MAR IVANIOS COLLEGE

(AUTONOMOUS)

Affiliated to the University of Kerala,
Thiruvananthapuram
Kerala

SCHEME AND SYLLABUS FOR THE FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP)

MAJOR DISCIPLINE
BOTANY

(With effect from 2024 Admissions)

Approved by the Board of Studies in

Botany

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PREAMBLE

National Education Policy (NEP 2020) envisions 'higher education as playing an extremely important role in promoting human as well as societal wellbeing and in developing India as envisioned in its Constitution - a democratic, just, socially conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all' (Section 9.1). NEP also expects higher education 'to develop good, thoughtful, well-rounded, and creative individuals, enabling an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and 21st century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects' (Section 9.1.1). Hence, more than the creation of greater opportunities for individual employment, higher education represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation. (Section 9.1.3). NEP also identifies some of the major problems currently faced by the higher education system in India (Section 9.2) and envisions a complete overhaul and re-energizing of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion (Section 9.3). One of the major changes which the policy proposes is moving towards a more multidisciplinary undergraduate education (Section 9.3(b)) which develops all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner (Section 11.3). In order to achieve this in its full potential, NEP visions the adjusting of the structure and lengths of degree programmes accordingly. "The undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor 's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student." (Section 11.9)

In accordance with the NEP 2020, the UGC formulated a new student-centric "Curriculum

and Credit Framework for Undergraduate Programmes (CCFUP)" incorporating a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options and establishing three Broad Pathways,

(a) 3-year UG Degree,

(b) 4-year UG Degree (Honours), and

(c) 4-year UG Degree (Honours) with Research)

Accordingly, the Kerala Higher Education Reforms Commission 2022, headed by Prof Shyam B. Menon, has recommended a comprehensive reform in the undergraduate curriculum with the adoption of the 4-year undergraduate Programmes, which will bring undergraduate education in Kerala at par with the universities abroad. Consequently, Kerala State Curriculum Committee for Higher Education 2023 has been constituted, with Dr Suresh Das as Chairman, and they have proposed a model Kerala State Higher Education Curriculum framework for undergraduate education.

The University of Kerala has decided to introduce the Four Year Under Graduate Programmes (FYUGP) from the academic year 2024-2025 onwards in its teaching departments and all affiliated colleges, and has issued many draft documents and conducted college level awareness programmes about the same.

Mar Ivanios College, by virtue of its autonomy status, conferred in 2014 and extended in 2022, vide University Grants Commission (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations, 2023, has the power to review existing courses/programmes and, restructure, redesign and prescribe its own courses/programmes of study and syllabi and to formulate new courses/programmes within the nomenclature specified by UGC as per the Specification of Degrees 2014 as amended from time to time. Accordingly, the Board of Studies in Botany of Mar Ivanios College (Autonomous) proposed the implementation of the FYUGP scheme with effect from 2024 admission onwards and prepared the scheme and syllabi through many of the meetings and discussions. The Academic Council of the college which met on 30th April gave discussed the proposal and syllabi in detail and approved the same to be implemented from 2024 admission onwards, subject to the final directions of the University of Kerala.

The salient features of the syllabus prepared and presented by the Board of Studies include the following:

- The curriculum is designed based on Outcome Based Education (OBE) approach.
- The curriculum follows Choice-Based Credit System (CBCS): This system allows students to select courses from a prescribed list. A specified number of credits must be earned to award the degree

- The curriculum follows the basic framework, course wise/programme-wise minimum/maximum credits set by the University of Kerala for FYUGP and
- abides by the basic mandatory principles of **Four Year Under Graduate Programmes (UoK-FYUGP) Regulations, 2024.**
- The curriculum offers comprehensive insights into Plant Biology, Ecology, Taxonomy, Physiology, Genetics, Plant Pathology, Plant Biotechnology
- The course content, teaching methods, and learning outcomes align with the latest developments and advancements in the field.
- It clubs Emerging Research:, Technology, Interdisciplinary Approach and hands on training for an engaging learning experience

Graduate Attributes and Programme Outcomes (POs):

The National Higher Education Qualification Framework (NHEQF) envisages that students on completion of a programme of study must possess and demonstrate the expected graduate profile/attributes acquired through one or more modes of learning. The graduate profile/attributes indicate the quality and feature or characteristics of the graduate of a programme of study, including learning outcomes relating to the disciplinary area(s) relating to the chosen field(s) of learning and generic learning outcomes that are expected to be acquired by a graduate on completion of the programme(s) of study. The graduate profile/attributes include capabilities that help widen the current knowledge base and skills, gain and apply new knowledge and skills, undertake future studies independently, perform well in a chosen career, and play a constructive role as a responsible citizen in the society. The graduate profile/attributes are acquired incrementally and describe a set of competencies that are transferable beyond the study of a particular subject/disciplinary area and programme contexts in which they have been developed. Graduate profile/attributes are fostered through meaningful learning experiences made available through the curriculum and learning experience, the total college/university experience, and a process of critical and reflective thinking. Mar Ivanios College (Autonomous) is fully committed to ensuring the attainment of the necessary graduation attributes by the students. The college has clearly defined its raison de'tre, the philosophy of its existence, through the Motto "Truth Shall Liberate You" (Veritas Vos Liberabit) which refers to the ultimate enlightenment which can emerge only at the intersection of sharp intellect, sound physique, strong mind, staunch ethics, and

profound spirituality. This is further made explicit through its Vision, Mission and Goals and the same expect all students who graduate from the college to:

- Have inculcated "the values of truth and charity for the protection and promotion of human dignity and of a cultural heritage, through teaching, research, and extension activities dedicated to society";
- Be co-creators of a vibrant academic community known for its innovation, intellectual rigour and social commitment;
- Be "intellectually trained, morally upright, socially committed, spiritually inspired and ecologically conscious young men and women who would be dedicated to working for the good of society, the nation and the world";
- Have acquired "global competencies and skills";
- Have inculcated a sense of harmony, equality and fraternity among youth, transcending religious, linguistic, regional or sectional diversities; and
- Have developed "scientific temper, humanism and the spirit of inquiry and reform".

Programme Outcomes are the expected student attributes achieved by a student after the student completes the FYUGP from any of the streams/pathways.

The Programme Outcomes (POs) for the FYUGP programmes across all streams and pathways, based on the above core philosophy, and in consonance with the National Higher Education Qualifications Framework (NHEQF) are given below:

By the end of the Four-Year Under-Graduate Programme, students will:

PO 1	**Demonstrate the acquisition of all necessary knowledge and skills within their disciplinary/ multi-disciplinary areas of learning. These include the acquisition of:** • **comprehensive knowledge and coherent understanding of their chosen disciplinary/ interdisciplinary areas of study, their linkages with related fields, and the awareness of current trends in their chosen area of study;** • **essential knowledge for skilled work in chosen field(s), including self-employment and entrepreneurship skills;** • **proficiency in specialized areas within chosen fields of study, encompassing diverse practical skills applicable to different situations within those fields;** • **the ability to apply learned knowledge to novel situations, solve problems, and relate concepts to real-world scenarios rather than just memorizing curriculum content.**

PO 2	**Acquire problem-solving, critical thinking, analytical reasoning skills and demonstrate creativity in their thought processes** by demonstrating the ability to: • solve different kinds of problems in familiar and non-familiar contexts both within and outside their disciplinary/ multidisciplinary areas of learning; • apply analytic thought to a body of knowledge, including the analysis and evaluation of policies, and practices, as well as evidence, arguments, claims, and beliefs; • analyse and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples. • the ability to plan, execute and report the results of an experiment or investigation; • adhere to scientific temper and ethics in their thought process; • adopt innovative, imaginative, lateral thinking, interpersonal skills and emotional intelligence; and • incubate entrepreneurial and start-up ideas.
PO 3	**Develop a profound environmental dedication by fostering ecological awareness and engaging in actions that promote sustainable development** by achieving the ability to • recognize environmental and sustainability issues, and participate in actions to promote sustainable development as well as mitigate the effects of environmental degradation, climate change, and pollution; • contribute to effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, sustainable development and living, and the preservation of life in all forms. • participate in community-engaged services/ developmental activities and thus exemplify the ideals of community engagement and service learning and deep social commitment.
PO 4	**Accomplish perfect communication, teamwork, and leadership skills, particularly in academic and professional settings, while demonstrating nuance and attention to etiquette in all communicative contexts.** This will enable them to: • listen carefully, and read texts and research documents, and present complex information with clarity and precision to different audiences; • express thoughts and ideas and communicate effectively through speech and writing using appropriate media; • communicate using language which is respectful of gender and minority orientations; • act together as a group or a team in the interests of a common cause and working efficiently as a member of a team; • inspire the team with a vision to achieve a stated goal, and use

	management skills to guide the team in the right direction.
PO5	**Acquire the necessary skills, including 'learning to learn' skills, and foster innovative ideas to improve competence and employability, keeping pace with the evolving global landscape and technological advancements** by demonstrating the ability to: • pursue 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 the workplace, including adapting to the changes in work processes in the context of the fourth industrial revolution, through knowledge/ skill development/reskilling; • work independently, identify appropriate resources required for further learning; • acquire organizational and time management skills to set self-defined goals and targets with timelines; • be a proactive life-long learner. • use ICT in a variety of learning and work situations; • access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data; • navigate cyberspaces by following appropriate ethical principles and cyber etiquette. • use cutting edge AI tools with equal commitment to efficiency and ethics. • think 'out of the box' and generate solutions to complex problems in unfamiliar contexts;
PO6	**Develop research-related skills including the ability to conceptualize research hypotheses/projects and adopt suitable tools and methodologies for analysis** with: • a keen sense of observation, inquiry, and capability for asking relevant/ appropriate research questions; • the ability to problematize, synthesize, and articulate issues and design research proposals; • the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and effect relationships; • the capacity to develop appropriate methodology and tools for data collection; • the appropriate use of statistical and other analytical tools and techniques; • the ability to plan, execute and report the results of an experiment or investigation; • the ability to acquire the understanding of basic research ethics and

	skills in practicing/doing ethics in the field/ in personal research work, regardless of the funding authority or the field of study
PO7	**Assimilate a sound value system, a sense of autonomy, multicultural competence, social commitment, and the spirit of inclusivity and empathy by imbibing the spirit and the holistic ethos of the 'Multi-Dimensional Ivanian' (MDI) approach.** This will enable them to: • embrace and practice constitutional, humanistic, ethical, and moral values in life, including universal human values of integrity, truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values; • identify ethical issues related to work, follow ethical practices and be objective, unbiased, and truthful actions in all aspects of work, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights; • exercise responsibility and demonstrate accountability in applying knowledge and/or skills in work and/or learning contexts appropriate for the level of the qualification, including ensuring safety and security at workplaces; • practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies; • effectively engage in a multicultural group/society and interact respectfully with diverse groups; • identify with or understand the perspective, experiences, or points of view and emotions of another individual or group. • demonstrate gender sensitivity and adopt a gender-neutral approach, as also empathy for the less advantaged and the differently-abled including those with learning disabilities; • demonstrate proficiency in arts/ sports/ games, physical, mental and emotional fitness, entrepreneurial /organizational /pubic speaking/environmental/ community-oriented areas by actively participating in the wide range of co-curricular activities that are available to the students of Mar Ivanios College.

Programme Specific Outcomes (PSOs)

In conformity with the POs, the Programme Specific Outcomes (PSOs) of the Major in BOTANY are drafted as given below:

PSO 1	**Have a comprehensive understanding, awareness and appreciation of nature**
PSO 2	Be able to analyse complex botanical problems, evaluate evidence, and formulate well-reasoned conclusions and direct explorative learning

PSO 3	Uphold integrity, professionalism and respect for ethical principles
PSO 4	Acquire knowledge of plants for enhancing human health, wellness, and quality of life
PSO 5	Possess strong research and analytical skills and contribute to advancements in the field of botany
PSO 6	Enhance their laboratory skills using modern tools and techniques
PSO 7	Integrate interdisciplinary knowledge and technological proficiency
PSO 8	Address environmental challenges through sustainable practices
PSO 9	Demonstrate proficiency in plant practices

Course and Credit Structure of FYUGP

The pathway preferably followed by the department will be Major with Minor or Major with multiple disciplines of study.

The Course and Credit Structure of FYUGP is given below:

Sem	DSC (4 Cr)	DSE (4 Cr)	AEC (3 Cr)	SEC (3 Cr)	MDC (3 Cr)	VAC (3 Cr)	Internship (credit-2)/ Project/ Additional Courses (credit-12)	Total courses	Total credits
I	A-1 B-1 C-1		AEC (Eng)-1 AEC(OL)-2		MDC-1			6	21
II	A-2 B-2 C-2		AEC (Eng)-3 AEC(OL)-4		MDC-2			6	21
III	A-2 B-2 C-2	DSE A - 1			MDC (Kerala Studies)-3	VAC -1		6	22
IV	A-4 A-5	DSE A-2		SEC-1		VAC -2 VAC -3	Internship	6	21
V	A-6 A-7 A-8	DSE -3 DSE -4		SEC-2				6	23
VI	A-9 A-10 A-11	DSE -5 DSE -6		SEC-3				6	23
Total	A (11) B (3)	6	4	3	3	3	1*	36	133

	C (3)								
EXIT OPTION AVAILABLE AND STUDENTS WILL BE AWARDED UG DEGREE WITH MAJOR IN A									
VII	A-12 A-13 B/C-4 B/C-5 B/C-6	DSE -7						6	24
VIII	MOOC courses A -14, A -15						Research Project/ Internship /Project or 03 courses - 12Cr	2+1**/ 3***	20
Total	A (15) B(3) C (3) B/C(3)	7	4	3	3	3	1*+1**/ 3***	44+1* + 1**/3***	177

A – Major Discipline
B/C-Minor/Multiple discipline
* - Mandatory Internship at the end of Semester 4
** - Research Project/ Internship /Project as part of Honours with Research
*** - Additional courses of 4 credits each.
Cr - Credits

- **Research group project for students exiting after UG 3 years:** Students who propose to exit after 3 Year UG programme can do a group project with an extra two credits to obtain research experience in discipline-specific areas of the program. The BoS can decide the number of students for the group and the evaluation criteria.
- Students will be able to take other pathways permissible under **University of Kerala Four Year Under Graduate Programmes (UoK-FYUGP) Regulations, 2024,** subject to the availability of courses/ faculty/infrastructure of the college.
- The Board of Studies shall prepare and publish a list of online courses at different levels before the commencement of classes in the respective semester offered in various online educational platforms recognised by the academic

council of the college, which can be opted by the students for acquiring additional credits.

Course Participation/Attendance-

- A student shall be permitted to register for the end-semester evaluation of a specific course to acquire the credits only if the student has completed 75% of the prescribed classroom activities in physical, online, or blended modes, as stipulated by the BoS, including any makeup activities as specified by the faculty of that particular course.
- The reasons/cases of permissible authorised leave shall be specified by the college, with the approval of the Academic Council, ratified by the Governing Body.
- The condonation facility shall be availed as per the existing University/college norms.

Assessment and Evaluation

1. The assessment of a course shall combine a Continuous Comprehensive Assessment (CCA) and an End Semester Evaluation (ESE).
2. For courses without practical/lab modules, 30% weightage shall be given for CCA and the remaining 70% of the weight shall be for the ESE.
3. CCA will have two sub-components: Formative Assessment (FA) and Summative Assessment (SA).
4. The CCA subcomponents will be given marks as per the following proportions:
   - Discipline specific summative assessment – 15% of the total
   - Course attendance - 5 % of the total.
   - Discipline specific formative assessment - 10% of the total.
5. The details of summative and formative assessment criteria, including that of attendance, will be specified by each course coordinator at the beginning of the semester, with the approval of the respective Head of the Department/BoS Chairperson and the Principal, and will be published on the college website.
6. For courses with practical/lab modules, 40% weightage shall be given for CCA and the remaining 60% of the weight shall be for the ESE.
7. In such cases specified in the item above, the CCA subcomponents will be given marks as per the following proportions:

- Discipline specific summative assessment - 10% of the total
- Course attendance (Formative) - 5 % of the total
- Discipline specific formative assessment - 15% of the total.
- Summative Assessment (Practical Record, Practical test, skill, etc). -10% of the total.

The above is given in detailed tabular form as follows:

Sl.	**Activity**	**Percentage (%) of the**	
		Theory courses	Courses with practical
1.	Summative Assessment (written Test or any other discipline specific assessment tools like Open book test, Lab reports, problem-based assignments, individual or team project report, case study report, literature survey, book reviews, video/film/documentary productions, etc)	15	10
2.	Summative Assessment (Practical Record, Practical test, skill, etc)	----------	10
3.	Formative Assessment (Attendance)	5	5
4.	Formative Assessment (Class room activities, observation of skills, viva voce, quiz, interview, oral presentations, in class discussions, computerized adaptive testing, group tutorial work, reflection writing assignments, field study reports, self and peer assessments, service-learning activities, etc.)	10	15
	Total	30	40

8. The Course Coordinator shall be responsible for evaluating all the components of CCA for the course in question. Any grievances regarding the same shall be submitted to the Course Coordinator within 5 days of the publication of the same on the department notice board or official class group. If the grievance is not settled at the Course Coordinator level, the student is free to appeal to the Head of the Department, within the next 3 days, who will discuss the same in the Department Level Monitoring Committee (DLMC). If still needed, students can further appeal to the College Level Monitoring Committee (CLMC) or in essential situations the University Level Monitoring Committee (ULMC) in a time period as specified by these bodies.

9. Regarding evaluation, one credit will be evaluated for 20 marks in a semester; thus, a 4-credit course will be evaluated for 80 marks, and 3-credit courses for 60 marks. However, any changes to this if brought by the University will be followed.
10. The duration of the end semester examination of a course with 4 credits will be 2 hours and the same for a course with 3 credits may be 1.5 hours/2 hours.

Mark Distribution Table

Course	Credit		Marks		Lecture			Practical		
	Lecture	Practical	Lecture	Practical	CCA (30%)		ESE (70%)	CCA (40%)		ESE (60%)
					SA (50%)	FA (50%)		SA (50%)	FA (50%)	
4 credit courses	4	0	80	0	12	12	56	0	0	0
	3	1	60	20	9	9	42	4	4	12
	2	2	40	40	6	6	28	8	8	24
	1	3	20	60	3	3	14	12	12	36
	0	4	0	80	0	0	0	16	16	48
	Credits		Marks		Lecture			Practical		
	Lecture	Practical	Lecture	Practical	CCA (30%)		ESE (70%)	CCA (40%)		ESE (60%)
3 credit courses					SA (50%)	FA (50%)		SA (50%)	FA (50%)	
	3	0	60	0	9	9	42	0	0	0
	2	1	40	20	6	6	28	4	4	12
	1	2	20	40	3	3	14	8	8	24
	0	3	0	60	0	0	0	12	12	36

Letter Grades and Grade Point

1. A mark system is followed to evaluate each question. For each course in the semester, letter grades and grade points are introduced in a 10-point indirect grading system as per the guidelines given below.
2. The Semester Grade Point Average (SGPA) is computed from the grades to measure the student's performance in a given semester. The SGPA is based on the current term's grades, while the Cumulative Grade Point Average (CGPA) is based on the grades in all courses taken after joining the programme of study.
3. The weighted grade point will be mentioned in the student's final grade cards, issued by the college, based on the marks obtained.
4. **The grades and grade points will be given as per the following format:**

Letter Grade	Grade Point	Percentage of marks (X) (CCA + ESE together)	Class
O (Outstanding)	10	$X \geq 95\%$	FIRST CLASS WITH DISTINCTION
A+ (Excellent)	9	$85\% \leq X < 95\%$	
A (Very Good)	8	$75\% \leq X < 85\%$	
B+ (Good)	7	$65\% \leq X < 75\%$	FIRST CLASS
B (Above Average)	6	$55\% \leq X < 65\%$	
C (Average)	5	$45\% \leq X < 55\%$	SECOND CLASS
P* (*Pass*)	4	$35\% \leq X < 45\%$	THIRD CLASS
F (Fail)	0	X< 35%	FAIL
Ab (Absent)	0		FAIL

- For a course PASS, separate minimum of 35% is needed for CCA and ESE.
- Less than 35% in either ESE or CCA is FAIL.

Computation of SGPA and CGPA

SGPA (Semester Grade Point Average) and CGPA (cumulative Grade Point Average) will be computed as follows:

1. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in the semester. That is,

   $S_j = \frac{\sum(C_{ij} \times G_{ij})}{\sum C_{ij}}$

   where S_j is the SGPA in the jthsemester,

   C_{ij} is the number of credits for the ith course in the jthsemester, and

   G_{ij} is the the grade point scored by the student in the ith course in the jthsemester.

2. The CGPA is also calculated in the same manner considering all the courses undergone by a student over all the semesters of a programme. That is,

   $CGPA = \frac{\sum(C_i \times S_i)}{\sum C_i}$

   where $S_i$is the SGPA in the ithsemester and

   $\sum C_i$ is the total number of credits in the ith semester.

3. The SGPA and CGPA shall be rounded to 2 decimal points and reported in the transcripts

4. **Requirement for the successful completion of a Semester**: SGPA of 4 or above and a PASS in all the courses, that is, minimum total of 35% mark in each course (CCA + ESE), with a separate minimum of 35% mark for both CCA and ESE. Appropriate and permissible rules of rounding off numbers may be adopted as per decisions of the Academic Council**.**

Dr. Bindu Alex
Chairman BoS
Mar Ivanios College (Autonomous),
Thiruvananthapuram

Thiruvananthapuram
10-05-2024

List of Courses

COURSE CODE	COURSE TITLE	COURSE TYPE	CREDITS	HOUR DISTRIBUTION PER WEEK		
				L	**T**	**P**
SEMESTER I | Academic Level 100-199						
MIUK1DSCBOT 100.1	DIVERSITY OF PLANTS I	DSCA1	4	2	1	2
MIUK1DSCBOT 101.1	INTRODUCTORY BOTANY	DSCB/C	4	2	1	2
MIUK1DSCBOT 102.1	PLANT SCIENCE- AN OVERVIEW	DSCB/C *	4	2	1	2
MIUK1DSCBOT 103.1	ORGANIC FARMING	MDC	3	2	0	2
SEMESTER II | Academic Level 100-199						
MIUK2DSCBOT 150.1	DIVERSITY OF PLANTS II	DSCA2	4	2	1	2
MIUK2DSCBOT 151.1	GREEN INITIATIVES WITH FUTURE PRESPECTIVES	DSCB/C *	4	2	1	2
MIUK2DSCBOT 152.1	ART OF GARDENING	DSCB/C	4	2	1	2
MIUK2MDCBOT 153.1	SUSTAINABLE TOURISM	MDC	3	2	0	2
SEMESTER III | Academic Level 200-299						
MIUK3DSCBOT 200.1	ANATOMY OF FLOWERING PLANTS	DSC A3	4	2	1	2
MIUK3DSCBOT 201.1	PLANT PATHOLOGY AND DEFENSE MECHANISM	DSC B/C *	4	2	1	2
MIUK3DSCBOT 202.1	BIODIVERSITY CONSERVATION AND DISASTER MANAGEMENT	DSC B/C	4	2	1	2

MIUK3 DSE BOT 203.1	MICROTECHNIQUES AND BIOPHYSICS	**DSE**	4	2	1	2
MIUK3VACBOT 204.1	WASTE MANAGEMENT	VAC	3	2	0	2
SEMESTER IV | Academic Level 200-299						
MIUK4DSCBOT 250.1	ANGIOSPERM MORPHOLOGY AND REPRODUCTIVE BOTANY	**DSCA4**	4	2	1	2
MIUK4DSCBOT 251.1	CELL AND EVOLUTIONARY BIOLOGY	DSCA5	4	2	1	2
MIUK4DSCBOT 252.1	MICROBIOLOGY	DSCB/C	4	2	1	2
MIUK4DSCBOT 253.1	PHYTOCHEMISTRY	DSCB/C	4	2	1	2
MIUK4DSEBOT 254.1	ETHNOBOTANY AND PHARMACOGNOSY	DSE	4	2	1	2
MIUK4SECBOT 255.1	MEDICINAL PLANT MERCHANDISING	SEC	3	2	0	2
MIUK4VACBOT 256.1	FOOD PROCESSING	VAC	3	2	0	2
MIUK4VACBOT 257.1	AQUAPONICS AND HYDROPONICS	VAC	3	2	0	2
SEMESTER V | Academic Level 300-399						
MIUK5DSCBOT 300.1	TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY	**DSC A6**	4	2	1	2
MIUK5DSCBOT 301.1	ENVIRONMENTAL SCIENCE	DSC A7	4	2	1	2
MIUK5DSCBOT 302.1	GENETICS	**DSC A8**	4	2	1	2
MIUK5DSEBOT 303.1	PLANT BIOTECHNOLOGY	DSE	4	2	1	2

MIUK5DSEBOT 304.1	FORESTRY AND PHYTOGEOGRAPHY	DSE *	4	2	1	2
MIUK5SECBOT 305.1	MUSHROOM CULTIVATION	SEC	3	2	0	2
SEMESTER VI | Academic Level 300-399						
MIUK6 DSCBOT 350.1	HORTICULTURE AND PLANT BREEDING	DSC A9	4	2	1	2
MIUK6 DSCBOT 351.1	PLANT PHYSIOLOGY AND PHYTOCHEMISTRY	**DSC A10**	4	2	1	2
MIUK6DSCBOT 352.1	MOLECULAR BIOLOGY AND BIOINFORMATICS	DSC A11	4	2	1	2
MIUK6DSEBOT 353.1	FORENSIC BOTANY	DSE *	4	2	1	2
MIUK6DSEBOT 354.1	RESEARCH METHODOLOGY AND BIOSTATISTICS	DSE	4	2	1	2
MIUK6SECBOT 355.1	PLANT FIBRE TECHNOLOGY	SEC	3	2	0	2

* Mainly for Botany and Biotechnology Interdisciplinary Course

SEMESTER I

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK1DSCBOT 100.1				
Course Title	**DIVERSITY OF PLANTS I**				
Type of Course	**DSC A1**				
Semester	I				
Academic Level	100 – 149				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Curiosity in plants				
Course Summary	Eye Candy for budding botanist, knowledge about fascinating plants				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**History**	**7**
	1	Origin	
	2	Contribution of Botanist with special reference to Indian Scientists.	
	3	Botany as Mother Science, Influence on other science fields- medicine, art, Paintings, literary works, poetry, aesthetic values, philosophical approach.	
	4	**Activity**- Prepare a short biography on any luminary in the field	
II		**Wonders of Plant World**	**7**

	5	Fascinating World of plants	
	6	Overview of plant diversity, List of largest/ smallest plants, Biggest/ smallest flowers, Largest to smallest seeds	
	7	Heterotrophic plants	
	8	Adaptations for pollination	
	9	**Activity**- Explore and document the various adaptations in flowers	
III	**Classification**		**8**
	10	Two kingdom classification, Five kingdom classification	
	11	Introduction to plant kingdom (Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperm, Angiosperm)	
	12	Classification of plants based on plant taxonomy, life cycle, flowering, non- flowering and number of seeds.	
	13	**Activity**- Collect, preserve or propagate any two bryophytes and pteridophytes	
IV	**Human-Plant Synergy: Exploring Collaborative Dynamics**		**8**
	14	Plants and Civilization- Plants of Antiquity, Plants in Human Health through the Ages	
	15	The cultural and social significance of plants in different societies, including their roles in rituals, traditions, art, literature, and spiritual practices. Special reference to the culture of Kerala.	
	16	Plants used as pigments in art, Poetic Botany Movement	
	17	**Activity**- a) Discover the plants mentioned in popular culture, like music, poetry, mural art etc	
V	**Hotspots of Western Ghats**		**15**
	18	Geography, Climate, Biodiversity, Hotspots and Importance.	
	19	Diversity of Western Ghats	
	20	**Activity:** Documentary preparation	

Practicals (30 hrs)

1. Visit to Sites in Western Ghats
2. Photograph and Document.

3. Open-ended Exploration across various domains such as agriculture, medicine, culture, art literature and ecology on the vital role of plants in human life.

References:

1 Hill, A. F. (1952). Economic botany. A textbook of useful plants and plant products. *Economic botany. A textbook of useful plants and plant products.*, (2nd edn).

2 Pandey, B. P. (1999). *Economic botany*. S. Chand Publishing.

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4 .Kochhar S.L. (2016). *Economic Botany – A Comprehensive Study* (5th Ed). Cambridge English

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6 Sambamurty A.U. (2020). *A Text Book of Modern Economic Botany*. CBS.

7 Alexopoulos C.J& Mims C.V(1988). *Introductory Mycology*,JohnWiley&Sons.

8 Bilgarmi, K. S &Saha, L. C. (2010). *A Textbook of Algae*. CBS Publishers, New Delhi.

9 Chapman V.J & Chapman D.J (1973) . *The Algae*, Macmillan.

10 Dube H C (2012). *An Introduction to Fungi* 4th Edition,Scientific Publishers

11 Dube H C (2007). *A text book of Fungi, Bacteria & Virus* student edition, Scientific Publishers.

12 Asthana D.K and MeeraAsthana, (2006).AText Book of Environmental Studies, S. Chand & Company Ltd. New Delhi

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the contributions of Indian Botanists	U	PSO-1,
CO-2	Create enthusiasm in Students	U, An	PSO-1,7
CO-3	Familiarizing students about Basics of	U, An	PSO-1

	classification, plant types and vital position of Western Ghats		
CO-4	Understanding tips for creating documentary	C, Ap	PSO-6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: DIVERSITY OF PLANTS I

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
1	Understand the contributions of Indian Botanists	1	1	U	F	L
2	Create enthusiasm in Students	2,3	1,7	U, An	M	T /P
3	Familiarizing students about Basics of classification, plant types and vital position of Western Ghats	1	1	U, An	F	L
4	Understanding tips for creating documentary	5	6	C, Ap	P, M	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	2	2	-	-	-	-	3	-	-	-	2	-	3	-	-
CO3	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2		✓		✓
CO 3	✓	✓	✓	✓
CO 4			✓	

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK1DSCBOT 101.1				
Course Title	**INTRODUCTORY BOTANY**				
Type of Course	**DSC B/C**				
Semester	I				
Academic Level	100 – 149				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Needs Curiosity and interest in Plants.				
Course Summary	By the end of the course, students will be able to explain what plant life, their life process, evolution is.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Chemistry of plant life**	**10**
	1	What is life? PLANT LIFE- What are Plants? What are the parts of a plant? How do plants reproduce? Why are the plants important? What is a seed? Where do seeds come from?	
	2	From seeds to plants:- Planting seeds, Growing plants without seeds, Plants need water, Plats grow towards light, Where does our food come from. Photosynthesis, Respiration, Growth and death in plants /Life cycle of a plant. (brief).	
	3	Plant nutrients, Plant food elements, The value of soil	

		elements as plant food, Role of plant food elements inn their growth, Inorganic plant toxins and stimulants.	
	4	**Activity**:- Chart preparation and exhibition of different process in plant life.	
II		**Evolution**	**8**
	5	How plants evolved? From green algae. Plant diversity: evolutionary trends/Ancestral plants; "Bryophytes"	
	6	Got leaves- Lycophytes and ferns, Got seeds -Gymnosperms, Got flowers- Angiosperms	
	7	Avascular and vascular plants, Diversity of vascular plants Angiosperms- Monocots-dicots, Leaves, stems.	
	8	**Activity 1** :- Power point presentation of plant evolution	
III		**Plant Behaviour**	**7**
	9	The reproductive adaptations of angiosperm include flowers and fruits, Flower and pollination, fruits, seeds and dispersal	
	10	Angiosperms are very diverse in flowering and fruit setting	
	11	Agiosperm - central importance in ecological communities (Defence mechanism for survival, Interactions to increase in dominance)	
	12	Ecological plant community	
	13	**Activity:** 1. Setting up experiment to demonstrate phototropism, the bending of plant stems towards light. **Activity:2.** Setting experiments with seeds or seedlings in different orientations (e.g., horizontal and vertical). Students need to observe and compare the direction of root and stem growth and discuss the mechanisms.	
IV		**Plants and people**	**5**
	14	Food, medicines	
	15	Sacred, magical and monstrous plants	
	16	Plant people and sustainability	

	17	Plant communities, energy and production	
	18	Global change and plants	
V	**Evaluation**		**15**
	19	Human welfare greatly depends on plants - justify	
	20	Evolution to Genetic engineering	
	21	Biofuels offer the opportunities of reducing fossil fuel dependency	

Practicals: (30 hrs)

1. Setting a garden in your campus with different types of plants.
2. Explore seed dispersal mechanisms by collecting and studying seeds from different plant species.
3. Divide students into different groups. Assign them different roles and have them role-play interactions such as defence responses or symbiotic relationships.

Refrences:

1. Uno, Storey& Moore, Principles of Botany, 2001, McGraw Hill.
   Kenrick,P. & Crane, P. The Origin & early diversification of land plants (1997), Smithsonian Institute Press.
2. Bell, P.R. & Hensley, A.R. Green plants; their Origin & Diversity (2nd ed.), 2000, Cambridge University Press
3. Frenchel, T. The origin & early Evolution of life, 2002, Oxford University Press.
4. Hait, G., Ghosh, A. and Bhattacharya, K. A Text Book of Botany (Vols. I, II & III), 2007, New Central Book Agency
5. Lock, A.J., & Evans, D.E., Plant Biology, 2001, Viva Books
6. Mitra, D., Guha, J. &Chowdhuri, S.K. Studies in Botany (Vols. I & II), Latest Ed., Das Printers

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain what is plant life	U	PSO-1,4
CO-2	Explain how plant function, reproduce and are	R, U	PSO- 1,4

	adapted to their environment		
CO-3	Recognize major groups of plants and identify and discuss their evolution	An, E	PSO-4
CO-4	Understand the importance of plants to people and other organisms.	E, Ap	PSO-4
CO-5	Understand the fascinating ways in which plants respond to their environment and interact with other organisms	U, E	PSO-1,4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: INTRODUCTORY BOTANY

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Explain what is plant life	1	1,4	U	F	L
CO-2	Explain how plant function, reproduce and are adapted to their environment	1	1,4	R, U	F, C	T /P
CO-3	Recognize major groups of plants and identify and discuss their evolution	1	4	An, E	F,C	L
CO-4	Understand the importance of plants to people	1,7	4	E, Ap	M	L

	and other organisms.					
CO-5	Understand the fascinating ways in which plants respond to their environment and interact with other organisms	1,3	1,4	U, E	M	L/T

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**	**PSO 9**
CO1	3	-	-	-	-	-	-	3	-	2	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	1	-	-	2	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-
CO5	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)
d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1		✓		✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4		✓		✓
CO 5		✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK1DSCBOT 102.1				
Course Title	**PLANT SCIENCE: AN OVERVIEW**				
Type of Course	**DSC B/C**				
Semester	I				
Academic Level	100 – 149				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Needs Curiosity and interest in Plants.				
Course Summary	The course aims to offer basic understanding about the plant cell structure and its composition and to explore the avenues offered for career in the field of Botany				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**The Plant Network**	**6**
	1	Plants as dynamic systems- Plant sociobiology - Interconnectedness and Adaptation in Open Systems (cooperation and communication, behaviors)	
	2	Social Learning and Memory in plants - mycorrhizal network, plant micro biome	
	3	Kin Recognition and Altruism	
	4	**Activity**- Review latest literature and present a report	

II	**Plant cell structure**		**8**
	5	Key vocabulary terms relating to plant cell structure.	
	6	With the help of a permanent slide draw and label the parts of a plant cell.	
	7	Study and demonstrate the functions of plant cell parts.	
	8	**Activity-** Collect five different plants and study the structure of common cells in the collected plants.	
III	**Plants: An Overview**		**10**
	9	Dicot and Monocot – features	
	10	Structure of leaf, root and stem (brief- main characters only)	
	11	Study the modifications of leaf, root and Stem and their functions.	
	12	**Activity**- Label the part of the leaf, root, stem with the help of a real plant.	
IV	**Interdisciplinary Reach of Botanical Science**		**6**
	13	Space Science- space exploration and habitation, plant growth in microgravity environments, bioregenerative life support systems, and extraterrestrial agriculture for long-duration space missions	
	14	Medicine	
	15	**Activity-** Case study on " Artemisinin: The journey from natural product to Nobel Prize"	
V	**Exploring Botany and Plant Science Careers**		**15**
	16	Invited talks by eminent professionals	
	17	Efficiency to find out a job related to plant science	
	18	To build a determined personality through this course.	

Practicals: (30 hrs.)

1. Explore the campus and its surroundings.
2. Collect different types of plant and plant parts.
3. Photograph and document.

References:

1. Gagliano, M., Vyazovskiy, V. V., Borbély, A. A., Grimonprez, M., & Depczynski, M. (2016). Learning by association in plants. Scientific reports, 6(1), 38427.
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6. Anten, N. P., & Chen, B. J. (2021). Detect thy family: mechanisms, ecology and agricultural aspects of kin recognition in plants. Plant, Cell & Environment, 44(4), 1059-1071.
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8. Michael, O. S. (2015). Artemisinin: The journey from natural product to Nobel Prize. Annals of Ibadan Postgraduate Medicine, 13(2), 113-117.
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11. Capon, B. (2010). *Botany for gardeners*. Timber Press.
12. Coutler E. G. (1969) Plant Anatomy – Part I Cells and Tissues – Edward Arnold, London
13. Esau K (1965) Plant Anatomy- Wiley Eastern, NewYork.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify and classify plants based on their characteristics	U	PSO-1
CO -2	Describe the structure and function of plant parts.	U, E	PSO-1
CO-3	Realize the importance of botany and related career.	An	PSO-1, 7
CO-4	Explore the diversity of plants.	Ap, E	PSO-1

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PLANT SCIENCE: AN OVERVIEW

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
1	Identify and classify plants based on their characteristics	1	1	U	F	L
2	Describe the structure and function of plant parts.	1	1	U, E	F,C	T /P
3	Realize the importance of botany and related career.	1,5	1,7	An	M	L
4	Explore the diversity of plants.	1	1	Ap, E	P	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	2	-	-	3	-	-	-	-	-	1	-	-
CO4	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4		✓		

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK1DSCBOT 103.1				
Course Title	**ORGANIC FARMING**				
Type of Course	**MDC**				
Semester	I				
Academic Level	100 – 149				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hours	-	2 hours	4
Pre-requisites	Interest in plant practices				
Course Summary	Will be able to understand the concept of organic farming, understand the scope and importance of organic farming and to ensure safe and a healthy food production. **Healthy Soil-Healthy Plants-Sustainable Life**				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**FUNDAMENTALS OF ORGANIC FARMING**		**6**
	1	Introduction, Need and benefits of organic farming.	
	2	Organic farming: Definition, Concept, Opportunity, Benefits and Challenge, Types of Farming (Advantage & disadvantage of each system).	
	3	Sustainable cultivation with a promising future: Integrated Farming system (Combination of Organic and Inorganic),	

		Mixed Farming, Intercropping. Importance and benefits of intercropping and crop rotation.	
	4	Certification and Marketing: Inspection, Certification and Labelling procedure, Marketing and Export.	
	5	**Activity**: Visit different farming areas and make a chart of Comparison of organic and conventional farming.	
II	**PREPARATION AND APPLICATION OF ORGANIC INPUT**		**8**
	6	Need and benefits of organic fertilizers.	
	7	Preparation of organic fertilizers and converting soil into organic (Demonstrations and land preparation from an organic farm)	
	8	Organic manures and methods of composting: Preparation of green pesticides such as panchagavya, jeevamrutam, vermicomposting, Azolla cultivation.	
	9	**Activity**: Visit to Organic farm to study the various components, identification and utilization of Organic products.	
III	USE OF MICRO ORGANISMS		**10**
	10	Need, benefits and management of microorganisms. Active promotion of soil organisms. Soil microorganisms as fertilizer drivers. Bio fertilizers, definition, importance and advantages, Sources of Bio fertilizers -Bacteria, Cyanobacteria, Mycorrhiza and PSM.	
	11	Definition, Composition of Soil- Soil texture and Types, Soil structure, Soil Profile, Humus & Soil pH, Role of Soil in Organic Farming, Soil factors affecting plant Growth: light, heat, water, humidity, pH and Nutrition, C: N ratio of good fertile Soil, Soil fertility as the basis of organic production, Humus building (Brief description only). How to increase humus content in long term and increase the nutrient supply in short	

		term?	
	12	**Activity**: Method of application of different types of fertilizer and Green manure.	
IV	**BOTANICAL AND FUNGAL BIOPESTICIDES**		**6**
	13	Biological control agents and their characteristics.	
	14	Types of biopesticides:- advantages and disadvantages	
	15	Characteristics of biological fungicides-Trichoderma, Pseudomonas and Fusarium species; production and processing of biological fungicides.	
	16	Bioinsecticides and nematicides	
	17	**Activity**: Preparation of Neem products and other botanicals for Pest and disease control.	
V	**PLANT NUTRIENTS**		**15**
	18	Effect of plant population on growth and yield based on sources of nutrients-Prepare some plant nutrients with the help of organic farmers.	
	19	Nutrient use efficiency, meaning and factors affecting nutrient use efficiency.	
	20	**Activity**: Preparation of Organic Compost-Over ground compost, Pit compost, Liquid compost, Vermi compost (any one)	

Practicals: (30 hrs.)

1. Practicing and experiencing in Farmer's Fields.
2. Preparation of vermicompost.
3. Training on preparation of Neem kernel powder and Neem Kernel Aquaous Extract (NKAE)
4. Preparation of Panchagavya/ Jeevamrutam

-

References:

1. Sharma, Arun K. 2002. A Handbook of Organic farming. Agrobios, India.

2. Sathe, T.V. 2004, Vermiculture and Organic Farming. Daya Publishers.

3. Alvares, C. 1996. The Organic Farming Source Book. The Other India Press, Mapusa, Goa.

4. Gupta, M., 2004. Organic Agriculture Development in India. ABD publishers, Jaipur, India.

5. S.P. Palaniappan, K. Annadurai, 1999. Organic Farming- Theory and Practice, Scientific

Publishers, Jodhpur, India.

6. Dr. Pratiksha Raghuvanoki. Handbook of Organic Farming.

7. Organic Farming: The Ecological System- Agronomy Monograph 54, ASA, USA.

8. Subha Rao, N.S. 200, Soil Microbiology, Oxford & IBH Publishers, New Delhi

9. Dongarjal R. P. and Zade S.B. 2019. Insect Ecology and Integrated Pest Management, Akinik Publications, New Delhi.

10. Guideline of National Project on Organic Farming, Department of Agriculture and Cooperation, INM Division, Ministry of Agriculture, Govt. of India

11. Dushyent Gehlot. 2005. Organic Farming- standards, accreditation, certification and inspection. Agribios, India.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Acquire knowledge and skills necessary to practice sustainable agriculture and the production of healthy, organic food.	U, Ap	PSO-4
CO-2	Understand various principles, need and prospect of organic farming including the importance of sustainability, biodiversity and ecological balance.	Ap, An	PSO-8
CO -3	Gain hands on experience through field work, farm visits or practical exercises to apply their knowledge in a real world setting.	Ap, C	PSO-6
CO-4	Explore the significance of soil health in organic farming and various methods to enhance soil fertility through composting and crop rotation.	R, U,	PSO-9

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ORGANIC FARMING

Credits: 2:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Acquire knowledge and skills necessary to practice sustainable agriculture and the production of healthy, organic food.	1	4	U, Ap	F, M	L
CO-2	Understand various principles, need and prospect of organic farming including the importance of sustainability, biodiversity and ecological balance.	3	8	Ap, An	C	T /P
CO - 3	Gain hands on experience through field work, farm visits or practical exercises to apply their knowledge in a real world setting.	5	6	Ap, C	C, P	L/P
CO-4	Explore the significance of soil health in organic	1,5	9	R, U,	P, M	L

	farming and various methods to enhance soil fertility through composting and crop rotation.					

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO3	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-
CO4	2	-	-	-	3	-	-	-	-	-	-	-	-	-	-	3

Correlation Levels:

a. - (NA), 1 (Mild), 2 (Moderate) 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	**Assignment**	**Project Evaluation**	**End Semester Examinations**
CO 1	✓			✓
CO 2		✓	✓	✓
CO 3	✓		✓	✓
CO 4	✓	✓		✓

SEMESTER II

Mar Ivanios College (Autonomous)

Discipline	**BOTAN Y**				
Course Code	MIUK2DSCBOT 150.1				
Course Title	DIVERSITY OF PLANTS-II				
Type of Course	**DSC A2**				
Semester	II				
Academic Level	150-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Have a grasp of the ecological roles and habitats of lower plants.				
Course Summary	The course gives an overview of plant diversity, introducing students to the major groups of plants and paleobotany. The course include classification, morphology, life cycles, ecological roles, and economic significance of major plant groups. Students would compare the morphology, physiology, and life cycles of Algae, Fungi, Lichen, Bryophytes, Pteridophytes and Gymnosperms, identifying both similarities and differences among these group. The course includes fossilization process and fossil types.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Phycology**	**8**
	1	Detailed study of classification by F.E. Fritsch, Centres of algal research in India, Contributions of an Indian Phycologists- M.O.P. Iyengar.	
	2	Diversity of Algae - Habitat, thallus organisation, pigments and reproduction.	
	3	Salient features of the following major groups with reference to the Systematic position, structure, reproduction and life cycle of the types given below (Excluding the developmental details) a. Cyanophyceae –*Nostoc* b. Chlorophyceae – *Oedogonium* e. Phaeophyceae –*Sargassum* d. Rhodophyceae –*Polysiphonia*	
II		**Mycology & Lichenology**	**9**
	4	General characters, affinities with plants and animals, Classification based on Ainsworth (1973). Contributions of an Indian Mycologists- C.V. Subramanian	
	5.	Distinguishing characters of different classes of fungi representing the following genera (Excluding Developmental details). a. Zygomycotina -*Rhizopus* b. Ascomycotina -*Peziza* c. Basidiomycotina -*Agaricus*	
	6.	Economic importance of Fungi	
	7	Lichenology: General account and economic importance; the structure,	

		reproduction and life cycle of *Usnea.*	
III	**Bryology**		**7**
	8.	Introduction and general characters, adaptations to land habit; range of thallus organization. Classification Proskauer (1957). Contribution of an Indian Bryologists - Shiv Ram Kashyap	
	9.	Morphology, anatomy and reproduction of following types of generation of the following types (Developmental details are not required) *Riccia, Funaria*	
	10	Economic importance of Bryophytes.	
IV	**Pteridology**		**6**
	11	Introduction: Classification of General characters morphological and phylogenetic classification, Life cycle of pteridophyte, Contribution of an Indian Pteridologist – Dr. S.S. Bir.	
	12	Study of the habitat habit, internal structure, reproduction and life cycle of the following types (Developmental details not required). *Psilotum, Selaginella and Pteris*	
	13	Stelar evolution in Pteridophytes - Economic importance of Pteridophytes	
V	**Gymnosperms and Paleobotany**		**15**
	14.	Introduction –General characters and classification of Gymnosperms (Sporne,	
	15.	Study of the habit, anatomy, reproduction and life cycle of the following types (Developmental details are not required) *Cycas* and *Pinus*	
	16	Evolutionary trends in gymnosperms, Economic importance of Gymnosperms	
	17.	Geological time scale, Fossil formation, types of fossils (compression, impression, petrifaction, coal balls).	
	18	Fossil Pteridophytes- *Rhynia, Lepidodendron*. Fossil gymnosperms- *Lyginopteris*	
	19.	**Activity** - Submit the collected specimen of Algae, Fungi, Bryophyte,	

		Pteridophyte and Gymnosperms	

Practicals (30 hrs.)

1. Identify the algal specimens up to the generic level , make labelled sketches of the specimens observed and submission of record.

2. A detailed study of structure and reproductive structures of types of fungi given in the syllabus and submission of record *Rhizopus, Peziza and Usnea.*

3. A detailed study of types mentioned in the syllabus - *Riccia*- Habit- T.S of Thallus, *Funaria*- Habit, gametophyte with sporophyte

4. A detailed study of types mentioned in the syllabus *Psilotum* -Habit, Stem T.S., Synangium T.S.

5. *Selaginella* - Habit, stem and rhizophore, T.S, V.S of strobilus, Megasporophyll and Microsporophylls

6. *Pteris* - Habit, Rhizome and Petiole

7. Field trips to be conducted for the students to get familiarized with local flora

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO1	Gain knowledge about the diversity of Algae, Fungi, Bryophytes and Pteridophytes and Gymnosperms including their classification, and morphology.	U	PSO 1
CO 2	Ability to analyse and identify various major group of plants and their ecology.	U, Ap	PSO 1
CO-3	Understand the economic importance of major groups	U	PSO 1,4
CO--4	Observe and evaluate the disease symptoms caused by algae and fungi	Ap	PSO 1,4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: DIVERSITY OF PLANTS-II

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Gain knowledge about the diversity of Algae, Fungi, Bryophytes and Pteridophytes and Gymnosperms including their classification, and morphology.	1	1	U	F	L
CO-2	Ability to analyse and identify various major group of plants and their ecology.	1	1	U, Ap	F, C	T /P
CO-3	Understand the economic importance of major groups	1	1,4	U	F,C	L
CO-4	Observe and evaluate the disease symptoms caused by algae and fungi	1	1,4	Ap	P	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO	PSO	PSO	PSO	PSO	PSO	PSO	PSO	PSO

								1	2	3	4	5	6	7	8	9
CO1	3	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	2	-	-	1	-	-	-	-	-
CO4	3	-	-	-	-	-	-	2	-	-	1	-	-	-	-	-

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)
d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓

Mar Ivanios College (Autonomous)

Discipline	**Botany**				
Course Code	MIUK2DSCBOT 151.1				
Course Title	**GREEN INITIATIVES WITH FUTURE PERSPECTIVE**				
Type of Course	**DSC B/C**				
Semester	II				
Academic Level	150-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Conscience on environmental protection and sustainable living.				
Course Summary	The course provides students with a comprehensive understanding of environmental challenges, sustainable development principles, and practical solutions for building a greener and more sustainable future.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction**		**5**
	1	Importance of green initiative, Sustainability- definition and concepts, historical context and evolution of sustainability practices; sustainable development goals (SDGs); Triple bottom line concepts; holistic approaches to sustainability-	

		principles and strategies.	
II	**Policies**		**6**
	2	Policy frameworks and Governance- Government- funding and investment, research and innovation, international cooperation; NGOs- advocacy and awareness, monitoring and accountability, capacity building, partnership and collaboration; Cooperatives –community engagement, collective action, resource management, social and economic development and policy advocacy.	
III	**Green initiatives**		**15**
	3	Initiatives in energy sector- appliance upgrades, LED lighting, Insulation and air sealing on the building, solar photovoltaic, wind turbines, hydroelectric power, Biomass energy.	
	4	Initiatives in transportation solutions- Electric vehicles (EVs), Public transportation systems, Bicycle sharing programmes, alternative fuels (biofuels, hydrogen), urban planning design- walkability and pedestrian friendly design, Access to green space and nature.	
	5	Zero waste initiatives- principles and practices-Reduce, Reuse and Recycle principles(3R's)- package free shops, community composting programmes, textile recycling, reusable cups and containers, zero waste schools and businesses.	
IV	**Green building technology**		**4**
	6	Concepts and strategies; Passive design, net zero energy buildings, biophilic design, cradle to cradle (C2C) design, green infrastructure, resilient design, healthy building materials.	
	7	Living walls and green roofs, permeable pavements, urban forest- Environmental, social and economic benefits	
V	**Considerations**		**15**
	8	Challenges and difficulties - Cost barriers, lack of	

		understanding, awareness campaigns and education, inadequate policies and inconsistent regulations, limitations with existing infrastructure, challenges in the existing infrastructure, behavioural barriers, complexities in global supply chains and financial instability.	
	9	Future perspectives- low carbon economy, carbon pricing mechanism, precision agriculture, biomimicry and regenerative design, take-make-dispose models, resilience at community level, global collaboration and international agreements, empowering of individuals in schools, colleges and universities.	
	10	Carbon footprint- calculation- ways to minimise it.	
	11	Lifestyle changes to achieve sustainability	

Practicals (30 hrs)

1 An institutional visit to Energy Management Cell (EMC), Sreekaryam, TVM
2 Collection and sorting and processing of waste, and production of biogas or biofuels.
3 Making use of knowledge obtained through syllabi, awareness campaigns to the builders, locals and school students
4 Convert organic waste such as weeds, plant parts etc. into useful products
5 Students can conduct a waste audit to quantify and categorize the types of waste generated by their colleges, university and community.
6 Students can participate in tree planting on road sides, industrial areas and urban areas.

Reference

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2. Donald L. Klass (1998): Biomass for Renewable Energy, Fuels, and Chemicals.
3. William R. Black (2010): Sustainable Transportation: Problems and Solutions.
4. Bea Johnson (2013). Zero Waste Home: The Ultimate Guide to Simplifying Your Life by Reducing Your Waste.
5. William McDonough and Michael Braungart (2002). Cradle to Cradle: Remaking the Way We Make Things.

6. Carol Kraemer (2007): Recycling and Waste Management Guide to the Internet.
7. Thomas Hootman (2012). Net Zero Energy Design: A Guide for Commercial Architecture.
8. Eric Toensmeier (2016). The Carbon Farming Solution: A Global Toolkit of Perennial Crops and Regenerative Agriculture Practices for Climate Change Mitigation and Food Security
9. Steffen Lehmann (2014): The Low-Carbon City: Transforming Urban Systems.
10. Joseph G. Allen and John D. Macomber (2020). Healthy Buildings: How Indoor Spaces Drive Performance and Productivity.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify and prioritize green initiatives in the energy sector , and develop strategies for promoting sustainability in various sectors, including energy, transportation, waste management, and urban planning	E	PSO 1,8
CO-2	Evaluate the effectiveness of zero waste strategies in reducing waste generation and promoting resource conservation	E	PSO 4 8
CO-3	Identify and analyse challenges and difficulties associated with green initiatives, including cost barriers, policy gaps, infrastructure limitations, and behavioural barriers.	U, An	PSO 2
CO-4	Propose strategies for empowering individuals through education and awareness, and promoting international cooperation and agreements for sustainability.	C	PSO 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: GREEN INITIATIVES WITH FUTURE PERSPECTIVE

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Identify and prioritize green initiatives in the energy sector , and develop strategies for promoting sustainability in various sectors, including energy, transportation, waste management, and urban planning.	3	1,8	Ap	M	L
CO-2	Evaluate the effectiveness of zero waste strategies in reducing waste generation and promoting resource conservation	7	4,8	E	M	L/T
CO-3	Identify and analyze challenges and difficulties associated with green initiatives, including cost barriers,	2	2	U, An	P,M	T

	policy gaps, infrastructure limitations, and behavioral barriers.					
CO-4	Propose strategies for empowering individuals through education and awareness, and promoting international cooperation and agreements for sustainability.	3	7	C	M	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CO1	-	-	3	-	-	-	-	3	-	-	-	-	-	-	3	-
CO2	-	-	-	-	-	-	2	-	-	-	2	-	-	-	3	-
CO3	-	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-	-	3	-	-

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)
d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓		✓
CO 3	✓		✓	✓
CO 4	✓	✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK2DSCBOT 152.1				
Course Title	**ART OF GARDENING**				
Type of Course	**DSC B/C**				
Semester	II				
Academic Level	150 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3	-	2	5
Pre-requisites	Interest in gardening				
Course Summary	Students will be able to learn gardening, qualities of successful gardener, and also familiarize with various types of plants, seeds, fertilizers, pesticides, different tools & equipment used in the gardening work and their use.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to gardening**		**5**
	1	Concepts and components of garden.	
	2	Elements and principles of garden.	
	3	Qualities of a successful gardener.	

	4	**Activity**: Make a verbatim report with a gardener.	
II		**Types of gardens**	**10**
	5	Flowering garden, Herb Garden, Butterfly Garden, Kitchen/Vegetable Garden, Indoor Garden, Foliage Garden, Seasonal flower garden, Water Garden, Vertical Garden, Rock Garden.	
	6	Medicinal garden, Meditation Garden, Balcony Garden, Raised Garden, Religious Garden.	
	7	Familiarize different types and construct a model garden in your campus and also visit a regional garden and identify and study the plants, seeds, fertilizers and pesticides used in different gardens,	
III		**Introduction to landscaping**	**10**
	8	Importance and Scope. Elements and Designs of landscaping.	
	9	Classification of garden plants: annuals, biennials, perennials, herbs, shrubs, trees, climbers, creepers, succulents, cacti, ferns, gymnosperms, palms, orchids, bulbous ornamentals. Awareness about pergolas, topiary, hedges, edges, trophy, paths, fountains.	
	10	**Activity**: Submit a layout of landscape.	
IV		**GARDEN ACCESSORIES**	**5**
	11	Containers in nursery management – portrays, Pots and containers – different types.	
	12	Tools & implements: garden spade, rake, fork, garden shears, secateurs, pruning saw, chain saw, lopping shears, pole pruners, mowers, brush cutter, garden tillers	
	13	**Activity**: Document different garden tools	
V		**GARDENING PRACTICES**	**15**
	14	Pruning, bur lapping, crown thinning- crown raising, crown reduction, pinching, thinning, heading back.	
	15	Weeding and its application.	

	16	Nursery lay out and structures – green house, shade house, rain shelter, mist chamber, potting shed, composting shed.	

Practicals (30 hrs.)

1. Visit to a local nursery.
2. Identifying of important ornamental trees, shrubs, climbers and creepers, hedge and edge plants, ferns, cacti and succulents from a reputed nursery.
3. Construct a typical garden in your campus/home.

References

1. Acquaah J (2009), Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd.
2. Rao Manibhushan K. (1991), Textbook of horticulture. MaC Millan India Ltd.
3. Gangulee H. C. and Kar A. K. (2004), College Botany Vol II, New Central Book Agency
4. Sharma V. K. (1999), Encyclopaedia of Practical Horticulture, Vol I –IV, Deep and Deep Publ. Pvt. Ltd.
5. 5.Gopal Samy Iyengar ,1990, Complete Gardening In India, IBH, India
6. Indoor gardening, Vishnu Swarup, ICAR, New Delhi.
7. Nambison, K.M.P. 1992. Design elements of landscape gardening. Oxford and IBH Publications, New Delhi.
8. Pratibha and P.Trivedi, 1990. Beautiful shrubs, ICAR, New Delhi.
9. Pratibha and P. Trivedi. 1987. Home Gardening. ICAR, New Delhi.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand concepts and components of garden	U	PSO-1
CO-2	Identify different types of garden and garden tools	R, U, Ap	PSO- 1
CO-3	Make use of knowledge in designing a land.	An, C	PSO – 5
CO-4	Select a container based on the type of plants.	U, Ap	PSO- 6

CO- 5	Implement the green practices in gardening.	Ap, E	PSO-2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ART OF GARDENING

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Understand concepts and components of garden	1	1	U	F	L
CO-2	Identify different types of garden and garden tools	1	1	R, U, Ap	F, C	T /P
CO-3	Make use of knowledge in designing a land.	2	5	An, C	P	L
CO-4	Select a container based on the type of plants.	1	6	U, Ap	P	P
CO-5	Implement the green practices in gardening.	7	2	Ap, E	M	L/T

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	-	-	-	-	-	-	2	-	-

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (high)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓		✓	✓
CO 2	✓		✓	✓
CO 3	✓		✓	✓

CO 4	✓		✓	
CO 5	✓		✓	

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK2MDCBOT 153.1				
Course Title	**SUSTAINABLE TOURISM**				
Type of Course	**MDC**				
Semester	II				
Academic Level	150-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	2 hours	5
Pre-requisites	Ability to appreciate nature in all its form				
Course Summary	Aim to equip students with a comprehensive understanding of various aspects related to sustainable tourism.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to Sustainable tourism**		**8**
	1	History and scope, Components, Principles and characteristics of Sustainable tourism.	
	2	Site diagnostics, Target groups, industry and its stake holders, Resources and products of Sustainable tourism, Commercialization of Sustainable tourism.	
	3	Sustainable Resource Management and Sustainable Tourism Development.	

	4	**Activity**: Nature walks or hikes to explore natural habitats, observe wildlife, and learn about the local flora and fauna.	
II	**Sustainable tourism- Vistas**		**6**
	5	Agrotourism/ Farm tourism, Geo- ecotourism, Cultural-ecotourism – tangible and intangible heritages and tourism, Mass Tourism, Alternative Tourism, & Responsible Tourism.	
	6	Management plans.	
	7	**Activity:** Exploring rivers, lakes, or coastal areas to experience natural landscapes from a different perspective while minimizing disturbance to the environment and to report whether it is sustainable or not, if not suggestions.	
III	**Tourism resources**		**9**
	8	Eco-regions; Vegetation types; Protected areas; Endemism and biodiversity hotspots.	
	9	Historical monuments and historical sites; Adventure ecotourism destinations, Ecotourism potential (with reference to Kerala).	
	10	Sustainable tourism agenda:- Conference, Convention and Declaration Related To Environment- Johannesburg, Rio Declaration (Agenda 21), Quebec Declaration, View Of UNWTO	
	11	**Activity:** Conduct tree planting and reforestation programmes in your locality with barcoding and continuous evaluation and protection.	
IV	**Community participation**		**7**
	12	Present scenario, Future prospects (year-round ecotourism); Sustainability of ecotourism; Ecotourism in developed countries.	
	13	Community based ecotourism: case studies; Joint Forest management, Role of NGOs, Ethical and legal aspects.	
	14	Respect local traditions and customs, Aims to enhance cultural preservation	

	15	Eco travel and environmental awareness; Impacts of ecotourism, Green report card, Eco-labelling; Environmental sustainability practices.	
	16	**Activity:** Visit to a local village to engage with local communities and learn about their traditions, lifestyles, and conservation practices.	
V	**Economic Benefits**		**15**
	17	Contribution to the local economy by generating income for communities through tourism- Account on related activities such as accommodations, restaurants, tour guides, and handicrafts.	
	18	Revenue generated from tourism - reinvested into community development	
	19	Creating employment opportunities, Supporting local businesses.	
	20	Development of tourism infrastructure to minimize negative impacts on the environment and communities.	

Practicals (30hrs)

1. Visit to any one Tourist destination in Kerala viz. Kovalam, Kumarakom, Thekkady and Wayanad and prepare a documentary.

References

1. Bramwell , B. and Lane , B. 1993 . Sustainable tourism: An evolving global approach Journal of Sustainable Tourism , 1 (1) : 1 – 5 .
2. Butler , R.W. 1999 . Sustainable tourism: A state of the art review . Tourism Geographies , 1 (1) : 7 – 25 .
3. Clarke , J. 1997 . A framework of approaches to sustainable tourism . Journal of Sustainable Tourism , 5 (3) : 224 – 233 .
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13. Mathew, K. J., & Sinha, S. (2018). Community-Based Sustainable Tourism Initiatives: A Case Study of Kumarakom in Kerala, India. In Sustainable Development and Biodiversity (pp. 355-365). Springer.
14. Pillai, S. K., & Sreekumar, T. T. (2016). Community Participation in Sustainable Tourism Development: A Study of Kerala. International Journal of Social Science and Economic Research, 1(11), 3799-3813.
15. Rajan, K. S. (2017). Impact of Sustainable Tourism Development on Local Livelihoods in Kerala: A Case Study of Kumarakom. Journal of Social and Economic Development, 19(2), 231-252.
16. Suresh, N. (2015). Community Participation in Sustainable Tourism Development: A Case Study of Thekkady, Kerala. In Sustainable Tourism: Challenges and Opportunities (pp. 207-221). Springer.
17. Thampi, B. V. (2014). Tourism and Environment: A Case Study of Sustainable Tourism in Kerala. IOSR Journal of Humanities and Social Science, 19(2), 52-57.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Equips students with a comprehensive understanding of various aspects related to sustainable tourism.	U, Ap	PSO- 1
CO 2	Student understand the cultural and social dimensions of tourism and learn how tourism can positively or negatively affect local communities, cultures, and traditions.	R, U	PSO-2
CO-3	Students get familiar with policies, regulations, and planning strategies aimed at promoting sustainable tourism development at local, national, and international levels.	U, E	PSO-1
CO -5	Apply sustainable principles to the different sectors of tourism	U, Ap	PSO-5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: SUSTAINABLE TOURISM

Credits: 2:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Equips students with a comprehensive understanding of various	1	1	U, Ap	C	L

	aspects related to sustainable tourism.					
CO 2	Student understand the cultural and social dimensions of tourism and learn how tourism can positively or negatively affect local communities, cultures, and traditions.	7	2	R, U	C	L/T
CO-3	Students get familiar with policies, regulations, and planning strategies aimed at promoting sustainable tourism development at local, national, and international levels.	1	1	U, E	P	L
CO -4	Apply sustainable principles to the different sectors of tourism	2	5	E, C	M	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**	**PSO 9**
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	1	-	3	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-

CO4	-	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (high)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	**Assignment**	**Project Evaluation**	**End Semester Examinations**
CO 1	✓	✓		✓
CO 2	✓	✓	✓	✓
CO 3	✓			✓
CO 4	✓		✓	✓

SEMESTER III

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK3DSCBOT 200.1				
Course Title	**ANATOMY OF FLOWERING PLANTS**				
Type of Course	**DSC A3**				
Semester	III				
Academic Level	· 200 – 249				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Understanding of the basic principles of plant biology,				
Course Summary	This course help to cover the structure and function of various parts of plants, ranging from cells and tissues to organs and systems.				

Detailed Syllabus :

Module	Unit	Content	Hrs
I	**Tissues**		**5**
	1	Meristems - Definition, Classification based on origin, position, growth patterns, functions. Apical meristems & theories on apical organization - Apical cell theory, Histogen theory, Tunica - Corpus theory	
	2	Organization of root apex in dicots & monocots.	

	3	Permanent tissues – definition, classification (Simple, Complex and Secretory tissues)	
II	**Tissue systems**		5
	4	Epidermal tissue systems-stomata - structure and functions – Types	
	5	Ground tissue systems	
	6	Vascular tissue systems	
	7	**Activity-** Photograph/ Drawings of Epidermal outgrowths of different plants.	
III	**Internal structure I**		**9**
	8	Primary Structure – Root, stem and leaf (Dicot & Monocot)	
	9	Annual rings, heart wood and sap wood, hard wood and soft wood, tyloses, ring porous wood and diffuse porous wood	
	10	**Activity-** Document a) Different properties of wood (Nature, porosity, durability, colour, texture, industrial value) from nearby wood industry. b) Count the age of wood present in nearby wood mills	
IV	**Internal structure II**		11
	11	Secondary Structure- Formation and activity of cambial ring, Secondary vascular tissue, Periderm formation – lenticels	
	12	Secondary Thickening – Monocot and Dicot stem, Monocot and dicot root.	
	13	**Activity-** Collect and document herbs and shrubs that show secondary thickening	
V	**Anomalous Secondary Growth**		15
	14	Anomalous secondary thickening – *Bignonia, Boerhaavia*	
	15	**Activity-** Document the variation in secondary thickening amongst various ecotypes of *Bignonia, Boerhaavia*	

Practicals (30 Hrs)

1. Primary structure- Dicot stem- *Centella*, Monocot stem- Grass

2. Secondary structure – Stem (Normal type) – *Vernonia*
3. Secondary structure –Root (Normal type)- *Carica papaya*, Aerial root-*Ficus*
4. Anomalous secondary thickening – *Bignonia, Boerhaavia*

-

Suggested readings

1. David F. Cutler, Ted Botha and Dennis W M. Stevenson (2008) Plant Anatomy: An Applied Approach, John Wiley and Sons Ltd.
2. Eames, A. J., & Mac Daniels, L. H. (1947). An introduction to plant anatomy., (2nd ed).
3. Esau K (1965) Plant Anatomy- Wiley Eastern, NewYork
4. Esau K (2006) Anatomy of seed plants 2nd edition Wiley Eastern, NewYork
5. Fahn A (1995) – Plant Anatomy, Elsevier Science and Technology, Oxford, UK
6. Pandey B P (1997) Plant Anatomy – S Chand and Co. New Delhi Biology- Mc Graw Hill Co, New York
7. Pandey B P (2012) – Plant Anatomy. S Chand Publishing
8. Pijush Roy (2006) Plant Anatomy. New Central Book Agency (P)Ltd
9. Vashista P C (1984) – Plant Anatomy, Pradeep Publications, Jalandhar

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify and differentiate different plant tissues, tissue systems and organs.	U	PSO-1
CO-2	Discriminate between dicot and monocot plants based on anatomical features.	U, An	PSO-1
CO-3	Knowledge of internal structures of stem and root to analyse the stages of plant growth and characteristics of Wood	R, An	PSO-1
CO-4	Familiarity with epidermal outgrowths and stomatal types.	R, U	PSO-1

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ANATOMY OF FLOWERING PLANTS

Credits: 2:1:2 (Lecture: Tutorial: Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Identify and differentiate different plant tissues, tissue systems and organs.	1	1	U	F	L
CO-2	Discriminate between dicot and monocot plants based on anatomical features.	1	1	U, An	F, C	T /P
CO-3	Knowledge of internal structures of stem and root to analyse the stages of plant growth and characteristics of wood.	1	1	R, An	F, C	L
CO-4	Familiarity with epidermal outgrowths and stomatal types.	1	1	R, U	P	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-

Correlation Levels:

a- (NA),

b- 1 (Mild),

c- 2 (Moderate)

d- 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1			✓	✓
CO 2			✓	✓
CO 3			✓	✓
CO 4	✓	✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	**Botany**				
Course Code	MIUK3DSCBOT 201.1				
Course Title	**PLANT PATHOLOGY AND DEFENSE MECHANISM**				
Type of Course	**DSC B/C**				
Semester	III				
Academic Level	200-249				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Awareness about diseases in plants				
Course Summary	This course provides an in-depth exploration of plant-pathogen interactions, defence mechanisms and pathogen virulence, and advanced techniques in disease diagnosis and management.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to plant pathology**		**5**
	1	Importance, definition and concepts of plant pathology, History and growth of plant pathology, biotic and abiotic causes of plant diseases.	
	2	Growth , reproduction , survival and dispersal of important plant pathogens, role of environment and host nutrition on	

		plant diseases.	
	3	Host-Pathogen interaction, recognition, concept and infection, symptomology, disease development- role of enzymes, toxins, growth, defense strategies, phenolic, phytoalexins, Pr proteins, Elicitors, Altered plant metabolism as affected by plant pathogen	
	4	Prevention and control of plant diseases- Role of quarantine.	
II	**Ecology of Plant pathogens**		**15**
	5.	Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi, bacteria, actinomycete	
	6	History of plant viruses, shape, size, composition, structure and physical properties of viruses. Symptomatology of important plant viral diseases, transmission, virus vector relationship. Mechanism of resistance and management of plant viruses.	
	7	History and introduction to phyto-pathogenic bacteria and other fastidious prokaryotes. Importance of phyto-pathogenic bacteria	
	8	Fungal flora that causes plant diseases.	
	9	Activity:- study some common plant diseases caused by bacteria, virus, fungus, their symptoms and control measures.	
III	**Disease resistance in plants**		**5**
	10	Introduction and historical development, dynamics of pathogenicity, process of infection, variability in plant pathogens, gene centers as sources of resistance.	
	11	Disease escapes, disease tolerance, disease resistance, types of resistance, identification of physiological races of pathogens, disease progression in relation to resistance, stabilizing selection pressure in plant pathogens.	
	12	Host defense system, morphological and anatomical	

		resistance, preformed chemicals in host defense, post inflectional chemicals in host defense, phytoalexins, hypersensitivity and its mechanisms.	
	13	Gene-for-gene concept, protein-for-protein and immunization basis, management of resistance genes. Strategies for gene deployment.	
IV	**Post harvest diseases**		**10**
	14	Concept of post harvest diseases, definitions, importance with reference to environment and health.	
	15	Types of post harvest problems both by biotic and abiotic causes.	
	16	Integrated approach in controlling diseases and improving the shelf life of produce with special reference to mycotoxicogenic fungi, knowledge of Codex Alimentarious	
	17	Factors governing post harvest problems both as biotic and abiotic, role of physical environment, agro-ecocystem leading to quiescent infection, operational mechanisms and cultural practices in perpetuation of pathogens, pathogens and antagonist and their relationship, role of bio-control agents and chemicals in controlling post-harvest diseases.	
V	**Biological control of plant diseases**		**15**
	18	Concept of biological control, definitions, importance, principles of plant disease management with bioagents, history of biological control, merits and demerits of biological control.	
	19	Types of biological interactions, competition, mycoparasitism, exploitation for hypovirulence, rhizosphere colonization, competitive saprophytic ability, antibiosis, induced resistance, mycorrhizal associations, operational mechanisms and its relevance in biological control	
	20	Preparation of biopesticides, Commercial production of	

		antagonists, their delivery systems, application and monitoring, biological control in IDM, IPM and organic farming system, biopesticides available in market. Quality control system of biocontrol agents.	

Practicals (30 Hrs)

1. Identification of plant diseases by examining symptomatic plant samples and herbarium specimens.
2. Preparation of fungicides mentioned in the syllabus.
3. Evaluate different disease management strategies through field or greenhouse trials.
4. Test the efficacy of chemical, biological, and cultural control methods on disease incidence and severity.

References:

1. Mehrotra R S and Ashok Aggarwal (2007). Plant Pathology, third edition, Mc Graw Hill Education.
2. Rai J P and Alok K Singh (2014). Plant diseases: Identification and management.
3. Gail Schumaan (1991)Plant diseases: Their Biology and Social Impact.
4. Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.
5. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Students will gain knowledge of the biology, morphology, physiology, and life cycles of common plant pathogens, including fungi, bacteria, viruses, nematodes, and parasitic plants.	U	PSO- 1
CO-2	Students able to identify causal organisms of plant diseases and their mechanisms of pathogenesis.	U,E	PSO- 2

CO-3	Students will learn a range of disease management strategies, including cultural practices, chemical treatments, biological control agents, host resistance, and integrated pest management (IPM) approaches, and understand their application in agricultural systems.	U	PSO- 5
CO-4	Students will analyze the impact of plant diseases on agricultural productivity, food security and ecosystem health, and evaluate strategies for mitigating disease impacts.	An, E	PSO- 9

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PLANT PATHOLOGY AND DEFENSE MECHANISM

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T) Practical (P)
1	Students will gain knowledge of the biology, morphology, physiology, and life cycles of common plant pathogens, including fungi, bacteria, viruses, nematodes, and parasitic plants.	1	1	U	F	L
2	Students able to Identify causal organisms of plant diseases and their mechanisms	1	2	U,E	F, C	T /P

	of pathogenesis.					
3	Students will learn a range of disease management strategies, including cultural practices, chemical treatments, biological control agents, host resistance, and integrated pest management (IPM) approaches, and understand their application in agricultural systems.	2	5	U	F,C	L
4	Students will analyze the impact of plant diseases on agricultural productivity, food security and ecosystem health, and evaluate strategies for mitigating disease impacts.	2	9	An, E	P	L

F-Factual, C- Conceptual, P-Procedural, M-Metacog

Mapping of COs with PSOs and POs :

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2		✓		✓
CO 3		✓		
CO 4		✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK3DSCBOT 202.1				
Course Title	**BIODIVERSITY CONSERVATION AND DISASTER MANAGEMENT**				
Type of Course	**DSC B/C**				
Semester	III				
Academic Level	200-249				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Curiosity to know the management practices in conservation and during disaster				
Course Summary	The course aims to foster an appreciation for the beauty and value of the natural world and inspire students to become stewards of biodiversity in their personal and professional lives. Students learn methods for assessing and mitigating risks associated with different types of disasters. The course covers the strategies for preparing individuals, communities, and organizations to effectively respond to disasters.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Biodiversity**	**10**

	1	Importance of Biodiversity, levels of biodiversity- species, genetic and ecosystem diversity, threats to biodiversity- habitat loss and fragmentation, exotic species, Man and wild life conflict, overexploitation, IUCN categories of threaten species	
	2	IUCN, Red data Book; Extinct and Threatened species- endangered Rare; Endangered and endemic plant species of India	
	3	Ramsar sites, Terrestrial and marine hotspots of biodiversity; hotspots of biodiversity in India.	
II	**Conservation of biodiversity**		**7**
	4	Principles and importance of conservation biology; In- situ conservation of biodiversity sanctuaries, national parks, sacred groves ,biosphere reserves	
	5.	Ex-situ conservation of biodiversity: Principles and practices, field gene banks, seed banks and cryopreservation	
	6	Approaches for biodiversity conservation: tropical forests, wetlands and aquatic ecosystems	
	7	Activity – Visit to a research institution and submit a report	
III	**Conservation Practices in India and World**		**6**
	8	Biodiversity convention. International and national efforts to conserve biodiversity. Socio-cultural aspects of biodiversity. Aichi Biodiversity targets, Biotechnological needs for biodiversity conservation. Traditional knowledge and biodiversity Conservation	
	9	Organizations involved in conservation IUCN, WWF, UNEP, UNESCO,. General account on activities of DBT, BSI, NBPGR, Biodiversity register.	
	10	Stockholm Conference, Montreal Protocol, CITES,	

		Biodiversity policy and legislation.	
IV	**Disaster Management**		**7**
	11	Introduction, Definition and terminologies; scope and concept of disaster management.	
	12	Disaster- Types of Disaster- Natural & anthropogenic	
	13	Natural and Environmental disasters-a brief description of the following disasters- Earth quake, flood, coastal disasters, landslides, tsunami (role of mangroves in controlling tsunami disaster), cyclone, dam collapse, nuclear disaster, chemical , disaster, biological disaster..	
	14	Disaster management – four phases – mitigation, preparedness, responses, recovery. Emergency procedures and warning systems, application of GIS	
	15	Activity- Visit to an affected area	
V	**Mitigation efforts**		**15**
	16	UN draft resolution on Strengthening of Coordination of Humanitarian Emergency Assistance	
	17	Role and responsibilities of various agencies and mitigation strategies.	
	18	Regulation/guidelines for disaster tolerance building structure	
	19	Rehabilitation Work, Constraints in Monitoring and Evaluation	
	20	Education and Training in Health Management of Disasters	

Practicals (30hrs)

1. Field Survey in college campus for studying plant species diversity
2. Ex- situ conservation of plant species using in vitro technique
3. Microproagation of an endangered plant species
4. Green pod (embryo culture) culture of orchid

5. Prepare a report on case studies of natural hazards in India e.g Tsunami, Himalayan

Earthquakes and tropical cyclones

Reference

1. Chandel, K.P.S., Shukla, G. And Sharma, N. (1996). Biodiversity in Medicinal and Aromatic
2. Plants in India Conservation and Utilization, National Bureau of Plant Genetic Resources, New Delhi.
3. Council of Scientific and Industrial Research (1986). The Useful Plants of India Publication and Information Directorate, CSIR, New Delhi.
4. Nair, M.N.B. et. al. (Eds.) (1998). Sustainable Management of Non-wood Forest Products.
5. Faculty of Forestry, University Putra. Malaysia. 434 004 PM Serdong, Selangor, Malaysia.
6. Soule, M.E. (ed.) (1986). Conservation Biology. The Science of Scarcity and Diversity. Sinaur.Associates, Inc., Sunderland, Massachusetts.
7. Singh, J.S., Singh, S.P. and Gupta, S.R. 2006. Ecology, Environment and Resource Conservation,Anamaya Publishers, New Delhi.
8. Bolt, B.A. Earthquakes , W. H. Freeman and Company, New York. 1988
9. Carter, N,W. Disaster Management: A Disaster Manager's Hand Book, Asian Development Bank, Manila. 1992
10. Gautam Ashutosh. Earthquake: A Natural Disaster, Ashok Publishing House, New Delhi. 1994
11. Sahni, P.and Malagola M. (Eds.).Disaster Risk Reduction in South Asia, Prentice-Hall of India, New Delhi. 2003.
12. Sharma, V.K. (Ed.). Disaster Management, IIPA, New Delhi. 1995.
13. Singh T. Disaster management Approaches and Strategies, Akansha Publishing House, New Delhi. 2006
14. Sinha, D. K. Towards Basics of Natural Disaster Reduction, Research Book Centre, New Delhi. 2006
15. Smith, K. Environmental Health, Assessing Risk and Reduction Disaster, 3rd Edition, Routledge, London. 2001

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the concept of biodiversity and its importance in maintaining ecosystem stability.	U	PSO- 1
CO-2	Analyze the role of biodiversity in providing ecosystem services essential for human well-being.	An	PSO-1,4
CO-3	Gain an understanding of the concepts and principles of disaster management, -mitigation, preparedness, response, and recovery. Role of risk assessment and early warning systems in disaster prevention and mitigation.	R,U	PSO-5
CO-4	Analyze the various types of natural and human-induced disasters, including earthquakes, floods, hurricanes and industrial accident.	U, An	PSO-6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: BIODIVERSITY CONSERVATION AND DISASTER MANAGEMENT

Credits:2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Understand the concept of biodiversity and its importance in maintaining ecosystem stability.	1	1	U	F, C	T /P
CO-2	Analyze the role of biodiversity in providing ecosystem services essential for human well-being.	1	1,4	An	F,C	L

CO-3	Gain an understanding of the concepts and principles of disaster management, including mitigation, preparedness, response, and recovery. Explore the role of risk assessment and early warning systems in disaster prevention and mitigation.	5	5	R,U	P	L
CO-4	Analyze the various types of natural and human-induced disasters, including earthquakes, floods, hurricanes and industrial accident.	5	6	U, An	P	L/T

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	3	-	-	3	-	-	-	-	-
CO3	-	-	-	-	2	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	2	-	-	-	-	-	-	-	3	-	-	- 3

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)
d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2		✓		✓
CO 3		✓		
CO 4		✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK3DSEBOT 203.1				
Course Title	**MICROTECHNIQUE AND BIOPHYSICS**				
Type of Course	**DSE**				
Semester	III				
Academic Level	200- 249				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Basic knowledge in instrumentation				
Course Summary	Overview of the field, its significance in understanding living systems. Application of biophysical principles to understand the molecular and cellular basis of plant system.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to microtechnique**		**4**
	1	Microscopic techniques - simple and compound microscope– phase contrast; dark field illumination and electron microscopes (SEM and TEM).	
II	**Specimen preparation**		**15**
	2.	Killing and fixation agents – Carnoy's formula, Farmers formula, F.A.A	
	3.	Dehydration – reagents.	

	4.	Sectioning - hand and microtome– rotary and sledge.	
	5.	Stains and staining techniques - double staining. General account; Stains: safranin, haematoxylin, acetocarmine.	
	6.	Mounting media - D. P. X and Canada balsam.	
	7.	Whole mounts - cytological methods: maceration, smear and squash preparation	
III	**Introduction to Biophysics**		**6**
	8.	Solutions: representing concentrations: Molarity, Normality, Percentage and ppm.	
	9.	Buffers -their functions in biological systems - Uses of buffers in biological research.	
	10.	Principles and applications of Colorimeter, Spectrophotometer (UV-Visible)- Principle, -Working and uses	
IV	**Biophysical techniques**		**5**
	11.	Centrifugation: Principle, types of centrifuges, types of rotors (swinging bucket, fixed angle), Density gradient and Differential centrifugation. Applications	
	12.	Basic knowledge of the separation methods: - Chromatography (Column chromatography, paper chromatography and TLC), Electrophoresis (PAGE and AGE).	
	13.	Measurement of pH- pH meter	
V	**Applications**		**15**
	14	Overview of microtechnique, historical perspective, importance in various fields.	
	15	Micrometry, Camera lucida	
	16	Cryobiology–cryopreservation, freeze drying(lyophilisation) and its applications.	
	17	Applications of Microtechnique- Medical diagnostics, Biomedical research, material science and Forensic science.	
	18	Applications of Biophysics- Biophysical methods in drug discovery and development; medical diagnostic and imaging,	

		emerging trends and future directions in biophysics research	

Practicals: (30 hrs)

- Familiarize stains, fixatives and mounting media
- General awareness of Micro technique - maceration, smears &squash
- Demonstration of microtome sectioning and hand sectioning
- Measurement of specimens using micrometer
- Photomicrography and Camera lucida drawings (Demonstration only).
- Preparation of solutions of known concentrations using pure samples and stock solutions.
- Separation of plant pigments by paper chromatography/TLC.
- Preparation of buffer.
- Measurement of pH.
- Construct the absorption spectrum of any sample

References

1. DonaldA.Johansen (1940) Plant Microtechnique- Mac Graw Hill Book company
2. Elizabeth Allman (2004). Mathematical Methods in Biology, Cambridge University Press India Pvt. Ltd
3. Gieryn T.F. (1999). Cultural Boundaries of Science, Univer. Chicago Press.
4. Newton RG (2000) The truth of Science, 2nd edition, Harward University Press
5. Pattabhi V & Gautham N (2011)Biophysics, Narosa publishers
6. Peter Grey (2018) Hand book of microtechnique-Mac Graw Hill Bookcompany
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Course Outcomes

	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed

CO-1	Apply knowledge of microtechnique to research projects or laboratory investigations, demonstrating the ability to design experiments, collect data and analysing the results.	Ap	PSO-1
CO-2	Gain a solid understanding of the fundamental principles of physics as they apply to biological systems	U	PSO-1,7
CO-3	Acquire practical skills in using experimental and biophysical techniques commonly employed in research,	A	PSO-1,6
CO-4	Students should learn to integrate concepts and methodologies from physics, chemistry, biology, and mathematics to address complex questions .	E	PSO-7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: MICROTECHNIQUE AND BIOPHYSICS

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO -1	Apply knowledge of microtechnique to research projects or laboratory investigations, demonstrating the ability to design experiments, collect data and analysing the results.	1	1	U	F	L
CO -2	Gain a solid understanding of the fundamental principles of	2,	1,7	U, Ap	F, C	T /P

	physics as they apply to biological systems					
CO -3	Acquire practical skills in using experimental and biophysical techniques commonly employed in research,	5,6	1,6	U	F,C	L
CO -4	Students should learn to integrate concepts and methodologies from physics, chemistry, biology, and mathematics to address complex questions .	6	7	C	M	L/T

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**	**PSO 9**
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	3	-	-	-	-	-	3	-	-
CO3	-	-	-	-	2	3	-	3	-	-	-	-	3	-	-	-
CO4	-	-	-	-	-	3	-	-	-	-	-	-	-	2	-	- 3

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)
d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK3VACBOT 204.1				
Course Title	**WASTE MANAGEMENT**				
Type of Course	**VAC**				
Semester	III				
Academic Level	200 – 249				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	2 hours	5
Pre-requisites	Interest in waste disposal machinery				
Course Summary	To learn various aspects of waste management. To learn recovery of products from waste to compost, integrated waste management. To create clean and green environment.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Waste Generation and Characterization**		**6**
	1	Classification of waste generation aspects, collection, storage, transport and disposal of waste, waste processing techniques and source reduction, product recovery and recycling. Waste collection and Waste disposal.	
	2	Mechanical Treatment Material Recovery Facility, Recycling and Recovery, Processing and Treatment of Waste.	
	3	Biological methods for waste processing: Composting, Bio	

		methanation, Biodiesel, Biohydrogen, Mechanical Biological Stabilization Processing and Treatment of waste.	
	4	Incineration, Residues and its utilization, co-combustion, Pyrolysis, Gasification, Refuse Derived Fuel, solid recover fuel. Technologies Under Development, Bio-fuels and bio-chemicals, Bio CNG, Technologies for Smart Waste Collection, use of SCADA systems for waste management, technical options for Construction and Demolition Waste Management.	
II	**Waste Processing Techniques**		**6**
	5	Purpose of processing-Improving efficiency of SWM system, Recovering material for reuse, Recovering conversion products and energy.	
	6	Component separation- Air separation, Conventional chute type, Zigzag air classifier, Open inlet vibrator type, Magnetic separation, screening	
	7	Drying and dewatering	
	8	Source reduction, Product recovery, recycling	
III	**Composting**		**9**
	9	Introduction, Objectives, Benefits of composting, fermentation	
	10	Composting- Principles of composting- manual and mechanized methods.	
	11	Types of Composting - Backyard composting, Other Methods of Composting & Diversion – Grass cycling, Vermicomposting, Food Digesters, Commercial Compost Haulers.	
	12	Compost types, Compost feedstock, Compost starting mixes Composting methods Compost maturity	
	13	Composts and soil ecosystem resilience, Organic matter storage and transformation, Storage, transport and	

		transformation of nutrients, Soil structure, aggregate stability, water storage and transport	
	14	Microbiology of the composting process:- What are microorganisms? Where do the microorganisms in the compost come from? Why do microorganisms do it? What microorganisms need to be able to do all the work? How do microorganisms do it?	
IV	**Sustainable methods**		9
	15	Vermi composting	
	16	Aerobic composting	
	17	Activity- different types of sustainable composting	
V	**Regulatory and legal Frame work for waste management**		**15**
	18	Introduction:-Overview of waste management in India, importance of legal and regulatory frameworks, Difference between Regulatory and Legal frameworks, Legal Landmarks in the History of Waste management in India, Institutional framework on solid waste management in India	
	19	Waste Management Laws in India, The Environmental Protection Act, The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, The Plastic Waste (Management and Handling) Rules, 2011, Bio-Medical Waste (Management and Handling) Rules, 1998, The E- Waste (Management and Handling) Rules, 2011, The Batteries (Management and Handling) Rules, 2001.	
	20	Solid waste management rules 2016, Regulatory and Legal policy making in Waste Management	

Practicals (30 hrs)

1. Project:-Group project will choose and analyse particular waste related topics to explore in depth. / Composting.
2. Conduct awareness programs, poster presentations campaigns etc .

Reference

1. Tchobaanoglous, G., Theisen, H., and Samuel A Vigil, Integrated Solid Waste Management, McGraw-Hill Publishers, 1993.
2. Bilitewski B., Hard He G., Marek K., Weissbach A., and Boeddicker H., Waste Management, Springer, 1994.
3. White, F. R., Franke P. R.,, & Hindle M., Integrated solid waste management: a life cycle inventory. McDougall,P. John Wiley & Sons. 2001
4. Nicholas, P., & Cheremisinoff, P. D., Handbook of solid waste management and waste minimization technologies, Imprint of Elsevier Science. 2005

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify the physical and chemical composition of wastes	U	1
CO-2	Analyze the functional elements for solid waste management	An,E	2,5,7,8
CO-3	Analyze the functional elements for liquid waste management.	AP,An	2,5,7,8
CO-4	To Understand the effluent treatment Plant and its disposal	C	6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: WASTE MANAGEMENT

Credits: 2:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Identify the physical and chemical composition of	1	1	U	F,C	L

	wastes					
CO-2	Analyze the functional elements for solid waste management	3	2,5 ,7, 8	An,E	C	L
CO-3	Analyze the functional elements for liquid waste management.	3	2,5 ,7, 8	AP,An	C	L
CO-4	To Understand the effluent treatment Plants and its disposal	5	6	C	P	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**	**PSO 9**
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	1	-	-	2	-	2	3	-
CO3	-	-	3	-	-	-	-	-	1	-	-	2	-	2	3	-
CO4	-	-	-	-	2	-	-	-	-	-	-	-	3	-	-	-

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)
d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓
CO 4		✓	✓	✓

SEMESTER IV

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK4DSCBOT 250.1				
Course Title	**ANGIOSPERM MORPHOLOGY AND REPRODUCTIVE BOTANY**				
Type of Course	**DSC**				
Semester	IV				
Academic Level	250-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Knowledge about flower and its parts				
Course Summary	This course helps to study the reproductive processes and structures of plants. It encompasses various aspects of plant reproduction, including the formation of gametes, pollination mechanisms, fertilization, seed development, and dispersal.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Glossary of Morphology**	**5**
	1	Plant habit	
	2	Root system- modifications with examples (-Storage, aerial,	

		pneumatophores, buttress)	
	3	Stem- Habit, modification - Acaulescent, Caulescent, Cespitose Prostrate, Repent, Decumbent, Arborescent, Suffrutescent (Definition with examples only)	
	4	Leaves - Leaf base, leaf lamina, and petiole	
	5	**Activity-** a) Examine and compare the morphology of different types of leaves, stem and fruits. b) Visit to JNTBGRI and document the plants.	
II	**Flower**		**5**
	6	Flower as a modified shoot	
	7	Parts of flower- arrangements, relative position, numeric plan, cohesion, adhesion, symmetry of flower, aestivation, placentation types	
	8	Types of inflorescence	
	9	**Activity-** Collect, dry and preserve parts of flower showing the various types of adhesion and cohesion and prepare display cards	
	10	Technical description of flowers- floral diagram, floral formula	
III	**Fruit**		5
	11	Fruit types, albuminous and exalbuminous	
	12	**Activity:** Make digital presentation of fruits based on botanical structure and origin	
IV	**Reproductive Botany: Flower Anatomy and Development**		15
	13	Structure and development of Anthers and microspore.	
	14	Structure of Ovary, Megaspores- Types of Ovules	
	15	Structure of Embryo - Dicot- (development) and Monocot	
	16	**Activity:** Exploration of the diversity of anther morphology in flowers (photographs / drawings)	
V	**Fertilization Processes**		15
	17	Double fertilization, Barriers to fertilization	

	18	Endosperm types (cellular, nuclear and helobial)	
	19	Embryo sacs –Types (Monosporic, Bisporic and tetrasporic)	
	20	Pollination and its mechanisms	
	21	Adaptations for pollination	
	22	**Activity:** Minor report on the co-evolutionary interactions between plants and pollinators on any particular plant of choice.	

Practical (30 hrs)

1. Identify flowers, fruits and inflorescence. Collect the suitable plants from your campus.
2. Structure of anther and embryo

References:

1. Gangulee, H.C., J.S. Das & C. Dutta. 1982. College Botany (5th Ed.) New Central Book Agency, Calcutta.
2. George, H.M. Lawrence. 1951. Introduction to Plant Taxonomy. Mac Millan comp. Ltd., New York.
3. Simpson, M. G. 2006. Plant Systematics. Elsevier Academic Press, London 4. Ananta Rao T. Morphology of Angiosperms.
4. Bhojwani SS, Dantu PK &Bhatnagar SP(2014)The embryology of Angiosperms, Vikas Publishing
5. Johri B M (2011) Embryology of Angiosperms, Springer
6. Maheswari P (2011) An Introduction to the Embryology of Angiosperms, McGraw Hill, New York
7. Pandey AK (2000) Introduction to Embryology of Angiosperms, CBS Publishers & Distributors
8. Pandey S N and Chadha A (1997)– Plant Anatomy and Embryology, Vikas Publishing

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify and describe the structures involved in plant reproduction, including flowers, reproductive organs etc	U	1,4,5
CO-2	Mastery of the different mechanisms of pollination	U, An	4,5
CO-3	Explain the process of fertilization in plants	R, U	1
CO-4	Familiarize with the types of fruits and understand the stages of seed development	U	1

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ANGIOSPERM MORPHOLOGY AND REPRODUCTIVE BOTANY

Credits:2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Identify and describe the structures involved in plant reproduction, including flowers, reproductive organs etc	1	1,4,5	U	F, C	L/P

CO-2	Mastery of the different mechanisms of pollination	2,5	4,5	U, An	M	L/T
CO-3	Explain the process of fertilization in plants	5	1	R, U	P	T
CO-4	Familiarize with the types of fruits and understand the stages of seed development	1	1	U	C, P	L/P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CO1	3	-	-	-	-	-	-	3	-	-	1	1	-	-	-	-
CO2	-	3	-	-	2	-	-	-	-	-	1	1	-	-	-	-
CO3	-	-	-	-	2	-	-	3	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)
d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2		✓		✓
CO 3	✓		✓	✓
CO 4		✓	✓	✓
CO 5	✓			✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK4DSCBOT 251.1				
Course Title	**CELL AND EVOLUTIONARY BIOLOGY**				
Type of Course	**DSC**				
Semester	IV				
Academic Level	250 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	A good understanding of basics in cell and evolution are vitally important.				
Course Summary	The course offers deeper understanding on cell and its organelles emphasising on chromatin and further offers insights into evolutionary biology				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Fundamentals of Cell Organelles**	**5**
	1	History, Scope and Progress of cell	
	2	The cell: Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).	
	3	Structure and function of Cell wall, cell membrane, endoplasmic reticulum, Ribosomes, Lysosomes, Mitochondria, chloroplast and Nucleus.	

	4	Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.	
	5	**Activity:** Examine the photographs and draw different cell organelles.	
II	**Structure and Organization of Nucleus and Nuclear Material**		**10**
	6	Chromosome and its structure, eukaryotic chromosomes and its organization, Classification of chromosomes based on position and number of centromere, Chromatids and Chromatin- composition and structure, euchromatin and heterochromatin - Constitutive and Facultative heterochromatin, karyotype, Idiogram, Nucleoproteins – histones, non-histones, nucleosomes.	
	7	Types of chromosomes- Prokaryotic and eukaryotic chromosomes, autosomes and sex chromosomes.	
	8	Special Chromosomes- Giant chromosomes -Polytene and Lamp brush (structure and functions) and supernumerary chromosomes - B chromosomes.	
	9	Cell division and Cell cycle – Mitosis and Meiosis – Significance. Cell cycle, Regulation of cell cycle	
	10	**Activity**: Seminar on chromosomal aberrations	
III	**Introduction to Evolutionary Biology**		**6**
	11	Neo Darwinism, Modern synthetic theory.	
	12	Evidences of evolution- Physical – Paleontological, Morphological and anatomical, Biological- Embryological, Biogeographical and Molecular Biology.	
	13	Adaptive radiations - Patterns of Evolution- Parallel, Convergence, Divergence, Progressive, Retrogressive.	
IV	**Agents of Evolution**		**9**
	14	Isolation - Geographical Isolation (Ecological, Habitat, Temporal, Behavioural, Mechanical or Chemical)	

		Reproductive Isolation (Pre-zygotic and Post - zygotic)	
	15	Mutation - Transition mutation, Transversion mutation, Silent Mutation, Missense Mutation, Nonsense Mutation, Frame Shift Mutation	
	16	Migration and Genetic drift.	
	17	Speciation - Allopatric, Peripatric, Parapatric, Sympatric and Artificial	
V	**Evolutionary Ecology**		**15**
	18	Adaptation, Co- evolution, Endemic species, allele frequencies, genotype frequencies, Predator -prey relationship, Host – parasite interactions, Biological species concept (Advantages and limitations), Mass extinction.	
	19	Hybridization and Evolution, Polyploidy and Evolution, Anagenesis and Cladogenesis	
	20	**Activity:** Visit to Natural History Museum, Thiruvananthapuram.	

Practicals: (30 hrs.)

1. Study of plant cell structure with the help of epidermal peel mount of Onion/*Rhoeo*.
2. Make acetocarmine squash preparation of onion root tip and identify different stages of Mitosis.
3. Calculate Mitotic Index of root tips prepared by squash preparation.

-

References:

1. Aggarwal SK (2009) Foundation Course in Biology, 2nd Edition, AneBooks Pvt. Ltd
2. Cohn, N.S. (1964) Elements of Cytology. Brace and World Inc, NewDelhi
3. Darnel, J.Lodish, Hand Baltimore, D. (1991) Cell and molecular biology. Lea and Fibiger, Washington
4. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology, Scientific Americanooks.

5. Hall, B. K. (2012). Evolutionary developmental biology. Springer Science & Business Media.
6. Janet, I. & Wallace, M. (2017). KARP'S Cell and Molecular Biology. John Wiley & Sons, Inc.
7. Keller, E. F., & Lloyd, E. A. (Eds.). (1992). Keywords in evolutionary biology. Harvard University Press.
8. Niklas, K. J. (1997). The evolutionary biology of plants. University of Chicago Press.
9. Roy S.C. and Kalyan Kumar De (1997) Cell biology. New central Books, Calcutta
10. Sober, E. (Ed.). (1994). Conceptual issues in evolutionary biology. Mit Press.
11. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, NewYork
12. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd
13. Verma & Agarwal (2004) Cell Biology, Genetics, Molecular Biology, Evolution & Ecology, S Chand & Co.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the structure of a cell and can distinguish the various cell organelles	U, A	PSO-5,6
CO-2	Compare the structure of chromosomes and analyse various process about mitosis and meiosis.	U, An	PSO-1,5,6
CO-3	Build creativity in their thought processes by understanding the biological evolution on the earth.	Ap, An, C	PSO-5
CO-4	Cultivate a sense of curiosity and wonder about the diversity of plant science, inspiring a lifelong pursuit of learning and exploration in related fields.	R, U, E	PSO-1-9

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: CELL AND EVOLUTIONARY BIOLOGY

Credits:2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Explain the structure of a cell and can distinguish the various cell organelles	1	5,6	U, A	F, C	L
CO-2	Compare the structure of chromosomes and analyse various process about mitosis and meiosis.	1	1,5,6	U, An	F,P	L/P
CO-3	Build creativity in their thought processes by understanding the biological evolution on the earth.	1	5	Ap, An, C	C, M	T
CO-4	Cultivate a sense of curiosity and wonder about the diversity of plant science, inspiring a lifelong pursuit of learning and exploration in related fields.	1,5,6	1-9	R, U, E	M	L/T

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	1	-	-	-	2	2	-	-	-
CO2	3	-	-	-	-	-	-		-	-	-	3	2	-	-	-

								3								
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	3	-	-	-	2	2	-	2	3	2	2	3	3	2	2	- 3

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

-

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	**Assignment**	**Project Evaluation**	**End Semester Examinations**
CO 1	✓			✓
CO 2	✓	✓		✓
CO 3	✓	✓		
CO 4		✓	✓	✓
CO 5			✓	

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK4DSCBOT 252.1				
Course Title	**MICROBIOLOGY**				
Type of Course	**DSC M1**				
Semester	IV				
Academic Level	250- 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Basic knowledge about life forms				
Course Summary	This course provides a comprehensive understanding of the principles and practices in microbiology. By exploring the fascinating world of microorganisms, students gain insights into their diverse roles in nature and society and develop the skills needed to address current and future challenges in microbiology.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Fundamentals of Microbiology**		**5**
	1	Overview of microbiology; Historical perspective; Contributions of microbiologists; Biology of microorganisms, Microbial nomenclature and classification.	
	2	Microbial cell- structure and function- Prokaryotic and eukaryotic cell structure; Microbial nutrition, growth, factors	

		affecting microbial growth, methods for measuring microbial growth, Determination of cell count by hemocytometry and metabolism.	
	3	Strategies for microbial control and prevention:- physical (e.g., heat, radiation), chemical (e.g., disinfectants, antimicrobial agents), and biological (e.g., antibiotics, bacteriophages)	
II	**Microbial Diversity**		**10**
	4	Bacteria: general characteristics, Morphological classification, classification based on staining reaction; Types- archaebacteria, eubacteria, wall-less forms -mycoplasma; Cell structure; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction), Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).	
	5	Virus-physiochemical and biological characteristics; classification (Baltimore), Introduction to oncogenic viruses, Concepts of oncogenes and proto-oncogenes Virus as causal organisms of plant diseases.	
	6	General Properties of other viruses, viroids and prions ; Filamentous DNA phages, Single stranded RNA phages, Virus of Plants; HIV, Vaccinia and Simian virus of animals, Insect virus, lytic and lysogenic cycle.	
III	**Microbial Ecology**		**5**
	7	Microbial interactions- Mutualism, commensalism, parasitism, competition and ammensalism; Environmental factors affecting microbial interactions.	
	8	Community dynamics- Succession, diversity and stability, keystone species, spacial arrangement.	
IV	**Environmental Microbiology**		**10**
	9	Soil Microbiology- Soil microorganisms, the rhizosphere - Distribution of microbes; Role of microbes in soil fertility, Nitrogen fixation; Biofertilizers.	

	10	Aquatic microbiology- Microorganisms as indicators of water quality: coliforms and faecal coliforms; role of microbes in sewage and domestic waste water treatment systems (Brief account only).	
	11	Food and Dairy microbiology - Food and microorganisms, Food spoilage and food poisoning, Microorganisms in milk, food preservation methods - physical methods; chemical methods, antibiotics and bacteriocins.	
	12	Microbes in/on human body (Microbiomics) & animal (ruminants) body, Microbial succession in decomposition of plant organic matter,	
V	**Industrial Microbiology**		**15**
	13	Scope of microbes in industry and environment; institutes of microbial research; Role of microorganisms in fermentation, Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, Use of viral vectors in cloning and expression, Gene therapy and Phage display	
	14	Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.	
	15	Microbial production of industrial products -enzyme (amylase); organic acid (citric acid); alcohol (ethanol); antibiotic (penicillin)	
	16	Bioreactors- Components of a typical bioreactor, Types of bioreactors; Fermenters - fermentation processes- Solid state and liquid state (stationary and submerged) fermentations; Batch and continuous Fermentations.	

Practicals (30hrs)

1. Electron micrographs/Photographs of viruses – T-Phage (Bacteriophage) and TMV; Lytic and Lysogenic Cycle.
2. Bacterial identification by using temporary or permanent slides. Electron micrographs of bacteria, binary fission, endospore, conjugation, Gram staining method

3. Principles and functioning of instruments in microbiology laboratory -autoclave, laminar air flow, incubators and types of fermenters.
4. Isolation of microorganisms from water and soil - Serial dilution method. Determination of BOD, COD, TDS and TOC of water samples (Industrial visit)
5. Determination of coliforms in water samples by using eosin methylene blue (EMB) medium
6. An industrial visit/ microbiology research lab visit.

Suggested readings:

1. Alain Durieux (2009). Applied Microbiology, Springer International Edition.
2. Pelzar, M.J. Jr., Chan E.C. S., Krieg, N.R. (2010). Microbiology: An application based approach. New Delhi, Delhi: McGraw Hill Education Pvt. Ltd., Delhi.
3. Baveja C P (2017). Text Book of Microbiology. Arya Publications
4. Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. San Francisco, SF: Pearson Benjamin Cummings, 9th edition
5. Dubey R .C. & Maheswari D .K (2012). A text Book of Microbiology – Chand & Co
6. Stanbury, P.F., Whitaker, A., Hall, S.J. (2016). Principles of Fermentation Technology. Amesterdam, NDL: Elsevier Publication
7. Gunasekharan G. (2007). Laboratory Manual of Microbiology – New AgePub:
8. Heritage. L. (2007). Introductory Microbiology. Cambridge University Press India Pvt Ltd
9. Patel, A.H. (2008). Industrial Microbiology, Bangalore, India: McMillan India Limited
10. Schlegel (2008). General Microbiology. CambridgeUniversityPressIndiaPvtLtd
11. Mohapatra. P.K. (2008). Textbook of Environmental Microbiology New Delhi, Delhi.
12. Bertrand, Jean-Claude, Caumette, P.
13. , Lebaron, P, Matheron, R., Normand, P., Sime-Ngando, T. (2015). Environmental Microbiology: Fundamentals and Applications. Amesterdam, Netherlands, Springer
14. Casida, J.R. (2016). Industrial Microbiology. New, Delhi, Delhi, New Age International Publishers

15. Tortora G.J., Funke B.R. and Case C.L. (2019). Microbiology an Introduction 13th Edition Pearson Education, Inc.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the historical development of microbiology and students able to identify causal organisms of plant diseases and their mechanisms of pathogenesis.	U	PSO-1
CO-2	Critically evaluate current trends and emerging technologies in microbial biotechnology, considering their potential impact on industry, environment, and society.	E	PSO-4,6
CO-3	Evaluate and explain the significance of soil microbes in enhancing soil fertility, sewage and domestic wastewater treatment systems, including biological processes involved in wastewater remediation.	U, E	PSO- 6
CO-4	Critically evaluate emerging trends and advancements in soil, aquatic, and food microbiology, considering their implications for environmental sustainability and public health.	E	PSO-4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: MICROBIOLOGY

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)/ Practical

						(P)
1	Understand the historical development of microbiology and students able to identify causal organisms of plant diseases and their mechanisms of pathogenesis.	1	1	U	F, C	L/P
2	Critically evaluate current trends and emerging technologies in microbial biotechnology, considering their potential impact on industry, environment, and society.	1	4,6	E	P	T
3	Evaluate and explain the significance of soil microbes in enhancing soil fertility, sewage and domestic wastewater treatment systems, including biological processes involved in wastewater remediation.	1	5,6	U, E	P, C	L/P
4	Critically evaluate emerging trends and advancements in soil, aquatic, and food microbiology, considering their implications for environmental sustainability and public health.	1	4,5	E	F, P	L

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	2	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	3	3	-	-	-	\

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2		✓	✓	✓
CO 3	✓		✓	✓
CO 4		✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK4DSCBOT 253.1				
Course Title	**PHYTOCHEMISTRY**				
Type of Course	DSC				
Semester	IV				
Academic Level	250- 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Knowledge about plant secondary metabolites				
Course Summary	Students understands the basic principles of phytochemistry, including the classification of plant compounds, their biosynthesis, and their uses. Students explore the chemical diversity of natural products derived from plants, including their chemical structures, properties, and sources. Students study about the medicinal plants, including their identification, cultivation, harvesting, and pharmacological properties.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction and scope of phytochemistry**		**5**
	1.	Introduction to phytochemistry	
	2.	Basics of phytochemistry	
	3.	Sources of drugs from plants	

	4.	Application of phytochemistry	
	5	Quality control and analysis of phytochemicals	
II	**Primary metabolites**		**7**
	6.	Molecules and life	
	7.	Carbohydrates - Classification, occurrence, structure and functions of monosaccharides (glucose and fructose), oligosaccharides (sucrose and maltose), polysaccharides (starch and cellulose), glycosidic bonds – Enzymatic hydrolysis of glycosidic bonds – amylases and invertases.	
	8.	Amino acids- classification based on polarity, structure - Amphoteric property of Amino acids	
	9.	Peptide formation–Aminoacid metabolism–reductive amination and transamination	
	10.	Proteins – Structure, classification, properties and function; Role of bonds in stabilizing protein structure - hydrolysis of proteins	
III	**Secondary Metabolites**		**8**
	11.	Introduction to secondary metabolites: Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins	
	12.	Cultivation of medicinal plants and factors influencing cultivation of medicinal plants.	
	13.	Activity – Preparation of herbarium for five medicinal plants	
IV	**Extraction and isolation of Phytoconstituents**		**10**
	14.	Different methods of extraction	
	15.	Role of solvents for extraction procedure	
	16.	Preliminary phytochemical screening	
	17.	Fractionation of phytochemicals	
V	**Analytical Techniques**		**15**
		Application of latest techniques like spectroscopy,	

	18.	Chromatography and Electrophoresis in isolation	
	19.	Purification and identification of crude drugs	
	20.	Bioactivity of phytochemicals	

Practicals (30 hrs)

1. Qualitative analysis of carbohydrate
2. Identification tests for Proteins
3. Quantitative analysis of reducing sugars
4. Preliminary phytochemical screening
5. Collection and identification of medicinal plants
6. Qualitative analysis of primary and secondary metabolites
7. Estimation of flavonoid
8. Separation of secondary metabolites by different methods
9. Cytotoxic effect of different samples

References:

1. Jain J L, Sanjay Jain and Nithin Jain (2016). Fundamentals of Biochemistry. S Chand and Co

2. Jain J. L. (2005). Fundamentals of Biochemistry 6 th Edition,S. Chand &Company.

3. Keith Wilson and John Walker (2008) Principles and techniques of Biochemistry and Molecular Biology, 6th Edition, Cambridge University Press, India Pvt. Ltd.

4. Lehninger (2012). Principles of Biochemistry 6th Edition,W H Freeman &Co.

5. Plummer D. T. (2006). An introduction to Plant Biochemistry 3rd Edition, Tata Mc GrawHill.

6. Saini, A. K., D'souza, M. R., Gireesh Babu, K., Singh, A., & Premalatha, S. J. (2024). *Textbook of Pharmacognosy and phytochemistry-I*. Shashwat Publication.

7. Shah, B. N. (2009). Textbook of pharmacognosy and phytochemistry. Elsevier India.

8. Raaman, N. (2006). Phytochemical techniques. New India Publishing.

9. Harborne, A. J. (1998). Phytochemical methods a guide to modern techniques of plant analysis. springer science & business media.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Students will gain a comprehensive understanding of the chemical constituents present in plants, including primary and secondary metabolites.	U	PSO-1
CO-2	Students will be able to demonstrate various methods of isolating and extracting plant compounds from different plant parts using appropriate techniques.	R,U	PSO-2
CO-3	Able to describe the biological activities of plant compounds, including their pharmacological effects and potential therapeutic uses.	R,U, E	PSO-4,7
CO-4	Students will develop interdisciplinary research skills by integrating knowledge from chemistry, biology, pharmacology to address complex questions in phytochemistry and natural product research.	U,Ap, An, E	PSO-7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PHYTOCHEMISTRY

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)
CO-1	Students will gain a comprehensive understanding of the chemical constituents present in plants, including	1	1	U	F	L

	primary and secondary metabolites.					
CO-2	Students will be able to demonstrate various methods of isolating and extracting plant compounds from different plant parts using appropriate techniques.	5	2	R,U	F,C,P	T/P
CO-3	Able to describe the biological activities of plant compounds, including their pharmacological effects and potential therapeutic uses.	1	4,7	R,U, E	P	L/P
CO-4	Students will develop interdisciplinary research skills by integrating knowledge from chemistry, biology, pharmacology to address complex questions in phytochemistry and natural product research.	1	7	R, U, E	C,P	L/P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	2	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	3	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)

d. 3 (High)

-

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2		✓		✓
CO 3		✓		✓
CO 4	✓	✓	✓	✓
CO 5	✓	✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK4DSEBOT 254.1				
Course Title	**ETHNOBOTANY AND PHARMACOGNOSY.**				
Type of Course	**DSE**				
Semester	IV				
Academic Level	250- 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	2 hours	5
Pre-requisites	General awareness about Ethnobotany and pharmacognosy				
Course Summary	The goal of this course is to introduce students to the fascinating world of the relationship between people and plants. The course offers a unique and multidisciplinary approach that includes plant structure and function. Plant diversity and the uses of the plants by people around the world.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Relevance of Ethnobotany**		**6**
	1	Introduction, relevance, scope and status. Classify international, National and Reginaol (J.W.Harshberger, E.K.Janakiammal, S.K.Jain, K.S.Manilal,V.V. Sivarajan &P.Pushpangadan)- any two. Centres of ethnobotanical studies in India, AICRPE, FRLHT and their contributions to	

		ethnobotany of India.	
	2	Study in a brief about Tribal/Folk communities of Kerala state focussing on Anthropololgy, Customs and beliefs (Koraga, Kurichiya, Adiyan, Paniya, Cholanaikan, Kadar, Kurumba, Kuruman, Kani, Ulladan) .	
	3	Role of ethnomedicine and its scope in modern times.	
	4	**Activity:** Collection of information on traditional methods of treatments using crude drugs, utilization practices. Collect information about spiritual plant species.	
II		**Fundamentals of Ethnobotany**	**8**
	5	Ethnobotany- 1. Concepts and scope, 2.The factors and Endogenous regulations	
	6	Ethnic groups from ancient literature. Methods and techniques used in Ethnobotany- Field visit to collect datas. Collect information about culture. (Documentation- Audio, video, Photographs, Interview, Questionnaire).	
	7	Impact of ethnobotany in herbal-medicine industry, land-use development, agriculture, forestry, betterment of rural livelihood and education. Biodiversity and conservation of some useful medicinal plants. Plant used in ethno medicines eg. *Trichopus, Ocimum, Aegle, Phyllanthus neruri.*	
III		**Ethnopharmacognosy**	**9**
	8	Pharmocognosy definition, scope and applications in herbal medicine. Methods of collection, process and storage of medicinal and aromatic plants. the holistic concepts of drug administration - description of Sapta padarthas in Dravya guna.	
	9	Plants used by ethnic groups as food, medicines, (ethnomedicine), beverages, fodder, fibre, resins, oils, fragrances and other uses. NWFP-Non wood forest products, animal products, minerals, artefacts and rituals used by tribal and folk communities of Kerala.	
	10	Ethnobotany and ethnopharmacology as a tool to protect	

		interests of ethnic groups and rural development.	
	11	**Activity**:- Collect information about 15 plant drugs	
IV	**Ethnobotany and Coservation**		**7**
	12	Ethnobotany and conservation of plant resources, Importance of ethnobotany in Environmental Conservation.	
	13	Sacred grooves	
	14	Ethnobotanical importance in folklore	
V	**Importance of Pharmacognosy**		**15**
	15	Relevance of pharmacognosy and the study of sources of crude Systems of indigenous medicines and their availability, natural medicinal resources in use.	
	16	Difference between herbal/ botanicals and pharmaceutical medicine. Role of ethnopharmacology in drug development.	
	17	**Activity**: Production of new medicine or cosmetics and submit.	

Practicals (30 Hrs)

1. Documentary preparation of ethnic groups in India.
2. Familiarize with at least 5 folk medicines and study the medicinal application.
3. Observe the plants of ethnobotanical importance in your area.
4. Visit to an Ayurveda college or Ayurvedic centre.

Reference :-

1. K. Jain. Glimpses of Ethnobotany. Oxford and IBH Publishing Company, New Delhi.

2. S.K. Jain, 1987. A Manual of Ethno botany. Scientific Publishers, Jodhpurcomes

3. Cotton C M (1996). Ethnobotany-Principles and Applications. John Wiley & Sons, Ltd. England.

4. T.E Walles. Text book of Pharmacognosy.

5. Rajiv K Sinha. Ethnobotany

No.	Upon completion of the course the graduate	Cognitive	PSO

	will be able to	Level	addressed
CO-1	Rescue and document Ethnobotanicals for sustainable use of plant resources	U	PSO- 1, 8
CO-2	Understand the need for development of f safe and more rational use of herbal preparations	R, E	PSO-4
CO-3	Application of plang drugs	An, Ap	PSO-6
CO-4	Conservation of Sacred grooves	Ap, C	PSO-8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create----------

Name of the Course: Ethnobotany and Pharmacognosy

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Rescue and document Ethnobotanicals for sustainable use of plant resources	1,2	1,8	U	F, M	L
CO-2	Understand the need for development of safe and more rational use of herbal preparations	1	4	R, E	C	T /P
CO-3	Application of plant drugs	5	6	An, Ap	C, P	L/P
CO-4	Conservation of Sacred grooves	3	8	Ap, C	P, M	L

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	3	-	-	-	-	-	3	-	-	-	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	2	-	-	-	-	-	-	-	3	-	-	-
CO4	-	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2		✓	✓	✓
CO 3	✓		✓	✓
CO 4	✓	✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK4SECBOT 255.1				
Course Title	**MEDICINAL PLANT MERCHANDISING**				
Type of Course	**SEC**				
Semester	IV				
Academic Level	250 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	-	3
Pre-requisites	Interest in medicinal plants and commercialization				
Course Summary	This course equips you with the foundational knowledge of medicinal plants, its processing and requirements for commercialization; essential for understanding business opportunities using medicinal plants.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Get Acquainted With Medicinal Plants**	7
	1	Study and identification of the major medicinal plants in Kerala with special reference to their Botanical description morphology of the useful part and medicinal properties. 1. Akshoka (Walnut) 2. Amaravalli (Akasavalli) 3. Amra (Ambazham) 4. Bimbi (Kova) 5. Damanaka (Nilampala) 6. Himsra (Kakkathondi) 7. Musali (Musalli) 8. Neeli	

		(Neelayamari) 9. Sarja (Kuntirikkappayin) 10. Vrikshamla (Punampuli)	
II	**Medicinal Plant Cultivation And Processing**		**10**
	2	Harvesting and Collection: Gathering of medicinal plants at the appropriate stage of growth to ensure the highest concentration of active compounds. Factors such as season, time of day, and plant part (leaves, roots, flowers, etc.)	
	3	Drying and Storage: Proper drying techniques are essential to preserve the potency and quality of medicinal plants. Sun drying, shade drying, oven drying. Proper storage conditions, including humidity and temperature control	
	4	Extraction Methods: Extraction methods- maceration, percolation, Soxhlet extraction, steam distillation, and supercritical fluid extraction. (Each method in terms of efficiency, selectivity, and suitability for specific plant materials and target compounds.)	
	5	Purification and Concentration: Chromatography (column chromatography, high-performance liquid chromatography) and filtration (Brief account)	
III	**Present scope of herbal drug industry**		8
	6	Current Scenario of Herbal Industry	
	7	Everything need to know about preservatives, shelf life	
	8	Stories and advice from a local grower, Stories of success and interviews with the real life Plant entrepreneur	
	9	Popular Herbal Industry in India, Research and manufacturing organization related to Medicinal Plants in India .Industrial Perspective of Herbal Drug's Commercialization and regulations.	
IV	**Plant Excipients**		5
	10	Significance of substances of natural orgin as excipients, colourants, sweetners, binders, diluents, viscosity builders, disintegrants, flavours and perfumes.	

	11	Formulation and Product Development: Excipients, stabilizers, and additives to enhance stability, bioavailability, and patient compliance. (Brief account)	
V	**MERCHANDISING**		15
	12	Detailed study on cultivation practices- Post harvest management and uses of any fifteen medicinal plants of high demand	
	13	Institutes, National and state agencies for promoting cultivation of medicinal plants (CIMAP, NMPB and SMPBs). Private Ayurvedic pharmaceutical manufacturing companies in Kerala.	
	14	Regulatory and Legal Considerations- Overview of regulatory frameworks governing the cultivation, processing, marketing, and sale of medicinal plants Good and herbal products.	
	15	Agricultural and Collection Practices (GACP), Good Manufacturing Practices (GMP), and labelling requirements.	
	16	Sustainability and Conservation: Sustainable harvesting practices, conservation strategies, and ethical considerations in the commercial exploitation of medicinal plants to ensure long-term viability and ecological integrity	
	17	Research and Innovation: Innovations in medicinal plant science, including novel plant-based therapies, biotechnological approaches, and opportunities for interdisciplinary collaboration.	

Practicals:-

1. Identify medicinal plants and match the botanical names of plants with their common names and medicinal uses.
2. Analyse and research medicinal plants in the market and prepare presentations
3. Practice cultivation and propagation of medicinal plants
4. Develop Value-Added Product

5. Investigate traditional uses of medicinal plants, folklore, and indigenous knowledge systems, emphasizing the importance of ethical sourcing and cultural sensitivity in merchandising practices.

Reference:

1. Hao, D. C., Gu, X. J., & Xiao, P. G. (2015). Medicinal plants: chemistry, biology and omics. Woodhead Publishing.
2. Tarentino, K. (2001). Medicinal Plants of the World, Volume 2. Chemical Constituents, Traditional and Modern Medicinal Uses. Ivan A. Ross. Totowa, NJ: Humana Press, 2001, 488 pp., $99.50. ISBN 0-896-03877-7. Clinical Chemistry, 47(8), 1504-1505.
3. The Ayurvedic Pharmacopoeia of India, Govt. of India
   - Publication. Lohar D.R. (2008) Protocol for testing ayurvedic, siddha and unani medicines government of India,.
4. Willard H.H., Lynne L. Merritt (jr.), Frank Settle, John A. Dean ·(1988) Instrumental methods of analysis. CBS Publishers and Distributors Delhi.
5. Beckett A.H. and Stenlake J.B. (1988) Practical Pharmaceutical Chemistry – Part-II. Athlone Press
6. Ravishankar S. (2022) Pharmaceutical Analysis. Rx Publications
7. Kasture A.V. (2008) Pharmaceutical Analysis. Nirali Prakasan
8. David G Watson (2020) Pharmaceutical analysis. Elsevier
9. Cannors K.A. (1982) Text book of pharmaceutical analysis.Wiley
10. Chatton L.G. (1986) Pharmaceutical chemistry, Vol. I & II. Marcel Dekker
11. Beckett A.H. and Stenlake J.B. (1988) Practical Pharmaceutical Chemistry – Part-II. Athlone Press
12. Jenkins GL, Knevel AM and DiGangi FE (1967) Quantitative pharmaceutical chemistry. Mc Graw Hill
13. Quality control methods for herbal materials. WHO.
14. Harborne J. B. (1998) Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. Chapman and Hall Ltd.
15. Kokate C K and Gokhale SB (2008) Practical Pharmacognosy Vallabh prakashan.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate an understanding of the principles and techniques involved in herbal drug industry	U	1
CO-2	Identify medicinal plants of Kerala and understand their processing methods (hygiene and sanitation practices in extracting processing)	R, U	2
CO-3	Develop value-added medicinal products from raw materials.	E, C, Ap	2,6
CO-4	Acquire hands-on experience through practical training sessions	Ap	4,6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: MEDICINAL PLANT MERCHANDISING

Credits: 2:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Demonstrate an understanding of the principles and techniques involved in herbal drug industry	1	1	U	C,P	L
CO-2	Identify medicinal plants of Kerala and understand their processing methods	1	2	R, U	F, C	T /P

	(hygiene and sanitation practices in extracting processing)					
CO-3	Develop value-added medicinal products from raw materials.	5	2,6	U, Ap	F, C,P	L
CO-4	Acquire hands-on experience through practical training sessions	1,5	4,6	E, C, Ap	P,M	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO3	-	-	-	-	2	-	-	-	3	-	-	-	3	-	-	-
CO4	3	-	-	-	2	-	-	-	-	-	3	-	3	-	-	- 3

Correlation Levels:

a. -(NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments

- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓		✓	✓
CO 2	✓		✓	✓
CO 3			✓	✓
CO 4		✓	✓	

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK4VACBOT 256.1				
Course Title	**FOOD PROCESSING**				
Type of Course	**VAC**				
Semester	IV				
Academic Level	250 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	2	5
Pre-requisites	Awareness of the potential of seasonal fruits				
Course Summary	A course in food processing gives an understanding about various aspects of food production, preservation and safety.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Fruits And Vegetable**	**6**
	1	Seasonal fruits of Kerala- Jackfruit, papaya, pineapple, custard apple, guava, cucumber.	
	2	Harvesting, transportation and storage of fruits and vegetables.	
	3	Post harvest processing of fruits and vegetables: Peeling, sizing, blanching, Canning of fruits and vegetables.	
	4	Good manufacturing practices, Standard operating	

		procedures, good laboratory practices.	
	5	Sanitation and the food industry: Sanitation, sanitation laws and regulations and guidelines, Relationship of microorganisms to sanitation, allergens, allergen control.	
	6	Personal hygiene and sanitary food handling: Role of HACCP in sanitation, quality assurance for sanitation cleaning compounds, handling and storage precautions; Sanitizers, sanitizing methods, sanitation equipment, waste product handling, solid waste disposal, liquid waste disposal	
II	**Food Microbiology**		7
	7	Introduction, Classification of micro- organism, importance of micro-organisms in food- primary sources of micro-organisms in food- intrinsic and extrinsic parameters of food affecting microbial growth. Isolation and detection of microorganisms in food.	
	8	Spoilage of foods - principles and types of spoilage. Microbial spoilage and its prevention.	
	9	Food in relation to diseases- Food poisoning and intoxication- Bacterial, Non bacterial- protozoa, fungi, virus, algae – characteristics and preventive measures. Indicators of water and food safety and quality.	
III	**Value Added Products**		**10**
	10	Preparation of Fruit Jam , jellies, and preserves;	
	11	Fruit Juice and Nectars; Fruit Sauces and Syrups;	
	12	Dried Fruits; Fruit Leather; Fruit Vinegar; Fruit Chutneys; Fruit Salsas; Fruit Ice Cream and Sorbet; Fruit Infused Spirits	
	Instrumentation		7
	13	Unit operations–classification -conservations of mass and energy- Dimensions and units–Dimensional and unit consistency–dimensionless ratios–EvaporatorsSingle and multiple effect evaporator- Vacuum evaporator- Forced circulation evaporators.	

IV	14	Mechanical separations- Filtration equipment. Sedimentation, Gravitational sedimentation of particles in fluid and gas. Setting under combined forces- Centrifugal and liquid – Liquid separatoin – Centrifuge – Size reduction.	
	15	Principles of combination in Crushing and Mixing – Characteristics- Particle size distribution – Energy and power requirements – Crushing efficiency- Mixing of solids, pastes, dry powders- Criteria of mixer effectiveness- Mixing index. Solar equipment – Heaters, driers, cookers, distillators for food products.	
	16	Refrigerators – Types of refrigeration system- Mechanical vapour compression – Vapour absorption system – Components of mechanical refrigeration- Refrigerants Properties- Comparison of Freon and ammonia systems- cold storages- Design of cold storages- Defrosting- Humidifiers and dehumidifiers.	
V	**Technology**		15
	17	Scope and importance of food preservation, Historical developments in food processing. Types of foods and causes of food spoilage. Definition of shelf life, perishable foods, semi perishable foods, shelf stable foods. Principles of Food Preservation	
	18	Freezing and Refrigeration: Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on food.	
	19	Food Preservation by high temperature Thermal Processing- Introduction, classification of Thermal Processes, Principles of thermal processing, Thermal resistance of microorganisms, Thermal Death Time, Lethality concept, characterization of heat penetration data. Commercial heat preservation methods: Sterilization, commercial sterilization, Pasteurization, and	

		blanching.	
	20	Food Preservation by Moisture control Drying and Dehydration - Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), heat and mass transfer, factors affecting rate of drying, normal drying curve,; Effect of food properties on dehydration, change in food during drying ,drying methods and equipments air convection dryer, tray dryer, tunnel dryer ,continuous belt dryer , fluidized bed dryer, spray dryer, drum dryer, vacuum dryer ,freeze drying ,foam mat drying.	

PRACTICAL (30 hrs)

1.Isolation and identification of specific microorganisms of normal and spoiled.

a. Fruits b. Vegetables

2.Preparaation and preservation of seasonal fruits and vegetables

Preservation of foods by sugar-Jam, Jelly, Marmalade, Cordial, Squash, Fruit bars, Fruit Preserves-Tuity Fruity (Papaya), Ginger Murabha (Ginger).

3. Preservation of foods by salt and acid-Vathal, Vadagam, Tomato ketchup and Squash, Pickles-Lemon, Mango, Mixed vegetable, Garlic.

4. Preservation by fermentation- Wine, Vinegar

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1. Fellows, P. J. (2022). *Food processing technology: principles and practice*. Woodhead publishing.
2. Simpson, B. K., Nollet, L. M., Toldrá, F., Benjakul, S., Paliyath, G., & Hui, Y. H. (Eds.). (2012). *Food biochemistry and food processing*. John Wiley & Sons.
3. Brennan, J. G., & Grandison, A. S. (Eds.). (2012). *Food processing handbook*. Weinheim, Germany: Wiley-Vch.
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Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Conserve excess seasonal foods	U	PSO-1,4
CO-2	Start a new product business	R, U, Ap,C	PSO-6
CO-3	Detect food spoilage	E, Ap, An	PSO-2,4
CO-4	Use some instruments in food processing	An	PSO-6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FOOD PROCESSING

Credits: 2:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Conserve excess seasonal foods	1,2	1,4	U	F	L
CO-2	Start a new product business	5	6	R, U, Ap,C	F, C	T /P
CO-3	Detect food spoilage	1,2	2,4	E, Ap, An	F, C	L
CO-4	Use some instruments in food processing	6	6	An	P	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	3	-	-	-	-	-	3	-	-	3	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	-	-	-	-	1	-	-	-
CO3	3	3	-	-	-	-	-	-	3	-	2	-	-	-	-	-
CO4	-	-	-	-	-	3	-	-	-	-	-	-	3	-	-	-

Correlation Levels:

e. (NA),
f. 1 (Mild),
g. 2 (Moderate)
h. 3 (high)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓		✓	✓
CO 2	✓		✓	✓
CO 3			✓	✓

CO 4		✓	✓	✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK4VACBOT 257.1				
Course Title	**AQUAPONICS AND HYDROPONICS**				
Type of Course	**VAC**				
Semester	IV				
Academic Level	250-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Student must interest and awareness about this topic				
Course Summary	By the end of the course, students will acquire the knowledge about Aquaponics and hydroponics and able to maintain a sustainable cultivation and to find out a self-employment.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction and Over view**		**10**
	1	Definition and principles of Aquaponics.	
	2	History and application of aquaponics.	
	3	Nutrient and Ph maintenance, Working of aquaponics.	
	4	Merits and demerits of aquaponics.	
II	**Aquaponic Systems and maintenance**		**10**

	5	Components of aquaponics: - Fish tank, Filter, Mechanical and biofilters, Sump tank, Aerators	
	6	Types of aquaponic units: - media based grow bed, Deep water culture bed-(Floating raft system),Nutrient film techniques- Channel or gutter style system	
	7	Types of and fishes in aquaponics, Fish health management, maintenance of water quality	
	8	Setting up and maintenance of aquaponics	
III	**Hydroponics**		**10**
	9	Introduction, Definition and principles of Hydroponics.	
	10	History and application of hydroponics.	
	11	Hydroponic production – Basic principles, Historical Perspectives	
	12	Advantages/Disadvantages.	
IV	**Hydroponic System**		**15**
	13	Types of Hydroponics Systems. Hydroponic systems - NFT, DWC, gravel/sand/ebb-and flood, slab culture	
	14	Growing Substrates Plant Nutrition, Nutrient Solution and System Monitoring: EC, pH,	
	15	Aerial Environmental Factors and Plant Growth: Light, Temperature, CO2, RH, Cooling Systems.	
	16	Controlled Environment Agriculture –Indoor Vertical Farming – Plant Factory Organic hydroponics	
	17	Hydroponics Systems in leafy greens, herbs, and microgreens Hydroponics Systems in other crops.	
V	**Productive output**		**15**
	18	Evaluation of new crops for greenhouse/CEA use Indoor and vertical farming	
	19	Overview of Controlled Environment Agriculture (CEA) and Hydroponics	
	20	Plant and NFT management, Microgreens Production	

Practicals (30 hrs)

1. Identification to aquarium accessories like aerator, bubblers, feeding cup, food dispenser, filters-bottom, column and surface.

2. Checking and Adjusting pH of aquaponic culture

3. Identification of aquaponics animals (Tilapia, catfish, common carp) selecting crop, their management and care.

4. Field visit

References:-

1.Tyson, R. V., D. D. Treadwell, and E. H. Simonne. "Opportunities and Challenges to Sustainability in Aquaponic Systems." [In English]. Horttechnology 21, no.1 (Feb 2011): 6-13.

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Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Manage hydroponic and aquaponic production systems.	U,Ap	6
CO-2	Design and construction of hydroponic plant production facilities.	Ap, C	2

CO-3	Produce disease resistant plants and avoid life style diseases	U,Ap	9
CO-4	Describe specific hydroponic systems for successfully growing leafy greens, culinary herbs, and fruiting vegetables	R,Ap,An	4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ORGANIC FARMING

Credits: 2:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Manage hydroponic and aquaponic production systems.	1	6	U,Ap	F, M	L
CO - 2	Design and construction of hydroponic plant production facilities.	8	2	Ap, C	C, P	L/P
CO-3	Produce disease resistant plants and avoid life style diseases	1	9	U,Ap	P, M	L
CO - 4	Describe specific hydroponic systems for successfully growing leafy greens, culinary herbs, and fruiting vegetables	4	4	R,Ap,An	P	L/T

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	3	-	-	3	-	-	-	-	-
CO3	-	-	-	-	2	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	2	-	-	-	-	-	-	-	3	-	-	- 3

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2		✓	✓	✓

CO 3	✓		✓	✓
CO 4	✓	✓		✓

SEMESTER V

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK5DSCBOT 300.1				
Course Title	**TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY**				
Type of Course	**DSC** A6				
Semester	V				
Academic Level	300 – 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Students should complete the course Angiosperm morphology and Reproductive Botany				
Course Summary	Course is designed to provide students with a deep understanding of plant classification, identification, and structural features. The course covers the principles and methods of plant taxonomy, including the use of morphological and anatomical characteristics for plant classification. Students learn about economically important plants and their uses.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Nomenclature and Classification**	10
	1	Definition, scope and significance of Taxonomy, History of plant taxonomy. Plant Identification, documentation (keys and flora), Concepts of Taxonomic hierarchy - Species/Genus/Family, species concept and intraspecific categories - subspecies, varieties and forms. Basic rules of Binomial Nomenclature and International Code of Nomenclature for algae, fungi and plants (ICN or ICNafp). Preservation – preparation of preservative – FAA. Importance of herbarium, Herbarium techniques and Botanical gardens.	
	2	Systems of classification: 1. Artificial -Carolus Linnaeus (Brief account only) 2. Natural -Bentham & Hooker- Detailed account 3. Phylogenetic –Engler & Prantl (Brief account only) 4. APG system- Brief account only	
	3	**Activity**- Create fictitious plant names that comply with standard nomenclature regulations; in order to encourage students to apply their understanding of plant nomenclature while fostering creativity and imagination.	
II		**Study of Polypetalae Families**	**8**
	4	A study of the following families with emphasis on the morphological peculiarities and Economic importance of its members (based on Bentham & Hooker's system) Annonaceae , Malvaceae, Rutaceae, Anacardiaceae, Combretaceae, Leguminosae	
III		**Study of Gamopetalae Families**	**7**
	5	A study of the following families with emphasis on the morphological peculiarities and Economic importance of its members (based on Bentham & Hooker's system) Apiaceae, Rubiaceae , Sapotaceae, Asteraceae, Apocynaceae ,	

		Solanaceae, Lamiaceae	
IV		**Study of Monochlamydeae and Monocotyledonae Families**	5
	6	A study of the following families with emphasis on the morphological peculiarities and Economic importance of its members (based on Bentham & Hooker's system) Monochlamydeae - Amaranthaceae,Euphorbiaceae ,	
	7	Monocotyledonae- Orchidaceae, Liliaceae and Poaceae	
V		**Economic Botany**	15
	8	Study of the major crop in Kerala with special reference to their Methods of cultivation, Botanical description, morphology of the useful part and economic importance - Coconut and Paddy.	
	9	A brief account on the utility of the following plants, specifying the Binomial, family and morphology of the useful parts. **Cereals**– (Wheat & Maize), Millets- (Ragi & Fox tail millet), **Pulses** – (Black gram, Green gram, Bengal gram), **Sugar yielding plants** – (Sugar Cane), **Spices**- (pepper, cloves, cardamom), **Beverages** – (Coffee, Tea), **Fibre yielding plants**- (Cotton), **Dye Yielding plants** – (Henna and *Bixa Orellana*), **Resins**- (Asafoetida), **Tuber crops** – (Tapioca, Potato), **Oil yielding plants**- (Sesame, ground nut), **Latex yielding plants**- (Rubber), **Medicinal plants** – (*Sida, Zingiber officinalis, Aloe vera* and *Vinca rosea*), **Insecticide**-(Neem)	
	10	**Activity** –Collect and submit any five plant materials used in our day today life (Which are not mentioned in the syllabus)	

Practical **30 Hrs**

1. Students must be able to identify the angiosperm members included in the syllabus up to the level of families. Draw labelled diagram of the habit, floral parts, L S of flower, T S of ovary, floral diagram, and floral formula and describe the salient features of the member in technical terms. (Minimum two plants from each dicot family and one from monocot family).

2. Identify the economic products obtained from the plants mentioned under Economic Botany
3. Students must submit practical records, Herbarium sheets (20 Nos: representing one sheet from each family) and Field book at the time of practical examination.
4. Field visits are to be conducted to familiarize the local flora. Field trips are to be conducted for three days either as continuous or one daytrips.

References

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3. Mukash Biswas (2014). Taxonomy of Angiosperms, Thomson publishers, ND
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Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understanding the fundamentals of Angiosperm taxonomy	**U**	**PSO- 1**
CO-2	Identify and classify plant species, using keys and taxonomic principles.	**U, Ap**	**PSO 1&2**
C0-3	Analyse and identify common plant families and species based on morphological characteristics such as leaves, flowers, fruits, and seeds and familiar with the immense diversity of angiosperms,	**U, Ap**	**PSO 6**
C0-4	Learn about the cultivation practices of common crops and economic importance of angiosperms in areas such as agriculture, horticulture, forestry, medicine, industries etc.	**U**	**PSO 4**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
CO-1	Understanding the fundamentals of Angiosperm taxonomy	1	1	U	F, C	L	
CO-2	Identify and classify plant species, using keys and taxonomic principles.	1, 2	1,2	U, Ap	F,P	L	

C0-3	Analyse and identify common plant families and species based on morphological characteristics such as leaves, flowers, fruits, and seeds and familiar with the immense diversity of angiosperms,	1, 5	6	U, Ap	P	L	P
C0-4	Learn about the cultivation practices of common crops and economic importance of angiosperms in areas such as agriculture, horticulture, forestry, medicine, industries etc.	2, 5	4	U		L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	3	2	-	-	-	-	-	-	-
CO3	3	-	-	-	2	-	-	-	-	-	-	-	3	-	-	-
CO4	-	3	-	-	2	-	-	-	-	-	3	-	-	-	-	-

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓		✓	✓
CO 4	✓	✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK5DSCBOT 301.1				
Course Title	**ENVIRONMENTAL STUDIES**				
Type of Course	**DSC**				
Semester	**V**				
Academic Level	300-349				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Should complete all courses of IV Semester				
Course Summary	Inculcate environmental awareness among students for the protection of nature				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**NATURAL RESOURCES AND ITS CONSERVATION**		**8**
	1	Natural Resources - Renewable and Non-renewable Land and Air, Soil, Water, Energy, Minerals, Food and agriculture, Forests, Plants & animals; Wild life resources. Degradation of natural resources - Land degradation, degradation of water resources, Loss of flora and fauna;	

		Causes – population explosion, over exploitation, deforestation, agriculture mismanagement, desertification, overgrazing, soil erosion, mining, urbanization and industrialization- change in land use, depletion of water resources.	
	2	Conservation of Natural resources and sustainable life styles. Land and soil- Afforestation, regeneration of waste land Energy - Promoting use of renewable resources-solar, tidal and wind; biodiesel, biofuels. Forests- Reforestation, Community forestry programmes	
II	**ECOSYSTEMS**		**10**
	3	Ecosystems - Concept, definition, structure and function; components- biotic and abiotic, energy flow.	
	4	Food chains -Food web ,ecological Pyramids, biogeochemical cycles - Carbon and Phosphorous cycle	
	5	Ecological succession: Definition, primary and secondary succession, climax concept, hydrosere and xerosere.	
	6	Plant adaptations- Morphological, anatomical, physiological adaptations of Hydrophytes, Xerophytes, Halophytes, Epiphytes, Parasites	
	7	Introduction- types, characteristic features, structure and functions of the following ecosystems. Forest ecosystem, 2. Grassland ecosystem, 3. Desert ecosystem, 4. Aquatic ecosystems- Ponds, Streams, Rivers, Oceans, Estuaries (brief account only)	
	8	Millennium Ecosystem Assessment (MA), Cultural services: recreational opportunities, spiritual and aesthetic values, and cultural heritage associated with ecosystems.	
III	**ENVIRONMENT AND SOCIAL ISSUES**		**8**
	9	Climate changes and rise in sea level, global warming ,acid rains, Ozone layer depletion , Nuclear accidents and holocaust	
	10	Resettlement and rehabilitation of people – Problems and	

		concerns	
	11	Water conservation, Rain water harvesting , Watershed management , ground water dams	
	12	Sustainable development; Key aspects, sustainable agriculture , sustainable forestry	
IV	**ENVIRONMENTAL LEGISLATIONS**		**4**
	13	Environment protection Act (1986); Air [prevention and control of pollution] Act (1981; Amended 1987); Water [prevention and control of pollution] Act (1974; Amended 1988); Wildlife Protection Act (1972); Forest conservation Act (1980). (Scope and relevance only)	
	14	Environmental Organisations –UNEP, IPCC, WWF, Central Pollution Control Board	
V	**ENVIRONMENTAL POLLUTION**		**15**
	15	Definition, causes, effects and control measures of – 1. Air pollution, 2. Water pollution, 3. Soil pollution, 4. Marine pollution, 5. Noise pollution, 6. Thermal pollution.	
	16	Solid Waste Management- waste minimization, Recycling and Reuse, Consuming environment friendly products. E-waste management.	

Practicals (30hrs)

1. Visit a local polluted site and report major pollutants.
2. Study of ecological and anatomical modifications of Xerophytes, Hydrophytes,
3. Halophytes, Epiphytes and Parasites.
4. Observe and study different ecosystems mentioned in the syllabus.

References :

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20. Verma, P. S. and V. K. Agrawal. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd., New Delhi.
21. Silent Spring by Rachel Carson - 1962.
22. The End of Nature by Bill McKibben - Published in 1989.
23. Collapse: How Societies Choose to Fail or Succeed by Jared Diamond - 2005.
24. Cradle to Cradle: Remaking the Way We Make Things by William McDonough and Michael Braungart - 2002.
25. The Sixth Extinction: An Unnatural History by Elizabeth Kolbert - Published in 2014.
26. Ecology: The Economy of Nature by Robert E. Ricklefs and Rick Relyea - 2007.
27. Environmental Science: Earth as a Living Planet by Daniel B. Botkin and Edward A. Keller - 1995.
28. Environmental Politics and Policy by Walter A. - 1989.

29. An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It by Al Gore - 2006.
30. Our Common Future (The Brundtland Report) by the World Commission on Environment and Development - 1987.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO1	Gain awareness of environmental issues and develop critical thinking skills to evaluate environmental problems, analyze data, and propose potential solutions.	Ap, An	**PSO -1,2**
CO2	Appreciate the interdisciplinary nature of environmental science by integrating knowledge from fields such as biology, chemistry, physics, geology, sociology, economics, and political science.	U	**PSO - 7**
CO3	Understand the principles of sustainability and the importance of sustainable practices in managing natural resources and ecosystems.	U, Ap	**PSO -8**
CO4	Gain insight into environmental policy frameworks, regulations, and international agreements, and their role in addressing global environmental challenges.	R, E	**PSO -1,8**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ENVIRONMENTAL STUDIES

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO	CO	PO	PSO	Cognit	Kno	Lecture

No.				ive Level	wled ge Cate gory	(L)/Tutoria l (T) Practical (P)
CO 1	Gain awareness of environmental issues and develop critical thinking skills to evaluate environmental problems, analyze data, and propose potential solutions.	1	1,2	U,Ap	F	L/T
CO 2	Appreciate the interdisciplinary nature of environmental science by integrating knowledge from fields such as biology, chemistry, physics, geology, sociology, economics, and political science.	1,3	7	U	C	L
CO 3	Understand the principles of sustainability and the importance of sustainable practices in managing natural resources and ecosystems.	1,3	8	An	C	L/T
CO 4	Gain insight into environmental policy frameworks, regulations, and international agreements, and their role in addressing global environmental challenges.	1	1,8	E	C	L

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	3	2	-	-	-	-	-	-	-
CO2	3	-	3	-	-	-	-	-	-	-	3	-	-	3	-	-
CO3	3	-	3	-	2	-	-	-	-	-	-	3	-	-	3	-
CO4	3	-	-	-	2	-	-	3	-	-	-	-	-	-	3	-

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4		✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK5DSCBOT 302.1				
Course Title	**GENETICS**				
Type of Course	**DSC** A8				
Semester	V				
Academic Level	300 – 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Students should complete the course Cell and Evolutionary Biology				
Course Summary	Gives an overview of genetics, including the history of the field, and the basic principles of inheritance and inheritance of various traits. The course imparts the role of chromosomes in inheritance, including linkage, crossing over, and sex determination and sex chromosomal anomalies. Population genetics focuses on the study of genetic variation within and between populations. Epigenetics includes basic concepts and explain the main epigenetic mechanisms and environmental influences on epigenetic modification				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Mendelian Genetics**	**5**
	1	Mendel and his experiments- Experimental plant, characters selected, Principles, reason for the success	
	2	Monohybrid Experiments- law of segregation	
	3	Dihybrid Experiments- Law of Independent assortment, Back	

		cross and Testcross, Reciprocal cross	
II	**Interaction of Genes and Variation from Mendelian ratios**		10
	4	Allelic interaction- Incomplete dominance –Flower color in *Mirabilis;* Codominance-AB blood group, .MN blood Group	
	5	Non allelic Interaction of genes-Collaborative gene-Comb pattern in poultry, 9:3:3:1;Epistasis – Recessive epistasis- Coat color in mice. 9:3:4; Dominant epistasis- Fruit colour in summer squash, 12:3:1; Complementary genes-Flower color in *Lathyrus* 9:7; Duplicate gene with cumulative effect- Fruit shape in summer squash. 9:6:1; Duplicate dominant genes – Fruit shape in *Capsella bursa-pastoris* -15:1; Inhibitory gene- Leaf color in Paddy, 13:3.Pleiotropism- Phenylketonuria; Penetrance and Expressivity	
III	**Patterns of Inheritance**		**10**
	6	Multiple alleles-General account. ABO blood group in man. Rh factor, Self-sterility in *Nicotiana*	
	7	Quantitative characters- General characters of quantitative inheritance, polygenic inheritance; Skin color in man, Ear size in Maize.	
	8	Extra nuclear inheritance General account, maternal influence. Plastid inheritance in *Mirabilis*. Shell coiling in snails, kappa particle in *Paramecium*.	
V	**Population Genetics and Epigenetics**		**5**
	9	Hardy Weinberg law, Factors affecting equilibrium - Mutation, Migration, selection and Genetic drift.	
	10	Epigenetics- Basic Concepts -an overview of basic genetics concepts like DNA, genes, and heredity, epigenetic mechanisms- DNA methylation, histone modifications, and non-coding RNAs. , Environmental Influence: Highlight how environmental factors can influence epigenetic modifications.	
	11	**Activity** -Discuss studies that demonstrate how diet, stress, toxins, and lifestyle choices can impact gene expression	

		through epigenetic changes	
IV	**Chromosomal Basis of inheritance**		**15**
	12	Linkage - Linkage and its importance, linkage and independent assortment. Complete and incomplete linkage.	
	13	Crossing over – a general account, two point, three point cross. Determination of gene sequence. Interference and coincidence. Mapping of chromosomes.	
	14	Sex determination- Sex chromosomes, chromosomal basis of sex determination XX- XY, XX-XO mechanism. Sex determination in higher plants (*Melandrium album*)	
	15	Sex chromosomal abnormalities in man- Klinefelter's syndrome, Turner's syndrome. Sex linked inheritance- X- linked inheritance - White Eye colour in *Drosophila*, Hemophilia in man. Y-linked inheritance-Hypertrichosis of the ear.	

Practicals (30 Hrs)

1. Monohybrid cross (Dominance and incomplete dominance), Dihybrid cross (Dominance and incomplete dominance)

2. Gene interactions (All types of gene interactions mentioned in the syllabus)

a. Recessive epistasis 9: 3: 4.

b. Dominant epistasis 12: 3:1

c. Complementary genes 9:7

d. Duplicate genes with cumulative effect 9: 6:1

e. Inhibitory genes 13:3

f. Duplicate dominant gene 15: 1

g. Collaborative gene 9:3:3:1

4. Linkage and crossing over

a. Two point and three point crosses

b. Construction of genetic map.

References

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2. Gardner,E.J and Snustad,D.P(1984) Principles of Genetics. John Wiley, New York.

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4. John Ringo (2004) Fundamental Genetics. Cambridge University Press India Pvt. Ltd
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7. Verma, P. S. & V. K. Agarwal, 2003, Genetics. S. Chand &Co. Ltd., New Delhi
Wiley & Sons, New York.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Grasp fundamental concepts Mendelian inheritance, and genetic variation.	U	PSO-1
CO-2	Equip with a strong foundation in genetic principles and the skills necessary to apply them in various contexts, whether in further academic study and research.	R, U	PSO-5,6
CO-3	Equip for solving problems with relevance to the principles and applications of genetics.	App,An	PSO-2
CO-4	Learn how genetics intersects with other fields such as medicine, agriculture, forensics, anthropology, or evolutionary biology.	E	PSO-1

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: GENETICS

Credits 4: 3:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T) Practical (P)

CO-1	Grasp fundamental concepts Mendelian inheritance, and genetic variation.	1	1	U	F, C	L/P
CO-2	Equip with a strong foundation in genetic principles and the skills necessary to apply them in various contexts, whether in further academic study and research.	1, 5	5,6	R, U	F,P	L
C0-3	Equip for solving problems with relevance to the principles and applications of genetics.	2	2	App,An	P	L/P
C0-4	Learn how genetics intersects with other fields such as medicine, agriculture, forensics, anthropology, or evolutionary biology.	1	7	U	F,C	L/P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	2	-	-	-	-	-	-	3	3	-	-	-
CO3	-	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-

CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	**Assignment**	**Project Evaluation**	**End Semester Examinations**
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK5DSEBOT 303.1				
Course Title	**PLANT BIOTECHNOLOGY**				
Type of Course	**DSE**				
Semester	V				
Academic Level	301-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Should have a knowledge about plant cell and cell division .				
Course Summary	Overview in the field of plant biotechnology, historical context, and its significance in agriculture, medicine, and industry. Study the techniques for the in vitro culture and manipulation of plant cells, tissues, and organs, including callus culture, cell suspension culture, organogenesis, and somatic embryogenesis. Students. Study principles and methods of genetic engineering, recombinant DNA technology, transformation methods. Skill in doing plant tissue culture and basic biotechnological techniques to explore molecular biology of plants. Acquire hands-on experience in laboratory techniques related to plant biotechnology.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Plant Tissue Culture**	**6**
	1	Introduction – History- major achievements-Biotechnology in India.	
	2	Plant Tissue culture – Totipotency- definition and importance – dedifferentiation, redifferentiation and Cytodifferentiation.	
	3	Equipments and other requirements in tissue culture laboratory – instruments, tools, glass wares	
	4	Sterilization- Explants, equipments and medium	
	5.	Culture media-MS Medium, composition and preparation	
	6	Inoculation – Subculture, Callus and suspension culture, meristem culture	
	7.	Soma clonal variation, Somatic embryogenesis, Embryo culture and embryo rescue. and organogenesis.	
	8	Production of haploids – pollen culture, anther culture – protoplast culture –somatic hybrids – cybrids - for production of haploid Plant hardening transfer to soil, green house technology.	
	9.	Economic exploitation of plant tissue culture.	
II		**Recombinant DNA technology**	**6**
	10	General account of cloning vehicles – plasmid, bacteriophages, cosmids and phagemids. Cutting and joining of DNA molecules – restriction endonucleases, ligases – Gene library.	
	11.	Brief account of gene transfer techniques – Direct DNA uptake by protoplast vector method Agrobacterium mediated, physical method- electroporation- shot gun method – microinjection.	
III		**Methods in Biotechnology.**	**9**
	12.	Isolation and purification of DNA from plant cells.	

	13.	Agarose gel electrophoresis	
	14.	PCR, RFLP, DNA sequencing-Sanger's method, Next-generation sequencing (NGS), Southern blotting, ELISA.	
	15.	Forensics - DNA finger printing.	
IV	**Application of genetic transformation**		**9**
	16.	Medicine – edible vaccines from plants, gene therapy	
	17.	Agriculture – nif genes, genetically modified crops – Golden rice, Flavr savr tomato, Bt crops - herbicide resistance, fungal resistance,	
	18.	Environment- Bioremediation- use of genetically engineered bacteria-Super bug	
	19.	Production technology of plantibodies and monoclonal antibodies by hybridoma technology. Transgenic plants as bioreactors.	
	20	Biosafety and ethical issues, Intellectual Property Rights (IPR)	
V	**Industrial applications**		**15**
	21	Horticulture and Floriculture Industry,	
	22	Production of alcohol	
	23.	Production of vitamins	
	24.	Single cell protein	
	25.	**Activity:** Visit to biotechnology lab and document.	

PRACTICALS (30 hrs)

1. Preparation of MS medium.
2. Process of in vitro sterilization and inoculation methods by using different explants (leaf, nodal bud and seeds of tobacco, Datura, Brassica)
3. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis
4. Extraction and separation of plant DNA by agarose gel electrophoresis.
5. Extraction and separation of Plant protein by SDS-PAGE.

Reference

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2. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt.Ltd., New Delhi. 5th edition.

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4. Chawla, H.S. (2002). Introduction to Plant Biotechnology. New Delhi: Oxford and IBHP Publishing Co. Pvt. Ltd.

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10.Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Learn various biotechnological techniques used in plant research and agriculture.	U	PSO-1,2
CO-2	Enhance skill in the technique that involves the aseptic culture of plant cells, tissues, or organs in a nutrient-rich medium to propagate plants.	U,C	PSO-5
CO-3	Able to apply biotechnological approaches to	Ap	PSO-6

	improve crop traits for yield and resistance .		
CO-4	Acquire hands-on experience in laboratory techniques commonly used in plant biotechnology research	R,U,Ap	PSO-6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PLANT BIOTECHNOLOGY

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	**CO**	**PO**	**PSO**	**Cognitive Level**	**Knowledge Category**	**Lecture (L) /Tutorial (T)/ Practical (P)**
CO-1.	Learn various biotechnological techniques used in plant research and agriculture.	1	1,2	U	F	L
CO-2	Enhance skill in the technique that involves the aseptic culture of plant cells, tissues, or organs in a nutrient-rich medium to propagate plants	5	5	U,C	C ,F,P	T/P
CO-3	Able to apply biotechnological approaches to improve crop traits for yield and resistance.	1,5	6	Ap	,F,,C P	L/P

CO-4	Acquire hands-on experience in laboratory techniques commonly used in plant biotechnology research	1,5	6	R,U,Ap	C,P	L/P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CO1	3	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	3	-	-	-	3	-	-	-	-
CO3	3	-	-	-	2	-	-	-	-	-	-	-	3	-	-	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-	3	-	-	-

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)
d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal	**Assignment**	**Project**	**End**	**Semester**

	Exam		Evaluation	Examinations
CO 1	✓	✓		✓
CO 2		✓		✓
CO 3	✓	✓		
CO 4		✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK5DSEBOT 304.1				
Course Title	**FORESTRY AND PHYTOGEOGRAPHY**				
Type of Course	**DSE II**				
Semester	V				
Academic Level	300 – 349				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Awareness about forestry and phytogeography				
Course Summary	Conserving the natural heritage of the country by preserving the remaining natural forests with the vast variety of flora and fauna.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Fundementals of forestry**		**5**
	1	Basic definitions:- Forestry, Silviculture, Pollarding, Lopping, Pruning, Taungya system, Coppice, Seed orchards, Seed stand, Pricking out, Wind breaks, Shelter belts, Tending, Felling.	
	2	Afforestation, Reforestation, Age crop, Age classification, Alpine, Basal area, Bole, Breast height, Coupe, Crown, Dendrology.	

	3	Reserved forest, Protected forest, Unclassed forest, Log,Logging, Pod, Raft, Scrub, Succession.	
II	**Silviculture**		**5**
	4	Introduction:- Siliviculture pertains to the raising, development, care, reproduction and overall management of forest crops.	
	5	Objectives of silviculture Silviculture – General Silviculture-Systems Silviculture – Mangrove and Cold desert Silviculture of Trees	
	6	Soil science, Chemistry and fertility of soil.Forest Soils, Soil Conservation and Watershed Management.	
III	**Forest**		**13**
	7	Types of forest and functions of forest	
	8	Agroforestry:- Agroforestry - definition, concept and objectives. Classification of agroforestry systems - primary systems and subsystems - inheritance effects. Tree-crop interactions - above and below ground - competition for space, water, light and nutrients. Microclimatic modifications - nutrient cycling and soil fertility improvement -Allelopathy and allelochemicals. - Ecological aspects of agroforestry - benefits and limitations of agroforestry. Urban Forestry - definition and scope - benefits - choice of tree species - planting techniques and management	
	9	Social forestry -objectives and scope and necessity - its components and implementation in local and national levels .	
	10	Forest Protection :-Role of forest protection in Indian forestry. Injuries caused by various agencies - by human beings, plants, animals, insects, birds, adverse climatic factors. Forest fire -beneficial and adverse causes - fire	

		protection methods and rehabilitation. Pests and diseases of economic trees - control measures for pests and diseases for major tree species - biological, chemical and integrated pest and disease management methods. Termites - types and their management. Alien or invasive weeds and their management - forest encroachments and grazing.	
	11	Wildlife Biology and Management:- Wildlife and wild animals - food chain - prey and predator relationship. Introduction to wildlife management. Ecology and biology of wildlife - principles and techniques of management - Man and Biosphere (MAB) programme **Activity:** Power point presentation on different types of forest	
IV		**Phytogeography**	7
	12	Concept & definition, species distribution- continental drift, continuous and discontinuous distribution.	
	13	Vegetation in India – Forests- tropical, temperate, sholas, sub alpine, alpine, mangroves & Grass lands.	
	14	Phytogeographical regions of India -Western and eastern Himalayas, Desert, Western Ghats, Deccan Peninsula, Gangetic Plain, North East India, Coasts & Islands	
	15	**Activity**: Site study	
V		**Forest policies**	**15**
	16	Salient features of Indian Forest policies	
	17	Forest laws -necessity - general principles - Indian Forest Act 1927, Forest Conservation Act 1980, Wildlife Protection Act, Recent Policies and Acts - Tribal Bill, 2007, Biodiversity Bill, 2002, National Agroforestry Policy 2014. ITTO, GATT and its relevance to timber export - Rio summit and Kyoto Protocol and its relevance to timber export.	

Practicals (30hrs)

1. Phytogeographical regions of India- Photos/Diagram

References:

1. Baumer 1989. Agroforestry for watershed management. ICRAF,Kenya
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Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Students will be able to identify forest and other tree species, their distribution, and associated vegetation.	U, An	PSO-1
CO-2	Students will also help to understand the components and dynamics of forest or different forest types.	R, U	PSO-1,2
CO - 3	The student will also be able to acquire knowledge of soil testing and sustainable management practices.	E	PSO-5
CO -4	Students will be able to understand the soil processes which maintain, soil –water relationships, nutrients availability and soil fertility in forest soils.	U, Ap	PSO-1

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FORESTRY AND PHYTOGEOGRAPHY

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Students will be able to identify forest and other tree species, their	1	1	U,An	F, M	L

	distribution, and associated vegetation.					
CO -2	Students will also help to understand the components and dynamics of forest or different forest types.	2	1,2	R,U	C, P	L/P
CO-3	The student will also be able to acquire knowledge of soil testing and sustainable management practices.	1	5	E	P, M	L
CO -4	Students will be able to understand the human animal conflict	2	1	U,Ap	P	L/T

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**	**PSO 9**
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	3	3	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)
d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	**Assignment**	**Project Evaluation**	**End Semester Examinations**
CO 1	✓			✓
CO 2		✓	✓	✓
CO 3	✓		✓	✓
CO 4	✓	✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK5SECBOT 305.1				
Course Title	**MUSHROOM CULTIVATION**				
Type of Course	**SEC**				
Semester	V				
Academic Level	300-349				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hours	-	2 hours	4
Pre-requisites					
Course Summary	Enable the students to identify edible and poisonous mushrooms Provide hands on training for the preparation of bed for mushroom cultivation and spawn production and storage. Help the students to learn a means of self-employment and income generation by cultivating mushrooms .				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to Mushrooms**		**10**
	1	History and introduction: Edible mushrooms and Poisonous mushrooms. Systematic position, morphology, distribution-Vegetative characters	
II	**Common edible mushrooms**		**5**

	2	Button mushroom (*Agaricus bisporus*), Milky mushroom (*Calocybe indica*), Oyster mushroom (*Pleurotus sajorcaju*) and paddy straw mushroom (*Volvariella volvcea*).	
		Activity: Collection of different types of mushrooms	
III	**Principles of mushroom cultivation**		**10**
	3.	Cultivation: Paddy straw mushroom – substrate, spawn making. Methods – bed method, polythene bag method, field cultivation. Oyster mushroom cultivation –Substrate, spawning, pre-treatment of substrate. Maintenance of mushroom.	
	4.	Diseases, pests and nematodes, weed moulds and their management strategies.	
	5.	Processing - Blanching, steeping, sun drying, canning, pickling, freeze drying, Storage – short term and long term storage.	
	6.	Storage – short term and long term storage.	
IV	**Health benefits of mushroom**		**5**
	7.	Nutritional and medicinal values of mushrooms. Therapeutic aspects- Antiviral, antibacterial effect, antifungal effect, anti-tumour effect.	
V	**Mushroom Marketing**		**15**
	8.	Common Indian mushrooms. Production level, economic return, Foreign exchange from Mushroom cultivating countries and international trade	

Practicals (30 hrs.)

1.Sterilization and sanitation of mushroom house, instruments and substrates

2. Preparation of mother culture, media preparation, inoculation, incubation and spawn production

3. Cultivation of oyster mushroom using paddy straw/agricultural wastes

4**.** Visit to a mushroom cultivating laboratory

Suggested Readings

1. Pandey B P (1996). A textbook of fungi. Chand and Company NewDelhi.
2. Pavel Kalc (2016) Edible mushrooms, Chemical composition and nutritional value, Elseveir book aid international
3. Marimuthu, T. et al. (1991). Oster Mushroom. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.
4. Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH
   Publishing Co. Pvt. Ltd., New Delhi
5. Pandey R.K, S. K Ghosh, 1996. A Hand Book on Mushroom Cultivation. Emkey Publications.
6. Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology.
7. Agrobios, Jodhpur.Tewari Pankaj Kapoor, S. C. (1988). Mushroom Cultivation. Mittal Publication, New Delhi.
8. Tripathi, D.P. (2005) Mushroom Cultivation, Oxford & IBH Publishing Co. PVT.LTD, New Delhi.
9. V.N. Pathak, Nagendra Yadav and Maneesha Gaur, Mushroom Production and Processing Technology/ Vedams Ebooks Pvt Ltd., New Delhi (2000)

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Gain the knowledge of cultivation of different types of edible mushrooms and identify edible types of mushroom	R, U	PSO-1,2
CO-2	Identify and manage the diseases and pests of mushrooms	R, U,Ap	PSO-2,6
CO3	Acquire hands-on experience through practical training sessions	R,An, Ap	PSO-6

CO-4	Learn a means of self-employment and income generation	R,Ap	PSO-1,9

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: MUSHROOM CULTIVATION

Credits: 2:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)
CO-1	Gain the knowledge of cultivation of different types of edible mushrooms and identify edible types of mushroom	1	1,2	R, U,Ap	F,M	T/P
CO-2	Identify and manage the diseases and pests of mushrooms	5	2,6	R,An, Ap	C,	C, P
CO-3	Acquire hands-on experience through practical training sessions	5	6	R,Ap	C, P	C,P
CO-4	Learn a means of self-employment and income generation	1	1,9	U,Ap	M	C,M

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO	PO2	PO	PO	PO	PO	PO	PS	PS	PS	PS	PS	PS	PS	PS	PS

	1		3	4	5	6	7	O 1	O 2	O 3	O 4	O 5	O 6	O 7	O 8	O 9
CO1	3	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	3	-	3	-	3	-	-	-
CO3	-	-	-	-	2	-	-	-	-	-	-	-	3	-	-	-
CO4	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2		✓		✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓		✓

SEMESTER VI

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK6DSCBOT 350.1				
Course Title	**HORTICULTURE AND PLANT BREEDING**				
Type of Course	**DSC**				
Semester	VI				
Academic Level	350-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Basic interest in horticulture				
Course Summary	Understanding the importance of horticulture. Learn the methods of plant reproduction and propagation. Demonstrate proficiency in the techniques and practices used in the cultivation, propagation, management of horticultural crops, irrigation, pest control, and crop maintenance. Exploring various career paths in horticulture, including roles in research, extension and industry.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Horticulture**	**7**
	1	Introduction, scope and significance; branches of horticulture.	
	2	Irrigation – Surface, sprinkle, drip and gravity irrigation.	
	3	Bonsai–Principle, creating the bonsai. Cultivation and post-harvest management of vegetables and ornamental plants.	
	4	Flower Arrangement- Containers and requirements for flower arrangements Free style, Shallow and Mass arrangement, Japanese –Ikebana, Bouquet and garland making Dry flower arrangement.	
	5	Growth regulators in horticulture: Rooting hormones, Growth promoters, Flower induction, Parthenocarpy.	
II		**Plant Propagation**	**9**
	6.	Cuttings- root, stem, leaf Layering – Air layering, Ground layering (Tip, Trench and Compound) Budding – T-Budding, Grafting – Approach grafting, Bridge grafting, whip and tongue grafting. **Activity:** Should trained to do - Cutting/ layering/ grafting/budding	
III		**Plant Breeding**	**9**
	7	History of plant breeding. Concept of centres of origin, their importance with reference to Vavilov's work. Important national and international plant breeding Institutes. Contribution of M.S. Swaminathan.	
	8.	Plant introduction. Agencies of plant introduction in India, Procedure of introduction - Acclimatization -Achievements.	

IV		**Breeding Techniques**	**5**
	9.	Selection - mass selection, pure line selection and clonal selection. Genetic basis of selection methods.	
	10.	Hybridization: Procedure of hybridisation, inter generic, inter specific, inter varietal hybridisation with examples. Composite and synthetic varieties.	
	11.	Heterosis and inbreeding depression- genetic basis; male sterility	
	12	Mutation breeding – method – achievements in India	
V		**Seed Technology**	**15**
	13.	Seed Priming and seed Pelletting; Commercial seed Trade; Genetically Modified Seeds; Seed Industry; Seed Certification. Quarantine measures. Plant breeder's rights Act. National Biodiversity Policy. Modern tools for plant breeding: Genetic Engineering and products of genetically modified crops (brief study only).	

PRACTICALS (30 hrs)

1. Students must be trained to do Cutting/ layering/ grafting/budding.
2. Preparation of nursery bed
3. Preparation of potting mixture – Potting, repotting.
4. Field work in cutting, grafting, budding, layering
5. Familiarizing gardening tools and implements
6. Visit to a horticulture station
7. Techniques of emasculation and hybridization of any bisexual flower.
8. Estimation of pollen sterility and fertility percentage
9. Visit to plant breeding station. Submit a report

References

1. Andiance and Brison. (1971). Propagation Horticultural Plants.
2. George Acquaah, (2005) Horticulture: Principles and Practices. Pearson Education, Delhi.
3. Hudson, T. Hartmann, Dale K. Kester, Fred T. Davies, Robert L. Geneve, Plant

Propagation, Principles and Practices.

4. Kolay, A.K. Basic Concepts of Soil Science. New Age International Publishers, Delhi..
5. Nishi Sinha: Gardening in India, Abhinav Publications, New Delhi.Prasad, S., and U. Kumar.
6. Green house Management for Horticultural Crops, Agrobios, Jodhpur.
7. Allard. R.W. (1960). Principles of Plant breeding, John Wiley & Sons, Inc, New York.
8. Chaudhari. H.K. Elementary Principles of Plant breeding, Oxford & IBH Publishers.
9. Singh, B.D. (2005). Plant Breeding - Principles & methods , Kalyani Publishers, NewDelhi..
10. Swaminathan, Gupta & Sinha (1983) Cytogenetics of Crop plants Macmillan India Ltd.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Able to identify a wide range of horticultural plants, including ornamentals, fruits, vegetables, and herbs	R,U	PSO-1
CO-2	Recognize the importance of horticultural practices and be able to implement horticultural practices in various plant species.	U, Ap	PSO-5,6
CO-3	Familiar with various breeding methods and techniques used in plant breeding.	U	PSO-6
CO-4	Students will enhance their critical thinking skills by analyzing and evaluating scientific literature, experimental results, and real-world challenges in horticulture and plant breeding.	U, C	PSO-7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: HORTICULTURE AND PLANT BREEDING

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)
CO-1	Able to identify a wide range of horticultural plants, including ornamentals, fruits, vegetables, and herbs	1	1	R,U	F	L
CO-2.	Recognize the importance of horticultural practices and be able to implement horticultural practices in various plant species.	5	5,6	U, Ap	F,C	T/P
CO-3	Familiar with various breeding methods and techniques	5	6	U	F	L
CO-4	Students will enhance their critical thinking skills by analyzing and evaluating scientific literature, experimental results, and real-world challenges in horticulture and plant breeding.	2	7	U, C	P,M	L/T

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	-	-	-	3	3	-	-	-
CO3	-	-	-	-	2	-	-	-	-	-	-	-	3	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2		✓		✓
CO 3	✓	✓	✓	✓
CO 4	✓	✓		✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK6 DSCBOT 351.1				
Course Title	**PLANT PHYSIOLOGY AND PHYTOCHEMISTRY**				
Type of Course	**DSC**				
Semester	VI				
Academic Level	350-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Should have completed all courses till Semester V				
Course Summary	Student understands plant life processes.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Plant -Water Relations**		**5**
	1	Water relations of plants: Importance of water to plant life	
	2	Absorption of water- organs of absorption, root and root hair. Physical aspects of absorption- imbibition, diffusion and osmosis. Plant cell as an osmotic system; water potential and osmotic potential. Plasmolysis and its significance, practical applications. Mechanism of water absorption – active and passive absorption,	

		root pressure. Pathway of water across root cells.	
	3	b. Ascent of sap- vital and physical theories.	
	4	c. Loss of water from plants: transpiration-cuticular, lenticular and stomatal mechanism, Theories – starch sugar hypothesis, potassium - ion theory.	
	5	Transpiration, Significance, Guttation, anti-transpirants, factors affecting transpiration.	
II	**PHOTOSYNTHESIS**		**10**
	6	Introduction, significance and general equation; Photosynthetic apparatus, structure and function of chloroplast, quantasomes - solar spectrum and its importance - Fluorescence and phosphorescence; Red drop, Emerson effect.	
	7	Two pigment systems, raw material for photosynthesis, Mechanism of Photosynthesis- Light reaction - cyclic and non - cyclic photophosphorylation, Hill Reaction.	
	8	Dark reaction: Calvin cycle; Comparative study of C3, C4 and CAM plants, Photorespiration.	
	9	Factors affecting photosynthesis - Law of limiting factor.	
III	**RESPIRATION**		**10**
	10	Introduction, definition and significance and general equation, Respiratory substrate	
	11	Types of respiration- aerobic and anaerobic.	
	12	Aerobic respiration - glycolysis, Krebs's cycle, terminal oxidation.	
	13	Anaerobic respiration – fermentation: alcoholic and lactic acid fermentation.	
	14	Energy relation of respiration - R Q and its significance,	

		Factors affecting respiration	
	15	Nitrogen metabolism: Biological nitrogen fixation – symbiotic and asymbiotic. Nitrogen fixation by blue green algae - rotation of crops. Nif genes- Leg haemoglobin. Nitrate and ammonia assimilation.	
IV		**Plant Growth and Response**	5
	16	Growth: Phases of growth- vegetative and reproductive growth, growth curves-J and S shaped	
	17	Plant growth regulators - Auxins, Gibberellins, Cytokinin, Ethylene, Abscisic acid, synthetic plant hormones - practical applications.	
	18	Senescence and abscission, Photoperiodism	
	19	Vernalization - phytochrome and its significance. Physiology of bud and seed dormancy, germination.	
	20	Plant movements: Tropic and nastic movements. Circadian rhythm and biological clock.	
	21	Stress physiology: water stress, salt stress.	
V		**Mineral nutrition**	**15**
	22	Gross chemical analysis of the plant body, ash analysis, criteria for essentiality of elements.	
	23	macro and micro elements, role of essential elements and their deficiency symptoms.	
	24	Culture methods - sand culture, hydroponics and aeroponics.	
	25	Mechanism of mineral absorption (a) passive absorption- ion exchange and Donnan's equilibrium (b) active absorption- carrier concept, Lundegardh hypothesis.	

Practicals (30hrs)

1. Water potential of onion peel / *Rhoeo* peel by plasmolytic method.

2. Imbibition of water by different types of seeds.

3. Effect of temperature on permeability.
4. Papaya petiole osmoscope.
5. Determination of stomatal index.
6. Determination of water absorption and transpiration ratio.
7. Measurement of rate of transpiration using Ganong's potometer or Farmer's potometer.
8. Evolution of oxygen during photosynthesis.
9. Light screen experiment
10. Measurement of photosynthesis by Wilmott'sbubbler.
11. Evolution of CO2 during respiration.
12. Ganong's respirometer and measurement of R.Q
13. Alcoholic fermentation using Kuhn's fermentation vessel
14. Geotropism using clinostat (Excluded from practical exam)
15. Measurement of growth using Arc auxanometer. (Excluded from practical exam)

References:

1. Devlin RM &Witham FH(1986). Plant Physiology 4thEdition, C B S publishers.
2. InamA, Sahay S,Akhtar A(2016).Experiments in Plant Physiology, Biochemistry and Ecology, Jaya Publishing House, N Delhi
3. Kochhar P. L. & Krishnamoorthy H. N. (1964). Plant Physiology. Atmaram &Sons- Delhi, Lucknow
4. Kumar & Purohit (1996). Plant Physiology - Fundamentals and Applications Agrobotanical Publications
5. Malik C. P. & Srivastava A. K. (2005). Textbook of Plant Physiology, KalyaniPublishers- NewDelhi
6. Noggle G R & Fritz G J (1983). Introductory Plant physiology 2nd Edition,Prentice Hall of India.
7. Pandey S.N. & Sinha B. K. (1996) Plant physiology 3rd Edition, Vikas publishingHouse- NewDelhi.
8. Purohit. S.S(2003). Plant physiology, Student Edition, Jodhpur
9. Salisbury F. B. & Ross C. W.4th Edition (2005) Plant physiology, Wadsworth publishing company.
10. Sinha RK (2004). Modern Plant physiology, Narosa PublishingHouse, NewDelhi
11. Verma V (2016) Plant Physiology, 2nd Edition, Athena Academic, London

12. William G. Hopkins (2008) Introduction to Plant Physiology 4th Edition, JohnWiley & Sons, NewYork

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
1	Explain fundamental physiological processes in plants, including photosynthesis, respiration, transpiration, mineral nutrition, hormone signalling, and plant-water relations.	U	PSO-1
2	Design, conduct, and analyze experiments in plant physiology, using appropriate techniques and instrumentation, and interpret experimental results to draw conclusions about plant physiological processes.	A	PSO-1,6
3	Apply their understanding of plant physiology principles to solve problems related to plant growth, development, adaptation, and responses to environmental challenges, both in theoretical and practical contexts.	Ap	PSO-1
4	Critically evaluate scientific literature in plant physiology, including research articles, reviews, and experimental data, and synthesize information to develop informed perspectives on current topics and research questions.	E	PSO-2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T) Practical (P)
CO 1	Explain fundamental physiological processes in plants, including photosynthesis, respiration, transpiration, mineral nutrition, hormone signalling, and plant-water relations.	1, 2	1	U	F	L/T
CO 2	Design, conduct, and analyze experiments in plant physiology, using appropriate techniques and instrumentation, and interpret experimental results to draw conclusions about plant physiological processes.	1, 5	1,6	An	P	P
CO 3	Apply their understanding of plant physiology principles to solve problems related to plant growth, development, adaptation, and responses to environmental challenges, both in theoretical and practical contexts.	2	1	Ap	C	L P
CO 4	Critically evaluate scientific literature in plant physiology, including research articles, reviews, and experimental data, and synthesize information to develop informed perspectives on current topics and research	6	2	E	M	L

	questions.					

F-Factual, C- Conceptual, P-Procedural, M- Meta cognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	3	-	-	3	-	-	-	-	3	-	-	-
CO3	-	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	3	-	-	3	-	-	-	-	-	-	-

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK6DSCBOT 352.1				
Course Title	**MOLECULAR BIOLOGY AND BIOINFORMATICS**				
Type of Course	**DSC**				
Semester	VI				
Academic Level	300 – 349				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	A good understanding of basics in genetics and cell biology are vitally important.				
Course Summary	The student will be able to understand the structural organisation of cells and the functions of the organelles. The student will be able to differentiate between plant and animal cells and to analyse different stages of mitosis and meiosis. The student can analyse the structure and function of both DNA and RNA. Students will learn fundamental concepts, tools, and techniques used in bioinformatics research, with a focus on genome analysis, sequence alignment, structural biology, and data mining. •				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Structure and Organization of Nucleus and Nuclear Material**	**6**

	1	Nucleic acids: Carriers of genetic information, Experimental evidence- Griffith's experiment on bacterial transformation, Avery's experiment, Hershey- Chase experiment.	
	2	Types of genetic material, denaturation and renaturation, cot curves, Organization of DNA and structure of RNA- Prokaryotes, Viruses, Eukaryotes	
II	**Genetic Materials**		**6**
	3	Molecular Structure of DNA, Watson and Crick double helical model, Salient features of double helix, biological significance of double helical model of DNA, Chargaff's rule	
	4	Forms of DNA- A, B and Z DNA, Satellite and repetitive DNA, chloroplast DNA, Mitochondrial DNA. Structure, Properties and functions of RNA- mRNA, tRNA, rRNA, SnRNA and microRNA	
III	**Replication of DNA**		**9**
	5	General principles –semi discontinuous replication, Semi conservative model- Meselson and Stahl experiment, leading strand, lagging strand synthesis, Okazaki fragments, replication fork and origin of replication, unidirectional and bidirectional replication, replisome.	
	6	Role of enzymes- Topoisomerase, DNA polymerases, Primases, Helicase, Ligase, DNA repairing mechanism – photoreactivation, Replication of DNA in eukaryotes (brief account only)	
	7	Transcription in prokaryotes and eukaryotes, RNA modifications- introns, exons, removal of introns, spliceosome Ribozymes, exon shuffling; RNA editing and mRNA transport. Translation (Prokaryotes and eukaryotes), Central dogma of molecular biology.	
	8	Genetic code, Wobble hypothesis, lac- operon, steroids and peptide hormones; Gene silencing transcriptional gene regulation in eukaryotes (brief account)- promoters, enhancers, RNA interference	

IV	**Bioinformatics**		**9**
	9	Introduction: Definition, Origin of concept of Bioinformatics; Brief history, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics. Importance of bioinformatics; Wet lab and Web lab.	
	10	Basics of 'omes' and 'omics'-Genomics, Proteomics & Comparative genomics	
	11	Introduction, Biological sequence databases, NCBI, Tools and databases of NCBI, sequence submission to NCBI. Classification format of Biological Databases: Nucleic acid databases (EMBL, Gen Bank, DDBJ); Protein sequence databases. (PIR, SWISS PROT, UNIPROT); Protein structure databank- (PDB), Model organism databases and Biodiversity data bases (brief account only); Biological database retrieval systems-SRS, ENTREZ.	
	12	Gene sequence, Homology searches- Genetic map and physical map; Sequence analysis and alignment- introduction and concept of alignment. Pair wise sequence alignment, multiple sequence alignment (MSA), Sequence Alignment Tools: BLAST- number of hits and hit extension, CLUSTAL X - Scoring Matrices- PAM and BLOSUM.	
V	**Bioinformatics tools and its applications**		**15**
	13	Bioinformatics in relation to Biomolecular structure; Molecular visualization tool- Rasmol	
	14	Phylogenetic analysis: Phylogenetic tree- components; Molecular phylogeny- advantages; Methods of Phylogeny- Distance matrix, Parsimony. Software for Phylogenetic tree construction- **PHYLIP and PHYLOBLAST.**	
	15	Applications of Bioinformatics: Structural Bioinformatics in Drug design and drug discovery, Microbial genome applications, Gene therapy, Personalized medicine, Evolution, antibiotic resistant, preventive health care, bioinformatics tool and Crop improvement.	

Practicals (30 Hrs)

1. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et.al., Griffith's, Hershey & Chase's experiments
2. Nucleic acid and protein databases- FASTA files
3. Sequence retrieval from databases- SRS, ENTREZ
4. Sequence alignment- BLAST, CLUSTAL X
5. Sequence homology and Gene annotation- physical map and genetic map
6. Construction of phylogenetic tree- PHYLIP, PHYLOBLAST.

-
- **Suggested References**

1. Baxevanis, A.D. and Ouellette B.F.F. (2001) Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins. 2nd Edition John Wiley & Sons,Inc.
2. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
3. David Mount (2004) Bioinformatics: Sequence and Genome Analysis, 2 nd Edition Cold spring harbor press.
4. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt.Ltd.
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6. Jin Xiong, (2007). Essential Bioinformatics. Cambridge University Press India Pvt. Ltd.
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9. Xiong (2006). Essential Bioinformatics. Cambridge University Press.
10. Marketa J Zvelebil (2007). Understanding Bioinformatics. Garland Science.
11. Shui Quing Ye (2019). Bioinformatics: A practical Approach. CRC Press.
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13. Mani K and Vijayaraj N (2002). Bioinformatics for beginners. Kalaikathir Achchagam.

14. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology. Scientific Americanbooks.
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16. Twymann, R.M. (1998) Advanced molecular biology, Viva books NewDelhi.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand and analyse the genetic makeup of an organism and have an elementary idea of different forms of DNA and RNA	U, A	1
CO-2	Understand how does DNA replication occurs in prokaryotes and eukaryotes.	R, U	1
CO-3	Evaluate the importance of bioinformatics in modern biological research, particularly in understanding complex biological systems and developing therapeutic interventions.	U, An	5, 6
CO -4	Implement bioinformatics approaches in structural bioinformatics to identify potential drug targets, predict protein-ligand interactions, analyze microbial genomes for drug resistance genes, and develop strategies for personalized medicine and crop improvement.	U, An	3,6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: MOLECULAR BIOLOGY AND BIOINFORMATICS

Credits: 2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)/ Practical (P)
1	Understand and analyse the genetic makeup of an organism and have an elementary idea of different forms of DNA and RNA	1	1	U, A	F, C	L/T
2	Understand how does DNA replication occurs in prokaryotes and eukaryotes.	1,2	1	R, U	F, C	L
3	Evaluate the importance of bioinformatics in modern biological research, particularly in understanding complex biological systems and developing therapeutic interventions.	2	5,6	U, An	P, C	L
4	Implement bioinformatics approaches in structural bioinformatics to identify potential drug targets, predict protein-ligand interactions,	5,6	3,6	U, An	P, M	L/T/P

	analyze microbial genomes for drug resistance genes, and develop strategies for personalized medicine and crop improvement.					

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	3	-	-	3	-	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	3	3	-	-	-
CO4	-	-	-	-	2	3	-	-	-	2	-	-	3	-	-	- 3

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)
d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4			✓	✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK6DSEBOT 353.1				
Course Title	**FORENSIC BOTANY**				
Type of Course	**DSE**				
Semester	VI				
Academic Level	350 – 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. Students should complete up to semester V				
Course Summary	Course is designed to familiarize students to professional practice in the field.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**INTRODUCTION**	**4**
	1	Definition, Introduction, Different divisions and units of Forensic Science Laboratory, Legends and their contributions in the field of forensic science.	
	2	The Bharatiya Nyaya Sanhita (2023)	
	3	Case studies and other works from the forensic literature	
II		**FORENSIC BOTANY**	**6**

	4	Pollen calendar, Pollen for Geolocation and Time of Death Estimation	
	5	Forensic mycology - spores, fruiting bodies, botanical decomposition, site conditions	
	6	Analysis of diatoms	
	7	Considerations while Plant Evidence Collection and Preservation and digitalizing evidence	
	8	**Activity**- Prepare micrographs of pollen from local flora	
III	**MOLECULAR TECHNIQUES**		**15**
	9	Polymerase Chain Reaction (PCR), Short Tandem Repeat (STR) Analysis, Single Nucleotide Polymorphism (SNP) Analysis, Mitochondrial DNA (mtDNA) Sequencing, Y-Chromosome Analysis: Next-Generation Sequencing (NGS), Real-Time PCR (qPCR), DNA Methylation Analysis, RNA Analysis, High-Resolution Melting Analysis (HRM)	
	10	DNA Extraction procedure from various samples- (Blood, Saliva, Seminal fluid, Bone, tissues and inert items.)	
IV		**AGENCIES**	5
	11	National and International Agencies- Central Bureau of Investigation (CBI), National Crime Records Bureau (NCRB), Central Forensic Science Laboratory (CFSL), International Criminal Police Organization (INTERPOL), International Society for Forensic Genetics (ISFG), United Nations Office on Drugs and Crime (UNODC)	
V		**FORENSIC PLANT TAXONOMY**	15
	12	Plants as poison, Pollen and spore examination.	
	13	Green villans – plants as instruments of crime.	
	14	**Activity:** Documentary preparation on previous case histories on notorious plant involvements in criminal cases.	

Practicals (30 Hrs)

1. Acetolysis of pollen grains
2. Staining of fungal hyphae using aniline blue.
3. Training in photography of crime sites

4. Preparation of slides photographing diatoms

References

1.Adler F. (5th Edition) (2004), Criminology, McGraw-Hill

2. Ashraf Mozayani, Carla Noziglia. The Forensic Laboratory Handbook Procedures and Practice, 2nd edition, Humana Press 2010

3. Barak G. (1998), Integrative Criminology, Ashgate Pub Ltd.

4. Barnett P.D. (2001), Ethics in Forensic Science: Professional Standards for the Practice of Criminalistics, CRC press .

5. Bridges (1942), Practical Finger Printing, Funk and Washalls Co. New York.

6. Cooke G. (1980), The role of Forensic Psychologist, Thomas Publication.

7. Gaensselen R., Harris H. and Lee H. (2007), Introduction to Forensic Science and Criminalistics, McGraw-Hill Education.

8. Haward R.C.L. (1981), Forensic Psychology, Batsford Academic and Educational.

9. Hess A.K. and Weiner I.B. (2nd Edition) (1999), Handbook of Forensic Psychology, Wiley, John & Sons, Incorporated

10. James S.H and Nordby J.J. (2003), Forensic Science: An introduction to scientific and investigative techniques, CRC Press, USA.

11. Johnson E.H. (4th Edition) (1978), Crime, Correction and Society, Dorsey Press.

12. Kirk P.L. (1953), Criminal Investigation: physical evidence and the police laboratory, Interscience Publisher Inc. New York.

13. Mehta M. K. (1980), Identification of Thumb Impression & Cross Examination of Finger Prints, N. M. Tripathi (P) Ltd. Bombay.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Knowledge of Plant Evidence Collection and Preservation	**U**	**1**
CO-2	Understanding of Forensic Palynology and Plant	**U**	**1,6**

	Microscopy		
CO-3	Critically assess research literature, case reports, and scientific findings	**U, E**	**1,6**

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FORENSIC BOTANY

Credits:2:1:2 (Lecture: Tutorial: Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Knowledge of Plant Evidence Collection and Preservation	1	1	U	F	L
CO-2	Understanding of Forensic Palynology and Plant Microscopy	1,5	1,6	U	C	T
CO-3	Critically assess research literature, case reports, and scientific findings	1,6	1,6	U, E	M	L/P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	-	-	-	3	-	-	3	-	-	3	-	3	-	-	-
CO3	3	-	-	-	-	3	-	3	-	-	-	3	3	-	-	-

Correlation Levels:

a. - (NA),

b. 1 (Mild),

c. 2 (Moderate)

d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓	✓	✓
CO 2	✓	✓	✓	✓
CO 3			✓	✓

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK6DSEBOT 354.1				
Course Title	**RESEARCH METHODOLOGY AND BIOSTATISTICS**				
Type of Course	**DSE**				
Semester	VI				
Academic Level	350– 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Cleared the requirements upto V semester				
Course Summary	Equip students with essential tools and skills needed to conduct rigorous and ethical research in the life sciences, preparing them for careers in academia, industry, healthcare or public health.				

Detailed Syllabus

Module	Unit	Content	Hrs
I	**Research Methodology**		5
	1	Introduction; Need for research; Stages of Research – Definition of problem, execution of the problem, interpretation of results	
	2	Characteristics of Research, Types of research- Qualitative & quantitative.	

	3	Experimental design, components of experimental designs- Randomized blocks, completely randomized designs	
	4	**Activity**- a) Design a hypothesis and its alternative hypothesis b) Design an RBD experiment and solve it. (Example- A pharmaceutical company wants to compare the effectiveness of four different drug formulations in treating a particular medical condition. However, patient responses may vary due to factors such as age and gender. Design an RBD experiment to control for these potential sources of variability and accurately assess the efficacy of the drug formulations.	
II	**Preparation of a project report**		5
	5	Data analysis and consolidation of photographs, illustrations, tables and graphs	
	6	Title, introduction, review of literature, materials and methods, results, discussions, summary, references, acknowledgements; Bibliography – Method of citing and arrangement of references – Reference management software – Mendeley, EndNote	
	7	**Activity –** Explore Google scholar platform and compile latest reference source on any selected topic of student's choice and present it in APA and MLA format.	
III	**Basics of Biostatistics**		9
	8	Biostatistics - definition –an outline of statistical methods - Statistical terms and symbols, basic principles; Variables –types, measurements; significance, limitations and uses of statistics.	
	9	Distribution of data in Biology -Nature and types - Typical examples, Data collection- primary and secondary; methods for collection of data; Data presentation- tables, diagrams (bar & pie diagrams) and Graphs (Histogram, frequency polygon, frequency curve &	

		Ogives).	
	10	Samples and sampling methods- random sampling and non-random sampling.	
	11	**Activity** – Make a questionnaire for data collection using google forms	
IV	**Descriptive statistics**		11
	12	Statistical treatment of data: frequency distribution; Measures of central tendencies (mean, median, mode- merits and demerits), Measures of dispersion (range, mean deviation, variance, standard deviation, standard error, skewness and kurtosis, quartile deviation –merits and demerits); coefficient of variation.	
	13	Correlation - types and methods of correlation-Pearson's correlation, regression analysis-types, simple regression equation, fitting prediction, Differences and similarities of correlation and regression analysis.	
V	**Inferential statistics**		15
	14	Hypothesis – testing hypothesis - student' s t' test (paired and unpaired), chi square test, F-test (ANOVA-one-way ANOVA and two-way ANOVA), probability test.	
	15	Application of biostatistics-Public health, Quantitative genetics, Expression data, other studies; Scope of biostatistics.	

Practicals (30 Hrs)

1. Tabulation and presentation of data- Diagrams and Graphs**.**
2. Calculation of Frequency distribution, measures of central tendancy and
- measures of dispersion, coefficient of variation.
3. Calculation of correlation coefficient- Pearson's and regression analysis.

4. Statistical inference - hypothesis – student ‘t’ test - chi square test, F-test (ANOVA-one-way ANOVA and two-way ANOVA), probability test.
5. Uses of software in biostatistics- Excel, Instat, SPSS, sigmaplot and R software.

Suggested readings

1. Gurumani N. (2006) Research Methodology For Biological Sciences, MJP Publ.

2. Kothari C R & Garg C (2014) Research methodology methods and techniques, New Age international publishers

3. Rastogi, Veer Bala.; Fundamentals of Biostatistics; 2nd edition, New Delhi : Ane Books India 2008.
4. Bailey T.J. (1995) Statistical Methods in Biology (3rd Edition) – Cambridge University Press India Pvt Ltd.
5. Elizabeth Allman (2004). Mathematical Methods in Biology, Cambridge University Press India Pvt. Ltd
6. Mann, S. P. (2016). Introductory Statistics, 9th edition. Hoboken, NJ, Jone Wiley and Sons Inc.
7. Khan and Khanum (1994). Fundamentals of Biostatistics, Saras Publications
8. Marcello Pagano and Kimberlee Gauvreau (2018) Principles of Biostatistics 2nd Edition CRC Press, Chapman & Hall
9. Khan, I.A., Khanum, A. (2004). Fundamentals of Biostatistics, 5th edition. Hyderabad: Ukaaz publications
10. Zar, J.H. (2014). Biostatistical Analysis, 5th edition. London, London: Pearson Publication.
11. Saha I and Paul B (2016) Essentials of Bio-statistics 2ndEdition Academic Publishers
12. Stephen W. Looney (2009). Biostatistical Methods, Humana Press, Springer International Edn.
13. Veer Bala Rastogi (2008). Fundamentals of Biostatistics, Ane Books Pvt. Ltd
14. Pandey, M. (2015). Biostatistics Basic and Advanced. New Delhi, Delhi: M V Learning.
15. Sundar Rao, P.S.S., Richards, (1996). An introduction to Biostatistics, 3rd edition. Vellore, Tamil Nadu: J. Christian Medical College.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Students will develop the ability to critically evaluate research studies, including assessing the validity, reliability, and generalizability of research findings.	An, E	**PSO** -1
CO-2	Learn various data collection techniques, such as surveys, interviews, observations, and experiments, and understand their strengths, limitations, and appropriate applications.	U, Ap	**PSO**-2
CO-3	Enhance their ability to effectively communicate research findings through written reports, presentations, and academic publications	Ap, C	**PSO** -1
CO-4	Students will appreciate the interdisciplinary nature of research methodologies and understand how different disciplines approach research questions and problems.	U, An	**PSO** -7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: RESEARCH METHODOLOGY AND BIOSTATISTICS

Credits:2:1:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Students will develop the ability to critically evaluate	1	1		F	L

	research studies, including assessing the validity, reliability and generalizability of research findings.			An, E		
CO-2	Learn various data collection techniques, such as surveys, interviews, observations, and experiments, and understand their strengths, limitations, and appropriate applications.	1,2	2	U, Ap	F, P	T/P
CO-3	Enhance their ability to effectively communicate research findings through written reports, presentations and academic publications	6	1	Ap, C	C	P
CO-4	Students will appreciate the interdisciplinary nature of research methodologies and understand how different disciplines approach research questions and problems.	6	7	U, An	F, M	L

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-		2	-	3	-	-	-	-	-
CO3	-	-	-	-	-	3	-	1	-	-	-	3	-	-	-	-

CO4	-	-	-	-	-	3	-	-	-	-	-	-	-	3	-	-

Correlation Levels:

a - (NA),

b 1 (Mild),

c 2 (Moderate)

i. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	**Assignment**	**Project Evaluation**	**End Semester Examinations**
CO 1	✓	✓		
CO 2		✓		✓
CO 3		✓	✓	
CO 4	✓		✓	

Mar Ivanios College (Autonomous)

Discipline	**BOTANY**				
Course Code	MIUK6SECBOT 355.1				
Course Title	**PLANT FIBRE TECHNOLOGY**				
Type of Course	SEC				
Semester	VI				
Academic Level	350-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Needs Curiosity and interest.				
Course Summary	By the end of the course, students will be able know about different types of fibers and dyes.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Textile fbres Introduction**		**8**
	1	a) Classification of textile fibres according to their nature and origin, b) essential and desirable properties of textile fibres, c) staple fibre and continuous filaments, d) comparision of natural and man made fibres.	
	2	Natural fibres: A) Vegetable (bast, leaf and seed fibres) B. cotton: concept of varieties; definition of grading, distinctive	

		properties and end uses, C) jute:- varieties, distinctive properties and end uses, F) flax and pineapple fibres:- brief introduction and uses.	
	3	Texturing: Introduction, purpose, bulked and textured yarns, methods of texturing thermoplastic and non-thermoplastic yarns, basic principles, feed material characteristics-study of twist-set-detwist, false twist, edge crimp, stuffer box crimp; knit de-knit techniques of texturing and the techniques of modified stretch yarn;, properties and uses of textured and bulked yarns.	
	4	Dyeing:- Process	
II	**Textile Technology**		**7**
	5	**Staple fibre Spinning** (brief idea): Introduction, raw material, ginning, opening, cleaning, blending, equalizing, drafting, yarn formation, different systems of spinning.	
	6	Introductory concept of Ginning: Cotton ginning and bailing-object of ginning, different methods and their limitations, description of modern ginning machine, ginning performance on yarn quality, impurities	
	7	**Opening and Cleaning:** Introduction, the need for opening and cleaning, type of opening and degree of opening, impurities to be eliminated. Blending: The purpose of blending, selection of blend constituents, measures of blending, blending procedures-merits and demerits. Blow Room: a) Introduction, basic operations in the blow room, opening, cleaning, dust removal, even feed of material to card, blow room line as a sequence of machines need for various types of machines; b) Components of blow room machines: feed apparatus- feed with two clamping cylinders, feed with a roller and pedals;	
	8	Carding: a) Introduction, object of carding, operating principle, various actions in carding; different types of design (cotton card, woolen card, worsted card, jute card). b) Operating regions of the card, feed of material,	

		requirements, material or flock feeding. c) Card clothing: choice of clothing, classification (flexible, semirigid, metallic) d) Handling sliver: laying down in cans, coiler mechanisms., can changing. e) Auto levelling equipment: basic, classification, principles of short-term auto levelling regulation at the delivery, f) Carding maintenance: stripping the clothing, burnishing the clothing, grinding of clothing.	
III	**Fabric Formation**		**7**
	9	Introduction: a) The fabric, b) methods of fabric formation, c) phases in the formation of fabric by weaving, d) a technical introduction to weaving: basic motions, principal mechanisms of a loom, path of warp through a loom, motion of the healds, sley and shuttle, idea of other loom mechanisms.	
	10	Preparatory processes: Introduction, sequence of processes. Single and multiend winding. Single –end Warp Winding-a) Introduction, b) need for winding, c) cleaning, clearing, d) different types of packages and package build-parallel, near parallel wind & cross wound packages, standard package formats (cop, cone, cheese, pineapple etc.)	
	11	winding techniques-random, precision and combined, winding parameters: winding rate, wind and traverse ratio, gain, winding angle, winding faults; pattern formation, principles of pattern breaking. winding operation, i) unwinding- side and over end withdrawal.	
	12	Multi-end Winding/Warping: a) Introduction, b) principal methods of warping, c) warping process, d) warping creels-continuous chain creel, truck creel, magazine creel, automatic creel, unrolling creel	
	13	**Activity: I**ndustrial visit and study fabric dyeing	

IV	**TEXTILE TESTING**		**8**
	14	Introduction to textile testing: Properties of fibres, yarns and fabrics and their relevance in assessing the performance of textiles during and after manufacture, selection of samples for testing, random and biased samples, review of statistical techniques.	
	15	Fibre Testing: Measurement of fibre length: length and its variability measurement, cumulative frequency diagram, fibre length distribution, wt. distribution curve, methods of measurement and associated parameters: fibre fineness: technical significance, various parameters of measurement, gravimetric, optical, air flow and vibroscopic method.	
	16	Determination of maturity of cotton: significance, maturity ratio, maturity coefficient, degree of thickening, methods of measurement- air flow, dye method,polarising light method and NaOH method; tensile testing of fibres: comparative stress-strain diagrams of different fibres, tensile testing of single fibre, bundle strength testing.(Brief)	
	17	Yarn testing: Yarn dimensions and numbering: linear density, yarn numbering systems, determination of yarn count, conversion from one system to another, measurement of yarn diameter, measurement of twist: twist, diameter and count relation, twist factor, optimum twist, effect of twist on fabric properties, methods of twist measurement.	
	18	Yarn strength: the concept of yarn rupture, types of tests-single thread, lea and ballistic test, types of testers and their principles of working.	
V	**FIBRE FUNDAMENTALS AND DYEING**		**15**
	19	Chemical structure of fibres: General introduction, nature of	

		matter, nature of fibres, requirements for fibre formation, chemical structure of synthetic fibres, chemical structure of natural fibres-vegetable or cellulosic, (b) Microstructure and macrostructure of natural fibres: cotton and other vegetable fibres.	
	20	PHYSICAL PROPERTIES: a) Optical Properties, b) Thermal properties, c) Fiber friction and d) Dielectric properties. MECHANICAL PROPERTIES (Brief treatment without testing procedure) (a) Tensile properties:and (b) Elastic recovery, strain recovery, work recovery: Shear, bending, torsion and compression.	
	21	Eco- friendly preparation of dyeing, printing and finishing. Pollutants in processing industries, and their effect on ecology, Special techniques for reducing pollution caused by textile processing. Ecofriendly substitutes .	

Practicals: (30 hrs)

A.Fibre 1. To prepare a Baer sorter diagram and determine the following: a) Effective Length b) Mean Length c) Dispersion percentage d) Short fibre percentage.Through industrial visit.

B.Yarn 1. To determine yarn count by Knowle's, Beesley, Quadrant and electronic balance.

Refrences:

1. Manmade Fibres by R.W. Moncrieff,
2. Textile Chemistry, Vol. I, by R.H. Peters,
3. Dyeing and Chemical Technology of Textile Fibres by E.R. Trotman,
4. Handbook of Fiber Science and Technology, Vol. IV, Fiber Chemistry by M. Lewin and E.M. Peare,
5. Man-made Fibres Science and Technology, Vol. 1,2,3, by H.F. Mark, S.M. Atlas and E. Cernia,
6. Polyester Fibres Chemistry and Technology by H. Ludwig,
7. Textbook of Polymer Science by F.W. Billmeyer.
8. The Technology of Short Staple Spinning by W. Klein
9. A Practical Guide to Opening & Carding, W. Klein

10. Manual of Cotton Spinning (Opening & Cleaning) by C. Shrigley,
11. Manual of Cotton Spinning (Carding) by W. G. Byerley et. al.,
12. Spun Yarn Technology by Eric Oxtoby,
13. Spun Yarn Technology (Vol-1 & Vol-2) by A Venkatasubramani
14. Principles of Textile Testing by J. E. Booth,
15. Textile Testing by Skinkle, ß
16. Physical Properties of Textile Fibres by W.E. Morton and J.W.S. Hearle,
17. Testing and Quality Management by V.K. Kothari

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Will able to examine different types of textiles	U	PSO-1
CO-2	students will be able to identify the nature of fabrics	R, U	PSO-1,2
CO-3	will be able to understand the dyeing process	An, E	PSO-6
CO-4	will be able understand the methods of manufacture of different fibres, knowledge of textile testing	E, Ap	PSO-6

S-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course:

Credits: 3:0:2 (Lecture:Tutorial:Practical)

CO No.	CO	PO	PSO	Cognitive Level	Knowledge Category	Lecture (L) /Tutorial (T)/ Practical (P)
CO-1	Will able to examine different types of textiles	1	1	U	F	L
CO-2	students will be able to identify the nature of fabrics	1,2	1,2	R, U	F, C	T /P
CO-3	will be able to understand the dyeing process	5	6	An, E	F,C	L
CO-4	will be able understand the	2	6	E, Ap	M	L

	methods of manufacture of different fibres, knowledge of textile testing					

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9
CO1	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	3	2	-	-	-	-	-	-	-
CO3	-	-	-	-	2	-	-	-	-	-	-	-	3	-	-	-
CO4	-	3	-	-		-	-	-	-	-	-	-	3	-	-	-

Correlation Levels:

a. - (NA),
b. 1 (Mild),
c. 2 (Moderate)
d. 3 (High)

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1		✓		✓
CO 2	✓	✓	✓	✓
CO 3	✓	✓	✓	✓

CO 4		✓		✓
CO 5		✓		✓

MAR IVANIOS COLLEGE (AUTONOMOUS), THIRUVANANTHAPURAM

BOARD OF STUDIES IN BOTANY, 2023 – 2026

No	Name	Designation
1.	Dr Bindu Alex (Chairman)	Assistant Professor, Dept of Botany, Mar Ivanios College.
2.	Prof. (Dr.) Shiburaj Sugathan (University Nominee)	Professor, Dept of Botany, University of Kerala, Kariavattom.
3.	Dr Victoria P K	Associate Professor, Dept of Botany, Mar Ivanios College.
4.	Dr C. Suju Skaria	Assistant Professor, Dept of Botany, Mar Ivanios College.
5.	Dr Rejitha L R	Assistant Professor, Dept of Botany, Mar Ivanios College.
6.	Dr Preetha S S	Assistant Professor, Dept of Botany, Mar Ivanios College.
7.	Dr Mary Sheeba A	Assistant Professor, Dept of Botany, Mar Ivanios College.
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9.	Dr M. Anilkumar	Associate Professor & Head Dept of Botany, Union Christian College,
10.	Dr. K.K. Sabu	Principal Scientist and Head, Biotechnology & Bioinformatics Division, JNTBGRI, Palode.
11.	Dr. Jude Emmanuel	Environmental Scientist, Directorate of Environment & Climate Change, Thampanoor.
12.	Dr. TK. Hrideek	Senior scientist, Kerala Forest Research Institute, Peechi.
13.	Dr. Vignesh RM	Farm Superintendent, Pharmacognosy Unit,Govt. Ayurveda

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14.	Dr. Mahesh S	Asst. Professor and HOD, Dept. of Botany, Christian College, Kattakada.
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