MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Marthoma College, Kuttapuzha P.O, Tiruvalla					
Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Elizabeth George					
Contributors	Jincy P. Abraham					
Course Name	Fundamentals of Plant Biotechnology & Industrial Botany					
Type of Course	DSE					
Specialization title	Plant Biotechnology and Industrial Botany					
Course Code	MG3DSEBOTA03					
Course Level	200					
Course Summary	This course provides an introduction to the basic principles and techniques of plant biotechnology. Students will explore topics such as plant tissue culture & genetic engineering. The course explores the fundamental concepts of how plants are used as raw materials in various agro-based industries such as food & pharmaceuticals and the applications of industrial botany in modern era.					
Semester	3	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any	Students should have a basic knowledge in plant science.					

Course Outcomes (CO)

Number of COs		**5**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Define, list, and describe the principles and techniques of plant genetic engineering and their applications in agriculture.	K	PO1, PO2
2	Demonstrate the methods and techniques involved in micropropagation	U	PO1, PO2
3	Analyze and differentiate synthetic seed technologies, somatic hybridization, cybrid production and somaclonal variation strategies.	AN	PO1, PO2, PO6
4	Evaluate different nursery and floriculture systems	E	PO1, PO2, PO3
5	Design an integrated agro-based production plan with attention to sustainability and regulatory/biosafety standards.	C	PO2, PO8, PO9

**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	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	2	-	-	-	-
CO 4	2	2	1	-	-	-	-	-	-	-
CO 5	-	3	-	-	-	-	-	1	2	-

'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 Plant Biotechnology (15Hrs.)			
	1.1	Overview of Plant biotechnology. Importance in agriculture and food production; Genetic engineering in Plants: Principles and Techniques.	5	["1"]
	1.2	Plant tissue culture: Basics of tissue culture techniques, applications in plant propagation, germplasm conservation and genetic resource management.	5	["1"]
	1.3	Challenges in plant biotechnology : Regulatory constraints and policy issues, biosafety concerns and ecological impacts; Future prospects and implications: Potential impact on agriculture and food security.	5	["1"]
2	Micropropagation Methods (15hrs.)			
	2.1	Micropropagation: Introduction, stages, influencing factors & techniques.	5	["2"]
	2.2	Synthetic seeds and their significance: Composition of synthetic seeds, Techniques- Alginate encapsulation, Polymeric encapsulation. Analyse any two latest research articles on recent trends in synthetic seed production and submit a report of their prospects	5	["3"]
	2.3	Somatic hybridization and cybrids: History of somatic hybridization & cybridization, applications & advantages of somatic hybrids and cybrids; Somaclonal variation and its implementation in crop improvement	5	["3"]
3	Industrial Botany in the Modern Era (15 hrs)			
	3.1	Introduction to agro-industries; floriculture industry and plant nursery; Floriculture industry: Important floricultural crops, open cultivation practices, harvesting and marketing.	5	["4"]
	3.2	Plant nurseries: Concept and types of nurseries:	5	["4"]
	3.3	ornamental plant nursery, fruit plant nursery and vegetable plant nursery	5	["4"]
4	Agro -based Industries (15 hrs)			
	4.1	Organic farming – Concept, need, types of organic fertilizers, advantages and limitations; Importance of seed industries: Seed processing and marketing	5	["5"]
	4.2	Microgreens: Introduction – History, sprouts and microgreens, Nutritional value; Learning activity: "Microgreens- Experimenting with Flavour Variations in Diverse Recipes"	5	["5"]
	4.3	Mushroom production and harvesting (Volvoriella volvacea); value added products from mushrooms	5	["5"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, 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** Home assignments Open book exams/ Viva Oral presentations Visit to a plant tissue culture laboratory **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – End semester 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 or two Sentences - (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

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- Slater, A et al. (2003). Plant Biotechnology : The Genetic Manipulation of Plants, Oxford University Press.
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- Bhojwani and Rajdhan (1996). Animal and Plant Biotechnology, Elsevier.
- V. Bhargav, Raja Babu K., Sumalatha A. (2020). Nihzesa Floriculture. 2nd Edition. New Vishal Publications.
- Ahlawat, O.P. & Arora, Bindvi. (2016). Paddy Straw Mushroom (Volvariella volvacea) Cultivation. Mushrooms Cultivation, Marketing and Consumption. First Edition. ICAR-DMR, Solan HP.
- K. Parimala, K. Subramanian. S. Mahalinga Kannan and K. Vijayalakshmi. (2013). A Manual on Seed Production and Certification. Centre for Indian Knowledge Systems, Chennai Revitalising Rainfed Agriculture Network.
- Priya Lokare. (2021). Spirulina Farming : To Ingrain the Entrepreneurship. Notion Press..
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Suggested Readings

- Heldt, Hans-Walter (1997). Plant Biochemistry & Molecular Biology, Oxford University Press.
- Lindsey. K and M.G.K. Jones. (1990). Plant Biotechnology in Agriculture, Prentice Hall, New Jersey.
- Anik K. Singh. Anjana Sisodha. (2020). Textbook Of Floriculture And Landscaping. New India Publishing Agency.
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- Stamets, P., Chilton, J.S. (1984). The Mushroom Cultivator: A Practical Guide to Growing Mushrooms at Home. . Olympia, Washington. Agarikon Press.
- Pushpa Srivastava. (2017). Nutraceutical Spirulina : Commercial Cultivation Using Rural Technology in India. Aavishkar Publishers.
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Affidavit

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2024 Admission Onwards

SYLLABUS						
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Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Elizabeth George					
Contributors	Jincy P. Abraham					
Course Name	Elementary principles and applications of Plant Biotechnology & Industrial Botany					
Type of Course	DSE					
Specialization title	Plant Biotechnology and Industrial Botany					
Course Code	MG4DSEBOTA03					
Course Level	200					
Course Summary	This course provides an in-depth exploration of modern strategies and tools in plant biotechnology. This course provides a comprehensive exploration of plant-based materials and their industrial applications and its impact on society.					
Semester	4	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any	Should have a basic knowledge in plant science					

Course Outcomes (CO)

Number of COs		**6**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	List and define key milestones in Plant Biotechnology	K	PO1, PO2
2	Explain the scientific principles underlying cryopreservation, rDNA techniques, and transgenics	U	PO1, PO2
3	Apply biotechnological approaches to improve crop yield and assess the ethical implications of biotechnological interventions in environmental and agricultural contexts.	A	PO3, PO6
4	Compare and analyze case studies to identify factors governing success and limitations.	AN	PO1, PO2, PO10
5	Design a conservation strategy followed by industrial disturbances.	C	PO1, PO2, PO6
6	Evaluate different plant-based products	E	PO1, PO2

**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	-	-	-	-	-	-	-	-
CO 3	-	-	3	-	-	1	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	2
CO 5	3	3	-	-	-	1	-	-	-	-
CO 6	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	Concepts of Plant Biotechnology (15hrs)			
	1.1	Brief history and important milestones in plant biotechnology; Various technologies and their uses, High-throughput technologies (the -omics)	5	["1"]
	1.2	Cryopreservation & its types: Principles, techniques, types & applications; Recombinant DNA technology	5	["2"]
	1.3	Transgenics and its importance in crop improvement: Development, types, advantages and disadvantages of transgenic plants	5	["2"]
2	Applications of biotechnology & genomics (15hrs)			
	2.1	Environmental biotechnology: Environmental monitoring ,waste management, pollution prevention	5	["3"]
	2.2	Biotechnological applications in agriculture, ethical issues(Brief account); Case study- Impact of micropropagation in agriculture and industry (Musa or Orchid)	5	["3", "4"]
	2.3	Marker Assisted Breeding: Biotechnology regulations: Types of Molecular Markers, Case Studies of Marker-Assisted Breeding In Crop Improvement	5	["4"]
3	Plant-Based Materials & Industrial Applications (15hrs)			
	3.1	Exploring plant-based sources for biofuels Concept of biofuel and its need, Plants used for biofuel production.	5	["6"]
	3.2	Introduction to polymers and biopolymers; sources and types of plant based polymers; synthesis and modifications; applications Bioplastics : definition, types, production methods and applications; Evaluate the biodegradability of any bioplastic / biopolymer	5	["6"]
	3.3	Methods for extracting and processing valuable compounds from plants -essential oils, natural dyes	5	["6"]

Module	Units	Course Description	Hrs	CO No.
4	Industrial botany in environment conservation 15hr			
	4.1	Plants for environmental monitoring and bioremediation, optimizing resource management.	5	["5"]
	4.2	Biodiversity Conservation : creating protected areas, restoring degraded habitats, developing strategies for plant recovery after industrial disturbances.	5	["5"]
	4.3	Importance of biodiversity parks, gene bank, orchidarium,fern house, ginger house (Brief Account Only)	5	["5"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, flipped classroom, Lecture based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, group discussions, 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** Home assignments, Open book exams/ Viva, Oral presentations, Visit to a plant based industry. **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – End semester 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 or two Sentences - (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

- Evans D. A, Sharp W. A, Amirato, P. V., Yamada, Y (1983). Hand Book of Plant Cell Culture. (ed.) Macmillan, New York.
- Thorpe T. A. 1981 Plant Tissue Culture - Methods and Applications in Agriculture (Ed). Academic Press, London.
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Suggested Readings

- Ram Lakhan Singh. (2018). Principles and Applications of Environmental Biotechnology for a Sustainable Future (Applied Environmental Science and Engineering for a Sustainable Future). Springer Verlag, Singapore.
- Narayanaswamy, S 1(994). Plant Cell and Tissue Culture. Tata –Mc Graw Hill Publishing Co., Ltd., New Delhi.
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- George C. Khachatourians, Y. H. Hui, Ralph Scorza, Wai-Kit Nip (2002). Transgenic plants and crops, First Edition. CRC Press.
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- I. Rajcan, J.G. Boersma, E.J. Shaw (2011). Plant Genetic Techniques: Plant Breeder's Toolbox. Comprehensive Biotechnology (Second Edition), Volume 4, Academic press.
- Lizamoni Chungkrang, Smita Bhuyan and Ava Rani Phukan (2021). Natural Dyes: Extraction and Applications. International Journal of Current Microbiology and Applied Sciences. 10(01): 1669-1677.
- Dr. Padma S Vankar. (2016). Handbook on Natural Dyes for Industrial Applications (Extraction of Dyestuff from Flowers, Leaves, Vegetables) 2nd Revised Edition. NIIR Project Consultancy Services.

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SYLLABUS						
SIGNATURE COURSE						
Name of the College	Marthoma College, Kuttapuzha P.O, Tiruvalla					
Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Elizabeth George					
Contributors	Jincy P. Abraham					
Course Name	Applications of rDNA technology					
Type of Course	DSE					
Specialization title	Plant Biotechnology and Industrial Botany					
Course Code	MG5DSEBOTA03					
Course Level	300					
Course Summary	This course provides an in-depth exploration of recombinant DNA technology and its transformative applications in various fields such as agriculture, medicine, industry, and environmental management. Students will gain a foundational understanding of the molecular tools and techniques involved in gene cloning, vector design, and genetic transformation. The course emphasizes real-world applications, including the development of genetically modified organisms (GMOs), production of therapeutic proteins and vaccines, gene therapy, and biosensors. Ethical, legal, and biosafety aspects related to rDNA use are also critically examined.					
Semester	5	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4				60
Pre-requisites, if any	Students are expected to have basic knowledge in the various techniques of plant tissue culture and an overview of how plant raw materials are processed in industries.					

Course Outcomes (CO)

Number of COs		**5**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Identify, list, and describe the organization of genomes and the main tools of genetic engineering.	K	PO1, PO2
2	Explain the principles and protocols of gene transfer	U	PO1, PO2
3	Analyze and categorize the roles of transgenics in industrial biotechnology.	AN	PO1, PO2, PO9
4	Evaluate the implications of GMO crops and GEOs, and justify measures for the safe release and management of transgenic plants.	E	PO1, PO2, PO8
5	Critically discuss ethical, regulatory, and biosafety issues related to genetically modified crops	E	PO6, PO8

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

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CO 4	3	3	-	-	-	-	-	2	-	-
CO 5	-	-	-	-	-	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	Mechanism of rDNA technology (15 Hrs)			
	1.1	Genome organization (nuclear & organellar-Mitochondria & chloroplast); Gene cloning-process, PCR , applications of gene cloning	5	["1"]
	1.2	Tools for genetic engineering: Isolation of DNA from Nucleus, Mitochondria and chloroplast; Restriction enzymes- types and role; DNA ligase.	5	["1"]
	1.3	Plant transformation Vectors – Ti plasmid & Ri plasmid; protein expression vectors- high level protein expression in E. coli and yeast.	5	["1"]
2	Gene transfer in plants (15 hrs)			
	2.1	Introduction; Objectives of gene transfer; Vector mediated gene transfer: Agrobacterium, viral vectors, plant associated symbiotic bacteria, other plasmid vectors Advantages and disadvantages of vector mediated gene transfer	5	["2"]
	2.2	Direct gene transfer: electroporation, sonoporation, microinjection, gene gun, chemical methods silicon carbide and liposome mediated gene transfer; pollen-tube-pathway-mediated plant genetic transformation methods Advantages and disadvantages of direct gene transfer	5	["2"]
	2.3	Transgenics in crop improvement-tolerance against biotic & abiotic stress, herbicide resistance; GRAS protein-structure, function and analyse applications	5	["3"]
3	Role of rDNA technology in Industrial Botany (15hrs)			
	3.1	Concept of metabolic engineering- production of industrial enzymes, edible vaccines & secondary metabolites	5	["3"]
	3.2	Novel products from genetically modified plants- biodegradable plastics, antimicrobial fabrics; Case study: Research in India focuses on developing effective and durable antimicrobial finishes for textiles, with a growing emphasis on eco-friendly approaches.	5	["4"]
	3.3	Transgenic plants as commercial crops; Transgenic plants as bioreactors- examples, benefits	5	["3"]

Module	Units	Course Description	Hrs	CO No.
4	Applications of plant biotechnology in agriculture (15 hrs)			
	4.1	Genetic engineering in cloning of nif genes; transfer of nif genes and production of biofertilizers	5	["4"]
	4.2	GM crops-production, examples (golden rice, Flavr savr tomato, Roundup-ready soybean); Molecular farming- introduction, concepts, advantages & application	5	["4"]
	4.3	Ethical issues related to transgenic crops; biohazards of rDNA technology Risk factors involved in the release of GEOs, Possible dangers, risk evaluation and release of GEO's. Bio safety handling of hazardous chemicals and radioisotope	5	["5"]

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References

- Sharma A.D. (2014). rDNA technology. Himalaya publishing house.
- Gupta, P. K. (2009). Plant Biotechnology, Kalyani Publishers, Ludhiana.
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- Diana Santos Morais, Rui Miranda Guedes. Maria Ascensão Lopes. (2016). Antimicrobial Approaches for Textiles: From Research to Market. Materials, 9(6), pp. 498
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Suggested Readings

- Ara Kirakosyan and Peter B. Kaufman. (2009), Recent Advances in Plant Biotechnology. Springer-Verlag New York Inc.
- Toshio Hakoshima. (2018). Structural basis of the specific interactions of GRAS family proteins. FEBS Letters. 592(4), pp. 489-501.
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- Roberta M. Berry. (2008). The Ethics of Genetic Engineering. Routledge.

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Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Elizabeth George					
Contributors	Jincy P Abaraham					
Course Name	Empirical Implementation of Plant Biotechnology & Industrial Botany					
Type of Course	DSE					
Specialization title	Plant Biotechnology and Industrial Botany					
Course Code	MG6DSEBOTA03					
Course Level	300					
Course Summary	This course emphasizes the practical application of botanical knowledge in real-world industrial contexts, fostering skills in value addition, and basic product development.Students will engage in field visits, laboratory work, and small-scale industrial processes to understand how raw plant materials are transformed into marketable products. The course also introduces entrepreneurship opportunities in plant-based industries and promotes awareness of environmental and ethical practices.By the end of the course, students will have the practical skills needed to contribute to or initiate small-scale plant-based industrial ventures with a sustainable and scientific approach.					
Semester	6	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any	Knowledge of fundamental business concepts, including market analysis, feasibility studies, business models, and entrepreneurship principles. This will help students understand how to develop, launch and sustain bio ventures.					

Course Outcomes (CO)

Number of COs		**6**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Recall and describe key entrepreneurial traits, types, motivations, and barriers in industrial botany.	K	PO1, PO2
2	Identify and explain different business structures and communication strategies.	U	PO2, PO4, PO9
3	Apply IP and regulatory frameworks to a bio-business scenario by matching relevant agencies	A	PO1, PO2, PO8, PO9
4	Analyse and compare public and private support programs for bio-start-ups	AN	PO1, PO2, PO5, PO9

Number of COs		6	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
5	Design and propose an original bio-venture model	C	PO2, PO5
6	Demonstrate fundamental plant tissue culture techniques and interpret the results.	A	PO1, PO2, 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	-	-	-	-	-	-	-	-
CO 2	-	3	-	2	-	-	-	-	2	-
CO 3	2	3	-	-	-	-	-	2	2	-
CO 4	2	3	-	-	1	-	-	-	2	-
CO 5	-	2	-	-	2	-	-	-	-	-
CO 6	3	3	-	-	-	-	-	-	-	2

'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	Implementing Entrepreneurship in Industrial Botany(15 Hrs)			
	1.1	Introduction: Characteristics, categories, and attributes of entrepreneurs; values; inspiration; obstacles; and inventions; Various form of business organization (sole proprietorship, partnership, corporations, Limited Liability Company)	5	["1", "2"]
	1.2	Communication: negotiation, personal selling, risk-taking, resilience	5	["2"]
	1.3	Bio - Entrepreneurship: Definition, introduction, scope and opportunities	5	["1"]
2	Organizational Assistance (15 hours)			
	2.1	Public and private agencies (MSME, DBT, BIRAC, Startup, and Make in India). Patent landscape, IP protection and commercialization strategies.	5	["3"]
	2.2	Financial assistance by different agencies.- SIDCO ,Micro, Small and Medium Enterprises; various governmental schemes (Mudra Yojana, Pradhan Mantri Rozgar Yojana, Udyogini); Non-governmental schemes (MAHILA, Shakti Scheme, Women Entrepreneurs India Scheme)	5	["4"]
	2.3	Regulatory affairs in Bio business-regulatory bodies and their regulations (FDA, EU, DSIR, AYUSH, FSSAI).	5	["4"]

Module	Units	Course Description	Hrs	CO No.
3	Bio-ventures (15 Hrs)			
	3.1	Plant Nursery as an innovative way of self – employment; Spirulina Farming - Industrial culturing and utility of Spirulina	5	["5"]
	3.2	Aromatic plants - essential oils; Medicinal plants - cultivation and extraction; Learning activity- "Novel Aromatic Oil from Plants: Extraction and Evaluation"	5	["5"]
	3.3	Botanicals in the Cosmetic industry - Skin & Hair care products .	5	["5"]
4	Practical (30 hrs)			
	4.1	Preparation of nutrient media- MS media; Preparation, sterilization and inoculation of explant in nutrient media	5	["6"]
	4.2	Immobilisation of plant tissues by the preparation of synthetic seeds	5	["6"]
	4.3	Isolation of DNA from plant cells	5	["6"]
	4.4	Agarose gel electrophoresis of plasmid and vector DNA (demonstration only)	5	["6"]
	4.5	Visit any local plant based industry and submit a detailed report.	5	["4"]
	4.6	Case study and biographical analysis of successful Entrepreneurs.	5	["5"]

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

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Both **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 25 Marks** Home assignment, Field study report, Viva, Open Book Exam,Written test, **• Practical – 15 Marks** Lab Involvement, Practical Skills, Record, Report **B. End Semester Evaluation (ESE)** **• Theory – 50 Marks** Assessment Methods – End Semester 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 ∘ One or two Sentences - (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 Assessment: 20, Report of case study: 5, Field Report :5, Record :5 Duration of Examination – 2.00 Hrs

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Suggested Readings

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- Sow, Sumit & Ranjan, Shivani. (2021). Cultivation of Spirulina: An innovative approach to boost up agricultural productivity. The Pharma Innovation. 10. 799-813.
- Maja Berden Zrimec et al., (2024). Advances in Spirulina Cultivation: Techniques, Challenges, and Applications. Insights Into Algae - Fundamentals, Culture Techniques and Biotechnological Uses of Microalgae and Cyanobacteria.

Affidavit

- We, Marthoma College, Kuttapuzha P.O, Tiruvalla and Elizabeth George, retain the copyright of this syllabus and expressly prohibit its distribution in complete form to any institution outside our own.
- We, Marthoma College, Kuttapuzha P.O, Tiruvalla, agree to appoint a new course coordinator for the proposed Plant Biotechnology and Industrial Botany 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, Marthoma College, Kuttapuzha P.O, Tiruvalla and Elizabeth George, 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.