: food, healthcare, crafts, cosmetics, and bio-materials	4	["1"]
	1.2	Biological Basis and Resources • Plant parts used in value addition: roots, rhizomes, leaves, fruits, seeds, bark, flowers • Traditional Knowledge in value addition • Integration of Indigenous Knowledge Systems (IKS) with scientific approaches	4	["1"]
	1.3	Principles and Practices of Value Addition • Value addition: Principles and steps (Selection of Raw Material, Harvesting, Pre-processing, Processing, Formulation (optional), Quality Assessment, Packaging and Labelling, Storage and Distribution) Brief study only. • Pre-processing Techniques: Cleaning, grading, sorting, peeling, blanching, slicing – importance in ensuring quality and safety. • Bioprospecting: Principles, Ethical bioprospecting and value chain models	7	["1"]
2	Processing and Preservation Techniques			
	2.1	Traditional and Scientific Processing Asepsis, Drying, pulverizing, infusion, fermentation, filtration, blending, formulation, smoking, vulcanization of rubber.	5	["2"]
	2.2	Preservation • Spoilage control: humidity, microbes, oxidation • Natural methods: Salt, vinegar, sugar, drying, smoking • Modern techniques: Vacuum sealing, refrigeration, dehydration, lyophilization, chemical additives.	5	["2"]
	2.3	Detailed study • Processing and preservation of Tea • Processing and preservation of Chocolate	5	["2"]

Module	Units	Course Description	Hrs	CO No.
3	Value Addition in Personal Care and Lifestyle Products			
	3.1	Cosmetic and Personal Care Products • Plant-based ingredients in cosmetics: Different types (creams, face packs, soaps, oils, shampoos), examples, benefits and limitations. • Extraction and formulation of essential oils and hydrosols, Aromatherapy	5	["3"]
	3.2	Natural Dyeing and Fragrances • Plant sources of dyes: Process of natural dye extraction and application in textile, cosmetics and food (Indigo, Bixa, Turmeric, Henna) • Perfumery plants: Rose, Lavender, Vetiver, Cananga	5	["3"]
	3.3	Eco-Friendly Utility and Craft Items • Value-added craft items: Fiber-based products, coconut shell utensils, bamboo décor • Cultural significance of eco-crafts in India	5	["3"]
4	Commercialization and Policy Perspectives			
	4.1	Entrepreneurship and Market Dynamics • Value chain development in plant-based industries • Business planning: target products, customers, packaging • Pricing, branding, and distribution channels	5	["4"]
	4.2	Standards and Certification • FSSAI, AYUSH, AGMARK, BIS certifications • Organic certification and quality assurance • Labelling laws and shelf-life regulations	5	["4"]
	4.3	Policies, Challenges, and Case Studies • Government initiatives: MSME, Start-Up India, PM-FME, KVIC, AYUSH Mission • Challenges in the commercialization of value-added products. • Case studies: successful plant-based enterprises	5	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, group discussions, brainstorming, hands-on activities, demonstrations, use of samples and visuals, student presentations, videos, flowcharts, field visits, guest lectures, case studies, role plays, use of ICT tools, project-based learning, label design, product development, marketing pitch

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** • Test/Quiz/MCQs • Assignment • Group Discussions, • Project/Field Visit Report • Class Participation **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – 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 ◦ 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. Bhat, R., & Sridhar, K. R. (2018). Value Addition to Spices and Medicinal Plants. CRC Press. 2. Ghosh, S. P. (2001). Horticulture and Value Addition. ICAR Publications. 3. Joshi, V. K., & Sharma, S. (2019). Food Preservation and Safety. Academic Press. 4. Kumar, N. et al. (2015). Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants. Oxford & IBH. 5. Nair, V. R., & George, K. C. (2015). Handicrafts and Traditional Uses of Plants. Orient Blackswan. 6. Pareek, S. (Ed.) (2017). Advances in Processing Technology. New India Publishing. 7. Rai, M., Pandey, S. & Kumar, S. (2015). Value Addition in Horticultural Crops. New India Publishing Agency. 8. Saha, S. (2020). Nutraceuticals and Functional Foods: Processing and Technology. Wiley-Blackwell. 9. Singh, R. S., & Chauhan, O. P. (2017). Postharvest Management of Horticultural Crops. Springer. 10. Varmudy, V. L. (2014). Value Addition to Agricultural Products. Indian Publisher Distributors 11. Food Safety and Standards Authority of India (FSSAI). (2024). Nutraceuticals Guidelines. https://fssai.gov.in 12. Ministry of AYUSH. (2023). Standards and Protocols for Herbal Products. https://ayush.gov.in 13. Kerala State Horticulture Mission. (2022). Opportunities in Value-Added Plant Products. https://horticulture.kerala.gov.in 14. HerbalGram. (2023). Trends in Herbal Cosmetics Market. American Botanical Council. https://herbalgram.org

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Undergraduate Programmes (HONOURS)
2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	B.C.M. College, Kottayam					
Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Antu Mariya Jose					
Contributors	Dr. Peter K Mani					
Course Name	Plant-Based Nutraceuticals					
Type of Course	DSE					
Specialization title	Plant Based Startups					
Course Code	MG5DSEBOTA04					
Course Level	300					
Course Summary	This course explores the science and significance of plant-based nutraceuticals, focusing on their bioactive components, traditional knowledge systems, and health benefits. Students will learn about major classes of phytochemicals, their role in disease prevention, and the scientific basis for their use. The course also covers modern extraction methods, quality testing, and regulatory aspects, preparing students for practical applications and innovation in the nutraceutical industry.					
Semester	5	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any						

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Describe the concept, classification, and bioactive components of plant-based nutraceuticals.	U	PO1, PO2, PO3, PO4, PO6, PO7, PO8, PO9, PO10
2	Analyze the relevance of traditional knowledge and ethnobotanical approaches in nutraceutical discovery.	AN	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10
3	Explain the role of Indian knowledge systems and ethnobotany in the identification and use of traditional nutraceuticals.	AN	PO1, PO2, PO3, PO4, PO6, PO7, PO8, PO9, PO10
4	Examine modern plant extraction methods, testing tools, and legal frameworks in the nutraceutical industry.	AN	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10

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CO 1	3	3	2	1	-	2	2	1	1	2
CO 2	3	3	3	2	1	3	3	3	2	3
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CO 4	3	3	3	2	1	2	2	3	2	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 Plant-Based Nutraceuticals and Functional Foods			
	1.1	Fundamentals and Scope • Definitions and evolution of nutraceuticals and functional foods • Importance in preventive healthcare, immunity enhancement, and wellness • Distinction between nutraceuticals, pharmaceuticals, dietary supplements, and herbal drugs	5	["1"]
	1.2	Classification and Key Bioactive Components • Types of nutraceuticals: Natural, fortified, functional, synthetic • Classification based on source, function, and chemical constituents • Major plant-derived bioactive compounds: polyphenols, flavonoids, alkaloids, terpenoids, saponins, fibers	5	["1"]
	1.3	Emerging Functional Ingredients and Product Types • Microgreens and sprouts: Nutrient-rich fast-growing sources of vitamins and phytochemicals • Fruit and leaf powders: e.g., Moringa oleifera, Emblica officinalis for nutrition and detox • Mushrooms as functional foods: Ganoderma lucidum, Cordyceps sinensis, Grifola frondosa (antioxidant, adaptogen) • Formulation and shelf-stability of functional food products: powders, capsules, juices, herbal teas	5	["1"]
2	Traditional Knowledge Systems and Ethnobotany in Nutraceutical Discovery			
	2.1	Traditional Medicine Systems and Plant-Based Nutrition • Overview of Ayurveda, Siddha, and tribal healing systems • Use of plants in traditional food and healthcare practices • Importance of these systems in identifying nutritionally and medicinally useful plants	5	["2"]
	2.2	Ethnobotany and Bioprospecting • Meaning and importance of ethnobotany in nutraceutical discovery • How traditional knowledge is collected: fieldwork, interviews, herbarium records • Bioprospecting: exploring traditional plants for commercial and scientific use • Ethical concerns: protecting indigenous rights	5	["2"]
	2.3	Case Studies of Traditional Nutraceutical Plants • Moringa oleifera (Drumstick): Rich in nutrients, used in traditional diets • Ocimum sanctum (Tulsi): Used for immunity and stress relief • Emblica officinalis (Amla): High in vitamin C, supports digestion and skin health • Curcuma longa (Turmeric): Anti-inflammatory, widely used in traditional remedies	5	["2"]

Module	Units	Course Description	Hrs	CO No.
3	Health Benefits and Therapeutic Potential of Plant-Based Nutraceuticals			
	3.1	Health Benefits of Nutraceuticals • General benefits: supports immunity, reduces risk of illness, improves overall wellness • Common uses: energy boosting, digestion, skin and hair health • Advantages and Disadvantages of using plant-based nutraceuticals	5	["3"]
	3.2	Nutraceuticals in Common Health Conditions • For heart health: garlic, arjuna • For diabetes: bitter gourd, fenugreek • For brain and memory: ashwagandha, brahmi • For weight management and digestion: Fiber-rich foods, herbal teas	5	["3"]
	3.3	Scientific Support and Safety • Basic idea of how studies support the use of nutraceuticals • Importance of using safe amounts • Awareness of possible side effects and quality of products	5	["3"]
4	Extraction, Testing, and Regulation of Plant-Based Nutraceuticals			
	4.1	Extraction Techniques for Nutraceuticals • Selection of plant parts (leaves, roots, seeds, fruits) for extraction • Common extraction methods: o Solvent extraction o Soxhlet extraction o Supercritical fluid extraction (SFE) o Ultrasound and microwave-assisted extraction	5	["4"]
	4.2	Testing of Plant-Based Nutraceuticals • Purpose: To ensure product quality, safety, and consistency • Main analytical techniques: HPLC, GC-MS, UV-Vis Spectrophotometry and Fluorescent analysis (Principle and significance) • Importance of testing: Ensures standardization, correct dosage, and consumer safety	5	["4"]
	4.3	Regulatory Frameworks and Intellectual Property Rights (IPR) • Key regulatory bodies: FSSAI (India), AYUSH, WHO, • Rules for labeling, safety approval, and selling nutraceutical products • Introduction to Intellectual Property Rights (IPR): o Patents for new plant-based formulations o Traditional Knowledge Digital Library (TKDL) for protecting indigenous plant knowledge	5	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, group discussions, Debates, brainstorming, hands-on activities, demonstrations, use of samples and visuals, student presentations, videos, flowcharts, field visits, guest lectures, case studies, role plays, use of ICT tools, project-based learning, label design, product development, marketing pitch

Assessment Types

MODE OF ASSESSMENT
Mode of Assessment: Theory

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• Theory – 70 Marks
Assessment Methods – Examination
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References

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Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Antu Mariya Jose					
Contributors	Dr. Peter K Mani					
Course Name	Plant-Based Startups for Environmental Sustainability					
Type of Course	DSE					
Specialization title	Plant Based Startups					
Course Code	MG6DSEBOTA04					
Course Level	300					
Course Summary	This course explores the role of plant-based startups in promoting environmental sustainability. It introduces students to sustainable innovations using plant resources such as eco-friendly materials, biocontrol agents, composting, and green products. Students will learn about green entrepreneurship, circular economy, and relevant policy frameworks. Through hands-on activities, they will design prototypes and develop startup models using plant-based solutions for real-world environmental challenges. The course encourages innovation, sustainability thinking, and entrepreneurial skills among Botany students.					
Semester	6	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand the role and scope of plant-based startups in addressing environmental challenges	U	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10
2	Analyze plant-based materials, products, and technologies contributing to sustainable development.	AN	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10
3	Evaluate sustainability frameworks and emerging trends for real-world plant-based entrepreneurship.	E	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10
4	Demonstrate practical skills in developing, prototyping, and presenting plant-based startup solutions.	C	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, 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	2	2	1	1	3	3	2	1	2
CO 2	3	3	2	1	1	2	3	2	1	2
CO 3	3	3	3	2	2	3	3	3	2	3
CO 4	2	3	2	3	3	2	3	2	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 Plant-Based Startups and Environmental Sustainability			
	1.1	Introduction to Plant-Based Startups • Definition, characteristics, and scope • Historical background and emerging trends • Relevance to global green transition and sustainable livelihoods	5	["1"]
	1.2	Environmental Challenges and Plant-Based Solutions • Deforestation, climate change, biodiversity loss, plastic pollution • Role of plants in carbon sequestration, bioremediation, ecological restoration • Case examples: bamboo for carbon offsetting, vetiver in erosion control	5	["1"]
	1.3	Classification and Case Studies of Startups • Agro-based: organic farming, seed savers, hydroponics • Bioproducts: herbal sanitizers, biodegradable utensils, eco-cleaners • Eco-packaging and lifestyle brands: banana fibre, areca leaf, palm sheath • Case studies: Bakey's, EcoSoul, Wild Ideas, Bamboo India	5	["1"]
2	Sustainable Products and Technologies from Plants			
	2.1	Innovative Plant-Based Materials • Natural fibres: banana, hemp, flax, pineapple, coconut coir • Bioplastics from starch, algae, cellulose – preparation, properties, applications • Plant-based inks, dyes, adhesives, and plant leather (mushroom, cactus) • Bioenzymes and herbal cleaning agents (e.g., citrus peels, neem, tulsi) • Packaging from areca, bamboo, palm leaves	5	["2"]
	2.2	Green Agricultural Inputs and Bioinnovations • Biofertilizers: Rhizobium, Azospirillum, Mycorrhizae • Biopesticides: neem extract, pyrethrins, • Endophyte mediated biocontrol • Nano-bio inputs: green-synthesized nanofungicides and delivery systems	5	["2"]
	2.3	Waste-to-Wealth Models and Circular Economy • Composting: aerobic, vermicomposting, bokashi, Khamba composting • Biochar production and applications • Business models using agri-waste: cutlery, paper, packaging, plant pots	5	["2"]

Module	Units	Course Description	Hrs	CO No.
3	Sustainability Frameworks and Startup Ecosystem			
	3.1	Green Business Models and Environmental and Social Ethics • Sustainable development: definitions and principles • Circular economy and zero-waste philosophy • SDGs focus: Goal 12 (Responsible Consumption), Goal 13 (Climate Action), Goal 15 (Life on Land)	5	["3"]
	3.2	Green Business Models and Ethics • Triple Bottom Line: People, Planet, Profit • Social and community-based entrepreneurship using plants • Ethical harvesting, biodiversity conservation, and benefit-sharing	5	["3"]
	3.3	Institutional and Policy Support • Startup India Mission, NABARD schemes, MSME initiatives • Certification systems: India Organic, PGS, Forest Stewardship Council, ECOCERT • Role of incubation centres and academic entrepreneurship cells (e.g., IEDC, Atal Innovation Mission)	5	["3"]
4	Practical			
	4.1	Any two practical can be provided to the students • Extraction of plant-based dyes from turmeric, beetroot, and hibiscus • Preparation of citrus peel bioenzyme and evaluation of its cleansing efficacy • Development of compost using dry leaves and kitchen plant waste • Business model development for an eco-startup using a local plant resource • Product prototyping – herbal soap, packaging material, eco-bricks, biofertilizer sachet	10	["4"]
	4.2	Field Engagement, • Field visits to: o Local composting units o Herbal product startups or coir units	10	["4"]
	4.3	Expert Interaction and Green Audit • Guest lectures from green entrepreneurs • Green audit of selected campus area (energy, biodiversity, plastic use)	10	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, group discussions, Debates, brainstorming, hands-on activities, demonstrations, use of samples and visuals, student presentations, videos, flowcharts, field visits, guest lectures, case studies, role plays, use of ICT tools, project-based learning, label design, product development, marketing pitch.

Assessment Types

MODE OF ASSESSMENT
Mode of Assessment: Both

A. Continuous Comprehensive Assessment (CCA)
• **Theory – 25 Marks**
• Test/Quiz/MCQs • Assignment • Group Discussions, • Project/Field Visit Report • Class Participation
• **Practical – 15 Marks**
• Lab involvement and practical skills • Record

B. End Semester Evaluation (ESE)
• **Theory – 50 Marks**
Assessment Methods – Examination
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

- 1. Armbrecht, A. (2021). The business of botanicals: Exploring the healing promise of plant medicines in a global industry. Chelsea Green Publishing. 2. Bhaskar, A. K., & Pandey, A. (Eds.). (2019). Bioproducts from plant wastes. Springer. https://doi.org/10.1007/978-981-13-7205-6 13. Bureau of Indian Standards – Ecomark Scheme Guidelines 3. Centre for Sustainable Agriculture. (n.d.). Innovations in sustainable farming. https://www.csa-india.org 9. Cohen, B., & Winn, M. I. (2007). “Market Imperfections and Sustainable Entrepreneurship.” Journal of Business Venturing. 14. Daily Dump – Composting solutions and guides 4. Edwards, C. A. (2004). Earthworm Ecology. CRC Press. 5. Elkington, J. (1998). Cannibals with Forks: The Triple Bottom Line of 21st Century Business. New Society Publishers. 6. Food and Agriculture Organization. (2020). The role of agriculture and forestry in the circular bioeconomy. FAO. https://www.fao.org/3/cb0401en/CB0401EN.pdf 7. Graedel, T. & Allenby, B. (2018). Industrial Ecology and Sustainable Engineering. Pearson. 15. Kerala State Biodiversity Board – Handbook on Green Campus Audit 8. Khanna, D. R., & Bhutiani, R. (2014). Herbal Technology: Concepts and Approaches. Discovery Publishing House. 10. Kirchherr, J., Reike, D., & Hekkert, M. (2017). “Conceptualizing the Circular Economy.” Journal of Cleaner Production. 11. Lal, R. (2020). “Soil Organic Carbon Sequestration and Climate Change Mitigation.” Springer Nature. 9. Ministry of Commerce and Industry, Government of India. (2016). Startup India Action Plan. https://www.startupindia.gov.in 10. Mohanty, A. K., Misra, M., & Drzal, L. T. (2005). Natural Fibers, Biopolymers, and Biocomposites. CRC Press. 16. NABARD – Startup Support for Agri-Based Enterprises www.nabard.org 11. National Innovation Foundation. (n.d.). Grassroots innovations database. https://nif.org.in 12. Plant Based Products Council. (n.d.). Resources and industry updates. https://pbpc.com 13. Sharma, P. D. (2022). Ecology and Environment. Rastogi Publications. 14. Shiva, V. (1997). Biopiracy: The Plunder of Nature and Knowledge. South End Press. 17. Startup India – Government startup resources 15. Sudesh, K. (Ed.). (2021). Bioplastics and biopolymers: From production to waste management. Wiley. https://doi.org/10.1002/9783527827724 18. The Better India – Stories of eco-entrepreneurs 16. Union for Ethical BioTrade (UEBT). (n.d.). Standard for ethical sourcing of ingredients. https://www.uebt.org 19. United Nations (2015). Transforming our world: The 2030 Agenda for Sustainable Development 17. United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. https://sdgs.un.org/2030agenda 12. Vimal, S. R., et al. (2017). “Bio-waste valorization: Composting and vermicomposting.” Biotechnology Reports. 18. Weidinger, C., Fischler, F., & Schmidpeter, R. (Eds.). (2013). Sustainable entrepreneurship: Business success through sustainability. Springer. https://doi.org/10.1007/978-3-642-38753-1

Affidavit

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- We, B.C.M. College, Kottayam, agree to appoint a new course coordinator for the proposed Plant Based Startups 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.
- We, B.C.M. College, Kottayam and Antu Mariya Jose, declare that no part of this signature course submitted here for approval has been taken from the course content developed by, or from any of the course titles prepared by, the BoS/expert committee in the same discipline under our University.