SACRED HEART COLLEGE (AUTONOMOUS), THEVARA
KOCHI, KERALA, 682013

CURRICULUM AND SYLLABI

CHOICE BASED CREDIT AND SEMESTER SYSTEM
(CBCSS)

UNDERGRADUATE PROGRAMME IN BOTANY
(B.Sc. BOTANY - MODEL I)

INTRODUCED FROM 2019 ADMISSION ONWARDS

BOARD OF STUDIES IN BOTANY
Sacred Heart College, Thevara, Kochi, Kerala

CONTENTS

FORWORD

Science is a study dealing with a body of facts or truths systematically and the base of all developments in the world is because of practical application of science, *i.e.* technology. The creation of a scientific thinking in society necessitates proper education and guidance. In order to achieve this, one must update the developments in every field of science. To achieve this goal, the curriculum of every programme in science should be revised frequently to incorporate the recent advances in science.

In line with the changes in higher education, the state of Kerala had introduced the autonomy in its 13 selected colleges in 2014. Exercising the opportune occasion of autonomy, the dept. of Botany had attempted to redraft the entire syllabus of UG in a different perspective and the rearrangement of the courses in a more systematic and learner friendly manner in 2015.

The Board of Studies in Botany has made a thorough evaluation of the present syllabus and decided to revise the curriculum in tune with the parent University and the University Grants Commission's model for Under Graduate Curriculum. In this process care has been taken to give emphasis to various aspects such as the creativity of students, knowledge of current developments in the discipline, awareness of environmental impacts due to the development of science and technology, the skills essential for handling equipment and instruments in laboratories and industries, employability and entrepreneur development. Later, consequent of the Hon'ble Supreme Court of India order and the subsequent UGC circular, the Academic Council of the college decided to incorporate Environmental Studies and Human Rights in the UG curriculum, as an additional core course.

Mahatma Gandhi University has revised the curriculum for the UG programs in 2017. In that they have included Environmental Studies and Human Rights in an impressive way. The BOS in Botany of this college decided to follow the syllabus of that course with appropriate modification as full course in Semester V.

The Academic Council of the college decided to implement the revised syllabus with effect from the academic year 2019-20.

The following are the major changes envisaged in the new draft.

1. Under graduate programme in Botany has 13 courses designed as per a well thought out draft scheme where care is given to the scientific coherence of progression subjects. The dissertation of the sixth semester is modified in such a way that the candidates shall opt for either conventional dissertation or any of the hands on training projects of the following types. The hands on training shall be streamlined in such a way that an MoU shall be signed with the outside professional agency, if any, with that of the department.
   The following are the projects considered for hands on training:

1. Mushroom cultivation	2. Landscaping and garden designing
3. Nursery Management	4. Flower arrangement and Vegetable carving
5. Topiary and Bonsai	6. Poly-house farming & Precision farming
7. Organic farming and Plantation management	8. Plant tissue culture
9. Cultivation of Medicinal plants	10. Traditional post-harvest technology
11. Natural fibre extraction and Handicrafts	12. Natural dyes and Mural painting
13. Vermi composting and Organic manure	14. Bio-pesticides and Bio-insecticides
15. Bio-fertilizers and Biological control	16. Floriculture and Cut flower marketing
17. Traditional and Natural food processing	18. Home-made Chocolate Making
19. Wood and Timber Processing	20. Budding, Layering, Grafting

Virtual Lab and Additional Credits

In tune with the new trends, ICT enabled teaching methods and to spread the message of non-invasive methods, Green Chemistry and protection of environments, virtual labs are offered in the new syllabus. Out of the 13 courses in Botany programme, 8 courses are appended with a minimum of 3 virtual lab experiments. During the tenure of the programme, students can choose at least 18 experiments from these without sparing a course completely for which they can earn an additional credit.

Thevara **Dr. (Fr.) Jose John**

August 15, 2018 Chairman, BoS in Botany

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CURRICULUM

1. TITLE

B. Sc. BOTANY PROGRAMME

Graduate Programme under Choice Based Credit Semester System, 2019.

2. SCOPE

Applicable to regular Under Graduate Programme B.Sc. Botany, conducted by the Sacred Heart College (Autonomous) with effect from 2019-20 admissions.

3. STUDENT ATTRIBUTES

To our knowledge, the Earth is the only planet where life exists. Chlorophyll bearing organisms assimilate the atmospheric CO_2 and release O_2, the vital component required for existence of life. Green plants are the only ultimate source of food for other living organisms. Plants and plant produce have been used as drug, cloth and shelter. Industrial revolution and its aftermath made a paradigm shift in the minds of the people around the world. The significance of ecosystem and natural environment with its natural products is accepted world over now. Botany programme envisages to unravel the significance of plants in the maintenance of life on planet earth.

Attributes:

1. Love and understanding of nature
2. Protection of natural habitats and biodiversity
3. Scientific character of observation and reasoning
4. Co-operation and team work
5. Practice of plant science knowledge in real life
6. Need based training in Botany of adequate quality at the undergraduate level
7. Use of Information Communication Technology to gather knowledge of current developments in plant sciences
8. Acquire skills essential for handling equipment and instruments in chemical laboratories

9. Enhance employability and an aptitude for entrepreneurship

4. DEFINITIONS

4.1 ***Programme*** means a three year programme of study and examinations spread over six semesters, according to the regulations of the respective programme, the successful completion of which would lead to the award of a degree.

4.2. ***Semester*** means a term consisting of a minimum of 450 contact hours distributed over 90 working days, inclusive of examination days, within 18 five-day academic weeks.

4.3. ***Academic Week*** is a unit of five working days in which distribution of work is organized from day-one to day-five, with five contact hours of one hour duration on each day. A sequence of 18 such academic weeks constitutes a semester.

4.4. ***Course*** means a complete unit of learning which will be taught and evaluated within a semester.

4.5. ***Common Course I*** means a course that comes under the category of courses for English and ***Common Course II*** means additional language, a selection of both is compulsory for all students undergoing undergraduate programmes.

4.6. ***Core course*** means a course in the subject of specialization within a degree programme.

4.7. ***Complementary Course*** means a course which would enrich the study of core courses.

4.8. ***Open course*** means a course outside the field of his/her specialization, which can be opted by a student.

4.9. ***Choice based core course*** means a compulsory course for all under graduate students (as per the UGC directive) to enrich their general awareness.

4.10. ***Credit*** is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.

4.11. ***Additional credit or extra credit*** is the numerical value assigned to Club activities, Social service, Internship etc. which is not added with the total academic credits of the students.

4.12. ***Grade*** means a letter symbol (*e.g.*, A, B, C, etc.), which indicates the broad level of performance of a student in a course/ semester/programme.

4.13. ***Grade point (GP)*** is the numerical indicator of the percentage of marks awarded to a student in a course

4.14. ***Grace Marks*** shall be awarded to candidates as per the University Orders issued from time to time.

Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes.

5. DURATION OF THE PROGRAMME

The duration of U.G. programmes shall be 6 semesters The duration of odd semesters shall be from June to October and that of even semesters from November to March. 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.

6. COURSE DESIGN

The UG programme in Botany consists of the following types of courses:

a) Common courses.
b) Core courses.
c) Complementary courses.
d) Open courses.
e) Choice based courses.
f) Project

The core course is in the discipline of Botany and two complementary courses, in Zoology and Chemistry. No course shall carry more than 4 credits. The student shall select any one open course in Semester V offered by other departments including Department of Physical Education.

A student can earn extra credits as detailed below:

- ➢ Service - Learning.
- ➢ Courses offered by talent clubs.

➢ Course in Virtual Lab Experiments.

7. PROGRAMME STRUCTURE

Programme Duration	6 Semesters
Total Credits required for the successful completion of the programme	120 Credits
Credits required from Common Course I (*English*)	22 Credits
Credits required from Common Course II (*Second Language*)	16 Credits
Credits required from Core Course, Complementary Courses and Project	79 Credits
Open Course	3 Credits
Minimum attendance required	75 %

7.1. *Course-wise Distribution of Credits:*

The B. Sc. Botany programme consists of common courses with 38 credits, core course, Choice based course and complementary courses with 79 credits and open course with 3 credits.

The number and credits of different types of courses of the programme are listed below.

Type of the Course	No. of Courses	No. of Credits
Common Course I (*English*)	6	22
Common Course II (Additional *Language*)	4	16
Total	**10**	**38**
Core Courses – *Theory*	12	34
Core Courses – *Practical*	6	12
Choice Based Course	1	3
Project & Viva – Voce	1	2
Total	**20**	**51**
Complementary Courses – *Theory*	8	*20*
Complementary Courses – *Practical*	2	8

Total	**10**	**28**
Open Course	1	3 **3**
Grand Total	**41**	**120**

7.2. *Extra-Credit Courses:*

The list of extra-credit courses and their corresponding credits are given below:

Course	No. of Credits
Service-Learning (*Mandatory*)	1
Courses offered by talent clubs	1
Virtual lab Experiments	1

7.3. *Semester-wise Distribution of Credits and Instructional Hours*:

	Sem I		Sem II		Sem III		Sem IV		Sem V		Sem VI	
	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week	Credit	Hrs./ Week
Common Course I (*English*)	7	9	7	9	4	5	4	5	-	-	-	-
Common Course II (*Second Language*)	4	4	4	4	4	5	4	5	-	-	-	-
Core Course - *Theory*	2	2	2	2	2	3	2	3	12	11	12	12
Core Course - *Practical*	1	2	2	2	1	2	2	2	4	8	4	10
Complementary Course – I *Zoology- Theory*	2	2	2	2	3	3	3	3	-	-	-	-
Complementary Course – I *Zoology- Practical*	-	2	2	2	-	2	2	2	-	-	-	-
Complementary Course – II *Chemistry - Theory*	2	2	2	2	3	3	3	3	-	-	-	-

Complementary Course – II *Chemistry – Practical*	-	2	2	2	-	2	2	2	-	-	-	-
Project	-	-	-	-	-	-	-	-	-	2	2	-
Open Course	-	-	-	-	-	-	-	-	3	4	-	-
Choice Based Core Course	-	-	-	-	-	-	-	-	-	-	3	3
Total	**18**	**25**	**22**	**25**	**18**	**25**	**22**	**25**	**19**	**25**	**21**	**25**

SEMESTER	No. of Credits	No. of Instructional Hours
I	**20**	**25**
II	**20**	**25**
III	**20**	**25**
IV	**20**	**25**
V	**19**	**25**
VI	**21**	**25**
Total	**120**	**450**

8. EXAMINATIONS

The evaluation of each course shall contain two parts:

(i) CONTINUOUS INTERNAL ASSESSMENT (*CIA*)

(ii) END-SEMESTER EXAMINATION (*ESE*)

The internal to external assessment ratio shall be 1:3, for both courses with or without practical. There shall be a maximum of 75 marks for external evaluation and maximum of 25 marks for internal evaluation.

Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

8.1 *Mark Distribution for all Core Theory Papers*:

a) Marks of End Semester Examination : **60**

b) Marks of Internal Evaluation : **20**

Different components of theory paper internal evaluation is given below. All three components are mandatory.

Components of Theory – *Internal Evaluation*	**Marks**
Attendance	**5**
Assignment / Seminar/ Viva-Voce	**5**

Internal Assessment Tests (*Two*) (*2 × 5 = 10*)	**10**
Total	**20**

Note: *Decimal are to be rounded to the next whole number*

8.1.1 *Mark Distribution for Open course*

a) Marks of End Semester Examination : **75**

b) Marks of Internal Evaluation- Core Courses : **25**

Different components for the open course internal evaluation is given below.

Components of Theory – *Internal Evaluation*	**Marks**
Attendance	**5**
Assignment	**5**
Seminar/ Viva-Voce	**5**
Internal Assessment Tests (*Two*) (*2 × 5 = 10*)	**10**
Total	**25**

Note: *Decimal are to be rounded to the next whole number*

Assignment:

Assignments are to be done by the students from I, II, III and IV Semesters. At least one assignment should be done in each semester for all courses. Assignments shall be a field visit with report in a structured format, collection, preservation and presentation of botanical specimens, teacher monitored group discussions supported by report, museum enrichment, herbarium preparation, preparation of models, charts, posters, short report based on scientific papers or scripts on topics of respective semesters, small survey reports, written quiz, etc.

Seminar / Viva:

A student shall present a seminar in any one course in the V and VI semesters and shall appear for a Viva- voce for all the remaining courses.

Internal Assessment Tests (IAT):

Two internal assessment tests (IAT) are to be attended in each semester for each paper. The marks for the tests will be converted into a 5 mark scale for the test paper component of internal evaluation.

Hands on Training/ Research Project *Internal* Evaluation:

Components	Marks
Attendance & Punctuality	10
Commitment	10
Skill	10
Conduct	10
Group Involvement	10
TOTAL	**50**

The assignments include written assignments, preparation of models, charts, posters etc., field survey, field work.

Hands on Training/ Research Project *External* Evaluation:

Components	Marks
Project Report	25
Presentation	15
Viva voce	10
Total	**50**

8.2 *Mark Distribution for all Practical Papers*:

The practical end-semester examination is conducted only at the end of even semesters. Pattern and scheme of evaluation of the examination will be decided by the board of practical examination.

a) Marks of End Semester Examination : **30**

b) Marks of Internal Evaluation : **10**

Different components of practical paper internal evaluation is given below. All three components are mandatory.

Components of *Practical – Internal Evaluation*	Marks
Attendance and Lab Involvement	5
Record	5
Total	**10**

Note: *Decimal are to be rounded to the next whole number*

8.3 *Attendance Evaluation for Both Theory and Practical Papers:*

Mark distribution for attendance, rules regarding attendance and condonation of shortage of attendance are given below.

8.3.1 *Mark Distribution for Attendance:*

Percentage of Attendance	Marks
90 % and above	**5**
Between 85 and 90%	**4**
Between 80 and 85%	**3**
Between 75 and 80%	**2**
75%	**1**

8.3.2 *Condonation of Shortage of Attendance:*

Candidate can seek condonation of shortage of attendance only once in a 2 year course and twice in other courses of longer duration. Following are the rules regarding attendance requirement:-

i.) Every candidate is to secure 75% attendance of the total duration of the course.

ii.) A candidate having a shortage of 10% can apply for condonation of shortage in prescribed form on genuine grounds. Condonation of shortage of attendance if any should be obtained at least 7 days before the commencement of the concerned semester examination.

iii.) It shall be the discretion of the Principal to consider such applications and condone the shortage on the merit of each case in consultation with the

concerned course teacher and HoD.

iv.) Unless the shortage of attendance is condoned, a candidate is not eligible to appear for the examination.

9. COMPUTATION OF GRADE AND GRADE POINTS

For all courses (theory & practical), grades are given on a 08-point scale based on the total percentage of marks ***(CIA + ESE)*** as given below:

% of Marks for a course	Grade	Grade Point
95% and above	O - Outstanding	10
85 to below 95%	A^+ - Excellent	9
75 to below 85%	A - Very Good	8
65 to below 75%	B^+ - Good	7
55 to below 65%	B - Satisfactory	6
45 to below 55%	C - Average	5
35 to below 45%	D - Pass	4
Below 35	F - Failure	0
	Ab – Absent	0

9.1.Computation of SGPA (*Semester Grade Point Average*)

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

$$\textbf{SGPA } (S_i) = \frac{\sum (C_i \times G_i)}{\sum C_i}$$

Where, S*i* is the SGPA of the ith semester, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

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

Illustration for SGPA:

Course	Credit	Grade Letter	Grade Point	Credit Point (*Credit* × *Grade Point*)
Course 1	3	B	6	3 × 6 = 18
Course 2	4	A	8	4 × 8 = 32
Course 3	3	A^+	9	3 × 9 = 27
Course 4	3	B^+	7	3 × 7 = 21
Course 5	3	C	5	3 × 5 = 15

Course 6	4	O	10	4 × 10 = 40
	Σ C*i* = 20			**Σ (C*i* × G_i) = 153**

$$\textbf{SGPA } (S_i) = \frac{\sum(C_i \times G_i)}{\sum C_i} = \frac{153}{20} = 7.65$$

9.2 Computation of CGPA (*Cumulative Grade Point Average*)

The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, *i.e.*

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

Where, S*i* is the SGPA of the i^{th} semester and C_i is the number of credits in that semester.

Note: The CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration for CGPA:

Semester	SGPA (S_i)	Credits (C_i)	$S_i \times C_i$
I	**9.69**	**18**	**174.42**
II	**9.12**	**22**	**200.64**
III	**8.50**	**18**	**153.00**
IV	**8.75**	**22**	**192.50**
V	**9.13**	**15**	**136.95**
VI	**9.50**	**25**	**237.50**
		Σ C*i* = 120	**Σ (S*i* × C_i) = 1095.01**

$$\textbf{CGPA} = \frac{\sum(S_i \times C_i)}{\sum C_i} = \frac{1095.01}{120} = 9.13$$

Grades for the different semesters and overall programme are given based on the corresponding SGPA/ CGPA as shown below:

SGPA /*CGPA*	Grade

9.50 to 10.00	*O - Outstanding*
8.50 to 9.49	*A+ - Excellent*
7.50 to 8.49	*A -Very Good*
6.50 to 7.49	*B+ – Good*
5.50 to 6.49	*B – Satisfactory*
4.50 to 5.49	*C – Adequate*
3.5 to 4.49	*D - Pass*
Below 3.5	*F – Failure*

Note: A separate minimum of 30% marks each for internal and external (*for both theory and practical*) and aggregate minimum of 35% are required for a pass for 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 offered in a Semester / Programme only **F** grade will be awarded for that Semester/Programme until he/she improves this to **D** grade or above within the permitted period. Candidate secure **D** grade and above will be eligible for higher studies.

10. SCHEME OF CORE AND COMPLEMENTARY COURSES

10.1 SCHEME OF BOTANY *CORE* COURSES (*Semester-wise Distribution*)

Course Code	Course Title	Credits	Hours / Week	Hour / Sem.	Examination		
					ESE *Duration*	ESE *Max. Marks*	CIA *Max. Marks*
SEMESTER I							
19U1CRBOT1	Microbiology and Phycology *Practical 1	2	2 2	72	3 Hrs.	60 15	20 05
SEMESTER II							
19U2CRBOT2	Mycology, Lichenology and Plant Pathology *Practical 2	2	2 2	72	3 Hrs.	60 15	20 05
19U2PRBOT1	Practical 1 and Practical 2 combined	2			3 Hrs.	30	10

SEMESTER III							
19U3CRBOT3	Bryology, Pteridology, Gymnosperms and Paleobotany *Practical 3	3	3 2	90	3 Hrs.	60 15	20 05
SEMESTER IV							
19U4CRBOT4	Anatomy, Microtechnique and Angiosperm Morphology *Practical 4	3	3 2	90	3 Hrs.	60 15	20 05
19U2PRBOT2	Practical 3 and Practical 4 combined	2			3 Hrs.	30	10
SEMESTER V							
19U5CRBOT5	Angiosperm Systematics and Economic Botany *Practical 5	2	3 2	90	3 Hrs.	60 15	20 05
19U5CRBOT6	Environmental Science and Ecotourism *Practical 6	3	3 2	90	3 Hrs.	60 15	20 05
19U5CRBOT7	Genetics and Plant Breeding *Practical 7	3	3 2	90	3 Hrs.	60 15	20 05
19U5CRBOT8	Cell and Molecular Biology and Evolution *Practical 8	3	3 2	90	3 Hrs.	60 15	20 05
19U5OCBOT1	Agribased Microenterprises *(Open Course)*	3	4	72	3 Hrs.	75	25
SEMESTER VI							
19U6CRBOT9	Plant Physiology and Biochemistry *Practical 9	2	3 2	90	3 Hrs.	60 15	20 05
19U6CRBOT10	Perspectives of Science, Methodology and General Informatics *Practical 10	3	3 2	90	3 Hrs.	60 15	20 05
19U6CRBOT11	Biotechnology and Bioinformatics *Practical 11	3	3 2	90	3 Hrs.	60 15	20 05
19U6CRBOT12	Horticulture, Nursery Management, Embryology and Reproductive Biology *Practical 12	3	3 2	90	3 Hrs.	60 15	20 05
19U6CRBOT13EL	Phytochemistry and Pharmacognosy *(Elective Course)*	3	4	54	3 Hrs.	75	25
19U6PJBOT1	Hand on Training Cum Project*	2	1	36	-	50	50
19U2PRBOT3	Practical 5 and Practical 6 combined	2			3 Hrs.	30	10
19U2PRBOT4	Practical 7 and Practical 8 combined	2			3 Hrs.	30	10
19U2PRBOT5	Practical 9 and Practical 10 combined	3			3 Hrs.	30	10
19U2PRBOT6	Practical 11 and Practical 12 combined	2			3 Hrs.	30	10

10.2 SCHEME OF BOTANY *COMPLEMENTARY* COURSES (*Semester-wise Distribution*)
(For students who have opted for Zoology as Core)

Course Code	Course Title	Credits	Hours / Week	Hour / Sem.	Examination		
					ESE *Duration*	ESE *Max. Marks*	CIA *Max. Marks*
SEMESTER I							
19U1CPBOT1	Cryptogams, Gymnosperms and Plant Pathology Practical 1	2 1	2 2	72	3 Hrs.	60 15	20 05
SEMESTER II							
19U2CPBOT2	Plant Physiology Practical 2	2 1	2 2	72	3 Hrs.	60 15	20 05
19U2PCBOT1	Practical 1 and Practical 2 combined	2			3 Hrs.	30	10
SEMESTER III							
19U3CPBOT3	Angiosperm Taxonomy and Economic Botany Practical 3	3 1	3 2	90	3 Hrs.	60 15	20 05
SEMESTER IV							
19U4CPBOT4	Anatomy and Applied Botany *Practical 4	3 1	3 2	90	3 Hrs.	60 15	20 05
19U2PCBOT2	Practical 3 and Practical 4 combined	2			3 Hrs.	30	10

11. B. Sc. BOTANY PROGRAMME - *CONSOLIDATED SCHEME*

The programme structure with detailed semester-wise distribution of common courses, core courses, complementary courses, open course, choice based course and project are listed below.

Sl. No.	Type of Course	Course Title	Credits	Hrs./ Week	Hrs./ Sem.
SEMESTER I					
1.	Common	English - I	4	5	90
2.	Common	English Common Course - I	3	4	72
3.	Common	Second Language - I (*Mal / Hin / San / Fre*)	4	4	72
4.	Core	Botany Core - I	2	2	54

5.	Core	Botany Core I - Practicals	1	2	36
6.	Complementary	Zoology - I	2	2	72
7.	Complementary	Zoology Practicals - I	1	2	36
8.	Complementary	Chemistry - I	2	2	72
9.	Complementary	Chemistry Practicals - I	1	2	36
		Total	**20**	**25**	**450**
SEMESTER II					
1.	Common	English - II	4	5	90
2.	Common	English Common Course - II	3	4	72
3.	Common	Second Language - II (*Mal / Hin / San / Fre*)	4	4	72
4.	Core	Botany Core - II	2	2	36
5.	Core	Botany Core II - Practicals	1	2	36
6.	Complementary	Zoology - II	2	2	36
7.	Complementary	Zoology Practicals – II	1	2	36
8.	Complementary	Chemistry – II	2	2	36
9.	Complementary	Chemistry – Practical II	1	2	36
		Total	**20**	**25**	**450**
SEMESTER III					
1.	Common	English - III	4	5	90
2.	Common	Second Language - III (*Mal / Hin / San / Fre*)	4	5	90
3.	Core	Botany Core - III	3	3	54
4.	Core	Botany Core III - Practicals	1	2	36
5.	Complementary	Zoology - III	3	3	54
6.	Complementary	Zoology Practicals – III	1	2	36
7.	Complementary	Chemistry – III	3	3	36

9.	Complementary	Chemistry – Practical III	1	2	36
		Total	**20**	**25**	**450**
SEMESTER IV					
1.	Common	English - IV	4	5	90
2.	Common	Second Language - IV (*Mal / Hin / San / Fre*)	4	5	90
3.	Core	Botany Core - IV	3	3	54
4.	Core	Botany Core IV - Practicals	1	2	36
5.	Complementary	Zoology - IV	3	3	54
6.	Complementary	Zoology Practicals – IV	1	2	36
7.	Complementary	Chemistry – IV	3	3	54
8.	Complementary	Chemistry Practicals – IV	1	2	36
		Total	**20**	**25**	**450**
SEMESTER V					
1.	Core	Angiosperm Systematics and Economic Botany *Practical 5	4	5	90
2.	Core	Environmental Science and Ecotourism *Practical 6	4	5	90
3.	Core	Genetics and Plant Breeding *Practical 7	4	5	90
4.	Core	Cell and Molecular Biology and Evolution *Practical 8	4	5	90
5.	Open	Agribased Microenterprises *(Open Course)*	3	4	72
6.	Core	Hand on Training Cum Project*	2	1	18
		Total	**19**	**25**	**450**
SEMESTER VI					
1.	Core	Plant Physiology and Biochemistry *Practical 9	4	5	90
2.	Core	Perspectives of Science, Methodology and General Informatics *Practical 10	4	5	90
3.	Core	Biotechnology and Bioinformatics	4	5	90

		*Practical 11			
4.	Core	Horticulture, Nursery Management, Embryology and Reproductive Biology *Practical 12	4	5	90
5.	Choice Based	Phytochemistry and Pharmacognosy *(Elective Course)*	3	4	72
6.	Core	Hand on Training / Research Project*	2	1	18
		Total	**21**	**25**	**450**

RESTRUCTURED CURRICULUM FOR B. Sc. DEGREE IN BOTANY PROGRAMME

COURSE STRUCTURE

Total Credits 120
Total Instructional hours150

Semester 1

No	Course Title	Hrs/ week	Credit
1	Common Course English -1	5	4
2	Common Course English -2	4	3
3	Common Course Sec. language -1	4	4
4	Core Course -1 Microbiology and Phycology + Practical	4	3
5	1st Complementary – Zoology- 1	2	2
6	1st Complementary – Zoology- l Practical	2	1
7	2nd Complementary- Chemistry -1	2	2
8	2nd Complementary- Chemistry - 1 Practical	2	1
	Total	**25**	**20**

Semester 2

No	**Course Title**	**Hrs/ week**	**Credit**
1	Common Course -English -3	5	4
2	Common Course -English -4	4	3
3	Common Course - Sec. language -2	4	4
4	Core Course -2 Mycology, Lichenology and Plant Pathology + practical	4	3

5	1st Complementary - Zoology - 2	2	2
6	1st Complementary - Zoology - 2 practical	2	1
7	2nd Complementary -Chemistry -2 + Practical	4	3
	Total	**25**	**20**

Semester 3

No	Course Title	**Hrs/ week**	**Credit**
1	Common Course English -5	5	4
2	Common Course Sec. language -3	5	4
3	Core Course -3 Bryology, Pteridology, Gymnosperms and PaleoBotany + practical	5	4
4	1st Complementary - Zoology - 3	3	3
5	1st Complementary - Zoology - 3 practical	2	1
6	2nd Complementary - Chemistry -3	3	3
7	2nd Complementary - Chemistry – 3 practical	2	1
	Total	**25**	**20**

Semester 4

No	Course Title	Hrs/Week	Credit
1	Common Course - English - 6	5	4
2	Common Course Sec. language -4	5	4
3	Core Course - 4 Anatomy and Angiosperm Morphology + practical	5	4
4	1st Complementary - Zoology - 4	3	3
5	1st Complementary - Zoology - 4 practical	2	1
6	2nd Complementary - Chemistry - 4	3	3
7	2nd Complementary - Chemistry – 4 practical	2	1
	Total	**25**	**20**

Semester 5

No	Course Title	Hrs/Week	Credit
1	Core Course - 5 Angiosperm Systematics, Floral Morphology and Economic Botany + Two Practical including practicals of project	6	4
2	Core Course - 6 Environmental Science and Ecotourism + Practical	5	4

3	Core Course -7 Genetics and Plant Breeding + Practical	5	4
4	Core Course - 8 Cell and Molecular Biology and Evolution + Practical	5	4
5	Open Course : Agri. Based Microenterprises	4	3
	Total	**25**	**19**

Semester 6

No	Course Title	Hrs/Week	Credit
1	Core Course -9 Plant Physiology and Biochemistry + Practical	5	4
2	Core Course -10 Perspectives of Science, Methodology and General Informatics + Practical	5	4
3	Core Course -11 Biotechnology and Bioinformatics + practical	5	4
4	Core Course -12 Horticulture, Nursery Management, Embryology and Reproductive Biology + Practical	5	4
5	Core Choice Based – 13 Phytochemistry and Pharmacognosy	3	3
6	Hands on Training/ Research Project	2	2
	Total	**25**	**21**

Grievance Redressal Mechanism

In order to address the grievance of students regarding Continuous internal assessment (CIA) a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1:

At the level of the concerned course teacher

Level 2:

At the level of a department committee consisting of the Head of the Department, a coordinator of internal assessment for each programme nominated by the HoD and the course teacher concerned.

Level 3:

A committee with the Principal as Chairman, Dean of concerned Faculty, HOD of concerned department and one member of the Academic council nominated by the principal every year as members.

B.Sc. BOTANY
Programme Outcomes (POs)

PO1	**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO2	**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
PO3	**Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO4	**Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.
PO5	**Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions and accept responsibility for them.
PO6	**Global Perspective**: Understand the economic, social and ecological connections that link the world's nations and people.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1	Understand functional and theoretical concepts of the biological world and their relative role in the sustainability of natural habitats and biodiversity (PO1, PO2, PO3, PO4, PO5, PO6)
PSO 2	Understand knowledge on the evolutionary relationships among the plant (PO1, PO4, PO6)
PSO 3	Understand the applications of plant biology in various disciplines (PO1, PO3, PO4, PO5)
PSO 4	Perform laboratory procedures as per ethics and following standard protocols (PO1, PO2, PO5)
PSO 5	Synthesize the scientific character of observation, reasoning and apply the knowledge in designing of experiments (PO1, PO2, PO3, PO5, PO6)

Syllabi

MODEL I
B.Sc. Programme in BOTANY
Semester l

Course 1

19U1CRBOT1 MICROBIOLOGY AND PHYCOLOGY

(Theory: 48 hours; Practical: 24) **(Theory Credit 2, Practical Credit 1)**

COURSE OUTCOMES (COs)	
CO 1	Understand the world of microbial diversity
CO 2	Understand the reproductive behaviour in Algae and microbes
CO 3	Understand ecological significance of the lower groups of plants and protists
CO 4	Understand economic significance of the lower groups of plants and protists
CO 5	Collect various algal forms and classify them in the laboratory
CO 6	Compare various algal forms on the basis of their thallus structure

MICROBIOLOGY **(Theory: 16 hours; Practical: 6 hours)**

Module 1 **1 hr**

Introduction, Scope of Microbiology

Module 2 **8 hrs**

Bacteria: Fine structure - cell wall - Peptidoglycan- cytoplasm - Nucleoid, Flagella
Reproduction- Binary fission
Genetic recombination - Conjugation, transformation & transduction
Three Domains of Life. Mycoplasma - general characters

Module 3 **4 hrs**

Virus - General morphology and structure.
Plant viruses – architecture of TMV
RNA viruses, DNA viruses (Examples only)

Brief account of virus replication.

Module 4 Applied Microbiology **3 hrs**

1. Biofertilizers & Biopesticides
2. Biogas production.
3. Reconvertion of waste products.
4. Bioremediation.
5. Antibiotics.
6. Production of single cell protein and Probiotics.

Practical **6 hrs**

Students are expected to do the following practical

1. Preparation of bacterial smear.
2. Grams staining.
3. Isolation of microbes from soil (Streaking method).

Additional Credit – Virtual Lab Experiments:

1. Gram Staining
2. Streak plate method
3. Isolation and identification of two bacterial unknowns

PHYCOLOGY (Theory: 32 hours; Practical: 18 hours)

Module 1 : Introduction to Phycology and Classification of Algae **7 hrs**

Introduction: general characters, habitat diversity, range of thallus structure and pigments in algae; 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 **18 hrs**

General characters of the following major groups with special reference to the structure, reproduction and life cycles of the following types.

a. Cyanophyceae: *Nostoc*
b. Chlorophyceae: *Volvox, Oedogonium*, *Cladophora, Chara*
c. Xanthophyceae: *Vaucheria*
d. Bacillariophyceae: *Pinnularia*
e. Phaeophyceae : *Sargassum*
f. Rhodophyceae :*Polysiphonia*

Module 3 **4 hrs**

Economic importance

a. Algae as pollution indicator and in waste water treatment
b. Commercial products: Agar, Alginates, Carrageenin, Diatomaceous earth
c. Algae in soil fertility, Fertilizer, Nitrogen fixation, minerals, soil algae and symbiosis

d. Sources of food & medicine
e. Diatoms and nanotechnology
f. As a source of Hydrogen as fuel
g. Toxic algae – Algal blooms, red tides & fish poisoning
h. Algae as primary producers – Oxygen liberators
i. Cyanobacteria as a source of restriction endonuclease
j. Role of algae in aquaculture.

Module 4 **3 hrs**

Algal culture: isolation, cultivation and preservation of micro- and macro-algae. (Brief account only)

Pratical **18 hrs**

1. Conduct a field visit to any one of the ecosystems rich in Algae to experience algal diversity. Submit a report of the visit with photographs.
2. Make micro preparation of vegetative and reproductive structures of the types mentioned in the syllabus and make labelled sketches of the specimens observed.
3. Identify the algal specimens up to the generic level by noting their key characters.
4. Algal Culturing: isolation and cultivation of microalgae and macro algae using suitable growth media [Demonstration only].
5. Familiarize the technique of algal collection and preservation and submit at least five algal specimens.

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1. Agarwal S.K, 2008. *Foundation course in Biology*, Ane Books Pvt. Ltd., New Delhi.
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3. Aneja K. R, 1996. *Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation*. Wishwa Prakasan, Delhi.
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15. Lee Robert Edward, 2009. *Phycology*. 4th Edn. Cambridge University Press, New Delhi.

16. Mamatha Rao, 2009. *Microbes and Non flowering plants- impact and application* Ane Books P.Ltd.
17. Parihar L, 2008. *Advances in Applied Microbiology*, Agrobios, Meerut.
18. Pellczar M.J Reid and Chan E.C.S, 1977. *Microbiology*. Tata McGraw-Hill publishing Co., New Delhi.
19. Prescolt S.C, 2009.*Industrial Microbiology*, Agrobios, Meerut.
20. Sharma O.P, 2004. *Text Book of Algae*, Tata Mc. Graw Hill Co.
21. Sharma P. D, 2005. *Microbiology and Plant Pathology* Rastogi publication Meerut.
22. Vasishta B R, Sinha A.K, Singh V.P, 2004. *Botany for Degree Students. Algae*. S. Chand & Co. Ltd. New Delhi.

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http://www.algaebase.org/
http://www.seaweed.ie/
http://www.brphycsoc.org/ (British Phycological Society)
http://www.intphycsoc.org/ (International Phycological Society)
http://www.isaseaweed.org/ (International Seeweed Association)
http://botany.si.edu/projects/algae/
http://botany.si.edu/projects/algae/ (Smithsonian National Museum of Natural History)

Semester II

Course 2
19U2CRBOT2 MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

(Theory: 36 hours; Practical: 36 hours) (Theory Credit 2, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Understand the diversity of fungi and Lichens
CO2	Understand the reproductive behaviour in fungi and lichen
CO3	Understand the biotechnological application of fungi
CO4	Understand ecological significance of fungi and lichens
CO5	Know the economic significance of the fungal world
CO6	Carry out the mushroom cultivation in at a small scale industry level
CO7	Identify the plant diseases and it's control measures

I. MYCOLOGY (Theory 26 hours; Practical: 26 hours)

Module 1 **18 hrs**

1. Introduction, structure, reproduction, life cycle, evolutionary trends. Classification based on Ainsworth (1973)
2. Distinguishing characters of different classes of fungi with special reference to reproductive structures and life history of the genera mentioned in each group

a) Myxomycotina - General Characters
b) Mastigomycotina - *Albugo*
c) Zygomycotina - *Rhizopus*
d) Ascomycotina
- Hemiascomycetes - *Saccharomyces*
- Plectomycetes - *Pencillium*
- Pyrenomycetes - *Xylaria*
- Discomycetes - *Peziza*

e) Basidiomycotina
- Teliomycetes - *Puccinia*
- Hymenomycetes - *Agaricus*

f) Deuteromycotina - *Fusarium*

Module 2 **8 hrs**

1. Economic importance of Fungi – useful and harmful aspects.

2. Fungi of Agricultural importance – mycoherbicides, myconematicides, mycoparasites, Mycorrhiza – diversity, function and significance.
3. Fungal biotechnology- Fundamental principles.
   Mushrooms- edible and poisonous types.
   cultivation technique-Spawn production .
   Cultivation of Oyster mushroom.

Practical **24 hrs**

1. Students are expected to identify the following types by making suitable microprepartions and make labeled sketches *Albugo*, *Rhizopus, Saccharomyces, Pencillium, Xylaria, Peziza, Puccinia, Fusarium and Parmelia.*
2. Isolation and culture of Oyster mushroom mycelium.
3 Preparation of bed for mushroom cultivation.
4. Staining of endomycorrhiza or fungus using Trypan Blue.

Additonal Credit : Virtual Lab Experiments

1. Aseptic techniques and transfer of micro-organisms.
2. Selective and differential media for identifying micro-organisms.
3. Slide culture technique for fungi.

II. LICHENOLOGY **2 hrs**

Module 1

General account , economic and ecological importance of lichen
Structure, reproduction and life cycle of *Parmelia.*

III. PLANT PATHOLOGY (Theory 10 hours; Practical: 10 hours)

Module 1 **2 hrs**

History of plant pathology, Classification of plant diseases on the basis of causative organism and symptoms, Host parasite interaction, Defense mechanism in host, Mechanism of infection, transmission and dissemination of diseases.

Module 2 **1 hr**

Control of plant diseases –
Prophylaxis-quarantine measures, seed certification
Therapeutic – physical therapy, chemotherapy.
Biological control.

Module 3 **7 hrs**

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, Leaf mosaic disease of Tapioca, Citrus canker.
Fungicides - Bordeaux mixture, Tobacco Neem decoction, preparation. (Brief account only)

Practical **10 hrs**

Students are expected to:

1. Identify the diseases mentioned in the syllabus with respect to causal organisms and symptoms
2. Submit herbarium preparations of various stages (3stages) of any one of the diseases mentioned.
3. Students should be trained to prepare the fungicide – Bordeaux mixture, Tobacco decoction.

Suggested Additional Topics

Fungal ecology - details of fungal decomposition of organic matter, coprophilous fungi, cellulolytic fungi, lignin degrading fungi, details of wood decay, soil fungi, Plant diseases, Role of enzymes in pathogenesis.

References :

1. Ahamadjian Vernon and Hale M.E (eds) 1973. *The Lichens* , Academic press, New Delhi.
2. Ainsworth G.C ., Sparrow K.F & Sussman A.S (eds) 1973. *The Fungi an advanced Treatise*, Vol. 4 a & 4b, a Taxonomic review with keys , academic press New York.
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http://www.fs.fed.us/r6/nr/fid/coolpath.shtml
http://fruit.wsu.edu/
http://www.apsnet.org

Semester III

Course 3

19U3CRBOT3 BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS & PALAEOBOTANY

(Theory: 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Understand the morphological diversity of bryophytes, pteridophyte, and gymnosperms
CO2	Understand the reproductive behaviour in bryophytes, pteridophyte, and gymnosperms
CO3	Know the evolutionary trends in bryophytes, pteridophyte, and gymnosperms
CO4	Understand ecological significance of bryophytes, pteridophyte, and gymnosperms
CO5	Know the economic significance of bryophytes, pteridophyte, and gymnosperms
CO6	Understand the habitat variation in bryophytes, pteridophyte, and gymnosperms
CO7	Understand the diversity and distributions of prehistoric flora

BRYOLOGY (Theory: 16 hours; Practical: 9 hours)

Module 1 **2 hrs**

Introduction, general characters, classification, Evolution of Bryophytes.

Module 2 **12 hrs**

Morphology, anatomy and reproduction in *Riccia, Marchantia, Anthoceros* and *Funaria.* Evolution of sporophyte and gametophyte (Development of sex organs not necessary).

Module 3 **2 hrs**

Importance of Bryophytes, Prevention of soil erosion, pollution monitoring and control, Antibiotics, Horticultural importance.

Practical **15 hrs**

Make micro preparations of the types mentioned. Study vegetative and reproductive structures.

PTERIDOLOGY (Theory:16 hours; Practical :24 hours)

Module 1 **2 hrs**

Introduction, general characters, classification and evolution of Pteridophytes.

Module 2 **14 hrs**

Structural organization of sporophyte and gametophyte (development of sex organs not necessary) of the following types with special reference to stelar structure, heterospory and seed habit.

1. *Psilotum*
2. *Lycopodium*
3. *Selaginella*
4. *Equisetum*
5. *Pteris*
6. *Marsilea*

Practical **18 hrs**

Make micropreparations to study stelar structure and sporangia of the mentioned types. Identify at sight, noting the morphology.

GYMNOSPERMS **(Theory: 14 hours ; Practical :12 hours)**

Module 1 **2 hrs**

Introduction, general characters, classification, origin and evolutionary significance

Module 2 **12 hrs**

Study of morphology, anatomy and reproductive features of *Cycas, Pinus* and *Gnetum.*

Practical **12 hrs**

Study of the morphology, anatomy and reproductive structures of the types mentioned.

PALAEOBOTANY **(Theory: 8 hours)**

Module 1 **3 hrs**

Introduction, study of geological time scale, formation of fossil, fossil types & technique of study, fossil as a fuel.

Module 2 **4 hrs**

Detailed study of

Fossil Pteridophyte : *Rhynia*
Fossil Gymnosperm: *Williamsonia*
Fossil Angiosperm : *Palmoxylon*

Indian contribution to Palaeobotany **1 hr**

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http://www.bryoecol.mtu.edu/
http://www.mobot.org/MOBOT/tropicos/most/Glossary/glosefr.html
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http://www.fiu.edu/~chusb001/giant_equisetum.html
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http://www.nrm.se/en/menu/researchandcollections/departments/cryptogamicbotany/collections/pteridophytes.652_en.html
http://www.amerfernsoc.org/
http://www.gymnosperms.org/
http://www.plantapalm.com/vce/toc.htm
http://www.cycad.org/conservation.htm
http://allwebhunt.com/cgi.cfm/Top/Science/Biology/Flora_and_Fauna/Plantae/Cycadophyta/Cycadopsida/Cycadaceae/Cycas
http://www.forestgiants.com/
http://www.azpalmandcycad.org/

Semester IV

Course 4

19U4CRBOT4 ANATOMY, MICROTECHNIQUE AND ANGIOSPERM MORPHOLOGY

(Theory: 54 hours; Practical: 36 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (Cos)	
CO1	Understand the plant cell structure in a detailed manner
CO2	Understand the tissue level organization in plant system
CO3	Understand the morphological features of angiosperms
CO4	Know and carry out the plant anatomical specimen preparations
CO5	Understand the details of wood anatomy
CO6	Understand different inflorescence and fruit types in plant kingdom

ANATOMY (Theory: 36 hours, Practical: 18 hours)

Module 1: Structure and composition of plant cells 8 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.

Module 2: Organization of tissues 9 hrs

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

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 3: Plant body structure **6 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, and *Dracaena* stem.

Module 4: Wood anatomy **4 hrs** Basic structure of wood - heart wood, sap wood; hard wood, soft wood; growth rings and dendrochronology; porous and non-porous wood; ring porous and diffuse porous wood, tyloses. Reaction wood: tension wood and compression wood.

Practical **18 hrs**

1. Cell types and tissues.
2. Non-living inclusions – starch grains, cystolith, raphides, aleurone grains.
3. Primary structure of stem, root and leaf - Dicots and Monocots.
4. Stomatal types: - anomocytic, anisocytic, paracytic, diacytic and grass type.
5. Secondary structure of dicot stem and root.
6. Anomalous secondary structure of *Bignonia* stem and *Dracaena* stem.
7. Maceration of wood elements

MICROTECHNIQUE (Theory 9 hrs; Practical 9 hrs)

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.
5. Preparation of single stained hand sections (Permanent – demonstration only).

ANGIOSPERM MORPHOLOGY (Theory 9 hours; Practical: 9 hours)

Unit 1: Plant habit- Herbs, Ephemerals, Shrubs, Trees, Climbers (vines and lianas)
Unit 2: Leaf Morphology - types, venation, phyllotaxy
Unit 3: Morphology of flower - Parts of a flower- description of flower and its parts in technical terms.
Unit 4: Inflorescence:

(a) Racemose types-Simple Raceme, Corymb, Panicle, Umbel, Spike, Spadix, Head and Capitulum.
(b) Cymose types-Simple Cyme, Monochasial- Scorpoid and Helicoid, Dichasial
(c) Special type- Cyathium, Hypanthodium, Verticillaster, Thyrse

Unit 4 Fruits: Simple-Fleshy, Dry- dehiscent, indehiscent, Aggregate, Multiple (Sorosis and Syconus)

Practical

1. Based on the theory topics.

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Semester V

Course 5

19U5CRBOT5 ANGIOSPERM SYSTEMATICS AND ECONOMIC BOTANY

(Theory 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit1)

COURSE OUTCOMES (COs)	
CO1	Know about the natural order in plant kingdom
CO2	Understand the various classification systems and its scope in plant systematics
CO3	Understand the morphological and molecular features of angiosperms in a systematic way
CO4	Gain knowledge about various plants and plant products
CO5	Understand the role of plants in human welfare
CO6	Know about field exploration and plant specimen handling in botanical studies

Module 1: Floral Morphology **6 hrs**

a) Ovary position and types of flowers: Superior, Inferior and Half-inferior; Hypogyny, Perigyny, Epigyny, Epihypogynous and Epiperigynous
b) Floral symmetry- Actinomorphic, Biradial, Zygomorphic and Asymmetric.
c) Aestivation types- Imbricate, Twisted, Valvate, Imbricate-alternate, Quincuncial and Involute.
d) Placentation types- Axile, Apical, Apical-axile, Basal, Basal-axile, Marginal, Free-central, Laminar, Parietal, Parietal-axile and Parietal-septate.
e) Floral Diagram and Floral Formula.

Module 2: Systematic Botany **8 hrs**

a) Types of Classification- Artificial System- Linnaeus System, Natural system- Bentham and Hooker's System, and Phylogenetic System-APG (Brief account).
b) Binomial Nomenclature, ICN and its Principles
c) Cytotaxonomy, Chemotaxonomy and Molecular Systematics
d) Herbarium technique- steps involved in the preparation of herbarium and its significance.

e) Brief study on Flora, Revision and Monographs.

Module 3: Angiosperm Families **30 hrs**

Study the following families of Bentham and Hooker's System with special reference to their morphological and floral characters. Special attention should be given to common and economically important plants (Binomial, family and Morphology of useful parts) within the families.

(1) Annonaceae,	(2) Capparidaceae,	(3) Malvaceae,	(4) Rutaceae,
(5) Fabaceae,	(6) Caesalpiniaceae,	(7) Mimosaceae	(8) Combretaceae,
(9) Myrtaceae,	(10) Cucurbitaceae,	(11) Apiaceae,	(12) Rubiaceae,
(13) Asteraceae,	(14) Sapotaceae,	(15) Apocynaceae,	(16) Asclepiadaceae,
(17) Solanaceae,	(18) Convolvulaceae,	(19) Scrophulariaceae,	(20) Acanthaceae,
(21) Verbenaceae,	(22) Lamiaceae,	(23) Euphorbiaceae,	(24) Orchidaceae,
(25) Arecaceae,	(26) Poaceae.		

Module 4: Economic Botany **7 hrs**

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

a) Cereals - Rice, Wheat
b) Millets - Ragi
c) Pulses - Green gram, Bengal gram, Black gram
d) Sugar yielding plants - Sugarcane
e) Fruits - Apple, Pineapple, Orange, Mango and Banana
f) Vegetables - Bitter Gourd, Ladies finger, Carrot and Cabbage.
g) Timber yielding plants - Teak wood and Jack wood
h) Beverages - Tea, Coffee
i) Fibre yielding plants - Coir, Jute, Cotton
j) Oil yielding plants - Ground nut, Gingelly
k) Rubber yielding plants - Para rubber
l) Gums and Resins - White damer, Gum Arabic, Asafoetida
m) Spices - Cardamom, Pepper, Cloves , Ginger
n) Insecticide yielding Plants - Tobacco and Neem

Module 5: Ethnobotany **3 hrs**

Study of the following plants used in daily life by ethnic people and village folks for food, shelter and medicine.

a) Food- *Artocarpus, Corypha, Phoenix* (wild dates)
b) Shelter- *Bambusa, Ochlandra and Calamus*
c) Medicine- *Curcuma, Trichopus zeylanicus and Alpinia galanga*

Practical **45 hrs**

1. Identification of aestivation and placentation types.
2. Identify the families mentioned in the syllabus by noting their key, vegetative and floral characters. 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.
3. Study the finished products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
4. Identify and describe the ethnobotanical uses of the items mentioned in the syllabus.
5. Prepare and submit herbarium of 25 plants with duly certified field book.
6. Conduct field work for a minimum of 5 days under the guidance of a teacher

Suggested additional topics

1. Interdisciplinary approach in Taxonomy, Molecular taxonomy, Numerical taxonomy, Barcoding for species identification and Taxonomy for biodiversity characterization.
2. Binomial nomenclature- Historical account, ICBN, Principles and major rules in – Type concept, priority, valid publication, author citation.

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Semester V

Course 6

19U5CRBOT6 ENVIRONMENTAL SCIENCE AND ECOTOURISM

(Theory: 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Know about the significance of environmental science
CO2	Create responsible citizens on conservation of nature and natural resources
CO3	Design novel mechanism for the sustainable utilization of natural resources
CO4	Understand the ecological interactions in various ecosystems
CO5	Understand various environmental laws in India
CO6	Understand the current environmental issues and its global impacts
CO7	Analyze various ecosystems for its impact in human life

ENVIRONMENTAL SCIENCE **48 hrs**

Module 1 Environmental science and its multidisciplinary nature **1 hr**
Introduction, relevance and scope, public awareness

Module 2 Natural Resources **2 hrs**
Types of resources - renewable and non-renewable
Types based on utility -Forest resources, Water resources, Food resources, Energy resources, Land resources
Conservation of Biodiversity, ecological footprints, umbrella species and keystone species conservation.

Module 3 Ecosystems **10 hrs**
Structure and function of ecosystem: Ecosystem components- abiotic and biotic, Productivity – primary and secondary-gross and net productivity. Decomposition in nature, homeostasis in ecosystem
Ecological energetics: energy flow, trophic levels, food chain and food web, ecological pyramids
Nutrient cycles: Biogeochemical cycles of C, N and S.

Module 4 Community ecology **4 hrs**
Population: size, density, natality, mortality.

Community characteristics: Species diversity and species richness, dominance, growth forms and structure, trophic structure.
Association of communities: plant association, ecotypes, ecotone, edge effect, ecological indicators.
Ecological succession: types of succession, process – migration, ecesis, colonization, stabilization and climax community; hydrosere, xerosere, lithosere.

Module 5 Plants and environment **4 hrs**

Ecological complexes and factors affecting plants growth and response:
Climatic factors: temperature and pressure; water - precipitation, humidity, soil water holding capacity; light - global radiation.
Topographic factors: altitude and aspects
Edaphic factors - profile and physical and chemical properties of soil
Biotic factors: interactions – positive and negative.
Species – ecosystem interaction: Habitat, ecological niche, microclimate
Adaptation of plants to environment: To Water- Xerophytes, Hydrophytes; Temperature – thermo periodicity, vernalization; light – photoperiodism, heliophytes, sciophytes; salinity – halophytes, mangroves.

Module 6 Environmental pollution and Management **12 hrs**

Definition and general introduction
Air pollution: Causes and sources, types of pollutants-particulates-aerosol, mist, dust, smoke, fume, plume, fog, smog. Effect of air pollution on plants and animals, Bhopal Gas Tragedy.
Water pollution: Sources and types of pollutants. Water quality standards, water quality assessment. Ground water pollution-blue baby syndrome. Cycling of heavy metals, hydrocarbons. Eutrophication, BOD, Minamata disease.
Soil pollution: Causes and sources-waste dumps, municipal wastes, agrochemicals, mining, solid waste management-vermi composting.
Noise pollution: Sources, standards and measurements, effect on health, control techniques.
Thermal pollution: Sources and effects, management
Nuclear hazards: Sources and impacts, management, Chernobyl incident
EIA: Environmental Impact Assessment in polluted areas

Module 7 Social issues and the environment **2 hrs**

Climate change, global warming and greenhouse gases, IPCC, Acid rain, Ozone layer depletion, nuclear accidents and nuclear holocaust.
Significance of EIA (Environmental Impact Assessment)

Module 8 Environmental legislation and laws **1 hr**

Environment (protection) Act, 1986, (2) Air (Prevention and control of pollution) Act, 1981, (3) Water (Prevention and control of pollution) Act, 1974, (4) Wildlife (protection) Act, 1972, (5) Forest (Conservation) Act, 1980, (6) Biological Diversity Act (2002) (briefly).

Module 9 Biodiversity and Conservation biology **6 hrs**

Biodiversity – definition; Endemism: Definition-types-factors. Hotspot of endemism-hotspots in India. IUCN-threat categories, RET. Red Data Book, Western Ghats as the hottest spot and its conservations.
Biodiversity loss: Causes and rate of biodiversity loss, extinction-causes. Alien species, negative and positive impacts
Conservation efforts: Rio Earth Summit, Agenda 21, Kyoto protocol, COP 15(15^{th} Conference of the Parties under the U N Framework Convention on Climate Change), IPCC (Inter Governmental Panel for Climate Change) and its contribution. Conservation strategies and efforts

in India and Kerala, *In situ* and *ex situ* conservation methods. Applications of remote sensing and GIS (brief account). Role of NGOs in biological conservation

Module 10 Organizations, movements and contributors of Ecological studies 2 hrs
Organizations: BNHS, WWF, CSE, NEERI, MoEF, Green Peace, Chipko
Famous contributors of Ecology in India: Salim Ali, M.S. Swaminathan, Madhav Gadgil, M.C. Mehta, Anil Agarwal, Medha Patkar, John C. Jacob, Sunderlal Bahuguna.

Module 11 Environment and human rights 4 hrs
Environment and human rights: right to clean environment and public safety; issues of industrial pollution; Conservation of natural resources and human rights (briefly). Conservation issues of the Western Ghats – Madhav Gadgil committee report (brief study only).

ECOTOURISM 6 hrs

Definition, concept, introduction, history, relevance and scope. Components of ecotourism. Forms and types of ecotourism in India and Kerala, ecotourism resources- biological, historical, cultural, and geographical. Ecotourism centers in Kerala. Positive and negative impacts of ecotourism.

Practical 45 hrs

1. Estimation of CO_2, Cl_2, and salinity of water samples (Titremetry)
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. Visit to any forests types including grasslands and preparation of the list of Rare and threatened (R&T) plants (no collection of specimens)
7. Collection, identification and preparation of the list of exotic species in the locality.
8. Identification of pollutant to respective pollution types.
9. Study of anatomical, morphological, physiological adaptation of plants to the environment (Xerophytic, Hydrophytic, Epiphytic, Halophytic).
10. Collection and recording of rain data by using simple rain gauge.

Additional Credits: Virtual Lab Experiments

1. Biological Oxygen Demand
2. Chemical Oxygen Demand of waste water
3. Case studies on Ecology

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Semester V

Course 7

19U5CRBOT7 GENETICS AND PLANT BREEDING

(Theory 54 hours; Practical 45 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Understand the science of plant breeding and genetics
CO2	Understand the branch of plant breeding for the survival and success of human civilizations
CO3	Understand the techniques for the production of new superior crop varieties
CO4	Understand the modern strategies applied in genetics and plant breeding for human welfare
CO5	Understand the inheritance and variation of genetic characters
CO6	Understand the background of genetic disorders
CO7	Analyze and predict the occurrence of genetic traits and its impact in human life

GENETICS (Theory 40 hrs)

Module 1: Origin and development of Genetics **3 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.

Module 2: Exceptions to Mendelism **15 hrs**

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

Geneic interaction: Epistasis, (a) Dominant Epistasis - fruit colour in summer squashes (b) Recessive Epistasis - 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 3: Linkage of genes **5 hrs**

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.

Module 4: Determination of sex **7 hrs**

Sex determination: 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.

Module 5: Quantitative inheritance **3 hrs**

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

Module 6: Extra-chromosomal inheritance **5 hrs**

Extra chromosomal inheritance: chloroplast mutation - variegation in 4O'clock plant; mitochondrial mutations in yeast. Maternal effects - Streptomycin resistance in *Chlamydomonas*; infective heredity - kappa particles in *Paramecium*.

Module 7: Population genetics **2 hrs**

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

Practical **36 hrs**

a. Students are expected to work out and record the problems in:

1. Monohybrid, dihybrid cross and back crosses.
2. All types of modified Mendelian ratios mentioned in the syllabus.

b. Study of human karyotype and study of characteristic karyotypes and symptoms of the syndromes mentioned in the syllabus and record it.

PLANT BREEDING (Theory: 18 hours)

Module 1 **1 hour**

An Introduction to and objectives of plant breeding.

Module 2 **1 hr**

Plant introduction- procedure of plant introduction, quarantine regulations, acclimatization- agencies of plant introduction in India, major achievements.

Module3 **2 hrs**

Selection- mass, pure-line, clonal- genetic basis of selection- some achievements – semi dwarf wheat and Rice.

Module 4 **5 hrs**

Hybridization- Introduction, history, objectives and procedure- choice of parents, evaluation of parents, emasculation procedures such as hand method, succession method, hot water method, alcohol method and cold treatment methods- intergeneric, interspecific and intervarietal hybridization with examples- composite and synthetic varieties- heterosis in plant breeding, inbreeding depression; genetics of heterosis and inbreeding depression; single cross, pedigree

method, bulk population method, multiple cross, back cross, male sterility in plant breeding. Use of apomixis in plant breeding.

Module 5 **2 hrs**

Mutation breeding and polyploidy breeding - methods- achievements in India; breeding for pest, disease and stress resistance

Module 6 **2 hrs**

Modern tools for plant breeding; Genetic Engineering and products of genetically modified crops. Certification process for plant breeders; process, agencies and their significances

Practical **9 hrs**

1. Emasculation and bagging
2. Comparison of percentage of seed germination and the effect of any one chemical on the rate of elongation of radicle in any three crop seeds

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Semester V

Course 8

19U5CRBOT8 CELL MOLECULAR BIOLOGY AND EVOLUTION

(Theory: 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit 1)

	COURSE OUTCOMES (COs)
CO1	Understand the molecular biology of a cell and its implications
CO2	Differentiate the ultrastructure of prokaryotic and a eukaryotic cell
CO3	Understand the chromosomes and the aberrations in its number and structure
CO4	Understand the stages of cell cycle and carry out mitosis and meiosis
CO5	Understand the genetic variation due to mutation and its significance
CO6	Understand the molecular structure of nucleic acids
CO7	Know about the gene expression and its control
CO8	Know the genetic basis of cancer
CO9	Understand the concept of evolution as the basis of biodiversity

CELL BIOLOGY (Theory: 28 hrs)

Unit 1. Historical account of cell Biology, Cell theory, Protoplasm theory **1 hr**

Unit 2. Cell **8 hrs**

The physio-chemical nature of plasma membrane and cytoplasm Eukaryotic, Prokaryotic cell. The ultra structure of plant cell with brief description and function of the following organelles-Endoplasmic reticulum, Plastids, Mitochondria, Ribosomes, Dictyosome, Microbodies, lysosomes. Vacuole and cell sap, Nucleus - ultra structure, nucleolus structure and function.

Unit 3. Chromosomes **15 hrs**

Morphology - fine structure Dupraw model - Nucleosome model – chemical organization of nucleosome – nucleoproteins, karyotype and idiogram; Special type of chromosomes - salivary gland, Lampbrush and B chromosome. Cell cycle, mitosis, meiosis: significance of mitosis and meiosis. Change in number of chromosomes -Aneuploidy and Euploidy
Change in the structure of chromosomes - Chromosomal aberrations deletion, duplication, inversions and translocations. Meiotic behaviour of chromosomes. Lagging of chromosomes and Chromosome Bridge

Unit 4. Mutations **2 hrs**
Spontaneous and induced. Mutagens- Physical and Chemical mutagens.
Chromosomal and point mutations. Molecular mechanism of mutation - Transition, Transvesion and Substitution.

Unit 5. Stem cells; definition, sources and applications. **2 hrs**

MOLECULAR BIOLOGY (Theory: 17 hrs)

Unit1. Nucleic acids - structure of DNA and RNA - basic features, alternate forms of DNA - types and structure of RNA **3 hrs**

Unit2. Replication of DNA - Meselson-Stahl experiment - details of semiconservative replication of DNA **3 hrs**

Unit3. Gene expression - concept of gene, definitions - the central dogma - details of transcription in procaryotes and eucaryotes - RNA prosessing.details of translation - genetic cod features **6 hrs**

Unit4. Control of gene expression - positive and negative control - operon model - lac operon, trp operon -attenuation **3 hrs**

Unit5. Genetic basis of cancer - oncogenes - tumor suppressor genes - metastasis **2 hrs**

Practical
Problems based on DNA, RNA and Proteins **9 hrs**

EVOLUTION (Theory: 9 hrs)

Unit 1. Introduction, Origin of life – biochemical origina of life, Progressive, Retrogressive, Parallel and Convergent evolution. Theories of evolution - Lamark's, Darwin's, Weisman's and De Vries. **4 hrs**

Unit 2 Neo Darwinism **5 hrs**
Reproductive isolation, Mutation, Genetic drift, Speciation. Variation and evolution, hybridization and evolution, Polyploidy and evolution. Mutation and evolution.

Practical (36 hrs)

1. Make acetocarmine squash preparation of onion root tip to identify mitotic stages.
2. Study the Mitotic Index of onion root tip cells
3. Study of meioses in any flower bud by smear preparation of PMC's

4. Identification of Barr body
5. Identification of salivary gland chromosome.
6. Identify and study photographs and diagrams of cell division anomalies like lagging chromosomes, chromosome bridge, aneuploidy, polyploidy. Study the chromosomal patterns/ Karyotype in auto-, allo-, and aneuploids

Additional Credits: Virtual Lab Experiments

1. Lignin staining
2. Preparation of Buffer Stocks
3. Plasmid isolation

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Semester V

Open Course

BO5D01U AGRIBASED MICROENTERPRISES

(72 Hours) Theory Credits 3

	COURSE OUTCOMES (COs)
CO1	Know the plausibleness of entrepreneurial aspects in plant science
CO2	Know about the basics of organic farming in agriculture
CO3	Compare sustainable agricultural practices
CO4	Know the importance of floriculture and cut flower industry
CO5	Understand the nursery management and it's industrial significance
CO6	Design the mushroom cultivation techniques
CO7	Understand the basics of plant tissue culture

Module 1 Organic Farming and Composting Techniques **9 hrs**

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. Sustainable agriculture.

Module 2 Horticulture and Nursery management **20 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. Micropropagation by tissue culture. Gardening – Types of garden – ornamental, indoor garden, kitchen garden, vegetable garden for marketing. Rockery and artificial ponds. Ornamental garden designing – garden components – flower beds, borders, hedges, edges, drives and paths, garden adornments. Lawn - preparation by seeds, by transplanting seedling and by turfing. Bonsai preparation. Pruning of plants. Types of Nurseries – Management aspects and Maintenance. Irrigation Methods: surface, drip and mist chamber. Plant growth structures – advantages of green house, polyshed, fernery and orchidarium. Packaging of fruits, vegetables, nursery products and flowers.

Module 3 Floriculture and Flower Arrangement **7 hrs**

Prospects and problems of floriculture in Kerala, Scope of floriculture, especially anthurium, orchids and jasmine in Kerala, Common cut flowers- Rose, Gerbera, Gladiolus, Aster, Chrysanthemum, Carnation, Anthurium, Lilium, Orchids; Common leaves in flower arrangement – Cyprus, Podocarpus, Asparagus, palms, cycads, ferns; Flower arrangement types – western, eastern (Japanese), modern, wases, flower holders, floral foam, dry flower arrangement.

Module 4 Mushroom Cultivation and Spawn Production **9 hrs**

Significance of Mushrooms, General outline of life cycle. Types of mushrooms - button mushroom, oyster mushroom and milky mushroom, poisonous mushroom – methods of identification. Spawn – isolation and preparation. Cultivation of oyster and milky mushrooms – using paddy straw and saw dust by polybag. Farm design and control of pests and diseases. Value added products from mushroom – pickles, candies, dried mushrooms.

Module 5 Plant Tissue Culture and Micropropagation **9 hrs**

Protoplasm - basic structure of plant cell; Concept of totipotency - differentiation and dedifferentiation. Infra-structure of a tissue culture laboratory. Solid and liquid media-composition. Sterilization - dry, wet and filter sterilization. Explant- inoculation and incubation techniques. Callus induction- organogenesis and embryogenesis. Transplanting, hardening, package and transportation of tissue cultured plantlets.

Module 6 Self Employment Opportunities **3 hrs**

Funding Agencies and self-employment schemes, Procedure to get financial support, special scheme for women empowerment.

Hands on Training **15 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, epicotyle grafting and air layering on live plants
9. Familiarization of garden components from photographs
10. Familiarization of different mushrooms and preparation of a polybag of *Pleurotus* using straw/sawdust
11. Visit to a well established tissue culture lab, nursery and mushroom cultivation unit.
12. Familiarization of common cut flowers in Kerala
13. Fresh cut flower arrangement
14. Preparation and arrangement of dry flowers
15. Interaction with funding agencies

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Semester VI

Course 9

19U6CRBOT9 PLANT PHYSIOLOGY AND BIOCHEMISTRY

(Theory 54: hours; Practical: 45 hours) **(Theory Credit 2, Practical Credit 2)**

	COURSE OUTCOMES (COs)
CO1	Understand the relationship of plant with its habitat
CO2	Differentiate mineral nutrition and mechanism of absorption
CO3	Understand the mechanism of photosynthesis
CO4	Know the transport mechanism happening in plant system
CO5	Understand the respiration mechanism in plants
CO6	Know the plant responses to environment
CO7	Understand the physiology of growth and development in plants
CO8	Understand the biochemical nature of plant cell
CO9	Know the chemical nature of biomolecules
CO10	Understand the general features of enzymes
CO11	Identify the osmotic pressure, stomatal index, and pigment vations in plant system

PLANT PHYSIOLOGY (Theory: 36 hours; Practical: 33 hours)

Module 1 Water relations **6 hrs**

A. Physical aspects of absorption-Diffusion, imbibition, osmosis, OP, DPD, TP, WP, Concept of Water potential- osmotic/solute potential, gravity potential, matric potential, pressure potential.

B. Absorption of water-active & passive, radial pathway of water movement – apoplastic, symplastic & transmembrane pathway, Ascent of sap-cohesion tension theory, Transpiration-types-mechanism-theories- (starch-sugar inter conversion hypothesis, Active K^+ ion exchange)-significance – anti-transpirants, Guttation.

Module 2 Mineral Nutrition and mechanism of absorption **3 hrs**

Essential and non essential elements- macro& micro- role- deficiency symptoms. Absorption of minerals– active & passive- carrier concept, ion exchange.

Module 3 Photosynthesis **10 hrs**

History – PAR, Photosynthetic pigments, photo excitation- Fluorescence, Phosphorescence - Absorption and action spectra, Red drop and Emerson enhancement effect, Concept of photo systems, Cyclic & Non Cyclic photophosphorylation, Carbon assimilation pathways-C_3, C4, CAM-Photorespiration –factors affecting photosynthesis- Blackmann's law of limiting factors.

Module 4 Translocation of solutes **2 hrs**

Pathway-phloem transport-mechanism-pressure flow-phloem loading and unloading.

Module 5 Respiration **8 hrs**

Aerobic and Anaerobic, Glycolysis, Krebs cycle, Electron transport system & Oxidative phosphorylation. ATPases - chemi osmotic hypothesis-RQ –significance-factors affecting respiration.

Module 6 Plant responses to environment **1 hr**

Allelochemicals- herbivory

Module 7 Physiology of growth and development **4 hrs**

A. Physiological effects and practical applications of hormones- Auxins, Giberillins, Cytokinins, ABA, ethylene.
B. Physiology of flowering–phytochrome-photoperiodism-vernalization

Module 8 Stress physiology **2 hrs**

Abiotic - concept of plant responses to water, salt and temperature stresses; Biotic- pathogens

Practical (33 hours)

Core Experiments

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

Practical Experiments –Only demonstration.

1. Papaya petiole osmoscope.
2. Demonstration of tissue tension.
3. Relation between transpiration and absorption.
4. Necessity of chlorophyll, light and CO_2 in photosynthesis.
5. Simple respiroscope
6. Respirometer and measurement of R.Q.
7. Fermentation.
8. Measurement of transpiration rate using Ganong's photometer/ Farmer's Potometer.

BIOCHEMISTRY (Theory 18: hours; Practical: 12 hours)

Module 1 Water, Solutions & pH **2 hrs**

Physical and chemical properties of water, Acid and bases, pH definition, significance, measurement, pH indicators, buffer action, pH and lif .

Module 2 Chemistry of biological molecules **10 hrs**

Carbohydrates- structure and role of mono-di & poly-saccharides-common sugars seen in plants Proteins-peptide bond-essential and non-essential amino acids- structural levels of proteins - primary, secondary, tertiary and quaternary-physiologically important proteins. Lipids - general features and their roles - fatty acid types and structure - fatty acid derivatives- fats and oils, structure and functions - compound lipids

Module 3 Enzymes **6 hrs**

Nomenclature, characteristics mechanism and regulation of enzyme action, enzyme kinetics, factors affecting enzyme action.

Practical **(12 hours)**

1. General test for carbohydrates- Molischs test, Benedicts's tests, Fehling's test.
2. Colour test for starch – Iodine test.
3. Colour tests for proteins in solution. Biuret test, Million's test, Ninhydrin test.
4. Detect the presence of any three major organic compounds in the given food stuff/material viz. reducing /non-reducing sugar/fat proteins/starch/sucrose.
5. Action of various enzymes in plant tissues: peroxides, dehydrogenase.
6. Estimation of protein using colorimeter.

Additional Credits: Virtual Lab Experiments

1. Isolation of plant pigments by column chromatography
2. Construction of protein standard curve using Folin's Lowry method
3. Effect of substrate concentration on enzyme kinetics

Suggested additional topics

1. Mycorrihzae
2. Chelating agents
3. Photosynthetic rates, efficiencies and crop production.
4. Pentose phosphate pathway.
5. Nitrogen fixation.
6. Plant protective coats –cutins ,waxes and suberin.
7. Senescence and abscission.
8. Circadian rhythms.

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Semester VI

Course 10
19U6CRBOT10 PERSPECTIVES OF SCIENCE, METHODOLOGY AND GENERAL INFORMATICS

(Theory 54 hours, Practical 36 hours) **(Theory Credit 3, Practical credit 1)**

COURSE OUTCOMES (COs)	
CO1	Introduce the perspective of science
CO2	Understands the steps in scientific methods
CO3	Understand the steps in research methodology in plant science
CO4	Understand the uses and applications of general informatics
CO5	Understand the basis of computer in education
CO6	Understand and perform chromatography and other techniques in botany
CO7	Understand the statistical terms and its relevance in plant science

PERSPECTIVES OF SCIENCE (Theory 12 hours; Practical 4 hours)

Module 1 Introduction to science and scientific methods **4 hrs**

-Introduction to science
-Steps in scientific methods
- observation and thoughts
- formulation of a hypothesis
- designing of experiments
- testing of hypothesis
- formulation of theories

Module 2 Experimentation in science **8 hrs**

- Selection of a problem
- Searching the literature
- Selection of variables, study area, and a suitable design
- Necessity of units and dimensions
  Units of length, volume, area, concentration, temperature, pressure
- Setting of hypothesis, Null- hypothesis and alternative hypothesis
- Need of control, treatments and replication
- Analysis, presentation and interpretation of data
- Testing of hypothesis, need of statistical tools

- Examples of great experiments in life sciences
  - An example of moving from a question to hypothesis and then to an experimental design
  - Contributions and the great experiments of Louis Pasteur, and Robert Koch

-Ethics in science

Practical **4 hrs**

1. Prepare $CuSO_4$. H_2O solution of different molarity using a stock solution
2. Determination of the area of different types of leaves using graph paper.

METHODOLOGIES OF PLANT SCIENCE (Theory 24 hours, Practical 18 hours)

Module 1 Biophysics **8 hrs**

- Principles and applications of colorimeter, spectrophotometer and centrifuge, Beer-Lambert's Law,
- Separation methods :- chromatography; thin layer, paper, column (principle and applications only), electrophoresis; PAGE, Agarose gel electrophoresis (Principle and applications only)
- pH:- concept of pH, methods to measure pH ; pH paper and pH meter,
- Buffers:- definition, functions of buffers in biological systems, use of buffers in biological research, examples of commonly used buffers

Practical **10 hrs**

1. Preparation of 0.1M sodium phosphate buffer (pH 6 and 7)
2. Measurement of pH using pH meter
3. Paper chromatography of plant pigments (demonstration)
4. Electrophoresis of nucleic acids (demonstration)
5. Column chromatography of plant pigments (demonstration)
6. Determination of the concentration of a given solution of $CuSO_4$ using colorimetry

Additonal Credits: Vitual Lab

1. Western Blotting
2. Haemocytometer
3. PAGE

Module 2 Biostatistics **12 hrs**

- Introduction, statistical terms and symbols
- Sample:- concept of sample, sampling methods,
- Collection and representation of data, graphic representation of data(Line graph, bar diagram, Pie diagram & Histogram)
- Measures of central tendency:- mean, mode, median
- Measures of dispersion:- standard deviation, standard error
- Distribution patterns:- normal distribution, binomial distribution
- t-test :- introduction, uses, procedure
- chi-squire test:- introduction, uses, procedure

Practical **8 hrs**

Collect numerical data and find out the central tendencies and prepare different types of graph mentioned in the syllabus

1. Familiarize with situations requiring t-test, chi-squire test

Module 4 Research Methodology **5 hrs**

- Need for research
- Types of research
- Scientific literature, Books, Research Journals, Reputed National and International journals in life sciences, Research paper
- INSDOC services
- Laboratory Etiquette
- Laboratory Hygiene
-

GENERAL INFORMATICS (Theory 18 hours, Practical 12 hours)

Module 1 Overview of the Information Technology **3 hrs**

-Features of the modern personal computers and peripherals.

-Internet as a knowledge repository, e-mail, search engines (Google,), study of educational sites related to life sciences (DNAi, Scitable), academic search techniques, (Science direct and INFLIBNET)

-Introduction to the use of information technology in teaching and learning.

Module 2. Use of Computers **15 hrs**

-DOS – The basic concept of operating systems (Study of commands not required)

-MS-WINDOWS:- logging to windows, organizing files and folders, copying, moving, deleting and saving documents, installing software, installing hardware

-MS-WORD:- word processing using WORD, editing tools (cut , copy, paste,) formatting tools (font, paragraph) use of spell check, inserting tables (draw), inserting graphs and pictures

-MS-EXCEl:- Creating a worksheet, data entry, sorting (ascending and descending), use of statistical tools in EXCEL (SUM, MEAN, MODE, MEDIAN), preparation of graphs (bar diagram, pie chart and line graph)

-MS-POWERPOINT:- Creating a presentation, Inserting tables, charts and pictures into slides, Use of animation tools

Practical **12 hrs**

1. Gather information and pictures on a given topic using the internet. Make a list of the sites visited for the purpose
2. Prepare a project report using MS-WORD based on the information and pictures gathered from the internet.
3. Prepare a worksheet using a set of data collected and find out the SUM, MEAN, MEDIAN and MODE using EXCEL
4. Prepare suitable tables/ charts/graphs based on the data using EXCEL
5. Prepare a powerpoint presentation based on the 1 & 2 exercises

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Semester VI

Course 11

19U6CRBOT11 BIOTECHNOLOGY AND BIOINFORMATICS

(Theory 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Know about all the basic aspects of plant tissue culture
CO2	Understands the fundamentals of recombinant DNA technology, gene cloning strategies
CO3	Know the social and ethical issues in the field of biotechnology
CO4	Understand the scope and relevance of genome, transcriptome and proteome
CO5	Check the usefulness of biological databases
CO6	Understand the genome sequencing and sequence assembly
CO7	Know about the protein sequencing method and basics of protein structure prediction and modeling
CO8	Know the molecular phylogeny and phylogenetic trees
CO9	Outline the molecular visualization tool in proteomics

BIOTECHNOLOGY (Theory 36 hours; Practical 32 hours)

Module 1: **Plant tissue culture** **20 hrs**

1. Introduction: Defenition of biotechnology, land marks, definition of tissue culture.
2. Principles of tissue culture: Cellular totipotency, callus induction, organogenesis and somatic embryogenesis.
3. Tissue culture medium: Basic components in tissue culture medium, MS medium, Preparation medium
4. Aseptic techniques in tissue culture: sterilization of instruments and glass wares, medium, explants; working principle of laminar air flow and autoclave.
5. Micropropagation: definition, different stages of micropropagation, advantages and disadvantages.
6. Somaclonal variation: Reasons, advantages and disadvantages, applications
7. Applications of tissue culture: Shoot tip and meristem culture, Synthetic seed production, embryo rescue culture, Protoplast culture, Somatic cell hybridization, *in vitro*

secondary metabolite production, *in vitro* production of haploids – androgenesis and gynogenesis, triploid plant production, Cryopreservation.

Module 2 **8 hrs**

1. Recombinant DNA Technology
2. Gene cloning strategies – recombinant DNA construction – cloning vectors – plasmids pBR322, bacteriophage based vectors, Ti plasmids. Restriction endonucleases and ligases – Ligation techniques, transformation and selection of transformants – using antibiotic resistances markers, southern blotting; PCR.
3. Different methods of gene transfer – chemically stimulated DNA uptake by protoplast, transduction, electroporation, microinjection, microprojectiles, *Agrobacterium* mediated gene transfer gene library, gene banks.

Module 3 **6 hrs**

1. Important achievements in Biotechnology:
2. Production of human insulin, Bt Brinjal and Bt cotton, Golden rice, Flavr Savr tomato, Shikonin pigments
3. Current trends in Biotechnolgy:
4. Tissue Engineering, Stem cell cuture, Nanobiotechnology
5. Strategic Applications of Biotechnology:
6. Production of disease/ stress resistant plants, Gene therapy, DNA fingerprinting

Module 4 **2 hrs**

Social and ethical issues, biosafety, biowar, patenting and IPR issues.

Practical **32 hrs**

1. Preparation of nutrient medium – Murashige and Skoog medium, sterilization, preparation of explants, inoculation.
2. Extraction of DNA from plant tissue.
3. Immobilization of whole cells or tissues in sodium alginate.
4. Determination of appropriate flower bud containing uninucleate pollen for anther culture using cytological techniques
5. Study of genetic engineering tools and techniques using photographs/diagram (Southern blotting, DNA finger printing, PCR)
6. Visit a well-equipped biotechnology lab and submit a report along with the practical record.

Additional Credits: Virtual Lab Experiments

1. PCR
2. Transformation of host cells
3. 16s RNA Sequencing

BIOINFORMATICS (Theory: 18 hours; Practical: 10 hours)

Module 1 **7 hrs**

1. Introduction to Bioinformatics, scope and relevance, genome, transcriptome, proteome.
2. Biological data bases –

Nucleotide sequence database – EMBL, Gen Bank, DDBJ.
Protein sequence database – PDB, SWISS PROT
Organismal database – *Saccharomyces* genome database
Biodiversity database – Species 2000

3. Information retrieval from Biological database, sequence alignment types and tools: pair wise sequence alignment multiple sequence alignment, use of BLAST, FASTA.

Module 2 **6 hrs**

1. Genomics : DNA sequencing Sangers procedure-automation of DNA sequencing, genome sequence assembly, Genome projects – Major findings of the following genome projects – Human, *Arabidopsis thaliana*, Rice, *Haemophilus influenza*, Application of genome projects.
2. Proteomics : Protein sequencing- Edman degradation method, automation of sequencing, protein structure prediction and modelling (Brief account only)

Module 3 **5 hrs**

A brief account on

1. Molecular phylogeny and phylogenetic trees.
2. Molecular visualization – use of Rasmol.
3. Molecular docking and computer aided drug design.

Practical **13 hrs**

1. Familiarizing with the different data bank mentioned in the syllabus.
2. Molecular visualization using Rasmol.
3. Blast search.

Additional Credits: Virtual Lab Experiments

1. Retrieving sequence data from Entrez
2. Pair wise alignment of data using FASTA
3. Visualizing secondary structure of a protein
4. Designing a primer

Suggested additional topics

Tissue culture and crop improvement, Genetic transformation and transgenics, Advances in crop biotechnology molecular markers-molecular biology tools in plant breeding, Gene and genome library, Terminator technology, Advances in microbial biotechnology, enzyme technology, Advances in animal biotechnology-stem cell research. Micro array Bioinformatics.

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Semester VI

Course 12

19U6CRBOT12 HORTICULTURE, NURSERY MANAGEMENT, EMBRYOLOGY AND REPRODUCTIVE BIOLOGY

(Theory 54 hours; Practical: 45 hours) (Theory Credit 3, Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Understand the basics of horticulture and nursery management
CO2	Understand and execute propagation of horticultural plants
CO3	Understand to set a classical outdoor garden
CO4	Understand the structure and development of reproductive structures in Plant
CO5	Know about organic farming and composting techniques
CO6	Understand the aspects of organic manures and fertilizers
CO7	Understand the prospects and problems of floriculture
CO8	Awareness on self employment opportunities in horticulture

HORTICULTURE (Theory 14 hours; Practical 18 hours)

Module 1 **2 hrs**

Introduction to horticulture - definition, history, classification of horticultural plants, disciplines of horticulture; Garden tools and implements. Irrigation methods- surface, sub, drip and spray irrigations, mist chambers - advantages and disadvantages

Module 2 **6 hrs**

Propagation of horticultural plants- by seeds- Seed viability, seed dormancy, seed testing and certification, seed bed preparation, seedling transplanting, hardening of seedling; 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.

Module 3 **6 hrs**

Gardening- ornamental gardens, indoor gardens, home gardens- terrestrial and aquatic gardens- garden adornments; garden designing- garden components- lawns, preparation of lawns by seeds, seedling, turfing. Shrubs and trees, borders, hedges, edges, walks, drives- famous gardens of India;

Landscape architecture- home landscape design, parks. Physical control of plant growth- training and pruning; repotting; disease and pest control selection of plant for bonsai, bonsai containers and method of bonsai formation; Orchid cultivation.

Practical **18 hrs**

1. Tongue grafting, budding ('T' and patch) and 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. Preparation of potting mixture in the given proportion.

REPRODUCTIVE BIOLOGY (Theory 20 hrs; Practical 12 hrs)

Module 1 Introduction **2 hrs**

General account and interdisciplinary relevance of embryology, embryology in relation to taxonomy; experimental embryology.

Module 2 **4 hrs**

Structure and development of anther, microsporogenesis, development of male gametophyte, anthesis and anther dehiscence, structure of pollen, pollen germination, pollen tube growth and pollen viability.

Module 3 **4 hrs**

Structure and development of ovule, megasporogenesis, embryosacs-monosporic (polygonum type), bisporic (Allium type) and tetrasporic (Peperomia type). Structure of mature embryo sac.

Module 4 **4 hrs**

Breeding/Reproductive systems and pollination syndromes (with examples for each syndrome) in angiosperms; pollen stigma interaction; self-compatibility and incompatibility; syngamy and fusion; apomixis.

Module 5 **3 hrs**

Development of endosperm and embryo in Dicots and Monocots;
Poly-embryony; Development and general structure of fruits (dry and fleshy) and seed.

Module 6 **3 hrs**

Any Indian example from a reputed journal to study the pollination mechanisms and methods (eg. *Adathoda vasica*, *Strobilanthes kunthianus*

Practical **12 hrs**

1. Identification of C.S. of anther, embryo sac and embryo.
2. Identification of various anther types-monothecous, dithecous
3. Identification of placentation types.
4. Observation of pollen and locating pollen pore
5. Pollen germination study

NURSERY MANAGEMENT (Theory 20 hours; Practical 15 hrs)

Module 1 Introduction **4 hrs**

Preparation of potting mixtures, polybags. Plant Growth 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 transporting of seedlings.

Module 2 Organic farming and Composting Techniques **6 hrs**

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

Module 3 Cultivation of Vegetables, Fruits and Medicinal Plants **3 hrs**

Types of 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. Traditional production techniques and Post-harvest techniques.

Module 4 Floriculture and Flower arrangement **4 hrs**

Problems and prospects of Floriculture in Kerala.
Scope of growing Anthurium, Orchids and Jasmine in Kerala.
Common cut flowers – Rose, Gerbera, Gladiolus, Aster, *Chrysanthemum*, Daisys, Carnation, Golden rod, Anthurium, Orchids, Lilium and Limolium.
Common leaves used in flower arrangement – *Cyprus, Podocarpus*, *Asparagus*, Palms, Cycads, Ferns and *Eucalyptus.*
Floral arrangement: 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.

Module 5 Self Employment Opportunities **3 hrs**

Funding Agencies and self-employment schemes, Procedure to get financial support, special scheme for women empowerment.

Practical **15 hrs**

1. Preparation of potting mixture
2. Preparation of Tobacco/ Neem decoction
3. Familiarization of common fertilizers and manures
4. Familiarization of common cut flowers and leaves used in flower arrangements
5. Different flower arrangement types (demonstration)

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Semester VI

Core Course Choice Based

19U6CRBOT13 PHYTOCHEMISTRY AND PHARMACOGNOSY

(54 Hours) Theory Credits 3

COURSE OUTCOMES (COs)	
CO1	Understand the morphological, organoleptic, microscopic approach to study drug and aromatic plants
CO2	Understand the extraction and characterization techniques in studying the secondary metabolites in plants
CO3	Identify the occurrence, structure, classification, functions and pharmacological uses of plant derived drugs
CO4	Identify the Phytochemical properties of common plant of Kerala
CO5	Understand the volatile oil extraction methods for aromatic plants
CO6	Know the methods in pharmacognosy
CO7	Understand the traditional plant medicines and its scope in modern drug discovery

Module 1 Introduction **2 hrs**

Introduction to phytochemical approaches –morphological-organoleptic-microscopic- to study drug and aromatic plants

Module 2 Extraction and characterization techniques **4 hrs**

Cold extraction- hot extraction—soxhlet apparatus, clevenger apparatus; Solvents - petroleum ether, chloroform, ethanol, methanol, water. Separation technique-TLC, Column, HPLC. Characterization technique-GC/MS, HPTLC, UV Spectra, IR Spectra.

Module 3 Study of the drug plants and their active principles **10 hrs**

A. Alkaloids – introduction, properties, occurrence, structure, classification, functions, and pharmacological uses.
B. Triterpenoids. Introduction, properties, occurrence, classification, functions and pharmacological uses.
C. Phenolics. Quinines- benzoquinones, napthoquinones, anthraquinone, and coumarins.

Module 4 Study of the following plants with special reference to **20 hrs**

(1) Habit, habitat and systematic position and morphology of the useful part.
(2) Organoleptic, anatomical and chemical evaluation of the officinal part.
(3) Phytochemistry and major pharmacological action of plant drugs.
(4) Ayurvedic formulations using the plant

Tinospora cordifolia,	*Papaver somniferum,*	*Aegle marmelos ,*
Punica granatum,	*Plumbago rosea,*	*Adhatoda vasica,*
Withania somnifera,	*Achyranthes aspera,*	*Asparagus racemosus,*
Kaempheria galanga,	*Sida acuta,*	*Carica papaya,*
Azadirachta indica,	*Glycirrhiza glabra,*	*Phyllanthus neruri,*
Datura stramonium,	*Hemidesmus indicus,*	*Aloe veera,*
Tylophora indica,	*Acorus calamus.*	

Module 5 Study of the following aromatic plants - volatile oils and methods of extraction **10 hrs**

Vetiveria zizanoides, Cinnamomum zeylanica, Sysygium aromaticum, Santalum album, Eucalyptus, Ocimum bacilicum, Rosa, Mentha piperita, Cympopogon, Cananga, Pelargonium.

Module 6 Pharmacognosy **4 hrs**

Introduction, tools for identifying adulteration; methods in pharmacognosy- microscopy, phytochemical methods- study of starch grains of maize, wheat, rice, potato, curcuma

Ethnomedicine **4 hrs**

Traditonal 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 ethanopharmacological approach; Jeevani-Pushpangadan model of benefit sharing.

Suggested additional topics

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

Additional Credits: Virtual Lab Experiments

1. Estimation of saponification value of fats/ oils
2. Estimation of Iodine value of fats and oils
3. Extraction of caffeine from Tea

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PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/ She shall also submit a detailed scheme of evaluation along with the question paper.

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

Pattern of questions for External Examination for Theory Paper with Practical

	Total Number of questions	Number of questions to be answered	Marks of each question	Total marks
	8	8	1	8
	10	6	2	12
	6	4	4	16
	4	2	12	24
TOTAL	**28**	**20**	**X**	**60**

Pattern of questions for External Examination for Theory Paper without Practical

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	7	7	1	7
	12	10	2	20
	6	4	6	24
TOTAL				

	3	2	12	24
	28	**23**	x	**75**

MODEL QUESTION PAPERS

Semester I Course 1 **19U1CRBOT1**

MICROBIOLOGY AND PHYCOLOGY

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. Who is Father of Indian Algology?
2. What is Pamella stage?
3. What is coenobium?
4. Give an example for RNA virus
5. What is single cell protein?
5. What is nucule?
7. Name a toxic alga
8. Name a commercial product from algae

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. What are the general characteristics of bacteria?
10. Write a short note on root nodules
11. What is cap cell?
12. Write notes on bacterial flagella
13. Explain binary fission in bacteria
14. What is bioremediation?
15. What are mycoplasma?
16. Explain the thallus structure of Vaucheria
17. What are the economic importance of diatoms?
18. Explain the role of algae in soil fertility

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. With suitable diagram, explain cell wall structure in bacteria
20. Comment on algae as primary producers.
21. What are conceptacle and receptacle?
22. Explain sexual reproduction in Oedogonium
23. Explain briefly various mechanisms for movement in algae.
24. Enumerate the scope of microbiology

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. Explain the morphology of TMV. Add a note on virus replication.

OR

26. With suitable diagrams, explain genetic recombination in bacteria.

27. With the help of a schematic sketch describe the alternation of generations in the life cycle of *Polysiphonia*.

OR

28. Write an essay on thallus organization in algae with suitable examples.

Semester II Course 2 **19U2CRBOT2**

MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. Name the cell wall material of fungi
2. What is the characteristic fruiting body of ascomycetes?
3. What are basidia?
4. Why deutromycetes are called so?
5. What are the important characters of myxomycotina?
5. Name the causative organism of Bunchy top disease of banana
7. What is aspergillosis?
8. Name any two economically important lichen

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. Describe the fruiting body of Xylaria
10. Draw a labeled sketch of peziza fruiting body
11. What are the salient features of ascomycotina
12. Describe the fruiting body of agaricus
13. What is a macro cyclic fungus?
14. Name two harmful fungi
15. What is mycorrhiza?
16. Write down the steps for the spawn production of mushrooms
17. What is prophylaxis?
18. What is biological control?

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. Explain the role of fungi in biotechnology
20. With help of suitable sketches, explain the life cycle of saccharomyces cereviseae
21. Explain the asexual reproduction in pencillium
22. Explain the crozier formation in peziza
23. Explain the methods of reproduction in parmelia
24. Explain the preparation of Bordeaux mixture.

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. Explain the life cycle of puccinia with suitable illustrations

OR

26. With suitable diagrams, illustrate the life cycle of agaricus

27. Describe the agricultural importance of fungi

OR

28. Briefly explain the symptoms, causative organism, disease cycle and control measure of abnormal leaf fall of rubber

Semester III Course 3 **19U3CRBOT3**

BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS AND PALEOBOTANY

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. Name an aquatic Bryophyte?
2. Name a Bryophyte with branched photosynthetic filament?
3. Name a Bryophyte with pseudoelater?
4. Name a pteridophyte with Elater?
5. Name a pteridophyte with eustele?
5. Name a Gymnosperm with winged seed?
7. Name a Gymnosperm with circinate ptyxis?
8. Name the pale botanical centre in India?

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. Describe the Photosynthetic region of Marchantia?
10. Draw a labeled sketch of Pegged &Smooth rhizoids?
11. What are the salient features of Bryophytes ?
12. Describe the strobilus of Selaginella?
13. What is a Sporocarp, Give an example?
14. What is Eusporangiate &Leptosporangiate condition?
15. What is Endoscopic & Exoscopic Embryo development?
16. What is Palisade tissue, what is its function?
17. What are the different types of Fossil formations?
18. What is Bars of sanio ?

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. Explain the Sporophyte of Riccia ?
20. With help of suitable sketches, explain the life cycle of Anthoceros?
21. Explain the stem anatomy of Marsilea rhizome?
22. Explain the xerophytic adaptations of equisetum stem?
23. Explain the xerophytic adaptations of Pinus needle?
24. What are the Angiosperm characters of Gnetum?

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. What are the economic importance of Bryophytes?

OR

26. With suitable diagrams, illustrate the life cycle of Pogonatum?

27. Describe the the Stelar structure in Pteridophytes?

OR

28. Write an essay on the anatomy of Gnetum stem with diagrams ?

Semester IV Course 4 **19U4CRBOT4**

ANATOMY, MICROTECHNIQUE AND MORPHOLOGY OF ANGIOSPERMS

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. What is Casparian Thickening?
2. What is Plasmodesmata?
3. What is included phloem?
4. What is Duramen?
5. Give the names of any two natural dyes.
6. What is a carpel
7. What is a regma?
8. What is pinnately compound leaf ?

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. Distinguish between Sapwood and Heartwood
10. Distinguish between Diffuse porous wood and Ring porous wood ?
11. Explain apical cell theory
12. Write brief notes on Laticifers
13. What is a mordant? What is its function?
14. Draw alabelled diagram of a Bordered pit ?
15. What are the major anatomical differences between dicot and monocot leaf?
16. What is Apposition and Intssuception ?
17. What is Periderm ?
18. What is a cymose inflorescence

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. What are the importance of fibres?
20. With the help of labelled diagram explain the tissue system in Dicot stem
21. What are the different types of cell wall thickening of tracheid?
22. What do you mean by killing and fixing?
23. Distinguish between monochasial cyme and Dichasial cyme ?
24. Write a brief note on different dry dehiscent fruits .

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. With the help of suitable labelled diagrams, describe the anomalous secondary structures in Bignonia and Bougainvillia

OR

26. With the help of suitable diagrams explain secondary growth in Dicot root

27. Write an essay on different cell types in Xylem and Phloem

OR

28. Give an account of microscopic and sub microscopic growth of cell wall

Semester V Course 05 **19U5CRBOT5**

ANGIOSPERM SYSTEMATICS AND ECONOMIC BOTANY

Time 3 hours Maximum 60 Marks

Part A

I.Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. What is obdiplostemonous condition?
2. What is syngenesious anthers?
3. What is a pollinium?
4. What is corolline corona?
5. Write the binomial of any two economically important plants of the family Rutaceae.
5. Define polyadelphous condition.
7. Write common name and binomial of any pulse plant
8. What is the characteristic feature of stigma in Apocynaceae.

Part B

II. AnswerANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. What is synsndrous condition? Give example.
10. What is an epigynous flower?
11. Draw floral diagram of vexillary aestivation
12. Differentiate ray floret and disc floret.
13. With the help of a diagram explain stipule in Rubiaceae.
14. Write an account on the economic importance of Cucurbitaceae.
15. Describe the gynostegium in Orchidaceae
16. Describe the essential whorls of Poaceae family
17. Give the binomial of 2 economically important plants of Arecaceae
18. Write a short note on the economic importance of the family Asteraceae.

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. Write economic importance of the family Verbenaceae and Lamiaceae
20. Write binomial, useful part and uses of 2 economically important plants each from the -families Apiaceae, Myrtaceae, Lamiaceae and Rutaceae
21. Describe the floral features of Solanaceae
22. Differentiate between Scrophulariaceae and Acanthaceae
23. Describe the flower of Sapotaceae
24. Differentiate between Verbenaceae and Lamiaceae

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. Write an essay on the family cucurbitaceae

OR

26. With the help of suitable diagrams explain the characteristic features of the family Euphorbiaceae

27. Compare the floral characters of the families Fabaceae, Caesalpiniaceae and Mimosaceae

OR

28. Compare and contrast Apocynaceae and Asclepiadaceae families

Semester V Course 6 **19U5CRBOT6**

ENVIRONMENTAL SCIENCE AND ECOTOURISM

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

Write short notes on the following

1. Key stone species
2. Energy plantations
3. Renewable energy sources
4. Food security problem
5. Itai Itai disease
6. Land degradation
7. Noise pollution
8. Eutrophication

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. Give an account on ecological pyramids.
10. What is the importance of Forest (conservation) Act, 1980
11. What is meant by blue baby syndrome?
12. Explain briefly on Bhopal tragedy.
13. What is meant by environmental Impact assessment?
14. What are the famous ecotourism centres in Kerala?
15. Write a note on BNHS
16. What is the contribution of Salim Ali in the field of ecology?
17. What are the components of ecotourism?
18. Briefly give an account of mangrove ecosystems.

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. Write a note on the environmental laws in India.
20. Explain the sources of sound pollution and its control
21. What are the problems due to climate change?
22. What are the forms and types of ecotourism in India?
23. Briefly explain the biogeochemical cycles of Carbon and Nitrogen.
24. Write a note on the positive and negative impacts of ecotourism

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. Write an essay on ecological succession. Distinguish between ecotone and edge effect

OR

26. Give a detailed account of environmental pollution and its management.

27. Describe the components of ecotourism and explain different types of ecotourism

OR

28. What are the reasons for biodiversity loss? Explain the different types of conservation of biodiversity

Semester V Course 7 **19U5CRBOT7**

GENETICS AND PLANT BREEDING

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. Define genetics
2. What is meant by an 'allele'?
3. What is dominance ?
4. What is a test cross?
5. How do you differentiate phenotype and genotype?
6. What is back cross?
7. Define reciprocal cross
8. Name a Y- linked gene.

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. Briefly describe complementary gene interaction.
10. Distinguish between epistasis and dominance
11. What is meant by interference?
12. What is coincidence?
13. Describe briefly Turner's syndrome
14. Distinguish between Klinefelter's syndrome and Down's syndrome
15. Describe haemophilia in man
16. Write notes on cytoplasmic inheritance
17. What do mean by Hardy-Weinberg law?
18. What are quarantine regulations?

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. What is recessive epistasis? Explain with suitable example.
20. Distinguish between Inter-genic interaction and Intra-genic interaction
21. Describe XX-X0 method of sex determination.
22. What is reversion or Atavism?
23. Examine the role of linkage in Mendel's experiments
24. What is sex linked inheritance? Explain with an example.

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 2 x 12 = 24 marks

25. With suitable example, explain multiple allelism.

OR

26. Explain chromosome theory of heredity.

27. Write an essay on genetic engineering and products of genetically modified crops

OR

28. Explain the procedures for plant introduction in the Indian context.

Semester V Course 8 **19U5CRBOT8**

CELL, MOLECULAR BIOLOGY AND EVOLUTION

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. What is the function of lysosome?
2. What is meant by endomitosis?
3. What is meant by chromosomal bridge?
4. What is fluid mosaic model of cell membrane?
5. What is genetic drift?
6. Name any two properties of genetic code
7. Write down the central dogma in Molecular Genetics
8. Define speciation.

Part B

II. Answer ANY SIX questions; each question carries TWO marks 6 x 2 = 12 marks

9. Draw a labeled diagram of mitochondria
10. Write note on ribosomes.
11. Distinguish between kayotype and Idiogram
12. Briefly explain on B chromosome
13. What is meant by cell cycle?
14. What are the differences between DNA and RNA?
15. Describe the structure of tRNA
16. What is a gene?
17. What are oncogenes?
18. Explain Lamarck's theory of evolution.

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. Explain different types of chromosomal aberrations.
20. What is the significance of mitosis?
21. What are the types of mutations and their importance?
22. Write note on Polyploidy.
23. Explain RNA processing
24. Explain biochemical origin of life.

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. Explain the sources and applications of stem cells

OR

26. Describe the various phases of first meiotic division with diagrams

27. Explain the operon model of gene expression

OR

28. Write an essay on the structure of DNA. Add a note on different types.

Semester V Open Course 0l BO5D01UU

AGRIBASED MICROENTERPRISES

Time 3 hours Maximum 75 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 10 x 1 = 7 marks

1. Give any two commonly used organic manures
2. What is spawn?
3. What is topiary?
4. What is turfing?
5. Name a biopesticide
5. What do you mean by explants?
7. Name any two common leaves used in flower arrangement

Part B

II. Answer ANY TEN questions; each question carries TWO marks. 10 x 2 = 20 marks

8. Differentiate between edges and hedges
9. What is vermiwash?
10. What is surface irrigation?
11. Write a note on value added products from mushroom
12. List different types of mushrooms
13. What is grafting?
14. Explain advantages of green house
15. What is pruning?
16. Comment on Trichoderma
17. What is PGPR?
18. What are the merits of drip irrigation?
19. What is arboriculture? What are its merits?

Part C

III. Answer ANY FOUR questions; each question carries SIX marks. 4 x 6 = 24 marks

20. How will you prepare tobacco decoction?
21. What are the steps involved in a lawn preparation?
22. How do you make bonsai?
23. List the steps in plant tissue culture
24. How will you prepare a kitchen garden in your home?
25. Explain various flower arrangement types.

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

26. Write an essay on organic manures. What are the advantages of organic manures? Add a note on the preparation of vermi-compost at your home.
27. Explain various components of an ornamental garden.
28. Explain the cultivation of oyster mushroom using paddy straw.

Semester VI Course 9 **19U6CRBOT9**

PLANT PHYSIOLOGY AND BIOCHEMISTRY

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. What is Guttation?
2. Define water potential
3. Name the end products of alcoholic fermentation.
4. Name a pentose sugar.
5. Name the polysaccharide found commonly in the wood of conifers.
6. An example of a simple protein enzyme
7. Name the first stable product of C_4 cycle
8. What is phloem loading?

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. What is cellobiose?
10. Explain the structure of chlorophyll
11. Explain vernalization
12. What is RUBISCO?
13. Write the importance of transpiration in plants.
14. What is pH? What is the significance of buffers?
15. What are anti-transpirants?
16. Explain red drop phenomenon
17. What are the factors affecting photosynthesis?
18. What is glycolysis?

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. Explain the pressure flow hypothesis by Munch.
20. What are the significance of carbohydrates?
21. Draw the schematic representation of photorespiration.
22. Describe the cyclic electron transport in chloroplast.
23. What are the major characteristics of enzymes?
24. What are cytokinins?

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. Explain the path of carbon assimilation in Calvin cycle.

OR

26. Explain the role of plant hormones in growth and development

27. Explain the mechanism of enzyme action

OR

28. Make a comparison of C_3, C_4 and CAM plants.

Semester V Course 10 **19U6CRBOT10**

METHODOLOGY, PERSPECTIVES OF SCIENCE AND GENERAL INFORMATICS

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. Define hypothesis
2. What is a variable?
3. What is a null hypothesis?
4. What is the need of a control?
5. Expand DOS
5. Name a presentation software you have studied.
7. What is PAGE?
8. What is SD?

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. What is plagiarism?
10. What is mean?
11. What are bar diagrams?
12. Name the mobile phase in TLC and Paper Chromomatography
13. What is the use of EXCEL?
14. List the editing tools used in MS-WORD
15. What is the significance of buffer in Biology?
16. What is the principle of Chromatography?
17. Explain Beer-Lambert's law
18. What is the use of INFLIBNET?

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. What are the components of a good experiment?
20. With suitable examples, explain research engines
21. What are the applications of powerpoint?
22. What is the difference between standard deviation and standard error?
23. Comment on SEM
24. What is a colorimeter? What is its use?

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. Explain various steps involved in preparing a project report and presenting it using computer

OR

26. Compare and contrast the principle and applications of Compound Light Microscope and Electron Microscope

27. Write an essay on presentation of data

OR

28. Write an essay on separation techniques in biological science.

Semester VI Course 11 **19U6CRBOT11**

BIOTECHNOLOGY AND BIOINFORMATICS

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. Name a popular tissue culture medium
2. Name a transgenic plant
3. Name a surface sterilant
4. What is Rasmol?
5. Name a tissue culture technique used for producing haploid plants
6. Name a tissue culture technique to produce virus free plants
7. Name an Auxin.
8. What is EMBL?

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. Name the enzyme used for joining DNA fragments
10. What is the enzyme used for degrading cellulose in cell wall during protoplast isolation
11. What is an autoclave?
12. What is Flavr Savr
13. Define micropropagation.
14. What is the pH of M S medium/
15. What is the respiratory substrate added in tissue culture medium
16. What is FASTA?
17. Explain molecular docking?
18. What is DDBJ?

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. What is PCR? Name the heat resistant polymerase enzyme used in PCR
20. What are databases? Give an account of different databases you have studied.
21. Name the various cloning vectors and explain how a plasmid can be used for genetic engineering experiments.
22. What is the use of laminar air flow bench in tissue culture? Comment on its working principle?
23. What are the potential uses of artificial seeds?
24. Write a note on pBR322.

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. Explain Sangers dideoxy method of DNA sequencing? Write a note on autosequencing

OR

26. Explain Edman's degradation method for protein sequencing.

27. Write a comprehensive account of application of tissue culture.

OR

28. Explain different methods of gene transfer.

Semester VI Course12 **19U6CRBOT12**

HORTICULTURE, NURSERY MANAGEMENT, EMBRYOLOGY AND REPRODUCTIVE BIOLOGY

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. What is Parthanocarpy?
2. What is double fertilization?
3. What is tapetum?
4. What is topiary?
5. Give any two advantages of vegetative propagation?
6. What are hedges?
7. Comment on Trichoderma
8. List any two common biofertilizers

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. Differentiate monocot and dicot embryo
10. Define self incompatibility
11. What is anemochory? Write any two advantages of anemochorous seeds?
12. Define anthesis and anther dehiscence
13. Define micropropagation.
14. Differentiate between walks and paths
15. What is turfing?
16. Give the names of any two garden implements and their uses
17. How will you prepare vermiwash?
18. Explain the scope of floriculture in Kerala

Part C

III. Answer ANY FOUR questions; each question carries FOURmarks. 4 x 4 = 16 marks

19. Microsporogenesis
20. Illustrate the structure of mature embryosac
21. Briefly explain the modern strategies in plant propagation
22. What are the advantages of organic farming?
23. Why repotting is essential in bonsai formation?
24. Compare drip irrigation with mist chambers

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. Explain different pollination syndromes with examples for each syndrome

OR

26. Write an essay on the structure and development of ovule in Angiosperms

27. Write an essay on artificial vegetative propagation methods with suitable illustrations

OR

28. Design an ornamental garden of your choice giving suitable examples of plants and other garden components.

Semester VI Course 13 **19U6CRBOT13**

PHYTOCHEMISTRY AND PHARMACOGNOSY

Time 3 hours Maximum 75 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 7 x 1 = 7 marks

1. What are alkaloids?
2. What is Pharmacognosy?
3. What is meant by organoleptic identification?
4. What are volatile oils?
5. What is the characteristic feature of the starch of potato?
6. Why methanol is called a super solvent?
7. Name the ayurvedic formulation in which *Adhathoda vasika* is used

Part B

II. Answer ANY TEN questions; each question carries TWO marks. 10 x 2 = 20 marks

8. What are the ayurvedic use of *Acorus calamus*?
9. What is the phytochemistry and pharmacological action of *Tinospora caudifolia*?
10. Name four chemical constituents present in the oil of Vetiveria
11. Name the phytochemical constituent and pharmacological action of *Glycirrhiza glabara*
12. Compare the starch grains of Maize and Wheat
13. Explain hot extraction
14. What is the use of Clevenger apparatus?
15. Give an example for the use of traditional plant medicine as a source of new drug
16. Explain the use of chloroform as solvent
17. What is Rf value?
18. What is the use of Gas Chromatography?
19. Differentiate between fats and oils.

Part C

III. Answer ANY FOUR questions; each question carries SIX marks. 4 x 6 = 24 marks

20. Explain how microscopy is useful in pharmacognosy
21. Describe Thin Layer Chromatography
22. What is the principle of IR Spectroscopy?
23. What are phenolics?
24. Name any four alkaloids useful in medicine
25. What are the ayurvedic formulations developed from *Aegle marmelos*?

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

26. Describe the principle and applications of HPLC
27. Describe the properties, occurrence, classification and functions of Triterpenoids.
28. Describe the organoleptic, anatomical, chemical evaluation and pharmacological action of *Phyllanthus niruri* and *Aloe vera*.

Practical Model Question Papers

B.Sc. BOTANY Programme
Core Course Practical 1- 19U2PRBOT1
19U1BOT1 & 19U2BOT2 combined

MICROBIOLOGY, PHYCOLOGY, MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

Time 3 hrs **Marks – 30**

Q .1. Conduct Gram Staining / Serial Dilution / Streaking method of sample **A** 3 marks
- Conduct of experiment 1 mark
- Procedure / flow chart 1 mark
- Diagram 1 mark

Q. 2. Make suitable micro preparation of sample **B** & **C** 6 marks
- Preparation 1 mark
- Identification 1 mark
- Diagram 1 mark

Q. 3. Make suitable micro preparation of sample **D** & **E** to reveal the reproductive structure.
- Identify the material and draw labeled diagram of the part displayed 6 marks
- Preparation 1 mark
- Diagram 1 mark
- Identification with reason 1 mark

Q. 4. Spot at sight **F, G, H, I** & **J** 5 marks
- Generic name ½ mark
- Part displayed ½ mark

Q. 5. Name the disease, causative organism, symptoms and control measures of plant disease **K**.
- Name of Disease ½ mark
- Causative Organism ½ mark
- Symptoms ½ mark
- Control Measures ½ mark 2 marks

Q.6. Prepare a bed for Oyster mushroom cultivation **L**. Comment on the role of …… in it.
- Preparation 1½ marks
- Comments ½ mark 2 marks

Viva voce (based on practicals) 2 marks
Record 4 marks

Instructions to the Examiners

1. A - Gram staining/serial dilution of soil sample to isolate microbes / streak plate method.
2. B – Algae Thallus
3. C - Fungi / Lichen thallus
4. D - Algae
5. E - Fungi / Lichen with reproductive structures
6. F & G – Spotters - Algae
7. H, I & J - Spotters - Fungi / Lichen
8. K - Any one pathology specimen from the syllabus
9. L – Materials for bed preparation has to be provided.
   Role of any material used (polybag, paddy straw, spawn, calcium carbonate, water)

B.Sc. (BOTANY) Programme

Core Course– Practical 2- 19U4PRBOT2
19U3BOT3 & 19U4BOT4 cOMBINED
BRYOLOGY, PTRIDOLOGY, GYMNOSPERM, ANATOMY, MICROTECHNIQUE & MORPHOLOGY OF ANGIOSPERMS

Time 3 hrs. **Marks – 30**

Q .1. Make micro preparation of A/B

Preparation	1 marks	
Labeled diagram	0.5 mark	
Key characters	1 mark	
Identification	0.5 mark	3 marks

Q. 2. Make Micro preparation and compare stelar type of C & D

Identification of stelar types	0.5 mark	
Labeled diagram	1 mark	
Comparison	1 mark	2.5 x 2 = 5 marks

Q. 3. Take a T.S of given material E & F, stain and mount in Glycerine

Preparation	1 mark	
Diagram	1 mark	
Identification with reason	2 marks	4 x 2 = 8 marks

Q. 4. Identify the stomata type of the material G

Identification with diagram	2 marks	
Preparation	1 mark	

OR

Q.4. Macerate the given material G and identify any two wall thickening types of xylem elements.

Preparation	1 mark	
Identification with diagram	2 mark	3 marks

Q. 5. Spot at sight H, I & J

Generic name	0.5 mark	
Parts displayed	0.5 mark	3 x 1 = 3 marks

Q.6. Identify and comment on K & L

	1 mark each	2 x 1 = 2 marks

Q. 7. Viva voce (based on practicals) 2 marks

Q. 8. Record 4 marks

Instructions to the Examiners

A. Thallus of Bryophyte
B. Stem/leaf/ of Gymnosperm
C. & D stem / petiole /rhizome of pteridophyte
E & F Anatomy of primary/secondary/Anomalous material
G Stomata on leaf / material for maceration
H Spot at sight of reproductive part of Bryophytes
I. Spot at sight of reproductive part of Pteridophytes
J Spot at sight of reproductive part of Gymnosperm
K. Morphology of leaf/ Morphology of fruit
L. Morphology of inflorescence

B.Sc. BOTANY Programme
Core Course– Practical 3- 19U6PRBOT3
19U5CRBOT5 & 19U5CRBOT6 Combine

ANGIOSPERM SYSTEMATICS, ECONOMIC BOTANY, ENVIRONMENTAL SCIENCE & ECOTOURISM

Time 3 hrs **Marks - 30**

Q.1. Identify specimen **A** up to respective families giving systematic keys and characters **4 marks**

Identification	1 mark
Family characters	1mark
Characters up to series and plant description	2 mark

Q. 2. Estimate the CO_2/ Cl/ Salinity in the given water sample **B** **4 marks**

Procedure	1 mark
Conduct	2 marks
Calculation and Result	1 mark

Q. 3. Describe the given flower **C** in technical terms (floral formula, floral diagram), draw an LS of the flower **3 marks**

Floral formula	½ mark
Floral Diagram	½ mark
Identification with reason	2 marks

Q. 4. Take TS of the given material **D**, identify the ecological importance, giving reasons and draw a labeled diagram **3 marks**

Preparation	1 mark
Identifying characters	1 mark
Identification with diagram	1 mark

Q.5. Find out the Density/abundance/frequency from the given data **E** obtained through a quadrat study **2 marks**

Formula	1 mark
Calculation	1 mark

Q.6. Identification of 2 herbarium specimens **F & G** (1 mark each) **2 marks**

Q.7. Write down the binomial, family and morphology of useful part of the given materials **J** and **K** (1 mark each) **2 marks**

Q.8. Identify and write environmental impact based on the given photograph **L**

Or

Identify ecotourism methods adopted in the given photograph **L** **1 mark**

Q.9. Herbarium of 25 specimens including field book **3 marks**

Q.10. Viva voce (based on practicals) **2 marks**

Q.11. Record **4 marks**

Instructions to the Examiners:

A. Flowering specimen from any angiosperm family included in the syllabus
B. Water sample from the estuary
C. Flower from Sub class Polypetalae or Gamopetale
D. Hydrophyte/ Xerophyte/ Halophyte/ Epiphyte (Stem/ leaf/ roots)
E. Data from the quadrat study (Maximum 5 Quadrats)
F. Any herbarium from the student's collection
G. Any herbarium from the student's collection
H. Inflorescence/ Fruit
I. Inflorescence/ Fruit
J. Specimen with economic importance included in the syllabus
K. Specimen with economic importance included in the syllabus
L. Photograph of any environmental impact of any Anthropogenic activity/ Photograph of an Ecotourism spot

B.Sc. BOTANY Programme

Core Course - Practical 4- 19U6PRBOT4
19U5BOT7 & 19U5BOT8 - Combined

GENETICS, PLANT BREEDING, CELL AND MOLECULAR BIOLOGY AND EVOLUTION

Time 3 hrs **Max. Marks - 30**

I. Work out the problems **A, B** and **C** 10 marks
- Monohybrid/ Dihybrid 2 marks
- Intergenic Interaction 4 marks
- Molecular Genetics 4 marks

II. Make acetocarmine squash preparations of the root tips supplied as **D** and Submit any two stages of Mitosis. 6 marks
- Preparation 2 marks
- Identification ½ + ½ = 1 mark
- Labelled Diagrams ½ + ½ = 1 mark

Calcualtion of Mitotic Index
- Tabulation 1 mark
- Calculation 1 mark

III. Identify the given stage of Meiosis in **E** 1 mark

IV. Match the Karyotype with the phenotype **F** and identify the genetic disorder. Make comments on karyotype and phenotype 3 marks
- Correct matching 1 mark
- Comments 2 mark

V. Conduct emasculation/ budding/ grafting/ layering in **G** and draw labeled diagram
- Conduct of the experiment 2 marks
- Labelled diagram 1 mark 3 marks

VI. Identify the chromosomal anomaly in the given photograph/ diagram **H**. 1 mark

VII. Viva voce (based on practicals) 2 marks

VIII. Record 4 marks

Instructions to the Examiners

1. Problem A – Monohybrid / Dihybrid
   Problem B – Intergenic Interaction
   Problem C – Molecular Genetics
2. Onion Root tip (fresh material) shall be supplied.
3. Meiosis photograph/ diagram/ permanent slide shall be used.
4. Photographs of Turner's / Klinefelter's / Down's syndrome (any one) and the respective ideogram shall be displayed.
5. Materials for emasculation / budding / grafting / layering shall be supplied.
   Photographs of any of the Chromosomal anomalies studied in the syllabus.

B.Sc. BOTANY Programme

Core Course- Practical 4- 19U6PRBOT5
19U6BOT9 & 19U6BOT10 - Practical 5

PLANT PHYSIOLOGY, BIOCHEMISTRY, PERSPECTIVES OF SCIENCE AND METHODOLOGY

Time 3 hrs **Marks – 30**

Q .1. Conduct the experiment and bring out the result. 10 marks

Requirement	1 mark
Procedure	2 marks
Setting up the experiment	4 marks
Labeled diagram	1 mark
Result and Inference	2 marks

Q. 2. Examine the compound leaf supplied and measure the lengths of the leaflets

a. Group them into frequency classes according to their length
b. Calculate the mean and standard deviation of the data manually
c. Prepare a histogram using EXCEL to represent the data.
d. Make a print out and submit. 6 marks

Construction of the classes and scoring of frequency	2 mark
Mean	1 mark
Standard deviation	1 mark
Histogram	2 mark

Q. 3. Determine the concentration of the given solution of $CuSO_4$ using colorimetry. Use the values supplied for the preparation of a standard graph. 4 marks

Standard Graph	2 marks
Determination of Concentration from standard graph	2 marks

Q. 4. Comment on the defect in the experiment set up 2 marks

Defects	½ + ½ marks
Correct set up	½ + ½ marks

Q. 5. Detect any two organic compounds in the given sample 2 marks

Conduct of experiment	½ + ½ marks
Identification	½ + ½ marks

Q. 6. Viva voce (based on practicals) 2 marks
Q. 7. Record 4 marks

Instructions to the Examiners

1. A – Physiology experiments –
    a. Determination of OP by plasmolytic method
    b. Comparison of stomatal indices
    c. Paper Chromatographic separation of plant pigments
    d. Measurement of rate of photosynthesis.

2. Compound leaves (at least 20-30 leaflets) should be provided. Students should take the print out of the graph/ histogram.

3. Values of standard graph should be provided.

4. Any experimental set up with at least two defects.

5. Students should be supplied with samples containing non-reducing sugar/ reducing sugar/ protein.

B.Sc. BOTANY Programme
Core Course - Practical 3- 19U6PRBOT6
19U6CRBOT11 & 19U6CRBOT12 – Combined

BIOTECHNOLOGY, BIOINFORMATICS, HORTICULTURE, NURSERY MANAGEMENT, EMBRYOLOGY & REPRODUCTIVE BIOLOGY

Time 3 hrs. **Marks - 30**

Q.1. Extract DNA from the given plant material A		5 marks
Requirements and Procedure	2 marks	
Working	4 marks	
Result	2 marks	
Q. 2. Immobilize whole cells/plant tissue B in Alginate beads		5 marks
Requirements and Procedure	2 marks	
Working	4 marks	
Result	2 marks	
Q. 3. Sterilize the plant material C and inoculate into the medium supplied		2 marks
Steps followed	1 mark	
Working	1 mark	
Q. 4. Using Molecular visualization tool RASMOL, show required information of given protein D /BLAST		4 marks
Q.5. Comment on the given specimens E & F (½ mark each)		1 mark
Q.6. Identify and Comment on the given tools G & H (½ mark each)		1 mark
Q.7. Conduct germination experiments on the given pollen I		2 marks
Working	1 mark	
Procedure and Result	1 mark	
Q. 8. Conduct grafting/layering/budding experiments on the given plant material		4 marks
Requirements and Procedure	1 mark	
Working	3 marks	
Q.8. Viva voce (based on practicals)		2 marks
Q.9. Record		4 marks

Instructions to Examiners

1. Suitable plant material (onion, Coconut endosperm etc.) can be provided
2. Yeast cell or any plant tissue (meristem) can be provided
3. Shoot tip/stem/leaf/Nodal segment can be provided
4. Tools for RASMOL has to be installed and provide a computer with internet for BLAST - experiment
5. Any specimens/photographs from Biotechnology/ Bioinformatics
6. Tools used in Nursery management or Horticulture
7. Provide pollen and medium for the experiment
8. Materials for budding/ grafting/ layering

B.Sc. BOTANY PROGRAMME

SEMESTER I COMPLEMENTARY COURSE – I 19U1CPBOT1

CRYPTOGAMS, GYMNOSPERMS AND PLANT PATHOLOGY

(Theory: 36 hrs; Practical: 36 hrs) (Theory credit 2 Practical Credit 1)

COURSE OUTCOMES (COs)	
CO1	Understand the diversity of cryptogams and gymnosperms
CO2	Understand the reproductive behavior in algae, fungi, bryophytes, pteridophytes and gymnosperms
CO3	Understand ecological significance and economic importance of cryptogams and gymnosperms
CO4	Know the evolutionary trends in cryptogams and gymnosperms
CO5	Identify the plant diseases and it's control measures

CRYPTOGAMS

Module –1 **(9 hrs)**

Algae, classification based on pigments, thallus and habitat diversity, and life history of the following groups - Cyanophyceae - *Nostoc;* Chlorophyceae - *Volvox*, *Spirogyra*, *Cladophora;* Phaeophyceae – *Sargrassum;* Rhodophyceae – *Polysiphonia;* Economic importance of Algae.

Module –2 **(9 hrs)**

Fungi, Classification- Ainsworth, main features of hyphae, and life history of the following groups- Phycomycetes - *Phytophthora*; Ascomycetes - *Peziza;* Basidiomycetes - *Puccinia;* Economic importance of Fungi.

Module - 3 **(2 hrs)**

Lichens, classification, general account and economic importance of Lichens; morphology, anatomy, reproduction and life cycle of *Usnea.*

Module – 4 **(3 hrs)**

Bryophytes, general account; morphology, anatomy, reproduction and life cycle of *Riccia.*

Module – 5 **(4 hrs)**

Pteridophytes, general account, morphology, anatomy, reproduction and life cycle of *Selaginella*.

GYMNOSPERMS

Module – 6 **(5 hrs)**

Gymnosperms, general account; morphology, anatomy, reproduction and life cycle of *Cycas*

PLANT PATHOLOGY

Module – 7 **(4 hrs)**

Classification of plant diseases on the basis causative organism and symptoms; Study the following diseases with special emphesis on causative organism, symptoms and control measures - Nut fall of Arecanut, Bacterial blight of Paddy, Leaf mosaic of Tapioca.

Practical (36 hrs)

1. Identify Cryptogrammic and Gymnosperm specimens and their parts prescribed in the syllabus, make micro-preparations wherever necessary.
2. Identify plant diseases mentioned in the syllabus.

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B.Sc. BOTANY PROGRAMME
SEMESTER II COMPLEMENTARY COURSE II 19U2CPBOT2

PLANT PHYSIOLOGY

(Theory: 36 hrs; Practical: 36 hrs) **(Theory credit 2 Practical Credit 1)**

COURSE OUTCOMES (COs)	
CO1	Know about basic mechanisms of various physiological processes related to plant life
CO2	Understand the vital plant physiological functions such as photosynthesis and respiration in plants
CO3	Know the functions of various plant growth regulators
CO4	Know the water relation of plants and its significance.
CO5	Understand and carry out experiments related to plant physiology

Module 1 **10 hrs**

Unit 1: Water relations of plants: (a) Physical aspects of water absorption –imbibition, diffusion and osmosis. Plant cell as an osmotic system. Diffusion pressure deficit, water potential, plasmolysis (b) Mechanism of absorption of water- active and passive absorption. Ascent of sap – theories – transpiration pull theory, root pressure theory.

(4 hrs)

Unit 2: Transpiration – types, structure and mechanism of stomatal transpiration- (theories – starch sugar inter conversion hypothesis and Active K^+ transport mechanism) significance and factors affecting transpiration, antitranspirants, Guttation.

(4 hrs)

Unit 3: Stress Physiology – Water and salt stress, adaptations. (2 hrs)

Module 2 **14 hrs**

Photosynthesis: Structure of chloroplast, Pigments, Red drop and Emerson's enhancement effect: Two pigments systems, light and dark reaction C_3 – C_4 and CAM mechanisms. Factors affecting Photosynthesis: External and Internal, photo respiration.

Module 3 **12 hrs**

Unit 1 : Translocation of organic solutes: Path and mechanism of Translocation, Munch mass flow hypothesis.

(3 hrs)

Unit 2 : Nitrogen fixation, Nitrogen Cycles. (2hrs)

Unit 3 : Dormancy of seeds, factors causing dormancy, photoblastisms, techniques to break dormancy.

(2 hrs)

Unit 4 : Growth and Movements: Sigmoid curve, measurement of growth, regions of growth, general account of natural growth hormones, synthetic auxins (brief account) effect of ABA. Senescence and Abscission. Tropic and nastic movements with reference to geotropism, phototropism. Seismonastic and nyctinastic movements. Photoperiodism and Vernalization. (5 hrs)

Practical **36 hours**

Student should be trained to carry out or demonstrate the following experiments

Core Experiments:

1) Determination of osmotic pressure by plasmolytic method
2) Separation of Chlorophyll pigments by paper chromatography.
3) Demonstration of osmosis using plant membrane
4) Effect of carbondioxide concentration on the rate of photosynthesis by *Hydrilla* plants.

Demonstration Experiments:

1. Relation between transpiration and absorption
2. Evolution of O_2 during photosynthesis
3. Light screen expt.
4. Mohl's experiment
5. Experiment with variegated leaf
6. Measurement of growth using Arc Auxanometer
7. Experiment with Kleinostat.

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B.Sc. BOTANY PROGRAMME
SEMESTER III COMPLEMENTARY COURSE III 19U3CPBOT3

ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY

(Theory 54 hours; Practical 36 hours) Theory Credit 3 Practical Credit 1

COURSE OUTCOMES (COs)	
CO1	Understand the morphology of angiosperms
CO2	Understand the interdisciplinary aspects of taxonomy
CO3	Understand botanical nomenclature
CO4	Understand and apply the classification of angiosperms based on their floral features
CO5	Understand and prepare standard herbarium sheets
CO6	Understand the economic importance of angiosperms

Module 1. ANGIOSPERM TAXONOMY (Theory 36 hours; Practical 24 hours)

1. Classification: Importance of plant classification, types of classification-Artificial, Natural and Phylogenetic 1 Hr
2. Nomenclature: Binomial nomenclature, ICN and its principles 2 Hrs
3. Cytotaxonomy and chemotaxonomy. 2 Hrs
4. Herbarium techniques: Field study, field note, Vasculum, plant press, Steps involved in herbarioum preparation, significance of herbarium 3 Hrs
5. Bentham and Hooker's system of classification, merits and demerits 3 Hrs
6. Morphology of Angiosperms – flowers, inflorescence, fruits 4 Hrs
7. Study of the following families of Bentham and Hookers system of classification with special reference to major identifying characters and economic importance : Annonaceae, Malvaceae, Rutaceae, Leguminosae, Apiaceae, Rubiaceae, Asteraceae, Apocynaceae, Lamiaceae, Euphorbiaceae, Arecaceae, Poaceae
   22 Hrs

Module 2. ECONOMIC BOTANY (Theory 18 hours, Practical 12 hours)

1. Classification of economic plants based on their uses. (Cereals, legumes and pulses. tuber crops, spices, beverages etc.) 3 Hrs

2. Study of the following economic plants with special reference to their botanical name, family, morphology of useful part, economic products and uses. 10 Hrs

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.

3. Study of the following medicinal plants with special reference to their binomial, family, morphology of useful parts and uses. 5 Hrs

1. *Adhatoda,* 2. *Aloe*, 3. Brahmi (*Bacopa*), 4. *Catharanthus*, 5. *Eclipta*, 6. *Azadirecta*, 7. *Ocimum*, 8. *Phyllanthus amarus*, 9. *Rauvolfia*, 10. *Sida*.

Practical **36 hrs**

1. Students should be able to identify typical plants belonging to the families prescribed in the syllabus. They should be able to describe the floral parts in technical terms.

2. Students should study the botanical name, family, morphology of the useful part and the uses of the plants listed in the syllabus.

Suggested additional topics

1. Classification of Angiosperms proposed by Adolf Engler, John Hutchinson and Arthur Cronquist.
2. Origin of agriculture and crop plants; centers of origin of crop plants proposed by N.I Vavilov.
3. Ethnobotany – significance and methods of ethnobotanical research.

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B.Sc. BOTANY PROGRAMME
SEMESTER IV COMPLEMENTARY COURSE IV 15U4CPBOT4

ANATOMY AND APPLIED BOTANY

(Theory 54 hours; Practical 36 hours) Theory credit 3 Practical Credit 1

COURSE OUTCOMES (COs)	
CO1	Understand the plant cell structure in a detailed manner
CO2	Understand the tissue level organization in plant system
CO3	Know and carry out the plant anatomical specimen preparations
CO4	Understand the details of wood anatomy
CO5	Understand the anomalous anatomical features in plant system
CO6	Understand and apply the morphological and anatomical adaptations of plants to different habitats
CO7	Understand various techniques and procedures in crop improvement
CO8	Understand and carry out emasculation, layering, budding and grafting

Module 1: ANATOMY (Theory 30 hours; Practical 24 hours)

Unit 1: Cell types, electron microscopic studies on plant cell – living and non-living inclusions, cell wall – ultra structure of cell wall (brief account only) 4 hrs

Unit 2: Tissues: simple and complex; meristems, secretary tissues. 4 hrs

Unit 3: Cambium: origin, structure, function, role in budding and grafting. 2 hrs

Unit 5. Primary structure of stem and root in dicots and monocots. 3 hrs

Unit 6. Secondary thickening in dicot stem and dicot root; growth rings, heart wood and sap wood; hard wood and soft wood; ring porous wood and diffuse porous wood, Anomalous secondary thickening in *Bignonia*. 5 hrs

Unit 7. Anatomy of monocot and dicot leaf. 3 hrs

Unit 8. Ecological anatomy: Study of the morphological and anatomical adaptations of the following groups; Hydrophytes (*Nymphaea*), Xerophytes (*Nerium*), Epiphytes (*Vanda*) and Halophytes (*Avicinia/ Rhizophora*). 9 hrs

Module 2: APPLIED BOTANY (Theory 24 hrs; Practicals 12 hours)

Unit 1: Plant breeding- Defenition and objectives of plant breeding
1 hr

Unit 2: Asexual reproductionin plants- Apomixis (Apospory, Diplospory and Adventive embryony), Parthenogenesis, Parthenocarpy and Polyembryony 4 hrs

Unit 3: Classical methods of crop improvement -

i. Plant introduction- defenition, types of introduction, agencies involved, procedure, quarantine acclimatization, major achievements.
ii. Selection- definition, types, procedure and major achievements of mass selection, pureline selection and clonal selection
iii. Hybridization- definition, types, procedure, emasculation methods, major achievements.
5 hrs

Unit 4: Advanced methods of plant breeding.
1. Mutation breeding- definition, mutagens used, procedure, gamma gardens, major achievements
2. Polyploidy breeding- definition, procedure and important applications. 3 hrs

Unit 5: Horticultural practices – Plant propagation through cutting, layering, budding and grafting 5 hrs

Unit 6: Plant tissue culture- principle, composition of culture media, autoclave and laminar air flow, sterilization of explant, callus induction, organogenesis, somatic embryogenesis, production of artificial seeds. 6 hrs

Practicals

a. Types of tissue – simple and complex.
b. Primary structure of stem and root of dicots and monocots.
c. Structure of dicot stem and dicot root after secondary thickening.
d. Anomalous secondary thickening in *Bignonia.*
e. Anatomy of monocot and dicot leaf.
f. Morphological and anatomical adaptations of Hydrophytes (*Nymphaea* petiole), Xerophytes (*Nerium* leaf), Epiphytes (Velamen root of *Vanda*), Halophyte (Pneumatophore and vivipary of *Avicinia* or *Rhizophora*).
g. Emasculation of pea or *Caesalpinia* flower.
h. 'T'budding, approach grafting, air layering.
i. Demonstration of tissue culture techniques: culture media, callus induction and organogenesis..

Suggested additional topics

1. Anomalous secondary thickening in monocots.
2. Wood – seasoning, properties and uses.
3. Industrial uses of cellulose.
4. Contributions of Dr. Norman S. Borlaug and Dr. M.S. Swaminathan in the field of green revolution.

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MODEL QUESTION PAPERS

Semester I Complementary Course 1 **19U1CPBOT1**
CRYPTOGAMS, GYMNOSPERMS AND PLANT PATHOLOGY

Time 2 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. What is the nature of food in Rhodophyceae?
2. Name an alga where we find prokaryotic cell organization.
3. Name the type of nucleic acid present in TMV.
4. Name a viral disease in plants and the causal organism.
5. What is sporophyll?
6. What is coralloid root?
7. Name the two types of rhizoids seen in *Riccia*.
8. Name the two types of xylem in *Cycas*

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. What is coenobium? Give an example.
10. Describe carposporophyte in *Polysiphonia*.
11. Write a note on the asexual mode of reproduction in *Phytophthora*.
12. Write any two industrial uses of bacteria.
13. Explain the terms phycobiont and mycobiont.
14. Explain the nature of stele in *Selaginella*.
15. What is transfusion tissue? What is its function?
16. Explain the structure of mature sporophyte in *Riccia*.
17. What is plasmid? What is its role?
18. Write a note on the beneficial roles of fungi.

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. Describe the different methods of vegetative reproduction in *Riccia*?
20. What are the distinguishing features of Cyanophyceae?
21. Describe asexual reproduction in *Volvox*
22. Explain the structure of a bacteriophage
23. Describe the form and structure of lichens
24. Explain the internal structure of leaflet in *Cycas.*

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. Give an illustrated account of sporophyte of *Selaginella*
    OR
26. Describe the process of sexual reproduction in nannandrous species of *Oedogonium*.

27. Describe the life cycle of *Puccinia* in wheat plant
    OR
28. Explain the disease cycle in nut fall of arecanut. Add a note on the control measures.

Semester II Complementary Course 2 **19U2CPBOT2**

PLANT PHYSIOLOGY

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. What is Red drop?
2. Define Translocation.
3. What are the major factors affecting photosynthesis?
4. Expand CAM.
5. What is meant by water potential?
6. What is a nastic movement?
7. Name a volatile hormone.
8. What is vernalization?

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. What is photolysis of water?
10. Comment on Krantz anatomy?
11. Differentiate between PS 1 and PSII.
12. What are primary and accessory pigments?
13. Write a short note on RUBISCO.
14. What is the significance of photoperiodism?
15. What is meant by senescence?
16. What are antitraspirants?
17. Explain the mechanism of water absorption in plants.
18. What is meant by DPD?

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. What are the theories related to the closing and opening of stomata?
20. Write a brief note on nitrogen cycle.
21. Explain Munch mass flow of hypothesis.
22. Point out the differences between C_3 and C_4 cycle.
23. What are the factors affecting transpiration?
24. Distinguish between transpiration and guttation

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. With the help of schematic diagram, describe the mechanism of photophosphorylation.

OR

26. Explain the process of nitrogen fixation in plants.

27. Write an essay on plant movements

OR

28. Write an essay on Stress physiology in plants

Semester III Complementary Course 03 **19U2CPBOT2**

ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY

Time 3 hours Maximum 60 Marks

Part A

I. Answer ALL questions; each question carries ONE mark. 8 x 1 = 8 marks

1. What are the essential parts of a flower?
2. What is meant by a complete flower?
3. What is a zygomorphic flower? Give one example.
4. Explain the functions of calyx and corolla.
5. What do you mean by petalloid and sepaloid condition?
6. Who is considered as the Father of Taxonomy?
7. Write down the binomial and family of cotton.
8. What is chemotaxonomy?

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. How will you distinguish artificial classification from natural classification? Give examples.
10. Comment on any two spices you have studied.
11. What is binomial nomenclature? How is it different from polynomial nomenclature?
12. Describe the androecium and gynoecium in Rubiaceae.
13. What is aestivation? Name the different types of aestivation you have studied.
14. Differentiate between polypetalous and gamopetalous condition.
15. Write down the binomial of any two oil yielding plants giving their uses.
16. With the help of a neat diagram, explain different parts of stamen.
17. What is placentation? Explain different types of placentation.
18. What is meant by floral formula. Give example.

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 20 marks

19. Draw the floral diagram of a flower belonging to the family Rubiaceae.
20. What is phylogenetic or evolutionary classification?
21. Briefly explain ICBN.
22. Give the binomial, useful part and uses of any two cereals and pulses ?
23. What are the major criteria for biological classification?

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 2 x 12 = 24 marks

24. Give an account of various steps involved in Herbarium preparation.

OR

25. Explain Bentham and Hooker's system of classification. Add a note on its merits and demerits.

26. Describe the salient features of the family Apocynaceae with a suitable example.

OR

28. Evaluate the plants *Adhatoda, Catharanthus*, and *Rauvolfia* with special reference to their binomial, family, morphology of useful parts and uses.

Semester IV Course IV **19U2CPBOT2**

ANATOMY AND APPLIED BOTANY

Time 3 hours Maximum 60 Marks

Part A

I. Answer All questions; each question carries ONE mark. 8 x 1 = 8 marks

1. What is Heterosis?
2. What is Asepsis ?
3. What is Multiple cross ?
4. What is plasmodesmata ?
5. What is dendrochronology ?
6. What is inter fascicular cambium?
7. What are bulliform cells ?
8. What is vivipary ?

Part B

II. Answer ANY SIX questions; each question carries TWO marks. 6 x 2 = 12 marks

9. What is layering, what are the different types of Layering ?
10. What is Mutation breeding, Give an example?
11. What is Hybridization, mention different types?
12. What is plant introduction, mention the types of introduction?
13. Distinguish between Sap wood and Heart wood
14. Distinguish between storied cambium and non storied cambium?
15. Distinguish between Schizogenous and lysigenous type of inter cellular formation ?
16. What are the distinguishing features of monocot root?
17. Write two anatomical adaptations of Hydrophytes.
18. What are velamen roots?

Part C

III. Answer ANY FOUR questions; each question carries FOUR marks. 4 x 4 = 16 marks

19. What is Emasculation?
20. What is quarantine?
21. What is the anomaly in the secondary growth of Bignonia?
22. Explain the components of secondary Xylem.
23. What are bordered pits? Draw a labeled diagram.
24. What are the important extra cell wall materials? Name the tissues where each one is present?

Part D

IV. Answer ANY TWO questions; each question carries TWELVE marks. 12 x 2 = 24 marks

25. Give an account of microscopic and submicroscopic structure of cell wall. Explain how the cell wall grows in thickness

OR

26. Explain Structure, function and seasonal activity of cambium? What is the role of cambium in budding and grafting

27. Write an essay on Tissue culture. Mention the principles & requirements.

OR

28. Write an essay on the Methods of Plant improvement.

B.Sc Botany Programme
Practical 01- 19U2PCBOT1
Complementary (19U1CPBOT1 & 19U2CPBOT2 COMBINED)

Cryptogams, Gymnosperms, Plant Pathology & Plant Physiology

Time: 3 Hours Max. Marks:30

1. Make suitable micropreparations of **A** and **B**, stain and mount in glycerine, draw, label the parts and identify giving reasons.

Preparation	1 Mark	
Labelled diagram	1 Mark	
Identification	½ Mark	
Reasons	1 Mark	(3½ x2=7 Marks)

2. Identify **C** with reasons and draw diagram.

Identification	½ Mark	
Reason	½ Mark	
Labelled diagram	1 Mark	(2 x1=2 Marks)

3. Identify at sight **D** & **E**.

Part displayed	½ Mark	
Genus	½ Mark	(2x1=2 Marks)

4. Write note on pathological interest of **F**.

Name of the disease	½ Mark	
Causative organism	½ Mark	
Symptoms	1 Mark	(2x1=2 Marks)

5. Conduct the experiment **G**. Write the requirements,aim and procedure.

Requirements	1 Mark	
Aim	1 Mark	
Conduction of experiment	2 Marks	
Procedure	2 Marks	(6x1=6 Marks)

6. With suitable diagram, write the aim and 2 defects of the experiment **H**.

Aim	1 Mark	
Defects	1 Mark	(2x1=2 Marks)

7. Viva 3 Marks
8. Record 6 Marks

Instructions to the Examiners

A & B : Fresh or well preserved specimens from fungi, Bryophyte, Pteridophyte and Gymnosperms.

C : Specimens from algae.

D & E : Fresh or well preserved specimens from Fungi, Lichen, Bryophyte, Pteridophyte and Gymnosperms.

F : Any one pathological material mentioned in the syllabus.

G : From the list of core experiments.

H : From demonstration experiments.

Practical Complementary 02 -19U4PCBOT2

(19U3CPBOT3 & 19U4CPBOT4)

ANGIOSPERM TAXONOMY, ECONOMIC BOTANY ANATOMY AND APPLIED BOTANY

Time 3 hours **Max.Marks-30**

Questions

1.	Assign **A** to its family giving diagnostic characters.		
	Name of the family	1	
	Diagnostic characters	2	3x1= 3 marks
2.	Draw L.S. Construct floral diagram and write the floral formula of **B**		
	L.S of the flower	2	
	Floral diagram	1	
	Floral formula	1	4x1= 4 marks
3.	Identify **C** and **D** Write notes		
	Identification	½	
	Reason	1½	1½ x 2=3 marks
4.	Write the binomial, family and morphology of the useful part of **E** and **F**		
	Binomial	1	
	Family	½	
	Morphology	½	2x2= 4 marks
5.	Make stained transverse section of specimen **G**, mount in glycerin and identify giving diagnostic characters.		
	Preparation	2	
	Diagram,	1	
	Identification with reasons	2	1x5 = 5 marks
6.	Identify the given T S of the material **H**	½	½ x 1 = ½ mark
7.	Identify the cell inclusion '**I**' with reason.	1/2	1/2x1= 1/2 mark
8.	Assign **'J'** to the ecological group with reasons.		
	Ecological group	1/2	
	Reasons	1/2	½ x2 = 1 mark
9.	Carry out emasculation /T-budding/patch-budding in '**K**'		
	Demonstration	2	
	Aim & procedure	1	3x1 = 3 marks
10.	Viva		2 marks
11.	Record		4 marks

Instructions to the Examiners

I. **A -** typical plant twigs with flowers included in the syllabus from different subclasses of dicotyledons.
II. **B -** Fresh large flowers included in the syllabus.
III **C -** frominflorescences, D from fruits
IV. **E** and **F -** Economic Botany specimens included in the syllabus.
V**. G -** Stem or Root – Normal secondary thickening or Anomalous secondary thickening in *Bignonia*
VI. **H -** Slides of Primary Structure of Stem or Root**.**
VII. **I -** Non living inclusion (Cystolyth/ Raphide)
VIII. **J -** Specimens from ecological group mentioned in the syllabus.
IX **K -** Suitable materials for emasculation/ budding.