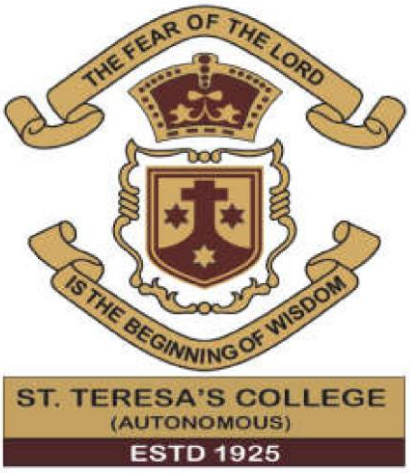
ST. TERESA'S COLLEGE (AUTONOMOUS)
ERNAKULAM

Affiliated to Mahatma Gandhi University, Kottayam



CURRICULUM AND SYLLABI FOR THE PROGRAMME

B.Sc. BOTANY
Program Code: BBOT

and

Complementary Courses

Under Choice Based Credit and Semester System
(2023 Admission Onwards)

Department of Botany

Board of Studies in Botany (2021-2024)

Sl. No	Category	Name	Designation	Official Address
1	Chairperson (HoD)	Dr. Liza Jacob	Chairperson	Associate Professor & Head, Department of Botany, St. Teresa's College (Autonomous), Ernakulam. Pin - 682035
2	Faculty Members	Dr. Elsam Joseph	Member from the Department with Ph. D.	Associate Professor, Department of Botany, St. Teresa's College (Autonomous), Ernakulam. Pin – 682035
		Dr. Alphonsa Vijaya Joseph	Member from the Department with Ph. D. (Principal)	Professor, Department of Botany, St. Teresa's College (Autonomous), Ernakulam. Pin – 682035
		Smt. Nishitha I. K.	Member from the Department	Assistant Professor, Department of Botany, St. Teresa's College (Autonomous), Ernakulam. Pin – 682035
		Dr. Arya P Mohan	Member from the Department with Ph. D.	Guest Faculty, Department of Botany, St. Teresa's College (Autonomous), Ernakulam, Pin- 682035
		Smt. Merin Alice George	Member from the Department	Guest Faculty, Department of Botany, St. Teresa's College (Autonomous), Ernakulam, Pin- 682035
		Dr. Aghil Soorya A.	Member from the Department with Ph. D.	Guest Faculty, Department of Botany, St. Teresa's College (Autonomous), Ernakulam, Pin- 682035
		Dr. Chandini V. K.	Member from the	Guest Faculty, Department of Botany,

			Department with Ph. D.	St. Teresa's College (Autonomous), Ernakulam, Pin- 682035
3	Subject Experts- Outside MG University	Dr. Bindu R. Nair	Subject Expert	Professor, Department of Botany, University of Kerala, Kariyavattom, Thiruvananthapuram.
		Dr. Manudev K. M.	Subject Expert	Assistant Professor, Department of Botany, St.Joseph's College (Autonomous), Devagiri, Kozhikode.
4	University Nominee	Dr. Stephen Sequeira	Subject Expert	Assistant Professor, Department of Botany, Maharaja's College, (Government Autonomous), Ernakulam.
5	Representative from Industry/ Corporate Sector/ Allied field related to placement	Dr. K. S. Rishad	Representative from Industry	Research Director, Unibiosys Foundation for Education and Research, Kalamasserry, Ernakulam.
6	Alumni Representative	Dr. C. T. Anitha	Alumnae	Assistant Professor, Post Graduate and Research Department of Botany, Sree Narayana College, Nattika, Thrissur.

PREFACE

The curriculum, which encompasses the totality of student experience, should ensure a collective and dedicated effort to birth an inspiring academic culture in a campus. It is this vision of quality knowledge, its production and transmission, that has fueled the Teresian quest for essential and elemental student development. St. Teresa's College has taken meticulous care in the conception of the new well-balanced curriculum by retaining the fundamental prerequisites mentioned by the University/Higher Education Council. With the constraints of a prescribed syllabus in mind, we have created an academic sanctuary, where a deeper access to knowledge is achievable to students and teachers as well.

The Syllabus restructuring of 2023 instigates opportunities of real-world learning to equip a modern scholar with the practicality of experience. As an autonomous institution under Mahatma Gandhi University, St. Teresa's College offers a significant number of Programmes with definite placement windows to the learners. Student knowledge and training across a range of subject areas is efficiently enriched by engaging them in work-based learning, as provided by the revised and restructured curriculum.

The indefatigable effort taken by the teachers in developing Programmes and Course outcomes is commendable. The blossoming of the cognitive and intellectual skills of the scholars, the initiation of a research mentality, and pragmatic skill sets to venture out confidently into a professional space, are the core off-shoots that are anticipated. The curriculum should equip the students to be educators themselves, with a voice that echoes global effectiveness.

I congratulate the efforts taken by the Principal Dr. Alphonsa Vijaya Joseph and her team for restructuring the syllabus in keeping with the latest demands in academia. We trust that the syllabus will transform minds to embark upon higher academic summits and thereby mould learners who will make significant contributions to the world. We look forward to sharing the outcomes of our restructured curriculum and the positive changes that would reshape the academic lives of all our scholars.

Dr. Sr. Vinitha (Celine E.)
Manager

FOREWORD

The most significant characteristic of an autonomous college is its commitment to curriculum renewal or revision. Academic autonomy has granted the college the freedom to fine tune the syllabus keeping in mind the changing needs of the new generation of students, the new educational scenario in the global context and incorporation of skill based curricula. Revision of the syllabus implies responsibility and accountability and this in turn leads to excellence in academics and proactive governance. Education in the current scenario throws up a multitude of challenges and the curricula and syllabi ought to reflect the paradigm shift that has occurred in the various disciplines.

A revision of the syllabus is implemented by modifying the curriculum after review to evaluate the effectiveness of the curriculum after it has been implemented and to reflect on what students did and did not get out of it. In line with the new Educational policy, a big educational reform can be effected by restructuring of syllabi to maintain a high level of quality in the standard of education that we impart.

The three themes under Higher Education relevant to policy initiative for restructuring of the curriculum i.e., integrating skill development in higher education, linking higher education to society and integration of new knowledge are considered with utmost importance during revision of the syllabus.

Outcome-Based Education emphasizes that the learning process is innovative, interactive and effective, where the main goal is student achievement at the end of the learning period. St. Teresa's College in its pursuit of imparting quality education has adopted Outcome Based Education (OBE) system that involves restructuring of curriculum, academic processes, teaching methodologies, assessment and evaluation systems in education to reflect the achievement of high order learning. It is a student-centric instruction model that focuses on measuring student performance through outcomes that include knowledge, skills and attitudes. The revised syllabus and curriculum is the result of the combined efforts of the members of the Board of studies, curriculum expert committee and the syllabus committee who worked as a team to revise the syllabus and curriculum in the stipulated period. Active consultations were held with various stakeholders to elicit multiple perspectives in higher education which were incorporated in the new curriculum.

With sincere gratitude I acknowledge the instinct support and constant guidance extended by Dr. Sr. Vinitha (Celine E.), Provincial Superior and Manager, Rev. Sr. Emeline, Director, Dr.

Sajimol Augustine M., Senior Administrator, Smt. Betty Joseph, Vice-Principal and Dr. Beena Job, Dean of self-financed programmes. I specially thank the team headed by Dr. Betty Rani Isaac, the Heads of the Departments and all the faculty members for their diligence, commitment and exceptional contribution towards this endeavour.

Prof. (Dr.) Alphonsa Vijaya Joseph
Principal

ACKNOWLEDGEMENT

As the Chairperson of the Board of Studies of B. Sc. Programme in Botany of St. Teresa's College (Autonomous), Ernakulam, I express my sincere thanks to all the well-wishers and stakeholders who have rendered significant suggestions and comments in the preparation of the curriculum and syllabus. My heartfelt gratitude to Dr. Stephen Sequeira, Assistant Professor, Department of Botany, Maharaja's College, (Government Autonomous), Ernakulam for his sincere effort and contributions in the preparation of this syllabus.

I place on record my sincere thanks to the subject experts, Dr.Bindu R.Nair, Professor, Department of Botany, University of Kerala, Kariyavattom, Thiruvananthapuram, Dr. Manudev K. M., Assistant Professor, Department of Botany, St.Joseph's College (Autonomous), Devagiri, Kozhikode and Dr. C.T. Anitha, Assistant Professor, Post Graduate and Research Department of Botany, Sree Narayana College, Nattika, Thrissur for their guidance and remarkable suggestions to restructure various courses of the programme. Thanks Dr. K. S. Rishad, Research Director, Unibiosys Foundation for Education and Research, Kalamasserry, Ernakulam, for his invaluable suggestions.

My sincere thanks to Dr. Kala M.S., Professor and IQAC Co - ordinator, Department of Physics and Dr. Betty Rani Issac, Associate Professor, Department of Home Science and other members of the syllabus committee for the guidance and help given to shape the overall frame work and structure of the curriculum and syllabus.

I extend my deep sense of gratitude to our Provincial Superior and Manager Dr. Sr. Vinitha (Celine E.), Principal Dr. Alphonsa Vijaya Joseph, Director Rev. Sr. Emeline CSST, Senior Administrator Dr. Sajimol Augustine M and Vice Principal Smt. Betty Joseph, for their valuable suggestions and support during the various stages of syllabus revision. My deep sense of appreciation to Dr. Elsam Joseph, Smt. I. K. Nishitha, Dr. Arya P. Mohan, Smt. Merin Alice George, Dr. Chandini V. K. and Dr. Aghil Soorya A. - the members of Board of Studies and faculty of Department of Botany, St. Teresa's College (Autonomous), Ernakulam for their sincere cooperation and hard work in compiling the curriculum and syllabi.

Dr. Liza Jacob
Chairperson, Board of Studies & Head
Department of Botany

CONTENTS

B.Sc. Programme in Botany under Choice Based Credit and Semester System (2023 Admission Onwards)

PREAMBLE

The Board of Studies of Bachelor's Programme in Botany recognizes that the curriculum, course content and assessment of scholastic achievement play mutually complementary roles in education. The restructured Curriculum for the Undergraduate Programme of Botany envisages Undergraduate Education as a combination of general and specialized knowledge, simultaneously introducing the concepts of breadth and depth in learning. It stresses on learning to learn rather than going through bland specific lessons. We attempt to prepare students for a life-long learning experience by drawing attention to the vast world of knowledge of plants and introducing them to the methodology of systematic academic enquiry. With this in mind, we aim to provide not only a firm foundation in every aspect of Botany but also to explain a broad spectrum of modern trends and to develop experimental, observational and computational skills which will mould them as ambassadors of sustainable development for our country.

The Programme is Outcome based. Outcome based education involves assessment and evaluation practices in education reflecting the attainment of expected learning and mastery in the programme. It is a systematic way to determine if a programme has achieved its goal. This approach of learning makes the student an active learner, the teacher a good facilitator and together they lay the foundation for life-long learning. The process includes framing of specific course outcomes at various appropriate levels of taxonomy, mapping the course outcomes of each course with the Programme Specific Outcomes and finally calculating the course attainment based on the marks scored by the student in both the Internal and External assessments.

PROGRAMME OUTCOMES (PO)

On completion of any undergraduate programme from St. Teresa's College (Autonomous), Ernakulam, students should be able to demonstrate the programme outcomes listed below:

PO 1. ***Disciplinary knowledge***

- Demonstrate a mastery of the fundamental knowledge and skills required in the discipline to function effectively as an entry-level professional in the field.

PO 2. ***Scientific Temper***

- Experiment with new approaches, challenge existing knowledge boundaries and take informed action to solve problems related to society.
- Identify, define, and deal with problems through logical, analytical and critical thinking acquired from different domains of knowledge

PO 3. ***Research and Digital Competence***

- Develop a research culture for lifelong learning and demonstrate competency in creating new knowledge.
- Analyze and choose from available data and information sources to communicate, collaborate and network through a range of digital media.

PO 4. ***Communication Skills***

- Develop language proficiency through interactions embedded in meaningful contexts.
- Demonstrate communicative competence particularly using technology in social and global environments.

PO 5. ***Leadership, Teamwork and Interpersonal Skills***

- Function effectively both as leader and/or member of a team.
- Collaborate and interact effectively with others.

PO 6. ***Moral & Ethical Awareness and Social Responsibility***

- Demonstrate social and national responsibility.
- Engage in activities that contribute to the betterment of society, with a preferential option for the economically challenged and the marginalized.

PROGRAMME SPECIFIC OUTCOMES (PSO)

On completion of the B.Sc. programme in Botany, students should be able to demonstrate the programme specific outcome listed below:

PSO1: Examine the plant and animal kingdom from the microbes to the most advanced life forms based on morphology, ecology and phylogeny (Apply)

PSO2: Articulate the concepts, processes and the applied aspects of chemistry and zoology (Apply)

PSO3: Analyse the structural features and reproductive processes in plant groups and summarize the concepts and processes involved in the various cellular mechanisms. (Analyse)

PSO4: Explain the strategies for environment and resource management, sustainable development and human rights. (Understand)

PSO5: Illustrate expertise in the application of Botany for research and entrepreneurship and develop communication skills and digital proficiency to share the knowledge with the society effectively. (Apply)

ELIGIBILITY

Pass in +2 Examination with Biology as an optional subject

PROGRAMME DESIGN

The U.G. Programme in Botany must include (a) Common courses, (b) Core courses, (c) Complementary Courses, (d) Choice Based Core Courses (e) Open Courses and (f) Project work. No course shall carry more than 4 credits. The student shall select any one open course in Semester V offered by any department other than their parent department including the physical education department, depending on the availability of infrastructure facilities, in the institution. The Programme contains 33 courses in six semesters. The total credit of the Programme is 120. The number of courses for the restructured Programme should contain 12 Compulsory Core courses, 1 Open Course, 1 Choice Based Core Course from the frontier area of the Core Courses, 6 Core Practical, 1 Project in the area of core, 8 Complementary Courses, 4 Complementary Practical otherwise specified, from the relevant subjects for complementing the core of study. There should be 10 Common Courses or otherwise specified, which includes the first and second language of study.

PROJECT

All students have to complete a project work and submit the dissertation for evaluation in the sixth semester. Project work shall be completed by working outside the regular teaching hours. Project work shall be carried out under the supervision of a teacher in the concerned department. The student can conduct individual project or take part in group projects of three students per group, as per the consultancy offered by the teacher in charge. A candidate may, however, in certain cases be permitted to work on the project in an industrial/research organization on the recommendation of the supervisor

PROGRAMME STRUCTURE

MODEL I B.Sc. BOTANY

A	Programme Duration	6 Semesters
B	Total Credits required for successful completion of the Programme	120
C	Credits required from Common Course I	22
D	Credits required from Common Course II	16
E	Credits required from Core course and Complementary courses including Project	79
F	Credits required from Open Course	3

COURSES

The Programme (Model I) consists of Common Courses with 38 credits, Core Courses, Choice Based Core Course and Complementary Courses with 79 credits and Open Course with 3 credits.

SCHEME OF COURSES

The different types of courses and numbers are as follows:

Model- I

Courses	**Number**
Common Courses	10
Core Courses (Theory)	12
Project/ Industrial Visit and Comprehensive Viva	1
Core Practical	6
Open Course	1
Choice Based Core Course	1
Complementary Courses	12
Total	**43**

COURSES WITH CREDITS (FOR MODEL 1)

Courses	Credits
Core Courses	46
Open Course	3
Choice Based Core Course	3
Project & Viva-voce	2
Total	**54**
Complementary Courses I	14
Complementary Courses II	14
Total	**28**
Common Courses	38
Total	**38**
Grand Total	**120**

SCHEME OF DISTRIBUTION OF INSTRUCTIONAL HOURS FOR CORE COURSES

Semester	Model I	
	Theory	Practical
First	2	2
Second	2	2
Third	3	2
Fourth	3	2
Fifth	16	9 (8+1 project)
Sixth	16	9 (8+1 project)

COURSE CODE FORMAT

The programme is coded according to the following criteria.

A. The first letter plus second letter/any letter from the programme ie., **BO.**

B. One digit to indicate the semester. i.e., **BO1 (Botany, 1st semester).**

C. One letter from the type of courses such as, **A** for common course, **B** for Complementary course, **C** for Core course, **D** for Open course, ie., **BO1C (Botany, 1st semester Core course) PR** for project and **I** for Internship.

D. Two digits to indicate the course number of that semester. ie., **BO1C01(Botany, 1st semester, Core course, course number is 01).**

E. The letter **B** to indicate Bachelors Programme.

F. **BO1C01B** (Botany, 1st semester, Core course, courses number 01, and **B** for bachelors Programme).

G. 23 to indicate the year**.** ie., **BO1C01B23.**

H. The letter **P** denotes practical – it should come after the code letter for the course ie., C**P** (core practical- eg.BO2CP01B23)/B**P** (complementary practical-eg. BO2BP01B23) .

I. The letter **PR** denotes project ie… Botany Core Project BO6PRB23.

J. The letter I denotes internship – It should come after the code letter for the course ie., CI (Core Internship-eg. BO2CI01B23).

DURATION OF PROGRAMME

- The duration of U.G. Programme shall be **6 Semesters**.
- A student may be permitted to complete the Programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the Programme.
- Attendance: Students having a minimum of 75% average attendance for all the courses only, can register for the examination.

B. Sc. BOTANY PROGRAMME – MODEL I
DETAILED PROGRAMME STRUCTURE

Sem	Course Type	Course Code	Course Title	Hrs/ week	Credits	Max Marks	
						ISA	ESA
I	Common Course I	EN1A01B23	Fine-tune Your English	5	4	20	80
		EN1A02B23	Pearls from the Deep	4	3	20	80
	Common Course II	FR1A01B23	French Language and Communicative Skills-I	4	4	20	80
		HN1A01B23	Kahaani Aur Upanyas				
		MA1A01B23	Kathasahithyam				
	Complementary Course I	CH1B01B23	Basic Theoretical and Analytical Chemistry	2	2	15	60
		CH2BP01B23	Volumetric Analysis	2	-	-	-
	Complementary Course II	ZY1B01B23	Non-Chordate Diversity	2	2	15	60
		ZY2BP01B23	Non-Chordate and Chordate Diversity	2	-	-	-
	Core Course	BO1C01B23	Anatomy and Microtechnique	2	2	15	60
	Core Practical	BO2CP01B23	Anatomy, Microtechnique, Microbiology, Mycology and Plant Pathology	2	-	-	-
	Total Credits – 17						
II	Common Course I	EN2A03B23	Issues that Matter	5	4	20	80
		EN2A04B23	Savouring the Classics	4	3	20	80
	Common Course II	FR2A03B23	French Language and Communicative Skills-II	4	4	20	80
		HN2A03B23	Kavita Vyakaran Aur Anuvad				
		MA2A03B23	Kavitha				
	Complementary Course I	CH2B01B23	Basic Organic Chemistry	2	2	15	60
		CH2BP01B23	Volumetric Analysis	2	2	10	40
	Complementary Course II	ZY2B01B23	Chordate Diversity	2	2	15	60
		ZY2BP01B23	Non-Chordate and Chordate Diversity	2	2	10	40
	Core Course	BO2C02B23	Microbiology, Mycology and Plant Pathology	2	2	15	60

	Core Practical	BO2CP01B23	Anatomy, Microtechnique, Microbiology, Mycology and Plant Pathology	2	2	10	40
	Total Credits – 23						
III	Common Course I	EN3A05B23	Literature and/as Identity	5	4	20	80
	Common Course II	FR3A05B23	An Advanced Course in French -I	5	4	20	80
		HN3A05B23	Naatak Aur Lambi Kavita				
		MA3A05B23	Drisyakalasahithyam				
	Complementary Course I	CH3B01B23	Inorganic and Organic Chemistry	3	3	15	60
		CH4BP01B23	Organic Chemistry Practicals (Micro)	2	-	-	-
	Complementary Course II	ZY3B01B23	Physiology and Immunology	3	3	15	60
		ZY4BP01B23	Physiology, Immunology and Applied Zoology	2	-	-	-
	Core Course	BO3C03B23	Phycology and Bryology	3	3	15	60
	Core Practical	BO4CP02B23	Phycology, Bryology, Pteridology, Gymnosperms, Palaeobotany and Evolution	2	-	-	-
	Total Credits – 17						
IV	Common Course I	EN4A06B23	Illuminations	5	4	20	80
	Common Course II	FR4A06B23	An Advanced Course in French -II	5	4	20	80
		HN4A06B23	Gadya Aur Ekanki				
		MA4A06B23	Malayala Gadhyarachanakal				
	Complementary Course I	CH4B01B23	Advanced Bio-Organic Chemistry	3	3	15	60
		CH4BP01B23	Organic Chemistry Practicals (Micro)	2	2	10	40
	Complementary Course II	ZY4B01B23	Applied Zoology	3	3	15	60
		ZY4BP01B23	Physiology, Immunology and Applied Zoology	2	2	10	40

	Core Course	BO4C04B23	Pteridology, Gymnosperms, Palaeobotany and Evolution	3	3	15	60
	Core Practical	BO4CP02B23	Phycology, Bryology, Pteridology, Gymnosperms, Palaeobotany and Evolution	2	2	10	40
	Total Credits – 23						
V	Core Course	BO5C05B23	Environmental Science and Human Rights	3	3	15	60
		BO5C06B23	Research Methodology, Biophysics and Biostatistics	3	3	15	60
		BO5C07B23	Angiosperm Morphology, Reproductive Botany, Economic Botany and Ethnobotany	3	3	15	60
		BO5C08B23	Angiosperm Taxonomy and Phytogeography	3	3	15	60
	Open Course	Offered by other Departments		4	3	20	80
	Core Practical	BO6CP03B23	Environmental Science, Human Rights, Research Methodology, Biophysics and Biostatistics	4	-	-	-
		BO6CP04B23	Angiosperm Morphology, Reproductive Botany, Economic Botany, Ethnobotany, Angiosperm Taxonomy and Phytogeography	4	-	-	-
	Project	BO6PRB23	Project	1	-	-	-
	Total Credits – 15						
VI	Core Course	BO6C09B23	Genetics, Plant Breeding and Horticulture	4	3	15	60
		BO6C10B23	Cell and Molecular Biology	3	3	15	60
		BO6C11B23	Plant Physiology and Biochemistry	3	3	15	60
		BO6C12B23	Biotechnology and Bioinformatics	3	3	15	60

		BO6C13CB23	Plant Genetic Resources Management	3	3	20	80
	Core Practical	BO6CP03B23	Environmental Science, Human Rights, Research Methodology, Biophysics and Biostatistics	-	2	10	40
		BO6CP04B23	Angiosperm Morphology, Reproductive Botany, Economic Botany, Ethnobotany, Angiosperm Taxonomy and Phytogeography	-	2	10	40
		BO6CP05B23	Genetics, Plant Breeding, Horticulture and Cell and Molecular Biology	4	2	10	40
		BO6CP06B23	Plant Physiology, Biochemistry, Biotechnology and Bioinformatics	4	2	10	40
	Project	BO6PRB23	Project	1	2	20	80
	Total Credits – 25						

CONSOLIDATED SCHEME FOR I TO VI SEMESTERS PROGRAMME STRUCTURE

1. B.Sc. BOTANY PROGRAMME (MODEL - I)

Course Code	Title of the Course	Category	Hrs/ week	Credits
SEMESTER-1				
BO1C01B23	Anatomy and Microtechnique	Core	2	2
BO2CP01B23	Anatomy, Microtechnique, Microbiology, Mycology and Plant Pathology	Core	2	-
	Total Credits	**2**		
SEMESTER-2				
BO2C02B23	Microbiology, Mycology and Plant Pathology	Core	2	2
BO2CP01B23	Anatomy, Microtechnique, Microbiology, Mycology and Plant Pathology	Core	2	2
	Total Credits	**4**		
SEMSTER-3				
BO3C03B23	Phycology and Bryology	Core	3	3
BO4CP02B23	Phycology, Bryology, Pteridology, Gymnosperms, Palaeobotany and Evolution	Core	2	-
	Total Credits	**3**		
SEMESTER-4				
BO4C04B23	Pteridology, Gymnosperms, Palaeobotany and Evolution	Core	3	3
BO4CP02B23	Phycology, Bryology, Pteridology, Gymnosperms, Palaeobotany and Evolution	Core	2	2
	Total Credits	**5**		
SEMESTER-5				
BO5C05B23	Environmental Science and Human Rights	Core	3	3
BO5C06B23	Research Methodology, Biophysics and Biostatistics	Core	3	3
BO5C07B23	Angiosperm Morphology, Reproductive Botany, Economic Botany and Ethnobotany	Core	3	3
BO5C08B23	Angiosperm Taxonomy and Phytogeography	Core	3	3

Offered by other Departments	Open Course	Open Course	4	3
BO6CP03B23	Environmental Science, Human Rights, Research Methodology, Biophysics and Biostatistics	Core	4	-
BO6CP04B23	Angiosperm Morphology, Reproductive Botany, Economic Botany, Ethnobotany, Angiosperm Taxonomy and Phytogeography	Core	4	-
BO6PRB23	Project	Core	1	-
	Total Credits	**15**		
SEMESTER-6				
BO6C09B23	Genetics, Plant Breeding and Horticulture	Core	4	3
BO6C10B23	Cell and Molecular Biology	Core	3	3
BO6C11B23	Plant Physiology and Biochemistry	Core	3	3
BO6C12B23	Biotechnology and Bioinformatics	Core	3	3
BO6C13CB23	(CBC) Plant Genetic Resources Management	Core	3	3
BO6CP03B23	Environmental Science, Human Rights, Research Methodology, Biophysics and Biostatistics	Core	-	2
BO6CP04B23	Angiosperm Morphology, Reproductive Botany, Economic Botany, Ethnobotany, Angiosperm Taxonomy and Phytogeography	Core	-	2
BO6CP05B23	Genetics, Plant Breeding, Horticulture, Cell and Molecular Biology	Core	4	2
BO6CP06B23	Plant Physiology, Biochemistry, Biotechnology and Bioinformatics	Core	4	2
BO6PRB23	Project	Core	1	2
	Total Credits	**25**		

OPEN COURSES

Sl. No.	Semester	Course Code	Course Title
1	V	BO5D01AB23	Horticulture and Nursery Management
2	V	BO5D01BB23	Agri-based Microenterprises
3	V	BO5D01CB23	Ecotourism

CHOICE BASED CORE COURSES

Sl. No.	Semester	Course Code	Course Title
1	VI	BO6C13AB23	Phytochemistry and Pharmacognosy
2	VI	BO6C13BB23	Agribusiness
3	VI	BO6C13CB23	Plant Genetic Resources Management

Complementary Courses offered by the Department of Botany

(for B.Sc. Zoology)

THEORY & PRACTICAL

Course Code	Title of the Course	Hrs per week	Credits
SEMESTER I			
BO1B01B23	Anatomy and Applied Botany	2	2
BO2BP01B23	Anatomy, Applied Botany, Cryptogams and Gymnosperms	2	-
SEMESTER II			
BO2B01B23	Cryptogams and Gymnosperms	2	2
BO2BP01B23	Anatomy, Applied Botany, Cryptogams and Gymnosperms	2	2
SEMESTER III			
BO3B01B23	Angiosperm Taxonomy and Economic Botany	3	3
BO4BP01B23	Angiosperm Taxonomy, Economic Botany, Plant Physiology and Crop Pathology	2	-
SEMESTER IV			
BO4B01B23	Plant Physiology and Crop Pathology	3	3
BO4BP01B23	Angiosperm Taxonomy, Economic Botany, Plant Physiology and Crop Pathology	2	2

EXAMINATIONS

The external theory examination of all semesters shall be conducted by the College at the end of each semester. Internal evaluation is to be done by continuous assessment.

Examinations will have two parts: Internal or In-Semester Assessment (ISA) & External or End– Semester Assessment (ESA). The ratio between ISA and ESA shall be 1:4. Both internal and external marks are to be rounded to the next integer.

MARKS DISTRIBUTION FOR END-SEMESTER ASSESSMENT (ESA) AND IN- SEMESTER ASSESSMENT (ISA)

Marks distribution for ESA and ISA and the components for internal evaluation with their marks are shown below:

For all courses without practical

a) End–Semester Assessment (ESA): 80 marks

b) In-Semester Assessment (ISA): 20 marks

ISA – Theory	Marks
Attendance	5
Assignment*	5
Test papers (2 x 5)	10
Total	20

Attendance

% of Attendance	Marks
90% or above	5
Between 85 and below 90	4
Between 80 and below 85	3
Above 75 and below 80	2
75 %	1
< 75	0

B. **For all courses with practical**

a) End–Semester Assessment (ESA): 60 marks

b) In-Semester Assessment (ISA): 15 marks

ISA – Theory	**Marks**
Attendance	**5**
Assignment*	**2**
Test papers (2 x 4)	**8**
Total	**15**

(i) *Assignment: for core papers (III & IV Semester), the student must undertake a Project/ Field work/ Industrial Visit/ Internship and the report of the same should be submitted for evaluation. The marks awarded to this can be considered for assignment of any one core paper

(ii)* Assignment (project/field work/ Industrial Visit) for Semester I & II- to be given by language teachers, report of which has to be submitted and for those programmes which do not have additional language the students must undertake the assignment (project/field work/ Industrial Visit) for any one core paper.

Projects which are preferably socially relevant/ industry oriented/ research oriented are to be undertaken by the students and the reports have to be submitted.

FOR ALL PRACTICAL PAPERS (conducted only at the end of even semesters):

(a) End–Semester Assessment (ESA): 40

(b) In-Semester Assessment (ISA): 10

ISA components	**Marks**
Attendance	**2**
Test paper (1 x 4)	**4**
Record**	**4**
Total	**10**

****Bona fide record of the practical work conducted shall be submitted at the time of examination

FOR PROJECTS AND COMPREHENSIVE VIVA- VOCE:

(a) End-Semester Assessment (ESA): 80

(b) In-Semester Assessment (ISA): 20

Components of Project and Viva – ESA	**Marks**
Dissertation * (External)	50
Project based Presentation and Viva-voce (External)	30
Total	**80**

*Bona fide reports of the project work conducted shall be submitted at the time of examination

All the four components of the ISA are mandatory

Components of Project – ISA	**Marks**
Punctuality	5
Experimentation / Data Collection	5
Knowledge	5
Report	5
Total	**20**

SEMINAR / VIVA

A student shall present a seminar in the 5th semester and appear for Viva-voce in the 6th semester for all courses.

IN-SEMESTER ASSESSMENT - TEST PAPERS

Two internal test-papers are to be attended in each semester for each paper. The evaluations of all components are to be published and are to be acknowledged by the students. All documents of internal assessments are to be kept in the college for two years. The responsibility of evaluating internal assessment is vested on the teachers who teach the course.

END-SEMESTER ASSESSMENT

The End-Semester examination of all courses shall be conducted by the College on the close of each semester. For reappearance/improvement, students can appear along with the next batch.

Pattern of Question Paper:

A question paper shall be a judicious mix of short answer type, short essay type/ problem solving type and long essay type questions.

For each course the End-semester Assessment is of 3 hours duration. The question paper has 3 parts. Part A contains 12 short answer type questions of which 10 are to be answered. Part B contains 9 short essay questions of which 6 are to be answered. Part C has 4 long essay questions of which 2 are to be answered.

Part	No. of Questions	No. of Questions to be Answered	Marks (for Courses with Practical)	Marks (for Courses without Practical)
A (Short Answer Type)	12	10	10 x 1 = 10	10 x 2 = 20
B (Short Essay)	9	6	6 x 5 = 30	6 x 5 = 30
C (Long Essay)	4	2	2 x 10 =20	2 x 15 = 30

CONDUCT OF PRACTICAL EXAMINATIONS PRACTICAL EXAMINATION

Practical examinations will be conducted only at the end of even semesters for all Programmes.

PATTERN OF QUESTION PAPERS

Pattern of questions for end-semester assessment of practical papers will be decided by the concerned Board of practical examination.

GRADES

Grades will be given on a 10 -point scale based on the total percentage of marks (ISA + ESA) for all Courses (Theory, Practical, Project).

% of marks	Grade	Grade point
Equal to 95 and above	S - Outstanding	10
Equal to 85 and < 95	A^+ - Excellent	9
Equal to 75 and < 85	A - Very good	8

Equal to 65 and < 75	B^+ - Good	7
Equal to 55 and < 65	B - Above average	6
Equal to 45 and < 55	C - Satisfactory	5
Equal to 35 and < 45	D - Pass	4
Below 35	F - Failure	0
	Ab - Absent	0

PASS CRITERIA

- A separate minimum of 30% marks each for ISA and ESA (for both theory and practical) and aggregate minimum of 35% is required for a pass in a course.
- For a pass in a programme, a separate minimum of Grade D is required for all the individual courses.
- If a candidate secures F Grade for any one of the courses in a semester/programme, only F grade will be awarded for that semester/programme until she improves this to D Grade or above within the permitted period.
- Students who complete the programme with D grade will have one betterment chance within 12 months, immediately after the publication of the result of the whole programme.

CREDIT POINT AND CREDIT POINT AVERAGE

Credit Point (CP) of a Course is calculated: **CP = C × GP**

C = Credit; GP = Grade point

Semester Credit Point Average (SCPA) of a Semester:

SCPA = TCP/TC

TCP = Total Credit Point of that Semester; TC = Total Credit of that Semester

Cumulative Credit Point Average (CCPA) is calculated:

CCPA = TCP/TC

TCP = Total Credit Point of that Programme; TC = Total Credit of that Programme

CREDIT POINT AVERAGE (CPA)

CPA of different category of courses *viz*. Common Courses, Complementary Courses, Core Courses, *etc*., are calculated:

CPA = TCP/TC

TCP = Total Credit Point of a category of Course; TC = Total Credit of that category of Course

Grades for the different Courses, Semesters and overall Programme are given based on the corresponding CPA:

CPA	GRADE
Equal to 9.5 and above	S Outstanding
Equal to 8.5 and < 9.5	A+ Excellent
Equal to 7.5 and < 8.5	A Very Good
Equal to 6.5 and < 7.5	B+ Good
Equal to 5.5 and < 6.5	B Above Average
Equal to 4.5 and < 5.5	C Satisfactory
Equal to 4 and < 4.5	D Pass
Below 4	F Failure

- For reappearance/improvement for other Semesters, candidate have to appear along with the next batch.
- There shall be supplementary exams only (no improvement) for V semester in the respective academic year.

- Notionally registered candidates can also apply for the said supplementary examinations.
- A student who registers her name for the End Semester Assessment for a Semester will be eligible for promotion to the next Semester.
- A student who has completed the entire curriculum requirement, but could not register for the Semester examination can register notionally, for getting eligibility for promotion to the next Semester.
- A candidate who has not secured minimum marks/credits in ISA can re-do the same registering along with the ESA for the same Semester, subsequently.
- There shall be no improvement for internal evaluation.
- **All rules and regulations are subject to change as and when modified by Mahatma Gandhi University, Kottayam to which St. Teresa's College (Autonomous), Ernakulam is affiliated.**

SYLLABI FOR CORE COURSES

SEMESTER I CORE COURSE

COURSE CODE: BO1C01B23

Course title: ANATOMY AND MICROTECHNIQUE

Credits: 2

Hours per week: 2 **Total Lecture Hours: 36**

Course Overview and Content

The course provides a detailed account on the structure, development and functions of the different tissues and organs in plants. It emphasises on the need for anatomical studies as an identification tool aiding phylogenetic and evolutionary analysis of plants. The course enables the student to analyse the structure function relationship in plants at different organisational levels. The biological techniques that are utilised for the effective study of plant tissues and their preservation are also emphasised.

The course provides students with skills required for jobs in Ayurvedic pharmaceutical industries where raw materials require identification using anatomical features. It also equips them with laboratory techniques obligatory of research centres, for preserving and maintaining specimens in biology labs, museums, herbaria and various conservational centres.

Course Outcomes

CO1: Explain the cellular structure and anatomical organization of plants. (Understand)

CO2: Relate anatomy of the different plant parts/organs to their function and utilise it for identification. (Apply)

CO3: Analyse secondary growth in plants and describe the different wood types. (Analyse)

CO4: Apply the procedures of microtechnique for preservation and microscopic study of plants. (Apply)

ANATOMY (27 hrs.)

Module 1: Structure and Composition of Plant Cells (4 hrs)

Cell wall**:** structure of cell wall; sub-microscopic structure - cellulose, micelle, micro fibril and macro fibril; structure and function of plasmodesmata, simple and bordered pits; different types of cell wall thickening in treachery elements; extra cell wall thickening materials. Growth of cell wall - apposition, intussusception.

Module 2: Organization of Tissues (8 hrs)

Tissues: meristematic tissue – characteristic features, functions and classification. Theories on apical organization - Apical cell theory, Histogen theory, Tunica-Corpus theory. Permanent tissues - structure and function of simple and complex tissues. Secretory tissues: external secretory tissue - glands and nectaries; internal secretory tissues - laticifers.

Non-living inclusions in plant cells: food products, secretory products, excretory (waste) products - nitrogenous and non-nitrogenous.

Module 3: Tissue systems and Plant Body Structure (8 hrs): epidermal tissue system - epidermis, cuticle, trichome; stomata – structure, types; bulliform cells. Ground tissue system - cortex, endodermis, pericycle, pith and pith rays. Vascular tissue system, different types of vascular bundles and their arrangement in root and stem.

Primary structure of stem, root and leaf (dicot and monocot).

Module 4: Secondary Growth and Wood Anatomy (7 hrs)

Normal secondary growth in dicot stem and root. Periderm: structure and development - phellum, phellogen, phelloderm, bark, and lenticels. Anomalous secondary thickening: *Bignonia* stem, *Boerhaavia* stem and *Dracaena* stem.

Wood Anatomy: Basic structure of wood; heart wood, sap wood; hard wood and soft wood; dendrochronology; growth rings; porous and non- porous wood; ring porous wood and reaction wood; tension wood and compression wood.

MICROTECHNIQUE (9 hrs)

Module 5: Preservation of Plant Specimens, Sectioning and Mounting (9 hrs)

Introduction to microtechnique. Killing and fixing - purpose. Dehydration - purpose, agents used - ethyl alcohol. Sectioning: hand sections, serial sections; Microtome - rotary, sledge (application only). Staining technique: principle of staining; stains - hematoxylin, fast green, acetocarmine; vital stains - neutral red, Evans blue; mordants - purpose with examples. Types of staining - single staining, double staining. Mounting and mounting media – purpose, mounting media - glycerine, DPX, Canada balsam. Use of permanent whole mounts; permanent sections; maceration, smear and squash preparation.

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MODEL QUESTION PAPER

B.Sc. DEGREE (C.B.C.S) EXAMINATION, NOVEMBER 2023

SEMESTER I - CORE COURSE FOR B.Sc. BOTANY

BO1C01B23: ANATOMY AND MICROTECHNIQUE

Time: 3 hours Maximum marks: 60

Part A

(Answer any ten questions. Each question carries 1 mark)

Qn.No.	Questions	CO	Level of question
1.	What are bordered pits?	1	U
2.	Name one extra cell wall material.	1	R
3.	How is quiescent centre important for plants?	2	U
4.	What are casparian strips?	1	U
5.	What feature of monocot leaves allows them to roll up under water scarcity?	2	Ap
6.	Explain dendrochronology.	3	U
7.	How is epiblema different from epidermis?	2	U
8.	What are isobilateral leaves?	2	U
9.	What do you mean by radial arrangement?	3	R
10.	Name a fixative.	4	R
11.	What are microtomes used for?	4	U
12.	Give an example of a mountant.	4	R

(10 x 1 = 10 marks)

Part B

(Answer any six questions. Each question carries 5 marks)

Qn.No.	Questions	CO	Level
13.	Explain the sub microscopic structure of cell wall.	1	U
14.	What are the theories on the growth of cell wall?	1	R
15.	How will you identify the different types of stomata?	2	AP
16.	What anatomical features are suggestive of a root? How is a dicot root different from a monocot root?	2	Ap
17.	Analyse the role of the cortical cells in extrastelar secondary growth in plants.	3	An
18.	Differentiate heart wood and sap wood?	3	An
19.	Explain the procedure for preserving a specimen in its most original state.	4	Ap
20.	What are mordants? Explain their use with examples.	4	U
21.	What are stains? Explain the principle of staining.	4	U

(6 x 5 = 30 marks)

Part C

(Answer any two questions. Each question carries 10 marks)

Qn.No.	Questions	CO	Level
22.	Why are xylem and phloem considered complex tissues? Explain their features.	2	U
23.	Write an essay on the non-living inclusions of the	1	U

	cell.		
24.	Explain the anatomy of shoot apical meristem and give the theories explaining its organisation.	1	U
25.	Differentiate secondary growth in *Bignonia* from that of normal dicot stem. Provide illustrations.	3	An

(2 x 10 = 20 marks)

CO : Course Outcomes

Level : R – Remember, U – Understand, Ap- Apply, An- Analyze, E- Evaluate, C- Create

SEMESTER II CORE COURSE

COURSE CODE: BO2C02B23

COURSE TITLE: MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY

Credits 2

Hours per week: 2 **Total Lecture Hours: 36**

Course Overview and Content

The course explains the diversity of life and introduces the different classificatory systems of the biological world and the plant kingdom. world of microbes, their unique features, genetic recombination in them, industrial and other economic importance of microbes and the common diseases caused by them. Also, it focuses on the diversity in the world of fungi and lichens. The course deals with some of the common plant diseases, their causative organisms and effective control measures. Ecological and economic significance of fungi and lichens are also included in the course. All aspects dealt in this course are significant in daily life situations.

After completion of this course, students can find jobs as microbiologists, plant breeders, field pathologists, and as researchers in various research organisations.

Course Outcomes

CO1: Analyse the morphological and ultrastructural features of bacteria, viruses, fungi and lichens. (Analyse)

CO2: Recognise the process of isolation and culturing of bacteria based on their morphology. (Remember)

CO3: Analyse the various adaptive strategies of the bacteria, viruses, fungi and lichens through phylogenetic line of evolution. (Analyse)

CO4: Explain the ecological, economic and pathologic importance of microorganisms. (Understand)

MICROBIOLOGY (13 hrs)

Module 1: Diversity of life and introduction to microbiology (5 hrs)

Diversity of life: Two kingdom classification (Carolus Linnaeus, 1735); phylogenetic classification (August W Eichler, 1878); five kingdom classification (R H Whittaker, 1969). Three domains, six kingdom classification, (Carl Woese, 1990).

Module 2: Introduction to microbiology (6 hrs)

Scope of microbiology

Bacteria: General characters and classification based on staining, morphology and flagellation. Reproduction - binary fission. Genetic recombination in bacteria - conjugation, transformation and transduction. Economic importance of bacteria.

Viruses: General characters of viruses, viroids and prions. Structure of Bacteriophage (λ). Multiplication of λ phage – lytic and lysogenic cycle.

Applied Microbiology (2 hrs)

Role of microbes: in producing antibiotics, vine, vinegar, curd – role in N2 fixation, as biofertilizers – role in food spoilage (Brief study only).

MYCOLOGY (17 hrs)

Module 3: Introduction, classification and type study. (13 hrs)

General characters of fungi. Classification of fungi - Ainsworth (1973). Distinguishing characters of the different classes of fungi with special reference to reproductive structures and life history of the genera mentioned in each group:

Myxomycotina – *Physarum*; Mastigomycotina – *Albugo*; Zygomycotina - *Rhizopus*; Ascomycotina – Hemiascomycetes - *Saccharomyces*; Plectomycetes - *Penicillium*; Pyrenomycetes – *Xylaria*; Discomycetes - *Peziza*; Basidiomycotina – Teliomycetes – *Puccinia*; Hymenomycetes – *Agaricus*; Deuteromycotina – *Fusarium*.

Module 4: Economic importance of Fungi (4 hrs)

Useful and harmful effects of fungi - medicinal, industrial, agricultural, food, genetic studies, spoilage, fungal toxins and diseases.

Interrelationships of fungi – Lichens – general characters and ecological significance. Anatomy and reproduction of *Parmelia*. Mycorrhiza: ecto- and endomycorrhiza. Significance.

PLANT PATHOLOGY (6 hrs)

Module 5: Plant disease development, Common plant diseases and Control of diseases

History of plant pathology. Classification of plant diseases on the basis of causative organism and symptoms.

Common plant diseases: Study of following diseases with emphasis on symptoms, cause, disease cycle and control: Bunchy top of Banana, Root wilt of Coconut, Abnormal leaf fall of Rubber, Leaf mosaic disease of Tapioca, Citrus canker.

Control of diseases: Prophylaxis - quarantine measures; Biological control and its significance. Preparation and application of fungicides - Bordeaux mixture; organic

pesticides - Tobacco and Neem decoction.

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SEMESTER II

CORE COURSE PRACTICAL 1

COURSE CODE: BO2CP01B23

COURSE TITLE: ANATOMY, MICROTECHNIQUE, MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY

Credits: 2

Hours per week: 2 **Total Hours: 72 (36+36)**

Course Overview and Content

The course envisages a detailed study on the features of living organelles and non living inclusions of plant cells. It emphasizes on the primary anatomical structural details of selected stems, roots and leaves. The secondary anatomical structure and anomalous features of certain plant organs are also included in the course.

The course also focuses on the detailed microscopic study of fungi and bacteria. The fermentation products of fungi which are of added value are also included. Hands on learning related to various diseases which affect selected economically important plants of Kerala and eco-friendly control measures are also part of the course. The course equips the students with the necessary skills and techniques for the preservation of plant specimens in biology labs, museums, herbaria and other conservational centres.

Course Outcomes:

CO1: Identify the microscopic features of cells, tissues and non-living inclusions (Understand).

CO2: Distinguish the unique anatomical features of selected stems, roots and leaves (Analyse).

CO3: Employ preservation techniques for plant and fungal specimens for macroscopic and microscopic studies (Apply).

CO4: Identify the plant diseases that affect selected economically important crops in Kerala and provide eco-friendly preventive and remedial measures (Understand).

SEMESTER I

ANATOMY AND MICROTECHNIQUE (36 hrs)

Anatomy (27 hrs)

1. Study of cell types and tissues.

2. Non-living inclusions - starch grains (Potato), cystolith, raphides, aleurone grains (Castor).
3. Primary structure of stem, root and leaf - Dicots and Monocots (Stem - *Eupatorium*, *Vernonia*, Root – *Musa*, Leaf – *Hibiscus*, Grass)
4. Dissect and identify the stomatal types - anomocytic, anisocytic, paracytic and diacytic.
5. Secondary structure of dicot stem and root (*Vernonia* stem, Papaya root)
6. Anomalous secondary structure of *Bignonia* stem, and *Dracaena* stem.

Microtechnique (9hrs)

1. Preparation and use of stains and fixatives.
2. Preparation of smears and squash.
3. Maceration and identification of tracheary elements.
4. Preparation of single stained hand sections (Permanent – demonstration only).

SEMESTER II

MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY (36 hrs)

Microbiology (6 hrs)

1. Gram staining - curd, root nodules.
2. Microbes and type of fermentation - vine, vinegar, curd.

Mycology (24 hrs)

1. Micropreparation and detailed microscopic study of *Rhizopus*, *Albugo*, *Saccharomyces*, *Penicillium*, *Xylaria*, *Peziza*, *Puccinia*, *Agaricus*, *Fusarium* and *Parmelia*.
2. Staining and microscopic observation of endomycorrhizal fungus.

Plant Pathology (6 hrs)

1. Identify the diseases mentioned in the syllabus with respect to causative organisms and symptoms.
2. Submit herbarium preparations of any three of the diseases mentioned.
3. Learn the technique of preparing Bordeaux mixture, Tobacco and Neem decoction.

SEMESTER III CORE COURSE

COURSE CODE: BO3C03B23
COURSE TITLE: PHYCOLOGY AND BRYOLOGY

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course overview and Content

The course gives emphasis to the study of different classes of algae and bryophytes. Students get familiarised with the evolutionary significance of lower plant groups and their role in maintaining ecosystem balance and their economic utility.

Study of phycology and bryology provides the students with skills required for biomonitoring and pollution control research centres as lab and field assistants. It also provides research opportunities in production of novel drugs and antibiotics.

Course Outcomes

CO1: Classify algae and bryophytes based on the characteristics and general features (Understand).

CO2: Explain habitat, range of thallus structure, reproduction and life cycle of algae and bryophytes. (Understand)

CO3: Interpret the significance of algae and bryophytes. (Apply)

CO4: Explain the economic importance of algae and bryophytes (Apply)

PHYCOLOGY (36 hrs)

Module 1: Introduction to Phycology and Classification of Algae (9 hrs)

Introduction: general characters, habitat diversity, range of thallus structure and pigments in algae; structure of algal flagella. Different types of life cycle and alternation of generations in algae. Classification: by Fritsch (1945); brief introduction to the modern classification by Lee (2009) [up to divisions].

Module 2: Type Study (18 hrs)

Salient features, thallus structure and reproduction of algae in the following groups with special reference to the type(s) mentioned: Cyanophyceae - *Nostoc*; Chlorophyceae - *Volvox*, *Oedogonium*, *Cladophora*, *Chara*; Xanthophyceae – *Vaucheria*; Bacillariophyceae - *Pinnularia*; Phaeophyceae – *Ectocarpus*, *Sargassum*; Rhodophyceae - *Polysiphonia*.

Module 3: Artificial Culture and Economic Importance of Algae (9 hrs)

Algal culture: isolation, cultivation and preservation of micro- and macro-algae. Economic importance of algae: algae as food, SCP, fodder, green manure, role in N2 fixation, medicine and biofuels. Commercial products from Algae - carrageenin, agar-agar, alginates and diatomaceous earth. Role of algae in pollution studies: as indicators of pollution and as bioremediation agents. Eutrophication – algal bloom; harmful and toxic algal blooms – neurotoxins and parasitic algae.

BRYOLOGY (18 hrs)

Module 4: General Introduction and Classification of Bryophytes (6 hrs)

Introduction, general characters and classification of bryophytes by Rothmaler (1951); a very brief account of systems and classifications by Goffinet et al (2008).

Economic importance of Bryophytes – biological, ecological, medicinal and as potting material.

Module 5: Type Study (12 hrs)

Distribution, morphology, anatomy, reproduction and life cycle of the following types (developmental details are not required): Hepaticopsida - *Riccia*, *Marchantia*; Anthocerotopsida - *Anthoceros*; Bryopsida - *Funaria*. Evolution of gametophyte and sporophyte among Bryophytes. A brief account of fossil bryophyte - *Naiadita lanceolata*

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SEMESTER IV CORE COURSE

COURSE CODE: BO4C04B23

COURSE TITLE: PTERIDOLOGY, GYMNOSPERMS, PALAEOBOTANY AND EVOLUTION

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Content

This course familiarizes the lower group of plants, the Pteridophytes, their classification, phylogenic and evolutionary analyses and the detailed study of Gymnosperms, a primitive group of plants that connect the lower and higher plant forms. It aids in identification of these plants in their natural habitats and recognize their ecological and economic significance, effective utilization for various economic purposes. It also includes the science of extinct plants, the processes of fossilization and the significance of fossil studies. The process of origin of life, theories, evidences, methods and aspects of formation of new species by the process of evolution is also discussed in detail.

Study of pteridology and gymnosperms provides the students with skills to identify habitat diversity and their role in ecological succession. Students are equipped to propose garden plants in differing habitats and find career in horticultural practices.

Course Outcomes

CO1: Classify Pteridophytes and Gymnosperms based on the characteristics and general features (Understand).

CO2: Compare the morphology, anatomy, reproduction and life cycle of different types of Pteridophytes and Gymnosperms (Evaluate).

CO3: Evaluate the economic and ecological significance of Pteridophytes and Gymnosperms. (Evaluate).

CO4: Analyse the evolutionary affinities of Pteridophytes and Gymnosperms (Analyse)

PTERIDOLOGY (27 hrs)

Module 1: General Introduction and Classification of Pteridophytes and Type Study (23 hrs)

Introduction, general characters and classification of Pteridophytes up to classes by Smith (1955) and a very brief account of the classification by Christenhusz *et al*., 2011. A brief study of fossil Pteridophyte – *Rhynia*.

Type study- Study the distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details are not required): Psilophyta - *Psilotum*; Lycophyta - *Lycopodium*, *Selaginella*; Sphenophyta - *Equisetum*; Pterophyta - *Pteris, Marsilea*. Stelar evolution in Pteridophytes; Heterospory and seed habit.

Module 2: Economic and Ecological Importance (4 hrs)

Importance of Pteridophytes: medicinal, ornamental, as biofertilizer.

GYMNOSPERMS (18 hrs)

Module 3: General Introduction, Classification of Gymnosperms and Type Study (16 hrs)

Introduction, General characters, classification of Gymnosperms by Sporne (1965) and a very brief account of the classification by Christenhusz *et al* (2011). Affinities of Gymnosperms with Pteridophytes and Angiosperms. A brief account of fossil Gymnosperm – *Williamsonia*.

Type study: Distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details are not required): Cycadopsida – *Cycas*; Coniferopsida – *Pinus*; Gnetopsida – *Gnetum*.

Module 4: Economic and Ecological Importance of Gymnosperms (2 hrs)

Uses of Gymnosperms: as food, medicine, in industry and as ornamental plants.

PALAEOBOTANY (3 hrs)

Module 5: Fossils and Palaeobotany in India

Introduction to Palaeobotany and its significance. Fossil formation, types of fossils. Geological time scale – major events in each era.

Palaeobotany in India: Brief study of the fossil deposits in India. Important Indian Paleobotanical Institutes, contributions of Indian Paleobotanist - Birbal Sahni – Birbal Sahni Institute.

EVOLUTION (6 hrs)

Module 6: Origin and Evolution of Life

Origin of life on earth from molecules to life – Oparin's hypothesis, Haldane's hypothesis, Miller- Urey experiment, Panspermia, origin of cells and the first organisms. Evidences of evolution; theories of evolution - Lamarck, Wallace, Charles Darwin, Hugo

De Vries. Neo- Darwinism – major postulates - isolation, mutation, genetic drift, and speciation.

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SEMESTER IV

CORE COURSE PRACTICAL 2

COURSE CODE: BO4BP02B23

COURSE TITLE: PHYCOLOGY, BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS PALAEOBOTANY AND EVOLUTION

Credits -2

Hours per week: 2 **Total Hours: 72 (36+ 36)**

Course Overview and Content

The course gives emphasis the study of different classes of algae and bryophytes giving importance to their characteristic features, diversity and economic importance. All the types studied will be made available to the learners so that they will get opportunity for hands-on training about what they learned in the theory class. This course familiarizes the lower group of plants, the Pteridophytes, their classification, phylogenic and evolutionary analyses and the detailed study of Gymnosperms, a primitive group of plants that connect the lower and higher plant forms.

On completion of this course students will be able to identify these plants in their natural habitats and recognize their ecological and economic significance. They also identify the effective utilization of these for various economic purposes. It also includes the science of extinct plants, the processes of fossilization and the significance of fossil studies. The process of origin of life, theories, evidences, methods and aspects of formation of new species by the process of evolution is also discussed in detail.

Course Outcomes:

CO1: Identify the different algal specimens and their vegetative and reproductive structures of each type (Remember)

CO2: Analyze the anatomy of thallus and reproductive structures of *Riccia, Marchantia, Anthoceros* and *Funaria.* (Analyze)

CO3: Analyze the habit, TS of stem, morphology of the strobilus of the following types: *Psilotum, Lycopodium, Selaginella, Equisetum, Pteris, Marsilea*. (Analyze)

CO4: Analyze the habit, TS of leaf and stem, TLS and RLS of coniferous wood (Pinus), morphology of reproductive structures of *Cycas*, *Pinus* and *Gnetum*. (Analyze)

SEMESTER III

PHYCOLOGY AND BRYOLOGY (27 HRS)

PHYCOLOGY (18 hrs)

1. Make micropreparations of vegetative and reproductive structures of the types mentioned in the syllabus.

2. Algal Culture: isolation and cultivation of micro- and macro-algae in suitable growth media (Demonstration only).
3. Familiarizing the technique of algal collection and preservation.

BRYOLOGY (9 hrs)

Study the habit, anatomy of thallus and reproductive structures of *Riccia*, *Marchantia*, *Anthoceros* and *Funaria*.

SEMESTER IV

PTERIDOLOGY, GYMNOSPERMS AND PALAEOBOTANY

PTERIDOLOGY (27 hrs)

1. Study of the habit, TS of stem, morphology of the strobilus of the following types: *Psilotum, Lycopodium, Selaginella, Equisetum, Pteris, Marsilea.*

GYMNOSPERM (9hrs)

1. Study of the habit, TS of leaf and stem, TLS and RLS of coniferous wood (Pinus), morphology of reproductive structures of *Cycas*, *Pinus* and *Gnetum*.

SEMESTER V CORE COURSE
COURSE CODE: BO5C05B23
COURSE TITLE: ENVIRONMENTAL SCIENCE AND HUMAN RIGHTS

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Content

The course intention is to understand current environmental problems and examine the ecosystem. The anthropogenic activities and the implications on the environment results in various environment issues now a days. Knowledge on relevance of biodiversity and its conservation methods in the national and international levels, various conservation strategies are relevant to tackle environment issues. The brief description of some selected disasters and how to manage the situation is detailed in the subject.

Human Rights includes details about *the rights of humans* and their progress through history. The subject familiarizes about the world's most important human rights, Universal Declaration of Human Rights. The human rights organizations, strategies, policies are detailing in the subject.

The course provides students with skills to work in environmental organizations and environmental consultancies. The course helps students to get jobs in sectors related to R&D of water companies and waste management companies etc

Course Outcomes

CO1: Describe the subdivisions of ecology and the structure and functions of ecosytem.(Understand)

CO2: Appraise the adaptive features of different plant groups to various habitats (Evaluate)

CO3: Analyze the measures of conservation of biodiversity and management of environmental pollution and natural disasters (Analyze)

CO4: Explain the concept and development of various Human rights (Understand)

Module 1: Introduction to Ecology, Ecosystems (18 hrs)

a) Ecology: introduction, definition, scope and relevance; sub-divisions of ecology - autecology, synecology and ecosystem ecology**.**

Population: population size, density, natality, mortality, age, rate of natural increase, growth form and carrying capacity, population interactions between species - competition, parasitism, predation, commensalism, proto co-operation, mutualism, neutralism.

Community: community concept, biotic community, species diversity, species richness, dominance; growth forms and structure, trophic structure, ecotone, edge effect, habitat, ecological niche, micro- climate, ecological indicators, keystone species**.**

b) Structure and function of ecosystems, ecosystem components: abiotic - atmosphere, climate, soil, water; biotic - producers, consumers, decomposers. Productivity - primary and secondary - gross and net productivity - homeostasis in the ecosystem. Concept of energy in ecosystems - energy flow, food chain, food web, trophic levels, trophic structure and ecological pyramids - pyramid of numbers, biomass, energy. Nutrient cycles - biogeochemical cycles of C and N2. Ecosystem development: ecological succession process, climax community, hydrosere, xerosere.

Adaptations of plants to environment - xerophytes, hydrophytes, epiphytes, halophytes, mangroves.

Module 2: Biodiversity and its Conservation (10 hrs)

Biodiversity: definition, types, examples – endemism - hot spots; hot spots in India - Western Ghats as hot spot. Wetlands and their importance. Biodiversity loss - IUCN threat categories, Red data book; causes and rate of biodiversity loss - extinction, causes of extinction. Conservation: methods - *in-situ*, *ex-situ*. Joint Forest management - peoples participation in biodiversity conservation: community reserve, eg. Kadalundi-Vallikkunnu. Remote sensing and GIS: introduction, principle, application of remote sensing and GIS in environmental studies and biodiversity conservation (brief account). Ecotourism: ecotourism centers in Kerala - Thenmala and Thattekkad WLS.

Module 3: Environmental Pollution (10 hrs)

Environmental studies - definition, relation to other sciences, relevance. Environmental pollution - introduction, definition; Air pollution - air pollutants, types, sources, effect of air pollution on plants and humans, control measures; Water pollution – common pollutants, sources, impact, control measures; water quality

standards - DO and BOD; eutrophication. Soil Pollution - causes, sources, solid waste, biodegradable, non-biodegradable, management of solid waste, composting, e – waste. Environmental issues - global warming, greenhouse effect, climate change - causes and impact, ozone layer depletion. Carbon sequestration.

Module 4: Conservation of Nature (13 hrs)

Global conservation efforts - Rio Earth summit - Agenda 21, Kyoto protocol, COP15 (15thConference of the parties under the UN framework convention on climate change) and Paris protocol -major contributions. Conservation strategies and efforts in India and Kerala. Organizations, movements and contributors of environmental studies and conservation: organizations- WWF, Chipko, NEERI; contributors - Salim Ali, Sunder Lal Bahuguna, Madhav Gadgil, Anil Agarwal, Medha Patkar, Vandana Siva (brief account only).

Environmental Legislation and Laws: Environment (protection) Act 1986, Air (protection and control of pollution) act, 1981 Water (protection and control of pollution) Act, 1974, Wildlife (protection) Act, 1972, Forest (conservation) Act, 1980, Biological Diversity Act (2002) [brief account only]. Natural and Environmental disasters-a brief description of the following disasters- earth quake, flood, landslides, tsunami (role of mangroves in controlling tsunami disaster), cyclone, biological disaster.

Disaster management – four phases – mitigation, preparedness, responses, recovery. Emergency procedures and warning systems, application of GIS (brief account only).

Module 5: Human Rights (3 hrs)

Introduction, meaning, concept and development. Three generations of human rights - civil and political rights, economic, social and cultural rights. Human Rights and United Nations: contributions; main human rights related organizations - UNESCO, UNICEF, WHO, ILO; Declarations for women and children, Universal declaration of human rights. Human rights in India: fundamental rights and Indian constitution, rights for children and women, scheduled castes, scheduled tribes, other backward castes and minorities.

Conservation issues of Western Ghats – Madhav Gadgil committee report, Kasturi Rangan report.

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SEMESTER V CORECOURSE

COURSE CODE:BO5C06B23

COURSE TITLE: RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course overview and Content

This course finds, identifies and describes various methodologies of scientific research and statistics. The content is to study stages of research to solve a biological problem and also to study various tools and techniques for research and data analysis.

On completion of this course students gain skills to design a research problem, collect data and conduct statistical analysis. They will also be able to use various biophysical instruments for research purposes.

Students will have scope as project fellow, data analyst, research associate, biophysical technician, instrumentation analyst and others.

Course Outcomes

CO1: Apply the different laboratory techniques and knowledge of biophysical instruments in carrying out experiments. (Apply)

CO2: Collect information from various resources to carry out research and data analysis (Apply)

CO3: Interpret numerical data with different statistical methods and tools. (Analyze)

CO4: Apply information technology expertise for general applications and for solving research problems. (Apply)

RESEARCH METHODOLOGY (18 Hrs)

Module 1: Introduction and Process of Research (11 hrs)

Types of research: pure and applied; Steps in scientific methods; Process of research: Identification of research problem; Objectives of research; Collection of data- Review of literature, literature sources – names of reputed National and International journals in life science. Impact Factor; reprint acquisition - INSDOC, INFLIBNET, Google Scholar, Shodhganga, e-pathshala; analysis and interpretation; design the study.

Structure of Research report: IMRAD system - preliminary pages, introduction and review of literature, materials and methods, results, discussion, conclusion and bibliography, Style of citation; latest methods of ICT based presentations

Module 2: Use of Computer in Research (7 hrs)

Introduction to MS - WINDOWS and LINUX, application of MS WORD - word Processing, editing tools (cut, copy, paste), formatting tools. MS EXCEL - creating worksheet, data entry, sorting data. Statistical tools (SUM, MEAN, MEDIAN and MODE). Preparation of graphs and diagrams (Bar diagram, pie chart, line chart, histogram). MS-POWERPOINT - presentation based on a biological topic; inserting tables, charts, pictures. Open source and free alternatives to MS Office: Libre Office, Open Office (brief study). Search engines: Google.com; meta search engine – dogpile.com; academic search - Google scholar. Educational sites related to biological science - Scitable, DNAi.

BIOPHYSICS (18 hrs)

Module 3: Introduction (2 hrs)

Introduction to biophysics; branches of biophysics - molecular, cellular, membrane and biomedical instrumentation (scope only).

Module 4: Biophysical Instrumentation (16 hrs)

Principle, working and applications of the following:

Microscopy: compound microscope, phase-contrast microscope and electron microscope – SEM. Colorimeter, spectrophotometer. Centrifuge: clinical centrifuge, cold centrifuge (in detail) and a brief account on ultracentrifuge. Chromatography: paper, thin layer and column. Electrophoresis, PAGE. pH meter. Haemocytometer.

BIOSTATISTICS (18 hrs)

Module 5: Statistical Tools and Techniques

Introduction, statistical terms and symbols (Brief study only). Sampling: concept of sample, sampling methods - random and non-random sampling. Collection and representation of data: diagrammatic and graphical representation - line diagram, bar diagram, pie diagram, histogram, frequency curve. Measures of central tendency: mean, median, mode, (discrete and continuous series). Measures of dispersion: standard

deviation. Distribution patterns: normal distribution, binomial distribution. Tests of significance: Chi-square test - uses, procedure.

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SEMESTER V CORE COURSE

COURSE CODE: BO5C07B23

Course title: ANGIOSPERM MORPHOLOGY, REPRODUCTIVE BOTANY, ECONOMIC BOTANY AND ETHNOBOTANY

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Content and overview

The course deals with the external morphology of angiosperm plants and utilising these features as descriptors for identification of plants. It also covers the aspects of plant reproduction and development enhancing the ability of the student to analyze the relationship between structure and function. The course also familiarises students with economically important products from plants and their source and also to explore the hidden potentialities of various underutilized plants by applying the principles of ethnobotany.

The course provides students with skills as taxonomists in plant identification and opportunities for jobs as botanists in botanical gardens, and as conservationists.

Course Outcomes

CO1: Analyse morphological characters of plants vital in classification. (Analyse)

CO2: Identify the reproductive structure of plants and its utility in plant classifications (Understand)

CO3: Explain the botanical details and uses of plants of economic importance (Understand)

CO4: Identify ethnobotanical practices of a few tribal communities in Kerala with respect to food, shelter and healthcare. (Understand**)**

ANGIOSPERM MORPHOLOGY (20 hrs)

Module 1 : Morphological description of a flowering plant **(20 hrs)**

Habit

A. **Root**: types - tap root, fibrous root; modifications - definition with examples - storage roots, aerial roots, pneumatophores, buttress roots.

B. **Stem**: habit - acaulescent, caulescent, cespitose prostrate, repent, decumbent, arborescent, suffrutescent (definition with examples); modification - underground, aerial and subaerial with examples.

C. **Leaves**: lamina, petiole, leaf tip, leaf base, stipule, pulvinus; phyllotaxy; types -simple and compound; shapes of lamina; leaf tip; leaf base; leaf margin; leaf surface features: hairiness - tomentose, glabrous, scabrous, strigose, hispid.

Inflorescence: racemose, cymose and specialised (cyathium, hypanthodium, coenanthium verticillaster, thyrsus)

Flower: flower as a modified shoot - detailed structure of flowers - floral parts -their arrangement, relative position, cohesion and adhesion - symmetry of flowers - types of aestivation and placentation - floral diagram and floral formula.

Fruits: types, classification with examples; seed structure - dicot and monocot - albuminous and exalbuminous, aril, caruncle; dispersal of fruits and seeds.

REPRODUCTIVE BOTANY (14 hrs)

Module 2: Introduction and Gametophyte Development (12 hrs)

Introduction to embryology, floral morphology - parts of flower.

Microsporangium and Male Gametophyte: Microsporangium: structure and development of anther, microsporogenesis, dehiscence of anther, structure of pollen. Male gametophyte development.

Megasporangium and Female Gametophyte: Megasporangium: types of ovules – anatropous, orthotropous, amphitropous, campylotropous, circinotropous. Megasporogenesis – female gametophyte – structure of a typical embryosac, types of embryosacs - monosporic (Polygonum type), bisporic (Allium type) and tetrasporic (Peperomia type).

Module 3: Fertilization, Endosperm and Embryo (6 hrs)

Mechanism of pollination, agents of pollination, germination of pollen grains; double fertilization.

Endosperm and Embryo: Endosperm: types – cellular, nuclear and helobial. Embryogeny, structure of dicot and monocot embryo, seed formation. Polyembryony.

ECONOMIC BOTANY (15 hrs)

Module 4: Study the binomial, family, morphology of useful part, products and uses of plants mentioned below.

1. Cereals and millets – rice, wheat and bajra.

2. Pulses and legumes – green gram, Bengal gram, black gram, red gram/cow pea, cluster bean, and pigeon pea.
3. Sugar – sugar cane, beet root.
4. Fruits – apple, pine apple, papaya, banana, mango, guava, jackfruit, grapes, sapota, pomegranate.
5. Vegetables – root – carrot, beet root, tapioca; stem – corm, potato; fruits – cucurbits- bitter gourd, cucumber, snake gourd, ridge gourd; okra; leaves – cabbage, amaranth, moringa.
6. Ornamentals – rose, anthurium, jasmine.
7. Masticatories – betel vine, betel nut, tobacco.
8. Beverages – coffee, tea, cocoa.
9. Fibre – Coir, Cotton, Jute.
10. Timber – teak, rosewood, jackfruit tree.
11. Fats and oils – coconut, sesame, mustard, sunflower, oil palm.
12. Latex – rubber
13. Gums and Resins – dammar, gum arabic, asafoetida
14. Spices –pepper, ginger, cardamom, turmeric, clove, mace, allspice, cinnamon
15. Insecticides – Neem, tobacco.

ETHNOBOTANY (5 hrs)

Module 5: Introduction, scope and significance of ethnobotany. Brief account of any two tribal communities of Kerala. Study of the following plants used in daily life by tribals and village folks for food, shelter and medicine: Food –Ragi, *Dioscorea*; Shelter - *Bambusa*, *Ochlandra* and *Calamus*; Medicine – *Curcuma aromatica*, *Trichopus zeylanicus* and *Alpinia galanga*.

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SEMESTER V CORECOURSE
COURSE CODE: BO5C08B23
COURSE TITLE: ANGIOSPERM TAXONOMY AND PHYTOGEOGRAPHY

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Content

To acquaint the students with the objectives and components of taxonomy. To make them understand the systems of classification of angiosperms and to make them aware of Bentham and Hooker's system of classification. Students will know the concept of methodology in taxonomy. They should be able to identify the common angiosperm species of Kerala and learn herbarium techniques. To make them aware of present and past floristic vegetation patterns and also explores the processes that influence the distribution of plants across different biomes.

Study of plant taxonomy provides students with job opportunities as plant bio curator, green auditing, herbarium curator, plant conservationist and ecologist, and also provides research activities in identification of evolutionary relationships, and its systematic arrangement. Helps to develop a career as a plant scientist. Analyzing the phytogeographical distribution of plants provided to develop a career as naturalist and conservation biologist. Analysis of plant diversity create fundamental awareness about the conservation, importance of plants and geographical variations

Course Outcomes

CO1: Explain the principles of plant systematics and nomenclature. (Understand)

CO2: Analyse the significance of angiosperm taxonomy and distribution of plant species. (Analyze)

CO3: Interpret the angiosperm families based on Bentham and Hooker's classification emphasising the common angiosperm species of Kerala. (Apply)

CO4: Explain biogeographic principles to predict the characteristics of plant communities. (Apply)

TAXONOMY (44 hrs)

Principles of Plant Systematics (12 hrs)

Aim, scope, significance and components of taxonomy. Types of classification - artificial (brief account), natural – Bentham and Hooker (Detailed account) and Phylogenetic (Brief account). Angiosperm phylogeny group system (introduction only).

History of taxonomy in India – Contributions of Hendrich van Rheede,

Taxonomic structure – hierarchy; concepts of taxa; species concepts – biological, phenetic and phylogenetic; genus; family.

Taxonomic character – concept, primitive and advanced characters

Plant nomenclature - binomial, ICBN/ICN principles - rule of priority and author citation.

Interdisciplinary approach in taxonomy - Cytotaxonomy and Chemotaxonomy.

Taxonomic information resources – herbarium- principles and practices; world herbaria; BSI; Indian herbaria; botanic gardens; indexes; journals; monographs; revisions; floras; online resources and databases.

Module 3: Detailed Study of Families (32 hrs)

Study the following families of Bentham and Hooker's System with special reference to their vegetative and floral characters; special attention should be given to common and economically important plants within the families: Annonaceae, Nymphaeaceae, Malvaceae, Rutaceae, Anacardiaceae, Leguminosae (Mimosoideae, Caesalpinioideae and Papilionoideae), Combretaceae, Myrtaceae, Cucurbitaceae, Umbelliferae (Apiaceae), Rubiaceae, Compositae (Asteraceae), Sapotaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Convolvulaceae, Scrophulariaceae, Acanthaceae, Verbenaceae, Labiatae (Lamiaceae), Euphorbiaceae, Orchidaceae, Palmae (Arecaceae), Graminae (Poaceae).

PHYTOGEOGRAPHY (10 hrs)

Definition, concept, scope and significance of phytogeography; Centres of origin and distribution of species. Patterns of plant distribution - continuous and discontinuous distribution, vicarism, migration and extinction; Continental drift - evidences and impact; glaciation; theory of land bridges; Endemic distribution, theories on endemism, age and area hypothesis; Phytogeographical zones (phytochoria) of the world and India.

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- Sharma, P. D. (2009). Ecology and Environment, Rastogi Publications, Meerut.

SEMESTER VI CORE COURSE
COURSE CODE: BO6C09B23
COURSE TITLE: GENETICS, PLANT BREEDING AND HORTICULTURE

Credits: 3

Hours per week: 4 **Total Lecture Hours: 72**

Course Overview and Content

The course facilitates both theoretical and practical knowledge for the production of new variety of plants through various techniques and skills. It includes theories and concepts on genetic interactions in production of variety of species. The context also provides the basic principles and techniques of plant breeding and plant improvements. Further, the course platforms in developing horticultural gardening skills that promotes sustainable development.

Genetics, plant breeding and Horticulture opens scope as plant breeder, researcher, scientist, agriculturalist and teachers in educational institutes, plant breeding centres, genetic engineering firms, nurseries, agricultural departments, crop plantations, ministries of agriculture, etc. The course helps an individual become an entrepreneur in horticulture.

Course Outcomes

CO1: Analyse Mendelian principles behind heredity and inheritance (Analyse)

CO2: Evaluate Non Mendelian inheritance and population genetics. (Evaluate)

CO3:Interpret various plant breeding techniques for plant improvement in horticulture. (Apply)

CO4: Explain various horticultural and gardening skills. (Apply)

GENETICS (27 hrs)

Module 1: Origin and Development of Genetics (13 hrs)

Genetics as a Science: Origin - Experiments of Mendel with Pisum sativum, general terminology used in genetics. Principles of inheritance, Mendelian laws - monohybrid and dihybrid cross, test cross and backcross.

Exceptions to Mendelism -Modification of Mendelian ratios: incomplete dominance - Mirabilis; Co-dominance - MN blood group in man; Lethal genes – pigmentation in Snapdragon..

Geneic Interaction: Epistasis, (a) Dominant - fruit colour in summer squashes (b) Recessive - coat colour in mice; Complementary genes - flower colour in sweet pea. Non-epistasis - comb pattern in Fowls. Multiple alleles – ABO blood groups in man; self-sterility in Nicotiana.

Module 2: Mechanisms of Inheritance (24 hrs)

Linkage of Genes- Linkage and crossing over: chromosome theory of linkage; crossing over - types of crossing over, mechanism of crossing over. Linkage map - 2-point cross, interference and coincidence.

Determination of Sex: sex chromosomes and autosomes; chromosomal basis of sex determination; XX- XY, XX-XO mechanism; sex determination in higher plants (Melandrium album). Sex linked

inheritance: X-linked - Morgan's experment e.g. eye colour in *Dorsophila*, Haemophilia in man; Y- linked inheritance; sex limited and sex influenced inheritance. Pedigree analysis.

Quantitative Inheritance: Quantitative characters: polygenic inheritance, continuous variation - kernel color in wheat, ear size in maize**.**

Extra-Chromosomal Inheritance: chloroplast mutation - variegation in 4O'clock plant; mitochondrial mutations in yeast. Maternal effects - shell coiling in snail; infective heredity - kappa particles in Paramecium.

Population Genetics- Concept of population, gene pool, Hardy-Weinberg principle (brief).

PLANT BREEDING (17 hrs)

Module 3: Plant Breeding and Techniques for Plant Improvement (17 hrs)

Introduction and objectives of plant breeding. Plant breeding centers in Kerala, their achievements – CPCRI, CTCRI, RRII.

Plant Introduction-Plant introduction: domestication - centers of origin - procedure of plant introduction - quarantine regulations, acclimatization, agencies of plant introduction in India, major achievements.

Selection- Plant Selection: mass, pure-line and clonal.

Hybridization- types, procedure, important achievements. Heterosis in plant breeding, inbreeding depression, genetics of heterosis and inbreeding depression. Handling segregating generation - pedigree method, bulk method, back cross method. Disease resistance breeding.

Mutation Breeding and Polyploidy Breeding-Mutation breeding: methods, applications and important achievements. Polyploidy breeding: methods and applications.

Tissue Culture as Method in Plant Breeding-Application of meristem culture, embryo culture and pollen culture in plant breeding. Role of tissue culture in the creation of transgenic plants.

HORTICULTURE (18 hrs)

Module 4: Introduction to Horticulture (4hrs)

Introduction to Horticulture - definition, history. Classification of horticultural plants. Disciplines of horticulture - pomiculture, olericulture, floriculture, arboriculture.

Garden implements - budding knife, secateurs, hedge shear, hand cultivator, sprayers, lawn mower, garden rake and spade.

Irrigation methods: surface, sub, drip and spray irrigations; mist chambers - advantages and disadvantages.

Module 5: Gardening (8 hrs)

Types of gardens: brief study on ornamental garden, indoor garden, kitchen garden, aquatic garden, vertical garden, medicinal garden, terrace garden, terrarium.

Garden designing: garden components - lawns, shrubs and trees, borders, topiary, hedges, edges, walks, drives.

Physical control of plant growth: training and pruning. Bonsai - selection of plant - bonsai containers and method of bonsai formation.

Plant growing structures: green house, orchidarium, conservatory; Potting mixture – components.

Module 6: Plant Propagation Techniques (6 hrs)

Plant Propagation: Seed propagation: seed testing and certification, seed bed preparation, seedling transplanting, hardening of seedling; advantages and disadvantages of seed propagation. Vegetative propagation: natural and artificial; artificial methods - cutting, layering, grafting and budding, micro-propagation; advantages and disadvantages of vegetative propagation.

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SEMESTER VI CORE COURSE

COURSE CODE BO6C10B23

COURSE TITLE: CELL AND MOLECULAR BIOLOGY

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Content

This course provides an insight into the relationship between structure and function of cell organelles at the molecular level and how organisms grow, develop, and differentiate during their lifetime based on interplay between genetics and the environment. It elucidates the principles of cell biology and describes the structure and functions of DNA as the source of heredity and variation in living systems. This course also enables the learner to understand that physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes.

Cell and molecular biology course provides scope in various fields such as molecular biologist, genetic engineer, research associate, lab technician, and others.

Course Outcomes

CO1: Analyse the morphological and ultrastructural features of the cell and cell organelles (Analyse)

CO2: Evaluate the phases of cell cycle in mitosis and meiosis giving their significance. (Evaluate)

CO3: Explain the structure of DNA, chromosome aberrations and mutations. (Understand)

CO4: Evaluate the central dogma of molecular biology and the genetics of cancer. (Evaluate)

CELL BIOLOGY (27 hrs)

Module1: Ultra Structure of Cell Components (14 hrs)

Cell biology through ages: A brief history of cell biology. Cytosol - chemical composition. Composition, structure and function of plasma membrane - fluid mosaic model.

The ultra-structure of a plant cell with structure and function of the following organelles and membrane structures: endoplasmic reticulum, chloroplasts, mitochondria, ribosomes,

dictyosomes, microbodies - peroxisomes and glyoxisomes, lysosomes and vacuole. Cytoskeleton - microtubules and microfilaments.

Ultrastructure of nucleus: nuclear envelope - detailed structure of pore complex, nucleoplasm - composition, nucleolus.

Chromosomes: Chromosomes: introduction, chromosome number, autosomes and allosomes, morphology - metacentric, submetacentric, acrocentric and telocentric. Structure - chromatid, chromonema, chromomere, centromere and kinetochore, telomere, secondary constriction and nucleolar organizer. Chromatin fibres: heterochromatin and euchromatin. Karyotype and ideogram. Chemical composition of chromatin: histones and non-histones, arrangement of proteins and DNA in chromatin - the 10 nm fibre (nucleosome model), 30 nm fibre (solenoid model) and central axis with radial loops of 300 nm fibre.

Special type of chromosomes: giant chromosomes (salivary gland chromosomes, Lamp brush chromosomes), supernumerary chromosomes (B chromosome).

Module 2: Cell Division (6 hrs)

Cell cycle - definition, different stages – interphase (G1, S and G2) and division phase. Mitosis: karyokinesis and cytokinesis, significance of mitosis. Meiosis: stages - first meiotic division (reduction division) and second meiotic (equational division), structure and function of synaptonemal complex, significance of meiosis; comparison of mitosis and meiosis.

Module 3: Chromosomal Aberrations and Mutations (7 hrs)

Numerical: heteroploidy; euploidy – haploidy; polyploidy – autopolyploidy, allopolyploidy (Raphanobrassica); aneuploidy - monosomy, trisomy (Fruit morphology in Datura), nullisomy (Triticum). Numerical chromosomal abnormalities in man: Down's syndrome, Klinefelter's syndrome, Turner's syndrome.

Structural: deletion (Cri-du-chat syndrome), duplication (Bar eye in Drosophila), inversions (paracentric and pericentric) and Translocations (Robertsonian translocation).

Mutation: Mutation: definition, importance. Types of mutations: somaticand germinal; spontaneous and induced; chromosomal and gene or point mutations. Molecular basis of mutation: frame shift, transition, transversion and substitution. Mechanism of mutation induction: base replacement, base alteration, base damage, errors in DNA replication.

Mutagens: physical - non-ionizing and ionizing radiations; chemical - base analogs, alkylating agents, deaminating agents.

MOLECULAR BIOLOGY (27 hrs)

Module 4: The Genetic Material and Replication of DNA (12 hrs)

Molecular biology: A brief historical prelude. Identification of DNA as genetic material: direct evidences – transformation experiment by Avery et al.; Hershey and Chase Experiment. Evidences for RNA as genetic material in some viruses.

Nucleic acids: DNA and RNA, important features of Watson and Crick model of DNA; Chargaff's rule. Alternate forms of DNA - comparison of A, B and Z forms. Structure and function of different types of RNA - tRNA, mRNA, rRNA, snRNA, miRNA.

Replication of DNA: Semiconservative replication of DNA - Messelson and Stahl's experiment; process of semiconservative replication with reference to the enzymes involved in each step.

Module 5: Gene Expression and Regulation (15 hrs)

Gene expression: Concept of gene, split genes, one gene one enzyme hypothesis, one gene one polypeptide hypothesis, the central dogma, reverse transcription. Details of transcription in prokaryotes and eukaryotes; hnRNA, splicing, release of mRNA. Translation - initiation, elongation and termination. Genetic code and its features, wobble hypothesis.

Regulation of gene expression: Regulation of gene expression in prokaryotes: operon concept, inducible and repressible systems, negative control and positive control. Lac operon, catabolic repression. Tryptophan operon, attenuation. Regulation in eucaryotes (brief account only).

Genetics of cancer: Genetic basis of cancer – brief description of proto-oncogenes and oncogenes, tumour suppressor genes; characteristics of cancer cells.

REFERENCES

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- Waseem Ahammede Faridi, (2013). Genetics and Genomics. Pearson translation and genetic code.

SEMESTER VI CORE COURSE

COURSE CODE: BO6C11B23

COURSE TITLE: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Content

This course provides a clear view on the basic concepts and various mechanisms in plants such as water and mineral relations, transpiration, photosynthesis and respiration. The curriculum introduces theoretical and practical aspects plant hormones in plant growth, movement and development particularly in stressed conditions. Further, the context provides a platform to analyse about diverse biomolecules and their role in plants.

Plant physiology and biochemistry has a wide scope of job opportunities in the fields of food production, agriculture, horticulture, textiles, teaching, medicine and pharmaceuticals as research assistant, scientists, plant physiologist, teacher, etc.

Course Outcomes

CO1: Evaluate the concept and mechanism of water relations and nutrition in plants (Evaluate)

CO2: Evaluate the processes of transpiration, photosynthesis and respiration in plants. (Evaluate)

CO3: Analyse the cellular mechanisms involved in growth and development of plants and their stress responses.(Analyse)

CO4: Analyse the classification, structure and function of biochemical compounds,and plant biomolecules (Analyse)

PLANT PHYSIOLOGY (36 hrs)

Module 1: Water Relations and Mineral Nutrition (9 hrs)

Plant water relations - diffusion, imbibition, osmosis, OP, DPD, TP; water potential - concepts and components (pressure potential, gravity potential, osmotic potential and matric potential). Absorption of water - active and passive, pathway of water movement - apoplastic and symplastic pathway. Ascent of sap - cohesion-tension theory. Transpiration - types, mechanism, theories (Starch-sugar, Proton-K+ ion exchange), significance; antitranspirants. Guttation.

Mineral nutrition: Role of major and minor elements in plant nutrition, deficiency symptoms of essential nutrients; mineral uptake - passive (ion exchange) and active (carrier concept).

Module 2: Plant Metabolism (20 hrs)

Photosynthesis: Photosynthetic pigments, photo excitation - fluorescence, phosphorescence; red drop and Emerson enhancement effect. Photosystems - components and organization; cyclic and non-cyclic photophosphorylation; carbon assimilation pathways - C3, C4 plants - krantz anatomy, CAM. Photorespiration. Factors affecting photosynthesis – Blackmann's law of limiting factors.

Translocation of solutes: Pathway of phloem transport, mechanism - pressure flow, mass flow hypothesis; phloem loading and unloading.

Respiration: Respiration: anaerobic and aerobic; glycolysis, Kreb's cycle, mitochondrial electron transport system- components, oxidative phosphorylation, ATPase, chemiosmotic hypothesis. RQ - significance. Factors affecting respiration.

Module 3: Plant Growth and Development and Stress Physiology (7 hrs)

Plant hormones: their physiological effect and practical applications - auxins, gibberellins, cytokinins, ABA, and ethylene. Plant movements: tropic movements - geotropism and phototropism; nastic movements - seismonastic and nyctinastic movements. Physiology of flowering - phytochrome, photoperiodism, vernalization.

Stress physiology: Concepts of plant responses to abiotic stresses (water, salt, temperature), biotic stress (pathogens). Allelopathy.

BIOCHEMISTRY (18 hrs)

Module 4: Water (3 hrs)

Physical and chemical properties of water, acids and bases; pH - definition, significance; measurement of pH – colorimetric, electrometric (brief study only). Buffers: buffer action, uses of buffers.

Module 5: Plant Biomolecules (15 hrs)

Carbohydrates: General structure and functions; classification - mono (glucose and fructose), di (maltose and sucrose) and polysaccharides (starch and cellulose).

Proteins: General structure and classification of amino acids - peptide bond; structural levels of proteins - primary, secondary, tertiary and quaternary; functions of proteins.

Lipids: General features and roles of lipids, types of lipids; fatty acids - saturated and unsaturated; fatty acid derivatives - fats and oils; compound lipids (brief study only).

Enzymes: Classification and nomenclature, mechanism of action. Enzyme kinetics, Michaelis- Menten constant (brief study only). Regulation of enzyme action. Factors affecting enzyme action.

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SEMESTER VI CORE COURSE

COURSE CODE: BO6C12B23

COURSE TITLE: BIOTECHNOLOGY AND BIOINFORMATICS

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Content

This course examines the necessary concepts to understand the basics in the field of Biotechnology. Biotechnology is a vast scientific area that combines biological and technical disciplines that uses cellular and biological processes to create new technologies and products that can be used in research, agriculture, industry, health care, and the environment. The context also introduces the recombinant DNA technology, application of biotechnology, relevance of the following technologies and their ethical issues, genomics, sequence analysis and biological data bases.

The students after completing the course have scope in public and private sectors as biophysicist/biochemist, research associate, epidemiologist, lab technician, and others.

Course Outcomes

CO1: Explain the isolation and manipulation of DNA (Understand)

CO2: Analyse rDNA technology and its applications. (Analyse)

CO3: Evaluate the techniques and applications of plant tissue culture. (Evaluate)

CO4: Apply appropriate bioinformatics tools for processing, storing and analysing biological data. (Apply)

BIOTECHNOLOGY (36 hrs)

Module 1: Plant Tissue Culture (20 hrs)

Plant tissue culture: The concept of biotechnology, landmarks in biotechnology; Plant tissue culture – Basic concepts, Cellular totipotency, in vitro differentiation – dedifferentiation and redifferentiation. Tissue culture medium – basic components in tissue culture medium – solid and liquid medium – suspension culture. Murashige and Skoog medium – composition and preparation. Aseptic techniques in tissue culture – sterilization – different methods – sterilization of instruments and glass wares, medium,

explants, working principle of laminar air flow and autoclave; preparation of explants – surface sterilization.

Applications of Plant Tissue Culture: Micropropagation, methods - axillary bud proliferation, adventitious regeneration – shoot organogenesis and somatic embryogenesis - direct and indirect; meristem culture. Stages of micropropagation, hardening and transplantation. Advantages and disadvantages of micropropagation somaclonal variations. Embryo culture, callus and cell suspension culture, in vitro production of haploids - anther and pollen culture; uses of haploids. Protoplast culture: isolation of protoplast, culture methods, applications; protoplast fusion - cybrids. Artificial seeds, advantages and disadvantages. *In vitro* production of secondary metabolites; cell immobilization, bioreactors- Stirred tank bioreactor (brief study only).

Module 2: Recombinant DNA Technology and its Applications (11 hrs)

Recombinant DNA technology: Steps in recombinant DNA construction – cloning vectors – plasmids pBR322. Restriction enzymes- exonucleases, endonuclease. Ligases – ligation mechanism, transformation and selection of transformants (Brief account). Different methods of gene transfer – chemically stimulated DNA uptake by protoplast, transduction, electroporation, microinjection, microprojectiles, Agrobacterium mediated gene transfer, Ti plasmids, gene library, gene banks.

DNA isolation, agarose gel electrophoresis, southern hybridization, autoradiography. DNA finger printing and its applications. PCR and its applications. DNA sequencing by Sanger's dideoxy method. Uses of refrigerated centrifuges, UV trans-illuminator, gel documentation system and Laminar Air Flow chamber (brief account only).

MODULE 3: Application of Biotechnology (5 hrs)

Achievements of recombinant DNA technology: in medicine (Human insulin and gene therapy); in agriculture – Bt cotton; in environmental cleaning - super bugs.

BIOINFORMATICS (18 hrs)

MODULE 4: Basic Bioinformatics (7 hrs)

An introduction to bioinformatics, objectives and applications of bioinformatics. Biological data bases: types - primary, secondary and composite databases; nucleotide sequence databases – NCBI (GenBank), EMBL-ENA, DDBJ; Protein Sequence databases - SWISS-PROT, PIR; Protein structure database – PDB; bibliographic database – PubMed.

MODULE 5: Sequence Analysis and Molecular Phylogeny (11 hrs)

Sequence analysis tools - BLAST and FASTA, Molecular visualization tool - RASMOL (basic commands), Sequence alignment - Scoring matrices, global and local alignment, Pairwise and multiple sequence alignment; common software used in alignment - CLUSTAL W & CLUSTAL X (Brief account only). Molecular phylogeny - homologs, orthologs and paralogs; phylogenetic tree - rooted and unrooted tree, advantages of phylogenetic tree, use of PHYLIP software (Brief account only).

Genomics: A brief account on genomics and proteomics; major findings of the following genome projects – E. coli, Human, Arabidopsis thaliana.

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CORE COURSE PRACTICAL 3
COURSE CODE: BO6CP03B23
COURSE TITLE: ENVIRONMENTAL SCIENCE, HUMAN RIGHTS, RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

Credits : 2

Hours per week: 4 (2+ 2) **Total Hours: 81 (36+45)**

Course overview and Context

The course trains students to analyse various ecological and environmental factors that play vital role in maintaining the sustainability of the ecosystem. The course creates writing skill in students in relation with research article writings and publications. The course also provides skilled knowledge on various biophysical instruments using which plant research are carried out. The course also provides analytic skill to provide the probability of a data through different statistical formulae.

The course offers students with job opportunities at environmental monitoring organizations, environmental consultancies, distilleries, pollution Control Board, Water Authority Board, agriculture, pharmaceuticals, health care, research, Education Board, science journals, instrumentation, laboratories, and more as research assistant, agriculturalists, research content writer, biotechnician, field assistant, etc.

Course Outcomes

CO 1: Illustrate the environmental and ecological factors that support earth's sustainability. (Apply)

CO 2: Solve the given problem and obtain statistical results. (Apply)

CO 3: Apply the different laboratory techniques and employ the various biophysical instruments in carrying out experiments. (Apply)

CO 4: Determine normal distribution pattern of a population with different statistical methods and tools. (Apply)

SEMESTER-V

ENVIRONMENTAL SCIENCES AND HUMAN RIGHTS (36 hrs)

1. Estimation of CO_2, Cl, and alkalinity of water samples (Titrimetry)
2. Determination of pH of soil and water.
3. Assessment of diversity, abundance, and frequency of plant species by quadrat method (Grasslands, forests).
4. Study of the most probable number (MPN) of Coliform bacteria in water samples.
5. EIA studies in degraded areas (Sampling, Line transect, Quadrat).
6. Ecological adaptations in xerophytes, hydrophytes, epiphytes, halophytes and mangroves.

SEMESTER-V

RESEARCH METHODOLOGY, BIOPHYSICS, BIOSTATISTICS (45 hrs)

1. Prepare outline of a dissertation (IMRAD system).
2. Prepare a list of References (not less than 10) on a topic in biological science.
3. Review the literature on a given topic.
4. Collect information on a topic related to biological science using the internet.
5. Make a report based on the collected information from the internet using (MS-WORD).
6. Prepare tables/charts/graphs using EXCEL.
7. Prepare a worksheet using a set of data collected and find out the SUM.
8. Prepare a PowerPoint presentation based on the report in Experiment.
9. Measurement of pH and adjusting pH using pH meter.
10. Separation of plant pigments using TLC.
11. Determination of the concentration of a sample solution using colorimeter.
12. Demonstration of column chromatography.
13. Count the number of cells/spores using a Haemocytometer.
14. Collect numerical data, tabulate and represent in different types of graphs and diagrams mentioned in the syllabus.
15. Problems related to mean, median, mode, standard deviation and Chi-square test.

SEMESTER VI

CORE COURSE PRACTICAL 4

COURSE CODE: BO6CP04B23

COURSE TITLE- ANGIOSPERM MORPHOLOGY, REPRODUCTIVE BOTANY, ECONOMIC BOTANY, ETHNOBOTANY, ANGIOSPERM TAXONOMY AND PHYTOGEOGRAPHY

Credits: 2

Hours per week: 4 (2 + 2) **Total Hours: 81 (36+45)**

Course overview and Content

The course provides better understanding about the external morphology, habit, distribution and origin of angiosperm plants and utilising these features for preparing identification manuals for plants. It also covers the aspects of plant reproduction and development enhancing the ability of the student to analyze the relationship between structure and function. The course also familiarises students with economically important products from plants and their source and also to explore the hidden potentialities of various underutilized plants by applying the principles of ethnobotany.

This course helps students to develop skills and choose a career as field assistants, field biologist, plant bio curator, green auditing, herbarium curator, plant conservationist and ecologist. Ethnobotanical and economic importance of plants makes the students to learn about the hidden potentialities and commercial utilization of plants for becoming an entrepreneur. Knowledge on reproductive botany provides awareness on the better crop production strategies in agriculture. The overall practices in this paper also initiates the interests of student towards research on plant systems also can aware them how to approach problems in agriculture, health, and the environment.

Course Outcomes

CO1: Understand the habit, vegetative characters and distribution pattern of Angiosperms (Understand)

CO2: Develop skills in plant identification, characterisation and documentation (Application)

CO3: Interpret morphological characters and reproductive characters of plants vital in classification (Analyse)

CO4: Explain the economic importance and ethnobotanical significance of plants. (Analyse)

SEMESTER V
ANGIOSPERM MORPHOLOGY, REPRODUCTIVE BOTANY, ECONOMIC BOTANY AND ETHNOBOTANY (36 hrs)

ANGIOSPERM MORPHOLOGY(12 hrs)

1. Students have to identify and record the flower, inflorescence and fruit types mentioned in the syllabus.
2. Examination of floral morphology and record the aestivation and placentation types.

REPRODUCTIVE BOTANY (8 hrs)

1. Dissect and display parts of different types of flowers.
2. Identification of C.S. of anther, embryo sac and embryo.
3. Identification of various anther types - monothecous, dithecous.
4. Identify the different types of ovules.

ECONOMIC BOTANY (12 hrs)

1. Study the finished products of plants mentioned in the syllabus of economic botany with special reference to the morphology of the useful part, botanical name and family

ETHNOBOTANY (4 hrs)

1. Identify and describe the ethnobotanical uses of the items mentioned in the syllabus.

SEMESTER V
ANGIOSPERM TAXONOMY AND PHYTOGEOGRAPHY (45 hrs)

1. Identify the families mentioned in the syllabus by noting their vegetative and floral characters.
2. Students must describe the floral parts, draw the L.S., floral diagram and write the floral formula of at least one plant from each family.
3. Prepare herbarium of 25 plants with field notes.
4. Conduct field work for a period of not less than 3 days under the guidance of a teacher and submit field report.
5. Drawing the phytogeographic zones of India.

SEMESTER VI

CORE COURSE PRACTICAL 5

COURSE CODE: BO6CP05B23

COURSE TITLE: GENETICS, PLANT BREEDING, HORTICULTURE, CELL AND MOLECULAR BIOLOGY

Credits: 2
Hours per week: 4 **Total Hours: 81 (45+36)**

Course Overview and context

The course provides required knowledge to the students to work out the problems related to character inheritance based on Mendelian and Non-Mendelian ratios. The problems on DNA structure and central dogma will make the students enthusiastic in carrying out research work in the field of Molecular Biology. It also provides ample opportunity to the students to get exposed to hands on training on various tools and techniques in gardening and various plant breeding and plant propagation practices which are necessary to get established as promising entrepreneurs in the field. A detailed microscopic study on the mitotic and meiotic divisional stages of plant cells is included in the course, which will be helpful for the students in higher studies and research. The chromosomal anomalies that lead to the development of various syndromes in human beings covered in the course can aid the students in choosing unique and relevant topics for their higher studies as well as research.

Course Outcome

CO1: Solve problems related to inheritance of characters, central dogma and structure of DNA (Apply).

CO2: Practice various techniques of plant breeding, plant hybridisation, plant propagation and gardening (Apply).

CO3: Identify the various stages of mitosis and meiosis through microscopic observation (Understand).

CO4: Identify the chromosomal anomalies which lead to the development of selected syndromes in human beings (Understand)

SEMESTER V

GENETICS, PLANT BREEDING AND HORTICULTURE (45 HRS)

Genetics (18 hrs)

1. Students are expected to work out at least two problems each from: monohybrid, dihybrid, back- cross and test cross; all types of modified Mendelian ratios mentioned in the syllabus.

Plant Breeding (9 hrs)

1. Emasculation and bagging.
2. Demonstration of hybridization in plants.
3. Estimation of pollen sterility/viability.

Horticulture (18 hrs)

1. Whip and tongue grafting and Approach grafting, T budding and Patch budding, Air layering.
2. Identification of different garden tools and their uses.
3. List out the garden components in the photograph of the garden given.
4. Visit to established horticultural/agricultural/ornamental/kitchen gardens and observe the components there.

SEMESTER VI

CELL AND MOLECULAR BIOLOGY (36 hrs)

Cell Biology (27 hrs)

1. Make acetocarmine squash preparation of onion root tip to identify mitotic stages.
2. Study the mitotic index of onion root tip cells (Demonstration only).
3. Study of the different stages of meiosis and identification of different substages of prophase I using photomicrographs or pictures.
4. Identify and study the chromosomal anomalies, patterns and karyotype in man such as Down's syndrome, Turner's syndrome and Klinefelter's syndrome.

Molecular Biology (9 hrs)

1. Work out elementary problems based on DNA structure, replication, transcription and translation and genetic code.

SEMESTER VI

CORE COURSE PRACTICAL 6

COURSE CODE: BO6CP06B23

COURSE TITLE: PLANT PHYSIOLOGY, BIOCHEMISTRY, BIOTECHNOLOGY AND BIOINFORMATICS

Credits: 2

Hours per week: 4 (2 + 2) **Total Hours: 81 (45+36)**

Course overview and content

The course focuses on the experiments to demonstrate and to provide hands on training on the various physiological process happening in plant systems. The course accommodates the biochemical tests to detect starch ,carbohydrate and protein in plant cells. The tests to detect the activity of selected enzymes on plant tissues are also included. The course familiarises the students with various instruments, techniques and procedures of biotechnology. The course also makes the students proficient in handling the software tools used in Bioinformatics.

The course will enhance the employability of the students in research institutes and labs carrying out works related to Biotechnology. They can also get placed in research centers and pharmaceutical companies.

Course outcomes

CO1: Analyse the physiological processes of plant life. (Analyse)

CO2: Identify the major organic molecules in plant samples (Understand)

CO3: Interpret basic techniques in biotechnology (Apply)

CO4: Operate the instruments in Biotechnology and practice software tools in Bioinformatics (Apply)

SEMESTER VI

PLANT PHYSIOLOGY AND BIOCHEMISTRY (45 hrs)

PLANT PHYSIOLOGY (27 hrs)

Core Experiments (any four compulsory):

1. Determination of osmotic pressure of plant cell sap by plasmolytic/weighing method.
2. Compare the stomatal indices of hydrophytes, xerophytes and mesophytes (any two).
3. Separation of plant pigments by TLC/Paper chromatography.
4. Measurement of photosynthesis by Wilmott's bubbler/any suitable method.
5. Estimation of plant pigments by colorimeter.

Demonstration experiments:

1. Papaya petiole osmoscope.
2. Demonstration of tissue tension.

3. Relation between transpiration and absorption.
4. Necessity of chlorophyll, light and CO_2 in photosynthesis.
5. Simple respiroscope.
6. Respirometer and measurement of RQ.
7. Fermentation.
8. Measurement of transpiration rate using Ganong's potometer/Farmer's potometer.

BIOCHEMISTRY (18 hrs)

1. General test for carbohydrates – Molisch's test, Benedicts's tests, Fehling's test.
2. Colour test for starch - Iodine test.
3. Colour tests for proteins in solution – Xanthoproteic test, Biuret test, Million's test, Ninhydrin test.
4. Action of various enzymes in plant tissues: peroxidase, dehydrogenase.
5. Quantitative estimation of protein using colorimeter.

SEMESTER VI

BIOTECHNOLOGY AND BIOINFORMATICS (36 hrs)

1. Preparation of nutrient medium – Murashige and Skoog medium (Demonstration only).
2. Sterilization and inoculation of plant tissue in culture media.
3. Establishing shoot tip, axillary bud cultures (Demonstration only).2
4. Immobilization of whole cells or tissues in sodium alginate.
5. Isolation of DNA from plant tissue.
6. Agarose gel electrophoresis of the isolated DNA (Demonstration only).
7. Familiarize the instruments included in the syllabus such as Autoclave, laminar air flow chamber, UV- trans-illuminator, PCR machine, Electrophoresis apparatus, centrifuge etc and prepare short notes with diagrammatic sketch or photographs.
8. Familiarizing GENBANK, DDBJ, ENA, SWISS-PROT and PDB databases (Demonstration only).
9. Analysis of structural features of proteins using RASMOL.
10. Local alignment of sequences using BLAST (Demonstration only).
11. Retrieving a few research papers related to genetic engineering from PubMed (Demonstration only).

CORE COURSE
Project: BO6PRB23

Credits: 2

Total Hours: 36

Course overview and content

Students take up investigatory projects related to the subject during the final year of the degree programme. They work individually or in groups to systematically carry out experiments, collect, record and analyse data in order to substantiate their hypothesis. The students learn to compile their report scientifically and to present their work in a concise manner.

Course Outcomes:

CO1: Formulate hypothesis and design the experiments required for the research work (Create)
CO2: Employ extensive literature survey and data collection (Apply)
CO3: Apply various tools and techniques relevant for research. (Apply)
CO4: Develop scientific writing and presentation skills (Create)

SYLLABI FOR OPEN COURSES

SEMESTER V OPEN COURSE
COURSE CODE: BO5D01AB23
COURSE TITLE: HORTICULTURE AND NURSERY MANAGEMENT

Credits: 3
Hours per week: 4 **Total Lecture Hours: 72**

Course Overview and Content

This course offers basic knowledge for the beginners to understand the important aspects and practice in nursery management like potting of seedling, manuring and irrigation, plant protection measures, weed control, packaging and marketing of nursery plants. The topics includes the basic concepts of landscaping and garden designing that helps the learners to Inculcate interest in landscaping, gardening and flower and fruit culture.

The learners gain skills in plant propagation and the art of landscaping to start a plant nursery.

Course Outcomes

CO1: Identify the basic concepts of landscaping and garden designing. (Understand)
CO2: Distinguish the essential requirements for plant growth (Analyse)
CO3: Examine the concepts of landscaping and garden designing (Apply)
CO4: Describe the propagation of horticultural plants (Understand)

HORTICULTURE (48 hrs)

Module 1: Introduction (10 hrs)

Introduction to Horticulture: Definition, history; classification of horticultural plants, disciplines of horticulture. Soil: formation, composition, types, texture, pH and conductivity. Garden tools and implements. Preparation of nursery bed; manures and fertilizers - farm yard manure, compost, vermicompost, biofertilizers; chemical fertilizers - NPK; time and application of manures and fertilizers, foliar spray. Irrigation methods - surface, sub, drip and spray irrigations - advantages and disadvantages - periodicity of irrigation.

Module 2: Propagation of Plants (10 hrs)

Propagation of horticultural plants - by seeds; seed development and viability, seed dormancy, seed health, seed testing and certification. Growing seedlings in indoor containers and field nurseries, seed bed preparation, seedling transplanting; advantages and disadvantages of seed propagation.

Vegetative propagation - organs used in propagation - natural and artificial vegetative propagation; methods - cutting, layering, grafting and budding; advantages and disadvantages of vegetative propagation; micropropagation.

Module 3: Gardening (24 hrs)

Gardening - Ornamental gardens, indoor gardens, kitchen gardens - terrestrial and aquatic gardens - garden adornments; garden designing; garden components - lawns, shrubs and trees, borders, hedges, edges, drives, walks, topiary, trophy, rockery; Famous gardens of India. Landscape architecture - home landscape design, urban planning, parks, landscaping and public buildings, industrial and highway landscaping. Bonsai - physical control of plant growth - training and pruning - selection of plant, bonsai containers and method of bonsai formation.

Terrarium: Introduction, Preparation of Terrarium, Terrarium culture.

Floriculture: Introduction, production of cut flowers, quality maintenance, packing, marketing. Flower arrangements - basic styles - upright and slanting. Japanese ikebana, dry flower arrangement.

Olericulture: Olericulture - types of vegetable growing - home gardens and market gardens

Pomology: Pomology - preparation of land, spacing, planting, irrigation, hormones, harvest and storage. Factors affecting duration of storage. Principles of preservation - temporary and permanent - agents for fruit preservation. Preparation of pickles, jams, jellies and squashes using locally available fruits.

Mushroom Cultivation: Types of mushroom - Calocybe, Agaricus, Pleurotus. Spawn – isolation and preparation. Cultivation of milky mushrooms – using paddy straw and saw dust by polybag. Value added products from mushroom – pickles, candies, dried mushrooms.

Module 4: Gardening – Additional Features (4 hrs)

Garden friends - honey bees, ladybirds, frogs, spiders, earthworms, centipedes and millipedes. Garden foes - pests, pathogenic fungi, bacteria, virus. Control measures - pesticides and fungicides; neem tobacco decoction. Hazards of chemical pesticides; equipment used in controlling horticultural pests - sprayers, dusting equipment - sterilization, fumigation. Weeds - annual, perennial; weed control - prevention, eradication - hand weeding, tillage, burning, mowing, biological control, use of herbicides - selective and non-selective - mechanisms involved in herbicidal actions.

NURSERY MANAGEMENT (6 hrs)

Module 5: Nurseries (6 hrs)

Nursery: definition, types; management strategies - planning, layout, budgeting - production unit, sales unit. Plant growing structures - green houses, fernery, orchidarium, arbetorium.

ON HAND TRAINING (18 hrs)

1. Preparation of potting mixture of known combination and potting in earthern pots/polybags.
2. Preparation of nursery beds.
3. Preparation of compost/vermicompost using different substrates.
4. Working knowledge and identification of garden tools and implements.
5. Practical knowledge in different plant propagation techniques listed in syllabus.
6. Cultivation of a vegetable/ornamental plant/fruit crop listed in the syllabus.
7. Practice of different pruning operations (top dressing, shaping and topiary).
8. Visit a well-established nursery and submit report.

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SEMESTER V OPEN COURSE
COURSE CODE: BO5D01BB23
COURSE TITLE: AGRI-BASED MICROENTERPRISES

Credits: 3

Hours per week: 3 **Total Lecture Hours: 72**

Course overview and Content

This course examines the core qualities of an entrepreneur. Financial assistance from banks, role of institutions like MSME training institute, Khadi and village industries board, self-help groups, co-operative sector, Kudumbasree projects and microenterprises. It goes on to study the preparation and preservation techniques of value-added food products, cultivation of vegetables, fruits and medicinal plants, floriculture and apiculture.

Course Outcomes

CO1: Identify the different organic farming and composting. (Remember)

CO2: Explain the different horticultural and nursery management methods. (Understand)

CO3: Practice the different propagation and culture practices of horticultural plants. (Apply)

CO5: Practice the different tissue culture techniques. (Apply)

Module 1: Organic Farming and Composting Techniques (9 hrs)

Advantages of organic manures and fertilizers. Composition of fertilizers – NPK content of various fertilizers. Common organic manures – bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost - aerobic and anaerobic - advantages of both; vermicompost - preparation, vermiwash. Biofertilizers: definition, types – *Trichoderma, Rhizobium,* PGPR. Biopesticides – Tobacco and Neem decoction. Biological control.

Module 2: Horticulture and Nursery Management (18 hrs)

Soil components. Preparation of potting mixture. Common Garden tools and implements. Methods of plant propagation - by seeds - advantages and disadvantages. **Vegetative propagation** - advantages and disadvantages. Natural methods of vegetative propagation.

Artificial methods - cutting, grafting, budding and layering. Use of growth regulators for rooting.

Gardening - types of garden - ornamental, indoor garden, kitchen garden, vegetable garden for marketing.

Module 3: Food Spoilage and Preservation Techniques (9 hrs)

Causes of spoilage. Preservation techniques - asepsis, removal of microorganisms, anaerobic conditions and special methods – by drying, by heat treatment, by low temperature storage and by chemicals (Food Additives). Preparation of wine, vinegar and dairy products.

Module 4: Mushroom Cultivation and Spawn Production (9 hrs)

Types of mushrooms - button mushroom, oyster mushroom and milky mushroom, poisonous mushroom – methods of identification. Spawn – isolation and preparation. Cultivation milky mushrooms – using paddy straw and saw dust by polybag. Value added products from mushroom – pickles, candies, dried mushrooms.

Module 5: Plant Tissue Culture and Micropropagation (9 hrs)

Concept of totipotency. Micropropagation: different methods – shoot tip, axillary bud and meristem culture; organogenesis, somatic embryogenesis. Infra structure of a tissue culture laboratory. Solid and liquid media - composition and preparation. Sterilization techniques. Explant - inoculation and incubation techniques. Stages of micropropagation – hardening and transplantation. Packaging and transportation of tissue culture regenerated plantlets.

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SEMESTER V OPEN COURSE

COURSE CODE: BO5D01CB23

COURSE TITLE: ECOTOURISM

Credits: 3

Hours per week: 3 **Total Lecture Hours: 72**

Course overview and Content

The course will provide students with knowledge about biodiversity, importance of natural heritage centres and natural resource management. Specifically, this course will help the students to incorporate individual, social, economic, and environmental benefits into ecotourism. The course focuses on the key components such as natural environment, ecological and cultural sustainability and local and regional considerations.

The course will help students to plan for sustainable recreation facilities and services that result in positive outcomes for visitors, local communities, economies, and the environment. This will also help students to find jobs in tourism department as environmentalist, biologist, instructor, travel guidance and use strategies and techniques to manage natural areas for recreation and tourism.

Course Outcomes

CO1: Explain the principles, context and practice of ecotourism (Understand)

CO2: Analyze the key issues related to sustainable use of ecotourism destinations (Analyze).

CO3: Apply planning and management frameworks for developing recreation opportunities on a site, community, and landscape level (Apply)

CO4: Plan for sustainable recreation facilities and services that result in positive outcomes for visitors, local communities, economies, and the environment. (Create)

Module 1: Principles and Components of Ecotourism (30 hrs)

Introduction: Definition, concept, introduction, history, relevance and scope. Key principles and characteristics of ecotourism: Nature area focus, interpretation, environmental sustainability practice, contribution to conservation, benefiting local communities, cultural respect, customer satisfaction, responsible marketing.

Components of Ecotourism: Travel, tourism industry, biodiversity, local people, culturaldiversity, resources, environmental awareness, interpretation, stake holders,

capacity building in ecotourism.

Ecotourism terms: Adventure tourism, certification, commercialization chain, cultural tourism,canopy walkway, conservation enterprises, ecosystem, ecotourism activities, ecotourism product, ecotourism resources, ecotourism services, endemism, ecolabelling, ecotourism "lite",geotourism, green washing, stakeholders, sustainable development, sustainable tourism, leakages.

Module 2: Ecotourism Resources in India and Kerala (14 hrs)

Major ecosystems vegetation types and tourism areas in Kerala. Festivals and events, entertainment, overview, culture, famous destinations, sightseeing, historical monuments, museums, temples, national parks & wildlife sanctuaries, hill stations, waterfalls, rivers, wildlife watching and bird watching sites, agricultural sites, tribal areas, tribal museums, tribal arts, rural handicrafts, tribal medicines, archeological sites, adventure sports, sacred groves, mountains, etc.

Module 3: Forms of Ecotourism in India and Kerala (8 hrs)

Eco regions, eco places, waterfalls in Kerala and India, eco travel, dos and don'ts on ecotravel, ecotrips. Potential of ecotourism in Kerala. Community based ecotourism, ecotourism and NGOs.

Module 4: Ecotourism Planning (16 hrs)

Background, objectives, strategy, design of activities, target groups, opportunities, capacity building, threats, expectations positive and negative impacts, strength and weakness, benefits and beneficiaries, stakeholders, linkages, economics, ecotourism auditing. Problems with ecotourism. Carrying capacity of ecotourism. ecotourism facilities – Green report card. Ecotourism management – issues.

Module 5: Ecotourism and Livelihood Security (4 hrs)

Community, biodiversity conservation and development – Eco-development committees.

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SYLLABI FOR CHOICE BASED CORE COURSES

SEMESTER VI CHOICE BASED CORE COURSE

COURSE CODE: BO6C13AB23

COURSE TITLE: PHYTOCHEMISTRY AND PHARMACOGNOSY

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Content

This course provides a platform with the aim of motivating students to understand the structures of the secondary metabolites found in various plants. The subject helps to increase knowledge on the basic analysis, biosynthesis, extraction, separation, purification and application of phytochemical compounds in the plants. The phytochemical study also has relevance to the field of plant physiology also thus helps to improve the plant functions.

It will inculcate in the learners the knowledge about the important medicinal plants which are highly valuable in the treatment of various fatal ailments. They will also get an insight into the preparation and uses of various ayurvedic formulations using these medicinal plants. The detailed study about the biologically active compounds helps in the discovery of drugs with various applications.

The course offers job opportunities in the R&D sector of pharmaceutical, industrial and agriculture sectors.

Course Outcomes

CO1: Differentiate the role and functions of various secondary metabolites from the plants (Analyse)

CO2: Distinguish the various methods of extraction and characterization of phytochemicals. (Analyse)

CO3: Discuss the role of selected medicinal plants as a source of valuable phytochemicals relevant in modern and traditional medicine. (Understand)

CO4: Explain the methods of drug evaluation to identify adulteration. (Apply)

PHYTOCHEMISTRY (46 hrs)

Module 1: Introduction (2 hrs)

Introduction to phytochemical approaches: morphological, organoleptic, microscopic - to study drug and aromatic plants. Definition of Ayurvedic medicinal plants.

Module 2: Extraction of Phytochemicals and Study of the Active Principles (14 hrs)

Extraction and characterization techniques: cold extraction, hot extraction - Soxhlet-Clevenger apparatus; Solvents - petroleum ether, chloroform, ethanol, water. Separation techniques –TLC, Column, HPLC, HPTLC, GC. Characterization techniques - MS, UV Spectra, IR Spectra.

Study of the Active Principles- Alkaloids - introduction, properties, occurrence, structure, classification, functions, and pharmacological uses. Triterpenoids. Introduction, properties, occurrence, classification, functions and pharmacological uses. Phenolics- Quinines – classification- benzoquinones, napthoquinones, anthraquinone and coumarins- properties, occurrence, functions and pharmacological uses.

Module 3: Plants of Importance (20 hrs)

Study of the following plants with special reference to habit, habitat, systematic position, morphology of the useful part, phytochemistry, major pharmacological action and name of any two major ayurvedic formulations - *Tinospora cordifolia, Aegle marmelos, Punica granatum, Adhatoda vasica, Withania somnifera, Sassurea lappa, Asparagus racemosus, Sida acuta, Azadirachta indica, Phyllanthus amarus, Datura stramonium* and *Acorus calamus*. Organoleptic evaluation of the following plants and important chemical test to identify each - *Papaver somniferum, Aloe vera, Ricinus communis, Glycyrrhiza glabra, Acacia catechu,* and *Curcuma longa*.

Module 4: Aromatic Plants and Their Uses (10 hrs)

Study of the following aromatic plants - volatile oils and methods of extraction *Vetiveria zizanoides, Cinnamomum zeylanicum, Syzygium aromaticum, Santalum album, Eucalyptus globulus, Ocimum basilicum, Rosa, Mentha piperita, Cymbopogon citratus, Cananga odorata, Pelargonium*.

PHARMACOGNOSY (8 hrs)

Module 5: Pharmocognosy and Ethnomedicine (8 hrs)

Introduction, classification of crude drugs- morphological, chemical and pharmacological. Methods of drug evaluation to identify adulteration; study of starch grains of maize, wheat, rice, potato, arrow root. Traditional plant medicines as a source

of new drugs – The process of modern drug discovery using ethnopharmacology – Taxol, Artemisinin, Galathamine and Flavopyridole as examples of drug discovery based on ethnopharmacological approach. Jeevani-Pushpangadan model of benefit sharing.

Suggested additional topics:

1. Basic principles in spectroscopy - UV, NMR, IR.
2. Use of secondary metabolites for protection against pathogens, herbivores.

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SEMESTER VI CHOICE BASED CORE COURSE

COURSE CODE: BO6C13BB23

COURSE TITLE: AGRIBUSINESS

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Content

The course offers knowledge required for an entrepreneurship from the basics to production. It teaches and explains an idea about the business opportunities in the field of plant sciences through which one can develop an entrepreneurial mindset. The context provides an idea about the need and process of sustainable development and organic farming. Further, various horticultural techniques through which plants with value-added products could be cultivated organic farming in the current scenario is also imparted. It also harnesses the opportunities and potentials of these value-added and their processing techniques.

Agribusiness opens the scope of entrepreneurship for each individual in their unique way. It also provides platform to sprout as agriculturalist, plant breeder, researcher, scientists and teachers in educational institutes, plant breeding centres, genetic engineering firms, nurseries, agricultural departments, crop plantations, ministries of agriculture, etc.

Course Outcomes

CO1: Explain about entrepreneurship and its business opportunities (Apply)

CO2: Practice sustainable development and organic farming. (Apply)

CO3: Assess the opportunities and techniques in the field of processing technology of value-added products and food sciences. (Evaluate)

CO4: Explain the cultivation of different plants through various horticultural techniques (Apply)

AGRIBUSINESS (54 hrs)

Module 1: Entrepreneurship (2 hrs)

Basic qualities of an Entreprenuer. Financial assistance from Banks, role of Insttitutions like MSME Training Institute, Khadi and village industries board, self-groups, Co-operative sector, Kudumbasree projects and microentreprises.

Module 2: Value Added Products and Processing Techniques (16 hrs)

Preparation and preservation techniques, causes of spoilage of food. Principles of preservation – asepsis, removal of microorganisms, anaerobic situation and special methods – drying, thermal processing – pasteurization, sterilization and canning – low temperature, use of chemical preservatives and food additives. Preparation of wine, vinegar, pickles, jam, jelly, syrups, sauce, dry fruits, diary products – cheese, butter, yorghurt, paneer.

Processing techniques: Processing of latex: centrifuged laterx products and galvanized rubber products. Processing, storage and marketing of Cocoa, Coconut (copra, coir and tender coconut), Rice (par boiled raw rice and rie flour), Pepper, Cardamom, Ginger, Arrowroot, Tapioca, Cashew, Mango, Jack fruit, Guava, Grapes, Lemon, Papaya, Musa, Garcinia.

Module 3: Nursery management, Organic Farming and Composting Techniques (12 hrs)

Preparation of potting mixtures, polybags. Plant growing structures – green houses, shaded houses, polyshed, mist chamber, sprinkling system, drip irrigation. Modern strategies in propagation by root initiation of cutting, layering technique, budding and grafting technique; micropropagation. Planting, transplanting and hardening of seedlings, after care of seedlings. Packing and transport of seedlings.

Organic Farming and Composting Techniques- Organic manures and fertilizers, composition of fertilizers. NPK content of various fertilizers and preparation of fertilizer mixtures. Common organic manures - bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost - aerobic and anaerobic - advantages and limitations. Vermicompost - preparation; Vermiwash - preparation. Biofertilizers - definition and preparation of different types - Trichoderma, Rhizobium, PGPR, PSB, mycorrhiza. Application of biofertilizers. Biopesticides, Tobacco and Neem decoction. Biological control of disease and pests.

Module 4: Cultivation of Vegetables, Fruits, Medicinal Plants, Floriculture, Mushroom Cultivation and Apiculture (16 hrs)

Types - Home gardening, market gardening and truck gardening. Packing and transporting of vegetables. Organic farming of fruit crops - packing and transporting of fruits. Induction of flowering and weed control. Cultivation of medicinal and aromatic plants of common use and great demand.

Floriculture: Problems and prospects of floriculture in Kerala. Scope of growing Anthurium, Orchids and Jasmine in Kerala. Common cut flowers - Rose, Gerbera, Gladiolus, Aster, Chrysanthemum, Anthurium and Orchids. Common leaves used in flower arrangement - Cyprus, Podocarpus, Asparagus, Palms, Cycads and Ferns.

Mushrooms: Significance, nutritive value. Types of Mushrooms – Button – *Pleurotus*, *Volvorella*. Spawn production, storage and marketing. Growth of Mushrooms on paddy straw and saw dust by poly bag. Mushroom growing structures and maintenance of humidity. Pests and defects of mushrooms. Storage, transporting and marketing of mushrooms.

Apiculture: Scope and significance. Structure, installation and maintenance of an Apiarium. Extraction, processing, preservation and marketing of honey.

Module 5: Flower Arrangement and Ornamental Garden Designing (8 hrs)

Types - Western, Eastern (Japanese/ Ikebana) and modern. Wases, flower holders and floral foam. Wase life of flowers and leaves. After care of flower arrangements – Bouquets. Packing and maintenance of flowers and leaves.

Ornamental Garden Designing- Garden components. Lawn preparation by seeds, seedling and turfing. Maintenance of garden by Irrigation, Pruning, Repotting. Disease and Pest control.

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SEMESTER VI CHOICE BASED CORE COURSE

COURSE CODE: BO6C13CB23

COURSE TITLE: PLANT GENETIC RESOURCES MANAGEMENT

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Content

This course will help to develop an awareness regarding the importance of plant genetic resources. The rules and regulations regarding the management of the genetic resources will be made clear. It also helps to develop an ecofriendly approach among the students. Various aspects of biodiversity and its conservation will be dealt in detail. The module on ethnobotany is designed in such a way that the students get an idea regarding the ethnobotanical resources. The course also explains the importance of numerous underutilized plant resources.

The course offers jobs in government and non government organization as Technical Assistant, Research fellow etc

Course Outcomes

CO1: Differentiate the role of conservation and sustainable use of plant genetic resources (Analyse)

CO2: Identify the underutilized plants of Kerala as a food source (Understand)

CO3: Discuss the role and relevance of technology for systematic examination of diversity of life on earth (Understand)

CO4: Compare practical uses of local flora in human culture (Analyse)

PLANT GENETIC RESOURCES MANAGEMENT (54 hrs)

Module 1: Introduction (4 hrs)

Introduction - historical developments in crop botany, Centers of origin - Vavilovian concept - primary and secondary centers. Exploration and collection of genetic resources – importance of wild relatives of crop plants and their genetic diversity in cropimprovement.

Module 2: Plant Genetic Resources, Regulations and Rules (14 hrs)

Major threats to the genetic resources: human interference and deforestation, alien invasive plants, over exploitation of resources. Endemism and biodiversity hot spots.

Conservation of genetic resources: in situ - biosphere reserves, national parks and wildlife sanctuaries; ex situ - in vivo - botanic gardens, field gene banks; in vitro - seed banks - short term, medium term and long term storage of seeds, tissue culture storage and cryopreservation.

Regulations and rules- Role of Governmental and non-governmental organizations in plant genetic resource management; Governmental organizations - regional – TBGRI and KFRI; national - BSI and NBPGR; International- IPGRI (IBPGR) and ICRISAT; Non-Governmental Organizations - WWF andMNHS.

Module 3: Study of Biodiversity (5 hrs)

Remote sensing: principle, concept of remote sensing and components of remote sensing, application of remote sensing in conservation of endangered plants and habitat studies; IUCN - role and activities. Documentation of endangered and threatened plants - red data book.

Module 4: Ethnobotany and Conservation (4 hrs)

Ethnobotany in relation to conservation of genetic resources: mythology and conservation of ecosystems, sacred groves and their role in the conservation of gene pool; taboos for conservation of selected plant species.

Module 5: Crop plants and Unexploited and Underutilized Plants of Kerala (27 hrs)

Important Crop plants of Kerala - taxonomy and uses and cultivation of, food crops - Rice,Tapioca; Vegetables - Elephant foot yam, Cow pea, Bitter gourd; Spices. Ginger, Black pepper, Nutmeg, Cardamom; Medicinal plants - Vasaka, Aloe; Plantation crops – Rubber, Coffee; cashew, Coconut and Tea; Fruits - Banana, Pineapple and Mango.

Unexploited and Underutilized Plants: Underutilized plants and its importance for future food requirements. Botany and uses of the following under exploited edible plants - Vegetables - *Averrhoa bilimbi* (Bilimbi, Chemmeenpuli, Irumbampuli), *Averrhoa carambola* (Carambola apple, Chathurappuli), *Dioscorea esculenta* (Cherukizhangu, Nanakizhangu), *Canavalia gladiate* (Sword bean, Valpayar), *Psophocarpus tetragonolobus* (Winged bean,Chathurapayar), (Sessile joyweed), *Sauropus androgynus* (Velicheera, Chikurmanis,Sauropus), *Ipomoea turbinate* (Nithya Vazhuthana); Fruits; *Artocarpus heterophyllus* (Jack,Plavu, chakka), *Artocarpus hirsutus* (Anjili, Ayani, Wild jack), *Aporosa cardiosperma* (Vetti), *Spondias pinnata* (Ambazham, Hog plum),

Syzygium cumini (Njara, Njaval, Black plum), *Flacourtia montana* (Kattuloovika).

Millets - *Echinochloa crus-galli* (Barnyard grass, Indian BarnyardMillet)

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SYLLABI FOR COMPLEMENTARY COURSES FOR B.Sc. ZOOLOGY

SEMESTER I

COMPLEMENTARY COURSE

COURSE CODE: BO1B01B23

COURSE TITLE: ANATOMY AND APPLIED BOTANY

Credits: 2

Hours per week: 2 **Total Lecture Hours: 36**

Course overview and Content

This course provides a detailed account on the structure, development and functions of the different tissues and organs in plants. It emphasizes on the need for anatomical studies as an identification tool aiding phylogenetic and evolutionary analyses of plants. The course also introduces the students to the techniques of plant breeding and tissue culture.

The course offers students with job opportunities at pharmaceutical industries for plant identification using anatomical features. Also students have scope as plant breeder, researcher, agriculturalist at plant breeding centres.

Course Outcomes

CO1: Explain the anatomical organization of plants. (Understand)

CO2: Determine plant/wood identity based on anatomical features. (Apply)

CO3: Apply skills in plant breeding and horticultural techniques for improving crop/plant quality. (Apply)

CO4: Apply the principles of tissue culture in micropropagation of plants. (Apply)

PLANT ANATOMY (21 hrs)

Module 1: Cells and Tissues (9 hrs)

Gross structure of primary and secondary cell walls; structure and function of plasmodesmata; non- living inclusions - cystolith, raphides; Tissues - meristematic and permanent, types of meristems; simple and complex tissues, secretory tissues (nectaries, hydathodes, mucilage ducts and lactiferous tissue)

Module 2: Anatomy of Plant Organs (12hrs)

Primary structure of stem and root in dicots and monocots; anatomy of monocot and dicot leaf. Secondary thickening in dicot stem and dicot root; growth rings,

dendrochronology, heart wood and sap wood; tyloses; hard wood and soft wood. Anomalous secondary thickening in Bignonia.

APPLIED BOTANY (15 hrs)

Module 3: Plant Breeding (10 hrs)

Objectives of plant breeding, methods of plant improvement - plant introduction, acclimatization, plant quarantine; selection - mass selection, pureline selection and clonal selection; hybridization - intervarietal, interspecific and intergeneric; procedure of hybridization.

Artificial vegetative propagation methods

Propagation of plants through cutting, layering - air layering; budding T and patch budding; grafting - tongue and splice grafting. Role of cambium in budding and grafting.

Module : Plant Tissue Culture (5 hrs)

Principles of tissue culture, micropropagation - different steps - selection of explants, culture media, sterilization (explants and culture media), callus. Regeneration of plants: organogenesis, somatic embryogenesis; artificial seeds. Applications of plant tissue culture.

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MODEL QUESTION PAPER
B.Sc. DEGREE(C.B.C.S) EXAMINATION, NOVEMBER 2023
SEMESTER I - COMPLEMENTARY COURSE FOR B.Sc. ZOOLOGY
BO1B01B23: ANATOMY AND APPLIED BOTANY

Time: 3 hours Maximum marks: 60

Part A

(Answer any ten questions. Each question carries 1 mark)

Qn.No.	Questions	CO	Level of questions
1.	Explain the function of plasmodesmata.	1	U
0.	Differentiate cystolith and raphides.	1	U
0.	What are tyloses?	1	U
0.	Explain on conjoint vascular bundles.	2	Ap
0.	How do tracheids differ from vessels?	2	Ap
0.	Define acclimatization.	3	R
0.	What are annual rings? What is its significance?	2	Ap
0.	Explain the role of cambium in budding and grafting.	3	Ap
0.	Differentiate explant and callus.	4	U
0.	What is hybridization?	3	Ap
0.	Define totipotency.	4	U
0.	Explain plant quarantine.	3	Ap

(10 x 1 = 10 marks)

Part B

(Answer any six questions. Each question carries 5 marks)

Qn.No.	Questions	CO	Level
0.	Describe simple tissues with suitable diagrams.	1	U
0.	Explain complex tissues.	1	U
0.	Explain secretory tissues in plants.	1	U
0.	Differentiate the primary structure of stem and root with labelled diagrams.	2	U
0.	What are different types of vascular bundles?	2	Ap
0.	Explain the conventional and non-conventional methods of plant breeding.	3	Ap
0.	Describe the applications of plant tissue culture.	4	Ap
0.	Explain the different types of budding and grafting techniques with suitable diagrams.	3	Ap
0.	Explain the secondary growth in dicots stem.	2	U

(6 x 5 = 30 marks)

Part C

(Answer any two questions. Each question carries 10 marks)

Qn.No.	Questions	CO	Level

0.	What are permanent tissues? Explain the major classes with their functions.	1	U
0.	Describe the artificial vegetative propagation methods of plants.	3	Ap
0.	Explain the anomalous secondary thickenings of plants with special reference to *Bignonia* .	2	Ap
0.	What is tissue culture? Write an account on the steps involved in plant tissue culture.	4	Ap

(2 x 10 = 20 marks)

CO : Course Outcomes

Level : R – Remember, U – Understand, Ap- Apply, An- Analyze, E- Evaluate, C- Create

SEMESTER II

COMPLEMENTARY COURSE

COURSE CODE: BO2B01B23

COURSE TITLE: CRYPTOGAMS AND GYMNOSPERMS

Credits: 2

Hours per week: 2 **Total Lecture Hours: 36**

Course Overview and Content

This course is focused general features and diversity of the plant world. The course also gives emphasis on the study of different classes of algae, fungi, lichens, bryophytes, pteridophytes and gymnosperms giving importance to their characteristic features, diversity and economic importance. All topics dealt in this course are having importance in the daily life situations and has scope for research.

Study of phycology, lichenology, mycolology, pteridology, bryology and gymnosperms provides the students with job opportunities in bio monitoring, evolutionary biology and pollution control research centres. Phycology and mycology studies provide opportunity in industries such as biotechnology, biofuels, and medicine and marine botanists. It also provides research opportunities in production of novel drugs and antibiotics.

Course outcomes

CO1: Describe the evolutionary advancement and diversity of the plant world. (Understand)

CO2: Explain the distribution, structure, reproduction and life cycle patterns of algae, fungi and lichens. (Understand)

CO3: Explain the morphological, anatomical, reproductive features and life cycles of bryophytes, pteridophytes and gymnosperms. (Analyze)

CO4: Discuss the economic value of cryptogams and gymnosperms (Understand)

CRYPTOGAMS (30 hrs)

Module 1: Algae (14 hrs)

Algae: General characters of algae and their classification up to classes (F E Fritsch); range of thallus variation in Algae. Reproduction and life history of the following groups with reference to the types mentioned: Cyanophyceae – *Nostoc*; Chlorophyceae –

Spirogyra (*Volvox*, *Oedogonium*, *Cladophora* – vegetative features only), Phaeophyceae – *Sargassum*; Rhodophyceae – *Polysiphonia*.

Economic importance of Algae: food, industry, medicine, biofertilizers; algal bloom.

Module 2: Fungi and Lichens (10 hrs)

Fungi: General characters and outline on the classification of fungi by Ainsworth. General characters, thallus structure, reproduction, and life history of the following groups with reference to the types mentioned: Zygomycotina – *Rhizopus*; Ascomycetes – *Xylaria*; Basidiomycetes – *Agaricus*.

Economic importance of Fungi: as food, industry, decomposition of organic matter. Fungal toxins and human health.

Lichens: General account on morphology and anatomy of vegetative and reproductive structure. Classification based on thallus morphology, Economic importance of lichen.

Module 3: Bryophytes and Pteridophytes (7 hrs)

Bryophytes: General characters of Bryophytes. Morphology, anatomy, reproduction and life cycle of *Riccia*.

Pteridophytes: General characters of Pteridophytes. Morphology, anatomy (stem), reproduction and life cycle of *Selaginella*.

GYMNOSPERMS (5 hrs)

Module 4: Gymnosperms (5hrs)

Gymnosperms: General characters of Gymnosperms. Morphology, anatomy (stem, root, coralloid root, rachis and leaf let), reproduction and life cycle of *Cycas*.

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SEMESTER II

COMPLEMENTARY PRACTICAL 1

COURSE CODE: BO2BP01B23

COURSE TITLE: ANATOMY, APPLIED BOTANY, CRYPTOGAMS, AND GYMNOSPERMS

Credits: 2

Hours per week: 2 **Total Hours: 36 + 36**

Course overview and Content

This course covers the basics of plant anatomy allowing students to know the anatomical features of plants and their organisation. The students learn to use this knowledge in identifying plants, the tissue composition of different organs, development and their functions in plants. It enables them to utilise anatomical studies as an identification tool aiding phylogenetic and evolutionary analyses of plants. The course also introduces the students to the techniques of plant breeding and tissue culture. The course also gives emphasis on the study of different classes of algae, fungi, lichens, bryophytes, pteridophytes and gymnosperms giving importance to their characteristic features and diversity.

The course offers students with job opportunities at pharmaceutical industries for plant identification using anatomical features. Also students have scope as plant breeder, researcher, agriculturalist at plant breeding centres.

Course Outcomes

CO1: Relate anatomy of the different plant parts/organs to their function and utilise it for identification. (Apply)

CO2: Employ plant breeding and horticultural techniques for improving crop/plant quality and the principles of tissue culture in micropropagation of plant (Apply)

CO3: Interpret correctly the specimens belonging to the various plant groups using their morphology, anatomy and reproductive features. (Apply)

CO4: Explain the morphological, anatomical, reproductive features and life cycles of cryptogams and gymnosperms. (Apply)

SEMESTER I

ANATOMY AND APPLIED BOTANY (36 hrs)

1. Primary structure of stem and root of dicots and monocots; Dicot stem - *Centella*; Monocot stem – Bamboo, grass, asparagus; Dicot root - *Tinospora*; Monocot root - Colocasia, Musa.
2. Structure of dicot stem and dicot root after secondary thickening; Stem - *Vernonia*, *Eupatorium*; Root - *Tinospora*, Papaya.
3. Anomalous secondary thickening in *Bignonia*.
4. Emasculation of pea or *Caesalpinia* flower.
5. Conduct T and patch budding.
6. Demonstration of tissue culture techniques: culture media, surface sterilization and inoculation of explants.
7. Identification of non-living inclusions – cystolith and raphides.

SEMESTER II

CRYPTOGAMS AND GYMNOSPERMS (36 hrs)

1. Micropreparation and identification preparation of the following:
2. Algae: Vegetative structure of *Nostoc, Volvox, Spirogyra, Oedogonium, Cladophora, Polysiphonia.* Vegetative and reproductive structure of *Sargassum*.
3. Fungi: Vegetative and reproductive structure of *Rhizopus, Xylaria, Agaricus*.
4. Bryophytes: *Riccia* thallus morphology and anatomy.
5. Pteridophytes: Selaginella – morphology (vegetative and reproductive) and anatomy (stem).
6. Gymnosperms: Cycas – morphology (vegetative and reproductive) and anatomy of leaflet. (Anatomy of corolloid root and rachis- Spotters)

SEMESTER III

COMPLEMENTARY COURSE

COURSE CODE: BO3B01B23

COURSE TITLE: ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Content

To acquaint the students with the objectives and components of taxonomy. To make them understand the systems of classification of angiosperms and to make them aware of Bentham and Hooker's system of classification. Student will know the concept of methodology in taxonomy. They should be able to identify the common angiosperm species of Kerala and learn herbarium techniques. To make them aware of economically important products from the plants with their source. To explore the medicinal importance of common medicinal plants in Kerala.

Study of plant taxonomy provides students with job opportunities as plant biocurator, green auditing, herbarium curator, plant conservationist and ecologist, also provides research activities in identification of evolutionary relationships, and its systematic arrangement. Helps to develop a career as a plant scientist. Analyzing the economic importance and medicinal importance of plants provided to develop a career in photochemistry, Pharmacognosy for developing natural drugs. Economic botanists work to find ways that will allow the plant to be used sustainably and can start self-owned business

Course Outcomes

CO1: Distinguish the plant species based on their morphological characters (Analyse)

CO2: Employ Bentham and Hooker's classification to identify angiosperm species of Kerala. (Apply)

CO3: Identify economically important plants of Kerala. (Remember)

CO4: Identify selected medicinal plants for the treatment of common ailments. (Remember)

ANGIOSPERM TAXONOMY (42 hrs)

Module 1: Morphology of Angiosperms (16 hrs)

Leaf: simple, compound; venation and phyllotaxy.

Flower: as a modified shoot, structure of flower - floral parts, essential whorls, non-essential whorls, their arrangement, relative position; cohesion and adhesion of floral parts, symmetry of flowers; types of aestivation and placentation; floral diagram and floral formula.

Inflorescence: Types

1. Racemose - simple raceme, spike, spadix, catkin, corymb, umbel and head
2. Cymose – simple cyme, monochasial- helicoid and scorpoid; dichasial and polychasial
3. Special types – cyathium, verticillaster, hypanthodium, thyrsus and panicle..

Fruits: Types (Outline classification) special reference to the following with examples

1. Simple: Succulent (Fleshy)- drupe, berry, hespeidium, pepo; Dry Dehiscent- capsule, legeume, Dry indehiscent- Caryopsis, Cypsella, Schizocarpic- lomentum, carcerulus, regma, cremocarp
2. Aggregate fruits.
3. Multiple (Composite) fruit: sorosis, syconus.

Module 2: Plant Classification and Herbarium Techniques (6 hrs)

Classification: Objectives and Importance; Systems of classification: artificial; Linnaeus, natural; Bentham and Hooker (up to series), its merits and demerits and phylogenetic; Angiosperm Phylogeny Group system (brief account only); Nomenclature- binomial system, ICBN (Brief account only); Modern trends in taxonomy- Cytotaxonomy and chemotaxonomy (brief account only); Herbarium techniques; importance of herbarium.

Module 3: AngiospermFamilies (20 hrs)

Study of the following families of Bentham and Hooker's system of classification with special reference to major identifying characters and economic importance: Annonaceae, Malvaceae, Leguminosae (Mimosaceae, Caesalpiniaceae and Fabaceae), Cucurbitaceae, Rubiaceae, Asteraceae (Compositae), Apocynaceae, Lamiaceae (Labiatae), Euphorbiaceae, Poaceae (Gramineae).

ECONOMIC BOTANY (12 hrs)

Module 4: Classification and Study of Economically Important Plants (7 hrs)

Classification of economically important plants based on their uses. Study of the following groups of plants with special reference to their botanical name, family, morphology of useful part, economically important products and uses.

1. Cereals - Paddy, Wheat
2. Pulses - Green gram, Bengal gram
3. Tuber crops- Tapioca
4. Spices - Pepper, Cardamom
5. Beverages - Tea, Coffee
6. Oil yielding plants - Coconut, Groundnut
7. Fibre yielding plants - Cotton, Coir
8. Timber yielding plants - Teak, Rose wood
9. Latex yielding plants - Para rubber
10. Bio pesticides - Neem, Tobacco
11. Ornamental plants - Rose, Orchids, Anthurium.

Module 5: Medicinal Plants (5 hrs)

Study of the following medicinal plants with special reference to their binomial, family, morphology of useful parts and uses: *Adhatoda*, *Aloe*, *Bacopa*, *Catharanthus*, *Eclipta*, *Azadirachta*, *Ocimum*, *Phyllanthus amarus*, *Rauvolfia*, and *Sida*.

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SEMESTER IV

COMPLEMENTARY COURSE

COURSE CODE-BO4B01B23

COURSE TITLE: PLANT PHYSIOLOGY AND CROP PATHOLOGY

Credits: 3

Hours per week: 3 **Total Lecture Hours: 54**

Course Overview and Content

This course is focused on the various physiological aspects occurring in lower and higher plants and the significance of each. The course will enable the learner to understand the various aspects of plant growth and development and techniques underlying it.

This course helps the students to get jobs in research fields, as technical and skill assistant in various research institutes, plantation corporations and several agricultural development boards

Course Outcomes

CO1: Explain the mechanism of water and mineral absorption in plants. (Understand)

CO2: Analyse the mechanisms of photosynthesis, translocation of photosynthates and respiration. (Analyse)

CO3: Analyse the processes of growth and development in plants. (Analyse)

CO4: Recognise selected plant diseases of Kerala and their control measures. (Remember)

PLANT PHYSIOLOGY (49 hrs)

Module 1: Water Relations and Mineral Nutrition (15 hrs)

Plant water relations: Physical aspects of water absorption - Diffusion, DP, DPD. Imbibition. Osmosis OP, Exosmosis, Endosmosis, Plasmolysis. Water potential and its components. Mechanism ofwater absorption by root - active and passive absorption. Movement of water towards xylem by apoplast and symplast pathway. Ascent of sap – theories - transpiration pull theory, root pressure theory; guttation.

General account on micro and macro nutrients. Absorbable form, function and deficiency symptoms of the following mineral nutrients: N, P, K, Mg, B, Fe, Zn.

Module 2: Photosynthesis and Translocation of Photosynthate (13 hrs)

Basic requirements of Photosynthesis: Light - PAR; organs and site of photosynthesis; chloroplast. Photosynthetic pigments, photosynthetic unit; red drop and Emerson's enhancement effect; two pigment systems. Mechanism of photosynthesis: light dependent reaction - cyclic and non cyclic photo phosphorylation. Light independent reaction (dark reactions) C3 cycle, brief account on C4 and CAM Cycles. Factors affecting photosynthesis. Photorespiration (brief study only).

Translocation of photosynthate and organic solutes: path of translocation, mechanism of translocation (Pressure Flow Hypothesis).

Module 3: Respiration (10 hrs)

Respiration: anaerobic and aerobic; glycolysis, Kreb's cycle, mitochondrial electron transport system- components, oxidative phosphorylation, ATPase, chemiosmotic hypothesis. RQ - significance. Factors affecting respiration.

Module 4: Growth and Development (11hrs)

Seed dormancy - causes of seed dormancy - methods of breaking dormancy. Germination of seeds - physiological changes. Growth: Phases of growth, plant growth regulators - auxins, gibberellins, cytokinins, abscissic acid and ethylene and their physiological role (brief study only). Photoperiodism-definition, short day plants, long day plants, day neutral plants. Vernalization. Stress physiology: Concepts of plant responses to abiotic stresses (water, salt, temperature), biotic stress (pathogens). Allelopathy.

CROP PATHOLOGY (5 hrs)

Module 5: Plant Diseases (5hrs)

Plant diseases: Classification of plant diseases on the basis of causative organism and symptoms. Study the following diseases with special emphasis on causative organism, symptoms and control measures: (i) Nut fall of Arecanut (ii) Bacterial blight of Paddy (iii) Leaf mosaic of Tapioca.

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SEMESTER IV
COMPLEMENTARY PRACTICAL 2

COURSE CODE: BO4BP01B23

COURSE TITLE: ANGIOSPERM TAXONOMY, ECONOMIC BOTANY, PLANT PHYSIOLOGY AND CROP PATHOLOGY

Credits : 2

Hours per week: 2 **Total Hours: 72 (36+36)**

Course overview and Content

The course helps the students to understand and identity unknown plant by its morphological characters and also helps to systematically place the plants according to the hierarchical classification system. The course familiarizes students, the use and relevance of various plants in human culture. The course includes the various plant function and behavior that includes various metabolic processes, growth, defense etc. The economic loss of country can be controlled by proper management of plant diseases and infection. The topic covers details on some common plant diseases and its control measures.

This course helps the students to acquire skills required for technical and skill assistants in various research institutes, plantation corporations and several agricultural development boards.

Course Outcomes

CO1: Analyse the taxonomical evidence of the plants to evaluate and classify according to the morphological features in the systematic position (Analyse)

CO2: Compare uses of different plants and the cultural uses of plants (Analyse)

CO3: Record the experimental techniques and methods in plant physiology. (Apply)

CO4: Identify plant diseases that affect crops based on symptoms and provide environment friendly preventive and remedial measures. (Understand)

SEMESTER III

ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY (36 hrs)

1. Identify the different types of inflorescences and fruits of typical plants belonging to the families prescribed in the syllabus.
2. Identify typical local plants belonging to the families prescribed in the syllabus.
3. Describe the floral parts in technical terms and draw the L.S. of flower, construct the floral diagrams and write the floral formula of at least one flower from each family.
4. Study the botanical name, family, morphology of the useful part and the uses of the medicinal plants listed in the syllabus.

5. Study of the groups of plants mentioned in the economic botany syllabus with special reference to their botanical name, family, morphology of useful part, economic products and uses.

SEMESTER IV

PLANT PYSIOLOGY AND PATHOLOGY (36 hrs)

PLANT PYSIOLOGY (32 hrs)

Core Experiments:

1. Demonstration of osmosis using Potato tuber Osmoscope/Papaya petiole Osmoscope.
2. Separation of leaf pigments by paper chromatography.
3. Compare the stomatal indices of mesophytes and xerophytes.
4. Evolution of oxygen during photosynthesis.

Demonstration experiments:

1. Measure the rate of transpiration by Ganong`s potometer.
2. Relationship between transpiration and absorption.
3. Measurement of growth using Arc Auxanometer.
4. Demonstration of geotropic curvature using Clinostat.
5. Mohl's half leaf experiment.
6. Ganong's Light screen experiment.
7. Ganong's repirometer.

CROP PATHOLOGY (4hrs)

1. Identify plant diseases mentioned in the syllabus