MAR ATHANASIUS COLLEGE

(AUTONOMOUS)

KOTHAMANGALAM-686666

KERALA, INDIA

NAAC Accredited 'A^{+}' Grade Institution

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UNDERGRADUATE PROGRAMME

(HONOURS)

SYLLABUS

(Semester I to VI)

MAC-UGP (Honours)

(2024 Admission Onwards)

Faculty : Science

BoS : Botany

Subject : Botany

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Preface

The four-year undergraduate program in Botany is structured in accordance with the guidelines set by the Department of Higher Education, Government of Kerala, and the National Education Policy. Its primary objective is to impart students with a comprehensive understanding of plant science.

The curriculum and syllabus of the BSc (Honours) Botany program is crafted to equip students with essential knowledge and skills to navigate the complexities of the plant world. With a specialization in Plant Biotechnology, the syllabus encompasses various facets of plant life, spanning from sub-microscopic structures to vast ecosystems that influence our environment. The holistic curriculum includes a balanced mix of theoretical knowledge, hands-on learning experiences, fieldwork, and case studies. This approach ensures that students stay informed about the latest advancements in plant sciences, offering them avenues to explore and develop their research interests. In short, the B. Sc. (Honours) Botany program is meticulously designed to foster critical thinking, scientific inquiry, and a profound appreciation for the vital role of plants in sustaining life on Earth.

Chairperson and Members
Board of Studies in Botany (UG)
Mar Athanasius College (Autonomous)
Kothamangalam

MAR ATHANASIUS COLLEGE (AUTONOMOUS), KOTHAMANGALAM

Members of the Board of Studies - UG Programme

Subject: BOTANY

Chairperson	**Dr. Siju Thomas T** Assistant Professor and Head Department of Botany, Mar Athanasius College (Autonomous), Kothamangalam.
Experts (2) (Outside University)	**1. Dr. Dennis Thomas T** Professor, Department of Plant Science, Central University of Kerala, Kasargod.
	2. Dr. Santhosh Nampy Professor, Department of Botany, University of Calicut, Thenhipalam, Malappuram.
One Expert - nominated by VC (M. G. University)	**Dr. E. A. Siril** Professor and Head, Department of Botany, University of Kerala, Kariavattom, Thiruvananthapuram
Member from Industry	**Dr. Safeer P. M** Director, CIRIST Ecosystem Pvt. Ltd., Kinfra Hitech Park, Kalamassery, Ernakulam.
Meritorious Alumnus	**Dr. Giby Kuriakose** Assistant Professor, Department of Botany, Sacred Heart College (Autonomous), Thevara, Kochi.
Other Members of the Department	**1. Dr. Aji Abraham** Associate Professor, Mar Athanasius College (Autonomous), Kothamangalam.
	2. Ms. Meril Sara Kurian Assistant Professor, Mar Athanasius College (Autonomous), Kothamangalam.

	3. Mr. Sarath G Nair Assistant Professor, Mar Athanasius College (Autonomous), Kothamangalam.
	4. Dr. Jayalakshmi P. S. Assistant Professor, Mar Athanasius College (Autonomous), Kothamangalam
	5. Dr. Akhila Sen Assistant Professor, Mar Athanasius College (Autonomous), Kothamangalam
	6. Dr. Dhannia P Narayanan Assistant Professor on contract, Mar Athanasius College (Autonomous), Kothamangalam.
Special Invitees if any	

Programme Outcomes (PO)

PO 1: Critical thinking and Analytical reasoning

Capability to analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.

PO 2: Scientific reasoning and Problem solving

Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.

PO 3: Multidisciplinary/interdisciplinary/transdisciplinary Approach

Acquire interdisciplinary /multidisciplinary/transdisciplinary knowledge base as a consequence of the learning they engage with their programme of study; develop a collaborative-multidisciplinary/interdisciplinary/transdisciplinary- approach for formulate constructive arguments and rational analysis for achieving common goals and objectives.

PO 4: Communication Skills

Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.

PO 5: Leadership and Entrepreneurship Skills

Ability to work effectively and lead respectfully with diverse teams; setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. After inculcating all the necessary graduate qualities, a graduate can become an entrepreneur.

PO 6: Social Consciousness and Responsibility

Ability to contemplate the impact of research findings on conventional practices, and a clear understanding of responsibility towards societal needs and reaching the targets for attaining inclusive and sustainable development.

PO 7: Equity, Inclusiveness and Sustainability

Appreciate equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens; able to understand and appreciate diversity (caste, ethnicity, gender and marginalization), managing diversity and use of an inclusive approach to the extent possible.

PO 8: Moral and Ethical Reasoning

Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behavior.

PO 9: Networking and Collaboration

Acquire skills to be able to collaborate and network with educational institutions, research organisations and industrial units in India and abroad.

PO 10: Lifelong Learning

Ability to acquire knowledge and skills, including "learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Programme Specific Outcome

Upon completion of the B.Sc. (Honors) Botany Programme, the graduates will be able to:

Sl. No.	Programme Specific Outcomes	PO
1	Identify and differentiate major plant groups by analysing morphological and anatomical features.	1,2,7,10
2	Understand the ethical considerations, social consciousness and responsibilities associated with conservation of nature and sustainable practices.	6,7,8,10
3	Analyze the metabolic processes related to the growth, development, physiology, and reproduction of plants, and their applications in designing and interpreting scientific experiments.	1,2,3,9
4	Acquire computational skills, practical proficiency in laboratory techniques, fieldwork, and experimental methodologies in Botany, fostering employability.	2,5,4,9
5	Identify the interdisciplinary scope and applications of plant science and explore entrepreneurial skills.	1,3,5,9
6	Communicate scientific ideas and research findings through oral presentations, written reports, and scientific publications.	4,9,6,10

SCHEME OF INSTRUCTIONAL CREDITS AND HOURS

No	*Semester*	*Course Title*		*Course Type*	*Credit*	*Hrs/ Week*	*Total Hours*
1	1	Introduction to Plant Science and Applied Botany		DSC A	4	5	90
2	1	Ecotourism		MDC	3	4	72
3	2	Plant Resources and Avenues in Botany		DSC A	4	5	90
4	2	Gardening and landscaping		MDC	3	4	72
5	3	Microbiology and Phycology		DSC A	4	5	90
6	3	Mycology, Lichenology and Crop Pathology		DSC A	4	5	90
7	3	Analytical Techniques in Plant Sciences (S)	*Any One*	DSE	4	4	72
8	3	Horticulture and Post Harvest Technology					
9	3	Angiosperm Taxonomy and Economic Botany		DSC B	4	5	90
10	3	Agri based Micro Enterprises		MDC	3	3	54
11	3	Bioethics and IPR		VAC	3	3	54
12	4	Archegoniates		DSC A	4	5	90
13	4	Plant Cell and Molecular Biology		DSC A	4	5	90
14	4	Introduction to Biotechnology (S)	*Any One*	DSE	4	4	72
15	4	Phytotechnology					
16	4	Plant Anatomy and Microtechnique		DSC B	4	5	90
17	4	Biofertilizers and Biocontrol Agents		SEC	3	3	54
18	4	Conservation biology and Sustainable Development		VAC	3	3	54
19	4	Internship		INT	2		
20	5	Angiosperm Systematics and Economic Botany		DSC	4	5	90

21	5	Plant Physiology and Biochemistry		DSC	4	5	90
22	5	Plant Biotechnology and Introduction to Bioinformatics (S)	Any Three	DSE	4	4	72
23	5	Plant Tissue Culture		DSE	4	4	72
24	5	Bioactive Phytochemicals		DSE	4	4	72
25	5	Food Science and Quality Control		DSE	4	4	72
26	5	Mushroom Cultivation and Value Addition		SEC	3	3	54
27	6	Plant Anatomy and Developmental Biology		DSC	4	5	90
28	6	Research Methodology, Biostatistics and Computer Application		DSC	4	5	90
29	6	Microbial Biotechnology (S)		DSE	4	5	90
30	6	Genetics and Evolution	Any One	DSE	4	4	72
31	6	Phytogeography, Forestry and Ecotourism		DSE	4	4	72
32	6	Entrepreneurial Botany		SEC	3	3	54
33	6	Environmental Science and Human Rights		VAC	3	3	54

Syllabus Index: Botany Major

Name of the Major Subject: Botany

(Specialisation in Plant Biotechnology)

Semester 1

Course Code	*Title of the Course*	*Type of the Course*	*Credit*	*Hours/ Week*	*Hour distribution/ week*			
					L	T	P	O
M24BO1DSC100	Introduction to Plant Science and Applied Botany	DSC A	4	5	3	-	2	-
M24BO1MDC100	Ecotourism	MDC	3	4	2	-	2	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others

Semester 2

Course Code	*Title of the Course*	*Type of the Course*	*Credit*	*Hours/ Week*	*Hour distribution/ week*			
					L	T	P	O
M24BO2DSC100	Plant Resources and Avenues in Botany	DSC A	4	5	3	-	2	-
M24BO2MDC100	Gardening and landscaping	MDC	3	4	2	-	2	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others

Semester 3

Course Code	*Title of the Course*		*Type of the Course*	*Credit*	*Hours/ Week*	*Hour distribution/ week*			
						L	T	P	O
M24BO3DSC200	Microbiology and Phycology		DSC A	4	5	3	-	2	-
M24BO3DSC201	Mycology, Lichenology and Crop Pathology		DSC A	4	5	3	-	2	-
M24BO3DSE200	Analytical Techniques in Plant Sciences (S)	Any One	DSE	4	4	4	-	-	-
M24BO3DSE201	Horticulture and Post Harvest Technology								

M24BO3DSC202	Angiosperm Taxonomy and Economic Botany	DSC B	4	5	3	-	2	-
M24BO3MDC200	Agri based Micro Enterprises	MDC	3	3	3	-	-	-
M24BO3VAC200	Bioethics and IPR	VAC	3	3	3	-	-	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others, S- Specialisation

Semester 4

Course Code	*Title of the Course*	*Type of the Course*	*Credit*	*Hours/ Week*	*Hour distribution/ week*			
					L	T	P	O
M24BO4DSC200	Archegoniates	DSC A	4	5	3	-	2	-
M24BO4DSC201	Plant Cell and Molecular Biology	DSC A	4	5	3	-	2	-
M24BO4DSE200	Introduction to Biotechnology (S)	DSE	4	4	4	-	-	-
M24BO4DSE201	Phytotechnology							
M24BO4DSC202	Plant Anatomy and Microtechnique	DSC B	4	5	3	-	2	-
M24BO4SEC200	Biofertilizers and Biocontrol Agents	SEC	3	3	3	-	-	-
M24BO4VAC200	Conservation biology and Sustainable Development	VAC	3	3	3	-	-	-
M24BO4INT200	Internship		2					

Any One

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others, S- Specialisation

Semester 5

Course Code	*Title of the Course*		*Type of the Course*	*Credit*	*Hours/ Week*	*Hour distribution/ week*			
						L	T	P	O
M24BO5DSC300	Angiosperm Systematics and Economic Botany		DSC	4	5	3	-	2	-
M24BO5DSC301	Plant Physiology and Biochemistry		DSC	4	5	3	-	2	-
M24BO5DSE300	Plant Biotechnology and Introduction to Bioinformatics (S)	Any Three	DSE	4	4	4	-	-	-
M24BO5DSE301	Plant Tissue Culture								
M24BO5DSE302	Bioactive Phytochemicals								
M24BO5DSE303	Food Science and Quality Control								
M24BO5SEC300	Mushroom Cultivation and Value Addition		SEC	3	3	3	-	-	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others, S- Specialisation

Semester 6

Course Code	*Title of the Course*	*Type of the Course*	*Credit*	*Hours/ Week*	*Hour distribution/ week*			
					L	T	P	O
M24BO6DSC300	Plant Anatomy and Developmental Biology	DSC	4	5	3	-	2	-
M24BO6DSC301	Research Methodology, Biostatistics and Computer Application	DSC	4	5	3	-	2	-
M24BO6DSE300	Microbial Biotechnology (S)	DSE	4	5	3	-	2	-

M24BO6DSE301	Genetics and Evolution	Any One	DSE	4	4	-	-	-	-
M24BO6DSE302	Phytogeography, Forestry and Ecotourism								
M24BO6SEC300	Entrepreneurial Botany		SEC	3	3	3	-	-	-
M24BO6VAC300	Environmental Science and Human Rights		VAC	3	3	3	-	-	-

L – Lecture, T – Tutorial, P – Practical/Practicum, O – Others, S- Specialisation

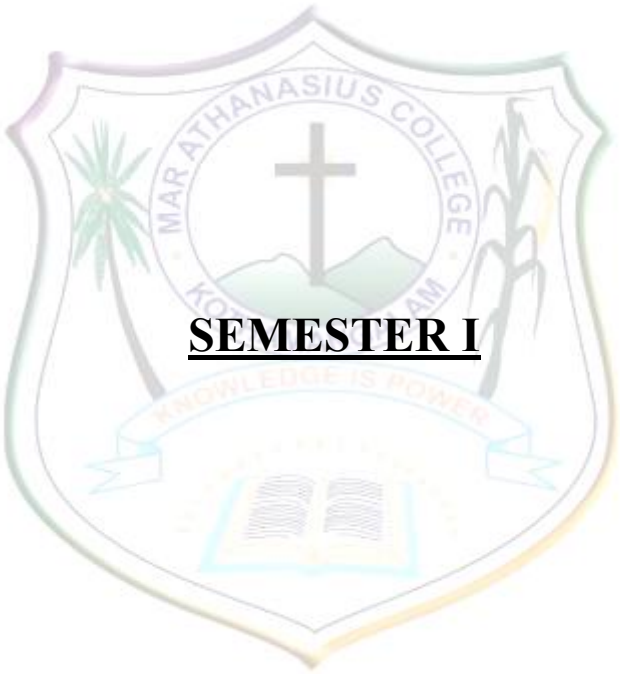
Courses which have Study tour/ Field visit / Institution visit

No	*Semester*	*Course Type*	*Course Title*	*Type of Activity*
1	1	DSC A	Introduction to Plant Science and Applied Botany	Field visit (1 day)
2	1	MDC	Ecotourism	Field visit (1 day)
3	2	DSC A	Plant Resources and Avenues in Botany	Industry visit (1 day)
4	2	MDC	Gardening and landscaping	Field visit (1 day)
5	3	DSC A	Microbiology and Phycology	Field visit (1 day)
6	3	DSE	Analytical Techniques in Plant Sciences	Institution visit (One day)
7	3	DSE	Horticulture and Post Harvest Technology	Visit to garden (1 day)
8	3	MDC	Agri based Micro Enterprises	Visit to lab/ Garden/ Agri- entrepreneur (1 day)
9	3	DSC A	Archegoniates	Field visit (1 day)
10	4	DSE	Phytotechnology	Visit to Botanical Garden (1 day)
11	4	SEC	Biofertilizers and Biocontrol Agents	Field visit (1 day)
12	5	DSC	Angiosperm Systematics and Economic Botany	Field visit (3 days)
13	5	DSE	Plant Biotechnology and Introduction to Bioinformatics (S)	Biotechnology Lab visit (1 day)
14	5	DSE	Plant Tissue Culture	Lab visit (1 day)
15	5	DSE	Food Science and Quality Control	Visit to food processing industry (1 day)
16	6	DSE	Microbial Biotechnology (S)	Lab/Industry visit (I day)

17	6	DSE	Phytogeography, Forestry and Ecotourism	Visit to ecotourism centres (1 day)

Courses with Practical and Record

	Semester	*Course Type*	*Course Title*
1	1	DSC A	Introduction to Plant Science and Applied Botany
2	1	MDC	Ecotourism
3	2	DSC A	Plant Resources and Avenues in Botany
4	2	MDC	Gardening and landscaping
5	3	DSC A	Microbiology and Phycology
6	3	DSC A	Mycology, Lichenology and Crop Pathology
7	3	DSC B	Angiosperm Taxonomy and Economic Botany
8	4	DSC A	Archegoniates
9	4	DSC A	Plant Cell and Molecular Biology
10	4	DSC B	Plant Anatomy and Microtechnique
11	5	DSC	Angiosperm Systematics and Economic Botany
11	5	DSC	Plant Physiology and Biochemistry
12	6	DSC	Plant Anatomy and Developmental Biology
13	6	DSC	Research Methodology, Biostatistics and Computer Application
14	6	DSE	Microbial Biotechnology (S)



SEMESTER I

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B. Sc. (Honours) Botany**
Course Name	**Introduction to Plant Science and Applied Botany**
Type of Course	**DSC A**
Course Code	**M24BO1DSC100**
Course Level	**100**
Course Summary	The course "Introduction to Plant Science and Applied Botany" aims to nurture an appreciation for the importance of plants among future generations. It will introduce students to notable botanists and their contributions, the distinct characteristics of key plant groups, traditional and contemporary methodologies in plant sciences, and various branches related to the field. Through this course, students are encouraged to foster a curiosity about the plant kingdom and to actively engage in efforts to conserve plant species.
Semester	1

Credits	Total	Theory	Practical
	4	3	1

Course Details	Learning approach (Hours/ Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5

Pre-requisite, if any	Basic knowledge of biology

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No.
01	Understand historical contributions of eminent scientists, identify major plant groups and analyse their significance to human life	U, An	1,2
02	Understand traditional methods used in plant sciences, recognize distinctive plant group members and their unique adaptations, and analyse the value of nature as a model for product innovation	U, An	4

03	Analyse the modern approaches, current trends in plant sciences and explore the potential research in major branches of plant sciences	An	5
04	Understand the techniques and develop skills in using instruments for conducting basic experiments in plant sciences	U, S	4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course Description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Insights into the History of Botany: Contributions of eminent botanists: (a) Theophrastus, (b) Carl Linnaeus, (c) Janaki Ammal (d) M S Swaminathan.	2	1
	1.2	Plants and Human life: Medicine, food and fibre, timber (Natural and Processed), aesthetic value, maintaining ecosystem services. **<u>Learning Activity 1:</u>** Group Discussion on ● Uses of plants ● Plants as Purifiers of our planet.	3	1
	1.3	Morphological characters, habit and habitat of major plant groups: Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. **<u>Learning Activity 2:</u>** An explorative nature walk to understand biodiversity of a selected locality: Paddy Field / Wetland ecosystem / Sacred Groves / Any other locality which harbors biodiversity and represents most of the major plant groups.	10	1
2	**Module 2 (15 hours)**			
	2.1	Brief overview of Botany, citing events that changed the course of world history: Quinine tree,	4	2

		Coconut, Rice, Wheat, Sugarcane and *Penicillium notatum* Distinct members of the plant world: Fungi, Mycorrhiza, Lichens (Salient features only) Psychoactive plants and zoopharmacognosy: Marula plant (*Sclerocarya birrea*); Lemurs eating tamarind and fig leaves.		
	2.2	Special adaptations in plants: Insectivorous plants, Heliotropism in sunflowers, Pseudocopulation strategy in orchids. Gigantic plants: e.g. *Sequoiadendron giganteum*. Plants that live in extreme environments: hot water springs, deserts, marshes, Arctic regions. Biomimicry: Nature as model: Lotus effect® technology in paint industry; *Citrus maxima* fruit wall inspired design of crash absorbing structures.	5	2
	2.3	Traditional approach and methods in plant science: (A) Exploration: Field Visit. (B) Collection of plant material: significance & tools used. (C) Preservation: Killing Agent: (Formalin), Fixing Agent: (FAA). Wet Preservation: Museum jar preservation. dry preservation: herbarium. (D) Free-hand sectioning: Transverse section (TS), Longitudinal section (LS). (E) Characters documented during field study. (F) Classification: Artificial, Natural and Phylogenetic (Definition and One Example Each). (G) Documentation: Significance of scientific diagrams and field books.	6	2
3	**Module 3 (15 Hours)**			
	3.1	Modern Approaches in plant science (A) Sectioning: Microtomy (B) Visualization techniques: Simple, compound and electron microscope (SEM & TEM) (Brief study only). (C) Separation techniques (Principle and Application):	5	3

		(i) Chromatography: TLC and Paper chromatography. (ii) Centrifugation: tabletop centrifuge and ultracentrifuge. (iii) Electrophoresis: agarose gel electrophoresis (AGE).		
	3.2	Recent trends in Plant science: (A) Molecular techniques (General Account and Applications): PCR, DNA barcoding (B) Remote Sensing (Brief Account): Application of Remote sensing and GIS for mapping of natural resources. (C) Use of Artificial intelligence (AI) in plant science. **<u>Learning Activity 3:</u>** Visit to a laboratory to familiarize with instruments mentioned above.	5	3
	3.3	Major Branches and Scope of Plant Science: Brief account and research potential in: Plant systematics, Ecology, Phytochemistry, Plant physiology, Genetics, Ethnobotany, Crop improvement & Plant genetic engineering	5	3
4	**Practical (30 hours)**			
	4.1	Field Activities (Mandatory) Conduct a field trip and survey, to appreciate the diversity of plant kingdom and to identify plants belonging to all the major groups discussed in theory. Prepare a set of 12 geo-tagged photographs containing at least one representative from each Major group.	15	4

	4.2	Laboratory Activities (Conduct Any Three) ❖ Prepare a report and presentation on Botanists who made significant contributions to science. ❖ Familiarize students with a compound microscope and dissecting / simple microscope. Assess the magnifications of the microscope you are examining. Compare the real image (Naked eye) with the magnified virtual image of an appropriate plant specimen and make illustrations of magnified specimens. ❖ Prepare temporary, single stained hand sections (TS and LS; one each) of appropriate plant specimens for light microscopic studies. ❖ Design a foldscope ❖ Prepare an extract of leaves of appropriate plant material and perform centrifugation using a table top centrifuge. ❖ Separation of plant pigments using paper/thin layer chromatography	15	4
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs

	Record 10 marks, Examination 25 marks

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SUGGESTED READINGS

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B. Sc. (Honours) Botany**
Course Name	**Ecotourism**
Type of Course	**MDC**
Course Code	**M24BO1MDC100**
Course Level	**100**
Course Summary	The course titled "Ecotourism" provides a comprehensive exploration of sustainable tourism practices and their impact on the environment. The course describes the principle, scope, and role of ecotourism in achieving conservation goals, community engagement and benefits, ecotourism resources, planning steps of ecotourism and the role of international non-governmental organizations in ecotourism.
Semester	1

Credits	Total	Theory	Practical
	3	2	1

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		2	-	2	-	4

Pre-requisites, if any	There are no specific prerequisites for this course.

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the principles, components and scope of ecotourism, examine the role of biodiversity hotspots and identify eco-friendly practices and strategies for promoting ecotourism	U	2
2	Analyze the potential of ecotourism and its role in enhancing livelihood security, identify ecotourism resources and comprehend the contributions of NGOs and international agencies in promoting sustainable ecotourism	A	2
3	Develop skills in promoting sustainable ecotourism	S	2

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Definition, concept, principles, relevance and scope, do's and don'ts of tourists in ecotourism, ecotourism impact on the environment. Eco-friendly practices, responsible tourism, sustainable tourism.	3	1
	1.2	Components of ecotourism-biodiversity conservation, education, local people, environmental awareness, cultural diversity and respect, responsible marketing, economic and social benefits.	3	1
	1.3	Ecotourism Resources – Natural, Geographical, cultural, festivals, events and Natural heritage sites. Terms associated with ecotourism - Adventure tourism, geotourism, wildlife tourism, canopy walkway, ecolabelling, greenwashing, hydel tourism, Eco-lodges.	3	1
	1..4	Ecotourism activities -Adventure sports, cultural activities, educational workshops, Photography, community development.	2	1
	1.5	Biodiversity and its conservation – significance of in situ conservation, Protected areas – national parks, wildlife and bird sanctuaries, forest reserves, marine national park (Gulf of Mannar). Endemism and biodiversity Hotspots - Western Ghats as a source of Ecotourism	4	1
2	**Module 2 (15 hours)**			
	2.1	Ecotourism prospects and potential of India, Ecotourism resources in India -Scope and destinations -Sundarbans, Kaziranga National Park.	3	2
	2.2	Ecotourism in Kerala, Ecotourism centres in Kerala, Wildlife tourism,	3	2

	2.3	Ecotourism Planning: Steps of Ecotourism Planning- Preliminary assessment, stakeholder engagement, ecotourism Goals and Objectives, carrying capacity, Infrastructure, visitors management, conservation of ecosystem in the area, community involvement and benefits.	4	2
	2.4	Ecotourism and livelihood security- Community-based ecotourism(CBET) a tool for conservation, challenges in CBET, Joint Forest Management	2	2
	2.5	Role of NGOs: Role of international agencies in ecotourism – The International Ecotourism Society (TIES), World Wide Fund for Nature (WWF) and United Nations World Tourism Organization (UNWTO).	3	2
	Practical/ Field visits (30 hours)			
3	**3.1**	Case study on Thenmala Ecotourism and Periyar Wildlife Sanctuary, Salim Ali Bird sanctuary Thattekkadu, Kodanadu ecotourism .	6	3
	3.2	Field visit to an ecotourism site, observe and analyse the sustainable practices and submit a detailed report.	15	3
	3.3	Identify and prepare a checklist of some plant species, birds and animals having economic, ecological and cultural significance as an ecotourist attraction	4	3
	3.4	Examine the current state of natural resources and develop suitable messages and appropriate media for educating different target groups	5	3
4	**Teacher-specific course components** (This content will be evaluated internally)			1,2

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based studies and interactions, 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** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 15 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. End Semester examination (ESE) Theory Total = 35 marks, Duration 1 hr Part A – 10 out of 12 x1 =10 marks Part B – 5 out of 7 x 5 = 25 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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SEMESTER II

	Mar Athanasius College (Autonomous), Kothamangalam FYUGP SYLLABUS
Programme	**B. Sc. (Honours) Botany**
Course Name	**Plant Resources and Avenues in Botany**
Type of Course	**DSC**
Course Code	**M24BO2DSC100**
Course Level	**100**
Course Summary	The course aims to impart knowledge on the importance of plants and plant based products in everyday life. Plethora of opportunities and innovations in plant science research are also discussed. The course is designed to provide the students with an idea about the career prospects in botany. The course also equips them with technical know-how on business prospects and skills needed to successfully convert them into entrepreneurial ventures.
Semester	2

Credits	Total	Theory	Practical
	4	3	1

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5
Pre-requisite, if any	Basic knowledge on plants resources and their importance in everyday life					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
01	Analyse the significance of plant resources in various contexts and plant based industries.	An	5
02	Summarize the basics of sustainable agriculture, horticultural practices, organic farming, nursery management and mushroom cultivation and develop an overview of research and innovations in plant science	U	2
03	Develop an understanding of entrepreneurial opportunities and career avenues in plant science	U	5
04	Develop skills in horticultural practices, mushroom cultivation, flower arrangement, and get acquainted with entrepreneurial practices	S	4

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
	Module 1 (15 Hours)			
1	1.1	Plants as resource: with special significance to useful part and plant products A. Drug yielding plants: (General account with special reference to the following): Danthappala (*Wrightia tinctoria*), Sarpagandhi (*Rauvolfia serpentina*) and Periwinkle (*Catharanthus roseus)* Interesting plants: Rooibos, Cordyceps, Yerba mate, Mandrake. B. Plant as staple food: Special reference to Rice (*Oryza sativa*) and Cassava (*Manihot esculenta*) C. Plant as source of fiber: Cotton and Coir. D. Rubber yielding plants: Pará rubber tree. E. Plants yielding essential oils: Eucalyptus and lemongrass F. Plants in herbal and cosmetic formulations: 'Bhringaraj (Eclipta alba)', *Hibiscus rosa-sinensis*, *Indigofera tinctoria* G. Vegan Cosmetics: Cleanser: Neem, Rose. H. Hair and Skin care products: Henna, Turmeric, Aloe vera. I. Plant based Milk alternatives: Green Milk	12	1
	1.2	Plant-based industries: Fruit production and processing: Dry Fruits and Canning. Fruit and Vegetable-based products: Pickle, Pulp, Soup, Jam and Jellies. Bamboo and Cane-based products. Plywood industry. Nutraceuticals.	3	1
2	**Module 2 (15 Hours)**			

	2.1	Introduction to Organic Farming, gardening and landscaping, Horticulture, Mushroom cultivation	2	2
	2.2	Budding, Grafting, Layering, Floriculture and Flower arrangement, Bonsai, Terrarium.	3	2
	2.3	Brief account of Plant Research Institutes in India. Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR), National Rice Research Institute (NRRI), Indian Cardamom Research Institute (ICRI), Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI), Kerala Forest Research Institute (KFRI), Central Plantation Crops Research Institute (CPCRI), Rubber Research Institute of India (RRII).	3	2
	2.4	Research and Innovations in Plant Science: Research: Significance in addressing Climate change, Food Security, Biodiversity conservation Innovations in plant Science (Mention only): Crop improvement - Flood resistant rice, Green Revolution (Norman Borlaug- high Yielding Wheat), Genetic engineering - Bt. Cotton, Gene editing for disease resistance, Synthetic biology	3	2
	2.5	Hands-on Training (Any Two): ● Mushroom cultivation ● Budding, Grafting, Layering ● Terrarium/Bonsai ● Development of an artificially propagated plant and submit for valuation. ● Algal culture. ● Tissue Culture. ● Flower arrangement **Activity 1 (Optional):** Industrial Visit / Flower Show / Agricultural Fest / Farm Visit / Food or a Center that utilizes Post Harvest Processing.	4	2
3	**Module 3 (15 Hours)**			
	3.1	Introduction to entrepreneurship: Definition and significance in the context of plant science. Basic traits and skills for entrepreneurs.	3	3

		Brief exploration of successful plant-based startups and their impact- grow the Funguy, Vgrow, Jackfruit 360, Synthite.		
	3.2	Identifying problems or opportunities within the plant science domain. Steps in the entrepreneurial journey: Overview of market assessment, enterprise selection, and resource mobilization. Schemes for Financial Assistance. Brief introduction to IPR, copyrights and GI tags.	4	3
	3.3	Opportunities in Green World: General – Scientific assistant, Plant geneticist, Computational biologist, Field botanist, Naturalist, Biotechnologist, Molecular Biologist, Nursery Manager, Plant Researcher, Teacher/Professor, Plant Pathologist, Ecologist, Plant Biochemist, Environmental Conservationist, Plant Microbiologist, Environment Consultant, Horticulturist, Plant explorer, Taxonomist, Cytologist, Biological Technician, Park Ranger, Nursery or Green House manager, Farming consultant, Paleobotanist, Plant certification, Quality assurance, Herbarium curator, Gardener, Landscape designer, Biophilic designer	4	3
	3.4	Career paths in Botany: Areas where a botanist can work: Research Lab/Institutions, Chemical Industry, Food Companies, Arboretum, Forest Services, Biotechnology Firms, Oil Industry, Land Management Agencies, Seed and Nursery Companies, Plant Health Inspection Services, National Parks, Biological Supply Houses, Plant Resources Laboratory and Educational Institutions **Activity 2:** Conduct a one-day workshop for students to confer awareness on academic progression, research, career and entrepreneurial prospects and opportunities in Botany.	4	3
4	**Practical (30 hours)**			
	4.1	Field Activities (Mandatory)		

		• Conduct one day industrial visit: To a plant-based industry in your vicinity. Prepare a report on functioning, products and marketing with Geo-tagged photographs	10	4
	4.2	Laboratory Activities (Conduct any five)		
		1. Make collections of plant products specified in the syllabus and submit 2. Polybag cultivation of mushroom 3. Demonstrate Air layering, T-budding and patch budding 4. Select any plant based start-up initiative and prepare a report 5. Present a mock up idea for a plant based entrepreneurship 6. Flower arrangement – fresh and dry 7. Jam, Jelly preparation	20	4
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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SUGGESTED READINGS

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B. Sc. (Honours) Botany**
Course Name	**Gardening and landscaping**
Type of Course	**MDC**
Course Code	**M24BO2MDC100**
Course Level	**100**
Course Summary	This course provides a comprehensive exploration of gardening and landscaping principles, equipping students with the knowledge and skill to create and maintain beautiful sustainable outdoor spaces. Students will earn foundational knowledge in nursery management techniques, including propagation and soil preparation. The course will familiarise students with essential tools, components and structures used in garden designing. Exploring eco-friendly practices in garden design can contribute to environmental conservation.
Semester	2

Credits	Total	Theory	Practical
	3	2	1

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		2	-	2	-	4
Pre-requisites, if any	Basic understanding of Biology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Recognize different types of gardens, horticultural practices, and understanding various methods of vegetative propagation.	U	1,4
2	Comprehend the basic concepts of plant growth structures, gardening tools, and the steps involved in landscape design.	K	4
3	Develop knowledge in gardening and landscaping	A	4

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Introduction to landscaping, gardening and commercial floriculture – importance and prospects	2	1
	1.2	Types of plants in landscaping– Trees, shrubs, climbers, annuals, herbaceous perennials, bulbous crops, palms, ferns, cacti & succulents, aquatic ornamentals.	2	1
	1.3	Types of gardens- fruit garden, ornamental garden, herbal garden, kitchen garden, Kids Garden Indoor plants (Money plant, Snake plant, Monstera, ZZ plant, Aglaonema)	4	1
	1.4	Horticultural practices related to gardening – training, pruning and mulching, its benefits. Nursery bed preparation	2	1
	1.5	Vegetative propagation methods – natural and artificial cuttings – leaf, stem and root, layering–air layering, simple layering, grafting- approach grafting, Tongue grafting, budding- T budding, patch budding	5	1
2	**Module 2 (15 hours)**			
	2.1	Nursery layout & structures: Polyhouse, mist chamber, rain shelter, potting shed, composting shed. Sprinkler irrigation.	3	2
	2.2	Gardening tools & implements Garden spade, rake, fork, garden shears, secateurs, grafting & budding knife, pruning saw, mowers, brush cutter, garden tillers	2	2
	2.3	Garden components and adornments (brief account only)	2	2

	2.4	Rockery, Terrarium, Kokedema, Bonsai (brief account only)	2	2
	2.5	Elements of art-colour, line, form, scale. Principles of Landscape design- Unity, Balance, transition, proportion, rhythm, focalisation, repetition, simplicity.	3	2
	2.6	Steps in developing a Landscape Design Brief Account Only a) Site analysis- b) Identification of functional requirements; c) site development by exploiting natural forms; d) Elements in landscape design- form, water, garden furniture, lights, paving etc. e) study of plant trees, shrubs and ground cover, indoor plants etc.	3	2
3	**Practicals (30 hours)**			
	3.1	Visit to a well-established nursery/ Garden and submit a detailed report	8	3
	3.2	TTC test for assessing seed viability	2	3
	3.3	Preparation of potting mixture	2	3
	3.4	On-hand training for air-layering, approach grafting and T-budding techniques	6	3
	3.5	Identification of Garden tools and implements.	4	3
	3.6	Designing of Terrarium	4	3
	3.7	Designing of Kokedama balls/ bottle gardens	4	3
4	**Teacher specific course components** (This content will be evaluated internally)			1,2

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based studies and interactions, 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** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 15 marks Quiz, Test Papers, seminar, Assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. End Semester examination (ESE) Theory Total = 35 marks, Duration 1 hr Part A – 10 out of 12 x1 =10 marks Part B – 5 out of 7 x 5 = 25 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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SEMESTER III

	Mar Athanasius College (Autonomous), Kothamangalam FYUGP SYLLABUS					
Programme	**B. Sc. (Honours) Botany**					
Course Name	**Microbiology and Phycology**					
Type of Course	**DSC A**					
Course Code	**M24BO3DSC200**					
Course Level	**200**					
Course Summary	The course will give an insight towards the diversity of microbes and algal flora. The study of microbiology provides a comprehensive understanding of microbes, its principles, and its applications in various fields, whereas phycology deals with the study of algae. Being the primary producers, both micro and macroalgae play a significant role in aquatic ecosystems. Students learn its salient/ diagnostic features and its importance to ecosystems. It also focuses on the economic and ecological significance and its applications.					
Semester	3					
Credits	Total	Theory		Practical		
	4	3		1		
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5
Pre-requisites, if any	Basic botanical knowledge and laboratory skills					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the characteristics and reproduction of microorganisms, their role in the environment, and their various applications across different fields.	U	2,5
2	Examine the salient features, range of thallus structure, pigment composition, photosynthetic end products and reproduction in various algal groups.	An	1,3
3	Analyse the economic and ecological importance of algae.	An	2
4	Acquire skills in bacterial and algal identification, recognizing key features in their structure, behaviour, and role in the environment.	S	4,5

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
	Module 1 (15 hours)			
1	1.1	Bacteria: General characters and classification based on staining, morphology and flagellation. Ultra structure of bacteria. Reproduction - binary fission. Genetic recombination in bacteria - conjugation, transformation and transduction.	6	1
	1.2	Viruses: General characters of viruses, viroids and prions. Structure of TMV and Bacteriophage (λ). Multiplication of λ phage – lytic and lysogenic cycle.	4	1
	1.3	Microbial interactions in ecosystems, Applications of microbes in industry, agriculture, food and medicine. Microbes in environmental conservation, waste management and as biocontrol agents. Harmful aspects of microorganisms (Brief account)	5	1
	Module 2 (15 hours)			
2	2.1	History of algal classification, study of classification by Fritsch (1945); Brief introduction to the modern classification by Lee (1989) [up to class]. Algae Base (Brief study)	2	2
	2.2	Distribution, habitat diversity, range of thallus structure, pigment composition and photosynthetic end products in various groups of algae. Reproduction - vegetative, asexual and sexual reproduction. Outline of major life cycle patterns found in algae.	2	2
	2.3	Salient features and thallus structure of algae in the following groups with special reference to the type(s) mentioned: Cyanophyceae - *Nostoc*; Chlorophyceae - *Volvox, Spirogyra, Cladophora, Chara* Bacillariophyceae - *Pinnularia*; Phaeophyceae– Sargassum*;* Rhodophyceae – *Polysiphonia*	11	2

		Reproductive structures of *Chara, Sargassum* and *Polysiphonia* (Brief account)		
	Module 3 (15 hours)			
3	3.1	Useful aspects of algae: Food, SCP, Biofertilizers, Medicine Exploration of algae as source of valuable commercially important products-carrageenan, agar-agar, alginate, diatomite Harmful effects of algae: Algal blooms, eutrophication, neurotoxins.	6	3
	3.2	Algae as primary producers and ecosystem engineers Algal associations and its significance (Parasitic algae, Symbiotic algae-association of algae with fungi, bryophytes, pteridophytes, gymnosperms, angiosperms, invertebrates) Algae based wastewater treatment for biodiesel production Role of algae as bioremediation agents. Role of algae in N_2 fixation	6	3
	3.2	Role of algae in scientific research -*Chlorella* Brief overview on cultivation of macroalgae and microalgae.	3	3
4	**Practical (30 hours)**			
	Microbiology (10 hours)			
	4.1	Gram staining – curd/ root nodules. Isolation of microbes from soil through serial dilution	8	4
	4.2	Demonstrate the culture of bacteria.	1	4
	4.3	Types of fermentation and respective microbes - wine, vinegar, curd	1	4
	Phycology (20 hours)			
	4.4	Conduct a field visit to any one of the ecosystems rich in algae to experience algal diversity. Submit a report with photographs or	3	4

		Collect algae from diverse habitats, observe through microscope and prepare microphotographs and submit a report.		
	4.5	Make micro preparations of thallus structures of the types mentioned in the syllabus.	16	4
	4.6	Familiarizing the technique of algal collection and preservation.	1	4
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam FYUGP SYLLABUS
Programme	**B. Sc. (Honours) Botany**
Course Name	**Mycology, Lichenology and Crop Pathology**
Type of Course	**DSC A**
Course Code	**M24BO3DSC201**
Course Level	**200**
Course Summary	The course provides a comprehensive exploration of the intricate worlds of fungi and plant diseases. Students delve into the morphology and ecological roles of fungi, gaining insights into their diverse functions as decomposers, symbionts, and pathogens. The curriculum also encompasses the study of plant diseases, investigating the interactions between plants and various pathogenic organisms, including fungi, bacteria, viruses, and nematodes. Through this course, students acquire the skills and knowledge necessary for disease diagnosis, prevention, and control, contributing to the sustainable management of plant populations in diverse settings.
Semester	3

Credits	Total	Theory	Practical
	4	3	1

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5
Pre-requisites, if any	Basic knowledge in botany					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Determine the diversity, reproductive behaviour and applications of fungi	U	1
2	Explain ecological and economical significance of fungi and lichens	U	1,2
3	Outline the basic aspects of plant pathogen interactions, identify plant diseases and suggest control measures	A	2,4
4	Identification of common macrofungi and diseases with respect to causal organisms and symptoms	A	1,4,5

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Introduction and general characters of fungi. Classification based on Ainsworth (1973); Assembling the Fungal Tree of Life (AFTOL) - a brief account. Mycobank (Brief account)	3	1
	1.2	Salient features of each group, thallus and reproductive structures of the genera mentioned in each group below; Myxomycotina - General Characters	1	1
	1.3	Mastigomycotina – *Albugo* (Difference between Oomycete and true fungi)	2	1
	1.4	Zygomycotina – *Rhizopus*	2	1
	1.5	Ascomycotina: - *Xylaria*	2	1
	1.6	Basidiomycotina – *Agaricus, Puccinia*	4	1
	1.7	Deuteromycotina - *Fusarium*	1	1
2	**Module 2 (15 hours)**			
	2.1	Economic importance of Fungi – Beneficial and detrimental aspects.	3	2
	2.2	Fungi of Agricultural importance – mycoherbicides, myconematicides, mycoparasites, Mycorrhiza – types, function, and significance.	3	2
	2.3	Mushrooms- edible and poisonous types. Cultivation technique-Spawn production of Oyster mushroom, cultivation of Oyster mushroom (General Outline)	4	2
	2.4	General account, economic and ecological importance of lichen	1	2
	2.5	Classification of lichens based on thallus and its significance	2	2
	2.6	Structure and life cycle of *Parmelia*.	2	2

3	**Module 3 (15 hours)**			
	3.1	History of crop pathology (Brief study)	1	3
	3.2	Classification of plant diseases based on causative organisms and symptoms	2	3
	3.3	Plant-Pathogen Interaction (general outline)	1	3
	3.4	Defense mechanisms in Plants	2	3
	3.5	Mechanism of infection, transmission, and dissemination of plant diseases.	2	3
	3.6	Prophylaxis - quarantine measures, seed certification; Therapeutic – physical therapy, chemotherapy.	1	3
	3.7	Biological control of plant diseases	1	3
	3.8	Study of following diseases with emphasis on symptoms, cause, and control: ● Bunchy top of Banana ● Bacterial blight of Paddy ● Root wilt of Coconut ● Abnormal leaf fall of Rubber ● Leaf mosaic disease of Tapioca ● Quick-wilt of pepper. ● Nut fall of Arecanut.	5	3
4	**Practical (30 hours)**			
	Mycology (20 hours)			
	4.1	Identification of the following types by making suitable micro preparations: *Albugo, Rhizopus, Xylaria, Puccinia, Agaricus, and Fusarium.*	8	4
	4.2	Staining of endomycorrhiza or fungus using Trypan Blue.	2	4
	4.3	Collection/identification of common macrofungi (5 types).	10	4
	Plant Pathology (10 hours)			
	4.4	Identify the diseases mentioned in the syllabus with respect to causal organisms and symptoms	3	4

	4.5	Submit specimens/ herbarium preparations of any three diseases/Geo tagged photos.	4	4
	4.6	Preparation of fungicides – Bordeaux mixture/ Tobacco decoction.	3	4
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, Assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Analytical Techniques in Plant Sciences**					
Type of Course	**DSE**					
Course Code	**M24BO3DSE200**					
Course Level	**200**					
Course Summary	This course will provide an overview of the various preparative methods and analytical techniques used in plant science. Students will learn the principles of different analytical techniques and its practical applications in plant research.					
Semester	3					
Credits	4					
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		4	-	-	-	4
Pre-requisites, if any	Basic knowledge in science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Outline the methods for preservation of plant specimens and procedures in microscopy	U	3,4
2	Summarize the working and application of microscopes, enumeration techniques, and micrometry	U	3,4
3	Illustrate the principles and applications of different instruments employed in plant science research and make use of them	A	3,4
4	Develop skill in various preparative methods and analytical techniques used in plant science	A,S	3,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Introduction to analytical techniques in plant science, Collection, preservation (dry & Wet) and preparation of plant materials: squash, smear, whole mount, maceration, and Sectioning. Retaining the natural colour of the plant samples (brief study).	4	1
	1.2	Killing and fixing: properties of good fixative: types of fixative and fixation; killing and fixing agents and their composition (Carnoy's fluid and FAA)	2	1
	1.3	Sectioning- free hand and microtomy, applications of microtome - rotary microtome, sledge microtome, and cryostat	3	1
	1.4	Stains and staining techniques – different types of stains and their composition- safranin, acetocarmine; vital stains - neutral red, Evans blue, types of staining - Single staining and Double staining.	4	1
	1.5	Mounting and preparation of slides - mounting media: glycerine, DPX, and Canada balsam; preparation of slides: temporary and permanent	2	1
2	**Module 2 (15 Hours)**			
	2.1	Principle, working, and application: Light microscopy – Compound and dissection microscopes, parts and uses. Phase contrast microscopy, Electron microscopy (Brief account).	6	2
	2.2	Enumeration Techniques: Haemocytometer, Sedgewick-rafter.	2	2
	2.3	Micrometry	2	2
	2.4	**Activity:** 1. Temporary mounting of a hand-sectioned single-stained specimen 2. Maceration of a given specimen (Cucurbita stem)	5	2
3	**Module 3 (15 Hours)**			

	3.1	Centrifugation - Principle, working, and application of high-speed centrifuge and ultracentrifuge (preparative and analytical model) Different types of centrifuges: Fixed angle, swinging bucket	4	3
	3.2	Photometric Analysis – principle, working, and application of colorimeter and spectrophotometer. Application of UV-visible spectroscopy in plant science and related fields.	6	3
	3.3	Principle, working, and application of pH meter	2	3
	3.4	**Activity** 1. Prepare a standard graph and estimate the concentration of a solution using a colorimeter 2. Adjust the pH of a solution using pH meter/ pH pen	3	3
4	**Module 4 (15 Hours)**			
	4.1	Chromatography Techniques: - principle, working, and application of paper chromatography, TLC, column chromatography.	5	4
	4.2	Electrophoresis: Electrophoretic mobility, factors affecting electrophoretic mobility. working and application of SDS-PAGE and agarose gel electrophoresis	4	4
	4.3	**Activity:** 1. Visit a recognized instrumentation lab or research lab and submit a report. 2. Separate plant pigments using paper/thin layer chromatography	6	4
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3,4

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar, assignment etc.

	B. End Semester Examination (ESE) Theory Total = 70 marks, Duration 2 hrs Part A – 10 out of 12 x 3 = 30 marks Part B – 8 out of 10 x 5 = 40 marks

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	Mar Athanasius College (Autonomous), Kothamangalam FYUGP SYLLABUS					
Programme	**B. Sc. (Honours) Botany**					
Course Name	**Horticulture and post-harvest technology**					
Type of Course	**DSE**					
Course Code	**M24BO3DSE201**					
Course Level	**200**					
Course Summary	Students are expected to gain knowledge on various Horticultural disciplines including gardening, field management and postharvest technologies. They will also develop an understanding of Regulatory Laws related to food safety and quality control along with exploring the entrepreneurial aspects within the field of Horticulture.					
Semester	3					
Credits	4					
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Hours
		4	-	-	-	4
Pre-requisites, if any	Familiarity with basic plant science, soil science and environmental science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Develop a comprehensive understanding of soil characters, irrigation and manuring practices	U	2,4
2	Explain gardening and landscaping styles and common plant propagation methods	U	4,5
3	Outline the major branches of horticulture and their significance	U	5
4	Identify post-harvest management techniques of horticultural crops, develop value addition strategies and entrepreneurial skills required for the horticultural industry	A	4,5
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 Hours)**			
	1.1	Introduction, Scope and Importance, Branches of horticulture.	3	1
	1.1	Components of soil: Organic, Inorganic & physiological-types and its importance.	2	1
	1.2	Classification of soil: Criteria for classification - soil profile- soil types - red soil, black soil, alluvial soil, laterite soil, coastal soil, sandy soil, serpentine soil, sodic soil, problematic soil, acidic and alkaline.	4	1
	1.3	Irrigation: Principles. Methods of irrigation - surface, subsoil and overhead irrigation system – types.	2	1
	1.4	Manuring: organic and Synthetic manures - Classification. Methods of manuring- broadcast, seed treatment, foliar application	3	1
	1.5	Estimation of soil pH using pH meter.	1	1
2	**Module 2 (15 Hours)**			
	2.1	Gardening: styles of gardens - English, Mughal, Japanese, Persian, French and Italian gardens - characteristics and components (Brief account Only). Garden tools and Implements – Types. Garden designing and layout. Different types of gardens: Outdoor, indoor garden, water garden, rockery.	6	2
	2.2	Landscape architecture: types - Contemporary, Environmental, Industrial, institutional and playground landscaping.	5	2
	2.3	Plant propagation methods: Budding, Grafting, Layering and Tissue culture.	4	2
2	**Module 3 (15 Hours)**			
	3.1	Major branches of horticulture: Floriculture: definition and significance, Components – Cut flower, loose flower, dry flower, Floral oil.	5	3

		Olericulture: definition and significance; Types of vegetables: Warm season and cool season vegetables, types of vegetable farming - kitchen, garden, terrace garden, market garden, truck garden. Pomology: Types of fruits – Tropical, Subtropical and Temperate. General care of fruit crops - techniques for planting, pruning and training, pest management.		
	3.2	Practice different types of grafting (approach, whip and tongue, cleft), T budding/ Patch Budding.	5	3
	3.3	Visit a garden and identify the components, plants, and prepare a report. Collect, familiarize and identify ornamental plant groups.	5	3
4	**Module 4 (15 Hours)**			
	4.1	Importance of post-harvest management. Postharvest handling methods: Washing, Grading, Waxing. Storage methods: Pre-cooling. Controlled atmospheric storage, Modified atmospheric storage – Low pressure storage and cold chain concept	3	4
	4.2	Packaging of fresh and processed products: general principles and methods of preservation - dehydration, thermal processing, chemical preservatives, fermentation, ionizing, radiation, Preparation of jams, jellies, squashes, pickles, salads, syrups and beverages.	4	4
	4.3	Government policies, regulations and specifications for fresh and processed products, Food safety and quality control-FSSAI. Export promotion agencies and their role on export of fresh and processed products.	3	4
	4.4	Importance and scope of processing industry in India. General guidelines for the establishment of small and large scale processing units. Business opportunities, Role of Horticorp and VFPCK.	2	4
	4.5	Training on making jams, jellies, squashes, pickles, salads, syrups and beverages	3	4
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3,4

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar, Assignment etc.
	B. End Semester Examination (ESE) Theory Total = 70 marks, Duration 2 hrs Part A – 10 out of 12 x 3 = 30 marks Part B – 8 out of 10 x 5 = 40 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Angiosperm Taxonomy and Economic Botany**					
Type of Course	**DSC B**					
Course Code	**M24BO3DSC202**					
Course Level	**200**					
Course Summary	The course provides a thorough understanding about the morphological and reproductive characters of angiosperm plants utilized for identification and classification. The course elaborates the classification of angiosperms by Bentham and Hooker.					
Semester	3					
Credits	Total	Theory		Practical		
	4	3		1		
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5
Pre-requisites, if any	Basic knowledge in plant science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the morphological structures of angiospermic plants.	U	1
2	Apply systems of plant classifications and taxonomic tools to organize plants to their respective families	A	1,4
3	Classify plants based on their uses and significance in various industries	U	5
4	Identify and assign plants to their respective families by examining vegetative and floral characters	A, S	1,4
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			

	1.1	Morphology Leaf - simple, compound; venation and phyllotaxy. Flower as a modified shoot, structure of flower - floral parts, their arrangement, relative position; cohesion and adhesion of floral parts, symmetry of flowers; types of aestivation and placentation; floral diagram and floral formula.	5	1
	1.2	Inflorescence Racemose - simple, spike, spadix, catkin, corymb, umbel and head; cymose - simple, monochasial ,helicoid and scorpoid; special types – cyathium, verticillaster.	6	1
	1.3	Fruits: Simple: Fleshy - drupe, berry, hesperidium; Dry - Dehiscent - legume, capsule; Indehiscent - Caryopsis, Cypsella, Schizocarpic - lomentum, carcerulus, regma, cremocarp with examples. Aggregte. Multiple: sorosis, syconus	4	1
2	**Module 2 (15 hours)**			
	2.1	Plant classification and Herbarium techniques Importance of plant classification, types of classification - artificial, natural and phylogenetic (brief account only)	3	2
	2.2	Binomial nomenclature; ICBN (Brief account only). Bentham and Hooker,s system of classification (up to series) and its merits and demerits.	3	2
	2.3	Cytotaxonomy and chemotaxonomy (brief account only). Herbarium techniques; importance of herbarium.	2	2
	2.4	Angiosperm families Study of the following families of Bentham and Hookers system of classification with special reference to major identifying characters and economic importance: Annonaceae, Malvaceae, Rutaceae, Leguminosae (Mimosaceae, Caesalpiniaceae and Fabaceae), Apiaceae (Umbelliferae)	7	2
	Module 3 (15 hours)			
3	3.1	Rubiaceae, Asteraceae (Compositae), Apocynaceae, Lamiaceae (Labiatae), Euphorbiaceae, Arecaceae (Palmae), Poaceae (Gramineae).	7	3

	3.2	Classification of economically important plants based on their uses. Study of the following groups of plants with special reference to their botanical name, family, morphology of useful part, economic products and uses: Cereals - Paddy, Wheat; Pulses - Green gram, Bengal gram; Tuber crops-Tapioca; Spices - Pepper, Cardamom; Beverages - Tea, Coffee; Oil yielding plants - Coconut, Groundnut; Fibre yielding plants - Cotton, Coir; Timber yielding plants - Teak, Rose wood; Latex yielding plants - Para rubber; Bio pesticides - Neem, Tobacco; Ornamental plants - Rose, Orchids, Anthurium	8	3
	Module 4 (Practical 30 hrs)			
4	4.1	Examine vegetative and floral features of different plants and assign them to respective families mentioned in the syllabus.	15	4
	4.2	Prepare and submit any 5 herbarium sheets	5	4
	4.3	Study of the groups of plants mentioned in the economic botany syllabus with special reference to their botanical name, family, morphology of useful part, economic products and uses	10	4
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, Assignment etc. Practical Total = 15 marks Lab performance, record, field report etc. **B. End Semester Examination** Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam FYUGP SYLLABUS
Programme	**B. Sc. (Honours) Botany**
Course Name	**Agri-based Microenterprises**
Type of Course	**MDC**
Course Code	**M24BO3MDC200**
Course Level	**200**
Course Summary	This course is designed to equip participants with the knowledge and skills necessary to establish and manage successful agri-based microenterprises. Focusing on key sectors such as organic farming, horticulture, tissue culture, and mushroom cultivation, the course provides a comprehensive understanding of sustainable and profitable agribusiness practices.
Semester	3
Credits	3

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	-	-	3
Pre-requisites, if any	Basic knowledge about agriculture					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Summarize key principles in organic farming and its components.	U	2,4
2	Understand the basics of gardening and tissue culture	U	4,5
3	Illustrate the concepts of mushroom cultivation, fruits and vegetable preservation and value addition	U	5

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 Hours)**			

	1.1	Introduction to Organic farming- Advantages of Manures over fertilizers. NPK value- Definition and significance.	2	1
	1.2	Common organic manures – bone meal, cow dung, poultry waste, oil cakes, Green manure (special reference to major element in the composition) Preparation of compost- vermicompost, vermiwash; familiarize KAMBA compost Biofertilizers-Definition and Types –, *Rhizobium, Mycorrhiza, Blue green algae and Azolla.* Activity-Hands on training on Vermicomposting Activity-Preparation of compost and establishing a small kitchen garden. Submit a report with geotagged photos	4	1
	1.3	Biological control Agents- *Trichoderma*, *Bacillus*; Biopesticides – Tobacco and Neem decoction. Activity-Prepare and submit any one Biopesticide formulation.	2	1
	1.4	Types of soil, preparation of potting mixture, Garden tools and implements Methods of plant propagation- Sexual (seed propagation) and Asexual; Artificial methods (cutting, grafting, budding and layering); Use of growth regulators for rooting. Hands on training on Artificial methods of propagation - budding and grafting. Activity-Demonstration of budding (T and Patch)	7	1
2	**Module 2 (15 Hours)**			
	2.1	Gardening - Types of gardens– Ornamental and Landscape garden, kitchen garden Water garden and aquascaping, Aquarium plants and its propagation Garden components (Brief account only), Bonsai, terrarium, Kokedama. **Activity-** Submit a self made terrarium/ kokedama/ aquarium (use only natural materials)	6	2
	2.2	Concept of totipotency, definition of explant, callus. Infrastructure of a tissue culture laboratory. Solid and liquid media – basic components of tissue culture medium.	3	2
	2.3	Sterilization of explants'. inoculation and incubation. Micro propagation: different stages, organogenesis and embryogenesis	6	2

		Visit to a well established tissue culture lab/ nursery/ mushroom cultivation unit		
3	**Module 3 (15 Hours)**			
	3.1	Scope and Significance of Mushroom cultivation, Edible and poisonous mushroom. Health benefits	1	3
	3.2	Types of commercially cultivated mushrooms - button mushroom, oyster mushroom and milky mushroom, Spawn -Definition.	1	3
	3.3	Cultivation methodology of Oyster mushroom – using paddy straw and saw dust Layout and set up of a mushroom house (small scale). Processing of mushrooms and Value added products- mushroom - pickle, candy, dried mushroom	4	3
	3.4	Elementary knowledge on horticultural types of fruits and vegetables, Concept of shelf life and perishable fruits, Ripening and biological ageing, Storage and preservation concerns.	2	3
	3.5	Fruits preservation-Room temperature (Juice, syrup, squash), heat treatment (Jelly, jams), Dehydration (sun drying, application of sugar syrup,salt), freezing Vegetable preservation-packaging and storage, dehydration techniques, vegetable products (flakes, chips, dried powder), frozen vegetables, Preservation by Canning and bottling. **Activity-** Prepare and submit any one fruit/vegetable product using methods prescribed in the syllabus Visit and submit an audio visual documentary on any one small scale entrepreneurship activity with reference to the skills mentioned in the syllabus Submit a proposal on any plant based entrepreneurship activity (other than mentioned in syllabus).	7	3
4	**Teacher specific course component** (This content will be evaluated internally)			1,2,3

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, Assignment etc.
	B. Semester End examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x2 =20 marks Part B – 6 out of 8 x 5 = 30 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B. Sc. (Honours) Botany**
Course Name	**Bioethics and IPR**
Type of Course	**VAC**
Course Code	**M24BO3VAC200**
Course Level	**200**
Course Summary	This course focus on systematic outline of the bioethics and Intellectual Property Rights. This will provide the core principles in the interaction of IPR and Bioethics, also give overview of the domestic and international legal regime dealing with intellectual property law.
Semester	3
Credits	3

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	-	-	3
Pre-requisites, if any	**Nil**					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Apply ethical principles in biological research	A	2,6
2	Discuss intellectual property rights and its benefit to society	U	2
3	Interpret knowledge on IPR, patents, copy right and trademarks	U	2,4

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 Hours)**			
	1.1	Bioethics – Need, issues (social and cultural) and applications; Misuse of modern molecular biology tools and techniques.	2	1
	1.2	Bioethics & Biodiversity**:** Convention on protecting Biodiversity, Protocols in exchanging Biological material across borders	2	1

	1.3	Issues and concerns pertaining to Genetically modified foods & food crops, Harm to the environment - potential impact of GMOs on the ecosystem.	3	1
	1.4	Bioethics in Medicine & Cloning: Protocols of ethical concerns related to prenatal diagnosis, gene therapy, organ transplantation, Xenotransplantation, ethics in patient care, informed consent	3	1
	1.5	Patenting biotech inventions: objective, applications, concept of novelty, concept of inventive steps	2	1
	1.6	Use of plants in research, human volunteers for clinical research, moral issues in patenting biotechnological inventions, Ethics related to professional streams.	3	1
2	**Module 2 (15 Hours)**			
	2.1	Meaning of Intellectual Property Rights – Introduction to TRIPS and WTO – IPR in India and the world	4	2
	2.2	Kinds of Intellectual property rights - Copy Right, Patent, Trade Mark, Trade Secret and trade dress	3	2
	2.3	Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge.	3	2
	2.4	**Activity – 1** Geographical Indication - Meaning & significance of GI, How to file GI.	5	2
3	**Module 3 (15 hours)**			
	3.1	Origin, Meaning of Patent, Types, Inventions which are not patentable	3	3
	3.2	Registration Procedure, Rights and Duties of Patentee, Patent Infringement.	3	3
	3.3	Copyright - Definition, Terms & Types of Copyright, Piracy. Information technology related IPR (computer software, database and data protection)	3	3
	3.4	Trade Marks - Meaning & Nature of Trade Marks, Types, Infringement & Remedies, Offenses relating to Trade Marks.	3	3
	3.5	**Activity – 2** Traditional Knowledge - Meaning, importance of TK, Sources of TK, TKDL (Traditional Knowledge Digital Library.	3	3

4	**Teacher specific course components** (This content will be evaluated internally)	1,2,3

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** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, Assignment etc.
	B. Semester End examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x2 =20 marks Part B – 6 out of 8 x 5 = 30 marks

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SEMESTER IV

	Mar Athanasius College (Autonomous), Kothamangalam FYUGP SYLLABUS
Programme	**B. Sc. (Honours) Botany**
Course Name	**Archegoniates**
Type of Course	**DSC A**
Course Code	**M24BO4DSC200**
Course Level	**200**
Course Summary	The course offers a fundamental introduction to the evolutionary importance, classification, morphology, and distinctive features of Archegoniates. Additionally, it provides a basic perspective on the ecological and economic relevance of Archegoniates.
Semester	4

Credits	Total	Theory	Practical
	4	3	1

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5
Pre-requisites, if any	Basic knowledge in botany					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the key characteristics, classification, and life cycle of bryophytes, and analyze their ecological and economic significance.	U	1,3
2	Demonstrate the key characteristics, classification, and life cycle of pteridophytes, and assess their ecological and economic relevance.	U	1,3
3	Explain the key characteristics, classification, and life cycle of gymnosperms, and analyze their ecological and economic significance.	U	1,3
4	Develop skills in identifying archegoniates by studying morphology, anatomy, and reproductive structures.	S	4

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

COURSE CONTENT

Module	Units	Course description	Hrs	CO No.
1	**Module 1 (15 hours)**			
	1.1	Common features of archegoniates; Adaptation to thrive in land habit; Alternation of generations.	2	1
	1.2	Evolution/ transition of the sporophytic and gametophytic phase of Bryophytes, Pteridophytes and Gymnosperms	3	1
	1.3	Bryophytes General characters, Classification by Rothmaler 1951 (up to family)	2	1
	1.4	Type study: Morphology and anatomy of thallus, Reproduction and life cycle of *Riccia, Anthoceros* and *Pogonatum* (Developmental details of sex organs and embryo not needed).	7	1
	1.5	Ecological and economic importance of bryophytes.	1	1
2	**Module 2 (15 hours)**			
	2.1	Pteridophytes General characters, Classification of up to classes by Smith (2006) and PPG system (Brief account only)	3	2
	2.2	Morphology and anatomy of thallus, Reproduction and life cycle of *Psilotum, Selaginella* and *Pteris* (Developmental details of sex organs not needed).	7	2
	2.3	Stelar evolution in pteridophytes, Heterospory and seed habit	3	2
	2.4	Ecological and economic importance of Pteridophytes, Ornamental pteridophytes	2	2
3	**Module 3 (15 hours)**			
	3.1	Gymnosperms	4	3

		General characters Classification by Sporne (1965) (up to family), Brief account of classification by Christenhuez (2011)		
	3.2	Morphology, anatomy, and reproduction of *Cycas*, *Pinus* and *Gnetum* (Developmental details of sex organs not needed)	8	3
	3.3	Economic importance of Gymnosperms, Ornamental Gymnosperms	3	3
4	**Module 4 Practical (30 hours)**			
	4.1	Conduct a field visit and submit a report with geo-tagged photos / images of gametophytes and/or sporophytes of archegoniates in your locality.	5	4
	4.2	Collect three recent research publications on archegoniates and submit a comparison report.	2	4
	4.3	Collect, identify the genus, and submit gametophytes and/or sporophytes of any five archegoniates.	5	4
	4.4	*Riccia* and *Anthoceros*– Morphology and anatomy of thallus. *Pogonatum*- Morphology of the sporophyte and gametophyte	6	4
	4.5	● *Psilotum*- Morphology of sporophyte and synangium ● *Selaginella*- Morphology of sporophyte, transverse section of the stem. ● *Pteris*- Morphology of sporophyte, transverse section of sporophyll	8	4
	4.6	● *Cycas*- Morphology of coralloid roots and reproductive structures; TS of leaflet. ● *Pinus*- Morphology of male and female cones; TS of the needle. ● Gnetum - Morphology of male and female cones	4	4
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam FYUGP SYLLABUS
Programme	**B. Sc. (Honours) Botany**
Course Name	**Plant Cell and Molecular Biology**
Type of Course	**DSC A**
Course Code	**M24BO4DSC201**
Course Level	**200**
Course Summary	Cell and Molecular biology play a crucial role in shaping understanding of life. The course emphasizes the basic principles that buttress the processes unique to living organisms at the molecular and cellular levels. Students will acquire a basic understanding of architecture of plant cells, organization of genetic material, the storage, transfer, and regulation of genetic information etc. The course envisages the application of modern molecular and cellular biology in Plant Sciences and provides a solid foundation for further studies in the areas of molecular life sciences, bioengineering, and biotechnology.
Semester	4

Credits	Total	Theory	Practical
	4	3	1

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5
Pre-requisites, if any	Basic understanding of cell structure in plants, process of cell division and knowledge of experiments that led to the discovery of genetic material					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Illustrate the structure and function of plant cell wall and cell organelles	U	3
2	Explain the structure of chromosomes, DNA and RNA, and their behaviour during cell cycle	U	3, 4
3	Analyse the gene regulatory network and inheritance in organisms and the role of enzymes regulating cell activities	An	3
4	Identify the stages of mitosis and calculate the mitotic index in *Allium* root tips	A, S	3,4

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	History and Scope of Cell and Molecular biology; Major developments in Cell and Molecular Biology.	1	1
	1.2	Composition, structure and functions of cell membrane – Fluid mosaic model	2	1
	1.3	Structure and Major Functions of the following cell organelles: Endoplasmic Reticulum, Lysosomes, Dictyosomes, Vacuole, Ribosomes (Brief Account) and Cytoskeleton. Major Components and Definitions of GERL and Endomembrane System. Structure and Major Functions of Semi-autonomous Cell Organelles - Chloroplast, Mitochondria.	6	1
	1.4	Ultra-Structure of Nucleus, Nuclear Envelope, Nuclear Pore Complex (NPC). Structure and Function of Nuclear lamina and Nucleolus. Morphology of a typical chromosome, Organization of genetic material in chromosomes. Structural organization: Histones, Non-histone proteins, Nucleosomes, Chromatosomes. Chromatin organization in eukaryotes	6	1
2	**Module 2 (15 hours)**			
	2.1	Special Chromosomes: Structure and Function of Polytene and Lamp brush chromosomes.	2	2
	2.2	Types and Organization of Chromatin: Heterochromatin, Euchromatin, Karyotype, Idiogram	1	2

	2.3	Eukaryotic Cell cycle (G1, S, G2, M) Mitosis, meiosis and their significance	3	2
	2.4	Programmed Cell Death (Apoptosis) (Overview). **Activity**: Students may submit appropriate illustrations with short descriptions to explain the different stages of mitosis and meiosis	2	2
	2.5	Basic understanding of Genetic material Types of DNA: A, B and Z DNA, Detailed structure of B DNA, Plastome - Chloroplast DNA. Types and functions of RNA: hnRNA, mRNA, tRNA, rRNA, snRNA and microRNA **Activity:** Prepare a comparative account on the types of RNA and submit for evaluation	3	2
	2.6	DNA replication (prokaryotic): Messelson and Stahl experiment, Role of enzymes - DNA Polymerases, Primases, Helicases, Ligases and DNA Topoisomerases. Brief account of enzymes involved in eukaryotic DNA replication	4	2
	Module 3 (15 hours)			
		Point Mutations: Definitions of Transition Mutations, Transversion Mutations, Silent mutations, Missense mutations, Nonsense Mutations. Molecular basis of point mutations. Definition and Significance of Frameshift mutations. Significance of DNA repair mechanisms in cells. **Activity:** Discuss how mutation in a single nucleotide leads to altered phenotype citing suitable examples.	4	3
3	3.1	Gene expression: Central dogma of molecular biology. Basic mechanism of Transcription in Prokaryotes.	7	3

		Perspective of transcription in Eukaryotes: Split genes, Introns, Exons, Spliceosomes (Definitions and significance). Genetic code, Wobble hypothesis. Post transcriptional modification of mRNA in Eukaryotes; capping, poly adenylation and splicing (brief account). Translation in Prokaryotes and Eukaryotes (brief account)		
	3.2	Regulation of gene expression in prokaryotes by Operons: *Lac* and *Trp* operon.	3	3
	3.3	Endosymbiont hypothesis (Overview), Significance of chloroplast and nuclear DNA in the biosynthesis of RUBISCO.	1	3
4	**Module 4 Practical (30 hours)**			
	4.1	Study of mitosis by squash preparation of *Allium* sp. root tip	30	4
	4.2	Calculate mitotic index of root tips prepared by squash preparation		
	4.3	Identification of various stages of meiosis I using appropriate illustrations		
	4.4	Isolation of plant DNA from appropriate plant specimen		
	4.5	Demonstration (any one) of ● Cell viability using tri-phenyl tetrazolium chloride (TTC). ● Cell counting using hemocytometer ● Observation of cyclosis and Chloroplast in leaf of *Hydrilla* or Staminal hairs of *Rheo discolor*		
	4.6	Submit a report of beneficial/harmful aspects of mutation.		
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. End Semester Examination Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Introduction to Biotechnology**					
Type of Course	**DSE**					
Course Code	**M24BO4DSE200**					
Course Level	**200**					
Course Summary	The course intended to provide an understanding on the process and the current developments in the field of Biotechnology. The course also highlights the application of biotechnology for human welfare..					
Semester	4					
Credits	4					
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		4	-	-	-	4
Pre-requisites, if any	Basic knowledge in cell and molecular biology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Understand the fundamental principles and techniques of plant tissue culture.	U	3
2	Recognize the various methods of micropropagation and their applications in plant propagation and crop improvement	U	4,5
3	Demonstrate a comprehensive understanding of recombinant DNA (rDNA) technology by explaining its principles and tools.	U	3,4
4	Discuss the diverse applications of biotechnology.	A	2,4,5
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			

	1.1	Biotechnology - an overview. Plant tissue culture - basic concepts, totipotency, differentiation, de-differentiation and re-differentiation.	3	1
	1.2	Tissue culture media: Components, role of plant growth regulators in tissue culture. Types of media and examples -solid, liquid, MS, White's, B5 media; Sterilization of equipments, glassware and culture medium, surface sterilization of explants.	5	1
	1.3	Micropropagation: Definition, selection and sterilization of explant, inoculation, culturing, hardening and transplantation.	4	1
	1.4	Learning activity 1. Familiarize with basic steps in micropropagation	3	1
2	**Module 2 (15 hours)**			
	2.1	Methods of micropropagation: - axillary bud proliferation, adventitious regeneration – shoot organogenesis and somatic embryogenesis - direct and indirect. Callus and cell suspension culture.	6	2
	2.2	Types of culture and applications: Embryo culture, anther and pollen culture, Protoplast culture. Production of synthetic seeds.	4	2
	2.3	Advantages and disadvantages of micropropagation - somaclonal variations.	2	2
	2.4	Learning activity 1. Immobilization of whole cells or tissues in sodium alginate	3	2
	Module 3 (15 hours)			
3	3.1	rDNA technology – introduction. Tools used in rDNA technology. Restriction endonucleases and ligases; Cloning vectors and their desirable properties; plasmids, cosmids, phage vectors, Phasmids, artificial chromosomes.	5	3
	3.2	Steps in rDNA technology Isolation of DNA, Cutting and joining of DNA molecules. Transformation and selection of transformants - using antibiotic resistances markers and complementation.	5	3
	3.3	Agarose gel electrophoresis, Southern blotting, PCR and its applications. Uses of refrigerated centrifuges, UV trans-illuminator, gel documentation system and Laminar Air Flow chamber (brief account only).	5	3

	Module 4 (15 Hours)			
4	4.1	Biotechnology in agriculture: Bt crops, nematode resistant crops, herbicide resistant crops, biofortification	4	4
	4.2	Biotechnology in medicine: Human insulin and gene therapy	3	4
	4.3	Biotechnology in marine resources: pharmaceuticals, enzymes	3	4
	4.4	Biotechnology in dairy processing: Bio-preservation (Bacteriosin), Probiotics	3	4
	4.5	Biotechnology in environmental monitoring – super bugs	2	4
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3, 4

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar, assignment **B. End Semester Examination** Theory Total = 70 marks, Duration 2 hrs Part A – 10 out of 12 x 3 = 30 marks Part B – 8 out of 10 x 5 = 40 marks

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	Mar Athanasius College (Autonomous), Kothamangalam FYUGP SYLLABUS					
Programme	**B. Sc. (Honours) Botany**					
Course Name	**Phytotechnology**					
Type of Course	**DSE**					
Course Code	**M24BO4DSE201**					
Course Level	**200**					
Course Summary	The present course focuses mainly on common herbal plants in our locality, their morphological peculiarities, nutritive and medicinal properties. This course also aims for the extraction of major principles of herbal plants in their crude form, also their cultivation, conservation practices and their applied aspects (Herbal Dyes, Organic pesticides, Biofuels).					
Semester	4					
Credits	4					
Course Details	Learning Approach (Hours/Week	Lecture	Tutorial	Practical	Others	Total
		4	-	-	-	4
Pre-requisites, if any	Knowledge in plant biology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Identify the common herbal plants in our locality.	U	1
2	Familiarize with the cultivation, harvesting and post-harvest management of medicinal plants.	U	2,3
3	Identify methods for extracting the various phytochemicals in crude form.	A	4
4	Develop insights into phytotechnology by visiting herbal gardens and research labs	A	5
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Overview of Herbal Medicine: Definition, history, and significance in traditional and modern healthcare.	2	1
	1.2	Botanical Fundamentals: Introduction to plant anatomy, morphology, and physiology relevant to herbal medicine.	3	1
	1.3	Plant Identification: Techniques for identifying medicinal plants in the wild and cultivated settings. Ethnobotany: Exploration of cultural and traditional uses of plants in various regions.	4	1
	1.4	Indian medicine system: Ayurveda, Siddha, Unani, Homeopathy	6	1
2	**Module 2 (15 hours)**			
	2.1	Introduction to Cultivation: Basics of soil preparation, planting, and maintenance for medicinal plants.	3	2
	2.2	Environmental Factors: Understanding the impact of climate, soil type, and geography on plant growth. Organic Cultivation Practices: Sustainable and environmentally friendly methods for growing medicinal plants	5	2
	2.3	Harvesting Techniques: Timing, methods, and best practices for harvesting medicinal plants to preserve potency.	4	2
	2.4	Post-Harvest Handling: Drying, storage, and processing techniques to maintain quality and efficacy.	3	2
3	**Module 3 (15 hours)**			

	3.1	Principles of Extraction: Understanding various extraction methods including maceration, infusion, decoction, and distillation.	3	3
	3.2	Solvents for extraction: Different solvents, solvent selection, concentration, and extraction efficiency.	4	3
	3.3	Quality Control: Methods for assessing the quality, purity and potency of herbal extracts..	4	3
	3.4	Formulation Development: Basics of herbal formulation including dosage and forms, compatibility, and stability	4	3
4	**Module 4 (15 hours)**			
	4.1	Visit to a well-maintained herbal garden such as JNTBGRI, Malabar Botanical Garden and other recognized institutes. (1 day)	7	4
	4.2	Visit to scientific labs regarding extraction, identification of phytochemicals. (1 day)	5	4
	4.3	Submit any 5 medicinal plants with their medicinal uses	3	4
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3,4

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** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar, assignment
	B. End Semester Examination Theory Total = 70 marks, Duration 2 hrs Part A – 10 out of 12 x 3 = 30 marks Part B – 8 out of 10 x 5 = 40 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**BOTANY**
Course Name	**Plant Anatomy and Microtechnique**
Type of Course	**DSC B**
Course Code	**M24BO4DSC202**
Course Level	**200**
Course Summary	This course is an introduction to the basic internal structure of plants, including their cells, tissues, and organs. Students get an insight into the organization of various tissue systems in a plant. Knowledge about the anatomical structure of stem and root of monocot and dicots, changes leading to secondary growth and a basic understanding of wood anatomy will be attained by the end of this course. Students will also develop skills in microscopy and Microtechnique for efficiently handling plant specimens.
Semester	4

Credits	Total	Theory			Practical	
	4	3			1	
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5
Pre-requisites, if any	Basic knowledge about plant structure					

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Discuss the structural features of plant cell, tissues, vascular bundles and stomata.	R	3
2	Identify the primary and secondary structures of plants and their applications in various fields	U	4,5
3	Choose methods for preparing microscopic slides of plant specimens	A	4
4	Gain the skills to differentiate the anatomical structures of plants, and become acquainted with the stains, mounting media, and instruments used in microtechnique.	S	4,5
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Introduction and scope of Plant Anatomy; Structure of plant cell, structure of cell wall	2	1
	1.2	Tissues and tissue systems: Structure and functions of meristematic tissues and permanent tissues (simple and complex), concept of tissue systems: dermal tissues, ground tissues and vascular tissues.	4	1
	1.3	Secretory tissues: glands, glandular hairs, nectaries, hydathodes, Laticifers –articulated and non-articulated	4	1
	1.4	Classification of meristems: Based on location (apical, intercalary and lateral), origin (promeristem, primary and secondary meristem) and plane of division (rib, plate and mass meristem). Apical meristems: Structure of shoot and root apex	3	1
	1.5	Vascular bundles- types: collateral, bicollateral, concentric and radial	1	1
	1.6	Stomata types- anomocytic, anisocytic, paracytic and diacytic	1	1
2	**Module 2 (15 hours)**			
	2.1	Primary structure of stem, root and leaf: Dicot and Monocot.	6	2
	2.2	Secondary Growth: Normal Secondary growth in stem and root.	4	2
	2.3	Wood anatomy: hard wood, soft wood. Growth rings-ring porous and diffuse porous wood. sap wood and heart wood, Tyloses	3	2
	2.4	Applications of anatomy in Plant systematics, forensics, Pharmacognosy and Dendrochronology	2	2
3	**Module 3 (15 hours)**			
	3.1	Microtechnique - Brief Introduction, Scope	1	3
	3.2	Microscopy: Simple and Compound, Parts of compound and dissection microscope	2	3
	3.3	Killing and fixing: Killing and fixing agents and their composition (Farmer's fluid and FAA)	2	3

	3.4	Sectioning-Free hand sectioning-TS, RLS, TLS	2	3
	3.5	Microtomy: rotary and sledge microtome, serial sectioning, applications of microtomy.	2	3
	3.6	Staining – types of stains: acidic, basic and neutral, vital stains, single staining, double staining, Preparation of stains-acetocarmine, safranin and crystal violet	3	3
	3.7	Mounting-temporary, semi-permanent and permanent, mounting media- glycerine, canada balsam, DPX	3	3
4	**Module 4 Practical (30 hours)**			
	4.1	Primary structure of stem and root (dicot and monocot	6	4
	4.2	Anatomy of dicot and monocot leaf (mesophytes)	6	4
	4.3	Identification of stomatal types	6	4
	4.4	Normal Secondary growth in dicot stem and root	6	4
	4.5	Familiarize with stains, mounting medium and instruments used in microtechnique	6	4
5	**Teacher specific course components** (This content will be evaluated internally)			1,2,3

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** A**. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. End Semester Examination Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B. Sc. (Honours) Botany**
Course Name	**Biofertilizers and Biocontrol Agents**
Type of Course	**SEC**
Course Code	**M24BO4SEC200**
Course Level	**200**
Course Summary	The course Biofertilizers and Biocontrol agents is designed in such a way to develop skills in graduate-level students to prepare various types of eco – friendly bioformulations for sustainable agriculture. The course deals with important categories of micro and macroscopic agents that can act as biofertilizers and biocontrol agents, their preparation and application methods.
Semester	4
Credits	3

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	-	-	3
Pre-requisites, if any	Knowledge in biology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No.
1	Explain the different concepts and approaches of sustainable agriculture	U	2
2	Demonstrate the knowledge of various organisms used in sustainable agricultural practices.	U	2,5
3	Compare and evaluate the role of various components of bioformulations.	An	4

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 Hours)**			
	1.1	Sustainable agricultural practices: Definition and concepts, Different approaches of sustainable agriculture/ natural farming: organic farming,	5	1

		Whole farm planning, Minimal cultivation, Environment-friendly agriculture **.** **Learning activity:** 1. Group discussion/Debate – conventional and sustainable agriculture. 2. Prepare and submit a report on various agricultural practices in an agricultural field based on a field visit.		
	1.2	Types of household wastes, manufacturing of biofertilizers using household waste: Procedure – sorting of household waste, composting (biodegradation) – enzymatic method, backward method, composting by microbial inoculation and biological beneficial organisms. Methods to improve the quality of household compost – mineral additives and plant hormones. **Learning activity:** Conduct the preparation of compost from household wastes using the Garden pot composting method or Pipe composting method.	10	1
2	**Module 2 (15 Hours)**			
	2.1	Brief history and concept of Biofertilizers, status, scope, and importance of Biofertilizers. Classification of Biofertilizers – (a) Nitrogen-fixing (b) Phosphorus-solubilising bio-fertilizers or PSB (c) Potash-solubilising bio-fertilizers (d) Plant growth promoting microbes (PGPR). Major groups of microbial biofertilizers – Bacteria (Rhizobium, Pseudomonas) and Fungi (AM mycorrhiza and ectomycorrhiza). Blue-green algae (BGA), Plant-based biofertilizer – Azolla. **Learning activity:** 1.Field exploration for macroscopic biofertilizers.	8	2
	2.2	Brief history and development of Biocontrol agents, Types: Macro biocontrol agents – egg parasitoids (*Trichogramma*) and Microbial biocontrol agents – (a) Bioinsecticides – *Bacillus thuringiensis*, (b) Bio fungicides – *Trichoderma*. Plant-based biopesticides: Neem and tobacco-based products (Brief account only). Commercially available botanical biopesticides – Pyrethrum, *Eucalyptus* essential oil. **Learning activity:** 1. Collect recipes, uses and modes of action of various types of plant-based biopesticides. 2. Conduct a presentation/group discussion on the recipes they collected.	7	2

3	**Module 3 (15 Hours)**			
	3.1	Bioformulations: Definition, components (Active ingredient, carrier material, additive), Types of bioformulations: Solid (granules, wettable powders, wettable granules, dust) liquid (suspension concentrate), encapsulation. Bioformulations for the uptake of nutrients like - Nitrogen, Phosphorus, Potassium, and Iron. Bioformulations as biocontrol agents/ biopesticides: Bacterial, Fungal and Viral. **Learning activity:** 1. Visit a biofertilizer/ pesticide manufacturing industry. 2. Make a comparison chart of the components of commercially available biofertilizers/ biopesticides.	8	3
	3.2	Rhizobium-based biofertilizer production steps: Selection of strain, Mass culture, Carrier preparation, Inoculant production. Formulation of *Trichoderma* as biocontrol agents. Delivery methods of various biofertilizer and biocontrol agents – seed treatment, soil amendment, soil drench, aerial spraying, root dip method. **Learning activity:** 1. Field exploration for plants with root nodules 2. Practice various methods of biofertilizer and biocontrol agent application.	7	3
4	**Teacher specific course components** (This content will be evaluated internally)			1,2,3

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** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc.
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x2 =20 marks Part B – 6 out of 8 x 5 = 30 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Conservation Biology and Sustainable Development**					
Type of Course	**VAC**					
Course Code	**M24BO4VAC200**					
Course Level	**200**					
Course Summary	The course provides a basic overview regarding the concepts in conservation biology. It also gives a basic outlook towards the need for biodiversity conservation and sustainable development. It also creates an awareness regarding the transition to green growth.					
Semester	4					
Credits	3					
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	-	-	3
Pre-requisites, if any	Basic understanding about biodiversity and its significance					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PSO No
1	Describe the concepts in conservation biology	U	2
2	Understand the concepts of biodiversity and its documentation	U	2,4
3	Explain the importance of sustainability and sustainable development	U	2
f******Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*			

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Conservation Biology (15 hours)**			
	1.1	Introduction to conservation Biology –Definition, career prospects in conservation biology, Conservation and management practices	3	1

	1.2	Conservation Techniques-Principles of conservation - ex-situ and in-situ conservation techniques, ecological restoration. Statistical and computational tools used in conservation biology- Population Viability Analysis (PVA), Minimum Viable Population, Decision Analysis and Multiple-Criteria Approaches	7	1
	1.3	Ecotourism-Ecotourism as a tool for conservation and sustainable development, difference between ecotourism and mainstream tourism, guidelines and green practices for ecotourism, impacts of tourism on culture and environment and its management-Examples, positive and negative impacts	5	1
2	**Biodiversity (15 hours)**			
	2.1	Definition, types and importance	3	2
	2.2	Biodiversity loss- Causes, extinction, IUCN account of biodiversity, red data book, rare, endangered and threatened species (RET).	5	2
	2.3	Concept of endemism, Biodiversity hotspots in India.	2	2
	2.4	Biodiversity documentation- Case study- Students have to submit a brief report with geo-tagged photographs of the biodiversity of the nearby locality.	5	2
3	**Sustainable development (15 hours)**			
	3.1	Introduction -aim and impact of sustainable development	3	3
	3.2	Sustainable development - Basic characteristics, Core elements, Principles and Goals	5	3
	3.3	Strategies and policies for sustainable development Examples of Sustainable development in daily life –Wind energy, solar energy, sustainable forestry, bio-composting, biogas production, water efficient fixtures, green spaces and sustainable construction.	7	3
4	**Teacher specific course components** (This content will be evaluated internally)			1,2,3

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** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x2 =20 marks Part B – 6 out of 8 x 5 = 30 marks

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SEMESTER V

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B. Sc. (Honours) Botany**
Course Name	**Angiosperm Systematics and Economic Botany**
Type of Course	**DSC**
Course Code	**M24BO5DSC300**
Course Level	**300**
Course Summary	Angiosperm systematics focuses on systematic arrangement of flowering plants, their evolutionary relationships, and interrelations among different species. Economic botany deals with the morphological characteristics of plant parts that are economically significant, focusing on their usefulness and real-world applications.
Semester	5

Credits	Total	Theory	Practical
	4	3	1

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5

Pre-requisites, if any	Knowledge in general characters of angiosperms

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Analyze plant morphology and evaluate classical and modern plant classification systems using online databases.	An,E	1,2
2	Understand herbarium techniques, basic principles of plant nomenclature and familiarize selected families.	U	2,3
3	Understand the salient features of selected families with their economic importance.	U	1,2
4	Develop skills to identify the morphological characteristics of plants and group them into respective families accordingly.	S	2,5

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

COURSE CONTENTS

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Plant Morphology Leaf morphology- Different types of leaves, Phyllotaxy Inflorescence Racemose-Simple Raceme, Spike, Catkin, Spadix, Corymb, Umbel, Head; Cymose- Simple cyme, monochasial- helicoid and scorpioid, dichasial and polychasial cymes; Special types- Cyathium, Verticillaster, Thyrsus, Hypanthodium and Panicle **Learning activity**: Collect and submit any 5 types of leaves and inflorescence mentioned in the syllabus.	4	3
	1.2	Flower – as a modified shoot Floral Whorls - arrangement, relative position- Symmetry, Aestivation, Placentation. Cohesion and adhesion of essential organs. Floral diagram and Floral Formula.	3	3
	1.3	Types of Fruits Simple fruits - Fleshy, Dry – Dehiscent, Indehiscent and Schizocarpic fruits Aggregate fruits and Multiple fruits. **Learning activity**: Collect and submit different types of fruits mentioned in the syllabus.	3	3
	1.4	Plant Taxonomy History of Plant Classification systems- Artificial System- (Linnaeus - Brief account), Natural System (B & H system- Detailed account), Phylogenetic Systems (E & P system- Brief study), APG (brief account).	3	2
	1.5	Botanical Literature- Floras- Regional and National Floras, Revision & Monographs (Brief account). Online Taxonomic Databases: International Plant Names Index (IPNI), Plants of the World Online (POWO), Botanicus.org (Brief account).	2	5

2	**Module 2 (15 Hours)**			
	2.1	Herbarium technique -Steps in preparation of herbarium, Importance of Herbaria, Major Herbaria - National and International, Virtual Herbaria- Index herbariorum, Botanical Survey of India.	3	4
	2.2	Plant Nomenclature- Binomial, ICN - Introduction & Principles (Brief study), Rule of priority, Author citation, Homonym, Synonym, Basionym.	2	1
	2.4	Type concept- (Holotype, Isotype, Lectotype).	3	1
	2.5	Taxonomic keys- Bracketed and Indented keys (Brief account).	2	1
	2.6	Study the following families of Bentham and Hooker's System with special reference to their vegetative and floral characters; special attention should be given to common and economically important plants within the families Annonaceae, Malvaceae, Rutaceae, Anacardiaceae, Cucurbitaceae.	5	3
3	**Module 3 (15 hours)**			
	3.1	Study the listed families from Bentham and Hooker's System, paying special attention to their vegetative and floral traits, along with noteworthy economically important plants within each family. Leguminosae (Mimosaceae, Caesalpiniaceae and Fabaceae) Apiaceae, Rubiaceae, Asteraceae, Sapotaceae,	6	3
	3.2	Apocynaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Arecaceae, Poaceae.	6	3
	3.3	**Economic Botany** Study following plants with special reference to the botanical name, family, morphology of useful parts and uses - Cereals (Rice, Wheat), Millets (Ragi, Fox tail millet), Pulses (Green gram, Bengal gram), Sugar Yielding (Sugar Cane), Fruits (Banana, Guava/Mango), Vegetables (Carrot, Ladies finger), Tuber crops (Tapioca, Greater Yam), Beverages (Tea, Coffee), Oil yielding plants (Coconut, Ground nut), Fibre yielding (Coir, Cotton), Gums and resins (White dammar, Gum Arabic, Asafoetida) Insecticide yielding plants (Tobacco, Neem).	3	2
4	**Module 4 Practical (30 hours)**			
		Practical (30 hours)	30	4

		1. Explore habitats to identify the inflorescence and fruit types mentioned in the syllabus. 2. Conduct field work for a period of not less than 3 days to familiarize plants under the guidance of faculties and submit a field report with geotagged photos. 3. Visit a recognized herbarium, practice herbarium technique and submit 15 herbarium sheets with a field book. 4. Examine vegetative and floral features of different plants and assign them to respective families mentioned in the syllabus. 5. Collect, identify and submit morphologically useful parts of any 10 plants mentioned in economic botany.		
5	**Teacher specific course components**			

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Plant Physiology and Biochemistry**					
Type of Course	**DSC**					
Course Code	**M24BO5DSC301**					
Course Level	**300**					
Course Summary	The course aims at introducing the physiology of plant systems and indulges the student in finding out various processes that function within the plant body. The course also deals with various biomolecules.					
Semester	5					
Credits	Total	Theory			Practical	
	4	3			1	
Course Details	Learning approach (Hours/ Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5
Pre-requisites, if any	Concept of a plant cell and cell components, Basic chemistry of biomolecules					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No.
1	Understand the concepts of plant-water relations, mineral nutrition, and structure and functions of carbohydrates and lipids.	U	1,2
2	Analyze the structure and function of proteins, mechanisms of enzyme action, and the processes of photosynthesis and transport of photosynthates in plants.	An	1,2,3
3	Explain the process of respiration, physiological roles and applications of major plant hormones, interpret plant responses to various stresses and regulation of flowering.	U, E	2,3
4	Perform experiments related to plant physiological and biochemical processes using standard laboratory techniques and interpret experimental results.	A	2,10
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 Hours)**			
	1.1	Plant water relations: Diffusion, imbibition, osmosis, water potential; Absorption of water - active and passive, apoplastic and symplastic pathways. Role of aquaporins.	3	2
	1.2	Ascent of sap: Cohesion-tension theory. Transpiration – types and significance; anti-transpirants. Guttation.	3	2,3
	1.3	Nutrient elements: Classification based on biochemical functions and Physiological roles. Beneficial elements. Mineral uptake - passive (ion exchange) and active (carrier concept).	3	2
	1.4	Carbohydrates: Classification: mono (glucose and fructose), di (sucrose) and polysaccharides (starch); general structure (Haworth Projection) and functions. Lipids: General features, roles and types of lipids (Simple and Compound, structural and storage lipids).	6	1
2	**Module 2 (15 Hours)**			
	2.1	Proteins: General account of proteins - amino acid, peptide bond. Structural levels of proteins - primary, secondary, tertiary, and quaternary; General functions of proteins Enzymes: classification and nomenclature, mechanism of action (Lock and Key Hypothesis, Induced fit theory). Enzyme inhibition and Factors affecting enzyme action**.**	5	1,5
	2.2	Photosynthesis: Pigments, Photosystems; Light Reactions - cyclic and non-cyclic photophosphorylation. Dark reactions - C3, C2, C4 pathway, CAM. Factors affecting photosynthesis.	8	2,3
	2.3	Translocation of photosynthates: Phloem loading and unloading, polymer trapping (brief account)	2	2
3	**Module 3 (15 Hours)**			

	3.1	Respiration: Anaerobic and Aerobic; Glycolysis, Kreb's cycle, Mitochondrial Electron Transport system, ATP synthesis - chemi-osmotic hypothesis, Respiratory quotient; Factors affecting respiration.	9	2,3
	3.2	Plant hormones: Physiological effect and practical applications - Auxins, Gibberellins, Cytokinins, ABA, and Ethylene.	2	2
	3.3	Stress Physiology: Abiotic (drought, salinity and heavy-metal), Biotic (pathogen) stress, Plant stress response (brief study).	2	2,4
	3.4	Physiology of flowering: Photoperiodism, Vernalization	2	2
4	**Practical (30 Hours)**			
	4.1	**Plant Physiology (20 Hours)** Core Experiments (Any Three): ● Preparation of molal, molar, normal, and percentage solutions and their dilutions ● Separation of plant pigments by TLC/Paper/ Column chromatography. ● Estimation of plant pigments by colorimetry. ● Estimation of Proline in plant tissue under abiotic stress. ● Estimation of Phenol in plant tissues under biotic stress. ● Calculation of stomatal index in mesophytes and xerophytes ● Estimation of rate of photosynthesis ● Measurement of growth using various parameters Demonstration experiments: (Any Four) ● Demonstration of plasmolysis. ● Demonstration of osmosis using osmoscope. ● Demonstration of Oxygen evolution during Photosynthesis. ● Measurement of transpiration rate using Ganong's potometer/Farmer's potometer ● Mohl's half leaf experiment.	20	1,2,3

	4.2	**Biochemistry (10 Hours)** ● General test for carbohydrates – Molisch's test, Benedict's tests / Fehling's test. ● Qualitative test for starch - Iodine test. ● Qualitative tests for proteins in solution – Biuret test/Million's test	10	2,3
	4.3	**<u>Activity</u>** (Any one) ● Design and perform an experiment related to plant physiology. Prepare and submit a report with geotagged photos. ● Prepare and submit a report with your views and conclusions on the latest research in physiology / biochemistry based on journal publications on any topic mentioned in the syllabus (A copy of the original publication has to be submitted with the report. ● Design models representing physiological or biochemical processes taking place in plants and submit them for evaluation. ● Prepare a review article in a selected research area in Physiology and biochemistry and submit for evaluation. ● Retrieve 5 research articles on any selected topic in Physiology/ biochemistry and submit them for evaluation.		
5	**Teacher specific course components**			

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks

	Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B. Sc. (Honours) Botany**
Course Name	**Plant Biotechnology and Introduction to Bioinformatics**
Type of Course	**DSE**
Course Code	**M24BO5DSE300**
Course Level	**300**
Course Summary	The course is designed as a comprehensive exploration to the field of Plant Biotechnology and Bioinformatics. The course aims to familiarize students with the key developments in the sphere of Plant Biotechnology and to discuss the potential applications of biotechnology in crop improvement and for novel uses for plants.
Semester	5

Credits	Total	Theory	Practical
	4	4	-

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		4	-	-	-	4
Pre-requisites, if any	General overview and key concepts of Biotechnology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the basic principles and sequential steps involved in recombinant DNA (rDNA) technology.	U	1,3
2	Develop knowledge and understand the principles and applications of molecular biotechnology	A	1,3
3	Understand the advanced molecular biotechnology tools and techniques and its applications.	A, An	1,2,6,8
4	Apply and utilize bioinformatics tools and biological databases to retrieve, analyze, and interpret molecular and genomic data.	A, An	2,3,10

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 Hours)**			
	1.1	Plant Biotechnology – overview, history and evolution. Introduction to recombinant DNA technology: Steps in rDNA technology (Brief outline). Cloning vectors: structure and applications of pBR322, M13, Ti plasmid, pCAMBIA, Lambda phage, BAC. Expression vectors, Shuttle vector- Brief account only. Restriction Endonucleases: Types I-IV, biological role and application. DNA Ligase: Ligation techniques – cohesive end ligation, blunt end ligation, linker mediated ligation, homopolymer tailing.	8	1, 2
	1.2	Methods of gene transfer: direct gene transfer - electroporation, microinjection, microprojectile /particle bombardment, In-direct gene transfer- Agrobacterium mediated gene transfer.	4	1, 3
	1.3	Selection of transgenics: Selectable markers and Reporter genes (Luciferase, GUS, GFP).	3	1, 2
2	**Module 2 (15 Hours)**			
	2.1	Herbicide resistant plants (RoundUp Ready soybean); transgenic crops with improved quality traits (Flavr Savr Tomato, Golden rice); improved horticultural varieties (Moondust carnations) – Development, salient features and significance.	7	4
	2.2	Role of transgenics in bioremediation (Superbug); Industrial enzymes (Aspergillase, Protease, Lipase); Genetically Engineered Products–Edible vaccine.	4	4
	2.3	DNA sequencing by Sanger's dideoxy method, DNA finger printing and its applications,	4	4
3	**Module 3 (15 Hours)**			

	3.1	Gene editing tools (CRISPR- Cas9) and its role in transgenic plant development and gene function studies (Brief account only) Synthetic biology and plant metabolic engineering for improved crop traits, Developing climate resilient crops (Brief account only)	4	2,4,5
	3.2	Ethical considerations in plant biotechnology IPR and Patents, Types of patents, Patenting biological material, GI tags, Plant breeders' rights (PBRs) and farmers rights. GM Crops - environmental, biosafety and ethical considerations Potential misuse of modern molecular biology tools and techniques, bioweapons, bioterrorism	5	4,5
	3.3	**Activity** Biotechnology instrumentation and Lab visit	6	4
4	**Module 4 (15 HRS)**			
	4.1	An introduction to bioinformatics, objectives and applications of bioinformatics. Biological data bases: types - primary, secondary and composite databases; nucleotide sequence databases – NCBI (GenBank), EMBL, DDBJ; Protein Sequence databases - SWISS-PROT/UNIPROT, PIR; Protein structure database – PDB; Bibliographic database – PubMed, Chemical Structure database:- Pubchem.	8	5
	4.2	Sequence analysis and molecular phylogeny Sequence analysis tools - BLAST and FASTA, Molecular visualisation tools - Pymol /Rasmol . Sequence alignment - Scoring matrices, global and local alignment, Pairwise and multiple sequence alignment; common software used in alignment - MEGA Molecular phylogeny - homologs, orthologs and paralogs; phylogenetic tree - rooted and unrooted tree, advantages of phylogenetic tree, use of MEGA/IQ-TREE	7	5
5	**Teacher specific course components**			

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar, assignment etc.
	B. End Semester Examination (ESE) Theory Total = 70 marks, Duration 2 hrs Part A – 10 out of 12 x 3 = 30 marks Part B – 8 out of 10 x 5 = 40 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Plant Tissue Culture**					
Type of Course	**DSE**					
Course Code	**M24BO5DSE301**					
Course Level	**300**					
Course Summary	The course aims to offer a comprehensive understanding of the principles, techniques, and types of tissue culture, along with its applications and benefits.					
Semester	5					
Credits	Total	Theory		Practical		
	4	4		-		
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		4	-	-	-	4
Pre-requisites, if any	Knowledge in plant cell biology, physiology and biochemistry					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the principles, techniques, and applications of plant tissue culture.	U	1,10
2	Analyze somaclonal variation and protoplast culture techniques and their applications.	An	2,4
3	Explain different tissue culture techniques, and their applications.	U	1,2,3
4	Appreciate germplasm conservation methods and the applications of plant tissue culture.	U	3,5,9

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 Hours)**			
	1.1	Plant Tissue Culture: Historical perspective, basic infrastructure of tissue culture lab. General composition of the tissue culture media and effect of nutrients: carbon source, nitrogen source, phosphate, plant growth regulators, precursors. Effect of environmental factors: light, temperature, Ph, aeration. Propagation in vitro: Techniques and stages of micropropagation (0-IV), Factors affecting micropropagation. Advantages and disadvantages of micropropagation, Applications of tissue culture.	5	1
	1.2	Types of culture: organized structures - shoot tip, node, embryo, unorganized structures - callus, suspension and protoplast cultures (brief study only). Cell culture technique: a) Isolation of single cells: from plant organs, mechanical method, enzymatic method, from cultured tissues. b) Suspension cultures: batch culture, continuous culture (brief study only). c) Synchronization of suspension cultures: physical methods and chemical methods. d) Measurement of growth of cultures: cell counting, packed cell volume, cell fresh weight. e) Measurement of viability of cultured cells: phase contrast microscopy, Evan's blue staining, Fluorescein diacetate method.	6	2
	1.3	Somatic embryogenesis: direct somatic embryogenesis, indirect somatic embryogenesis, factors regulating somatic embryogenesis. Differences between somatic and zygotic embryos. Encapsulation of somatic embryos, synthetic seed production; desiccated and hydrated types. Applications and limitations of synthetic seeds.	4	4
2	**Module 2 (15 hours)**			
	2.1	Origin of soma clonal variation: pre-existing variability, in vitro induced variability. Reasons for soma clonal variation - changes in ploidy level, changes in chromosome structure, gene mutations, gene amplifications, changes in extra nuclear genes, activation of transposable elements, DNA methylation.	7	4

	2.2	Isolation of soma clonal variants. Applications of soma clonal variation.	2	4
	2.3	Protoplast culture: Isolation and purification of protoplasts, culture of protoplasts, cell division and callus formation, plant regeneration.	3	1,5
	2.4	Protoplast fusion (somatic hybridization) - chemical, mechanical, electrofusion. Selection and isolation of heterokaryons, cybrids and their applications. Applications of protoplast culture.	3	4,5
3	**Module 3 (15 hours)**			
	3.1	Anther culture: Androgenesis, pretreatment of anther/pollen grains, media and growth regulators, Induction and stage of pollen development, regeneration, androgenic embryos, factors affecting androgenesis. Microspore culture: protocol, advantages over anther culture. Ovary and ovule culture: Gynogenesis: Developmental stage at inoculation, in vitro maturation of embryo sacs, triggering factors – pretreatment, medium. Applications and limitations of haploid plants.	5	4,5
	3.2	Endosperm culture: Conventional production of triploid plants, Triploid plants and their importance, Advantages and limitations of endosperm culture. Meristem culture: Methods, advantages and applications. Embryo culture: Mature embryo culture, embryo rescue, applications of embryo culture.	5	4,5
	3.4	Production of secondary metabolites Culture conditions for producing secondary metabolites, selection of high yielding lines, elicitation, large scale cultivation of plant cells (brief study only): immobilized cell cultures, free-cell suspension culture, immobilized cell culture, two-phase system culture, hairy root culture. Elicitor induced production of secondary metabolites: methodology of elicitation, biotransformation using plant cell cultures, secondary metabolite release and analysis.	5	5
4	**Module 4 (15 hours)**			
	4.1	Germplasm conservation: Importance, methods of conservation *In situ* and *ex situ* conservation Cryopreservation: Mechanism of cryopreservation, technique of cryopreservation (brief study only): development of sterile tissue cultures, addition of cryoprotectants and pretreatment, freezing, storage,	6	3

		thawing, re-culture, measurement of survival/viability, plant regeneration. Cold storage, low - pressure and low - oxygen storage		
	4.2	Role of tissue culture in biodiversity conservation and economic development. Micropropagation of orchids, forest plants and horticultural plants.	4	5
	4.3	Activity: Sterilization techniques – Surface sterilization, Hot air oven, autoclave, Laminar Air Flow, Filtration Media preparation Inoculation Immobilization of whole cells/tissues in sodium alginate Isolation of anther for culture Visit to a reputed biotechnology/ Tissue culture laboratory.	5	1
5	**Teacher specific course components**			

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar, assignment etc.
	B. End Semester Examination (ESE) Theory Total = 70 marks, Duration 2 hrs Part A – 10 out of 12 x 3 = 30 marks Part B – 8 out of 10 x 5 = 40 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B. Sc. (Honours) Botany**
Course Name	**Bioactive Phytochemicals**
Type of Course	**DSE**
Course Code	**M24BO5DSE302**
Course Level	**300**
Course Summary	This course will provide an understanding about the diversity of bioactive compounds present in plants. Students will also get an insight into the pathways of biosynthesis of these compounds and their significance.
Semester	5

Credits	Total	Theory	Practical
	4	4	-

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		4	-	-	-	4
Pre-requisites, if any	Knowledge in physiology and biochemistry of plants					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Classify plant bioactive compounds, identify their sources, and describe the biosynthetic pathways and significance of alkaloids, terpenoids, and phenolics.	U	2,10
2	Describe the structure, classification and functions of plant secondary metabolites like alkaloids, terpenoids, phenolics and coumarins	U	1,2
3	Explain the applications, ecological and taxonomic roles, and biotechnological production of plant secondary metabolites.	An	3,6
4	Apply appropriate extraction techniques and perform preliminary qualitative and quantitative analysis of plant secondary metabolites.	A	1,10

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 Hrs)**			
	1.1	Introduction: Plants as sources of bioactive compounds, historical perspectives. Common plant families with active principles, parts, Examples of plants with bioactive compounds.	4	1
	1.2	Chemical diversity of bioactive compounds, secondary metabolites	3	1
	1.3	Primary metabolites vs Secondary metabolites – interconnected pathways of synthesis	2	3
	1.4	Brief study of biosynthetic pathways of Alkaloids, Terpenoids and Phenolics	6	3
2	**Module 2 (15 Hrs)**			
	2.1	Alkaloids – introduction, properties, occurrence, structure, classification, functions	3	2
	2.2	Terpenoids – introduction, properties, occurrence, structure, classification, functions	3	2
	2.3	Phenolics – introduction, properties, occurrence, structure, classification, functions	3	2
	2.4	Flavonoids – introduction, properties, occurrence, structure, classification, functions	3	2
	2.5	Coumarins – introduction, properties, occurrence, structure, classification, functions	3	2
3	**Module 3 (15 Hrs)**			
	3.1	Pharmacological uses of plant bioactive compounds	3	4
	3.2	Phytochemicals in cosmetics and Food industry	3	4
	3.3	Ecophysiological significance of phytochemicals	3	4
	3.4	Role of Secondary metabolites in plant taxonomy	3	4
	3.5	Biotechnological approaches to produce bioactive compounds	3	4
4	**Module 4 (15 Hrs)**			
	4.1	Extraction of active principles from plants: methods – hot and cold extraction, Soxhlet extraction, Clevenger; Common solvents used for extraction	5	5
	4.2	Qualitative analysis of secondary metabolites – methods for preliminary analysis	4	5

	4.3	***Activity*** Extraction of bioactive components from plant samples: Hot and cold extraction, Soxhlet extraction Primary screening of bioactive compounds Extraction and estimation of selected secondary metabolites	6	5
5		**Teacher specific course components**		

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar, Assignment etc.
	B. End Semester Examination (ESE) Theory Total = 70 marks, Duration 2 hrs Part A – 10 out of 12 x 3 = 30 marks Part B – 8 out of 10 x 5 = 40 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Food science and quality control**					
Type of Course	**DSE**					
Course Code	**M24BO5DSE303**					
Course Level	**300**					
Course Summary	In this course, students will be familiarized with the components of food and the changes leading to spoilage. They acquire an in-depth understanding of the technologies used to produce safe and nutritious foods as well as the importance of food security. The course will also provide information about the regulations to be followed in food industries and food-related sectors.					
Semester	5					
Credits	Total	Theory		Practical		
	4	4		-		
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		4	-	-	-	4
Pre-requisites, if any	Basic understanding of the structure of carbohydrates, proteins and fats as components of food					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the composition of food, different types, and analyse their nutritional and functional significance.	U/An	1,2
2	Identify and classify food additives, detect common food adulterants, analyse the health hazards and food-borne diseases associated with contaminated food.	An	2,6,8
3	Analyse the causes and mechanisms of food spoilage and apply appropriate preservation methods and preservatives to enhance food safety and shelf life.	An/A	1,2,8
4	Explain the principles of quality control and evaluate food safety standards and regulatory systems used in the food industry.	U/E	2,9

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Composition and Types of food (14 hours)**			
	1.1	Introduction and scope of Food science Composition of food: ● Carbohydrates- Major sources and functions. ● Proteins-Major sources and functions. ● Lipids-Saturated and unsaturated fatty acids, Dietary sources, functions of fats. Fiber – Dietary sources, functions	5	1
	1.2	Minerals- Calcium, Phosphorus, Magnesium, Sodium, Potassium etc Vitamins- fat soluble and water soluble	2	1
	1.3	Enzymes- Amylase, Protease, Lipase, Phytase, Lipoxygenase, Pectic enzyme Pigments-Chlorophylls, Carotenoids	3	1
	1.4	Types of food- Nutraceuticals, Probiotics, Prebiotics, GM food, Organic food, Traditional food, Fermented food	4	1
2	**Food additives, Food adulteration and Food borne diseases (15 hours)**			
	2.1	Food additives: Food colours, Sweeteners, Gelling agents, Flavour enhancers, Surface acting agents, Bleaching agents, Stabilizers, and Thickeners Activity: Carry out a market survey of additives used in different types of foods, classify them based on their role and present your findings as PowerPoint presentations.	5	1,2
	2.2	Food adulteration: Definition, Common adulterants in food, Reasons for adulteration	1	2
	2.3	Testing adulteration in milk, ghee, sugar, salt, tea, coffee, chili powder, turmeric powder, sweets, poultry and fish (Brief account) Hands on training on Adulteration testing of milk, chilli powder and tea (market sample)	9	2
	2.4	Harmful effects of food adulteration	1	2
	2.5	Food borne illness and diseases associated: Food poisoning, Botulism, Ergotism, Staphylococcal intoxication, Mycotoxicosis	3	1,2
3	**Food spoilage and preservation (14 hours)**			
	3.1	Food spoilage: reasons for food spoilage, Physical and Chemical changes in food that affect texture, flavour, odour, stability and nutritive value during processing and storage.	2	3
	3.2	Food preservation methods: asepsis, removal of microorganisms, Drying, smoking, low temperature, high temperature, Canning, vacuum filling, UV radiation	8	3,4

		Activity: Familiarize with different preservation methods employed for preservation of vegetables, fruits, cereals, and pulses- Submission of report		
	3.3	Food Preservatives: Salt, Vinegar, Sugar, Benzoates, Sorbates, Nitrates, Propionates, Antioxidants, Antibiotics, Antifungal preservatives	4	4
4	**Quality control in Food industry (13 hours)**			
	4.1	Quality control (QC) in food industry, major concepts of QC, Significance	3	1,3,5
	4.2	Food safety Standards and Regulations-ISO 22000, HACCP, FSSAI, GMP, AGMARK Visit any Food industry/Food processing unit that follows food safety standards and regulations and submit a report	7	1,3,5
	4.3	Quality control activities-Sampling and Inspection, Certification, Testing laboratories	3	1,3,5
5	**Teacher specific course components**			

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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar, Assignment etc.
	B. End Semester Examination (ESE) Theory Total = 70 marks, Duration 2 hrs Part A – 10 out of 12 x 3 = 30 marks Part B – 8 out of 10 x 5 = 40 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Mushroom Production and Value Addition**					
Type of Course	**SEC**					
Course Code	**M24BO5SEC300**					
Course Level	**300**					
Course Summary	The present course encompasses various aspects of mushrooms focusing on their importance as a valuable food supplement. The course also deals with various aspects of mushroom cultivation including the process, requirements and post-harvest steps. The value addition and marketing strategies connected to this field are also included.					
Semester	5					
Credits	Total	Theory		Practical		
	3	3		-		
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	-	-	3
Pre-requisites, if any	General awareness in science					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain the morphology, identification, nutritional value, health benefits, and cultivation significance of mushrooms.	U	1,10
2	Demonstrate mushroom cultivation techniques and its management practices.	A, S	2,4,5
3	Analyze post-harvest processing, value addition, marketing strategies, and entrepreneurship opportunities.	An, S	6,9

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	General characters and morphology of mushrooms. Distinguishing characters of button, oyster and milky mushrooms.	3	1
	1.2	Identification of mushrooms - edible and poisonous. Scope and significance of mushroom cultivation	3	1
	1.3	Nutritional profile of mushrooms- Carbohydrates, proteins, amino acids, vitamins, minerals, fats and fibre.	2	2
	1.4	Health benefits of Mushrooms-anti-tumour, antiviral and antibacterial effect, in therapeutic diet (brief study)	2	2
	Module 2 (15 hours)			
2	2.1	Mushroom cultivation: Requirements, structure and construction of mushroom house, Sanitation and sterilization	2	2, 4
	2.2	Spawn preparation- requirements, spawn substrate selection, isolation of pure culture and nutrient media for pure culture, maintenance and storage of spawn. **Learning activity**: Demonstration of mushroom bed preparation/spawn preparation	5	2, 4
	2.3	Cultivation of Milky Mushroom (*Calocybe indica*), and Oyster Mushroom (*Pleurotus* sps.) using paddy straw. **Learning activity**: Training in Oyster mushroom cultivation	5	2,4
	2.4	Pest and disease management in mushroom cultivation (brief account), Spent mushroom substrate utilization-fodder, compost.	3	1, 2
3	**Module 3 (15 hours)**			
	3.1	Post-harvest processing of mushrooms- refrigeration / instant packing, freeze drying, dehydration, canning	2	3, 4
	3.2	Value-added products from mushrooms – soup powder, biscuits, chutney powder, pickles.	2	3, 4, 5
	3.3	Marketing strategies for mushroom products	1	4, 5

	3.4	Major problems in mushroom cultivation and solutions. self-employment schemes, Government aids **Learning activity:** Expert interaction and live bed preparation	10	4, 5
4	**Teacher-specific course components**			

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** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc.
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x2 =20 marks Part B – 6 out of 8 x 5 = 30 marks

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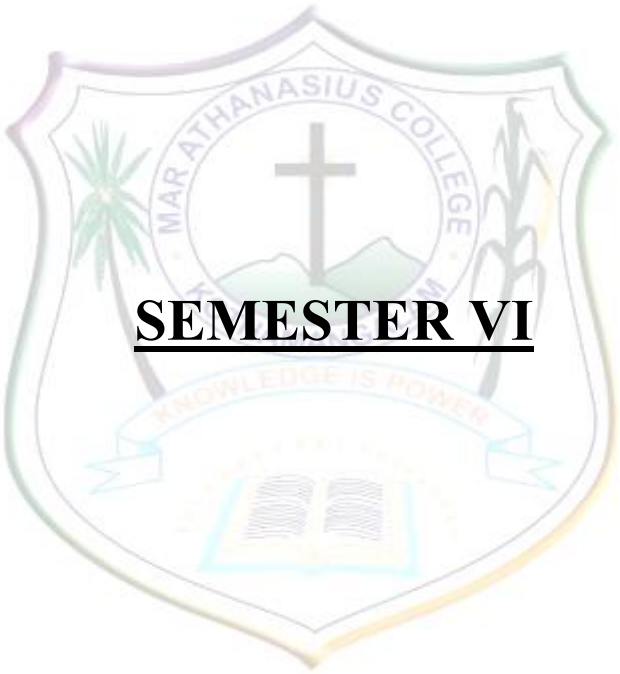

SEMESTER VI

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Plant Anatomy and Developmental Biology**					
Type of Course	**DSC**					
Course Code	**M24BO6DSC300**					
Course Level	**300**					
Course Summary	The course Plant anatomy and reproductive botany equip students with a deep understanding of the intricate structures and developmental processes in plants, enabling them to appreciate the complexity and beauty of plant life and its significance in the natural world.					
Semester	6					
Credits	Total	Theory		Practical		
	4	3		1		
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5
Pre-requisites, if any	Knowledge about structure of vegetative and reproductive parts of plants					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe plant cell and tissue organization, primary and secondary growth in plants.	U	1
2	Discuss secondary structure of stem, wood characteristics and their applications.	An	1,2
3	Explain sexual reproduction, apomixis and polyembryony in plants.	U	1
4	Prepare plant anatomical sections, conduct basic reproductive experiments, and document vegetative and floral structures using standard laboratory methods.	A	2

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Plant cell general view; Cell wall: Definition, Functions, Chemical composition of cell wall. Structure and function of plasmodesmata, simple and bordered pits, Growth of cell wall - apposition, intussusception**.**	3	1
	1.3	**Tissues:** Meristematic tissue – characteristic features, functions and classification. Permanent tissues - structure and function of simple and complex tissues. Secretory tissues: external secretory tissue - glands and nectaries; internal secretory tissues - laticifers.	4	2
	1.4	**Tissue systems:** Epidermal tissue system - epidermis, cuticle, trichomes; stomata – structure, types; bulliform cells. Ground tissue system - cortex, endodermis, pericycle, pith and pith rays. Vascular tissue system - structure of xylem and phloem, different types of vascular bundles and their arrangement in root and stem.	3	2
	1.5	Primary structure of stem and root (monocot and dicot) Normal secondary growth in dicot stem and root. Steps in secondary thickening: Intra-stelar secondary thickening, formation of cambium, structure and function of cambium, activity of cambium, role of cambium in wound healing, budding and grafting.	5	3
	Module 2 (15 hours)			
	2.1	Extra stelar secondary thickening: periderm – structure and development, bark, lenticels; factors affecting cambial activity, Seasonal activity of cambium, annual rings. Dendrochronology.	5	3
	2.2	Anomalous secondary thickening (general account).	2	3
	2.3	Types of wood; heartwood, sapwood, hard wood - porous nature, softwood - non porous nature (Brief study). Reaction wood: tension wood and compression wood.	2	4

	2.4	Identification of wood – using physical, microscopic, and macroscopic features. Identification of - fragmentary plant material as adulterants in crude drugs, food adulterants and contaminants. Archaeological plant remains and prediction of ancient climatic conditions. Forensic investigations evidence, and taxonomic significance characters. Wood modification technologies for industry (Brief account only). Relevance of anatomical studies in crop science.	6	4
3	**Module 3 (15 hrs)**			
	3.1	Flower as a reproductive structure, floral parts, and their roles.	1	5
	3.2	Microsporangium and male gametophyte, Microsporangium: structure and development of anther, microsporogenesis, Male gametophyte development, dehiscence of anther, structure of pollen.	3	5
	3.3	Megasporangium and female gametophyte, Megasporangium: Types of ovules – anatropous, orthotropous. Megasporogenesis – female gametophyte – structure of a typical embryo sac, types of embryo sacs - monosporic (Polygonum type).	4	5
	3.4	Fertilization: Mechanism of pollination, agents of pollination. Pollinators and global food security. Pollen pistil interaction, germination of pollen grains; double fertilization.	3	5
	3.5	Endosperm and Embryo development: Endosperm: types – cellular, nuclear and helobial. Embryogeny, structure of dicot and monocot embryo, fruit & seed formation. Polyembryony; Apomixis.	4	5
4	**Module 4. Practical (30 hrs)**			
	4.1	I. Select and conduct any two of the following learning activities a/b/c/d (Individual/Group): a. Submission of an assignment on anatomical organization of the plant body based on the higher secondary level syllabus.	20	1, 3, 4

		b. Collect herbaceous members of dicot and monocot – prepare stained sections of root, stem, leaves, and flower bud. c. Prepare photographs of each and locate – Tissue types, epidermal, ground, and vascular tissue systems. d. Identify locally available plants with secretory tissues and prepare a report/ poster/audiovisual document. I. Micro preparation of dicot and monocot root and stem (Primary/Secondary). II. Micro preparation of *Bignonia/Boerhavia* stem after secondary thickening.		
	4.2	I. Dissect a flower and document (photograph/illustration) II. Identification of C.S of the anther. III. Identification and documentation of anther dehiscence pattern in five locally available plants. IV. Pollen viability tests – Acetocarmine test / Tetrazolium test. V. Stigma receptivity test VI. Pollen germination test - Sugar solution test. VII. Dissection of dicot embryo.	10	5
5	**Teacher specific course components**			
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, group discussions, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.			
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.			

	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Research Methodology, Biostatistics and Computer Application**					
Type of Course	**DSC**					
Course Code	**M24BO6DSC301**					
Course Level	**300**					
Course Summary	The course discusses various aspects of research – like how to find a research problem, the major sources of literature for research, the major steps in research, methods of report writing, use of ICT and statistics in research.					
Semester	6					
Credits	Total	Theory		Practical		
	4	3		1		
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5
Pre-requisites, if any	Knowledge in science, numerical skills, and exposure to computer					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the fundamentals of research and research methodology.	U	1,2
2	Apply various computer programs in research.	A	1,2,3
3	Apply digital presentation tools, online academic resources, and fundamental statistical techniques in research.	A	2,3
4	Apply suitable tools and techniques for data analysis and preparation of scientific reports.	U, A	2,10

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Objectives of research. Types of research - pure and applied. Identification of research problem, formulation of hypothesis – Null hypothesis and alternate hypothesis.	3	1
	1.2	Major steps, purpose, literature sources, names of reputed National and International journals in life science (Minimum 2 international & 3 national); reprint acquisition – INFLIBNET, PubMed, NCBI.	5	1,2
	1.3	Definition of the problem; Identification of the objective(s); literature review (brief account only), introducing working hypothesis, design of the study – basic principles and significance; sampling for data – methods, Identification and collection of data, types of data – Primary and Secondary; Collection of primary data – observation method, interview method, questionnaire method, through schedules; analysis and interpretation of data, Report writing (Brief account).	7	2,3
2	**Module 2 (15 hours)**			
	2.1	Preparation of dissertation - IMRAD system - Preliminary pages – Title pages – Certificate, Declaration, Acknowledgement, Table of contents, Abstract; Main text - Introduction and review of literature, Materials and methods, Results, Discussion, Conclusion; End matter – Bibliography and Appendix.	3	3
	2.2	Basic components of a computer – concept of Hardware and Software, Major Operating Systems: Proprietary: Windows, Macintosh and Open source: Linux. Application suit – M.S Office (Brief introduction).	4	4
	2.3	MS WORD - Word Processing - creating a new document, saving a document, exporting to pdf, opening an existing document, basic text editing;	4	4

		Editing tools – cut, copy, paste, find, and replace, undo and redo; Formatting tools – font formatting, paragraph formatting, bullets and numbering, styles, page formatting. Track change		
	2.4	MS EXCEL - creating worksheet, data entry, sorting data. Statistical tools (SUM, AVERAGE, MEDIAN and MODE). Preparation of graphs and diagrams (Bar diagram, Pie chart, Line chart, Histogram).	4	3,4
3	**Module 3 (15 hours)**			
	3.1	MS-POWERPOINT: Steps of preparation of presentation based on a topic from biology, which includes Tables, Charts, and Images. Ideal characteristics of a presentation slide set for scientific purposes using a model template.	2	4
	3.2	LibreOffice – Writer, Calc, Impress; Open Office (brief study). Search engines: Google.com; meta-search engine – Metacrawler; academic search engine - Google scholar. Educational sites related to biological science – Scitable, DNAi.	4	4
	3.3	Statistical terms, and symbols (Brief study only). Sampling: concept of sample, sampling methods - random and non-random sampling.	2	5
	3.4	Diagrammatic and graphical representation - line diagram, bar diagram, pie diagram, histogram, frequency curve.	2	5
	3.5	Measures of central tendency: mean, median, mode, (discrete and continuous series). Measures of dispersion: standard deviation. Probability and distribution patterns: normal distribution, binomial distribution. Tests of significance (t–test/Chi-square test).	5	5
4	**Module 4 Practical (30 hours)**			
	4.1	Preparation of a list of references (not less than 10) on a given topic of biological science. Preparation of Review on a given topic using online and print resources.	5	1,2

	4.2	Collect information on a topic related to biological science using the internet and make a report based on the collected information (Using M.S WORD / Libre Office Writer)	3	2,3
	4.3	Collect a compound leaf with at least 25 leaflets of varying sizes from a plant, measure the length of each leaflet, and conduct the following works using M.S Excel/ Libre Office Calc and record: (a) Prepare data table/frequency table in M.S Excel / Libre Office Calc (b) Prepare bar diagram (c) Prepare Line chart (d) Prepare a Pie chart (e) Prepare Histogram Collect data on a particular topic using online or print questionnaires and perform the following activities in M.S Excel / LibreOffice Calc and record. (a) Calculate the average of variables (b) Calculate the median of variables (c)Calculate the mode of variables. Prepare a worksheet using a set of data collected and find out the SUM.	15	3,4
	4.4	Preparation of PowerPoint presentation using M.S PowerPoint / LibreOffice – Impress, based on a given topic. Problems related to a. Measures of central tendency b. Measures of dispersion c. Probability d. Test of significance (t – test/Chi-square test)	7	4,5

5	**Teacher specific course components**

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** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**
Programme	**B. Sc. (Honours) Botany**
Course Name	**Microbial Biotechnology**
Type of Course	**DSE**
Course Code	**M24BO6DSE300**
Course Level	**300**
Course Summary	The course in Microbial Biotechnology introduces students to the fundamental principles and techniques underlying the manipulation of microorganisms for various industrial and agricultural applications. Students explore the history and applications of fermentation processes, including aerobic and anaerobic fermentation, as well as submerged and solid-state fe rmentation, along with the factors influencing them.
Semester	6

Credits	Total	Theory	Practical
	4	3	1

Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	2	-	5
Pre-requisites, if any	Basic knowledge in microbiology and biotechnology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Explain principles of microbial biotechnology.	U	1,10
2	Understand the principles, types, and processes of fermentation.	U	2,4
3	Analyze the industrial production of microbial metabolites, food products, and single-cell protein.	An	2,4
4	Develop skills for microbial isolation and biochemical identification techniques.	S	3,5,9

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Microbial biotechnology, scope and techniques. Industrially important microorganisms, Gene transfer mechanisms in microbes, Transformation, transduction, conjugation and recombination.	5	1
	1.2	Genetic variability in microorganisms. Biotechnological tools to improve the microbial strains with respect to industry and agriculture.	2	1,2
	1.3	Microbial Growth: Definition, salient features of growth curve, generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxic growth curve.	8	1,2
2	**Module 2 (15 hours)**			
	2.1	Brief history of fermentation, Fermentation-general concepts, Applications of fermentation	2	2,3
	2.2	Range of fermentation process- Microbial biomass, enzymes, metabolites, recombinant products, transformation process, Component parts of a fermentation process.	5	3.4,5
	2.3	Types of fermentations- Aerobic and anaerobic fermentation, Submerged and solid-state fermentation, Factors affecting submerged and solid-state fermentation, Substrates used in SSF and its advantages, Culture media- types, components and formulations. Sterilization: Batch and continuous sterilization.	8	4,5
3	**Module 3 (15 hours)**			
	3.1	Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols. Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Enzymes.	7	3,4

	3.2	Exploitation of microorganisms and their products (curd, cheese, beer, alcohol, yoghurt). Single cell protein: microorganisms used; raw material used as substrate, condition for growth and production; nutritive value and uses of SCP. Baker's yeast; Production of probiotic biomass; and mold cultures. Mushroom production: cultivation of mushroom; edible mushroom.	8	3,4
4	**Module 4 Practical (30 Hours)**			
	4.1	Laboratory Activities (Conduct Any Three) 1. Isolation of microorganisms from different sources – air and water. 2. Isolation of microbes by serial dilution and pour plate/ spread plate method 3. Isolation of microbes by streak plate method 4. Microbiological examination of foods. i) Isolation and enumeration of bacteria and fungi from fresh and spoiled fruits. (ii) Isolation and enumeration of bacteria and fungi from fresh and spoiled vegetables. (iii) Isolation and enumeration of bacteria from fruit juices. 5. Effect of food preservatives on the growth of microbes. 6. IMVIC test 7. Oxidase test 8. Catalase test 9. Litmus milk test 10. Hydrogen sulphide test 11. Carbohydrate fermentation test	20	4,5
	4.2	Laboratory/Industry visit: Students are expected to conduct a visit to a sophisticated biotechnology laboratory/ research centre/ biotechnology industry to have an idea on the type of work going on there. A report on the visit should be prepared and submitted.	10	3,4
5		**Teacher specific course components**		

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** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc. Practical Total = 15 marks Lab performance, record, field report etc.
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x 2 =20 marks Part B – 3 out of 5 x 6 = 18 marks Part C – 1 out of 2 x 12 = 12 marks Practical Total = 35 marks; Duration- 2 hrs Record 10 marks, Examination 25 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Genetics and Evolution**					
Type of Course	**DSE**					
Course Code	**M24BO6DSE301**					
Course Level	**300**					
Course Summary	This course provides a comprehensive exploration of the fundamental principles underlying genetics and evolution. Students will delve into the molecular basis of inheritance, the mechanisms of evolution, and the interconnectedness of these fields. Through theoretical discussions, practical applications, and case studies, participants will gain a deep understanding of how genetic processes drive evolutionary change.					
Semester	6					
Credits	Total	Theory		Practical		
	4	4		-		
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		4	-	-	-	4
Pre-requisites, if any	History of genetics and contributions of Gregor Johann Mendel. Concept of gene and chromosome.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand principles of Mendelian and non-Mendelian inheritance.	U	1,2
2	Describe multiple allelism, linkage, crossing over, and patterns of extra-chromosomal and quantitative inheritance.	U	1,2,3
3	Explain mechanisms of sex determination and patterns of sex-linked inheritance and population genetics.	U, An	1,2,6
4	Describe the process of organic evolution.	U	1,2,6

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	a) Terms & Concepts – chromosome, gene, allele-dominant and recessive, locus, genotype & phenotype, chromosome theory of inheritance, cross-monohybrid & dihybrid, testcross, backcross b) Principles of Mendelian Inheritance-Dominance, Segregation, and Independent Assortment. c) Model genetic organisms- *Neurospora crassa*, and *Arabidopsis thaliana* (mention only their importance in genetic study)	5	1
	1.2	Modifications of Mendelian ratios a) Incomplete dominance: Example - flower colour in *Mirabilis jalapa.* b) Co-dominance: Example - MN blood type in humans. c) Lethal genes: Example - pigmentation in Snapdragon. d) Epistasis: - Dominant epistasis: Example - fruit colour in summer squashes; Recessive epistasis – coat colour in mice **Learning activity:** ● Workout Problems related to monohybrid cross, dihybrid cross, modified Mendelian ratios.	10	1
2	**Module 2 (15 hours)**			
	2.1	a) Complementary gene interaction: Example - flower colour in *Lathyrus odoratus*. b) Multiple alleles: definition, example –Blood grouping in human ABO, Self-sterility in *Nicotiana tabaccum*. **Learning activity:** ● Workout Problems related to complementary gene action and multiple alleles.	5	1
	2.2	a) Linkage – chromosome theory of linkage; complete and incomplete linkage. b) Crossing Over –mechanism of crossing over; types of crossing over – single, double and multiple; recombinant & non-recombinant gametes	5	2

		c) Linkage mapping, recombination frequency & map units; interference & co-incidence.		
	2.3	a) Extra chromosomal inheritance- cytoplasmic inheritance- Example: - leaf variegation in *Mirabilis jalapa,* Maternal effects - shell coiling in snail b) Quantitative inheritance: - polygenic; continuous traits. Example: ear size in maize; Quantitative trait Loci.	5	1,2
3	**Module 3 (15 hours)**			
	3.1	a) Chromosomal mechanism of sex-determination: XX-XY, XX-XO, ZZ-ZW, Haplo-Diplo system, genic balance system. b) Environmental Sex Determination: Sex determination in slipper limpet and reptiles c) X-linked inheritance - Haemophilia in man; Y-linked inheritance – Holandric gene d) Sex-limited Inheritance – Example-feathering pattern in Fowl; Sex-influenced Inheritance - Example – Baldness in humans e) Mechanisms of sex determination in plants- *Melandrium* (emphasis on Epigenetic inheritance)	10	3
	3.2	Concept of Population, Allelic frequency, genotypic frequency; Hardy- Weinberg Equilibrium and the factors affecting the equilibrium. **<u>Learning activity:</u>** Problems based on Hardy- Weinberg equation	5	4
4	**Module 4 (15 hours)**			
	4.1	a.) Origin of life- biochemical origin of life (Miller's Experiment). Theories of evolution -Darwin's theory and modern synthetic theory. Evidences for evolution- (brief study) b.) Character evolution; Microevolution and macroevolution; Convergent, divergent, and parallel- evolution- (definition with examples)	7	5
	4.2	a.) Biological Species concept; speciation - genetic divergences and isolating mechanisms- geographical isolation &	8	5

		reproductive isolation (prezygotic and postzygotic- isolation mechanisms)- (brief study) b.) Patterns of speciation- allopatric, sympatric, Peripatric, parapatric and quantum speciation - (brief study) c.) Population bottleneck and founder effect		
5	**Teacher specific course components**			

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** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar, Assignment etc.
	B. End Semester Examination (ESE) Theory Total = 70 marks, Duration 2 hrs Part A – 10 out of 12 x 3 = 30 marks Part B – 8 out of 10 x 5 = 40 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Phytogeography, Forestry and Ecotourism**					
Type of Course	**DSE**					
Course Code	**M24BO6DSE302**					
Course Level	**300**					
Course Summary	The course 'Phytogeography, Forestry and ecotourism' deals with the study of distribution of plant community, its management and conservation.					
Semester	6					
Credits	Total	Theory		Practical		
	4	4		-		
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		4	-	-	-	4
Pre-requisites, if any	Basic concepts of ecology					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Analyze ecological factors influencing plant growth and phytogeography.	An	1,2,6
2	Explain patterns and theories of plant distribution and the application of remote sensing and GIS in vegetation studies.	U, An	1,2,9
3	Analyze forest classification, sustainable forest management practices, and the importance of biodiversity conservation.	An	2,7,10
4	Examine the principles and impacts of ecotourism.	A, An	6,7,8

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Ecological complexes and factors affecting plants growth and distribution. Biotic factors: interactions – positive and negative	3	2
	1.2	Topographic factors: altitude and aspects. Edaphic factors – soil profile and physical and chemical properties of soil, soil formation	4	2
	1.3	Climatic factors: temperature and pressure, water - precipitation, humidity, soil water holding capacity, light - global radiation	3	2
	1.4	Morphological, anatomical, and physiological adaptation of plants to the environment with references to biomes.	5	2
2	**Module 2 (15 hours)**			
	2.1	Definition, principles governing plant distribution, factors affecting plant distribution	2	1
	2.2	Plant distribution- distribution of plants- continuous, discontinuous, and endemic. Theories of plant distribution – migration hypothesis, long distance dispersal hypothesis, theory of continental drift, age area hypothesis, land bridge theory.	5	1
	2.3	World Biomes - aquatic and terrestrial, Climatic, vegetational and botanical zones of India.	3	1
	2.4	Remote sensing - Definition and data acquisition techniques. Application of remote sensing in vegetation classification, understanding environmental issues and ecosystem management. Geographic information system (GIS).	5	1
3	**Module 3 (15 hours)**			
	3.1	Introduction to forestry: Classification of forests (Champion and Seth, 1968). Major types of forests in India. Silviculture; principles and practices- clear felling system, coppice system. Common plants in silviculture. Sustainable forest management approaches with reference to Kerala - timber plantation, agroforestry, social forestry, JFM	5	3,4
	3.2	Forest Ecosystems and biodiversity- Forest ecology and ecosystem services. Biodiversity- definition, values of biodiversity, levels of biodiversity. Biodiversity loss, Concept of endemism. Types of endemism.	5	3
	3.3	Species extinction – Rate of species extinction, reasons to stop extinction- methods to save species. Threats to forest biodiversity, IUCN- threat categories. IUCN account of biodiversity, red data book and hot spots.	5	4

	Module 4 (15 hours)			
4	4.1	Ecotourism definition, Elements and characteristics of ecotourism. Types of ecotourism – Heritage ecotourism, coastal ecotourism, cultural ecotourism, festival ecotourism, ayurvedic ecotourism. positive and negative impacts of ecotourism.	7	5
	4.2	Major ecotourism centers in Kerala – Gavi, Thattekadu, Thenmala. Learning activity: Visit an ecotourism center and identify the ecotourism components of the ecotourism and submit a report.	4	5
	4.3	Wildlife tourism and its opportunities with reference to Kerala- Periyar tiger reserve, Tholpetty wildlife sanctuary	4	5
5	**Teacher specific course components**			

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** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 30 marks Quiz, Test Papers, seminar, Assignment etc.
	B. End Semester Examination (ESE) Theory Total = 70 marks, Duration 2 hrs Part A – 10 out of 12 x 3 = 30 marks Part B – 8 out of 10 x 5 = 40 marks

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	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Entrepreneurial Botany**					
Type of Course	**SEC**					
Course Code	**M24BO6SEC300**					
Course Level	**300**					
Course Summary	The course aims to prepare the students for an entrepreneurial journey by giving an overview of entrepreneurship. The course discusses the process of developing an independent idea into ventures. Different areas of opportunity will also be addressed.					
Semester	6					
Credits	Total	Theory		Practical		
	3	3		-		
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	-	-	3
Pre-requisites, if any	Basic knowledge in botany and its applications					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Analyze and evaluate opportunities and challenges in botanical entrepreneurship, particularly in the Kerala context.	An	1,5,8
2	Understand the principles of value addition in plant-based products and the role of government schemes and support systems in promoting entrepreneurship in Kerala.	U	5,7
3	Understand various government initiatives and support mechanisms that promote entrepreneurship, including schemes for marginalized communities.	U	5,9,10

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

COURSE CONTENT

Module	Units	Course description	Hours	CO No.
1	**Module 1 (15 hours)**			
	1.1	Types and Characterization of Botanical Entrepreneurship. Exploring various types, including agribusiness, bio ventures and aesthetics. Characterizing ventures based on botanical products.	3	1, 5
	1.2	Need, Entrepreneurial Values, Motivation, and Barriers- Analysing the socio-economic factors driving entrepreneurial endeavours in botany. - Identifying values, motivation factors, and overcoming	2	1,2
	1.3	Entrepreneurship as Innovation, Risk Assessment, and Solutions- Examining the role of innovation in botanical entrepreneurship. Assessing risks specific to botanical ventures and proposing strategic solutions.	2	2
	1.4	Overview of Key Botanical Industries in Kerala Exploration of *Spirulina*, edible mushrooms, cashew, spices and coconut industries within the Kerala context.	3	2,3
	1.5	Case studies on successful ventures like Jackfruit 360 ,Vegrow and Synthite Biotech startups and support mechanisms Zaara Biotech, KDISC, Bio 360- Life science park, BioNest	3	4
	1.6	Exploring the market for ornamental plants and flowers in Kerala. Opportunities and challenges specific to the aesthetics industry in the state.	2	2
2	**Module 2 (15 hours)**			
	2.1	Preservation and products: Canning and Processing of Fruits in Kerala -Overview of fruit canning processes and equipment, with a focus on Kerala's fruit varieties. Adapting processes to meet the unique demands of the Kerala fruit market.	2	2
	2.2	Fruit and vegetable-based products- production of juices, squashes and other fruit-based products considering Kerala’s agricultural landscape	2	2
	2.3	Bamboo and cane-based products Plant based nutraceuticals, and oils- Herbal medicines and cosmetics	2	2

	2.4	Kerala Startup mission- schemes, support systems Start Up India. Overview of the Start Up India initiative, promoting innovation and entrepreneurship. Analyzing the support mechanisms provided to startups and success stories.	4	3,4
	2.5	MUDHRA Yojan- Overview, its role in funding micro enterprises. Practical insights into the application process and eligibility criteria. Stand Up India: Exploring the Stand-Up India scheme and its focus on promoting entrepreneurship among women and SC/ST communities.	5	3
3	**Module 3 (15 hours)**			
	3.1	Understanding the SC/ST Hub initiative and its role in supporting entrepreneurs from marginalized communities. Examining how the SC/ST Hub facilitates access to finance, markets, and capacity building.	3	3
	3.2	Navigating Government Support. Practical guidance on how entrepreneurs can navigate and access the above-mentioned government schemes	2	3
	3.3	Success Stories and Case Studies. Analysing real world success stories of entrepreneurs who have benefited from the mentioned government initiatives: BIRAC schemes, YIP, Atal innovation missions (Extracting key lessons and best practices.)	3	4
	3.4	Entrepreneurial Impact Assessment. Evaluating the impact of government schemes on entrepreneurial ventures. Discussing challenges faced and proposing solutions for improvement.	2	4
	3.5	**Activities** 1. Group Project on Government Schemes 2. Develop a comprehensive business plan integrating one or more government schemes and do presentations. 3. Case study on Success Stories 4. Each student presents an analysis of a chosen success story related to government support schemes. 5. Propose an entrepreneurial idea based on plant and plant products, conduct preliminary research and submit a report.	5	3, 4, 5

		6. Make an audio-visual document of an interview with an entrepreneur.		
4		**Teacher specific course component**		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, Group discussions, Problem-based learning, Flipped classroom, Discussion-based Learning, Case-based Learning, Experiential Learning, Inquiry-Based Learning, Game-Based Learning, Socratic Method, Peer Teaching, Simulations, Online Learning, Blended Learning, and other innovative approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment etc.
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x2 =20 marks Part B – 6 out of 8 x 5 = 30 marks

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SUGGESTED READINGS

1. Kerala startup mission handbook 2021

	Mar Athanasius College (Autonomous), Kothamangalam **FYUGP SYLLABUS**

Programme	**B. Sc. (Honours) Botany**					
Course Name	**Environmental Science and Human Rights**					
Type of Course	**VAC**					
Course Code	**M24BO6VAC300**					
Course Level	**300**					
Course Summary	This course provides a comprehensive study of environmental sciences, covering pollution sources, their impacts on health and ecosystems, and mitigation techniques. It explores conservation biology, emphasizing the importance of biodiversity and threats like habitat destruction and climate change. Students learn about conservation strategies, environmental policies, and the intersection of environmental sciences with human rights, fostering critical thinking and advocacy skills for a sustainable and equitable world.					
Semester	6					
Credits	Total	Theory			Practical	
	3	3			-	
Course Details	Learning Approach (Hours/Week)	Lecture	Tutorial	Practical	Others	Total
		3	-	-	-	3
Pre-requisites, if any	No pre-requisites for this course.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains*	PO No
1	Explain the fundamental principles of ecology, sustainable utilization of natural resources and analyze the causes, effects, and control measures of environmental pollution	U, An	1,2,6
2	Analyze the causes and impacts of global warming, evaluate global initiatives for biodiversity conservation and climate change mitigation, and appraise the environmental legislation in India.	An	1,2,6,7
3	Understand the relevance of human rights from individual, national, and global perspectives, and explain their role in promoting justice and equality.	U	6,7,8

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

COURSE CONTENT

Module	Units	Course description	Hrs.	CO No.
1	**Module 1 (15 hours)**			
	1.1	Introduction to Environmental Science: a) Definition, scope & significance, multidisciplinary nature of environmental studies b) Principles of ecology, ecosystem structure and function, biodiversity and its importance	3	1, 2
	1.2	Natural Resources: a) Concept of resource b) Classification of natural resources (renewable and non–renewable) c) Sustainable practices for resource utilization	4	2
	1.3	Overview of Environmental Pollution: Definition and types of pollution. Overview of air, water, soil, noise, and light pollution.	1	3
		Air pollution: Air pollutants, types, sources, effect on plants and humans, control measures	2	3
	1.4	Water pollution: Common pollutants, sources, impact, control measures; water quality standards - DO and BOD; eutrophication.	2	3
	1.5	Soil Pollution: Causes, sources, solid waste, biodegradable, non-biodegradable, management of solid waste, composting, e–waste, waste management and recycling.	3	3
2	**Module 2 (15 hours)**			
	2.1	Environmental issues: a) Global warming, greenhouse effect, causes and consequences of climate change, ozone layer depletion. b) Carbon sequestration. c) Carbon foot prints-Indian carbon footprint	3	4
	2.2	Global Conservation: a) Definition, importance, overview of threats to biodiversity b) International Conservation Organizations: Role of NGOs in Conservation (eg. WWF, Conservation International), United Nations Environment	7	4

		Programme (UNEP), International Union for Conservation of Nature (IUCN)-categories **c)** Overview of Key International Treaties (e.g., Kyoto Protocol, Paris Agreement)		
	2.3	Overview of Environmental Legislation in India: Acts and Amendments a) Environment (Protection) Act 1986 and Environment (Protection) Amendment Rules, (2023) b) Wildlife (Protection) Act, 1972, amended in 2022, c) Forest (Conservation) Act, 1980, Forest (Conservation) Amendment Bill 2023 Biological Diversity (Amendment) Act, 2023 [brief account only]. d) Corporate Environmental Responsibility [brief account only]	5	4
3	**Module 3 (15 hours)**			
	3.1	An introductory overview of human rights, history of Human Rights, Generations of Human Rights, Universality of Human Rights, Basic International Human Rights Documents - UDHR, ICCPR, ICESCR. -Value dimensions of Human Rights.	5	5
	3.2	Human Rights and United Nations: Human Rights coordination within the UN system, Role of UN secretariat, Economic and Social Council, Commission of Human Rights, Security Council and Human Rights, Committee on the Elimination of Racial Discrimination, Committee on the Elimination of Discrimination Against Women, Committee on Economic, Social and Cultural Rights, The Human Rights Committee, Critical Appraisal of UN Human Rights Regime.	5	5
	3.3	Human Rights National Perspective: Human Rights in Indian Constitution, Fundamental Rights, Directive Principles of State Policy and Human Rights- Human Rights of Women-Children -Minorities-Prisoners, Science Technology and Human Rights- National Human Rights Commission- State Human Rights Commission- Human rights awareness in education.	5	5
4	**Teacher-specific course components**			

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Interactive lectures, Group discussions, Problem-based learning, Flipped classroom, Discussion-based Learning, Case-based Learning, Experiential Learning, Inquiry-Based Learning, Game-Based Learning, Socratic Method, Peer Teaching, Simulations, Online Learning, Blended Learning, and other innovative approaches.
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** Theory Total = 25 marks Quiz, Test Papers, seminar, assignment
	B. End Semester examination (ESE) Theory Total = 50 marks, Duration 1.5 hrs Part A – 10 out of 12 x2 =20 marks Part B – 6 out of 8 x 5 = 30 marks

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Changes in course content recommended by Board of Studies in the meeting held on 10/03/2026 to improve clarity and to avoid repetitions of the course content.

Course Code	**M24BO5DSE300**
Course Name	**Plant Biotechnology and Introduction to Bioinformatics**
Type of Course	**DSE**

Course Content

Module No	Unit No.	Course Description (Existing)	Course Description (Modified)
1	1.1	Introduction to rDNA technology: Steps in recombinant DNA technology. Restriction Endonucleases (Types I-IV, biological role and application); T4 DNA Ligase. Cloning Vectors: properties of ideal cloning vector, features of cloning vectors: Plasmids, Cosmids, Phage vectors and artificial chromosomes. pCAMBIA, Ti plasmid, Lambda phage, YAC, BAC, Expression vectors, Shuttle vector- Brief account only. (8 Hours)	Plant Biotechnology – overview, history and evolution. Introduction to recombinant DNA technology: Steps in rDNA technology (Brief outline). Cloning vectors: structure and applications of pBR322, M13, Ti plasmid, pCAMBIA, Lambda phage, BAC. Expression vectors, Shuttle vector- Brief account only. Restriction Endonucleases: Types I-IV, biological role and application. DNA Ligase: Ligation techniques – cohesive end ligation, blunt end ligation, linker mediated ligation, homopolymer tailing.
1	1.3	Selection of recombinant clones: screening of recombinant DNA-Antibiotic resistance markers, complementation (Blue white screening). Reporter genes (GUS, GFP). (3 Hours)	Selection of transgenics: Selectable markers and Reporter genes (Luciferase, GUS, GFP).
2	2.3	PCR and its applications, Agarose gel electrophoresis and UV transilluminator	DNA sequencing by Sanger's dideoxy method, DNA finger printing and its applications

		Biotechnology instrumentation and Lab visit (10 Hours)	
3	3.2	Ethical considerations in plant biotechnology Biosafety considerations and IPR associated with GM crops (5 Hours)	Ethical considerations in plant biotechnology IPR and Patents, Types of patents, Patenting biological material, GI tags, Plant breeders' rights (PBRs) and farmers rights. GM Crops - environmental, biosafety and ethical considerations Potential misuse of modern molecular biology tools and techniques, bioweapons, bioterrorism

Existing			*Modified*		
Module	Unit No	Course Description	Module	Unit No	Course Description
2	2.3	Biotechnology instrumentation and Lab visit	3	3.3	Activity Biotechnology instrumentation and Lab visit

Course Code	**M24BO5DSE301**
Course Name	**Plant Tissue Culture**
Type of Course	**DSE**

Course Content

Module No	Unit No.	Course Description (Existing)	Course Description (Modified)
1	1.1	Plant Tissue Culture: Historical perspective Basic infrastructure of tissue culture lab Differentiation, Dedifferentiation and redifferentiation, Totipotency; Organogenesis (direct and indirect); Embryogenesis. Methodology - Sterilization (physical and chemical methods), Culture media - solid and liquid media, Gelling agents, Murashige and Skoog's (MS medium), Nutrient and hormone requirements (role of vitamins and hormones). Preparation of explants and inoculation, callus induction, subculturing, hardening. (6 Hours)	Plant Tissue Culture: Historical perspective, basic infrastructure of tissue culture lab. General composition of the tissue culture media and effect of nutrients: carbon source, nitrogen source, phosphate, plant growth regulators, precursors. Effect of environmental factors: light, temperature, Ph, aeration. Propagation in vitro: Techniques and stages of micropropagation (0-IV), Factors affecting micropropagation. Advantages and disadvantages of micropropagation, Applications of tissue culture.
1	1.2	Somatic embryogenesis: General aspects, initiation of embryogenic cultures, maturation of somatic embryos, regeneration of plants, factors regulating somatic embryogenesis. Differences between somatic and zygotic embryos. Encapsulation of somatic embryos, synthetic seed production; desiccated and	Types of culture: organized structures - shoot tip, node, embryo, unorganized structures - callus, suspension and protoplast cultures (brief study only). Cell culture technique: a) Isolation of single cells: from plant organs, mechanical method, enzymatic method, from cultured tissues. b) Suspension cultures: batch culture, continuous culture (brief study only).

		hydrated types. Applications and limitations of synthetic seeds. (6 Hours)	c) Synchronization of suspension cultures: physical methods and chemical methods. d) Measurement of growth of cultures: cell counting, packed cell volume, cell fresh weight. e) Measurement of viability of cultured cells: phase contrast microscopy, Evan's blue staining, Fluorescein diacetate method.
1	1.3	Origin of somaclonal variation – pre-existing variability, in vitro induced variability. (3 Hours)	Somatic embryogenesis: direct somatic embryogenesis, indirect somatic embryogenesis, factors regulating somatic embryogenesis. Differences between somatic and zygotic embryos. Encapsulation of somatic embryos, synthetic seed production; desiccated and hydrated types. Applications and limitations of synthetic seeds.
3	3.4	Production of secondary metabolites Culture conditions for producing secondary metabolites, selection of high yielding lines, elicitation, immobilization of cells. Hairy root culture – advantages of using hairy root culture, establishment of hairy root culture and production of secondary metabolites. (4 Hours)	Production of secondary metabolites Culture conditions for producing secondary metabolites, selection of high yielding lines, elicitation, large scale cultivation of plant cells (brief study only): immobilized cell cultures, free-cell suspension culture, immobilized cell culture, two-phase system culture, hairy root culture. Elicitor induced production of secondary metabolites: methodology of elicitation, biotransformation using plant cell cultures, secondary metabolite release and analysis.