ST.TERESA'S COLLEGE (AUTONOMOUS)

ERNAKULAM

(Affiliated to Mahatma Gandhi University, Kottayam)

CURRICULUM AND SYLLABI FOR

BACHELOR'S PROGRAMME IN BOTANY

AND

SYLLABI FOR COMPLEMENTARY BOTANY COURSES

(For Zoology)

Under Choice Based Credit & Semester System

(2018 Admissions)

Members of the Board of Studies in Botany

Sl. No.	Name of the Member	Official Address	Designation
1.	Dr. Lizzy Mathew	Associate Professor & Head, Department of Botany, St. Teresa's College, Ernakulam, Pin - 682035	Chairman
2.	Dr. Benny Jacob	Associate Professor and Head, Dept. of Botany, Mar Athanasius College, Kothamangalam, Pin- 686666	Subject Expert
3.	Dr. Joseph Job	Associate Professor, Department of Botany, S B College, Changanacherry, Pin- 686101	Subject Expert
4.	Dr. Sarala Samuel	GM, Research & Development, Kerala Ayurveda Ltd., Athani, Alwaye, Pin - 683585	Representative from Industry
5.	Dr. Thara K. Simon	Associate Professor, Dept. of Botany, Union Christian College, Alwaye, Pin - 683102	Alumnae
6.	Dr. Elsam Joseph	Associate Professor, Department of Botany, St. Teresa's College, Ernakulam Pin - 682035	Member from the Dept. with Ph. D.
7.	Dr. Alphonsa Vijaya Joseph	Associate Professor, Department of Botany, St. Teresa's College, Ernakulam Pin - 682035	Member from the Dept. with Ph. D.
8.	Dr. Romilly Margaret Mendez	Associate Professor, Department of Botany, St. Teresa's College, Ernakulam .Pin - 682035	Member from the Dept. with Ph. D. (CoE)
9.	Dr. Liza Jacob	Assistant Professor, Department of Botany, St. Teresa's College, Ernakulam.Pin - 682035	Member from the Dept. with Ph. D.
10.	Dr. Sheela D.	Associate Professor, Department of Botany, St. Teresa's College, Ernakulam Pin - 682035	Member from the Dept. with Ph. D.
11.	Smt. Nishitha I.K.	Assistant Professor, Department of Botany, St. Teresa's College, Ernakulam Pin- 682035	Member from the Dept.

Preface

As an autonomous college under Mahatma Gandhi University, St. Teresa's College has taken conscientious efforts to strengthen the curriculum by retaining all the fundamental stipulations of the University/Higher Education Council, to ensure a well-balanced Curriculum. Within the constraints of a prescribed syllabus, we have resolved to take a collective effort to create an inspiring academic culture in the institution, essential for teachers and students to access deeper knowledge and participate in its expansion and transmission. It is also to re-articulate the almost lost or forgotten fact that production and transmission of Quality Knowledge, essential for the development of students in particular and society in general, are the primary functions of any Educational Institution.

The Syllabus restructuring of 2018 aims to provide the students many opportunities to engage with authentic, real world learning. This has been evident through the significant number of new Programmes introduced at the wake of autonomy in 2014with their integral placement opportunities. Increasingly, however, opportunities for engagement in work-based learning that can be provided through the curriculum across a range of subject areas are creating new and exciting ways to support student learning.

I acknowledge the efforts taken by the teachers in developing Programme and Course outcomes that focus on cognitive and intellectual skills of the learners ,confidence to carry out independent and scholarly research in area of professional interest to them and to position themselves globally effective cross- cultural educators .

I congratulate the efforts taken by the Principal Dr. Sajimol Augustine M. and the team for restructuring the syllabi under the leadership of Smt. Shanty B.P in a meaningful manner. Transformation is what makes St. Teresa's distinctive. Transforming lives in order to make a real impact on the local and international stage through the creation, sharing and application of knowledge. We look forward to sharing with you the outcomes of our curriculum restructuring and these resources we hope will enable you to reflect on learning gain in our own institution.

DR. SR. VINITHA (CELINE E.)

DIRECTOR

Foreword

Autonomy in the field of higher education implies responsibility and accountability and this in turn leads to excellence in academics and proactive governance. St Teresa's College was given autonomous status in the year 2014 and we have made a concerted attempt to maintain a high level of quality in the standard of education that we impart.

Academic autonomy has granted us the freedom to fine tune the syllabus keeping in mind the changing needs of the new generation of students. 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. Structured feedback was taken from the Students, Alumni and the experts from the industry and the changes suggested by them were duly incorporated in the syllabi.

The Board of Studies constituted for each department meet regularly in the stipulated time frame and in depth discussions are conducted about the different dimensions of the curricula and syllabi. The IQAC team has felicitated the conduct of a number of workshops and conferences to equip the faculty with the necessary skill set to frame the syllabi, set question papers for internal tests that evaluate whether the learning outcomes enlisted in the syllabus have been achieved and to ensure the fair and transparent conduct of examinations.

The responsibility that autonomy has placed on us is indeed onerous but we have strived together to meet all the challenges that were placed in our way. We have worked towards moulding young women as responsible citizens who will carry forward the task of nation building in an exemplary manner. All effort has been made to nurture their academic ambitions as well as their skills in co curricular activities.

With sincere gratitude I acknowledge the instinct support and constant guidance extended by Rev. Sr. Dr. Vinitha, the Director of the College.

I specially thank the team headed by Smt. Shanty B. P. for updating the *syllabi*, the Heads of the Departments and all the faculty members for their diligence, commitment and exceptional contribution towards this endeavour.

DR. SAJIMOL AUGUSTINE M.

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. Benny Jacob, Associate Professor, Dept. of Botany, Mar Athnasious College, Kothamangalam, for his sincere effort and contributions in the preparation of this syllabus.

I place on record my sincere thanks to the subject experts, Dr. Joseph Job, Associate Professor, Dept. of Botany, St. Berchmans College, Changanacherry and Dr. Thara K. Simon, Associate Professor, Department of Botany, Union Christian College, Alwaye for their guidance and remarkable suggestions to restructure various courses of the programme. Thanks to Dr. Sarala Samuel, Head, Research & Development, Kerala Ayurveda Ltd., Athani, Alwaye, for her invaluable suggestions.

The Department of Botany, St. Teresa's College, gratefully acknowledges the role played by Dr. Jojy Alex, Associate Professor, Dept. of Chemistry, St. Thomas College, Pala for his guidance in framing the syllabus. My sincere thanks to Dr. Usha Nair, Associate Professor and IQAC Co-ordinator, Department of Hindi and Smt. Shanty B.P., Associate Professor, Department of Mathematics 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 Director Dr. Sr. Celine E. and Principal Dr. Sajimol Augustine M. for their valuable suggestions and support during the various stages of syllabus revision. My deep sense of appreciation to Dr. Elsam Joseph, Dr. Alphonsa Vijaya Joseph, Dr. Romilly Margaret Mendez, Dr. Liza Jacob, Dr. Sheela D. and Smt. I.K. Nishitha, the members of Board of Studies and faculty of Department of Botany, St. Teresa's College, Ernakulam, for their sincere cooperation and hard work in compiling the curriculum and syllabus.

Dr. Lizzy Mathew

Chairperson, Board of Studies &

Head of the Department of Botany

Contents

B.Sc. Programme in Botany under Choice Based Credit and Semester System (2018 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 mould them as ambassadors of sustainable development for our country.

GRADUATE ATTRIBUTES

The Bachelors Programme in Botany seeks to develop graduates of high distinction by providing high quality education. The Programme aims to encourage students to take responsibility for developing themselves throughout their studies at our institution. It encourages students to reflect on the broader purpose of their education. The students who are completing B.Sc. Programme in Botany will reflect the following graduate attributes.

1. Comprehensive knowledge and understanding about the importance of the discipline
2. Capacity to apply the achieved basic objectives of education in practical life
3. Open minded and curious attitude
4. Ability to work hard and be outstanding members of the society
5. Factual and functional knowledge about the diversity amongst life forms
6. Skill in practical work, experiments, use of advanced biological tool and techniques
7. Expertise in statistical analyses of biological data for better interpretations
8. Critical thinking and problem solving capacity
9. Spirit of teamwork and effective communication skills
10. Confidence to apply the acquired knowledge in practical life so as to make our country self- reliant
11. Curiosity and enthusiasm in Botany and related biological sciences
12. Interest in seeking higher studies in this discipline
13. Ability to appreciate and practice ethical principles in research and studies in the field of biological science
14. Awareness about the natural environment and realization of the importance of its conservation.
15. Ability to suggest innovative programme to care for nature and life for sustainable development.
16. Concern for fellow beings and care for the marginalized
17. Self-awareness and emotional intelligence

AIMS AND OBJECTIVES

The curriculum for the B.Sc. Programme in Botany has been designed with an aim of encouraging the broad instructional goals and to support the growing demands and challenging trends in the educational scenario. It targets at providing an environment that encourages, promotes and stimulates the intellectual, professional and personal development of the student. The curriculum caters to the all-round development of the student, rolling out globally ready individuals into the fast pacing world. The specific objectives of the Programme are as follows:

- Know the importance and scope of the discipline
- Inculcate interest in and love of nature with its myriad living forms
- Impart knowledge of Science as the basic objective of Education
- Create a scientific attitude to make students open minded, critical and curious
- Develop the ability to work hard and make students fit for society
- Expose students to the diversity amongst life forms
- Develop skill in practical work, experiments, equipments and laboratory use along with collection and interpretation of biological materials and data
- Make them aware of natural resources and environment and the importance of conserving it.
- Develop the ability for the application of acquired knowledge in various fields of life so as to make our country self sufficient
- Appreciate and apply ethical principles to biological science research and studies

PROGRAMME DESIGN

The U.G. Programme in Botany must include (a) Common courses, (b) Core courses, (c) Complementary Courses, (d) Choice Based courses (e) Open Courses and (f) Project work and Comprehensive Viva - voce. 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 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
G	Minimum attendance required	75%

COURSES

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

SCHEMES 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 Course	1
Complementary Courses	12
Total	**43**

COURSES WITH CREDITS (FOR MODEL 1)

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

COURSE CODE FORMAT

The Programme is coded according to the following criteria.

1. The first letter plus second letter/any letter from the Programme ie., **BO**
2. One digit to indicate the semester. i.e., **BO1 (Botany, 1st semester)**
3. One letter from the type of courses such as, **A** for Common Course, **B** for Core Course, **C** for Complementary Course, **D** for Open Course, ie., **BO1B (Botany, 1st semester Core course)**.
4. Two digits to indicate the Course number of that Semester. ie., **BO1B01 (Botany, 1st Semester, Core Course, Course Number is 01)**
5. The letter **B** to indicate Bachelors Programme.
6. **BO1B01B** (Botany, 1st semester, Core Course, Course Number 01, and **B** for Bachelors Programme)
7. **18 to indicate the year.** ie., **BO1B01B18**
8. The letter **P** denotes Practical – it should come after the code letter for the Course ie, **BP** (Core Practical-eg. BO2BP01B18)/ **CP** (Complementary Practical - eg. BO2CP01B18)
9. Botany Project: **BO6BPRB18**

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	17	8
Sixth	17	8

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

PROGRAMME STRUCTURE

Sem	Course Type	Course Code	Course Title	Hrs/ week	Credits	Max Marks	
						ISA	ESA
I	Common Course I	EN1A01B18	Fine-tune Your English	5	4	20	80
		EN1A02B18	Pearls from the Deep	4	3	20	80
	Common Course II	FR1A01B18	French Language and Communicative Skills-I	4	4	20	80
		HN1A01B18	Kahaani Aur Upanyas				
		MA1A01B18	Kathasahithyam				
	Complementary Course I	CH1C01B18	Basic Theoretical and Analytical Chemistry	2	2	15	60
		CH2CP01B18	Volumetric Analysis	2	-	-	-
	Complementary Course II	ZY1C01B18	Non Chordate Diversity	2	2	15	60
		ZY2CP01B18	Non Chordate and Chordate Diversity (Practical)	2	-	-	-
	Core Course	BO1B01B18	Methodology of Science and an Introduction to Botany	2	2	15	60
	Core Practical	BO2BP01B18	Methodology of Science, Introduction to Botany, Microbiology, Mycology and Plant Pathology	2	-	-	-
	Total Credits - 17						
II	Common Course I	EN2A03B18	Issues that Matter	5	4	20	80
		EN2A04B18	Savouring the Classics	4	3	20	80
	Common Course II	FR2A03B18	French Language and Communicative Skills-II	4	4	20	80
		HN2A03B18	Kavita Vyakaran Aur Anuvad				
		MA2A03B18	Kavitha				
	Complementary Course I	CH2C01B18	Basic Organic Chemistry	2	2	15	60
		CH2CP01B18	Volumetric Analysis	2	2	10	40
	Complementary Course II	ZY2C01B18	Chordate Diversity	2	2	15	60
		ZY2CP01B18	Non Chordate and Chordate Diversity (Practical)	2	2	10	40
	Core Course	BO2B02B18	Microbiology, Mycology and Plant Pathology	2	2	15	60

	Core Practical	BO2BP01B18	Methodology of Science, Introduction to Botany, Microbiology, Mycology and Plant Pathology	2	2	10	40
	Total Credits - 23						
III	**Common Course I**	EN3A05B18	Literature and/as Identity	5	4	20	80
	Common Course II	FR3A05B18	An Advanced Course in French -I	5	4	20	80
		HN3A05B18	Naatak Aur Lambi Kavita				
		MA3A05B18	Drisyakalasahithyam				
	Complementary Course I	CH3C01B18	Inorganic and Organic Chemistry	3	3	15	60
		CH4CP01B18	Organic Chemistry Practical	2	-	-	-
	Complementary Course II	ZY3C01B18	Physiology and Immunology	3	3	15	60
		ZY4CP01B18	Physiology, Immunology and Applied Zoology (Practical)	2	-	-	-
	Core Course	BO3B03B18	Phycology and Bryology	3	3	15	60
	Core Practical	BO4BP02B18	Phycology, Bryology, Pteridology, Gymnosperms and Paleobotany	2	-	-	-
	Total Credits - 17						
IV	**Common Course I**	EN4A06B18	Illuminations	5	4	20	80
	Common Course II	FR4A06B18	An Advanced Course in French -II	5	4	20	80
		HN4A06B18	Gadya Aur Ekanki				
		MA4A06B18	Malayala Gadhyarachanakal				
	Complementary Course I	CH4C01B18	Advanced Bio-Organic Chemistry	3	3	15	60
		CH4CP01B18	Organic Chemistry Practical	2	2	10	40
	Complementary Course II	ZY4C01B18	Applied Zoology	3	3	15	60
		ZY4CP01B18	Physiology, Immunology and Applied Zoology (Practical)	2	2	10	40
	Core Course	BO4B04B18	Pteridology, Gymnosperms and	3	3	15	60

			Paleobotany				
	Core Practical	BO4BP02B18	Phycology, Bryology, Pteridology, Gymnosperms and Paleobotany	2	2	10	40
	Total Credits - 23						
V	**Core Course**	BO5B05B18	Environmental Science and Human Rights	2	3	15	60
		BO5B06B18	Research Methodology, Biophysics and Biostatistics	3	3	15	60
		BO5B07B18	Plant Physiology and Biochemistry	2	2	15	60
		BO5B08B18	Anatomy, Reproductive Botany and Microtechnique	4	4	15	60
	Open Course	Offered by other Departments		4	3	20	80
	Core Practical	BO6BP03B18	Anatomy, Reproductive Botany, Microtechnique, Research Methodology, Biophysics and Biostatistics	2	-	-	-
		BO6BP04B18	Plant Physiology, Biochemistry, Environmental Science and Human Rights	2	-	-	-
		BO6BP05B18	Genetics, Plant Breeding, Horticulture Cell and Molecular Biology	2	-	-	-
		BO6BP06B18	Angiosperm Morphology, Taxonomy, Economic Botany, Biotechnology and Bioinformatics	3			
	Project	BO6BPRPB18	Project/Practical	-	-	-	-
	Total Credits - 15						
VI	**Core Course**	BO6B09B18	Genetics, Plant Breeding and Horticulture	3	3	15	60
		BO6B10B18	Cell and Molecular Biology	3	3	15	60
		BO6B11B18	Angiosperm Morphology, Taxonomy and Economic Botany	3	3	15	60

		BO6B12B18	Biotechnology and Bioinformatics	3	3	15	60
		BO6B13aB18	Phytochemistry and Pharmacognosy	3	3	20	80
	Core Practical	BO6BP03B18	Anatomy, Reproductive Botany, Microtechnique, Research Methodology, Biophysics and Biostatistics	2	2	10	40
		BO6BP04B18	Plant Physiology, Biochemistry, Environmental Sciences and Human Rights	2	2	10	40
		BO6BP05B18	Genetics, Plant Breeding, Horticulture Cell and Molecular Biology	2	2	10	40
		BO6BP06B18	Angiosperm Morphology, Taxonomy, Economic Botany, Biotechnology and Bioinformatics	3	2	10	40
	Project	BO6BPRB18	Project	-	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 per week	Credits
SEMESTER-1				
BO1B01B18	Methodology of Science and an Introduction to Botany	Core	2	2
BO2BP01B18	Methodology of Science, Introduction to Botany, Microbiology, Mycology and Plant Pathology	Core	2	-
	Total Credits			**2**
SEMESTER-2				

BO2B02B18	Microbiology, Mycology and Plant Pathology	Core	2	2
BO2BP01B18	Methodology of Science, Introduction to Botany, Microbiology, Mycology and Plant Pathology	Core	2	2
	Total Credits			**4**
SEMSTER-3				
BO3B03B18	Phycology and Bryology	Core	3	3
BO4BP02B18	Phycology, Bryology, Pteridology, Gymnosperms and Paleobotany	Core	2	-
	Total Credits			**3**
SEMESTER-4				
BO4B04B18	Pteridology, Gymnosperms and Paleobotany	Core	3	3
BO4BP02B18	Phycology, Bryology, Pteridology, Gymnosperms and Paleobotany	Core	2	2
	Total Credits			**5**
SEMESTER-5				
BO5B05B18	Environmental Science and Human Rights	Core	2	3
BO5B06B18	Research Methodology, Biophysics and Biostatistics	Core	3	3
BO5B07B18	Plant Physiology and Biochemistry	Core	2	2
BO5B08B18	Anatomy, Reproductive Botany and Microtechnique	Core	4	4
Offered by other Departments	Open Course	Open Course	4	3
BO6BP03B18	Anatomy, Reproductive Botany, Microtechnique, Research Methodology, Biophysics and Biostatistics	Core	3	-
BO6BP04B18	Plant Physiology, Biochemistry, Environmental Science and Human Rights	Core	2	-
BO6BP05B18	Genetics, Plant Breeding, Horticulture, Cell and Molecular Biology	Core	3	-
BO6BP06B18	Angiosperm Morphology, Taxonomy, Economic Botany, Biotechnology and Bioinformatics	Core	2	-
	Total Credits			**15**
SEMESTER-6				

BO6B09B18	Genetics, Plant Breeding and Horticulture	Core	3	3
BO6B10B18	Cell and Molecular Biology	Core	3	3
BO6B11B18	Angiosperm Morphology, Taxonomy and Economic Botany	Core	3	3
BO6B12B18	Biotechnology and Bioinformatics	Core	3	3
BO6B13B18	Choice Based Core Course	Core	3	3
BO6BP03B18	Anatomy, Reproductive Botany, Microtechnique, Research Methodology, Biophysics and Biostatistics	Core	3	2
BO6BP04B18	Plant Physiology, Biochemistry, Environmental Sciences and Human Rights	Core	2	2
BO6BP05B18	Genetics, Plant Breeding, Horticulture Cell and Molecular Biology	Core	3	2
BO6BP06B18	Angiosperm Morphology, Taxonomy, Economic Botany, Biotechnology and Bioinformatics	Core	2	2
BO6BPRB18	Project	Core	-	2
	Total Credits			**25**

OPEN COURSES

Sl. No.	Semester	Course Code	Course Title
1	V	BO5D01aB18	Horticulture and Nursery Management
2	V	BO5D01bB18	Agri-based Microenterprises
3	V	BO5D01cB18	Ecotourism

CHOICE BASED COURSES

Sl. No.	Semester	Course Code	Course Title
1	VI	BO6B13aB18	Phytochemistry and Pharmacognosy
2	VI	BO6B13bB18	Agribusiness
3	VI	BO6B13cB18	Plant Genetic Resources Management

Complementary Courses offered by the Department of Botany

(for Bachelors Programme in Zoology)

Theory & Practical

Course Code	Title of the Course	Hrs per week	Credits
SEMESTER I			
BO1C01B18	Cryptogams, Gymnosperms and Plant Pathology	2	2
BO2CP01B18	Cryptogams, Gymnosperms, Plant Pathology and Plant Physiology (Practical)	2	-
SEMESTER II			
BO2C01B18	Plant Physiology	2	2
BO2CP01B18	Cryptogams, Gymnosperms, Plant Pathology and Plant Physiology (Practical)	2	2
SEMESTER III			
BO3C01B18	Angiosperm Taxonomy and Economic Botany	3	3
BO4CP01B18	Angiosperm Taxonomy, Economic Botany, Anatomy and Applied Botany (Practical)	2	-
SEMESTER IV			
BO4C01B18	Anatomy and Applied Botany	3	3
BO4CP01B18	Angiosperm Taxonomy, Economic Botany, Anatomy and Applied Botany (Practical)	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/Seminar/Viva	**5**
Test papers (2 x 5)	**10**
Total	**20**

Attendance

% of Attendance	**Marks**
>90%	**5**
Between 85 and 90	**4**
Between 80 and 85	**3**
Between 75 and 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/Seminar/Viva	**2**
Test papers (2 x 4)	**8**
Total	**15**

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**

*Bonafide reports 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**

*Bonafide 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**

ASSIGNMENTS

Assignments are to be done from 1st to 4th Semesters. At least one assignment should be done in each semester for all courses.

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 objective 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

A 7-point scale based on the total percentage of marks (ISA + ESA) for all Courses (Theory, Practical, Project).

% of marks	Grade	Grade point
>95	S - Outstanding	10
85 - 95	A^+ - Excellent	9
75 - 85	A - Very good	8
65 - 75	B^+ - Good	7
55 - 65	B - Above average	6
45 - 55	C - Satisfactory	5
35 - 45	D - Pass	4
<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:

$$CP = C \times GP$$

C = Credit; GP = Grade point

Semester Grade Point Average (SGPA) of a Semester:

$$SGPA = TCP/TC$$

TCP = Total Credit Point of that Semester

TC = Total Credit of that Semester

Cumulative Grade Point Average (CGPA) is calculated:

$$CGPA = TCP/TC$$

TCP = Total Credit Point of that Programme

TC = Total Credit of that Programme

GRADE POINT AVERAGE (GPA)

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

GPA = 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 GPA:

GPA	Grade
>9.5	S - Outstanding
8.5 – 9.5	A^+ - Excellent
7.5 – 8.5	A - Very good
6.5 – 7.5	B^+ - Good
5.5 – 6.5	B - Above average

4.5 – 5.5	C - Satisfactory
3.5 – 4.5	D - Pass
<3.5	F - Failure

- For reappearance/improvement of I, II, III & IV Semesters, candidate have to appear along with the next batch.
- There will be supplementary exams 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

CURRICULUM FOR
BACHELOR'S PROGRAMME IN BOTANY
(CORE)

SEMESTER I
CORE COURSE 1
COURSE CODE: BO1B01B18
COURSE TITLE: METHODOLOGY OF SCIENCE AND AN INTRODUCTION TO BOTANY
(Theory 36 hrs; Practical 36 hrs; Credits 2 + 1)

Aim

- Make the learners understand the universal nature of science.
- Demonstrate the use of scientific method.
- Lay a strong foundation in Botany and to develop basic skills to study Botany.
- Impart an insight into the different types of classifications in the living kingdom.
- Make the learners appreciate the world of organisms and its course of evolution and diversity.

Course Overview and Context

This course introduces the learners to the universal nature of science the various methodologies in scientific study will be demonstrated so that inquisitiveness may develop in them which in turn can lead to scientific approach and research aptitude. It explores the diversity of life, courses of evolutions and different classificatory systems so that the learners may better understand and appreciate the beauty of nature and uniqueness of each life form. The basic botanical skills will be introduced to them and they will be given hands on training in these skills in the practical classes so that they can perform well in the practical of the higher classes. Overall this course will lay a strong foundation for the learners to study Botany.

Module 1: Introduction to Science and the methodology of science (4 hrs)

Scientific method: steps involved - observation and thoughts, formulation of hypothesis; inductive reasoning - testing of hypothesis; deductive reasoning - experimentation - formulation of theories and laws.

Module 2: Experimentation in Science (4 hrs)

Selection of a problem - searching the literature – designing of experiments - selection of variables, study area, and a suitable design. Need of control, treatments and replication. Mendel's experiments as an example of moving from observations to questions, then to hypothesis and finally to experimentation. Ethics in science.

Module 3: Origin and Evolution of Life (10 hrs)

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.

Module 4: Diversity of life and its classification (12 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) – criteria for classification, general characters of each kingdom. The three domains of life: Archaea, Bacteria, Eucarya – general characters of each. Diversity of plants: study the salient morphological features of vegetative and reproductive parts of algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms.

Module 5: Basic Botanical Skills (6 hrs)

Light microscope: dissection and compound microscope – parts and uses. Preparation of specimens for light microscopy - collection and preservation of plant specimens; killing and fixing; killing agents- formalin, ethyl alcohol; fixing agents - Carnoy's fluid, Farmer's fluid, FAA. Preparation of Normal, Molal and Molar solutions.

PRACTICAL (36 hrs)

1. Design an experiment to verify a given hypothesis.
2. To identify and collect plant specimens to appreciate the diversity of plant kingdom.
3. Submit five preserved specimens (in bottles and/or herbarium) belonging to diverse groups.
4. Identification of Conduct a survey-based inquiry on a given topic (To test the validity of a given hypothesis. E.g., all angiosperm parasites are Dicot plants).
5. Select an important classical experiment and find out the different elements of the methodology of science (e.g., Robert Koch experiment).
6. Conduct field surveys plants with vascular elements, plants which produce flowers, fruits, seeds, cone, sporophyll, embryos and study their salient features.
7. Prepare temporary, stained hand sections (TS) of plant specimens appropriate for light microscopic studies.

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COURSE COMPETENCIES

- Help the students in acquiring knowledge regarding the universal nature of science.
- Familiarize the students with the methods of scientific study.
- Make them competent in the basic skills to study Botany.
- Obtain an overview of the different classificatory systems of organisms and the course of organic evolution.
- Help them to enjoy the richness and importance of biodiversity.

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B.Sc. I Semester - Core Course 1

Course Code: BO1B01B18

Course Title: Methodology of Science and an Introduction to Botany

Modules	**Hours**	**PART A (Short Answer) 1 Mark 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 10 Marks 2/4**	**Total Marks**
1	4	1	1	-	6
2	4	2	2	1	22
3	10	3	2	1	23
4	12	3	2	1	23
5	6	3	2	1	23

B Sc PROGRAMME- BOTANY CORE COURSE
CODE: BO1B01B18 METHODOLOGY OF SCIENCE AND AN INTRODUCTION TO BOTANY
MODEL QUESTION PAPER
First Semester CBCSS Examination

Time: 3 Hrs **Total Marks: 60**

PART A
(Answer any 10 questions. Each question carries 1 mark)

1. Define null hypothesis.
2. What is meant by variables?
3. What is the need of control in an experiment?
4. Define panspermia.
5. Mention any one isolation mechanism.
6. What is meant by genetic drift?
7. Which are the three domains of life?
8. Who proposed the phylogenetic system of classification?
9. Which group of plants produces naked seeds?
10. How do you make 1 normal NaOH solution?
11. What is meant by killing in preservation?
12. Give an example of a killing agent.

(10 x 1=10 marks)

PART B
(Answer any 6 questions. Each question carries 5 marks)

13. Write notes on formulation of theories and laws.
14. Give an account on ethics in science
15. Discuss designing of experiments.
16. Explain Miller- Urey experiment.
17. Write a note on Oparin's hypothesis.
18. Give an account on the salient morphological features of the vegetative and reproductive parts of bryophytes.
19. Describe the general characters of Archea.
20. Explain the preparation of Carnoy's fluid. What is its use?
21. Write a note on the Preparation of specimens for light microscopy

(6x 5 = 30 marks)

PART C
(Answer any 2 questions. Each question carries 10 marks)

22. Write an essay on the three domains, six kingdom classification of Carl Woese (1990).
23. Discuss Mendel's experiments as an example of moving from observations to questions, then to hypothesis and finally to experimentation.

24. Give an account on the parts and uses of a compound microscope.
25. Explain the theories of evolution proposed by Lamarck and Wallace.

(2 x 10 = 20 marks)

SEMESTER II

CORE COURSE 2

COURSE CODE: BO2B02B18

COURSE TITLE: MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY
(Theory 36 hrs; Practical 36 hrs; Credits 2 + 1)

Aim

- Understand the world of microbes, fungi and lichens
- Appreciate the adaptive strategies of the microbes, fungi and lichens
- Study the economic and pathological importance of microorganisms

Course Overview and Context

The course explores the 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. It also deals with the various types of 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 is having importance in the daily life situation

MICROBIOLOGY (Theory 9 hrs; Practical 9 hrs)

Module 1: Introduction, Bacteria and Viruses (7 hrs)
Introduction to microbiology, scope of microbiology.
Bacteria: general characters and classification based on staining, morphology and flagellation. Ultra-structure of bacteria. Reproduction - binary fission. Genetic recombination in bacteria - conjugation, transformation and transduction. Economic importance of bacteria.
Viruses: General characters of viruses, viriods and prions. Structure of TMV and Bacteriophage (λ). Multiplication of λ phage – lytic and lysogenic cycle.

Module 2: Applied Microbiology (2 hrs)
Isolation and culture of bacteria; media used – general purpose and selective media, applications of bacterial culture (brief study only). Role of microbes: in producing antibiotics, vine, vinegar, curd – role in N_2 fixation, as biofertilizers – role in food spoilage (Brief study only).

PRACTICAL (9 hrs)
1. Gram staining - curd, root nodules.
2. Isolation of microbes from soil through serial dilution and streak plate method.

3. Demonstrate the culture of bacteria.
4. Microbes and type of fermentation - vine, vinegar, curd.

MYCOLOGY (Theory 16 hrs; Practical 18 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.*

Economic importance of Fungi (3 hrs)
Useful and harmful effects of fungi - medicinal, industrial, agricultural, food, genetic studies, spoilage, fungal toxins and diseases. Mycorrhiza: ecto- and endomycorrhiza. Significance.

Module 4: Lichens (2 hrs)
General characters, types, general internal structure. Economic and ecological significance of lichens. Structure, reproduction and life cycle of *Parmelia.*

PRACTICAL (18 hrs)
1. Micropreparation and detailed microscopic study of *Rhizopus, Albugo, Saccharomyces, Penicillium, Xylaria, Peziza, Puccinia, Fusarium* and *Parmelia.*
2. Staining and microscopic observation of endomycorrhizal fungus.
3. Investigation of fungal succession on cow dung.

PLANT PATHOLOGY (Theory 9 hrs; Practical 9 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. Host parasite interaction - defense mechanisms in host, mechanism of infection, transmission and dissemination of diseases.
Common plant diseases: Study of following diseases with emphasis on symptoms, cause, disease cycle and control: Bunchy top of Banana, Bacterial blight of Paddy, Root wilt of Coconut, Abnormal leaf fall of Rubber, Root knot disease of Pepper, Leaf mosaic disease of Tapioca, Citrus canker.
Control of diseases: Prophylaxis - quarantine measures, seed certification; Therapeutic - physical therapy, chemotherapy; Biological control and its significance. Preparation and application of fungicides - Bordeaux mixture; Biopesticides - Tobacco and Neem decoction.

PRACTICAL (9 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.

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COURSE COMPETENCIES

- Help the students in acquiring knowledge about the diversity of fungal world and its significance.
- Familiarize the students with the cultivation practices of oyster mushroom and will relate the importance of edible mushrooms to the wellbeing of man.
- Makes them aware of the diversity of lichens and their significance in environmental monitoring.
- Creates awareness regarding the various plant diseases prevalent in Kerala, the mechanisms of infection, transmission and dissemination, various measures adopted to control plant diseases and the impact of plant diseases on agriculture.
- Helps them to develop knowledge about the common types of fungal diseases affecting human beings and their prevention and control measures.

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B.Sc. II Semester Core Course 2

Code: BO2B02B18

Course Title: Microbiology, Mycology and Plant Pathology

Modules	**Hours**	**PART A (Short Answer) 1 Mark 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 10 Marks 2/4**	**Total Marks**
1	7	3	2	1	23
2	2	2	1	1	17
3	16	4	4	1	34
4	2	1	1	-	6
5	9	2	1	1	21

SEMESTER III

CORE COURSE 3
COURSE CODE: BO3B03B18
COURSE TITLE: PHYCOLOGY AND BRYOLOGY
(Theory 54 hrs; Practical 36 hrs; Credits 3 + 1)

Aim

- To study the evolutionary importance of Algae as progenitors of land plants
- To understand the unique and general features Algae and Bryophytes and familiarize it
- To study the external morphology, internal structure and reproduction of different types of Algae and Bryophytes
- To realize the application of Phycology in different fields

Course overview and context

The course gives emphasis to the study of different classes of algae and bryophytes giving importance to their characteristic features, diversity and economic importance. In the practical classes of this course, 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

PHYCOLOGY (Theory 36 hrs; Practical 27hrs)

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 N_2 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.

PRACTICAL (27 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 (Theory 18 hrs; Practical 9 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.

PRACTICAL (9 hrs)

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

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COURSE COMPETENCIES

- Help the learner to understand the diversity in habit, habitat and organization of the Algae and Bryophytes
- Develop knowledge regarding the characters of the lower groups of plants and their diversity
- Analyzes the anatomical features of the various parts of these plants
- Learns the ecological adaptations of Algae and Bryophytes to their habitats
- Gains knowledge on the reproductive features of these lower groups
- Relates the evolutionary trends among these groups of plants.
- Help them to acquaint with the economic importance of the lower forms of plants and their role in our daily life.

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B. Sc. Semester III - Core Course 3

Course Code: BO3B03B18
Course Title: Phycology and Bryology

Modules	Hours	PART A (Short Answer) 1 Mark 10/12	PART B (Short Essay) 5 Marks 6/9	PART C (Essay/Problem) 10 Marks 2/4	Total Marks
1	9	2	1	1	17
2	18	4	3	1	29
3	9	2	2	1	22
4	6	1	1	-	6
5	12	3	2	1	23

SEMESTER IV

CORE COURSE 4

COURSE CODE: BO4B04B18

COURSE TITLE: PTERIDOLOGY, GYMNOSPERMS AND PALEOBOTANY

(Theory 54 hrs; Practical 36 hrs; Credits 3 + 1)

Aim

- Understand the diversity in habits, habitats and organization of various groups of plants.
- To impart an insight into the modern classifications in lower forms of plants.
- Understand the evolutionary trends in Pteridophytes and Gymnosperms.
- Study the anatomical variations in vascular plants.
- Understand the significance of Paleobotany and its applications.

Course Overview and Context

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.

PTERIDOLOGY (Theory 27 hrs; Practical 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 a*l., 2011.

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.

PRACTICAL (27 hrs)

Habit, TS of stem, morphology of the strobilus of the following types:
Psilotum, Lycopodium, Selaginella, Equisetum, Pteris, Marsilea.

GYMNOSPERMS (Theory 18 hrs; Practical 9 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.

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.

PRACTICAL (9 hrs)

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.*

PALEOBOTANY (Theory 9 hrs)

Module 5: Fossils and Paleobotany in India

Introduction to paleobotany and its significance. Fossil formation, types of fossils. Evolutionary history of Biological diversity – fossil record; geological time scale – major events in each era. Study of fossil Bryophyte - *Naiadita lanceolata;* fossil Pteridophytes – *Rhynia, Calamites;* fossil Gymnosperm – *Williamsonia.* Applied aspects of Paleobotany - exploration of fossil fuels.

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

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COURSE COMPETENCIES

- Learner understands the diversity in habit, habitat and organization of Pteridophytes and Gymnosperms.
- Analyzes the anatomical features of the various parts of these plants.
- Learns the ecological adaptations of Pteridophytes and Gymnosperms to their habitats.
- Gains knowledge on the reproductive features of these groups.
- Relates the evolutionary trends among these groups of plants.
- Helps to study the morphological, anatomical and reproductive characters of various types, their phylogeny and affinities.
- Enables students to learn the aspects of fossils, their formation and significance.
- Helps to understand the various theories that explain the processes of evolution.
- Makes students aware about the modern theories and aspects of evolutionary process.

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B.SC. IV Semester - Core Course 4

Course Code:BO4B04B18

Course Title: Pteridology, Gymnosperms and Paleobotany

Modules	**Hours**	**PART A (Short Answer) 1 Mark 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 10 Marks 2/4**	**Total Marks**
1	23	4	2	2	34
2	4	1	1	-	6
3	16	4	3	1	29
4	2	1	1	-	6
5	9	2	2	1	22

SEMESTER V
CORE COURSE 5
COURSE CODE: BO5B05B18
COURSE TITLE: ENVIRONMENTAL SCIENCE AND HUMAN RIGHTS
(Theory 54 hrs; Practical 36 hrs; Credits 3 + 1)

Aim

- Acquaint the student with the significance of Environmental Science.
- Make the students aware about the extent of the total biodiversity and the importance of their conservation.
- Help the student to design novel mechanisms for the sustainable utilization of natural resources.
- Enable the students to understand the structure and function of the ecosystems.
- Enable the students to understand various kinds of pollution in the environment, their impacts on the ecosystem and their control measures.
- Make the students aware about various environmental laws in India and the role of various movements in the protection of nature and natural resources.

Course Overview and Context

Through this course the students will be acquainted with the significance of Environmental Science. It will help the students to develop an awareness regarding the structure and functions of ecosystem, ecological energetics and various biogeochemical cycles. It will help to create awareness regarding the importance of conservation of nature and natural resources, the threat of depletion of natural resources and to design novel mechanisms for the sustainable utilization of natural resources. Enables the students to learn about the types of interactions among populations in the ecosystems. It will help the students to identify various types of plant groups, the environmental factors affecting their growth performances and their adaptive features

ENVIRONMENTAL SCIENCE (48 hrs)

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 N_2.
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 (10 hrs)

Global conservation efforts - Rio Earth summit - Agenda 21, Kyoto protocol, COP15 (15^{th} Conference 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].

Module 5: HUMAN RIGHTS (6 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.

Environment and human rights: right to clean environment and public safety; issues of industrial pollution; prevention, rehabilitation and safety aspect of new technologies such as chemical and nuclear technologies, issues of waste disposal, protection of environment. Conservation of natural resources and human rights: reports, case studies and policy formulation. Conservation issues of Western Ghats – Madhav Gadgil committee report, Kasturi Rangan report. Over-exploitation of ground water resources, marine fisheries, sand mining *etc.*

PRACTICAL (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.

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COURSE COMPETENCIES

- To make the students understand the significance of Environmental Science.
- Develop awareness regarding the structure and functions of ecosystem and ecological energetics.
- Create awareness regarding the importance of conservation of nature and natural resources.
- Design novel mechanisms for the sustainable utilization of natural resources.
- Learn about the types of interactions among populations in the ecosystems.
- Identify various types of plant groups, the environmental factors affecting their growth performances and their adaptive features.

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B.Sc. Semester V
Core Course 5
Course Code: BO5B05B18
Course Title: Environmental Science and Human Rights

Module	**Hours**	**PART A (Short Answer) 1 Mark 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 10 Marks 2/4**	**Total Marks**
1	18	4	3	1	29
2	10	3	2	1	23
3	10	2	2	1	22
4	10	2	1	-	7
5	6	1	1	1	16

SEMESTER V

CORE COURSE 6
COURSE CODE: BO5B06B18
COURSE TITLE: RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

(Theory: 54 hrs; Practical: 45 hrs; Credits: 3 + 1)

Aim

- To equip the students to conduct independent research and prepare researchreports.
- To make the students acquaint with different tools and techniques used in researchwork.
- To equip the students with basic computer skills necessary for conductingresearch.
- To enable the students to have enough numerical skills necessary to carry outresearch.

Course overview and Context

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

RESEARCH METHODOLOGY (**Theory 18 hrs; Practical 18 hrs)**

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

Objectives of research. Types of research - pure and applied. Identification of research problem. Review of literature: purpose, literature sources – names of reputed National and International journals in life science (2 international & 3 national); reprint acquisition - INSDOC, INFLIBNET.

Process of research: Conducting research: define the problem, identify the objective, design the study, collection of data, analysis and interpretation. Preparation of research report: preparation of dissertation - IMRAD system - preliminary pages, introduction and review of literature, materials and methods, results, discussion, conclusion and bibliography.

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.

PRACTICAL (18 hrs)

1. Prepare outline of a dissertation (IMRADsystem).
2. Prepare a list of References (not less than 10) on a topic in biologicalscience.
3. Review the literature on a giventopic.
4. Collect information on a topic related to biological science using theinternet.
5. Make a report based on the collected information from the internet (usingMS-WORD).
6. Prepare tables/charts/graphs usingEXCEL.
7. Prepare a worksheet using a set of data collected and find out theSUM.
8. Prepare a PowerPoint presentation based on the report in Experiment4.

BIOPHYSICS (Theory 18 hrs; Practical 9 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.

PRACTICAL (9 hrs)

1. Measurement of pH and adjusting pH using pH meter.
2. Separation of plant pigments using TLC.
3. Determination of the concentration of a sample solution using colorimeter.
4. Demonstration of column chromatography.
5. Count the number of cells/spores using Haemocytometer.

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BIOSTATISTICS (Theory 18 hrs; Practical 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 graphic 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-squire test - uses, procedure.

PRACTICAL (18 hrs)

1. Collect numerical data, tabulate and represent in different types of graphs and diagrams mentioned in the syllabus.
2. Problems related to mean, median, mode, standard deviation and Chi-square test.

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COURSE COMPETENCIES

- Understand the importance and scope of scientific research
- Develop interest in scientific research
- Skill in practical work, experiments, handling equipments and laboratory tools
- Expertise in computer applications
- Attain knowledge in collection and interpretation of biological data
- Expertise in data analysis by using different statistical tools and techniques

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B. SC. Semester V - Core Course 6

Course Code: BO5B06B18
Course Title: Research Methodology, Biophysics and Biostatistics

Modules	Hours	PART A (Short Answer) 1 Mark 10/12	PART B (Short Essay) 5 Marks 6/9	PART C (Essay/Problem) 10 Marks 2/4	Total Marks
1	11	3	2	2	33
2	7	2	1	-	7
3	2	1	1	-	6
4	16	3	2	1	23
5	18	3	3	1	28

SEMESTER V
CORE COURSE 7
COURSE CODE: BO5B07B18
COURSE TITLE: PLANT PHYSIOLOGY AND BIOCHEMISTRY
(Theory 54 hrs; Practical 45 hrs; Credits 3 + 1)

Aim

- Acquire basic knowledge needed for proper understanding of plant functioning.
- Familiarize with the basic skills and techniques related to plant physiology.
- Understand the role, structure and importance of the bio molecules associated with plant life.

Course Overview and Context

This course examines the core concepts of mineral nutrition, photosynthesis, translocation of solutes, respiration and mechanism of absorption in plants. It goes on to explore the physiology of growth and development. The context is also to introduce the students to biochemistry and the role of biological molecules.

PLANT PHYSIOLOGY (Theory 36 hrs; Practical 27 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 - kranz 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.

PRACTICAL (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 phytosynthesis.
5. Simple respiroscope.
6. Respirometer and measurement of RQ.
7. Fermentation.
8. Measurement of transpiration rate using Ganong's potometer/Farmer's potometer.

BIOCHEMISTRY (Theory 18 hrs; Practical 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.

PRACTICAL (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.

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COURSE COMPETENCIES

- Understand the basic principles and metabolism related to various physiological functions in plant life.

- Familiarize with the basic skills and techniques related to doing experiments in plant physiology.
- Understand the role, structure and importance of the bio molecules associated with plant life.
- Familiarize with the recent trends in the field of plant physiology.
- Apply the knowledge of physiology in other fields like agriculture and career prospects.

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B. Sc. V Semester Core Course 7
Course Code: BO5B07B18
Course Title: Plant Physiology and Biochemistry

Modules	Hours	PART A (Short Answer) 1 Mark 10/12	PART B (Short essay) 5 Marks 6/9	PART C (Essay/Problem) 10 Marks 2/4	Total Marks
1	9	1	1	1	16
2	20	4	3	1	29
3	7	3	1	1	18
4	3	1	1	-	6
5	15	3	3	1	28

SEMESTER V
CORE COURSE 8
COURSE CODE: BO5B08B18
COURSE TITLE: ANATOMY, REPRODUCTIVE BOTANY AND MICROTECHNIQUE
(Theory 54 hrs; Practical 36 hrs; Credits 3 + 1)

Aim

- Imparting an insight into the internal structure and reproduction of Angiosperms.
- Understand the individual cells and also tissues simultaneously
- Understand the structural adaptations in plants growing in different environment.
- Understand the morphology and development of reproductive parts.
- Get an insight in to the fruit and seed development.
- Understand the techniques used to preserve and study plant materials.

Course Overview and Context

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. It also covers the aspects of plant reproduction and development enhancing the ability of the student to analyze the relationship between structure and function in plants at different organizational levels. The biological techniques that are utilized for the effective study of plant tissues and their preservation are also emphasized.

ANATOMY (Theory: 27 hrs. Practical: 18 hrs)

Module 1: Structure and Composition of Plant Cells and Organization of Tissues (17 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. Non-living inclusions in plant cells: food products, secretory products, excretory (waste) products - nitrogenous and non nitrogenous.

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.

Tissue systems: epidermal tissue system - epidermis, cuticle, trichome; stomata – structure, types; bulliform cells. Ground tissue system - cortex, endodermis, pericycle, pith and pith rays. Vascular tissue system - structure of xylem and phloem, different types of vascular bundles and their arrangement in root and stem. .

Module 2: Plant Body Structure and Wood Anatomy (10 hrs)

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

PRACTICAL (18 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.
4. Dissect and identify the stomatal types - anomocytic, anisocytic, paracytic and diacytic.
5. Secondary structure of dicot stem and root (papaya root).
6. Anomalous secondary structure of *Bignonia* stem, *Boerhaavia* stem, and *Dracaena* stem.

REPRODUCTIVE BOTANY (Theory 18 hrs; Practical 9 hrs)

Module 3: 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 4: 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 and development of dicot and monocot embryo, seed formation. Polyembryony.

PRACTICAL (9 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.

MICROTECHNIQUE (Theory 9 hrs; Practical 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 section; 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.

PRACTICAL (9 hrs)

1. Familiarize preparation and use of stains, fixatives and mounting media.
2. Preparation of smears and squash.
3. Demonstration of microtome sectioning.
4. Maceration and identification of tracheary elements.
5. Preparation of single stained hand sections (Permanent – demonstration only).

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COURSE COMPETENCIES

- Students understand the structure of the plant cell and the cell wall and nature and importance of the non-living inclusions in the cell.
- Enables students to identify the various tissues and tissue systems in plants and recognize their role in plant growth and development.
- Students are able to identify and differentiate monocots, dicots and plants with normal and anomalous secondary growth based on the anatomical features.
- The students gain knowledge on the reproductive development and life cycle of plants, the methods of pollination, fertilization, development of embryo and seed germination.
- Develop awareness about killing fixing, staining, dehydration, clearing, embedding and sectioning; whole mounts and specimen preparation for electron microscopy.

BLUEPRINT

B. Sc. V Semester Core Course 8
Course Code: BO5B08B18
Course Title: Anatomy, Reproductive Botany and Microtechnique

Modules	**Hours**	**PART A (Short Answer) 1 mark 10/12**	**PART B (Short Essay) 5 marks 6/9**	**PART C (Essay/Problem) 10 marks 2/4**	**Total Marks**
1	17	3	3	1	28
2	10	2	2	1	22
3	12	3	2	1	23
4	6	1	1	-	6
5	9	3	1	1	18

OPEN COURSES FOR OTHER STREAMS

SEMETER V
OPEN COURSE 1
COURSE CODE: BO5D01aB18
COURSE TITLE: HORTICULTURE AND NURSERY MANAGEMENT
(Theory 72 hrs; Credits 3)

Aim

- Understand the importance of horticulture in human welfare.
- Introduce the learners to the art of gardening, soil management, plant propagation methods, irrigation and plant protection measures.
- Develop competency in the various aspects of gardening, vegetable, fruit and flower cultivation techniques, marketing procedures and enable them to apply this science for the betterment of human life.
- Understand the propagation and cultural practices of useful vegetable, fruit and garden plants.
- Understand the impact of modern technologies in biology on horticultural plants.
- Understand the basic concepts of landscaping and garden designing.
- Inculcate interest in landscaping, gardening and flower and fruit culture.

Course Overview and Context

This course is focused to understand the significance of horticulture and nursery industry in human welfare. It provides deep knowledge regarding growing of plants on commercial scale, processing and marketing of plant products. The course also gives emphasis to the study the art and principles of establishing outdoor and indoor gardens, the various components of gardening, landscaping and its significance and beautification of public places and home gardens. The on hand training programme enables them to handle various garden tools, know in detail about soil and its characteristics, planting and propagation methods and develop practical skills to apply these techniques for betterment of society.

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.

Floriculture: Introduction, commercial floriculture - jasmine, orchid, anthurium, rose, gladiolus; 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; cultivation practices of leafy vegetable (Amarathus), tuber (Potato), fruit (Tomato), flower (Cauliflower).

Pomology: Pomology - cultivation of fruit crops - mango, banana and pine apple - 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.

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; equipments used in controlling horticultural pests - sprayers, dusting equipments - 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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COURSE COMPETENCIES

- Help in acquainting the students with scope and branches of horticulture, soil and management of soil.
- Develop knowledge regarding the various methods of plant propagation.
- Create awareness regarding gardening techniques, cultivation of flowers on commercial basis, flower arrangement and principles of landscaping and its importance in society.
- Acquire knowledge regarding the cultivation, preservation and marketing of vegetables and fruits and their products.
- Know the various plant protection measures and application of agrochemicals.

BLUE PRINT

B.SC. V Semester - Open Course

Course Code: BO5D01aB18

Course Title: Horticulture and Nursery Management

Modules	**Hours**	**PART A (Short Answer) 2 Marks 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 15 Marks 2/4**	**Total Marks**
1	10	2	1	1	24
2	10	3	2	1	31
3	24	3	3	1	36
4	4	2	2	-	14
5	6	2	1	1	24

B.Sc. PROGRAMME-BOTANY OPEN COURSE

COURSE CODE: BO5D01aB18

HORTICULTURE AND NURSERY MANAGEMENT

QUESTION PAPER

V Semester CBCSS Examination

Time: 3 Hrs **Total Marks: 80**

PART A

(Answer any 10 questions. Each question carries 2 marks)

1. Explain soil texture.
2. Write the various disciplines of horticulture.
3. Describe how a seed bed is prepared.
4. What is seed testing?
5. What are the advantages of seed propagation?
6. Write on garden adornments.
7. Differentiate hedges and edges with examples.
8. What are the differences between topiary and trophy?
9. Comment on pathogenic fungi.
10. What are fungicides? Give an example.
11. What is a fernery?
12. Comment on arboretum.

(10 x 2=20 marks)

PART B

(Answer any 6 questions. Each question carries 5 marks)

13. Differentiate manures and biofertilizers.
14. Explain micropropagation and its significance.
15. What is seed dormancy? What are the factors causing seed dormancy?
16. Give a short account on kitchen garden.
17. Explain the hazards of chemical pesticides.
18. Write an account on biological control.
19. What are the different types of nurseries?
20. Explain indoor gardening.
21. What are the steps involved in the maintenance of lawn?

(6x 5 = 30 marks)

PART C

(Answer any 2 questions. Each question carries 15 marks)

22. Describe the various methods of irrigation.

23. With suitable examples and diagram explain the various methods of vegetative propagation.
24. Write an essay on landscape gardening.
25. Give an account on plant growing structures and their significance

(2 x 15 = 30 marks)

SEMESTER V
OPEN COURSE 2
COURSE CODE: BO5D01bB18
COURSE TITLE: AGRIBASED MICROENTERPRISES
(Theory 72 hrs; Credits 3)

Aim

- Provide basic information about the business opportunities in plant sciences.
- Inform the student about sustainable agriculture and organic farming.
- Inculcate an enthusiasm and awareness about ornamental gardening, nursery management and mushroom cultivation.
- Enable the learner to understand the basics of entrepreneurship.
- Develop competency in composting techniques and sustainable agriculture.
- Introduce the learners to the principles of agribusiness.
- Give proper understanding of the need for sustainable development and organic farming.
- Impart competency to apply the business opportunities in the field of plant sciences.

Course Overview and Context

This course examines the core basic 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.

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.

ON HAND TRAINING (18 hrs)

1. Prepare a chart showing the NPK composition of minimum 6 manures and fertilizers.
2. Identification and familiarization of the following organic manures: cow dung (dry), coconut cake, vermicompost, neem cake, organic mixture, bone meal.
3. Preparation of potting mixture.
4. Make a vermicompost pit /pot in the campus/ house of the student.
5. Familiarization of common garden tools and implements.
6. Estimation of germination percentage of seeds
7. Demonstrate the effect of a rooting hormone on stem cutting.
8. Demonstration of T-budding and air layering on live plants.
9.
10. Familiarization of garden components from photographs.
11. Preparation of vinegar/dairy product (any two) in class or home.
12. Familiarization of different mushrooms and preparation of a polybag of *Pleurotus* using straw/sawdust.
13. Visit to a well-established tissue culture lab, nursery and mushroom cultivation unit.

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COURSE COMPETENCIES

- Develop an entrepreneurial mindset and also to stick on to the core subject among the botany students.
- Imparts idea about the need of sustainable development and organic farming.
- Render students to explore the potentialities of organic farming in the current scenario.
- Inculcate and impart an idea about the business opportunities in the field of plant sciences.
- Understand the techniques of mushroom cultivation and tissue culture to initiate small scale industries.

SEMESTER V
OPEN COURSE 3
COURSE CODE: BO5D01cB18
COURSE TITLE: ECOTOURISM
(Theory 72 hrs; Credits 3)

Aim

- Make the students to opt various ecotourism programs in the self-employment stream
- Make the students aware of the usefulness of ecotourism in the conservation of natural resources.
- Help the students to assess various ecotourism programs
- Learn to respect nature and natural resources and how these can be sustainably utilized and managed for the future generation
- Create awareness regarding environmental protection is the most important objective of the course.

Course Overview and Context

This course deals with the significance of environment. Proper protection and management of nature and natural resources is dealt in detail. How a stabilized ecosystem controls the proper functioning of the whole biosphere is explored in the course. Environmental degradation caused by human beings, global environmental problems and climate change are also dealt in detail. The need for proper management of natural recourses for sustainable development is clearly revealed through this course

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, cultural diversity, 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, reaches, 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 eco travel, 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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COURSE COMPETENCIES

- Students will be acquainted with the significance of Environmental Science.
- Create awareness regarding the importance of conservation of nature and natural resources.
- Enables students to learn about the types of interactions among populations in the ecosystem.
- Design novel mechanisms for the sustainable utilization of natural resources.

SEMESTER VI
CORE COURSE 9
COURSE CODE: BO6B09B18
COURSE TITLE: GENETICS, PLANT BREEDING AND HORTICULTURE
(Theory 54 hrs; Practical 45 hrs; Credits 3 + 1)

Aim

- Impart an insight into the principles of heredity
- Understand the patterns of inheritance in different organisms
- Understand the inheritance pattern of nuclear and extra nuclear genes
- Understand the methods of crop improvement and plant breeding.
- Understand the importance of horticulture in human welfare and its various disciplines.
- Develop skill in gardening technique among students
- Develop competency in plant propagation and cultivation techniques of fruits, vegetables and ornamental plants.

Course Overview and Context

This course elucidates the principles of genetics 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. The course also examines the core concepts, objectives of plant breeding and methods of breeding self and cross pollinated plants. It goes on to explore achievements of breeding methods for crop improvement. The learner is introduced to the various disciplines of horticulture, gardens, cultivation of vegetables, fruits and ornamental plants and its prospects.

GENETICS (Theory 27 hrs; Practical 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 (14 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).

PRACTICAL (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 (Theory 13 hrs; Practical 9 hrs)

Module 3: Plant Breeding and Techniques for Plant Improvement (13 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.

PRACTICAL (9 hrs)

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

HORTICULTURE (Theory 14 hrs; Practical 18 hrs)

Module 4: Introduction to Horticulture and Plant Propagation Techniques (8 hrs)

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.

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.

Module 5: Gardening (6 hrs)

Types of garden: 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.

PRACTICAL (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.

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COURSE COMPETENCIES

- Demonstrates Mendelian principles and analyzes the basic principles of heredity.
- Understands the inheritance pattern of nuclear and extra nuclear genes.
- Understands the basic principles of plant breeding.
- Identifies the breeding methods of crop improvement for sustainable development.
- Acquires the theoretical knowledge and practical skills about plant breeding techniques.
- Understands the importance of horticulture in human welfare.
- Implements the knowledge of horticulture in their career prospects

BLUE PRINT

B.SC. VI Semester - Core Course 9
Course Code: BO6B09B18
Course Title: Genetics, Plant Breeding and Horticulture

Modules	**Hours**	**PART A (Short Answer) 1 Mark 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 10 Marks 2/4**	**Total Marks**
1	13	2	2	-	12
2	14	3	2	1	23
3	13	3	1	1	18
4	8	2	2	1	22
5	6	2	2	1	22

SEMESTER VI
CORE COURSE 10
COURSE CODE: BO6B10B18
COURSE TITLE: CELL AND MOLECULAR BIOLOGY
(Theory 54 hrs; Practical 36 hrs; Credits 3 + 1)

Aim

- Understand the ultra-structure and functioning of cell at the sub-microscopic and molecular level.
- Understand the origin, concept of continuity and complexity of life activities.
- Familiarization of life processes.
- Understand the basic and scientific aspect of diversity.
- Understand the cytological aspects of growth and development.
- Understand DNA as the basis of heredity and variation.

Course Overview and Context

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 understand that physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes.

CELL BIOLOGY (Theory 27 hrs; Practical 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.

PRACTICAL (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 (Theory 27 hrs; Practical 9 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.

PRACTICAL (9 hrs)

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

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COURSE COMPETENCIES

- Acquainted with the ultra-structure and functioning of cell at the submicroscopic and molecular level.
- Recognizes the cytological aspects of growth and development.
- Identifies DNA as the basis of heredity and variation.
- Demonstrates Mendelian principles and analyzes the basic principles of heredity.
- Understands the inheritance pattern of nuclear and extra nuclear genes.

BLUEPRINT

B. Sc. VI Semester Core Course 10
Course Code: BO6B10B18
Course Title: Cell and Molecular Biology

Modules	**Hours**	**PART A (Short Answer) 1 Mark 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 10 Marks 2/4**	**Total Marks**
1	14	3	2	-	13
2	6	1	1	1	16
3	7	1	1	1	16
4	12	3	2	1	23
5	15	4	3	1	29

SEMESTER VI
CORE COURSE 11
COURSE CODE: BO6B11B18
COURSE TITLE: ANGIOSPERM MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

(Theory 72 hrs; Practical 45 hrs; Credits 3 + 1)

Aim

- Acquaint with the aims, objectives and significance of taxonomy.
- Identify the common species of plants growing in Kerala and their systematic position.
- Develop inductive and deductive reasoning ability.
- Acquaint with the basic technique in the preparation of herbarium.
- Familiarizing with the plants having immense economic importance.

Course Overview and Context

To make the leaner understand the aims, objectives and significance of taxonomy thereby identifies the common species of plants growing in Kerala and their systematic position. To learn about the preparation of herbarium. To make them aware of economically important products from the plants with their source and to explore the hidden potentialities of various underutilized plants by applying the principles of ethnobotany.

ANGIOSPERM MORPHOLOGY

Module 1: Leaf, Inflorescence and Fruit Morphology (19 hrs)

Leaf Morphology: types, venation, phyllotaxy. Morphology of flower: flower as modified shoot; detailed structure of flowers - floral parts - their arrangement, relative position - symmetry, aestivation and placentation types - cohesion and adhesion. Floral diagram and floral formula. Inflorescence: racemose types - simple raceme, corymb, umbel, spike, spadix, head and catkin; cymose types - simple cyme; monochasial - scorpoid and helicoid, dichasial and polychasial; special type - cyathium, hypanthodium, verticillaster, thyrsus and panicle. Fruits: simple - fleshy, dry - dehiscent, schizocarpic, indehiscent, aggregate, multiple (sorosis andsyconus).

TAXONOMY

Module 2: 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).Plant nomenclature - binomial, ICBN/ICN principles - rule of priority and author citation. Interdiciplinary approach in taxonomy -

Cytotaxonomy and Chemotaxonomy. Herbarium technique – importance of herbarium; preparation of herbarium and their preservation.Important herbaria in India, BSI.

Module 3: Detailed Study of Families (30 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 (Mimosaceae, Caesalpiniaceae and Fabaceae), Combretaceae, Myrtaceae, Cucurbitaceae, Umbelliferae (Apiaceae), Rubiaceae, Compositae (Asteraceae), Sapotaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Convolvulaceae, Scrophulariaceae, Acanthaceae, Verbenaceae, Labiatae (Lamiaceae), Amaranthaceae, Euphorbiaceae, Orchidaceae, Palmae (Arecaceae), Graminae (Poaceae).

ECONOMIC BOTANY AND ETHNOBOTANY

Module 4: Economic Botany (6 hrs)

Study the following groups of plants with special reference to the botanical name, family and morphology of the useful part and uses: Cereals - Rice, Wheat; Millets Ragi; Pulses - Green gram, Bengal gram, Black gram; Sugar yielding plants – Sugarcane; Fruits - Apple, Pineapple, Orange, Mango and Banana; Vegetables - Bittergourd, Ladies finger, Carrot and Cabbage; Tuber crops - Tapioca; Beverages - Tea, Coffee; Oil yielding plants - Ground nut, Coconut, Gingelly; Spices – Cardamom, Pepper, Cloves, Ginger; Timber yielding plants - Teak wood and Rose wood; Fibre yielding plants - Coir, Jute, Cotton; Rubber yielding plants - Para rubber; Gums and Resins - White damer, Gum Arabic, Asafoetida; Insecticide yielding Plants - Tobacco and Neem.

Module 5: Ethnobotany (5 hrs)

Introduction, scope and significance of ethnobotany. Study of the following plants used in daily life by tribals and village folks for food, shelter and medicine: Food – *Artocarpus*

heterophylla, *Corypha*; Shelter - *Bambusa*, *Ochlandra* and *Calamus*; Medicine – *Curcuma longa*, *Trichopus zeylanicus* and *Alpinia galanga.*

PRACTICAL (45 hrs)

1. Identify the following inflorescence and fruits with reference to their morphological specialities: (a) Inflorescence - simple raceme, spike, corymb, head, simple cyme, cyathium and hypanthodium. (b) Fruits - simple - (fleshy) - berry drupe, pepo, hespiridium. Dry indehiscent - nut. Dry dehiscent - legume, capsule (loculicidal), aggregate.
2. Preparation of floral formula and floral diagram from floral description (of families studied).
3. Identify the families mentioned in the syllabus by noting their vegetative and floral characters.
4. Students must describe the floral parts, draw the L.S., floral diagram and write the floral formula of at least one flower from each family.
5. Prepare herbarium of 25 plants with field notes.
6. Conduct field work for a period of not less than 3 days under the guidance of a teacher and submit field report.
7. 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.
8. Identify and describe the ethnobotanical uses of the items mentioned in the syllabus.

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COURSE COMPETENCIES

- Learner understands the aims, objectives and significance of taxonomy.
- Identifies the common species of plants growing in Kerala and their systematic position.
- Demonstrates skill in the preparation of herbarium.
- Relates the economically important products from the plants with their source.
- Students are able to explore the hidden potentialities of various underutilized plants by applying the principles of ethnobotany

BLUEPRINT

B.Sc. VI Semester- Core Course 11
Course Code: BO6B11B18
Course Title: Angiosperm Morphology, Taxonomy and Economic Botany

Module	**Hours**	**PART A (Short Answer) 1 Mark 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 10 Marks 2/4**	**Total Marks**
1	19	4	3	1	29
2	12	1	1	1	16
3	30	5	3	1	25
4	6	1	1	1	16
5	5	1	1	-	6

SEMESTER VI
CORE COURSE 12
COURSE CODE: BO6B12B18
BIOTECHNOLOGY AND BIOINFORMATICS
(Theory 54 hrs; Practical 36 hrs; Credits 3 + 1)

Aim

- To understand the current developments in the field of biotechnology and bioinformatics.
- Equip the students to carry out plant tissue culture.
- Introduce the vast repositories of biological data knowledge.
- Equip to access and analyze the data available in the databases.

Course Overview and Context

This course examines the core concepts of biotechnology. It goes on to explore the principles and techniques plant tissue culture, recombinant DNA technology. 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.

BIOTECHNOLOGY

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 – de differentiation and re - differentiation. 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, M13, bacteriophage based vectors, Ti plasmids, YAC, BAC. Restriction enzymes- exonucleases, endonuclease. Ligases – ligation mechanism, transformation and selection of transformants – using antibiotic resistances markers. Different methods of gene transfer – chemically stimulated DNA uptake by protoplast, transduction, electroporation, microinjection, microprojectiles, Agrobacterium mediated gene transfer, 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

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 visualisation 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.*

PRACTICAL (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).
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).

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COURSE COMPETENCIES

- Understand the fundamental principles of biotechnology, various developments in biotechnology and potential applications.
- Make aware that the life forms and activities can be exploited for human advancement.
- Impart an introductory knowledge about bio informatics to the students.
- Use computers to handle biological data base.
- Familiarize with the different data banks mentioned in the syllabus.

BLUEPRINT

B.Sc. VI Semester - Core Course 12
Course Code:BO6B12B18
Course Title: Biotechnology and Bioinformatics

Module	**Hours**	**PART A (Short Answer) 1 Mark 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 10 Marks 2/4**	**Total Marks**
1	20	4	3	1	29
2	11	3	2	1	23
3	5	-	1	-	5
4	7	2	1	1	17
5	11	3	2	1	23

CHOICE BASED COURSES
FOR
BOTANY CORE

SEMESTER VI
PROGRAMME ELECTIVE
COURSE CODE: BO6B13aB18
COURSE TITLE: PHYTOCHEMISTRY AND PHARMACOGNOSY
(Theory: 54 hours; Credit 3)

Aim

- Introduce the learners to the principles of phytochemistry and to familiarize them with the common separation and characterization techniques used in phytochemistry.
- Make the learners understand the structure and function of basic secondary metabolites in medicinal and aromatic plants.
- Give them understanding regarding the officinal parts present in the common medicinal plants and their use in Ayurvedic formulations.
- Make the learners competent to apply the knowledge of Ayurveda as an effective system of medicine.

Course Overview and Context

This course examines the core phytochemical and pharmacognostic approaches existing in traditional systems of medicine. 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. Overall the learners will get an awareness regarding the immense medicinal treasures lying hidden in the plant wealth.

PHYTOCHEMISTRY

Module 1: Introduction (2 hrs)

Introduction to phytochemical approaches: morphological, organoleptic, microscopic - to study drug and aromatic plants. Definition of Ayurveda plants and 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 somnifera, Aloe vera, Ricinus communis, Glycirrhiza 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 zeylanica, Syzygium aromaticum, Santalum album, Eucalyptus globulus, Ocimum basilicum, Rosa, Mentha piperita, Cymbopogon citrates, Cananga odorata, Pelargonium*

PHARMACOGNOSY

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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COURSE COMPETENCIES

- Understand the structure and function of basic secondary metabolites in medicinal and aromatic plants.
- Familiarize with the common separation and characterization techniques used in phytochemistry.
- Understand the basic officinal part present in the common medical plants and their use in ayurvedic formulations.
- Knowledge of Ayurveda as an effective system of medicine.
- Preparation of a home garden with medicinal plants.

BLUEPRINT

B.Sc. VI Semester – Choice Based Core Course(Botany)
Programme Elective Course
Course Code: BO6B13aB18
Course Title: Phytochemistry and Pharmacognosy

Modules	**Hours**	**PART A (Short Answer) 2 Marks 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 15 Marks 2/4**	**Total Marks**
1	2	2	-	-	4
2	14	3	3	1	36
3	20	3	2	1	31
4	10	2	2	-	14
5	8	2	2	2	44

B Sc PROGRAMME-BOTANY CORE COURSE

CODE: BO6B13aB18

PHYTOCHEMISTRY AND PHARMACOGNOSY

MODEL QUESTION PAPER

VI Semester CBCSS Examination

Time: 3 Hrs **Total Marks: 80**

PART A

(Answer any 10 questions. Each question carries 2 marks)

1. What is meant by organoleptic evaluation?
2. Define palisade ratio.
3. Expand HPTLC.
4. Example of an alkaloid.
5. Name any one separation technique.
6. Binomial of Aswagandha
7. Which is the family of *Tinospora cordifolia*?
8. Name any one active principle of *Sida acuta.*
9. Mention any one species of Rosa with medicinal importance.
10. What is meant by cohobation?
11. Give an example of a compound starch grain
12. What is meant by unorganized drug?

(10 x 2=20 marks)

PART B

(Answer any 6 questions. Each question carries 5 marks)

13. Describe IR spectra characterization.
14. Explain the method of cold extraction.
15. Give an account on classification of alkaloids.
16. Describe the phytochemistry and pharmacological action of *Aegle marmelos* and *Tinospora cordifolia.*
17. Explain the organoleptic features of the officinal parts of *Papaver somnifera* and *Acacia catechu* and chemical tests to identify them.
18. Discuss Enfleurage.
19. Write notes on phytonic process and supercritical fluid extraction.
20. Give an account on Jeevani-Pushpangadan model of benefit sharing.
21. Taking Taxol as example, explain the process of modern drug discovery using ethnopharmacology.

(6x 5 = 30 marks)

PART C

(Answer any 2 questions. Each question carries 15 marks)

22. Write an essay on the properties, classification and functions of Triterpenoids.
23. Give an account on the habit, habitat, systematic position, medicinal uses and morphology of the useful part of the following plants:
    a) *Acorus calamus.*
    b) *Datura stramoinium.*
    c) *Azadirachta indica.*
24. Write an essay on the classification of crude drugs.
25. Describe the various types of drug adulteration.

(2 x 15 = 30 marks)

B Sc PROGRAMME-BOTANY CORE COURSE
COURSE CODE: BO6B13bB18
COUSE TITLE: AGRIBUSINESS
VI SEMESTER CBCSS EXAMINATION
(Theory 54 hours; Credit 3)

Aim

- Inculcate and impart an idea about the business opportunities in the field of plant sciences.
- Develop an entrepreneurial mindset and also to stick on to the core subject among the Botany students.
- Give an idea about the need of sustainable development and organic farming.
- Harness the opportunities and potentials in the field of ecotourism, processing technology and food sciences.

Course Overview and Context

This course examines the entrepreneurship opportunities in the field of agribusiness. It gives an idea on the various value added products and their processing techniques. Various openings in agribusiness such as nursery management, floriculture, apiculture, mushroom cultivation, etc., will be familiarized to the students. Awareness will be created about flower arrangement and ornamental garden designing. The course will help the students to get an insight regarding the various aspects of Agribusiness.

Module 1: Entrepreneurship (2 hrs)

Basic 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.

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, dairy products - cheese, butter, yoghurt, paneer.

Processing techniques- Processing of latex: centrifuged latex products and galvanized rubber products. Processing, storage and marketing of Cocoa, Coconut (Copra ,Coir and

Tender coconut), Rice (par boiled, raw rice and rice 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 andpests.

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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COURSE COMPETENCIES

- Inculcate and impart an idea about the business opportunities in the field of plant sciences.
- Develop an entrepreneurial mindset and also to stick on to the core subject among the botany students.
- Give an idea about the need of sustainable development and organic farming.
- Harness the opportunities and potentials in the field of ecotourism, processing technology and food sciences.
- Help the students to explore the potentialities of organic farming in the current scenario.

B SC. PROGRAMME-BOTANY CORE COURSE
COURSE CODE: BO6B13cB18
COURSE TITLE: PLANT GENETIC RESOURCES MANAGEMENT
VI Semester CBCSS Examination
(Theory 54 hours; Credit 3)

Aim

- Acquaint the student with the history and evolution of crop plants, and their diversity.
- Familiarize the student with the available plant genetic wealth and the measures adopted for the conservation of these resources.
- Help the student to identify the crop plants and their wild relatives.
- Help the student to explore the potentialities of various underutilized plants to project as the future food prospects.
- Understand the significance of modern technology to locate the distribution of endangered species.

Course Overview and Context

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.

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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COURSE COMPETENCIES

- Acquaint the students with the history and evolution of crop plants, and their diversity.

- Familiarize the students with the available plant genetic wealth and the measures adopted for the conservation of these resources.
- Help the students to identify the crop plants and their wild relatives.
- Aid the students to explore the potentialities of various underutilized plants to project as the future food prospects.
- Understand the significance of modern technology to locate the distribution of endangered species.

COMPLEMENTARY COURSES
FOR
B.Sc. ZOOLOGY

SEMESTER I
COMPLEMENTARY COURSE 1
COURSE CODE: BO1C01B18
COURSE TITLE: CRYPTOGAMS, GYMNOSPERMS AND PLANT PATHOLOGY
(Theory 36 hrs; Practical 36 hrs; Credits 2 + 1)

Aim

- Acquire fundamental knowledge in plant science and to make the student to understand that Botany is an integral part of the human life and developments.
- Foster and encourage an attitude of curiosity, appreciation and enquiry of various life forms of plants.
- Understand the identifying characters of the different types included in the syllabus.
- Understand the diversity of plants with respect to Algae, Fungi, Lichens, Bryophytes, Pteridophytes and Gymnosperms.
- To introduce them to the common plant diseases that affect crops and their preventive and remedial measures.

Course Overview and Context

This course is focused on revealing the features of the five kingdom classification of plants by Whittaker. It introduces the learners to the general features and diversity of the plant world. It explores the world of microbes, their unique features, genetic recombination in them, industrial and other economic importance of microbes. 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. It also deals with the common plant diseases, their causative organisms and effective control measures. All topics dealt in this course are having importance in the daily life situations and has scope for research.

CRYPTOGAMS (27 hrs)
Module 1: Algae (13 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 - (*Volvox*, *Spirogyra*, *Cladophora* - vegetative features only), *Oedogonium*; Phaeophyceae – *Sargassum;* Rhodophyceae – *Polysiphonia.*

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

Module 2: Fungi and Lichens (9 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 – *Puccinia.*

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

Lichens: Classification based on thallus morphology. Usnea - morphology and anatomy of vegetative and reproductive structure. Economic importance of lichen: food, industry, medicine.

Module 3: Bryophytes (5 hours)

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.*

Module 4: Gymnosperms (4hrs)

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

PLANT 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.

PRACTICAL (36 hrs)

1. Micropreparation and identification preparation of the following:

(i) Algae: Vegetative structure of *Nostoc*, *Volvox*, *Spirogyra*, *Oedogonium*, *Cladophora*, *Polysiphonia*. Vegetative and reproductive structure of *Sargassum*.

(ii) Fungi: Vegetative and reproductive structure of *Rhizopus*, *Xylaria*, *Puccinia*.

(iii) Lichen: Morphology of *Usnea* thallus and apothecium.

(iv) Bryophytes: *Riccia* thallus morphology and anatomy.

(v) Pteridophytes: *Selaginella* – morphology (vegetative and reproductive) and anatomy (stem).

(vi) Gymnosperms: *Cycas* – morphology (vegetative and reproductive) and anatomy of corolloid root, rachis and leaflet.

2. Identify plant diseases mentioned in the syllabus.

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COURSE COMPETENCIES

- Understands the diversity and characters of algae and fungi.
- Understands the diversity of lichens, bryophytes and pteridophytes.
- Develops knowledge regarding the diversity and characters of gymnosperms.
- Imparts knowledge about the lower forms of life.
- Demonstrates skills in identifying major plant diseases.

BLUE PRINT

B. Sc. I Semester - Complementary Course
Course Code: BO1C01B18
Course Title: Cryptogams, Gymnosperms and Plant Pathology

Modules	**Hours**	**PART A (Short Answer) 1 Mark 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 10 Marks 2/4**	**Total Marks**
1	13	3	2	1	23
2	9	3	2	1	23
3	5	3	2	1	23
4	4	1	2	1	21
5	5	2	1	-	7

B. Sc. PROGRAMME

BOTANY COMPLEMENTARY COURSE

CODE: BO1C01B18 CRYPTOGAMS, GYMNOSPERMS AND PLANT PATHOLOGY

MODEL QUESTION PAPER

First Semester CBCSS Examination

Time: 3 Hrs **Total Marks: 60**

PART A

(Answer any 10 questions. Each question carries 1 mark)

1. What is coenobium?
2. What are cap cells?
3. Define thallus.
4. Name any two commercially beneficial fungi.
5. What are basidiocarps?
6. What is the nature of fungal cell wall?
7. What is a ligule?
8. Explain resurrection plant with an example.
9. What is a polystele?
10. Mention the role of coralloid roots.
11. What are systemic diseases?
12. Give the binomial of the organism causing nutfall of Arecanut.

\(10 x 1=10 marks)

PART B

(Answer any 6 questions. Each question carries 5 marks)

13. Write an account on fungal nutrition.
14. Explain the morphology of *Cycas* plant.
15. Describe the morphology of *Volvox* colony. Explain its asexual reproduction.
16. Describe the sporophyte of *Riccia.*
17. Explain the anatomy of Cycas rachis.
18. What are the commercial products obtained from algae?
19. Explain the diversity of thallus in lichens.
20. Rhizophore of *Selaginella* can be considered as a stem as well as a root. Justify.
21. Describe the causative organism, symptoms and control measures of blight of paddy.

(6x 5 = 30 marks)

PART C

(Answer any 2 questions. Each question carries 10 marks)

22. Explain the life cycle of *Cycas*.
23. Describe the reproduction and life cycle of *Selaginella*.
24. With suitable diagrams explain sexual reproduction in *Oedogonium*
25. Explain the life cycle of *Puccinia.*

(2 x 10 = 20 marks)

SEMESTER II

COMPLEMENTARY COURSE 2
COURSE CODE: BO2C01B18
COURSE TITLE: PLANT PHYSIOLOGY
(Theory 36 hrs; Practical 36 hrs; Credits 2 + 1)

Aim

- Acquire knowledge on the importance of the physiological processes in plants.
- Understand the mechanism of various physiological processes related to plant life.

Course Overview and Context

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.

Module 1: Water Relations (10 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.

Transpiration: types, mechanism of transpiration and stomatal movement K^+ - ABA theory), significance and factors affecting transpiration, antitranspirants.

Module 2: Mineral Nutrition (5 hrs)

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 3: Photosynthesis (10 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).

Module 4:Translocation of Photosynthate (3 hrs)

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

Module 5: Growth and Development (8 hrs)

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). Photoperiodismdefinition, short day plants, long day plants, day neutral plants.Vernalization.

PRACTICAL (36 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 geographic curvature using Clinostat.
5. Mohl's half leaf experiment.
6. Ganong's Light screen experiment.

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COURSE COMPETENCIES

- Familiarize with the fundamental physiological processes occurring in plants.
- Familiarize the process of plant metabolism and role of plants in sustaining nature.
- Understanding of the physiology of growth and development and relate the application of plant physiology in different fields of science.

BLUEPRINT

B.Sc. II Semester Complementary Course 2

Course Code:BO2C01B18

Course Title: Plant Physiology

Modules	**Hours**	**PART A (Short Answer) 1 Mark 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 10 Marks 2/4**	**Total Marks**
1	10	4	3	1	29
2	5	1	1	-	6
3	10	4	3	1	29
4	3	-	1	1	15
5	8	3	1	1	18

SEMESTER III
COMPLEMENTARY COURSE 3
COURSE CODE: BO3C01B18
COURSE TITLE: ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY
(Theory 54 hrs; Practical 36 hrs; Credits 3 + 1)

Aim

- Acquaint the student with the objectives and components of taxonomy.
- Help the student to understand the systems of classification of angiosperms.
- Help the student to identify the common angiosperm species of Kerala.
- Familiarize the student with plants of immense economic importance.

Course Overview and Context

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. They should be able to identify the common angiosperm species of Kerala and learn herbarium techniques.

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, their arrangement, relative position; cohesion and adhesion of floral parts, symmetry of flowers; types of aestivation and placentation; floral diagram and floral formula. Inflorescence: racemose - simple, spike, spadix, catkin, corymb, umbel and head; cymose - simple, monochasial- helicoid and scorpoid; special types – cyathium, verticillaster. Fruits: outline on the classification; Simple: Fleshy - drupe, berry, hesperidium; Dry - Dehiscent - legume, capsule; Indehiscent - Caryopsis, Cypsella, Schizocarpic - lomentum, carcerulus, regma, cremocarp with examples. Aggregate. Multiple: sorosis, syconus. (Examples should be from families prescribed in the syllabus).

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

Importance of plant classification, types of classification - artificial, natural and phylogenetic (brief account only); binomial nomenclature; ICBN (Brief account only). Bentham and Hooker's system of classification (up to series), its merits and demerits. Cytotaxonomy and

chemotaxonomy (brief account only). Herbarium techniques; importance of herbarium.

Module 3: Angiosperm Families (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, Rutaceae, Leguminosae (Mimosaceae, Caesalpiniaceae and Fabaceae), Apiaceae (Umbelliferae), Rubiaceae, Asteraceae (Compositae), Apocynaceae, Lamiaceae (Labiatae), Euphorbiaceae, Arecaceae (Palmae), 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: Cereals - Paddy, Wheat; Pulses - Green gram, Bengal gram; Tuber crops- Tapioca; Spices - Pepper, Cardamom; Beverages - Tea, Coffee; Oil yielding plants - Coconut, Groundnut; Fibre yielding plants - Cotton, Coir; Timber yielding plants - Teak, Rose wood; Latex yielding plants - Para rubber; Bio pesticides - Neem, Tobacco; Ornamental plants - Rose, Orchids, Anthurium.

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*, Neem, *Ocimum*, *Phyllanthus amarus*, *Rauvolfia*, and *Sida.*

PRACTICALS (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.

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COURSE COMPETENCIES

- Acquaint, with the objectives and components of Taxonomy.
- Understand, the systems of classification of angiosperms.
- Identifies the common angiosperm species of Kerala.
- Studies the herbarium techniques.
- Awareness of Bentham and Hooker's system of classification.

BLUE PRINT

B.Sc. Semester III

Complementary Course 3

Course Code: BO3C01B18

Course Title: Angiosperm Taxonomy and Economic Botany

Module	**Hours**	**PART A (Short Answer) 1 Mark 10/12**	**PART B (Short Essay) 5 Marks 6/9**	**PART C (Essay/Problem) 10 Marks 2/4**	**Total Marks**
1	16	4	3	1	29
2	6	1	1	1	16
3	20	4	2	1	24
4	7	4	2	1	22
5	5	1	1	-	6

SEMESTER IV

COMPLEMENTARY COURSE 04
COURSE CODE-BO4C01B18
COURSE TITLE: ANATOMY AND APPLIED BOTANY
(Theory 54 hrs; Practical 36 hrs; Credits 3+1)

Aims

- Understand different types of plant tissues.
- Understand the internal structure of different plant organs with reference to their functions.
- Understand the process of normal and anomalous secondary thickening in plants.
- Know the morphological and anatomical adaptations of plants growing in different habitats.
- Understand the applications of botanical knowledge in the field of crop improvement for human prosperity.

Course Overview and Context

This course explores different tissues, anatomy of stems, roots and about secondary thickening, and ecological anatomy of different plant groups. Applied botany emphases on crop improvement methods. Laboratory practices reinforce lecture material by taking section of plant materials and by doing agricultural practices like budding, layering and grafting to learn about crop improvement programmes.

PLANT ANATOMY (34 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 (16 hrs)

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*.

Module 3: Ecological Anatomy (9 hrs)

Study of the morphological and anatomical adaptations of the following groups: Hydrophytes – *Nymphaea, Hydrilla*; Xerophytes – *Nerium;* Epiphytes – *Vanda*; Halophytes – *Avicinia/Rhizophora.*

APPLIED BOTANY (20 hrs)

Module 4: Plant Breeding (14 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 5: Plant Tissue Culture (6 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.

PRACTICALS (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. Anatomical adaptations of Hydrophytes - *Nymphaea* petiole, *Hydrilla* stem; Xerophytes - *Nerium* Leaf; Epiphytes - Velamen root of *Vanda;* Halophyte – Pneumatophore of *Avicinnia.*
5. Emasculation of pea or *Caesalpinia* flower.
6. Demonstrate T and patch budding.
7. Demonstration of tissue culture techniques: culture media, surface sterilization and inoculation of explants.
8. Identification of non-living inclusions – cystolith and raphides.

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COURSE COMPETENCIES

- Student becomes aware of cell types.
- Understands Electron microscopic features of plant cells and tissues.
- Studies the primary structure of stem, root and leaves of plants.
- Learns about the secondary thickening in dicot stems and dicot roots.
- Students are familiarized with the techniques of plant breeding and horticulture.

BLUEPRINT

Complementary Course 4
Course Code: BO4C01B18
Course Title: Anatomy and Applied Botany

Module	Hours	PART A (Short Answer) 1 Mark 10/12	PART B (Short Essay) 5 Marks 6/9	PART C (Essay/Problem) 10 Marks 2/4	Total Marks
1	9	3	2	1	23
2	16	4	3	1	24
3	9	2	2	1	18
4	14	2	1	1	17
5	6	1	1	-	6