SYLLABUS

Core, Complementary
& Open Courses

UG PROGRAMME
IN BOTANY

Under Choice Based Credit Semester System

FAROOK COLLEGE
(AUTONOMOUS)

Board of Studies in Life Science
Farook College (Autonomous)

www.farookcollege.ac.in

CERTIFICATE

I hereby certify that the documents attached are the bonafide copies of the syllabus of Core Courses offered to B.s.c Botany programme and Complementary & Open Courses offered by the Department of Chemistry to be effective from 2022 admission onwards.

Principal

Date: 01 June 2023

Place: Farook College

CONTENTS

Sl. No	PARTICULARS	Page No
1	Preamble	6
2	Members of the Board of Studies	7
3	Programme Outcomes	8
4	Programme Specific Outcomes	10
UG PROGRAMME – AN OVERVIEW		
5	Definitions	11
PROGRAMME STRUCTURE		
6	Core, Complementary and Open Courses	12
7	Ability Enhancement Courses/ Audit Courses	13
8	Credits	13
9	Extra credit activities	13
10	Credit distribution of B.Sc. Botany Programme	14
11	Attendance	14
12	Project work / Theory course on Research Methodology	15
13	Grace marks	15
14	Registration	15
EXAMINATIONS		
15	Practical Examination	16
16	External viva voce	16
17	Project evaluation	16
18	Audit course	17
19	Improvement course	17
20	Moderation	17
EVALUATION AND GRADING		
21	Course Evaluation	17
22	Internal evaluation	17
23	External evaluation	19
24	Revaluation	19
25	Evaluation of Audit Course	19
26	Indirect grading system	19
27	Grade Card	20

28	Methods of Indirect grading	21
29	Guidelines for evaluation of project work	21
30	Practical records	23
31	Submissions	23
32	Question paper patterns	25
33	Semester wise distribution of credits	28
CORE & OPEN COURSES		
34	Course structure, work load and credit distribution	28
35	Instructional hours, mark distribution and scheme of examination	31
DETAILED SYLLABUS (Core)		
36	Sem. I Course 1: **Angiosperm Anatomy, Reproductive Botany & Palynology**	32
37	Sem. II Course 2: **Microbiology, Mycology, Lichenology & Plant Pathology**	38
38	Sem. III Course 3: **Phycology, Bryology & Pteridology**	44
39	Sem. IV Course 4: **Methodology and Perspectives in Plant Science**	50
40	Sem. V Course 6: **Gymnosperms, Palaeobotany, Phytogeography & Evolution**	56
41	Sem. V Course 7: **Angiosperm Morphology & Plant Systematics**	61
42	Sem. V Course 8: **Tissue culture, Horticulture, Economic Botany & Ethnobotany**	67
43	Sem. V Course 9: **Cell Biology & Biochemistry**	75
44	Sem. VI Course 10: **Genetics & Plant Breeding**	80
45	Sem. VI Course 11: **Biotechnology, Molecular Biology & Bioinformatics**	85
46	Sem. VI Course 12: **Plant Physiology & Metabolism**	91
47	Sem. VI Course 13: **Environmental Science**	95
50	Sem. VI Elective course - Choice - 1: **Genetic Engineering**	101
51	Sem. VI Elective course - Choice - 2: **Advanced Angiosperm Systematics**	106
52	Sem. VI Elective course - Choice - 3: **Genetics & Crop Improvement**	110
53	Sem. VI Elective course - Choice - 4:	114

	Agronomy & Entrepreneurship	
COMPLEMENTARY COURSES		
54	Course structure, Workload & Credit distribution	121
55	Mark distribution & Scheme of examination	122
56	Distribution of Internal marks	122
DETAILED SYLLABUS (Complementary)		
59	Sem. I Course 1: **Angiosperm Anatomy & Microtechnique**	123
60	Sem. II Course 2: **Cryptogams, Gymnosperms & Plant Pathology**	127
61	Sem. III Course 3: **Morphology, Systematic Botany, Economic Botany, Plant Breeding & Horticulture**	131
62	Sem. IV Course 4: **Plant Physiology Ecology & Genetics**	137
OPEN COURSES		
63	Sem. V Open course - Choice - 1: **General Botany**	143
64	Sem. V Open course - Choice - 2: **Applied Botany**	147
65	Sem. V Open course - Choice - 3: **Basic Tissue Culture**	151
MODEL QUESTION PAPERS		
66	**Core** - Theory	155
67	**Core** - Practicals	171
68	**Complementary** - Theory	178
69	**Complementary** - Practicals	182
70	**Open** - Theory	185

PREAMBLE

The revised Curriculum for Undergraduate Programme of B.Sc. Botany offered by Farook College focuses on imparting knowledge in basic and applied aspects of Botany. Due importance is given to fundamental and modern aspects of Botany, spanning many specialties and interests. An attempt has been made to make the study of Botany interesting and enjoyable, and to keep up with the speed with which technology advances. Formulation of the syllabus has been done by revamping the existing syllabus, with an understanding that the syllabus is addressing the 'digital native' generation.

The revised syllabus of B.Sc. Botany has been prepared in a participatory manner, after discussions with experts in the subject and by pooling suggestions from the teaching community. As far as possible, the suggested modifications have been incorporated in the syllabus. During the preparation of the syllabus, the existing syllabus, UGC model curriculum, syllabi of other universities, syllabi of XIth & XIIth standards and M.Sc. Botany syllabus of Calicut University have also been referred to. Care has been taken to ensure that the syllabus is compatible with the syllabi of other universities at the same level.

Concern for ever increasing pollution, biodiversity destruction and climate change is at its highest than ever. Keeping these issues in view, revision of the curriculum at the undergraduate level is done focusing towards creating awareness on these aspects.

AIMS AND OBJECTIVES OF THE PROGRAMME

- The fundamental objective of the curriculum is to impart effective science education at the undergraduate level, exposing students to recent trends and developments in the subject.
- Creating scientific temper is another major objective of this curriculum. Incorporating research components along with a sound academic foundation enables students to develop independent creative thinking. Sufficient emphasis is given for training in laboratory skills and instrumentation. The curriculum is meant to inspire creativity and combine passion with critical thinking skills in students who one day will be the citizens working to convert the world to more sustainable systems.
- Another major thrust given here is to develop an environmental concern in all activities of the students. 'Go green' has been taken as the motto of the syllabus. This emphasizes on creating awareness of the urgent need to conserve nature without destruction of natural resources.

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PROGRAMME OUTCOMES (UG)

PO1. Competency in Disciplinary Knowledge

Graduates acquire comprehensive knowledge in the subject and competence to demonstrate the same, identify the foundations of the respective discipline and develop essential interdisciplinary awareness.

PO2. Communication Skills and Digital Literacy

Graduates acquire sufficient communication skills in speech and writing to disseminate knowledge and critically analyze various discourses with the assistance of advanced communication technology in order to prepare themselves for learning, working and living in a digital society

PO3. Critical Thinking and Problem Solving

Graduates maintain the practical experience of critical thinking both in academia and real-life situations, master appropriate skills to analyze various issues and to formulate coherent arguments using scientific approach and develop individual capacity to solve problems in the real and anticipated life.

PO4. Leadership Skills and Professionalism

Graduates are able to live and work in diverse conditions with members hailing from diverse background towards the fulfillment of the institutional and societal goals, keeping up the spirit of team work and maintaining dynamism and professional behavior based on positive leadership qualities, constructive feedback system and productive corrective measures.

PO5. Moral and Ethical Awareness

Graduates are able to embrace moral and ethical values specific to the society and culture and uphold them consistently as responsible members of the society.

PO6. Social Responsibility and Citizenship Skills

Graduates demonstrate a sense of social responsibility and citizenship skills, including an understanding of social issues, and an awareness of cultural diversity.

PO7.Global Competence and Sustainability

Graduates are able to examine local, global and intercultural issues, understand and appreciate different perspectives and world views, interact successfully and respectfully with others, and take responsible action toward environmental and social sustainability.

PO8. Employability and Entrepreneurship

Graduates are able to achieve professional skills required to be employed in their career globally and the potential to formulate innovative ideas and to start up new enterprises.

PO9. Inclusiveness and Equity

Graduates are able to understand the importance of inclusiveness and equity in their professional and personal lives and demonstrate the ability to communicate effectively and respectfully with people from diverse backgrounds.

PO10. Scientific Temper and Open Mindedness

Graduates are able to develop scientific temper and open mindedness as processes of thinking, behaving and connecting with others based on scientific notions are able to apply the scientific method and its application in various scientific fields.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1. **Understand** the scope and importance of Botany in every field, especially in dealing with social and environmental issues, agriculture, ethics and human welfare.

PSO2. **Understand** the role of plants in sustaining life on earth; the interrelationships between man and nature; the basic hereditary and evolutionary principles.

PSO3. **Understand** the various tools and techniques employed in basic and applied fields of Botany, for effective conservation of biodiversity and meaningful utilization of plant resources.

PSO4. **Apply** the acquired knowledge to explain developmental aspects of plants; the climatic changes happened; to manipulate various equipments; to suggest solutions for various environmental issues; to produce plants having superior qualities to meet the increasing needs of humanity.

PSO5. **Analyze** the structural and developmental features of plants, to classify them based on gross morphological and anatomical features, to differentiate plant groups ranging from algae to angiosperms, to identify the importance of field studies and the need for biodiversity conservation.

PSO6. **Analyze** the importance of Traditional Botanical Knowledge; various cultivation and conservation strategies for economically and ethnobotanically significant plants; various patterns of plant distribution.

PSO7. **Evaluate** the beneficial and harmful inter-relationship between plants and microbes; the impact of plant diseases on crop production and their remedial measures; various ethical, social and legal issues concerned with genetic manipulation in plants.

PSO8. **Evaluate** the diverse morphology of plants and their evolutionary significance; the various levels of organization ranging from molecules to biosphere; the principles underlying the growth and development of organisms, fossilization; the facts and theories behind heredity and variations.

PSO9. **Create** awareness about the basic and advanced tools and techniques to develop scientific temper and problem-solving skills for undertaking scientific projects, to develop skills in identifying/classifying/illustrating plants; develop skills in various plant cultivation methods to meet the increasing demands of the society.

PSO10. **Create** awareness about the importance biodiversity conservation and sustainable use of natural resources, estimate the loss of biodiversity and develop conservation strategies.

UG PROGRAMME – AN OVER VIEW

DEFINITIONS

- **Programme** means the entire course of study and examinations for the award of a degree.
- **Duration of programme** means the time period required for the conduct of the programme. The duration of a UG degree programme shall be six semesters distributed in a period of 3 years or eight semesters in a period of 4 years.
- **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.
- **Semester** means a term consisting of 18 weeks (16 instructional weeks and two weeks for examination).
- **Course** means a segment of subject matter to be covered in a semester.
- **Common course** means a course that comes under the category of courses, including compulsory English and additional language courses, the selection of which is compulsory for all students undergoing UG programmes.
- **Core course** means a compulsory course in a subject related to a particular degree programme.
- **Open course** means a course which can be opted by a student at his/her choice.
- **Complementary course** means a course which is generally related to the core course.
- **Improvement course** is a course registered by a student for improving his/her performance in that particular course.
- **Ability Enhancement course/Audit course** is a course which is mandatory as per the directions from the Regulatory authorities like UGC, Supreme Court etc.
- **Credit (C)** is a unit of academic input measured in terms of weekly contact hours/course contents assigned to a course.
- **Extra Credit** is the additional credit awarded to a student over and above the minimum credits required in a programme, for achievements in co-curricular activities and social activities conducted outside the regular class hours, as decided by the College. For calculating CGPA, extra credits will not be considered.
- **Letter Grade** or simply 'Grade' in a course is a letter symbol (**O, A+, A, B+, B, C, P, F, I** and **Ab**). Grade shall mean the prescribed alphabetical grade awarded to a student based on his/her performance in various examinations. Each letter grade is assigned a '**Grade point**' **(G),** which is an integer indicating the numerical equivalent of the broad level of

performance of a student in a course.

- **Grade Point** means point given to a letter grade on 10 point scale.
- **Semester Grade Point Average' (SGPA)** is the value obtained by dividing the sum of credit points obtained by a student in the various courses taken in a semester by the total number of credits in that semester. SGPA shall be rounded off to three decimal places. SGPA determines the overall performance of a student at the end of a semester.
- **Credit Point'(P)** of a course is the value obtained by multiplying the grade point (G). by the credit (C). of the course: P = G x C
- **Cumulative Grade Point Average' (CGPA)** is the value obtained by dividing the sum of credit points in all the semesters taken by the student for the entire programme by the total number of credits in the entire programme and shall be rounded off to three decimal places.
- **Grade Card** means the printed record of students' performance, awarded to him/her.
- **Course teacher:** A teacher nominated by the Head of the Department shall be in charge of a particular course.
- **Strike off the roll** A student who is continuously absent for 14 days without sufficient reason and proper intimation to the Principal of the college shall be removed from the roll.

PROGRAMME STRUCTURE (excluding common courses).

- **CORE COURSES:**

  Core courses are the courses in the major (core). subject of the degree programme chosen by the student. Core courses are offered by the parent department.
- **COMPLEMENTARY COURSES:**

  Complementary courses cover one or two disciplines that are related to the core subject and are distributed in the first four semesters.
- **OPEN COURSES:**

  There shall be one open course in core subjects in the fifth semester. The open course shall be open to all the students in the institution except the students in the parent department. The students can opt that course from any other department in the institution. Each department can decide the open course from a pool of three courses offered by the college. Total credit allotted for open course is 3 and the hours allotted is 3. If there is only one programme, they can choose either language courses or physical education as open course.
- **ABILITY ENHANCEMENT COURSES/ AUDIT COURSES:**

  These are courses which are mandatory for a programme but not counted for the

calculation of SGPA or CGPA. There shall be one Audit course each in the first four semesters. These courses are not meant for class room study. The students can attain only pass (Grade P) for these courses. The students can attain these credits through Onlince courses like NPTEL, SWAYAM, MOOC etc.

Table - 1: THE LIST OF AUDIT COURSES IN EACH SEMESTER WITH CREDITS

Sl No	Semester	Course	Credit
1	1	Environment Studies	4
2	2	Disaster Management	4
3	3	*Human Rights/ Intellectual Property Rights/ Consumer Protection	4
4	4	*Gender Studies/ Gerontology	4
Total			**16**

* College can opt any one of the courses.

- **CREDITS:**

  A student is required to acquire a minimum of 140 credits for the completion of the UG programme, of which 120 credits are to be acquired from class room study and shall only be counted for SGPA and CGPA. Out of the 120 credits, 38 (22 for common (English) courses + 16 for common languages other than English) credits shall be from common courses, 2 credits for project/corresponding paper and 3 credits for the open course. The maximum credits for a course shall not exceed 5. Audit courses shall have 4 credits per course and a total of 16 credits in the entire programme. The maximum credit acquired under extra credit shall be 4. If more Extra credit activities are done by a student, which may be mentioned in the Grade card. The credits of audited courses or extra credits are not counted for SGPA or CGPA.

- **EXTRA CREDIT ACTIVITIES:**

  Extra credits are mandatory for the programme. Extra credits will be awarded to students who participate in activities like NCC, NSS and Swatch Bharath. Those students who could not join in any of the above activities have to undergo *Farook College Social Service Programme* (FCSSP). Extra credits are not counted for SGPA or CGPA.

Table - 2 CREDIT DISTRIBUTION OF B.Sc. BOTANY PROGRAMME

Semester	Common course		Core courses	Complementary courses		Open course	Total Credits (Class room study)	Audit course	Extra credits	Total Credits
	English	Additional Language		Chemistry	Zoology					
I	4+3	4	3	2	2		18	4		18
II	4+3	4	3	2	2		18	4		18
III	4	4	3	2	2		15	4		15
IV	4	4	3+4**	2+4**	2+4**		27	4		27
V			3+3+3+3			3	15			16
VI			3+3+3+3+32*+5**+5**				27		4	26
Total	**22**	**16**	**55**	**12**	**12**	**3**	**120**	**16**	**4**	**140**
* Credits of Project Work **Credits of Practical papers										

- **ATTENDANCE:**

  A student shall be permitted to appear for the semester examination, only if he/ she secure not less than 75% attendance in each semester. Attendance shall be maintained by the Department concerned. Condonation of shortage of attendance to a maximum of 10% in the case of single condonation and 20% in the case of double condonation in a semester shall be granted by the college, remitting the required fee. Benefits of attendance may be granted to students who attend the approved activities of the college/university with the prior concurrence of the Head of the institution. Participation in such activities may be treated as presence in lieu of their absence on production of participation/attendance certificate (within two weeks) in curricular/extracurricular activities (maximum 9 days in a semester). Students can avail of condonation of shortage of attendance in a maximum of four semesters during the entire programme (Either four single condonations or one double condonation and two single condonations during the entire programme).

  If a student fails to get 65% attendance, he/she can move to the next semester only if he/she acquires 50% attendance. In that case, a **provisional registration** is needed. Such students can appear for supplementary examination for such semesters after the completion of the programme. Less than 50% attendance requires **Readmission**. Readmission is permitted only once during the entire programme.

- **PROJECT WORK/ THEORY COURSE ON RESEARCH METHODOLOGY:**

  Every student of a UG degree programme shall have to work on a project of 2 credits or shall write a theory course based on Research Methodology as per the curriculum. College shall have the liberty to choose either of the above. Project work at UG level shall be of group nature, during the tenure of V^{th} and VI^{th} semester. A group of not more than five students can undertake one project under the supervision of a faculty member as per the curriculum.

- **GRACE MARKS:**

  Grace Marks may be awarded to a student for meritorious achievements in co-curricular activities (in Sports/Arts/NSS/NCC/Student Entrepreneurship) carried out besides the regular hours. Such a benefit is applicable and limited to a maximum of 8 courses in an academic year spreading over two semesters. In addition, maximum of 6 marks per semester can be awarded to the students of UG Programmes, for participating in the *College Fitness Education Programme* (COFE).

REGISTRATION

Each student shall make an online registration for the courses he/she proposes to take, in consultation with the Faculty Adviser within two weeks from the commencement of each semester. The college shall send a list of students registered for each programme in each semester giving the details of courses registered, including repeat courses, to the University in the prescribed form within 45 days from the commencement of the semester.

A student shall be normally permitted to register for the examination if he/she has required minimum attendance. If the student has a shortage of attendance below 65% in a semester, the student shall be permitted to move to the next semester (if the attendance is more than 50% - Provisional registration) and can write the examination for the entire courses of the semester in which shortage of attendance occurs as supplementary examination only after the completion of the entire programme**.** In such cases, a request from the student may be forwarded through the Principal of the college to the Controller of Examinations within two weeks of the commencement of the semester. If the attendance is less than 50%, the student is ineligible to continue the programme and has to seek readmission. **There will not be any Repeat semester in CBCSSUG 2022**.

A student who registered for the course shall successfully complete the programme within 6 years from the year of first registration. If not, such candidate has to cancel the

existing registration and join afresh as a new candidate.

For Open courses there shall be a minimum of 10 and maximum of 75 students per batch. For other courses existing pattern will be followed.

Those students who have followed the UG Programmes in annual pattern or *Choice based Credit & Semester System* pattern can cancel their earlier registration and register afresh for CBCSSUG 2022 scheme in the same discipline or a different one.

The students who have attendance within the limit prescribed, but could not register for the examination have to apply for **Token registration,** within two weeks of the commencement of the next semester.

EXAMINATIONS

There shall be *Semester End Examinations* (SEE) at the end of each semester.

- **PRACTICAL EXAMINATION**

  Practical examinations shall be conducted by the college as prescribed by the Board of Studies. There will be practical examinations at the end of 4th semester and 6th semester. Practical examination of 4th semester will be of 3 hrs duration. Practical examinations of 5th and 6th semesters conducted at the end of 6th semester will also be of 3 hrs duration.

- **EXTERNAL VIVA-VOCE**

  External viva voce if any shall be conducted along with the practical examination/ project evaluation. The model of question papers may be prepared by the concerned Board of Studies. Each question should aim at (1) assessment of the knowledge acquired (2) standard application of knowledge (3) application of knowledge in new situations.

  Different types of questions shall possess different marks to quantify their range.

- **PROJECT EVALUATION**

  Project evaluation shall be conducted at the end of sixth semester. 20% of marks are awarded through internal assessment. Internal assessment of the project will be based on its content, method of presentation, final conclusion and orientation to research aptitude.

- **AUDIT COURSE**:

  The students can attain only pass (Grade P) for these courses. At the end of each semester there shall be examination conducted by the college from a pool of questions set by the University. The students can also attain the credits through online courses like SWAYAM, MOOC etc. The College shall send the list of passed students to the University at least before the commencement of fifth semester examination.

- **IMPROVEMENT COURSE:**

Improvement of a particular semester can be done only once. The student shall avail of the improvement chance in the succeeding year after the successful completion of the semester concerned. The students can improve a maximum of two courses in a particular semester. The internal marks already obtained will be carried forward to determine the new grade/mark in the improvement examination. If the candidate fails to appear for the improvement examination after registration, or if there is no change in the results of the improved examination, the mark/grade obtained in the first appearance will be retained. Improvement and supplementary examinations cannot be done simultaneously.

- **MODERATION:**

  Moderation is eligible as per the existing rules of the Academic Council.

EVALUATION AND GRADING

Mark system is followed instead of direct grading for each question. For each course in the semester letter grade and grade point are introduced in 10-point indirect grading system as per guidelines given in Annexure-1.

- **COURSE EVALUATION**

  The evaluation scheme for each course shall contain two parts

  1) Internal assessment 2) External Evaluation

  20% weight shall be given to the internal assessment. The remaining 80% weight shall be for the external evaluation.

- **INTERNAL EVALUATION**

20% of the total marks in each course are for internal examinations. The internal assessment shall be based on a predetermined transparent system involving written tests, assignment, seminars, class room participation based on attendance etc in respect of Theory courses and practical test, records/submissions, lab involvement etc in respect of Practical Courses.

Table - 3: COMPONENTS WITH PERCENTAGE OF MARKS OF INTERNAL EVALUATION

Exam	Component	Percentage of marks	Marks
Theory (Total = 15)	Test paper	40%	**6**
	Assignment	20%	**3**
	Seminar	20%	**3**
	Class room participation based on attendance	20%	**3**

Practical (Total = 20)	Practical test	30%	**6**
	Records and submissions	30%	**6**
	Lab involvement	40%	**8**

(If a fraction appears in internal marks, nearest whole number is to be taken)

For the test paper marks, at least one test paper should be conducted. If more test papers are conducted, the mark of the best one should be taken. To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be notified on the notice board at least one week before the commencement of external examination. There shall not be any chance for improvement for internal marks. The course teacher(s) shall maintain the academic record of each student registered for the course, which shall be forwarded to the Controller of Examinations after obtaining the signature of both course teacher and Head of the Department.

Table - 4: SPLIT UP OF MARKS FOR TEST PAPER

Range of Marks in Test paper	Out of 8 (Maximum internal marks 20)	Out of 6 (Maximum internal marks 15)
Less than 35%	1	1
35% - 45%	2	2
45% - 55%	3	3
55% - 65%	4	4
65% - 85%	6	5
85% - 100%	8	6

Table-5: SPLIT UP OF MARKS FOR CLASS ROOM PARTICIPATION (CRP)

Range of CRP	Out of 4 (Maximum internal marks 20)	Out of 3 (Maximum internal marks 15)
50% ≤ CRP <75%	1	1
75% ≤ CRP <85%	2	2
85% and above	4	3

- **EXTERNAL EVALUATION**

  External evaluation carries 80% of marks. All question papers shall be prepared by the college. The external question papers may be of uniform pattern with 80/60 marks (The pattern is given in the Annexure III). The courses with 2/3 credits will have an external examination of 2 hours duration with 60 marks and courses with 4/5 credits will have an external examination of 2.5 hours duration with 80 marks.

  The external examination in theory courses is to be conducted by the college with question papers set by external experts. The evaluation of the answer scripts shall be done by examiners, based on a well-defined scheme of valuation and answer keys provided by the college.

The external evaluation in practical courses shall be conducted by two external examiners appointed by the college, in order to maintain the secrecy and seriousness of the examination. The project evaluation is also to be carried out by two external examiners. After the external evaluation only, marks are to be entered in the answer scripts. All other calculations including grading are done by the college.

- **REVALUATION**

  In the new system of grading, revaluation is permissible. The prevailing rules of revaluation are applicable to CBCSSUG 2019. Students can apply for photocopies of answer scripts of external examinations. Applications for photocopies/ scrutiny/ revaluation should be submitted within 10 days of publication of results. The fee for this shall be as decided by the college.

- **EVALUATION OF AUDIT COURSES:**

  The examination shall be conducted by the college itself from the Question Bank prepared by the college. The Question paper shall be of 100 marks of 3 hour duration. It may be of MCQ/ fill in the blank type questions or online question paper may be introduced.

INDIRECT GRADING SYSTEM

Indirect grading System based on a 10-point scale is used to evaluate the performance of students.

Each course is evaluated by assigning marks with a letter grade (**O, A+, A, B+, B, C, P, F, I or Ab**). to that course by the method of indirect grading. An aggregate of **P grade** (after external and internal put together) is required in each course for a pass and also for awarding a degree (A minimum of 20% marks in external evaluation is needed for a pass in a course. But no separate pass minimum is needed for internal evaluation). No separate grade/mark for internal and external will be displayed in the grade card; only an aggregate grade will be displayed. Also, the aggregate marks of internal and external are not displayed in the grade card.

A student who fails to secure a minimum grade for a pass in a course is permitted to write the examination along with the next batch.

After the successful completion of a semester, *Semester Grade Point Average* (SGPA) of a student in that semester is calculated using the formula given below. For the successful completion of a semester, a student should pass all courses. However, a student is permitted to move to the next semester irrespective of SGPA obtained.

SGPA of the student in that semester is calculated using the formula:

$$SGPA = \frac{\textbf{Sum of the credit points of all courses in a semester}}{\textbf{Total credits in that semester}}$$

The *Cumulative Grade Point Average* (CGPA). of the student is calculated at the end of a programme. The CGPA of a student determines the overall academic level of the student in a programme and is the criterion for ranking the students. CGPA can be calculated by the following formula.

$$CGPA = \frac{\textbf{Total credit points obtained in six semesters}}{\textbf{Total credits acquired } (\mathbf{120})}$$

SGPA and CGPA shall be rounded off to three decimal places. CGPA determines the broad academic level of the student in a programme and is the index for ranking students (in terms of grade points). An overall letter grade (cumulative grade). for the entire programme shall be awarded to a student depending on her/his CGPA.

GRADE CARD

The college shall issue to the student's grade/marks card (by online) on completion of each semester, which shall contain the following information:

Name of University, Name of College, Title of UG Programme, Semester concerned, Name and Register Number of student, Code number, Title and Credits of each Course opted in the semester, Letter grade in each course in the semester, the total credits, Total credit points and SGPA in the Semester (corrected to three decimal places).

The final Grade card issued at the end of the final semester shall contain the details of all courses taken during the entire programme including those taken over and above the prescribed minimum credits for obtaining the degree. The final grade card shall show CGPA (corrected to three decimal places), percentage of marks (corrected to two decimal places) and the overall letter grade of a student for the entire programme. The final grade card shall also include the CGPA and percentage of marks of common courses, core courses, complementary courses and open courses separately. This is to be done in a 10- point indirect scale. The final Grade card also contains the list of Audit courses passed and the details of Extra credits.

METHOD OF INDIRECT GRADING

Evaluation (both internal and external) is carried out using Mark system. The Grade on the basis of total internal and external marks will be indicated for each course, for each semester and for the entire programme. Indirect Grading System in 10-point scale is as below:

Table - 6: TEN POINT INDIRECT GRADING SYSTEM

Percentage of Marks (Both Internal & External put together)	**Grade**	**Interpretation**	**Grade point Average (G)**	**Range of grade points**	**Class**
95 and above	**O**	Outstanding	10	9.5 - 10	First Class with Distinction
85 to below 95	**A+**	Excellent	9	8.5 - 9.49	
75 to below 85	**A**	Very good	8	7.5 - 8.49	
65 to below 75	**B+**	Good	7	6.5 - 7.49	First Class
55 to below 65	**B**	Satisfactory	6	5.5 - 6.49	
45 to below 55	**C**	Average	5	4.5 - 5.49	Second Class
35 to below 45	**P**	Pass	4	3.5 - 4.49	Third Class
Below 35	**F**	Failure	0	0	Fail
Incomplete	**I**	Incomplete	0	0	Fail
Absent	**Ab**	Absent	0	0	Fail

GUIDELINES FOR THE EVALUATION OF PROJECT WORK

The evaluation of the project work shall be conducted at the end of the sixth semester, along with the practical examination. Evaluation of the Project Report shall be done under Mark System. The internal to external components is to be taken in the ratio 1:4. The total marks earmarked for the project work is 75 (Internal 15 & External 60). The marks shall be awarded on the basis of the originality, structural and content wise perfection of the work. The evaluation of the project will be done at two stages:

a) **Internal Assessment** (*assessed by Supervising teachers*)

Internal Assessment should be completed 2 weeks before the last working day of VI Semester. Internal Assessment marks should be published in the Department. Submission of the Project Report and presence of the student for viva are compulsory for internal evaluation. Internal assessment of the project will be based on its content, method of presentation, final conclusion and orientation to research aptitude.

b) **External evaluation** (*assessed by two External examiners appointed by the college*)

Grade for the project will be awarded to candidates, combining the internal and external marks. Project evaluation will be done along with practical examinations. External Examiners will be appointed by the college from the list of VI Semester Board of Examiners in consultation with the Chairperson of the Board. The Chairman of the VI semester examination should form and coordinate the evaluation teams and their work. The

Chairman Board of Examinations, may at his discretion, on urgent requirements, make certain exception in the guidelines for the smooth conduct of the evaluation of project. No marks shall be awarded to a candidate if she/ he fails to submit the project report for external evaluation. Project presentations (10 to 15 minutes) should be supported with electronic presentation methods (PowerPoint / any other similar presentation making program can be used).

Table - 7: ASSESSMENT OF DIFFERENT COMPONENTS OF PROJECT

Components		Percentage of marks
Internal (20%).	**External (80%)**	
Originality	Relevance of the topic, Statement of objectives	20
Methodology	Reference/ Bibliography, Presentation, quality of Analysis/ Use of Statistical tools	20
Scheme/ Organization of Report	Findings and recommendations	30
Viva – Voce	Viva – Voce	30

The student should get a minimum **P** Grade in aggregate of External and Internal. There shall be no improvement chance for the Marks obtained in the Project Report. In the extent of student failing to obtain a minimum of Pass Grade, the project work may be re-done and a new internal mark may be submitted by the Parent Department. External examination may be conducted along with the subsequent batch.

PRACTICAL RECORDS

A certified record book is evidence of the practical works done by the candidate during the course. The entire experiments mentioned in the practical syllabus are expected to be done at the Centre. Those items which do not demand illustrations can be excluded from the record. The records must be treated seriously and it should be valued properly. The genuine work should be appropriately rewarded. The total marks set apart for the records of the programme are **45,** i.e., 15 marks each for the records of practical papers I, II and III.

External evaluation of Record - Parameters

a. Content should cover all the practical works mentioned in the syllabus for recording.
b. Neatness and scientific accuracy and perfection.

SUBMISSIONS

Submissions are mandatory for each practical paper and it carries 30 marks altogether.

The items to be submitted as part of each practical paper for valuation are appended below.

Practical paper – I

Students are expected to submit any five properly identified specimens belonging to Pathology (either the diseases mentioned in the syllabus or any locally available common diseases of crop plants can be used), duly certified by the HoD.

Practical Paper – II

Every student has to submit (i) 10 properly identified herbarium sheets together with a field book and tour report duly certified by the HoD. The most common wild/cultivated species may be used to prepare the herbaria. Care should be taken to avoid Rare, Endangered, Threatened (RET) and Endemic species (ii) Study tour report duly certified by the HoD.

Practical Paper – III

Every student has to submit duly certified detailed reports of visit to (i) Plant breeding station (ii) Research station with reference to Biotechnology/ Molecular Biology.

Elective paper Record

There is no practical examination for elective papers; the practical works mentioned in the syllabus have to be done, recorded, and certified and to be submitted on the day of Practical examination of Paper III. For Advanced Angiosperm Systematics elective paper, record is replaced with photo album.

Study Tour Report

Every student has to submit a report of study tour conducted as per the conditions mentioned in the syllabus of Systematics under Core Course 6, duly certified by HoD. This should include at least three colour photo plates containing original images of habit, inflorescence/flower, floral parts etc of any three properly identified flowering plants of the families mentioned in the syllabus, with specifications on systematic position, location, date, name and reg. no of the student etc. Individuality should be strictly maintained while submitting the tour report and photo plates.

Table - 8 : MARK DISTRIBUTION OF SUBMISSIONS

Submission	Items	Marks

Practical P-I	Pathology herbarium sheets	5
Practical P-II	Taxonomy herbarium sheets + field book	10
Practical P-III	Report of visits to: (i) Plant breeding station (ii) Research station (Biotechnology/ Molecular Biology Lab)	5
	Record of Elective Paper	10
Total for submissions		**30**
Study tour report & Photo album		5

QUESTION PAPER PATTERNS

QUESTION PAPER TYPE 1

Scheme of Examinations:

The external QP with **80** marks and internal examination is of **20** marks. Duration of each external examination is **2.5** Hrs. The pattern of External Examination is as given below. The students can answer all the questions in Sections A & B. But there shall be ceiling in each section.

Section A: Short answer type carries 2 marks each - **15** questions (Ceiling – 25)

Section B: Paragraph/ Problem type carries 5 marks each - **8** questions (Ceiling – 35)

Section C: Essay type carries 10 marks (2 out of 4) - 2 x 10 = 20 marks

QUESTION PAPER TYPE 2

Scheme of Examinations:

The external QP with **60** marks and internal examination is of **15** marks. Duration of each external examination is **2** Hrs. The pattern of External Examination is as given below. The students can answer all the questions in Sections A & B. But there shall be ceiling in each section.

Section A: Short answer type carries 2 marks each - **12** questions (Ceiling – 20)

Section B: Paragraph/ Problem type carries 5 marks each - **7** questions (Ceiling – 30)

Section C: Essay type carries 10 marks (1 out of 2) - 1 x 10 = 10 marks

Table - 9: SEMESTER WISE DISTRIBUTION OF CREDITS

Semester	Course	Credit
I	Common course: English	4
	Common course: English	3
	Common course: Additional Language	4
	Core Course 1: Angiosperm Anatomy, Reproductive Botany & Palynology	3
	Complementary course: Chemistry	2
	Complementary course: Zoology	2
	Total credits acquired in the semester	**18**
II	Common course: English	4
	Common course: English	3
	Common course: Additional Language	4

	Core Course 2: Microbiology, Mycology, Lichenology & Plant Pathology	3
	Complementary course: Chemistry	2
	Complementary course: Zoology	2
	Total credits acquired in the semester	**18**
III	Common course: English	4
	Common course: Additional Language	4
	Core Course 3: Phycology, Bryology & Pteridology	3
	Complementary course: Chemistry	2
	Complementary course: Zoology	2
	Total credits acquired in the semester	**15**
IV	Common course: English	4
	Common course: Additional Language	4
	Core Course 4: Methodology and Perspectives in Plant Science	3
	Core Course 5: Practical of Semesters 1-4 (Paper- I)	4
	Complementary course: Chemistry	2
	Complementary course: Chemistry Practical	4
	Complementary course: Zoology	2
	Complementary course: Zoology Practical	4
	Total credits acquired in the semester	**27**
V	Core Course 6: Gymnosperms, Palaeobotany, Phytogeo. & Evolution	3
	Core Course 7: Angiosperm Morphology & Systematics	3
	Core Course 8: Tissue Culture, Horticulture, Econ. Bot. & Ethnobotany	3
	Core Course 9: Cell Biology & Biochemistry	3
	Open course	3
	Total credits acquired in the semester	**15**
VI	Core Course 10: Genetics & Plant Breeding	3
	Core Course 11: Biotech., Molecular Biology & Bioinformatics	3
	Core Course 12: Plant Physiology & Metabolism	3
	Core Course 13: Environmental Science	3
	Core Course 14: Elective paper	3
	Core Course 15: Practical of Semester 5 (Paper- II)	5
	Core Course 16: Practical of Semester 6 (Paper- III)	5
	Core Course 17: Project Work/ Research methodology paper	2

	Total credits acquired in the semester	**27**
	Total credits acquired in all semesters	**120**
	Audit courses (Semesters I, II, III & IV)	16
	Extra Credits	4
	Grand Total	**140**

B.Sc. PROGRAMME IN BOTANY

CORE & OPEN COURSES

Total credits: 58 (Core courses: 55 + Open courses 3)

Table - 10.1: COURSE STRUCTURE, WORK LOAD AND CREDIT

DISTRIBUTION OF CORE COURSES: (Semesters 1 - 4)

Semester	Course Code	Title of Course	Hours/ Semester		Hours/ Week		Credit
S- I	BBT1B01	CORE COURSE - 1 **Angiosperm Anatomy, Reproductive Botany & Palynology**	36	72	2	4	3
	-	Core Course - 1 Practical	36		2		*
S -II	BBT2B02	CORE COURSE - 2 **Microbiology, Mycology, Lichenology & Plant Pathology**	36	72	2	4	3
	-	Core Course - 2 Practical	36		2		*
S-III	BBT3B03	CORE COURSE - 3 **Phycology, Bryology & Pteridology**	54	90	3	5	3
	-	Core Course - 3 Practical	36		2		*
S-IV	BBT4B04	CORE COURSE - 4 **Methodology and perspectives in Plant Science**	54	90	3	5	3
	-	Core Course - 4 Practical	36		2		*
	BBT4B05 L	CORE COURSE – 5: Practical Paper - I **Angiosperm Anatomy, Reproductive Botany, Palynology, Microbiology, Mycology, Lichenology, Plant Pathology, Phycology, Bryology & Pteridology, Methodology and perspectives in Plant Science**					4
	TOTAL					**18**	**16**
***Credits of Practical paper (total given against Practical paper BBT4B05)**							

Table - 10.2: COURSE STRUCTURE, WORK LOAD AND CREDIT DISTRIBUTION OF CORE COURSES AND OPEN COURSES (Semester 5)

Course Code	Title of Course	Hours/ Semester		Hours/ Week		Credit
BBT5B06	CORE COURSE - 6 **Gymnosperms, Palaeobotany, Phytogeography & Evolution**	54	90	3	5	3
-	Core Course – 6 Practical	36		2		*
BBT5B07	CORE COURSE - 7 **Angiosperm Morphology & Systematics**	54	90	3	5	3
-	Core Course - 7 Practical	36		2		*
BBT5B08	CORE COURSE - 8 **Tissue culture, Horticulture, Economic Botany & Ethnobotany**	54	90	3	5	3
-	Core Course - 8 Practical	36		2		*
BBT5B09	CORE COURSE - 9 **Cell Biology & Biochemistry**	54	90	3	5	3
-	Core Course - 9 Practical	36		2		*
BBT5D01	OPEN COURSE - CHOICE I **General Botany**	54	54	3	3	3
BBT5D02	OPEN COURSE - CHOICE II **Applied Botany**	54	54	3	3	3
BBT5D03	OPEN COURSE - CHOICE III **Basic Tissue Culture**	54	54	3	3	3
BBT6B16P BBT6B16	PROJECT WORK / RESEARCH METHODOLOGY	36	36	2	2	**
TOTAL					**25**	**15**
*** Credits of practical (total provided in table 10.3, against Practical paper BBT6B15 P)**						
**** Credits of project work/ Research methodology (provided in Table 10.3)**						

Table - 10.3: COURSE STRUCTURE, WORK LOAD AND CREDIT DISTRIBUTION OF CORE COURSES: (Semester 6)

Course Code	Title of Course	Hours/ Semester		Hours/ Week		Credit
BBT6B10	CORE COURSE 10 **Genetics & Plant Breeding**	54	90	3	5	3
-	Core Course IX. Practical	36		2		*
BBT6B11	CORE COURSE – 11 **Biotechnology, Mol. biology & Bioinformatics**	54	90	3	5	3
-	Core Course- X. Practical	36		2		*
BBT6B12	CORE COURSE -12 **Plant Physiology & Metabolism**	54	90	3	5	3
-	Core Course- XI. Practical	36		2		*
BBT6B13	CORE COURSE – 13 **Environmental Science**	54	90	3	5	3
-	Core Course– XII. Practical	36		2		*
BBT6E01	CORE COURSE 14. Elective - Choice - I **Genetic Engineering**	54	90	3	5	3
-	Elective Choice – I. Practical	36		2		*
BBT6E02	CORE COURSE 14. Elective - Choice - II **Advance Angiosperm Systematics**	54	90	3	5	3
-	Elective Choice – I. Practical	36		2		*
BBT6E03	CORE COURSE 14. Elective - Choice - III **Genetics and Crop Improvement**	54	90	3	5	3
-	Elective Choice – II. Practical	36		2		*
BBT6E04	CORE COURSE 14. Elective - Choice - IV **Agronomy and Entrepreneurship**	54	90	3	5	3
-	Elective Choice – III. Practical	36		2		*
BBT6B14L	CORE COURSE 15: Practical Paper- II: **Gymnosperms, Palaeobotany, Phyto-geography, Angiosperm Morphology, Systematics, Tissue culture, Horticulture, Economic Botany, Ethnobotany, Cell Biology & Biochemistry**					5
BBT6B15L	CORE COURSE 16: Practical Paper- III: **Genetics, Plant Breeding, Biotechnology, Molecular Biology, Plant Physiology &**					5
BBT6B16P BBT6B16	CORE COURSE 17: PROJECT WORK / RESEARCH METHODOLOGY	**	**	**	**	2
TOTAL					**25**	**27**
*** Credits of practical (total given against Practical paper BBT6B16 P)**						
**** Workload eligible is shown in table 10.2 (Semester 5)**						

Table-11: INSTRUCTIONAL HOURS, MARK DISTRIBUTION AND SCHEME OF EXAMINATION OF CORE COURSES & OPEN COURSES

Course Code	Instructional Hours		Duration of Exams (hrs)	Marks			
	Theory	Practical		Theory		Practical	
				External	Internal	External	Internal
BBT1B01	36	36	2	60	15	--	--
BBT2B02	36	36	2	60	15	--	--
BBT3B03	54	36	2	60	15	--	--
BBT4B04	54	36	2	60	15	--	--
BBT4B05L (Practical)	--	--	3	--	--	80	20
Record	--	--		--	--	15	--
Submission	--	--		--	--	5	--
BBT5B06	54	36	2	60	15	--	--
BBT5B07	54	36	2	60	15	--	--
BBT5B08	54	36	2	60	15	--	--
BBT5B09	54	36	2	60	15	--	--
BBT5D01/D02/D03	54	---	2	60	15	--	--
BBT6B10	54	36	2	60	15	--	--
BBT6B11	54	36	2	60	15	--	--
BBT6B12	54	36	2	60	15	--	--
BBT6B13	54	36	2	60	15	--	--
BBT6E01/E02/E03/E04	54	36	2	60	15	--	--
BBT6B14L (Practical)	--	--	4	--	--	80	20
Record	--	--		--	--	15	--
Submission	--	--		--	--	10	--
Study tour	--	--		--	--	5	--
BBT6B15L (Practical)	--	--	4	--	--	80	20
Record	--	--		--	--	15	--
Submission	--	--		--	--	5	--
Record of Elective	--	--	--	--	--	10	--
BBT6B16P (Project)	--	36	--	--	--	60	15
BBT6B16 (Theory)	36*	--	2*	60*	15*	--	--

* **Applicable only if the Centre is opting for Research Methodology theory paper instead of project work**

CORE COURSES

FIRST SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE - 1

ANGIOSPERM ANATOMY, REPRODUCTIVE BOTANY AND PALYNOLOGY

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
1	BBT1B01	3	4	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Demonstrate** the ability to differentiate plant organs by observing anatomical features.	Apply	PSO4
CO2	**Understand** the non-living inclusions of plants and their significance	Understand	PSO1
CO3	**Differentiate** tissues and their functions.	Analyze	PSO5
CO4	**Illustrate** primary and secondary structures of root and stem	Analyze	PSO5
CO5	**Compare** primary and secondary structures of plant organs.	Analyze	PSO5
CO6	**Explain** various developmental details of angiosperms	Apply	PSO4
C07	**Determine** the significance and applications of palynology	Evaluate	PSO8

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

Sl no	Subject	Theory	Practical	Total
1	Angiosperm Anatomy	22	27	49
2	Reproductive Botany & Palynology	14	9	23
Total		**36**	**36**	**72**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Plant Anatomy	Reprod. Bot. & Palynology	Total marks
2 marks (total 12)	8	4	Ceiling 20
5 marks (total 7)	4	3	Ceiling 30
10 marks (total 2)	1	1	1 x 10 = 10
TOTAL			**60**

ANGIOSPERM ANATOMY

Module – I (5 hrs)

1. Cell Wall - Structure and development; Growth of Cell wall; cell wall materials (**2** hrs)
2. Non-living inclusions (**3** hrs)

a. Reserve food materials: carbohydrates, proteins, fats & oils. Carbohydrates: sugars & starch; Starch grains-structure, types with examples; Proteins- Aleurone grains with examples; Fats & oils examples.

b. Secretory materials – Pigments, nectar, oils, latex

c. Waste materials - Nitrogenous – alkaloids, Non-nitrogenous- gums, resins, tannins, organic acids, essential oils; Mineral crystals - Calcium oxalate, Druses, Raphides, Calcium carbonate - cystoliths with examples

Module - II (5 hrs)

1. Tissues: Definition –Types

a. Meristematic tissues - classification. (**2** hrs)

i. Theories on apical organization - Apical cell theory, Histogen theory, Tunica corpus theory

ii. Organization of shoot apex and differentiation of tissues (protoderrn, procambium and ground meristem).

iii. Organization of root apex in dicots- common types with three sets of initials- in monocots: Maize type with four sets of initials

b. Mature tissues: definition classification- simple complex and secretory (**3** hrs)

i. Simple tissues: structure occurrence and function.

ii. Complex tissues: Xylem & Phloem-structure, origin, phylogeny and function

iii. Secretory tissues: glands, glandular hairs, nectaries, hydathodes, schizogenous and lysigenous ducts, resin ducts, laticifers –articulated and non-articulated

Module – III (4 hrs)

1. Vascular bundles - Origin and types - conjoint, collateral, bi-collateral, open closed, radial, concentric - amphicribral and amphivasal. (**2** hrs)
2. Primary structure of root, stem & leaf (brief account only) (**2** hrs)

Module - IV (8 hrs)

1. Normal secondary growth in Dicot stem and Dicot root. Formation of vascular cambial ring - structure and activity of cambium – storied and non-storied, fusiform and ray initials; Formation of secondary wood, secondary phloem, vascular rays, growth ring, heart wood, sapwood. (**3** hrs)
2. Extrastelar secondary thickening in stem and root - Periderm formation. Structure - phellogen, phellem, phelloderm, bark, lenticels - structure & function. (**2** hrs)
3. Anomalous secondary growth - general account with special reference to the anomaly in Dicot stem – *Boerhaavia*, *Bignonia* and Monocot stem- *Dracaena* (**3** hrs)

PRACTICALS (ANGIOSPERM ANATOMY)

1. Identification at sight the different types of tissues and vascular bundles.
2. Primary structure of stem, root and leaf of Dicots and Monocots
   a. Dicot stem: normal –*Eupatorium*; bi-collateral – *Cephalandra*
   b. Dicot root – Pea/ Ficus
   c. Monocot stem – Bamboo/ Grass
   d. Monocot root – *Musa/ Colocasia*
   e. Dicot leaf – *Ixora*
   f. Monocot leaf – Grass
3. Secondary structure of Dicot stem - *Vernonia*, Dicot root - *Tinospora*
4. Anomalous secondary thickening in *Boerhaavia*, *Bignonia* and *Dracaena*

REFERENCES (ANGIOSPERM ANATOMY).

1. Cutter, E.G. (1969). *Plant Anatomy - Part I - Cells & Tissues*. Edward Arnold Ltd., London.
2. Cutter, E.G. (1971). *Plant Anatomy - Part II – Organs*, Edward Arnold Ltd., London.
3. Eames, A.J. & L.H. Mac Daniels (1987). *An Introduction to Plant Anatomy*. Tata Mac Grew Hill Publishing Company Ltd. New Delhi.
4. Esau K. (1985). *Plant Anatomy* (2nd ed.). Wiley Eastern Ltd. New Delhi.
5. Fahn A. (2000). *Plant Anatomy*, Permagon Press.
7. Pandey B.P. (2001). *Plant Anatomy*, S. Chand & Co. Delhi.
8. Pijush Roy (2006). Plant Anatomy. New Central Book Agency (P) Ltd
9. Tayal M.S. (2012). *Plant Anatomy*. Rastogi Publishers, Meerut.
10. Vasishta P.C. (1974). *Plant Anatomy*, Pradeep Publication, Jalandhar

REPRODUCTIVE BOTANY & PALYNOLOGY

1. Introduction to angiosperm embryology with special reference to Indian embryologists
2. Microsporogenesis: structure and function of wall layers, development of male gametophyte, dehiscence of anther
3. Types of ovules: Orthotropous, Anatropous and Campylotropous. Megasporogenesis: development of female gametophyte, embryo sac- development and types- monosporic: *Polygonum* type, bisporic: *Allium* type, tetrasporic: *Adoxa* type.
4. Pollination, fertilization, barriers of fertilization, germination of pollen grains, double fertilization.
5. Structure of embryo dicot (*Cypsella*), monocot (*Sagittaria*) and endosperm types
6. Palynology: pollen morphology- structure of pollen wall, shape of pollen grains, apertural morphoforms, exine ornamentation; pollen allergy, economic and taxonomic importance

PRACTICALS (REPRODUCTIVE BOTANY & PALYNOLOGY).

1. *Datura* anther T.S. (mature)
2. Types of ovules: Orthotropous, Anatropous and Campylotropous (Permanent slides may be used)
3. Dicot and monocot embryo of Angiosperms (Permanent slides may be used)
4. Pollen morphology of *Hibiscus*, and pollinia of Calotropis by acetolytic method
5. Viability test for pollen.
   a. *In vitro* germination using sugar solution. (Cavity slide method).
   b. Tetrazolium test
   c. Acetocarmine test (Acetocarmine & Glycerine 1:1)

REFERENCES (REPRODUCTIVE BOTANY & PALYNOLOGY)

1. Agarwal S.B. (1984). *Embryology of Angiosperms- a fundamental approach,* Sahithya Bhavan, Hospital Road, Agra
2. Bhattacharya K and Majumdar M R. (2011). *A text book of palynology*, New Central Book Agency, Calcutta
3. Bhojwani S.S. & Bhatnagar S.P. Dantu P.K. (2015). *The Embryology of Angiosperms*. 6th edition, Vikas Publishing House (P) Ltd.
4. Davis C.L. (1965). *Systematic Embryology of Angiosperms*. John Wiley, New York.
5. Eames M.S (1960). *Morphology of Angiosperms*, Mc Graw Hill New York.
6. Erdtman G. (1952). *Pollen Morphology & Plant Taxonomy* Part I. Almiquist & Wicksell Stockholm
7. Erdtman G. (1969). *Hand Book of Palynology*. National Botanical Gardens Publication, Lucknow.
8. Johri B.D. (1984). (ed.). *Embryology of Angiosperms,* Springer - Verlag, Berlin.

9. Maheswari P. 1985. *Introduction to Embryology of Angiosperms* - Mac Graw Hill, New York.
10. Nair P.K.K. (1970). *Pollen Morphology of Angiosperms* Vikas Publishing House, Delhi.
11. Raghavan, V. (2000). *Developmental Biology of Flowering plants*, Springer, Netherlands.
12. Saxena M.R. (1993). *Palynology* – A treatise-Oxford, I.B.H. New Delhi
13. Shivanna K.R. & Johri B.M. (1985). *The Angiosperm Pollen, Structure and function*, John Wiley & Sons Pte Ltd.
14. Shivanna K.R. & Johri B.M. (1985). *Pollen Biology: A Laboratory Manual,* Springer Verlag NewYork.
15. Shivanna, K.R. &. Rangaswami, N.S. (1993). *Pollen Biology,* Narosa Publishing House - Delhi.
16. Singh V., P.C. Pande & D.K. Jain (2001). *Embryology of Angiosperms* - Rastogi Publications, Meerut

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Demonstration:** Demonstration of free hands sectioning of plant organs, staining and micro-slide preparation.
4. **Microscopic observation:** To observe the types of tissues, types of ovule, pollen morphology and understand the features.
5. **Experiment:** Viability test for pollen.

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 5 = 100)

- Based on practical examination, records and submissions

SECOND SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE- 2

MICROBIOLOGY, MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
2	BBT2B02	3	4	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Understand** basics of microbial life and their economic importance.	Understand	PSO2
CO2	**Develop** general awareness on the diversity of microorganisms, fungi and lichens.	Create	PSO10
CO3	**Analyze** the ecological role played by bacteria, fungi and lichens	Analyze	PSO5
CO4	**Create** a general awareness of various fungal databases	Create	PSO9
CO5	**Determine** the inter-relationship between plants and microbes both beneficial and harmful	Evaluate	PSO7
CO6	**Determine** various plant diseases, their impact on crop production and to suggest their control measures	Evaluate	PSO7

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week).

Sl no	Subject	Theory	Practical	Total
1	Microbiology	12	9	21
2	Mycology	12	14	26
3	Lichenology	4	4	8
4	Plant Pathology	8	9	17
Total		**36**	**36**	**72**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Microbiology	Mycology	Lichenology	Pathology	Total
2 marks (total 12)	3	4	2	3	Ceiling 20
5 marks (total 7)	3	2	1	1	Ceiling 30
10 marks (total 2)	2				1 x 10 = 10
TOTAL					**60**

MICROBIOLOGY

1. Introduction to Microbiology - Scope and Significance (**1** hr)
2. Bacteria – Classification based on morphology and staining, Ultra-structure of bacteria; Bacterial growth, Nutrition, Reproduction – binary fission, methods of genetic recombination (transformation, conjugation, transduction) (**5** hr)
3. Viruses – Classification (based on shape, genetic materials), architecture and multiplication (Lytic and lysogenic cycles), Bacteriophages (λ), TMV, retroviruses- HIV, SARS-CoV-2 virus, viroids, prions. (**3** hrs)
4. Microbial ecology – Rhizosphere and Phyllosphere. (**1** hr)
5. Industrial microbiology – alcohol, acids, milk products single cell proteins (**1** hr)
6. Economic importance of bacteria -vaccines: importance, mechanism. (**1** hr)

PRACTICALS (MICROBIOLOGY)

1. Simple staining
2. Gram staining – curd, root-nodules
3. Culture and isolation of bacteria using nutrient agar medium (demonstration only).

REFERENCES (MICROBIOLOGY).

1. Alain Durieux (2009). *Applied Microbiology*, Springer International Edition
2. Dubey R.C. & D.K. Maheswari (2000). *A Textbook of Microbiology*, Chand & Co, New Delhi
3. Frazier W.C. (1998). *Food Microbiology*, Prentice Hall of India, Pvt. Ltd.
4. Hans G. Schlegel. (2012). *General Microbiology*, Cambridge University Press, Low Priced Indian Edition, Replica Press Pvt. Ltd.
5. Kumar H.D. & S. Kumar. (1998). *Modern Concepts of Microbiology*, Tata McGraw Hill, Delhi.
6. Pelzar M.J., E.C.S. Chan & N.R. Kreig. (1986). *Microbiology*, McGraw Hill, New York.
7. Prescott, L.M., Harley J.P., Klein D. A. (2005). *Microbiology*, McGraw Hill, India. 6th edition.
8. Rangaswami, R & C.K.J. Paniker. (1998). *Textbook of Microbiology*, Orient Longman.
9. Ross, F.C. (1983). *Introductory Microbiology*. Charles E. Merill Publishing Company.
10. Schlegel (2008). *General Microbiology*. Cambridge University press India Pvt Ltd
11. Sharma P.D. (2004). *Microbiology and Plant Pathology*, Rastogi Publication.
12. Tortora, G.J., Funke, B.R., Case. C.L. (2007). *Microbiology*. Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition.

MYCOLOGY

1. General characters and phylogeny of the kingdom Fungi, the concept of anamorph and teleomorph.
   (**2** hrs)
2. General characters, distribution, and biology of the following groups of fungi (**7** hrs)
   a) Mastigomycotina. Type: *Pythium*
   b) Zygomycotina. Type: *Rhizopus*
   c) Ascomycotina. Type: *Aspergillus*
   d) Basidiomycotina. Types: *Agaricus, Puccinia*
3. Economic importance of fungi: medicinal, industrial, agricultural. Fungi as model organisms for research. (**1** hr)
4. Ecological importance of fungi: different modes of nutrition (pathogenic/parasitic, saprobic, symbiotic – mycorrhiza, lichen). (**1** hr)
5. Introduction to fungal databases: Index fungorum, Species fungorum, Mycobank **(1 hr)**

PRACTICALS (MYCOLOGY)

1. Micropreparation and detailed microscopic study of the above-mentioned types.
2. Online demonstration of fungal databases studied.

REFERENCES (MYCOLOGY)

1. Alexopoulos C.J., Mims, C.W. and Blackwell, M. (1996). *Introductory Mycology*, 4th Edn. John Wiley and Sons, New York.
2. Alexopoulos, C.J. and Mims C.W. (1979). *Introductory Mycology*, 3rd edition, John Wiley and Sons, New York.
3. Crous, P.W., Gams, W., Stalpers, J.A., Robert, V. & Stegehuis, G. (2004). MycoBank: an online initiative to launch mycology into the 21st century. *Studies in mycology* 50: 19–22.
4. Jim Deacon (2007). *Fungal Biology*, 4th edition, Blackwell publishing, Ane Books Pvt Ltd.
5. Kirk P M, Cannon P F, Minter D W, Stalpers J A, 2008. *Dictionary of the Fungi* (X Edn). Wallingford, UK: CAB International.
6. Mehrotra R.S. and Aneja K.R. (1990). *An Introduction to Mycology*, Wiley, Eastern

Limited, New Delhi.

7. Nita Bahl, 2002. *Hand book on Mushrooms.* Oxford & IBH Publishing C. Pvt.
8. Redhead, S. Norvell, L. 2012. MycoBank, Index Fungorum, and Fungal Names recommended as official nomenclatural repositories for 2013
9. Sethi, I.K. and Walia, S.K. (2011). *Text book of Fungi and their Allies*, Macmillan Publishers India Ltd.
10. Webster J, Weber R (2007). *Introduction to Fungi*, 3rd edition, Cambridge University Press, UK.

LICHENOLOGY

1. Introduction: Type of Interaction between the component's symbiosis –mutualism. (**1** hr)
2. Classification of lichens, growth forms, structure, reproduction, economic importance. Type: *Usnea* (**2** hrs)
3. Ecological and economic importance of lichens: toxicology, lichens as food, bioremediation, ecological indicators, pollution indicators, lichen in soil formation and pioneers of xerosere.
   (**1** hr)

PRACTICALS (LICHENOLOGY)

1. Identification of different forms of Lichens
2. *Usnea*: structure of thallus, fruiting body

REFERENCES (LICHENOLOGY)

1. Ahamadjian Vernon, Hale M E (eds), (1973). *The Lichens.* Academic press, New Delhi.
2. Gilbert, O. (2004). *Lichen Hunters*. The Book Guild Ltd. England
3. Hale M E, (1983). *The Biology of Lichen* (III Edn). Edward Arnold, London.
4. Kershaw, K.A. (1985). *Physiological Ecology of Lichens*, Cambridge University Press.
3. Mamatha Rao, (2009). *Microbes and Non-flowering plants. Impact and applications*, Ane Books, New Delhi.
4. Sanders, W.B. (2001). *Lichen interface between mycology and plant morphology*. Bioscience, 51: 1025-1035.
5. http://www.lichen.com
6. http://www.newscientistspace.com

PLANT PATHOLOGY

1. Introduction – Concepts of plant disease, pathogen, causative agents, symptoms (**1** hr)
2. Symptoms of diseases: spots, blights, wilts, rots, galls, canker, gummosis, necrosis, chlorosis, smut, rust, damping off. (**1** hr)
3. Control measures: Chemical, biological and genetic methods, quarantine measures (**1** hr)
4. An introduction to Crop Pest Surveillance System (CPSS) of the Department of Agriculture, Government of Kerala (Online Plant Clinic). (**1** hr)
5. Brief study of Plant diseases in South India (Name of disease, pathogen, symptom and control measures). (**4** hrs)
    a) Citrus Canker
    b) Mahali disease of Arecanut
    c) Blast of Paddy
    d) Quick wilt of Pepper
    e) Mosaic disease of Tapioca
    f) Bunchy top of Banana
    g) Grey leaf spot of Coconut

PRACTICALS (PLANT PATHOLOGY)

1. Identification of the disease, pathogen, symptoms and control measures of the following: (drawings not required).
    a) Citrus Canker
    b) Mahali disease of Arecanut
    c) Blast of Paddy
    d) Quick wilt of Pepper
    e) Mosaic disease of Tapioca
    f) Bunchy top of Banana
    g) Grey leaf spot of Coconut
2. Online demonstration of Crop Pest Surveillance System (CPSS).

SUBMISSION (PLANT PATHOLOGY)

Students are expected to submit five properly identified Pathology specimens/

herbarium during the Practical Examination of Paper-I held at the end of Fourth semester. Diseases mentioned in the syllabus or any locally available common diseases of crop plants can be selected for submission.

REFERENCES (PLANT PATHOLOGY)

1. Agrios, G.N. (1997). *Plant Pathology* (4th ed). Academic Press.
2. Bilgrami K.H. & H.C. Dube. (1976). *A textbook of Modern Plant Pathology*. International Book Distributing Co. Lucknow.
3. Gupta V K, Paul T S. (2004). *Fungi & Plant diseases*. Kalyani publishers, New Delhi
4. Mehrotra, R.S. (1980). *Plant Pathology* – TMH, New Delhi.
5. Pandey, B.P. (1999). *Plant Pathology. Pathogen and Plant diseases*, Chand & Co., New Delhi.
6. Rangaswami, G. (1999). *Disease of Crop plants of India*, Prentice Hall of India Pvt. Ltd.
7. Sharma P.D. (2004). *Plant Pathology*, Rastogi Publishers.
8. http://cpsskerala.in/OPC/pages/OnlinePlantClinic.jsp

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Field trips:** field trips are conducted for the better understanding of fungi and their ecological roles and to study the plant diseases.
4. **Microscopic observations:** to learn micro morphological features of bacteria and fungi by using appropriate staining techniques.
5. **Demonstration**: Online demonstration of various databases.

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works.

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 5 = 100)

- Based on practical examination, records and submissions

THIRD SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE – 3

PHYCOLOGY, BRYOLOGY AND PTERIDOLOGY

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
3	BBT3B03	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs).

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Analyze** the diversity and evolutionary significance of lower plant groups	Analyze	PSO5
CO2	**Evaluate** the diversity in morphology, anatomy, reproduction and life cycle in lower groups of plants.	Evaluate	PSO8
CO3	**Differentiate** between algae, bryophytes and pteridophytes	Analyze	PSO5
CO4	**Compare** the affinities of the various cryptogams	Evaluate	PSO8
CO5	**Understand** the ecological and economic importance of lower plant groups	Understand	PSO1

DISTRIBUTION OF TEACHING HOURS (18 hrs/ Semester = 1hr/week).

Sl no	Subject	Theory	Practical	Total
1	Phycology	22	9	31
2	Bryology	10	9	19
3	Pteridology	22	18	40
	Total	**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Phycology	Bryology	Pteridology	Total
2 marks (total 12).	5	3	4	Ceiling 20
5 marks (total 7)	2	2	3	Ceiling 30
10 marks (total 2)	2			1 x 10 = 10
TOTAL				**60**

PHYCOLOGY

1. Introduction, range of thallus structure, pigments, reproduction (**2** hrs)
2. A brief introduction to Fritsch's (1935) classification of Algae (classes and criteria of classification (**3** hrs)
3. General Features: Occurrence, thallus structure, reproduction, and life cycle of the types given below: (**14** hrs)

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

4. Economic Importance: Algae as food, fodder, green manure, bio-fuels, pollution indicators, research tools, medicinal uses of algae, Commercial Products – carrageenin, agar-agar, alginates, diatomaceous earth. Harmful effects – Water bloom, eutrophication, neurotoxins, parasitic algae.

   (**3** hrs)

PRACTICAL (PHYCOLOGY)

1. Identification of the vegetative and reproductive structures of the types studied.
2. Conduct a field visit to any one of the aquatic ecosystems, rich in algal diversity. Report the species identified in the record book.

REFERENCES (PHYCOLOGY)

1. Anand, N. (1989). *Culturing and cultivation of BGA. Handbook of Blue Green Algae* Bishen Singh Mahendra Pal Singh, Dehradun.
2. Fritsch, F.E. (1935). *The structure and reproduction of the algae*. Vol. 1 and II, Cambridge University Press, Cambridge.
3. Kanika Sharma (2007). *Manual of Microbiology - Tools and Techniques* 2nd edition. Ane Books, New Delhi, India.
4. Kumar, H.D. (1999). *Introductory Phycology*. Affiliated East-West Press, Delhi
5. Lee, R.E. (2008). *Phycology*, 4th edition, Cambridge University Press, Cambridge.
6. Mamatha Rao. (2009). *Microbes and Non flowering plants: impact and application*. Ane Books Pvt. Ltd., New Delhi.
7. Morris, I. (1967). *An Introduction to the algae*. Hutchinson and Co. London.
8. Papenfuss, G.F. (1955). *Classification of the Algae. A Century of Progress in the Natural Sciences, 1853-1953*. California Academy of Sciences, San Francisco: 115-224.
9. Prescott, L.M., Harley J.P., Klein D. A. (2005). *Microbiology*, McGraw Hill, India. 6th edition.
10. Rober Edward Lee (2008). *Phycology*: Cambridge University Press India Pvt. Ltd. Ansari Road, New Delhi

11. Sahoo, D. (2000). *Farming the ocean: seaweeds cultivation and utilization*. Aravali International, New Delhi.
12. Van Den Hoek C., D.G. Mann and H.M. Jahns (2009). *Algae: an introduction to Phycology, XIV*, 623 p, Cambridge University Press, India Pvt. Ltd. New Delhi.
13. Vasishta, B.R., Sinha A.K. and Singh, V.P. (2010). *Botany for degree students: Algae,* S. Chand & Company Pvt. Ltd., New Delhi.

BRYOLOGY

1. Introduction, general characters, recent trends in classification - Goffinet *et al* (2008), Crandall-Stotler et al (2009) (**2** hrs)
2. Study the distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details are not required). (**6** hrs)
   a. *Riccia* (Marchantiophyta)
   b. *Anthoceros* (Anthocerotophyta)
   c. *Funaria* (Bryophyta)
3. Economic importance of Bryophytes (**1** hr)
4. Fossil Bryophytes (**1** hr)

PRACTICALS (BRYOLOGY).

1. *Riccia* – Habit, Anatomy of thallus, V.S. of thallus through antheridium, archegonium and sporophyte.
2. *Anthoceros*- Habit, Anatomy of thallus. V.S. of thallus through antheridium, archegonium and sporophyte.
3. *Bryum* (due to non-availability of *Funaria* at lower altitudes). - Habit, structure of antheridial cluster, archegonial cluster, L.S. of sporophyte.

REFERENCES (BRYOLOGY)

1. Campbell H.D. (1940). *The Evolution of land plants (Embryophyta),* University Press, Stanford.
2. Chopra R.N. and P.K. Kumar (1988). *Biology of Bryophytes*. Wiley Eastern Ltd. New Delhi.
3. Crandall-Stotler, B. and R. E. Stotler. (2008). In A. J. Shaw and B. Goffinet, *Bryophyte Biology,* Cambridge University Press (Revised edition).
4. Crandall-Stotler, B., Stotler, R. E., & Long, D. G. (2009). Phylogeny and classification of the Marchantiophyta. *Edinburgh Journal of Botany*, 66(1), 155-198.
5. Gangulee Das and Dutta. (2007). *College Botany* Vol.1, Central Book Dept. Calcutta.
6. Gangulee, H.C. and Kar A.K. (2011). *College Botany* Vol. II, New Central Book Agency.
7. Goffinet B, Buck WR, Shaw AJ. 2008. *Morphology, anatomy, and classification of the Bryophyta*. In: Goffinet B, Shaw AJ, eds. *Bryophyte biology, 2nd edn.*, Cambridge: Cambridge University Press, pp. 55–138.
8. Manju, C. N., & Rajesh, K. P. (2012). Present status of bryophyte diversity in Kerala. *Samagra*, *8*, 20-27.
9. Nair, M. C., K. P. Rajesh and P. V. Madhusoodanan.2005. *Bryophytes of Wayanad in Western Ghats,* Malabar Natural History Society, Kozhikode.
10. Parihar, N.S. (1991). *An introduction to Embryophyta*: Vol. I. *Bryophyta*. Central Book Depot., Allahabad.
11. Pócs, T., Nair, M., Rajesh, K., & Madhusoodanan, P. (2007). Liverwort (Marchantiopsida) records from the Western Ghats (Kerala State, Peninsular India). *Acta Botanica Hungarica*, *49*(1-2), 121-129.
12. Rajesh, K. P., & Manju, C. N. (2014). Bryophyte diversity of the lowlands and midlands of Kozhikode district, Kerala, India. *Frahmia*, *5*, 1-10.
13. Shaw J.A. and Goffinet B. (2000). *Bryophyte Biology*, Cambridge University Press.
14. Smith G.M. (1938). *Cryptogamic Botany* Vol. II. *Bryophytes and Pteridophytes*. Mc Graw Hill Book Company, London.
15. Sporne K.R. (1967). *The Morphology of Bryophytes*. Hutchinson University Library, London.
16. Vanderpoorten A. and B. Goffinet (2009). *Introduction to Bryophytes*. Cambridge Univ.Press.
17. Vasishta B.R. (2011). *Bryophyta* (Revised edition), S. Chand and Co., New Delhi.
18. Watson E.V. (1971). *The structure and life of Bryophytes*, Hutchinson University Library, London.

PTERIDOLOGY

1. Introduction, general characters and classification
   (Smith *et al*., 2008 – brief outline only)
   (**2** hrs)
2. Study the distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details are not required). (**12** hrs)
   a. *Selaginella* (Lycopsida)
   b. *Psilotum* (Psilotopsida)
   c. *Equisetum* (Equisetopsida)
   d. *Pteris* (Polypodiopsida)
3. Apogamy and apospory in Pteridophytes; Stelar evolution; Heterospory and seed habit; Affinities of Pteridophytes; Economic importance of Pteridophytes. (**8** hrs)

PRACTICAL (PTERIDOLOGY)

1. *Selaginella* – habit, T.S. of stem, T.S. of rhizophore, L.S. of Strobilus
2. *Psilotum*- habit, T.S. of stem, C.S. of synangium (Slides only)
3. *Equisetum* - habit, T.S. of stem, L.S. of strobilus
4. *Pteris* - habit, T.S. of stem, C.S. of sporophyll
5. Conduct a field trip inside the campus or a nearby area to understand the Pteridophyte diversity. Note down the species identified in the record book

REFERENCES (PTERIDOLOGY)

1. Bower, F.O. (1935). *Primitive Land Plants* – Cambridge, London.
2. Chandra S. & Srivastava M. (2003). *Pteridology in New Millenium*, Khuwer Academic Publishers.
3. Eames, A.J. (1979). *Morphology of Vascular Plants, lower group*. Wiley International edition, New Delhi.
4. Parihar, N.S. (1977). *Biology and Morphology of Pteridophytes*, Central Book Depot, Allahabad.
5. Rashid, A. (1976). *An Introduction to Pteridophyta*, Vikas Publishing Co. New Delhi.
6. Ranker, T.A. & Haufler, C.H. (eds.). (2008). *Biology and Evolution of Ferns and Lycophytes.* Cambridege University Press.

7. Mehltreter, K., Walker, L.R. & Sharpe, J.M. (eds.). (2010). *Fern Ecology*. Cambridge University Press.
8. Smith, A.R., Pryer, K.M., Schuttpelz, E. Korall, P., Schnelder, H. and Wolf., P.G. (2006). *A Classification for extant ferns*. Taxon 53: 705-731.
9. Smith, A.R., Pryer, K.M., Schuettpelz, E. (2008). *Fern classification. In*: T.A. Ranker and C.H. Haufler (eds.). *Biology and Evolution of Ferns and Lycophytes*. Cambridge Univ. press, U.K.
10. Smith G.M. (1938). *Cryptogamic Botany* Vol. II. *Bryophytes and Pteridophytes*. McGraw Hill Book Company, London.
11. Sporne, K.R. (1967). *Morphology of Pteridophytes* – Hutchi University Library, London.
12. Sreevastava, H.N. (1996). *A text book of Pteridophyta*, Pradeep Prakashnan, Meerut, India
13. Vasishta B.R. (1993). *Pteridophyta* – S. Chand and Co., New Delhi.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Field trips:** field trips are conducted to study the natural habitats of Algae, Bryophytes and Pteridophytes and their ecological roles.
4. **observations:** carried out by taking free hand sections to learn micro morphological features of Algae, Bryophytes and Pteridophytes
5. **Demonstration**: online demonstration of database and video screening.

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works.

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 5 = 100)

- Based on practical examination, records and submissions

FOURTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE- 4

METHODOLOGY AND PERSPECTIVES IN PLANT SCIENCE

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
4	BBT4B04	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Develop** scientific temper and problem-solving skills.	Create	PSO9
CO2	**Design** scientific projects and prepare project reports	Create	PSO9
CO3	**Manipulate** different tools and techniques used in research work.	Apply	PSO4
CO4	**Develop** basic computer skills necessary for conducting research.	Create	PSO9
CO5	**Interpret** scientific data using basic statistical methods	Understand	PSO3
CO6	**Organize** and display quantitative data and derive conclusions	Create	PSO9
C07	**Develop** skills to prepare permanent slides, applying the histochemical techniques	Create	PSO9
C08	**Operate** various equipments such as compound microscope, centrifuge, pH meter, microtome etc.	Apply	PSO4

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week).

Sl no	Subject	Theory	Practical	Total
1	Scientific Methods	9	9	18
2	Biostatistics	15	9	24
3	Biophysics	15	9	24
4	Microtechnique	15	9	24
	Total	**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Methodology	Biostatistics	Biophysics	Microtechnique
2 marks (total 12)	2	3	4	3
5 marks (total 7)	1	2	2	2
10 marks (total 2)	2			1 x 10 = 10
TOTAL				**60**

SCIENTIFIC METHODS

Module – I

1. What is science?; What is not science?; laws of science (**1** hr)
2. Steps in scientific methods (**2** hrs)
3. Structure of Research report, Style of citation, Biological Journals, Impact Factor, Sources of reference: Google Scholar, Sodh Ganga, NCBI, Inflibnet, e-pathshala (**4** hrs)
4. Latest methods of presentation. (**2** hrs)

PRACTICALS (SCIENTIFIC METHODS)

1. Bibliography searches using online tools
2. Familiarizing latest methods of ICT based presentations
3. Prepare a PowerPoint presentation based on a topic given.

REFERENCES (SCIENTIFIC METHODS)

1. Hewitt, P.G., J.A. Suchocki (2007). *Conceptual integrated science*, Pearson, London. ISBN-139780805390384.
2. Newton, R.G. (1997). *The truth of Science Physical theories and reality*. Viva Books, New Delhi, II Edition.
3. Ranjit Kumar (2014). *Research Methodology: A Step-by-Step Guide for Beginners*. SAGE Publications India Pvt Ltd, New Delhi.
4. Scott Freeman (2005). *Biological Science*. Pearson education international.
5. William S Beck, Karel F Liem, George Gaylord Simpson (1991). LIFE: *An Introduction to Biology* (III Edn). Harper Collins Publishers.

BIOSTATISTICS

Module – I (7 hrs)

1. Introduction to Biostatistics: Importance and limitations of Biostatistics (**1** hr)
2. Observations: direct and indirect observations, controlled and uncontrolled observations, human and machine observations. (**1** hrs)
3. Data collection: Introduction; Sampling; random and non-random. (**1** hrs)
4. Representation of data; Tables, Bar diagram, Pie diagram, Histogram, Frequency polygon, Ogive, Frequency curve [both manual and using computer (**3**

hrs)

5. Interpretation and deduction of data, significance of statistical tools in data interpretation, errors and inaccuracies. (**1** hrs)

Module II (8 hrs)

1. Measures of central tendency: mean, median and mode (**2** hrs)
2. Measures of dispersion: Range, Mean Deviation, Variance, Standard Deviation, Coefficient of variation. (**2** hrs)
3. Correlation and regression (brief account). (**2** hrs)
4. Test of hypothesis: Null hypothesis, Alternate hypothesis Chi-square test. (**2** hrs)

PRACTICALS (BIOSTATISTICS)

1. Work out problems under all types mentioned in the syllabus. One example each from all categories should be recorded.
2. Prepare tables/charts/graphs using Microsoft Excel.
3. Familiarize the technique of data representation (bar diagram, histogram, pie-diagram and frequency curve (both manual and using computer).

REFERENCES (BIOSTATISTICS)

1. Jasra. P.K. and Raj Gurdeep (2000). *Biostatistics*. Krishna Prakashan Media Pvt Ltd.
2. Khan, I.A. and Khayum (2004). *Fundamentals of Biostatistics*. Wraaz Publ. Hyderabad.
3. Norman T.J. Bailey (2007). *Statistical Methods in Biology*- Low Priced Edition, Cambridge University Press, Replica Press Private Ltd
4. Prasad, S. (2003). *Elements of Biostatistics*. Rastogi Publications, Meerut
5. Ramakrishnan, P. (1996) *Biostatistics*, 416 p, Saras Publications, Nagarcoil, Kanya kumari
6. Rastogi, V.B. (2009). *Fundamentals of Biostatistics*, 452 p, Ane Books, New Delhi.
7. Zar, J.H. (2012). *Biostatistical Analysis*. Pearson Publication. U.S.A. 4th edition

BIOPHYSICS

Module 1 (15 hrs)

1. Solutions: representing concentrations: Molarity, Normality, Percentage and ppm. (**2** hrs)
2. Acids and bases, buffers and pH, measurement of pH. Preparation and use of buffers in biological studies. (**3** hrs)
3. Photometry: Colorimetry and Spectrophotometry, principle, working and uses (**3** hrs)
4. Centrifugation: Principle, types of centrifuges and their applications (**2** hrs)

5. Chromatography - Principle and types: Adsorption chromatography, Partition chromatography, Ion exchange chromatography, Molecular sieving. (**5** hrs)

PRACTICALS (BIOPHYSICS)

1. Preparation of solutions of known concentrations using pure samples and stock solutions
2. Preparation of buffers
3. Measurement of pH and adjusting pH using pH meter.
4. Demonstration of the working of different kinds of centrifuges

REFERENCES (BIOPHYSICS)

1. Hoppe, W. (1983). *Biophysics*. Springer Verlag.
2. Keith Wilson and John Walker (2008). P*rinciples and techniques of Biochemistry and Molecular Biology*, 6th edition, Cambridge University Press.
3. Rogers, A.W. (1969). *Techniques of Autoradiography*. Elsevier Publishing Company.
4. Roy, R.N. (1996). *A Text book of Biophysics*. New Central Book Agency Pvt. Ltd., Calcutta.
5. Sasidharan, A. (1984). *Selected Topics of Biophysics*. Frontier Area Publishers.
6. Slayter. E.M. (1970). *Optical methods in Biology*. Wiley Intersciences.
7. Varantha Pallabhi, Gautham N. (2005). *Biophysics.* Narosa Publishing House, New Delhi.
8. Wong. C.H. (1965). *Radiation Tracer Methodology in Biophysical Sciences*, Prentice Hall.

MICROTECHNIQUE

Module – 1 (**9** hrs)

1. Principles of microscopy and parts of microscopes (**1** hr)
2. Types of microscopes: Light microscope, Compound microscope, Phase contrast microscope, Fluorescent microscope, Electron microscope: Transmission Electron Microscope (TEM). and Scanning Electron Microscope (SEM) (**6** hrs)
3. Micrometry – Stage micrometer, Ocular micrometer, Calibration and working. (**1** hr)
4. Preparation of illustrations using Camera lucida, Photomicrography (**1** hr)

Module – II (**6** hrs)

1. General account of Killing and fixing, agents used for killing and fixing. Common fixatives – Formalin–Aceto–Alcohol (FAA), Carnoy's fluid, Chromic acid–Acetic acid–Formation (CRAF).

(**2** hrs)

2. Dehydration and infiltration – general account of dehydration (Ethanol, Isopropyl alcohol, Acetone, Glycerine). Ethanol – Xylene series and Tertiary Butyl Alcohol series. (**1** hrs)
3. Infiltration – paraffin wax method, embedding. (½ hr)
4. Free hand sectioning; Microtome (Rotary and sledge), serial sectioning and its significance.
   (**1** hrs)
5. Staining – General account, Classification: natural dyes, coal tar dyes. Double staining, Vital staining
   (**1** hr)
6. Mounting, whole mounting, maceration and smears (½ hr)

PRACTICALS (MICROTECHNIQUE).

1. Parts of microscope and its operation (drawing not required).
2. Free hand sectioning of stem, leaves, staining and mounting.
3. Measurement of pollen size using micrometer.
4. Demonstration of dehydration, infiltration, embedding and microtoming.
5. Demonstration of Camera lucida drawings and Photomicrography

REFERENCES (MICROTECHNIQUE)

1. Johansen, D.A. (1940). *Plant Microtechnique*. Mc Graw –Hill Book Co., Inc. New York.
2. Kanika, S. (2007). *Manual of Microbiology – Tools and Techniques*. Ane's student edition, New Delhi.
3. Khasim, S.K. (2002). *Botanical Microtechnique; Principles and Practice*, Capital Publishing Company, New Delhi.
4. Prasad M K, Krishna Prasad M. (1986). *Outlines of microtechnique.* Emkay Publishers, New Delhi.
5. Toji, T. (2004). *Essentials of Botanical Microtechnique*. Apex Infotec Publ.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Microscopic observations and measurement:** of cells and tissues using Micrometry
4. **Demonstration**: of Microscopes, Micrometry, Camera Lucida, Photomicrography,

Centrifuges, pH meter, Microtome

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 5 = 100)

- Based on practical examination, records and submissions

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE - 6

GYMNOSPERMS, PALAEOBOTANY, PHYTOGEOGRAPHY AND EVOLUTION

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
5	BBT5B06	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs).

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Analyze** the role of gymnosperms as a connecting link between pteridophytes and angiosperms.	Analyze	PSO5
CO2	**Understand** the basic principles and current trends in classical evolution.	Understand	PSO2
CO3	**Apply** the principles of genetics and evolution in conservation, defining and better understanding of nature.	Apply	PSO4
CO4	**Determine** the importance of fossil study.	Evaluate	PSO8
CO5	**Examine** the climatic conditions of the past and realize the changes happened.	Apply	PSO4
CO6	**Identify** the phytogeographic zones of India and the various patterns of plant distribution.	Analyze	PSO6

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

Sl no	Subject	Theory	Practical	Total
1	Gymnosperms	9	18	27
2	Palaeobotany	9	9	18
3	Phytogeography	18	9	27
4	Evolution	18	-	18
	Total	**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Gymnosperms	Palaeobotany	Phytogeography	Evolution
2 marks (total 12)	4	2	3	3
5 marks (total 7)	2	1	2	2
10 marks (total 2)	2			1 x 10 = 10
TOTAL				**60**

GYMNOSPERMS

1. Introduction, General characters and classification of Gymnosperms (Sporne, 1965) (**1** hr)
2. Distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details not required): *Cycas*, *Pinus* and *Gnetum* (**6** hrs)
3. Evolutionary trends in Gymnosperms; Affinities of Gymnosperms with Pteridophytes and Angiosperms (**1** hr)
4. Economic importance of Gymnosperms. (**1** hr)

PRACTICALS (GYMNOSPERMS)

1. *Cycas*- Habit, coralloid root, T.S. of coralloid root, T.S. of leaflet, T.S. of rachis, male cone and L.S. of male cone, microsporophyll, megasporophyll, T.S. of microsporophyll, L.S. of ovule and seed.
2. *Pinus*- branch of unlimited growth, spur shoot, T.S. of stem and needle, male cone and female cone, L.S. of male cone and female cone, seed.
3. *Gnetum*- Habit, stem T.S., leaf T.S., male and female cones, L.S. of ovule, seed.

REFERENCES (GYMNOSPERMS)

1. Chamberlain C.J. (1935). *Gymnosperms –Structure and Evolution*, Chicago University Press.
2. Coutler J.M. and C.J. Chamberlain, (1958). *Morphology of Gymnosperms*, Central Book Depot. Allahabad.
3. Sporne K.R. (1967). *The Morphology of Gymnosperms*, Hutchinson and Co. Ltd. London.
4. Sreevastava H.N. (1980). *A Text Book of Gymnosperms*, S. Chand and Co. Ltd., New Delhi.
5. Vasishta P.C. (1980). *Gymnosperms*, S. Chand and Co., Ltd., New Delhi.

PALAEOBOTANY

1. Introduction and objectives (½ hr)
2. Fossil formation theories - Replacement theory and Infiltration theory. Factors affecting fossilization, Types of fossils. (**1**½ hr)
3. Geological time scale- sequence of plants in geological time (**1** hr)
4. Fossil Pteridophytes - *Rhynia*, *Lepidodendron* and *Calamites* (**2** hr)
5. Fossil gymnosperms - *Williamsonia* (**1** hr)
6. Brief study of the major fossil deposits in India. (Balasinor, Gujarat; Zanskar Valley, Kashmir; Thiruvakkarai, Tamilnadu; Waddham, Maharashtra) (**1** hr)

7. Contribution of the Indian Palaeobotanists: Birbal Sahni and Savithri Sahni (**1** hr)
8. Birbal Sahni Institute of Palaeosciences (BSIP) (½ hr)
9. Applied aspects of Palaeobotany - exploration of fossil fuels (½ hr)

PRACTICALS (PALAEOBOTANY)

1 Fossil Pteridophytes - *Rhynia* stem, *Lepidodendron*, and *Calamites*

2 Fossil gymnosperms- *Williamsonia*

(Drawings may be replaced with photos in the record).

REFERENCES (PALAEOBOTANY)

1. Andrews H.N. (1961). *Studies in Paleobotany*, John Wiley and Sons Inc., NewYork.
2. Arnold C.A. (1947). *Introduction to Palaeobotany*, Tata McGraw Hill, New Delhi.
3. Shukla, A.C. & S.P. Misra, (1975). *Essential of Palaeobotany*, Vikas Publishing House, Pvt. Ltd., Delhi.
4. Sreevastava H.N., (1998). *Palaeobotany*, Pradeep Publishing Company, Jalandhan. Sewart,
5. Taylor, T.N. (1981). *Palaeobotany - An Introduction to Fossil Plant Biology*. Mc Graw Hill, New York. pp. 589.
6. Steward A.C. (1935). *Fossil Plants* Vol. I to IV. Watson J. *An Introduction to study of fossil plants.* Adams and Charles Black Ltd. London.

PHYTOGEOGRAPHY

1. Definition, concept, scope and significance of phytogeography (**2** hrs)
2. Patterns of plant distribution - continuous distribution and discontinuous distribution, vicarism, migration and extinction (**3** hrs)
3. Continental drift - Evidences and impacts (**3** hrs)
4. Glaciation: Causes and consequences (**2** hrs)
5. Theory of land bridges (**2** hrs)
6. Endemic distribution, theories on endemism, age and area hypothesis (**3** hrs)

7. Phytogeographical zones (phytochoria) of India. (**3** hrs)

PRACTICALS (PHYTOGEOGRAPHY).

1 Mark the phytogeographic zones of India in an outline map.

REFERENCES (PHYTOGEOGRAPHY)

1. Armen Takhtajan, (1986). *Floristic Regions of the World*. (Translated by T.J. Crovello & A. Cronquist), University of California Press, Berkeley.
2. Ronald Good, (1947). *The Geography of Flowering Plants*. Longmans, Green and Co, New York.
3. Sharma, P.D. (2009). *Ecology and Environment*, Rastogi Publications, Meerut.

EVOLUTION

1. Theories on Origin of Universe, Earth and Origin of life. Condensation and Polymerization; Protenoids and Prions – Oparin's concept; Miller's experiment. (**3** hr)
2. Evolution of prokaryotic and eukaryotic cells. Archaebacteria, Early fossilized cells (**2** hrs)
3. Theories on origin and evolution of species: Darwinism; Neo-Darwinism and its objections; Arguments and support for Darwinism, Modern concept of evolution. (**3** hrs)
4. Evidences of organic evolution from Morphology, Anatomy, Embryology, Palynology, Genetics and Molecular Biology. (**3** hrs)
5. Genetic constancy and creation of variability: cell divisions and genetic constancy; – genetic variability by recombination, chromosomal variations, gene mutations, selection and genetic drift. (**4** hrs)
6. Speciation: Isolating mechanism, Modes of speciation: sympatric and allopatric (**3** hrs)

REFERENCES (EVOLUTION).

1. Bowler, P. J. (1989). *Evolution: the history of an idea*. Univ of California Press.
2. Crick F. (1981). *Life itself: Its origin and Nature*. Simon and Schuster, New York.
3. Dobzhansky, B. (1961). Genetics and the origin of species. Coloumbia University Press. NewYork.
4. Dott R.H. R.L. Batten, (1981). *Evolution of the earth* - 3rd edn. McGraw Hill New York.
5. Drake J.W. (1970). *The molecular basis of mutation*. Holden – Day – San Francisco.
6. Fox S.W. and Dose, K. (1972). *Molecular evolution and the origin of life*. W.H. Freeman

& Co., San Francisco.

7. Gould S.J. (1977). *Ontogeny and Phylogeny*. Harvard University Press, Cambridge, Mass.
8. Jardine N., D. Mc Kenzie (1972). Continental drift and the dispersal and evolution of organisms. *Nature*, 234: 20-24.
9. Miller, S.L. (1953). A production of amino acids under possible primitive earth conditions. *Science*, 117, p. 528-529.
10. Stearns, S. C., & Hoekstra, R. F. (2000). *Evolution, an introduction*. Oxford University Press.
11. Strickberger, (1990). *Evolution,* Jones and Bastlett Publishers International, England.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This invoves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Demonstration:** Demonstration of free-hand sectioning of gymnosperm specimens, fossil materials, various phytogeographic zones
4. **Microscopic observation:** Gymnosperms and fossils.

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 10 +5 = 110)

- Based on practical examination, record, submissions and study tour report.

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE - 7

ANGIOSPERM MORPHOLOGY AND SYSTEMATICS

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
5	BBT5B07	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Evaluate** the diverse morphology of angiosperms.	Evaluate	PSO8
CO2	**Compare** various types of leaves, inflorescences, fruits and seeds	Evaluate	PSO8
CO3	**Develop** skills in identification and classification of flowering plants.	Create	PSO9
CO4	**Develop** skills in herbarium preparation	Create	PSO9
CO5	**Classify** plants using dichotomous keys.	Analyze	PSO5
CO6	**Distinguish** locally available angiosperm plants and their families.	Analyze	PSO5
C07	**Make** scientific illustrations of vegetative and reproductive structures of plants.	Create	PSO9
C08	**Identify** the importance of field studies and the need for conservation	Analyze	PSO5

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week).

Sl no	Subject	Theory	Practical	Total
1	Angiosperm Morphology	14	9	23
2	Systematics	40	27	67
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Angiosperm. Morphology	Systematics	Total
2 marks (total 12)	4	8	Ceiling 20
5 marks (total 7)	2	5	Ceiling 30
10 marks (total 2)	2		1 x 10 = 10
TOTAL			**60**

ANGIOSPEM MORPHOLOGY

1. Technical description of a flowering plant (brief) (**2** hrs)
2. Leaf: simple, compound, phyllotaxy (**1** hr)
3. Inflorescence: racemose, cymose and specialised (cyathium, hypanthodium, coenanthium, verticillaster, thyrsus). (**3** hrs)
4. Flower: Flower as a modified shoot, detailed structure of flowers, floral parts – their arrangement, relative position, cohesion and adhesion - symmetry of flowers (**4** hrs)
5. Fruits– simple, aggregate and multiple with examples; seed structure - dicot and monocot - albuminous and exalbuminous, aril, caruncle; Dispersal of fruits and seeds - types and adaptations. (**5** hrs)

PRACTICALS (ANGIOSPERM MORPHOLOGY)

1. Identify the types of inflorescence and fruits mentioned in the syllabus.
2. All the types mentioned under inflorescence and fruits must be represented in the practical records as colour photos/plates (no drawings are required).

REFERENCES (ANGIOSPEM MORPHOLOGY)

1. Eames A. J. (1977) - *Morphology of Angiosperms* - Mc Graw Hill, New York.
2. Foaster A S, Giffad E M, (1962). *Comparative morphology of vascular plants*. Allied Pacific Pvt. Ltd. Bombay.
3. Gangulee, H.C., J.S. Das & C. Dutta. (1982). *College Botany* (5^{th} Ed.), New Central Book Agency, Calcutta.
2. George, H.M. Lawrence, (1951). *Introduction to Plant Taxonomy*, Mac Millan Company Ltd., New York.
3. Simpson, M. G. (2006). *Plant Systematics*, Elsevier Academic Press, London
4. Sporne, K.R. (1974). *Morphology of Angiosperms*, Hutchinson University Press, London

SYSTEMATICS

Module-I (**6** hrs)

1. Components of systematics: identification, description nomenclature and classification; objectives and importance of systematics (**2** hrs)
2. Systems of classification: Artificial – Linnaeus; Natural – Bentham and Hooker (detailed study) ; Phylogenetic – Hutchinson; Angiosperm Phylogeny Group (APG) system (**4** hrs)

Module – II (**14** hrs)

1. Detailed study (systematic position, distribution, common members, diagnostic features, description from habit to fruit and economic importance of the following families.
   Annonaceae, Malvaceae, Meliaceae, Fabaceae with sub families, *Myrtaceae, Cucurbitaceae, Rubiaceae, Asteraceae, Apocynaceae, Solanaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Liliaceae, Orchidaceae* and *Poaceae.*

Module- III (**8** hrs).

1. Taxonomic structure – Hierarchy; Concepts of taxa, Species, Genus, Family. (**1** hr)
2. Taxonomic character – concept, primitive and advanced characters, sources, comparative morphology, vegetative, reproductive, Macro and micromorphology, modern trends in taxonomy, cytotaxonomy, chemotaxonomy, numerical taxonomy, molecular taxonomy and phylogenetics. (**4** hrs)
3. Contributions of eminent Taxonomists: Hendrich van Rheede, William Roxburgh, Robert Wight, J.S. Gamble and E.K. Janaki Ammal.
   (**2** hrs)

Module – IV (12 hrs).

1. Plant Nomenclature – Limitations of common name, ICN - Principles (introduction only); Typification (holotype, isotype, syntype, paratype and lectotype); Priority – merits and demerits; Effective and valid publication; Author citation. (**3** hrs)
2. Plant identification – Keys; indented and bracketed, construction and applications (**2** hrs)
3. Taxonomic information resources – Herbarium preparation and maintenance, Herbarium types: International - Kew (K); National - Central National Herbarium (CAL), MH Coimbatore, Virtual herbarium, Botanic Gardens: RBG, Kew; IGB, Kolkotta; JNTBGRI, Palode, Thiruvananthapuram; Malabar Botanical Garden and Institute for Plant Sciences (MBGIPS), Kozhikode. (**4** hrs)
4. Taxonomic literature- Floras, e-Flora, Monographs, Revisions, Journals and online resources & Databases. (**3** hrs)

PRACTICALS (SYSEMATICS)

1. Students are expected to work out at least two members of each family mentioned in the syllabus and make suitable diagrams. Describe them in technical terms and identify up to species using the Flora. Orchidaceae may be excluded from practical examination scheme.
2. Students shall be able to prepare dichotomous keys to segregate any five given plants.

This must be recorded.

3. Familiarization of herbarium techniques. The students should submit not less than 10 properly identified herbarium specimens (from different families studied) along with a field book, during the time of their practical examination. (Only the most common/ cultivated/ weedy species may be selected for herbaria preparation)
4. It is compulsory that every student has to undertake field study trips of 3-5 days to study vegetation of ecologically or phyto-geographically important areas, under the guidance of teachers. Visits to standard Herbaria, Organizations/ Institutes involved in exploring plant resources, Botanical museums etc. may be conducted as part of study tour. Local habitats like sacred groves, rice fields, wetlands, forests, grasslands etc. also can be selected for field trips. Avoid visit to tourist places with meager plant diversity and of having only entertainment value. Submit a field visit report countersigned by the Head of the department during the practical examination.
5. Every student shall submit original images of plants, at least three from any of the families mentioned in the syllabus, duly certified by HoD, at the time of examination. The images of plants should be properly identified and they should carry details like systematic position, GPS location, date, name and reg. no. of the student etc. Separate images clearly showing habitat, habit, inflorescence type, single flower, floral parts etc. of each plant should be represented. Web sourced and outsourced images should not be used. The colour plates prepared may be submitted along with the study tour report.
6. If a student fails to undergo the study tour he /she may not be permitted to attend the examination.

REFERENCES (SYSEMATICS)

1. Bharati Bhattacharyya (2009). *Systematic Botany*, Narosa Publishing House Pvt. Ltd., New Delhi.
2. Burkill, I.H. (1965). *Chapters on the History of Botany in India*, Botanical Survey of India, Delhi, 245 p.
3. Clive A. Stace (1991). *Plant Taxonomy and Biosystematics*, Cambridge University Press.
4. Datta, S.C. (1988). *Systematic Botany*, 4th Ed, Wiley Estern Ltd., New Delhi..
5. Davis, P.H. & V.H. Heywood, (1963). *Principles of Angiosperm Taxonomy*. Oliver & Boyd Ltd., London.
6. Gurucharan Singh, (2012). *Plant Systematics - Theory and Practice*. Oxford & IBH, New Delhi.

7. Jeffrey, C. (1968). *An introduction to Plant Taxonomy*, Cambridge University Press, London.
8. Lawrence, H.M.G. (2012) - *Taxonomy of Vascular Plants*, Scientific Publishers, New Delhi.
9. Manilal, K.S. and M.S. Muktesh Kumar (1998). *A Handbook on Taxonomy Training*. DST, New Delhi.
10. Manilal, K.S. and A.K. Pandey, (1996). *Taxonomy and Plant Conservation*. C.B.S. Publishers & Distributors, New Delhi.
11. Manilal, K.S. (2003). *Van Rheede's Hortus Malabaricus. English Edition*, with Annotations and Modern Botanical Nomenclature. (12 Vols.) University of Kerala, Trivandrum.
12. Mondal A.K. (2009). *Advanced Plant Taxonomy*, New Central Book agency Pvt. Ltd. Kolkota.
13. Naik V.N. (1991). *Taxonomy of Angiosperms*, Tata Mcgraw-Hill Pub. Co. Ltd., New Delhi.
14. Nicholas J. Turland *et al*. (2018). *International Code of Nomenclature for algae, fungi, and plants- Shenzhen Code* (printed/ electronic version)., Koeltz Botanical Books
15. Pandey, S.N. & S.P. Misra. (2008). *Taxonomy of Angiosperms*. Ane Books India, New Delhi.
16. Radford, A.E. (1986). *Fundamentals of Plant Systematics*, Harper & Row Publishers, New York.
17. Sambamurthy A.S.S. (2005). *Taxonomy of Angiosperms*, I.K. International Pvt. Ltd, New Delhi.
18. Sharma, B.D. *et al*. (Eds.). (1996). *Flora of India* vol. I. Botanical Survey of India, Calcutta.
19. Simpson, M.G. (2006). *Plant Systematics*, Elsevier Academic Press, London.
20. Sivarajan, V.V. (1991). *Introduction to Principles of Plant Taxonomy*. Oxford & IBH, New Delhi.
21. Stuessy, T.F. (1990). *Plant Taxonomy–The systematic evaluation of Comparative data*. Columbia University Press, New York.

MODE OF TRANSACTION
1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction. 2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher. 3. **Field trips & Institution visits:** They are conducted to study vegetation of ecologically or phyto-geographically important areas. Visits to standard herbaria, organizations/ institutes involved in exploring plant resources, botanical museums etc. also may be conducted 4. **Plant collection:** Along with students to identify plants for herbaria preparation and

to take photos for preparing photoalbum

5. **Microscopic observations:** To learn micro-morphological features various floral parts
6. **Demonstration**: To study the morphology of leaves, inflorescence, flowers, family characters etc.

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 10 + 5 = 110)

- Based on practical examination, record, submissions and study tour report.

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE- 8

TISSUE CULTURE, HORTICULTURE, ECONOMIC BOTANY AND ETHNOBOTANY

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
5	BBT5B08	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Evaluate** the advantages of tissue culture and horticulture over conventional methods of propagation.	Evaluate	PSO7
CO2	**Apply** various horticultural practices in the field.	Apply	PSO4
CO3	**Develop** skills in various horticultural methods	Create	PSO9
CO4	**Identify** the economically important plants.	Analyze	PSO6
CO5	**Analyze** the importance of Traditional Botanical Knowledge	Analyze	PSO6
CO6	**Identify** the various ethnobotanically significant plants mentioned in the syllabus	Analyze	PSO6

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week).

Sl No	Subject	Theory	Practical	Total
1	Tissue culture	18	12	30
2	Horticulture	18	12	30
3	Economic Botany	9	9	18
4	Ethnobotany	9	3	12
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Tissue culture	Horti culture	Economic Botany	Ethno botany	Total
2 marks (total 12)	5	5	1	1	Ceiling 20
5 marks (total 7)	3	2	1	1	Ceiling 30
10 marks (total 2)	1	1	-	-	1 x 10 = 10
TOTAL					**60**

TISSUE CULTURE

Module - I (10 hrs)

1. Plant tissue culture – Principles and techniques; Cellular totipotency; *in vitro* differentiation – de differentiation and re-differentiation. (**1** hr)
2. Tissue culture medium – Basic components in tissue culture medium – Solid and liquid medium; Murashige and Skoog medium – composition and preparation. (**2** hrs)

3. Aseptic techniques in *in vitro* culture – sterilization – different methods –sterilization of instruments and glasswares, medium, explants; working principle of laminar air flow and autoclave. (**2** hrs)
4. Preparation of explants– surface sterilization, inoculation, incubation, subculturing (**1** hr)
5. Micropropagation - Different methods – apical, axillary bud proliferation, direct and indirect organogenesis and somatic embryogenesis (**2** hrs)
6. Different phases of micropropagation – multiple shoot induction, shoot elongation, *in vitro* and *in vivo* rooting, hardening, transplantation and field evaluation; advantages and disadvantages of micropropagation, somaclonal variation (**2** hrs)

Module – II (8 hrs)

1. Methods and Applications of Tissue culture:
    1. Shoot tip and meristem culture
    2. Somatic embryogenesis and synthetic seed production
    3. Embryo culture
    4. Protoplast isolation, culture and regeneration – transformation and transgenics
    5. Somatic cell hybridization, cybridization.
    6. *In vitro* secondary metabolite production — cell immobilization, bioreactors
    7. *In vitro* production of haploids – anther and pollen culture
    8. *In vitro* preservation of germ plasm

PRACTICALS (TISSUE CULTURE)

1. Preparation of nutrient medium – Murashige and Skooge medium using stock solutions (Demonstration only).
2. Familiarize the technique of preparation of explants, surface sterilization, inoculation and sub-culturing.
3. Preparation of synthetic seeds (Demonstration only).
4. Demonstration of anther culture.
5. Visit to a Tissue culture lab may be conducted to understand the various tissue culture techniques.

REFERENCES (TISSUE CULTURE)

1. Bhojwani S.S. and Razdan M.K. (1983). *Plant Tissue Culture: Theory and Practice*. Elsevier.
2. Bhojwani, Sant Saran and Prem Kumar Dantu (2013). *Plant Tissue Culture: An Introductory Text* , 318 p

3. Edwin F. George, Michael A. Hall and Geert-Jan De Klerk. (2008). *Plant propagation by tissue culture*, Volume 1. The Background. Springer, The Netherlands.
4. Gamborg, O.L. and G.C. Philips (Eds.). (1995). Pla*nt Cell, Tissue and Organ Culture: Fundamental Methods*. Narosa Publishing House, New Delhi.
5. Razdan M.K. (2019). *Introduction to Plant Tissue Culture* (3rd edition). Oxford & IBH publishing Co. Pvt. Ltd. 420pp.
6. Reinert J., and Bajaj PS (1978). *Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture*, Springer Verlag, Berlin, New York
7. Santhosh Nagar and Madhavi Adhav (2010). *Practical book of Biotechnology and Plant Tissue culture,* S. Chand and Co Ltd.

HORTICULTURE

Module - I (5 hrs)

1. Introduction, scope and significance; branches of horticulture. (**1** hr)
2. Soil- components of soil, types of soil. (**1** hr)
3. Fertilizers – Chemical, organic, biofertilizer, compost. (**1** hr)
4. Pots & potting – earthen, fibre, polythene bags, potting mixture, cocopeat, cocopeat discs, vermiculite, perlite, potting, repotting, top dressing. (**1** hr)
5. Irrigation – Surface, sprinkler, drip and gravity irrigation. (**1** hr)

Module – II (7 hrs)

1. Seed propagation –seed quality tests, seed treatment, essential condition for successful propagation – raising of seed beds, transplanting techniques. (**3** hrs)
2. Vegetative propagation: (**4** hrs)
    1. Cutting (stem, roots)
    2. Grafting (approach, cleft)
    3. Budding (T-budding, patch)
    4. Layering (simple, air)

Module - III (6 hrs)

1. Gardening – site selection; propagating structure: green house, poly house, moist chamber, net frame – Garden tools and implements. (**1** hr)
2. Indoor gardening – selection of indoor plants, care and maintenance of indoor plants, Bonsai – Principle, creating the bonsai. (**1** hr)
3. Outdoor gardening; landscaping- goals, types. (**1** hr)

4. Cultivation and post-harvest management of vegetables and ornamental plants (**1** hr)
5. Protection of horticultural plants: Precautions to avoid pests and diseases, biopesticides. (**1** hr)
6. Mushroom cultivation – Oyster mushroom (**1** hr)

PRACTICALS (HORTICULTURE)

1. Preparation of nursery bed and polybag filling.
2. Preparation of potting mixture – Potting, repotting.
3. Field work in cutting, grafting, budding, layering (drawing not required)
4. Familiarizing gardening tools and implements. (drawing not required)
5. Establishment of vegetable garden/ Visit to a horticulture station.
6. A brief report of item no. 5 may be recorded.

REFERENCES (HORTICULTURE)

1. Adriance G.W. and Brison F.R. (1979). *Propagation of Horticultural Plants*, Krieger Publication Company, 298 p.
2. Chadha, K.I. and Choudhury, B. (2014). *Ornamental Horticulture in India*, Indian Council of Agricultural Research
2. George Acquaah (2005). *Horticulture: Principles and Practices*, Pearson Education, Delhi.
3. Hudson, T. Hartmann, Dale K. Kester, Fred T. Davies, Robert L. Geneve, Sandra B. Wilson. (2018). *Plant Propagation, Principles and Practices.* 9th Edition
4. Katyal, S.L. (1977). *Vegetable growing in India*, Oxford, New York.
5. Kolay, A.K. (1994). *Basic Concepts of Soil Science*. New Age International Publishers, Delhi.
6. Naik, K.C. (1949). *South Indian Fruits and their Culture*. P. Varadachary & Co. London.
7. Nishi Sinha (1993). *Gardening in India,* Abhinav Publications, New Delhi.
8. Prakash, R and Raj Mohan K. (2005). *Jaivakrishi* (Organic farming), State Institute of Languages, Trivandrum.
9. Prasad, S., and Kumar U. (2012). *Green house Management for Horticultural Crops*, Agrobios, Jodhpur.
10. Sujith Kumar C.K. (2008). *Jaiva krishi – Prayogika sankethika vidyakal,* (Organic farming – practical technologies), Altermedia, Thrissur

ECONOMIC BOTANY

Study the different category of economically important plants; their Binomial, Family and Morphology of useful part, products and uses. (**9** hrs)

1. Cereals and Millets – Rice, Wheat, Maize, Ragi.
2. Pulses and legumes – Green gram, Bengal gram, Black gram.
3. Sugar – Sugar cane.
4. Fruits – Apple, Pine Apple, Papaya, Banana, Mango, Guava, Jack, Grapes, Sapota.
5. Vegetables – Carrot, Beet Root, Corm, Potato, Bitter gourd, Cucumber, Snake gourd, Ladies finger, Cabbage, *Amaranthus*.
6. Ornamentals – Rose, *Anthurium*, Jasmine.
7. Masticatories – Betel vine, Betel nut, Tobacco.
8. Beverages – Coffee, Tea, Cocoa.
9. Fibre – Coir, Cotton, Jute.
10. Timber – Teak, Rose wood, Jack, *Ailanthus*.
11. Fats and oils – Coconut, Gingelly, Sunflower.
12. Latex – Rubber.
13. Gums and Resins – Dammar, Gum Arabic, Asafoetida.
14. Spices – Pepper, Ginger, Cardamom, Clove, Nutmeg, Allspice, Cinnamon.
15. Medicinal – *Adhatoda*, *Catharanthus*, *Phyllanthus*, *Rauvolfia*, *Aloe*.

PRACTICALS (ECONOMIC BOTANY)

1. Students shall be able to identify plants or plant products (raw or processed) studied in theory and shall be able to write Botanical names, Family and morphology of useful parts of source plants.
2. Students need not make any illustrations but make a table in the record giving the details of the items mentioned in the theory syllabus.

REFERENCES (ECONOMIC BOTANY)

1. Bendre Kumar (2000). *Economic Botany*, Rastogi Publcations, Shivaji road, Meerut.
2. Jain. S. K. (1981). *Glimpses of Indian Economic Botany*. Oxford & IBH
3. Kochhar, S.L. (2011). *Economic Botany in the Tropics*, 4th edition, MacMillan Publishers India Ltd., New Delhi.

ETHNOBOTANY

1. Introduction, scope and significance. (**1** hr)
2. Major tribes of Kerala (**2** hrs)
3. Importance of Traditional Botanical Knowledge, JNTBGRI model of Benefit Sharing,

KIRTADS and tribal research (**2** hrs)

4. Ethnobotanical significance of the following: (**3** hrs)
    1. *Aegle marmelos*
    2. *Ficus religiosa*
    3. *Curcuma longa*
    4. *Cynodon dactylon*
    5. *Ocimum sanctum*
    6. *Trichopus zeylanicus*

PRACTICALS (ETHNOBOTANY)

Students are expected to identify the plants mentioned in the Ethnobotany syllabus and it must be recorded as a table showing Common name, Binomial, Family and Ethnobotanical significance. (Drawings not required).

REFERENCES (ETHNOBOTANY)

1. Baker. H.G. (1970). *Plant and Civilization*. 2nd Edition, Macmillian International Higher Education.
2. Balick, M. J., & Cox, P. A. (2020). *Plants, people, and culture: the science of ethnobotany*. Garland Science.
3. Cotton, C.M. (1996). *Ethnobotany – Principles and Applications.* John Wiley and Sons.
4. Hamilton, A., Shengji, P., Kessy, J., Khan, A. A., Lagos-Witte, S., & Shinwari, Z. K. (2003). *The purposes and teaching of applied ethnobotany* (Vol. 11). United Nations Educational, Scientific and Cultural Organization (UNESCO).
5. Jain, S. K. (1986). Ethnobotany. *Interdisciplinary Science Reviews*, *11*(3), 285-292.
6. Jain, S. K., & Mudgal, V. (1999). *A hand book of ethnobotany*. Bishen Singh Mahendra Pal Singh.
7. Jain. S. K. (2010). *Manual of Ethnobotany*. Scientific Publishers, Jodhpur.
8. Martin, G. J. (2010). *Ethnobotany: a methods manual*. Routledge.
9. Narayanan, M. R., Anilkumar, N., Balakrishnan, V., Sivadasan, M., Alfarhan, H. A., & Alatar, A. A. (2011). Wild edible plants used by the Kattunaikka, Paniya and Kuruma tribes of Wayanad District, Kerala, India. *Journal of Medicinal Plants Research*, *5*(15), 3520-3529.
10. Prance, G. T. (1991). What is ethnobotany today? *Journal of ethnopharmacology*, 32 (1-3), 209-216.

11. Rajith, N. P., & Ramachandran, V. S. (2010). Ethnomedicines of Kurichyas, Kannur district, Western Ghats, Kerala.
12. Sudhadevi, P. K. (1992). *Ethnobotany of medicinal plants used by tribes of Kerala* (Doctoral dissertation, Dept. of Pomology and Floriculture, College of Horticulture, Vellanikkara).

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Institutional visits:** Students are provided with sufficient exposure by visiting full-fledged labs and research stations.
4. **Demonstration**: Demonstration and video screening of various techniques involved in plant propagation methods, economically and ethnobotanically important materials,

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 10 + 5 = 110)

- Based on practical examination, record, submissions and study tour report.

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE - 9:

CELL BIOLOGY AND BIOCHEMISTRY

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
5	BBT5B09	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome	Learning Domain	PSO No.
	Upon completion of this couse, students will be able to:		
CO1	**Analyze** the ultra-structure of a plant cell, cell organelles and their functions.	Analyze	PSO5
CO2	**Determine** the importance of cell division in the reproduction, growth and development of organisms.	Evaluate	PSO8
CO3	**Calculate** the mitotic-index to find out the rate of cell division.	Apply	PSO4
CO4	**Develop** awareness on the interdisciplinary nature of botany and chemistry by studying the principles of plant life.	Analyze	PSO5
CO5	**Illustrate** and explain the structure of biomolecules.	Analyze	PSO5
CO6	**Develop** skill for testing of biomolecules by using standard procedures	Create	PSO9

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

Sl No	Subject	Theory	Practical	Total
1	Cell Biology	27	9	36
2	Biochemistry	27	27	54
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Cell Biology	Biochemistry	Total
2 marks (total 12)	6	6	Ceiling 20
5 marks (total 7)	4	3	Ceiling 30
10 marks (total 2)	1	1	1 x 10 = 10
TOTAL			**60**

CELL BIOLOGY

Module – I (**14** hrs)

1. Architecture of cells. Prokaryotic and Eukaryotic cells. (**1** hr)
2. Structure and function of the following: Cell membrane (fluid mosaic model), Endoplasmic reticulum, Golgi complex, mitochondria, chloroplast, Lysosomes, Glyoxisomes Ribosomes, Cytoskeleton, Cytosol, Vacuole (**5** hrs)
3. Nucleus - Nuclear membrane; Nuclear pore complex; organization of interphase Nucleus; Euchromatin and heterochromatin; Nucleolus. (**4** hrs)
4. Chromosomes - Morphology, classification, Centromere and Telomere, Chemical Composition and organization. (**4** hrs)

Module - II (**13** hrs)

1. Special types of chromosomes– Polytene chromosomes, lampbrush chromosomes (**1** hr)
2. Cell division - cell cycle - Mitosis & Meiosis – significance- molecular control of cell division
   (**5** hrs)
3. Chromosomal changes - structural aberrations: deletion, duplication, inversion, translocation - their meoitic consequences and significance (**3** hrs)
4. Numerical aberration - Definition - Basic chromosome number (Genomic Number) Aneuploidy, Haploidy and Polyploidy - their meiotic behaviour and significance (**4** hrs)

PRACTICALS (CELL BIOLOGY)

1. Mitosis - Acetocarmine squash preparation of Onion root tip.
2. Calculation of mitotic index
3. Demonstration of meiosis in *Rhoeo/ Chlorophytum*/ Maize and identification of different stages of Meiosis.

REFERENCE (CELL BIOLOGY)

1. Arumugham. N. (2014). *Cell Biology*. Sara Publication, Nagercoil.
2. Avinash Upadhyaya & Kakoli Upadhayaya (2005). *Basic Molecular Biology*. Himalaya Publishers.
3. De Robertis. E.D.P., & De Robertis E.M.S. (1998). *Cell and Molecular Biology* - Lea & Febiger.
4. Geoffery M. Cooper & Robert E. Haufman. (2007). *The cell - a molecular approach*. A.S.S. Press Washington, U.S.A.

5. Karp, G., Iwasa, J., & Marshall, W. (2020). *Karp's Cell and Molecular Biology*. John Wiley & Sons.
6. Karp, G., Iwasa, J., & Marshall, W. (2018). *Karp's Cell Biology*. John Wiley & Sons.
7. Lewis. J. Kleinsmith & Valerie M. Kish (1995). *Principles of Cell & Molecular Biology*.
8. Lewin B. (2017). *Genes XII.* Oxford University press.
9. Lodish. H. *et. al*., (2000). *Molecular Cell Biology*, Freeman & Company.
10. Power C.B. (1988). *Essentials of Cytology*, Himalaya Publishing House, pp. 368.
11. Rastogi S.C. (2005). *Cell Biology*. Tata Mc. Graw Hill Publishing Company, New Delhi
12. Rastogi. V.B. (2008). *Fundamentals of Molecular Biology*, Ane Books, New Delhi, India.

BIOCHEMISTRY

1. Macromolecules-building block biomolecules - metabolic intermediates-precursors) (**2** hrs)
2. Carbohydrates: Structure and Classification – Monosaccharides: Triose-glyceraldehyde, Pentoses- ribose, deoxyribose; Hexose-Glucose and Fructose; Disaccharides-Lactose, Maltose, Sucrose; Polysaccharides: Starch, Glycogen. (**5** hrs)
3. Lipids. Classification. Complex lipids, Simple lipids and derived lipids; Fatty acids saturated and unsaturated, triacyl glycerols, phospholipids, sphingolipids. (**4** hrs)
4. Amino acids, peptides and proteins. Amino acids: classification based on polarity; zwitterions, Dipeptides (**3** hrs)
5. Proteins: Primary, secondary, tertiary and quaternary structures of proteins. Native conformation and biological functions of proteins. Denaturation and renaturation (**3** hrs)
6. Nucleotides: structure, Functions of nucleotides and nucleotide derivatives (**4**hrs)
7. Secondary metabolites. A brief account of secondary metabolites, physiological roles. Significance: ecological importance. (**2** hrs)
8. Enzymes Classification (IUB), Mechanism of enzyme action, optimization of weak interactions in the transition state. Co-enzymes, inhibition, regulation: allosteric enzymes, covalently modulated enzymes. Isoenzymes. (**4** hrs)

PRACTICALS (BIOCHEMISTRY)

1. Qualitative tests for monosaccharides, and reducing non reducing oligosaccharides, starch, amino acids and protein.

1. Molisch's test for all carbohydrates
2. Benedict's test for reducing sugars
3. Barfoed's test for monosaccharides
4. Seliwanoff's test for ketoses
5. Iodine test for starch
6. Ninhydrin test for amino acids and protein
7. Xanthoproteic test for amino acids with aromatic R-groups
8. Biuret test for peptide linkage and proteins

REFERENCES (BIOCHEMISTRY)

1. Bell E.A. and Charlwood B.V. (eds.) (1980). *Secondary plant products, Vol. 8. Encyclopedia of Plant Physiology.* Springer – Verlag, Berlin
2. David L; Nelson and Michael M Cox (2000). *Lehninger. Principles of Biochemistry*. 3rd edition. Macmillon, Worth U.K.
5. Donald Voet and Judith Voet. (2004). Biochemistry. 3rd Edition. Wiley International Edition.
3. Goodwin Y.W., and Mercer E.I. (2003). *Introduction to Plant Biochemistry*. 2nd edition. CBS Publishers and distributors.
6. Jain J.L. (2005). Fundamentals of Biochemistry 6th Edition, S. Chand & Company, New Delhi
7. Jain J.L., Sanjay Jain and Nithin Jain (2016). Fundamentals of Biochemistry. S. Chand and Co., New Delhi
8. Keith Wilson and John Walker (2008). *Principles and techniques of Biochemistry and Molecular Biology*. 6th edition. Cambridge University Press.
9. Lehninger (2012). Principles of Biochemistry 6th Edition,W H Freeman & Co.
4. Sadasivam and Manickam (2007). *Biochemical methods*. New Age International Publishers. New Delhi.
10. Satyanaryana U. (2008). *Essentials of Biochemistry*, Books And Allied (p) Ltd, Kolkata
11. Trevor Palmer. (1991). *Enzymes- Biochemistry, Biotechnology and Clinical Chemistry*. Norwood Publishing, Chichester.

MODE OF TRANSACTION
1. **Face to Face Instruction:** This invove attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction. 2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher. 3. **Hands-on training:** students are trained to study various stages of mitosis by preparing acetocarmine squash of onion root tip.

4. **Microscopic observation:** Different cell division stages can be explained by this method.
5. **Experiment:** conducting qualitative tests for carbohydrates and proteins.

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 10 + 5 = 110)

- Based on practical examination, record, submissions and study tour report.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE- 10

GENETICS AND PLANT BREEDING

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
6	BBT6B10	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome	Learning Domain	PSO No.
	Upon completion of this couse, students will be able to:		
CO1	**Identify** the basic principles and current trends in classical genetics.	Analyze	PSO8
CO2	**Justify** the facts behind heredity and variations.	Evaluate	PSO8
CO3	**Evaluate** the relevance of the application of genetic principles in agriculture, medicine, research and industry.	Evaluate	PSO8
CO4	**Determine** the basic principles of inheritance and predict the pattern of inheritance.	Evaluate	PSO8
CO5	**Evaluate** problems related to classical genetics.	Evaluate	PSO8
CO6	**Compare** and **contrast** various plant breeding techniques.	Evaluate	PSO9
CO7	**Justify** the role of plant breeding in increasing crop productivity.	Evaluate	PSO9

DISTRIBUTION OF TEACHING HOURS (18 hrs / Semester = 1hr / week)

Sl no	Subject	Theory	Practical	Total
1	Genetics	36	27	63
2	Plant breeding	18	9	27
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Genetics	Plant breeding	Total
2 marks (total 12)	8	4	Ceiling 20
5 marks (total 7)	4	3	Ceiling 30
10 marks (total 2)	2		1 x 10 = 10
Total			**60**

GENETICS

Module – I (**23** hrs)

1. Introduction – Important terms in genetics – factors, genes, chromosomes, alleles, homozygous and heterozygous, hemizygous, traits, phenotypes, genotypes, locus, linkage, mutation; population, offspring, clone, test cross, back cross, reciprocal cross. (**1** hr)
2. Mendel's life history (brief), Mendelian experiments: Monohybrid cross and dihybrid cross, Mendelian ratios, Laws of inheritance; Back cross, test cross. (**4** hrs)
3. Modified Mendelian ratios:

a. Allelic interactions: dominant – recessive, Incomplete dominance – flower color in Mirabilis; Co dominance – Coat colour in cattle, Blood group in human beings; Lethal genes – Sickle cell anemia in Human beings. Modified dihybrid ratios by incomplete dominance of one pair of gene (3:6:3:1:2:1) and both pairs (1:2:1:2:4:2:1:2:1) (**6** hrs)

b. Interaction of genes: Non epistatsis - Comb pattern inheritance in poultry (9:3:3:1): Epistasis: dominant - Fruit colour in summer squashes; Recessive epistasis - Coat color in mice; Complementary gene interaction- flower color in *Lathyrus*. (**6** hrs)

4. Multiple alleles- general account: ABO blood group in man, Self-sterility in *Nicotiana*, Coat colour in Rabbits. (**3** hrs)
5. Quantitative inheritance / polygenic inheritance / continuous variation-Skin color in human beings, Ear size in maize. (**3** hrs)

Module – II (**13** hrs)

1. Linkage and crossing over- importance of linkage, linkage and independent assortment. Complete and incomplete linkage. Crossing over general account, 2 point and 3 – point crossing over, cytological evidence of genetic crossing over. Determination of gene sequences; interference and coincidence; mapping of chromosomes. (**7** hrs)
2. Extra nuclear inheritance- general account- maternal influence- plastid inheritance in *Mirabilis*, Shell coiling in snails (**3** hrs)
3. Population genetics; Hardy –Weinberg law and equation (**2** hrs)
4. Genetics and society - Eugenics and Euphenics (**1** hrs)

PRACTICALS (GENETICS)

1. Students are expected to work out problems related to the theory syllabus. One problem each from all the types mentioned should be recorded.
    a. Monohybrid cross
    b. Dihybrid cross
    c. Test cross and back cross
    d. Determination of genotypic and phenotypic ratios and genotype of parents
    e. Non epistasis
    f. Complementary gene interaction
    g. Epitasis: dominant and recessive
    h. Polygenic interaction
    i. Multiple allelism
    j. Chromosome mapping
    k. Calculation of Coincidence and interference

REFERENCES (GENETICS)

1. Benjamin A. Pierce (2012). *Genetics: A Conceptual Approach*, W. H. Freeman and Co., U.S.A., 400 pp.
2. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). *Introduction to Genetic Analysis*. 10th edition. W. H. Freeman and Co., U.S.A.
3. Gunther, S. Spend & Richard Calender (1986). - *Molecular Genetics,* CBS Publishers Delhi.
4. Gupta, P.K. (2018 -19). *Genetics*. Revised edition. Rastogi Publications, Meerut.
5. John Ringo (2004). *Fundamental Genetics,* Cambridge University Press.
6. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). *Concepts of Genetics*. Benjamin Cummings. U.S.A. 9th edition.
7. Lewin B. (2000). *Genes VII,* Oxford University Press.
8. Rastogi V.B. (2008). *Fundamentals of Molecular Biology*, Ane Books, India.
9. Robert H. Tamarin (2002). Principles of Genetics, McGraw-Hill Companies, New York
10. Sinnot, W.L.C. Dunn & J. Dobzhansky (1996). *Principles of Genetics*, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
11. Snustad, D.P. & Simmons, M.J. (2010). *Principles of Genetics*. 5th edition, John Wiley and Sons Inc., U.S.A.
12. Verma, P.S. & Agarwal (1999). *Text book of Genetics*. S. Chand & Co., New Delhi.

PLANT BREEDING

Module - I (**4** hrs)

1. Introduction and objectives of Plant breeding – Organization of ICAR and its role in plant breeding. (**1** hrs)
2. Plant breeding centers in Kerala & their achievements – CPCRI, CTCRI, RRII, IISR (**2** hrs)
3. Plant Genetic Resources - Components of Plant Genetic Resources. (**2** hr)

Module - II (**14** hrs)

1. Breeding techniques (**12** hrs)
    a. Plant introduction: Procedure, quarantine regulations, acclimatization- agencies of plant introduction in India (NBPGR, FRI, BSI), major achievements.
    b. Selection -mass selection, pure line selection and clonal selection, genetic basis of selection, significance and achievements.
    c. Hybridization – procedure; intergeneric, interspecific and intervarietal hybridization with examples; composite and synthetic varieties.
    d. Heterosis breeding - genetics of heterosis and inbreeding depression.
    e. Mutation breeding – methods - achievements.
    f. Polyploidy breeding - methods - achievements.
    g. Breeding for disease resistance
2. Modern tools for plant breeding: Genetic Engineering and products of Genetically Modified (GM) crops (brief mentioning only). (**1** hr)

PRACTICALS (PLANT BREEDING)

1. Techniques of emasculation and hybridization of any bisexual flower.
2. Floral biology of Paddy, any one Pulse and Coconut tree.
3. Visit to a plant breeding station and submission of its report.

REFERENCES (PLANT BREEDING)

1. Allard. R.W. (1960). *Principles of Plant breeding*, John Wiley & Sons, Inc, New York.
2. Chaudhari. H.K. (1966). *Elementary Principles of Plant breeding*, 2nd eds., Oxford & IBH Publishers.
3. Satya, P. (2016). Plant breeding – Genetic principles and methodologies, Books and Allied (P) Ltd, Kolkata, 568 pp.
4. Singh, B.D. (2005). *Plant Breeding: Principles & methods*, Kalyani Publishers, New Delhi.

5. Sinha U. & Sunitha Sinha (2000). *Cytogenetics, Plant breeding & Evolution*, Vikas Publishing House.
6. Swaminathan, Gupta & Sinha (1983). *Cytogenetics of Crop plants,* Macmillan India Ltd.

MODE OF TRANSACTION
1. **Face to Face Instruction:** This invove attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction. 2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher. 3. **Problem solving:** Genetics problems mentioned in the syllabus. 4. **Institutional visit:** To a plant breeding station and submission of its report. 5. **Experimentation:** Practicing techniques of emasculation and hybridization.
MODE OF ASSESSMENT
Internal Assessment (Theory - 15 Marks) 1. *Internal examination*: one Internal examination – 6 Marks. 2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks 3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks 4. *Classroom participation*: based on attendance - 3 Marks **Internal Assessment (Practicals - 20 Marks)** • Based on practical examination, records, submissions, lab involvement based on attendance, timely submissions of practical related works
External Assessment (Theory - 60 Marks) • Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper) **External Assessment (Practicals – Total 80 + 15 + 5 + 10 = 110)** • Based on practical examination, record, lab visit report and elective record.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE- 11

BIOTECHNOLOGY, MOLECULAR BIOLOGY AND BIOINFORMATICS

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
6	BBT6B11	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Analyze** the relevance of biotechnology in daily life	Analyze	PSO4
CO2	**Understand** the various tools employed in Biotechnology	Understand	PSO3
CO3	**Evaluate** various ethical legal and social issues of biotechnology	Evaluate	PSO7
CO4	**Understand** the basic aspects of bioinformatics and its applications	Understand	PSO3
CO5	**Understand** the basic concepts in molecular biology.	Understand	PSO3

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

Sl No	Subject	Theory	Practical	Total
1	Biotechnology	18	12	30
2	Molecular Biology	18	12	30
3	Bioinformatics	18	12	30
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Biotechnology	Molecular Biology	Bioinformatics	Total
2 marks (total 12)	4	4	4	Ceiling 20
5 marks (total 7)	2	2	3	Ceiling 30
10 marks (total 2)	2			1x10 = 10
Total				**80**

BIOTECHNOLOGY

Module – I (**13** hrs)

1. Introduction, concept, history of biotechnology (**1** hr)

2.Recombinant DNA Technology: Gene cloning strategies – recombinant DNA construction – cloning vectors – plasmid-based vector: pBR322, Ti plasmid, bacteriophage-based vector: λ phage. Restriction endonucleases and ligases, transformation and selection of transformants –

using antibiotic resistances markers, southern blotting; PCR. (**7** hrs)

3.Different methods of gene transfer – chemically stimulated DNA uptake by protoplast, electroporation, microinjection, biolistics. Agrobacterium mediated gene transfer, gene library, gene banks. (**5** hrs)

Module – II (**5** hrs)

1. Applications of Biotechnology (**5** hrs)
   a. In medicine - Production of human insulin, human growth hormone and
   b. In forensics - DNA finger printing.
   c. In agriculture - Genetically modified crops – Bt crops, Golden rice, Flavr-Savr Tomato, Virus, herbicide resistant crops, Edible vaccines. The Genetic Engineering Appraisal Committee (GEAC) of India and its roles.
   d. In environment- Bioremediation- use of genetically engineered bacteria - superbug.
   e. In industry - Horticulture and Floriculture Industry, production of vitamins, amino acids and alcohol.

PRACTICAL (BIOTECHNOLOGY)

1. Extraction of DNA from plant tissue.
2. Study of genetic engineering tools and techniques using photographs/ diagrams/ videos (Southern blotting, DNA finger printing, PCR).
3. Visit a Biotechnology laboratory to learn the various equipments and procedures.

REFERENCES (BIOTECHNOLOGY)

1. Balasubramanian, D. et.al (1996) (Ed): Concepts in Biotechnology; Costed IBN Universities press.
2. Brown T.A. (2006). *Gene cloning and DNA analysis*; Blackwell scientific publishers.
3. Chawla H.S. (2000). *Introduction to Plant Biotechnology*, Science Publishers.
4. Das H.K. (Ed.). (2005). *Text book of Biotechnology* (2nd ed.). Wiley India (Pvt.), Ltd. New Delhi.
5. Dubey, R.C (2001): *A text book of Biotechnology*. S. Chand, Limited, NewDelhi
6. Gupta, P.K. (1996). *Elementary Biotechnology*. Rastogi & Company, Meerut.
7. Hammond J., Megary P. *et al.* (2000). *Plant Biotechnology*. Springer Verlag.
8. Ignacimuthu S. (1997). *Plant Biotechnology*, New Hampshire Science Publishers.
9. Lewin B. (2004). *Genes VIII*. Oxford University Press.

10. Purohit S.S. (2003). *Agricultural Biotechnology*, Agrobios (India).
11. Satyanarayana U. (2010). *Biotechnology*, Books & Allied Ltd., Kolkata.
12. Sobti R.C. & Pachauri S.S. (2009). *Essentials of Biotechnology*; Ane Books, New Delhi.

MOLECULAR BIOLOGY

1. Nucleic acids - DNA – the genetic material; the discovery of DNA as the genetic material; bacterial transformation (Griffith's & Avery's experiments); Hershey & Chase experiment; Structure of DNA, contributions of Rosalind Franklin, Watson & Crick's Model, Types of DNA - (A, B, Z); DNA replication: semi conservative replication – Meselson and Stahl experiment; Molecular mechanism of Replication, RNA- structure, types and properties. (**6** hrs)
2. Gene action - One gene - one enzyme hypothesis, one cistron one polypeptide hypothesis; concept of colinearity; modern concept of gene-cistrons, recons and mutons (**2** hrs)
3. Genetic code - Characters of genetic code (**2** hrs)
4. Central dogma of molecular biology; protein synthesis - Transcription, post-transcriptional modification of RNA, translation; Teminism. (**3** hrs)
5. Gene regulation in prokaryotes - operon concept, (lac. operon, trp. operon) (**1** hr)
6. Gene regulation in eukaryotes - transcriptional, post transcriptional, translational and post translational events (**1** hr)
7. Mutation-spontaneous and induced; causes and consequences. Types of mutagens and their effects. Point mutations- molecular mechanism of mutation-Transition, Transversion and substitution (**3** hrs)

SUBMISSION (MOLECULAR BIOLOGY)

Visit a research station with well-equipped Biotechnology / Molecular biology lab and submit a duly certified detailed report of the same during the practical examination.

REFERENCES (MOLECULAR BIOLOGY)

1. Brown TA (2003). *Genomes*. John Willey and Sons.
2. Hawkins JD (1996). *Gene Structure and Expression*. Cambridge University Press.
3. Karp, G., Iwasa, J., & Marshall, W. (2020). *Karp's Cell and Molecular Biology*. John Wiley & Sons.
4. Lewin, Benjamin. (2017). *Gene XII*. Oxford University Press
5. Malathi, V. (2010). *Essentials of Molecular Biology*, Pearson Education Inc.
6. Russell, P. J. (2010). *Genetics - A Molecular Approach*, 3rd edition, Benjamin Cummings, U.S.A.
7. Waseem Ahmad, (2009). *Genetics and Genomics*. Pearson Education Inc.

8. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). *Molecular Biology of the Gene,* Pearson Benjamin Cummings, CSHL Press, New York. 6th edition.

BIOINFORMATICS

Module- I (**6** hrs)

1. Introduction to Bioinformatics, brief history, scope and relevance, wet lab to web lab
2. Basics of Genomics, Proteomics and comparative genomics
3. Biological data bases:
    i. Nucleotide sequence database – EMBL, Gen Bank, DDBJ.
    ii. Protein database – UniProtKB, PDB
    iii. Organismal database / Biodiversity database – Species 2000 /Human genome database
4. Information retrieval from Biological database, sequence alignment types and tools: pair wise sequence alignment, multiple sequence alignment, BLAST, Clustal W.

Module- II (**6** hrs)

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

Module - III (**6** hrs)

A brief account on:

1. Molecular phylogeny and phylogenetic trees: rooted, un-rooted, bifurcating and multifurcating types.
2. Molecular docking and computer aided drug design.

PRACTICALS (BIOINFORMATICS)

1. Familiarizing with the different data bases mentioned in the syllabus.
2. Blast search of nucleotide sequences
3. Pairwise alignment of DNA sequences by using BLAST.

REFERENCES (BIOINFORMATICS)

1. Campbell A. M., Heyer L. J. (2006). *Discovering Genomics, Proteomics and Bioinformatics.* 2nd edition. Benjamin Cummings. 352 pp.
2. Ghosh Z. and Bibekanand M. (2008). *Bioinformatics: Principles and Applications*. Oxford University Press.
3. Hall BG. (2017). *Phylogenetic Trees Made Easy, A How-To Manual.* Sinauer Associates is an imprint of Oxford University Press; 5th edition. 372pp.
4. Jin Xiong (2006). *Essential Bioinformatics*, Cambridge University Press, Replika Press Pvt. Ltd.
5. Pevsner J. (2009). *Bioinformatics and Functional Genomics.* 2nd Edition. Wiley-Blackwell.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This invove attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Video demonstration:** of Southern blotting, DNA finger printing, PCR.
4. **Institutional visit:** To a Biotechnology laboratory to learn the various equipments and procedures**.**
5. **Website search:** To learn various Biological data bases, sequence alignment types and tools

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 5 + 10 = 110)

- Based on practical examination, record, lab visit report and elective record.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE-12:

PLANT PHYSIOLOGY AND METABOLISM

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
6	BBT6B12	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Explain** the basic physiological processes in plants.	Apply	PSO4
CO2	**Analyze** the interdisciplinary nature of botany, chemistry and physics by studying the principles of plant life, growth and reproduction.	Analyze	PSO5
CO3	**Assess** the role of external factors in controlling the physiology of plants.	Evaluate	PSO8
CO4	**Explain** the metabolic processes taking place in each cell.	Apply	PSO4
CO5	**Compare** the energy fixing and energy releasing processes taking place in cells	Evaluate	PSO8

DISTRIBUTION OF TEACHING HOURS (18hrs/Semester = 1hr/week)

Sl no	Subject	Theory	Practical	Total
1	Module I	11	36	47
2	Module II	4		4
3	Module III	15		15
4	Module IV	9		9
5	Module V	15		15
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Mod. I	Mod. II	Mod. III	Mod. IV	Mod. V	Total
2 marks (total 12)	2	2	3	2	3	Ceiling 20
5 marks (total 7)	1	1	2	1	2	Ceiling 30
10 marks (total 2)	2					1 x 10 =10
TOTAL						**60**

Module - I

1. Plant cell and Water. Water as a solvent, cohesion and adhesion. Diffusion, osmosis, imbibition, plant cell as an osmotic system, osmotic pressure, osmotic potential, turgor pressure, wall pressure, water potential and its components (**4** hrs)
2. Transpiration: Types and process. Mechanism of guard cell movement. K^+ ion mechanism. Why transpiration? Antitranspirants. (**3** hrs)
3. Absorption of water – Active absorption and passive absorption. Ascent of sap – transpiration pull and cohesion of water molecules. Radial movement of water through root. Soil-plant-atmosphere continuum of water. (**4** hrs)

Module-II

1. Plants and inorganic nutrients. Macro and Micro nutrients. Uptake of mineral elements. Difference between passive uptake and active uptake. Simple and facilitated diffusion. Active uptake. Carrier concept. Evidences. (**4** hrs)

Module - III

1. Photosynthesis in higher plants: Photosynthetic apparatus. Electromagnetic radiation. Absorption of light. Fluorescence and phosphorescence. Organization of light harvesting antenna pigments. Photochemical and chemical phases of photosynthesis and its evidences. Red drop and Emerson enhancement effect. Two pigment systems, components. Photosynthetic electron transport and photophosphorylation. Assimilatory powers- ATP and NADPH. Photosynthetic carbon reduction cycle (PCR), RUBISCO, C3, C4, and CAM pathways. Ecological significance of C4, and CAM metabolism. Photorespiration. (**8** hrs)
2. Biological nitrogen fixation, symbiotic nitrogen fixation in leguminous plants. Biochemistry of Nitrogen fixation, Ammonia assimilation, assimilation of nitrate. Biosynthesis of amino acids. (**4** hrs)
3. Translocation and distribution of photo assimilates. Mechanism of phloem transport. Phloem loading and unloading; pressure flow hypothesis. (**3** hrs)

Module - IV

1. Plant growth and development. Auxins, Gibberellins, Cytokinins, Abscisic Acid and Ethylene, their physiological roles. Photoperiodism and vernalization. (**3** hrs)
2. Plant movements-phototropism, gravitropism. Nyctinastic and seismonastic movements. (**3** hrs)
3. Photomorphogenesis: Phytochrome: chemistry and physiological effects. (**2** hrs)

4. Seed dormancy and germination. (**1**hr)

Module – V

1. Intermediary metabolism: anabolism, catabolism, amphibolic pathways and anapleurotic reactions. (**3** hrs)
2. Catabolism of hexoses. Glycolysis: Two phases of glycolysis. Overall balance sheet. Fate of pyruvate under aerobic and anaerobic conditions. Citric acid cycle: Formation of acetate, Reaction of citric acid cycle, Anapleurotic reactions of citric acid cycle. Amphibolic nature of citric acid cycle. (**5** hrs)
3. Oxidation of fatty acids. β oxidation of saturated fatty acids in plants. (**2** hrs)
4. Oxidative phosphorylation: Electron transport reactions in mitochondrion. Electron carriers, redox potential, electron carriers functioning as multienzyme complexes, ATP synthesis. Chemiosmotic hypothesis, cyanide-resistant respiration, factors affecting respiration (**5** hrs)

PRACTICALS (PLANT PHYSIOLOGY)

Students should familiarize experiments and details must be recorded. (Drawings not required)

1. Fruit ripening/Rooting from cuttings (Demonstration)
2. Relation between water absorption and transpiration.
3. Separation of leaf pigments by paper chromatography/ column chromatography/TLC.
4. Effects of light intensity on photosynthesis by Wilmot's bubbler.
5. Thistle funnel osmoscope
6. Ganong's Potometer
7. Ganong's light-screen
8. Ganong's respirometer
9. Kuhne's fermentation vessel
10. Mohl's half-leaf experiment
11. Absorbo-transpirometer
12. Demonstration of gravitropism using Klinostat.

REFERENCES

1. Frank B. Salisbury and Cleon W. Ross (2002). *Plant Physiology*, 3rd edition. CBS publishers and distributors.
2. Goodwin Y.W. and Mercer E.I. (2003). *Introduction to Plant Biochemistry*. 2nd edition. CBS Publishers and distributors.
3. Hopkins WG (1999). *Introduction to Plant Physiology*, 2nd edition, John Wiley A Sons, Inc.

U.S.A. 4th edition

4. Hopkins, W.G. and Huner, A. (2008). *Introduction to Plant Physiology*. John Wiley and Sons.
5. Lincoln Taiz and Eduardo Zeiger (2002). *Plant Physiology*, 2nd edition. Sinauer Associates, Inc. Publishers. Sunderland, Massachusetts
6. Noggle G. R and Fritz G J (1983). *Introductory Plant Physiology*, Prentice Hall.
7. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A (2015). *Plant Physiology and Developmen*t. Sinauer Associates Inc. USA. 6th edition.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Experimentation:** To learn the principles and working of various physiology experiments and apparatus mentioned in the syllabus.
4. **Demonstration**: Video screening of various physiological processes mentioned in the syllabus.

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: One internal examination – 6 Marks
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: Based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 5 + 10 = 110)

- Based on practical examination, record, lab visit report and elective record.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE-13:

ENVIRONMENTAL SCIENCE

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of
6	BBT6B13	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Understand** the fundamental concepts in environmental science and the importance of ecological studies.	Understand	PSO1
CO2	**Create** awareness of the need of conservation of biodiversity and natural resources.	Create	PSO10
CO3	**Explain** the need to mitigate pollution and strategies for disaster management.	Apply	PSO4
CO4	**Understand** the various conservation strategies and develop environmental concerns in all their actions.	Understand	PSO3
CO5	**Develop** awareness about the various kinds of environment pollution, their impacts on the ecosystem and their control measures	Analyze	PSO4
CO6	**Explain** the reasons for climate change and find out ways to combat this.	Apply	PSO4

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

Sl no	Subject	Theory	Practical	Total
1	Module 1	15	12	27
2	Module II	14	6	20
3	Module III	13	6	19
4	Module IV	12	12	24
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Module I	Module II	Module III	Module IV	Total
2 marks (total 12)	3	3	3	3	Ceiling 20
5 marks (total 7)	2	2	2	1	Ceiling 30
10 marks (total 2)	2				1 x 10 = 10

TOTAL	60

ENVIRONMENTAL SCIENCE

Module - I

1. Ecosystem: Definition, abiotic and biotic factors, trophic structure, Food chain and food web, Ecological pyramids, Energy flow, Productivity of ecosystems. (**4** hrs)
2. Major ecosystems of the Biosphere: Sea; Estuarine ecosystem; Lentic: lake, Pond; Lotic: river; Desert; Forest; Grass land (brief account only). (**3** hrs)
3. Plant adaptations: Adaptations in Hydrophytes, Xerophytes, Halophytes, Epiphytes & Parasites. (**3** hrs)
4. Ecological succession: Definition – Primary & Secondary succession; Mechanism of plant succession – Xerosere & Hydrosere (**4** hrs)
5. Biogeochemical cycles (Carbon, Nitrogen, Phosphorous) (**2** hrs)

Module-II

1. Biodiversity and Conservation: Definition; Biodiversity - Global and Indian Scenario; Megadiversity nations and hotspots. (**3** hrs)
2. Threats to biodiversity; RET species, endemic plant species – Red data book - Exotic and indigenous plant species – Keystone species – Flagship species. (**4** hrs)
3. Conservation strategies - *ex situ* and *in situ* methods. Natural World Heritage Sites in India, Ramsar sites, People's Biodiversity Register (PBR) (**4** hrs)
4. Organizations – IUCN, UNEP, WWF, NBPGR, NBA, KSBB (**3** hrs)

Module-III

1. Pollution: Sources and types of pollution – air, water, soil, thermal and noise; biodegradable and non-biodegradable pollutants; biomagnification; BOD. (**4** hrs)
2. Management of environmental pollution – conventional and phytotechnological approaches – solid wastes management including e-wastes - environmental legislations in India (Prevention and Control of Pollution act, 1981) (**4** hrs)
3. Global environmental changes – climatic changes – global warming and greenhouse gases, acid rains, el-nino, la-nina (**2** hrs)
4. Global conservation efforts - Rio Earth summit - Agenda 21, Kyoto protocol, COP, Paris agreement - major contributions. (**3** hrs)

Module- IV

1. Ecology: introduction, scope and relevance; sub-divisions of ecology - autecology, synecology and ecosystem ecology**.** **(2** hrs)
2. Techniques in plant community studies – Quadrat and transect methods– species area curve– density, frequency, abundance, dominance of populations– importance value index – construction of phytographs. (**6** hrs)
3. Remote sensing and GIS: introduction, principle, application of remote sensing and GIS in environmental studies and biodiversity conservation (brief account). (**4** hrs)

PRACTICALS

1. Visit a nearby wetland/ mangrove ecosystem, identify and categorize the plants occurring in the area according to their types and record them.
2. Construct a food web of the ecosystem, from the data gathered.
3. Construct ecological pyramids of number, biomass and energy from the given set of data
4. Study of plant communities: Determination of density, abundance, dominance, frequency by Quadrat method.
5. Study of morphological and anatomical characteristics of plant groups: hydrophytes, xerophytes, halophytes, epiphytes, parasites.
6. Estimation of solid waste generated by your household (biodegradable and non-biodegradable) and its impact on land degradation.
7. Demonstration of determination of Dissolved Oxygen by Winkler's method.

REFERENCES

1. Abbassi, T. & Abbassi, S.A. (2010). *Remote sensing, GIS and Wetland management*, Discovery Publishing House, Pvt. Ltd.
2. Ahmedullah M., Nayar M.P. (1987). *Endemic plants of the Indian region*. Botanical survey of India, Calcutta
3. Anji Reddi M. (2000). *Remote sensing and Geographic Information System*, B.S. Publications, Hyderabad.
4. Asthana D.K, Meera Asthana. (2006). *A text book of environmental studies.* S Chand., New Delhi
5. Beeby A. & Brennan A.M. (2004). *First Ecology. Ecological Principles and Environmental Issues.* Oxford University Press.

6. Bharucha E. (2005). *Text Book of Environmental Studies for UG courses*. University Press (India). Private Limited Hyderabad.
7. Bharucha, Erach. (2003). *The Biodiversity of India.* Mapin Publishing Co., New Delhi.
8. Chandrasekharan C. (1962). A General note on the vegetation of Kerala state; *Indian Forester,* 88: 440-441.
9. Chandrasekharan C. (1962). Ecological Study of the Forests of Kerala State; *Indian Forester,* 88: 473-480.
10. Chandrasekharan C. (1962). Forest Types of Kerala State. *Indian Forester,* 88: 660-847.
11. Chang Kang – Tsung (2007). *Introduction to GIS,* Tata McGraw Hill Education.
12. Chapman J.L. (2006). *Ecology-Principles and Application,* Cambridge University Press India Pvt. Ltd
13. Chrisman and Nicholas (1997). *Exploring GIS,* John Wiley and Sons.
14. Clarke K. C. (1997). Getting started with Geographical Information System, Prentice Hall, New Jersey.
15. Cunninghan W.P. and M.A. Cunningham (2003). *Principles of Environmental Science: Inquiry and Applications.* Tata McGraw Hill Pub. N.D.
16. Dash M.C. (1993). *Fundamentals of Ecology*. Tata McGraw Hill Publishing Company Ltd. New Delhi.
17. Diamond, J., T.J. Case (1986). *Community ecology.* Harper & Row, New York.
18. Dix J.H. (1989). *Environmental Pollution. Atmosphere, Land, Water and Noi*se. Wiley Chichester.
19. Erwin Schanda (1976). *Remote Sensing for Environmental Sciences*. Springer – Verlag Berlin Heidelberg
20. Futuyma P.J., Slatkin M. (1983). *Co-evolution*. Sinauer Associates, Sunderland Mass.
21. Garg M R, Bansal V K, Tiwana N.S. (2007). *Environmental Pollution and Protection.* Deep and Deep Publishers, New Delhi.
22. IUCN, (2007). *The 2000 IUCN Red list of Threatened Species*. IUCN. Gland.
23. Jain S K, Sastry A R K (1984). *The Indian plant red data book*. Botanical survey of India, Calcutta.
24. Khitoliya R.K. (2007). E*nvironmental Pollution – Management and Control for Sustainable development,* S. Chand and Company Ltd., New Delhi.
25. Krebs, C.J. (1985). *Ecology* 3rd edn. Harper & Row, New York.
26. Kumar U, M Asija (2006). *Biodiversity: Principles and conservation.* Agrobios India.
27. Kumar, H.D. (2000). *Modern Concepts of Ecology*. Vikas Publishing House, New Delhi.

28. Mishra D.D (2008). *Fundamental Concepts in Environmental Studies*. S. Chand & Co., New Delhi.
29. Mishra S.P. & S.N. Pandey (2008). *Essential Environmental Studies*. Ane Books Pvt. Ltd. Thiruvananthapuram.
30. Myers N. (1988). Threatened biotas: "Hot spots" in tropical forests, *The Environmentalist* 8: 187-208.
31. Nayar M.P, Sastry A.R.K. (1987, 1988, 1990). *Red Data Book of Indian Plants*, Vols. I - III. Botanical Survey of India, Calcutta. 28.
32. Nayar M.P. (1996). *Hot Spots of Endemic Plants of India, Nepal and Bhutan.* Tropical Botanic Garden and Research Institute, Trivandrum.
33. Nayar M.P. (1997). Biodiversity challenges in Kerala and science of conservation biology. In: P. Pushpangadan, K S S Nair (Eds), *Biodiversity of tropical forests the Kerala scenario*. STEC, Kerala. 30.
34. Odum E P. (1971). *Fundamentals of Ecology*. WB Sunders.
35. Odum E.P. (1983). *Basics of Ecology*. Saunders International UN Edition.
36. Ramasastry A. A. (1984). *Weather and Weather forecasting,* Publication division, Ministry of Information and Broadcasting, Ministry of India.
37. Sabins F. F. (1997). *Remote Sensing-Principles and Interpretation*. W.H. freeman & Co., San Francisco
38. Sharma, P.D. (2008-2009). *Ecology and Environment*. Rastogi Publication.
39. Shukla R.S. & P.S. Chandel (2005). *A Text Book of Plant Ecology,* S. Chand & Co. Ltd. New Delhi.
40. Wilkinson, D.M. (2007). *Fundamental Processes in Ecology: An Earth Systems Approach*. Oxford University Press. U.S.A.
41. Wise, D.L. (2005). *Global Environmental Biotechnology*. Ane Books. Thiruvananthapuram

MODE OF TRANSACTION
1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction. 2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher. 3. **Field trips:** To nearby wetland/ mangrove ecosystem, to identify and categorize the

plants occurring in the area, to conduct quadrat studies

4. **Experimentation:** To estimate the solid waste generated by the households
5. **Microscopic observations:** To learn the morphological and anatomical characteristics of plant groups
6. **Demonstration**: To determine the amount of dissolved oxygen by Winkler's method

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works.

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 5 + 10 = 110)

- Based on practical examination, record, lab visit report and elective record.

CORE COURSE ELECTIVES

SIXTH SEMESTER B.Sc. BOTANY DEGREE PROGRAMME

ELECTIVE COURSE

Elective-1: GENETIC ENGINEERING

Semester	Course code	Credits	Hrs/wk	Marks (Ext. +	Duration of exam
6	BBT6E01	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Manipulate** various tools and techniques employed in genetic engineering.	Analyze	PSO4
CO2	**Explain** the features of genetically modified organisms with special reference to GM crops.	Apply	PSO4
CO3	**Evaluate** the ethical, social and legal issues associated with genetic engineering.	Evaluate	PSO7
CO4	**Explain** various applications of rDNA technology.	Apply	PSO4

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week).

Sl no	Subject	Theory	Practical	Total
1	Module I	12	36	48
2	Module II	16		16
3	Module III	16		16
4	Module IV	10		10
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN

Type of questions	No of questions	Total marks
2 marks	12	Ceiling 20
5 marks	7	Ceiling 30
10 marks	2	1 x 10 = 10
TOTAL	**21**	**60**

GENETIC ENGINEERING

Module – I:

Introduction to gene cloning (**12** hrs)

1. DNA isolation; DNA isolation solutions, isolation buffer pH, DNase inhibitors, detergents used for isolation, methods for breaking the cells
2. Removal of proteins from cell homogenate; using organic solvents, Kirby method and

Marmur method, using CTAB

3. Removal of RNA; using RNase A, RNase T1
4. Concentrating the isolated DNA; precipitating with alcohols, salts added along with alcohol
5. Determination of the concentration and purity of DNA; using UV spectrophotometry
6. Storage of DNA samples
7. Commercially available kits for genomic and plasmid DNA isolation
8. Isolation of plasmid DNA; protocol for small scale and large-scale preparations
9. Isolation and purification of RNA; purification of total RNA, RNase inhibitors, preparation of cell material, preparation of glass wares, guanidinium hot phenol method, isolation of poly A RNA

Module - II

Agarose Gel electrophoresis of DNA and RNA (**16** hrs)

1. Principles of electrophoresis,
2. Buffers used for electrophoresis of nucleic acids,
3. Gel concentration, sample concentration, sample loading solutions,
4. Gel staining: EtBr, EZ-Vision In-Gel.
5. Determination of molecular weight using molecular weight markers, special precautions and treatments required for electrophoresis of RNA, Elution of DNA from agarose gels; electro elution.
6. Nucleic acid transfer and hybridization; Northern blot hybridization, dot-blot transfer, in situ hybridization.
7. Preparation of probes for hybridization, radioactive labeling, digoxigen in labeling, nick translation.

Module - III

Principle of DNA cloning (**16** hrs)

1. Cloning vectors; essential features of a cloning vector, plasmid-derived vectors, bacteriophage-derived vectors, high capacity cloning vectors; BACs, PACs and YACs, Agrobacterium-based vectors.
2. Enzymes used in recombinant DNA technology; type II restriction endonucleases, ligases, S1 nuclease, alkaline phosphatase, terminal transferase, DNA polymerase I, reverse transcriptase, exonuclease III, bacteriophage λ exonuclease,
3. Finding gene of interest; shot gun cloning followed by screening, construction and use of

genomic DNA library and cDNA library, screening DNA libraries, chromosome walking.

4. Preparation of recombinant DNA molecule, blunt ends and sticky ends, using tailing method, using polylinkers
5. Methods to transfer the recombinant DNA molecule into the cloning host; transformation, transfection, transduction, electroporation, microinjection, microprojectiles and DNA gun.
6. Methods to select the recombinants; antibiotic markers, insertional inactivation, replica plating, use of reporter genes; GUS, luciferase and GFP genes

Module - IV

Transgenesis; introduction to transgenic organisms and their applications (**12** hrs)

1. Examples of transgenic crop plants and animals
2. Knock out models and their use
3. Applications of recombinant DNA technology: Agriculture – *nif* genes, Genetically modified crops.
4. Ethical, Social and legal issues associated with recombinant DNA technology.

PRACTICALS*:*

Students should be given sufficient exposure to the experiments listed below either by visiting nearby biotechnology labs or showing video clippings of the same. Centers selecting this elective are supposed to procure the required facilities in the meantime. Protocols of the listed experiments should be recorded.

1. Isolation of genomic DNA from plants and its quantification and purity checking using spectrophotometric method.
2. Agarose gel electrophoresis of the isolated plant genomic DNA, its visualization and photography.
3. Isolation of plasmid DNA from bacterium, and its quantification and purity checking using spectrophotometric method.
4. Agarose gel electrophoresis of the isolated plasmid DNA, its visualization and photography
5. Preparation of competent *E. coli* cells.
6. Preparation of recombinant plasmids, transformation of *E.coli* and selection of transformants.

(Record of the practical works done together with the detailed report of the Biotechnology Laboratory visit should be duly certified and submitted for the valuation at the time of practical examination).

REFERENCES

1. Alex Prokop et al., (1997). *Recombinant DNA technology and applications,* McGraw Hill.
2. JD Watson et al., (2006). *Recombinant DNA: genes and genomes – a short course*, WH Freeman & Co.
3. Nicholl, D. S. (2008). *An introduction to genetic engineering*. Cambridge University Press.
4. Old R.W. and S.B. Primrose, (2000). *Principles of Gene Manipulation: An Introduction to Genetic Engineering*, Blackwell Scientific
5. Sambrook J, Russel DW & Maniatis T. (2001). *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbour Laboratory Press.
6. Satyanarayana U. (2010). *Biotechnology,* Books & Allied Ltd., Kolkata.
7. Watson, JD (1992). *Recombinant DNA,* Scientific American Books

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Institutional visits:** Students are provided with sufficient exposure by visiting Biotechnology labs and research stations.
4. **Demonstration**: Online demonstration by video screening of various techniques involved in Genetic Engineering.

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 5 + 10 = 110)

- Based on practical examination, record, lab visit report and elective record.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

ELECTIVE COURSE

Elective - 2: ADVANCED ANGIOSPERM SYSTEMATICS

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
6	BBT6E02	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Develop** deep knowledge in angiosperm systematics.	Create	PSO9
CO2	**Create** ability to identify and classify plants in a faster and better way.	Create	PSO9
CO3	**Apply** imaging technologies in plant systematics.	Apply	PSO4
CO4	**Classify** plants using dichotomous keys.	Analyze	PSO5
CO5	**Distinguish** locally available angiosperm plants and their families.	Analyze	PSO5

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week).

Sl no	Subject	Theory	Practical	Total
1	Module I	12	36	48
2	Module II	22		22
3	Module III	5		5
4	Module IV	15		15
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN

Type of questions	No of questions	Total marks
2 marks	12	Ceiling 20
5 marks	7	Ceiling 30
10 marks	2	1 x 10 = 10
Total	**21**	**60**

ADVANCED ANGIOSPERM SYSTEMATICS

Module -I

1. Scope and importance of Taxonomy. (**2** hrs)
2. The history of taxonomy- Ancient classification; Evolution of different concepts in taxonomy. The herbalists; Early taxonomists; Linnaeus; Post Linnaean natural systems; Post Darwinian phylogenic; Modern Phenetic methods (Numerical taxonomy); Modern Phylogenic methods (Cladistics) APG system of classification (**10** hrs)

Module-II

The material basis of Systematics

1. Concept of character; Correlation of characters; character weighting; Character variation, isolation and speciation. (**4** hrs)
2. Sources of Taxonomic characters: Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry, Molecular Taxonomy. Role of the above-mentioned branches in taxonomic studies (**6** hrs)
3. Identification techniques: Taxonomic literature: Flora, Revision, monograph, use and construction of taxonomic keys. Herbarium: Definition, Steps involved in preparation and maintenance of herbarium, Herbarium consultation; General account of Regional and National herbaria with special emphasis to Kew, CAL, MH, CALI. (**5** hrs)
4. Botanic gardens and their importance in taxonomic studies – Important National and International Botanic Gardens – Royal Botanic Gardens, Kew; Indian Botanic Gardens, Calcutta; National Botanic Garden, Lucknow; JNTBGRI Thiruvananthapuram; MBGIPS Kozhikode. (**3** hrs)
5. Digital resources in taxonomy: Softwares, Databases, Online tools; use of TROPICOS, IPNI, Virtual herbaria, Digital flora/databases of Flora of Kerala. (**4** hrs)

Module – III

Plant Nomenclature (**5** hrs)

1. History of nomenclature – Polynomial and binomial systems
2. Brief outline of ICN
3. Major rules; Typification; Rule of priority; Effective and valid publication; author citation

Module – IV

Taxonomic review of selected families (**15** hrs)

Critical study of the following families with emphasis on identification of local members, economic importance, inter relationships and evolutionary trends: *Nymphaeaceae, Capparidaceae, Sterculiaceae, Rutaceae, Combretaceae, Lythraceae, Scrophulariaceae, Convolvulaceae, Bignoniaceae, Apocynaceae, Lamiaceae, Amaranthaceae, Urticaceae, Amaryllidaceae, Arecaceae, Cyperaceae*

PRACTICALS:

1. Identification of locally available plants belonging to the families mentioned under module -

IV using local floras.

2. Familiarize local flora and study the preparation of taxonomic keys and taxon card for plants coming under the families in module IV.
3. Students must workout at least one member of every family mentioned in module IV, and has to submit a photo album instead of record. The photo album must be based on APG system of classification and it should carry details like systematic position, GPS location, date, name and reg. no. of the student etc. Separate images clearly showing habitat, habit, inflorescence type, single flower, floral parts etc. of the plant should be represented.

REFERENCES

1. Heywood, V H & Moore, D M. (Eds) (1984). *Current concepts in Plant Taxonomy*
2. Lawrance, G H M. *Taxonomy of vascular plants*. Oxford & IBH
3. Sivarajan, V V. (1991). *Introduction to principles of plant Taxonomy*. Oxford & IBH.
4. Vasishta, P C. (1974). *Taxonomy of Angiosperms*. R. Chand & Co. New Delhi, 884p.
5. Singh, V & D K Jain (1997). *Taxonomy of Angiosperms*. Rastogi Publications, Meerut.
6. Stace, C A. (1989). *Plant Taxonomy and Biosystematics*. Edward Arnold, London
7. Henry & Chandrabose (1997). *An aid to International code of Botanical Nomenclature*. BSI.

MODE OF TRANSACTION
1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction. 2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher. 3. **Field trips:** They are conducted to study the vegetation and to learn the various plant families. 4. **Plant collection:** Along with students to identify plants and to take photos for preparing photoalbum 5. **Microscopic observations:** To learn micro-morphological features various floral parts. 6. **Demonstration**: To study the morphology of leaves, inflorescence, flowers, family characters etc., Online tools and digital resources in taxonomy
MODE OF ASSESSMENT
<u>Internal Assessment</u> (Theory - 15 Marks) 1. *Internal examination*: one Internal examination – 6 Marks. 2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks 3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks 4. *Classroom participation*: based on attendance - 3 Marks

<u>Internal Assessment</u> (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

<u>External Assessment</u> (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

<u>External Assessment</u> (Practicals – Total 80 + 15 + 10 + 5 = 110)

- Based on practical examination, record, submissions and study tour report.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

ELECTIVE COURSE

Elective-3: GENETICS AND CROP IMPROVEMENT

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of
6	BBT6E03	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Understand** about the vatious agencies and institutes involved in plant genetic resources activities and crop improvement	Understand	PSO1
CO2	**Analyze** various techniques employed for increasing crop productivity.	Analyze	PSO6
CO3	**Assess** various diseases affecting crop plants.	Evaluate	PSO7
CO4	**Develop** awareness on various crop research stations of the country.	Create	PSO10

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

Sl no	Subject	Theory	Practical	Total
1	Module I	11		47
2	Module II	10		10
3	Module III	4	**36**	4
4	Module IV	7		7
5	Module V	22		22
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN

Type of questions	No of questions	Total marks
2 marks	12	Ceiling 20
5 marks	7	Ceiling 30
10 marks	2	1 x 10 = 10
Total	**21**	**60**

GENETICS AND CROP IMPROVEMENT

Module - I

1. Crop genetics - General account of origin, genetic variability, floral biology, breeding techniques and achievements in: Rice, Coconut, Rubber, Arecanut, Cashew and Pepper (**11** hrs)

Module – II

1. Plant genetic resources- Definition; Classification of Plant Genetic resources. Activities – exploration, conservation, evaluation, documentation and utilization. (**2** hrs)
2. Agencies involved in plant genetic resources activities – NBPGR and IPGRI (**4** hrs)
3. International institutes for crop improvement – IRRI, ICRISAT, CIMMYT, IITA. Brief account on research activities and achievements of national institutes – IARI, CCMB, IISc, BARC, CPCRI, IISR, RRII, CTCRI, KFRI, TBGRI
   (**4** hrs)

Module- III

1. Methods of crop Improvement (**4** hrs)
   1. Plant introduction
   2. Selection - Principles, Selection of segregating populations, achievements
   3. Hybridization – Interspecific hybridization; intergeneric – achievements. Genetics of back crossing, Inbreeding, Inbreeding depression, Heterosis and Heterobeltiosis

Module - IV

1 Heteroploidy in crop improvement – achievements and future prospects –Significance of haploids and polyploids (**2** hrs)

2 Mutations in crop improvement – achievements and future prospects (**2** hrs)

3 Genetics of nitrogen fixation – Use of biofertilizers in crop improvement (**2** hrs)

4 Genetics of photosynthesis (**1** hr)

Module- V

1. Breeding for resistance to abiotic stresses – Introduction, importance of abiotic and biotic stresses and its characteristics. (**10** hrs)
   i. Breeding for drought resistance: Genetics of drought resistance; Breeding methods and approaches; Difficulties in breeding for drought resistance.
   ii. Breeding for mineral stress resistance: Introduction, Salt affected soils, Management of salt affected soils: Salinity resistance –general account.
2. Breeding for resistance to biotic stresses. (**12** hrs)
   i. Disease resistance – History of breeding for disease resistance; Genetics of pathogenicity – Vertical and horizontal resistance; Mechanism of disease resistance; Genetics of disease resistance – Oligogenic, polygenic and cytoplasmic inheritance –

Sources of disease resistance – Methods of breeding for disease resistance.

ii. Insect resistance – Introduction, Mechanism, Nature and genetics of insect resistance, Oligogenic, Polygenic and cytoplasmic resistance, sources of insect resistance, Breeding methods for insect resistance, Problems in breeding for insect resistance, Achievements, Breeding for resistance to parasitic weeds.

PRACTICALS:

1. Visit a leading breeding station in South India and a detailed report should be included in the practical record. The record duly certified by HoD should be submitted at the time of practical examination.
2. Make illustrations on the floral biology of Rice, Cashew and *Solanum* spp.
3. Demonstration of hybridization in Rice, Cashew and *Solanum* and describe the procedure.
4. Study the variability under induced stress (salinity and moisture) of seedlings of rice and green gram and record the observations.

REFERENCES:

1 Allard, R W. (1960). *Principles of Plant Breeding*. John Wiely & Sons, New York.

2 Benjamin Levin. (2007). *Genes VIII*.

3 Chahal, G S & S S Gosal, (1994). *Principles and procedures of Plant Breeding*. Narosa Publishing House, New Delhi.

4 Chrispeels M J and Sadava, D E. (1994). *Plants, Genes and Agriculture*. Jones and Bartlet Publishers, Boston, USA.

5 Sharma, J R. (1994). *Principles and Practice of Plant Breeding*. Tata McGraw – Hill Publishing Company, New Delhi.

6 Singh, B D. (2000). *Plant Breeding: Principles and Methods*. Kalyani Publishers, New Delhi.

MODE OF TRANSACTION
1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction. 2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher. 3. **Institution visits:** Visit a plant breeding station in South India 4. **Microscopic observations:** To learn the floral biology of Rice, Cashew and *Solanum* 5. **Demonstration**: To conduct hybridization in Rice, Cashew and *Solanum*, to study

the variability under induced stress of rice and green gram seedlings

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 80 + 15 + 10 + 5 = 110)

- Based on practical examination, record, submissions and study tour report.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

ELECTIVE COURSE

Elective - 4: AGRONOMY & ENTREPRENEURSHIP

Semester	Course code	Credits	Hrs/wk	Marks (Ext. +	Duration of
6	BBT6E04	3	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Understand** the various entrepreneurial opportunities in the field of Botany.	Understand	PSO3
CO2	**Develop** an entrepreneurial mindset among the Botany students.	Create	PSO9
CO3	**Analyze** the needs of the society and contribute towards sustainable development.	Analyze	PSO6
CO4	**Develop** basic skills in organic farming, olericulture, floriculture, pomiculture, mushroom cultivation, processing technology and food science.	Create	PSO9
CO5	**Distinguish** between the edible and poisonous mushrooms.	Understand	PSO1

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week).

Sl no	Subject	Theory	Practical	Total
1	Module I	16	36	24
2	Module II	10		20
3	Module III	20		30
4	Module IV	8		16
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN

Type of questions	No of questions	Total marks
2 marks	12	Ceiling 20
5 marks	7	Ceiling 30
10 marks	2	1 x 10 = 10
Total	**21**	**60**

AGRONOMY & ENTREPRENEURSHIP

Module - I:

Entrepreneurship, Value added Food products & Processing techniques (**16 hours)**

1. Types, Basic qualities of an entrepreneur. Co-operation and banking: Financial assistance from Banks, Role of institutions like MSME Training Institute, Khadi and Village Industries Board, Self Help Groups, Co-operative sector, Kudumbasree projects and Microenterprises.
2. Preparation and preservation techniques. Causes of spoilage of food. Principles of preservation – asepsis, removal of microorganisms, anaerobic situation and special methods – drying, thermal processing – pasteurization, sterilization and canning – low temperature, use of chemical preservatives and food additives.
3. Preparation of pickles, jam, jelly, syrups, sauce, dry fruits, dairy products – (cheese, butter, yoghurt, paneer), candies, chocolates, kondattam.
4. Processing of latex – Centrifuged latex products and galvanized rubber products.
5. Processing, storage and marketing of Cocoa, Coconut (copra, coir and tender coconut), Rice (par boiled, raw rice and rice flour), Pepper, Cardamom, Ginger, Arrowroot, Tapioca, Cashew, Mango, Jack fruit, Guava, Grapes, Lemon, Papaya, *Musa*, *Garcinia*.

Module - II:

Nursery Management, Organic farming and Composting Techniques (10 hours)

1. Definition and importance, management aspects of nurseries, planning, budgetting, lay out and types of nurseries, maintenance of nurseries.
2. Preparation of potting mixtures, polybags. Plant Growth structures – green houses, hot beds, cold frames, shade houses, polyshed, mist chamber. Media for the propagation of nursery plants - soil, sand, peat, sphagnum moss, vermiculite, perlite, soil mixture.
3. Preparation of nursery beds. Marketing- packaging and transporting of nursery products.
4. 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. Methods of fertilizer applications- broadcasting, placement, foliar application and fertigation
5. 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.
6. Application of Biofertilizers. Biopesticides – Tobacco and Neem decoction. Biological control of diseases and pests. Organic traps – Natural dyes.
7. Weeds- definition and characteristics - harmful and beneficial effects, uses; weed control methods – physical, cultural, biological, chemical, allelopathy.

Module - III:

Introduction to Horticulture (20 hours)

1. Definition, history, classification of horticultural plants, disciplines of horticulture; Garden tools and implements.
2. Irrigation and water management - surface, sub, drip and spray irrigations.
3. 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.
4. Olericulture – Types of vegetable growing, Home gardening, Market gardening, Truck gardening, Vegetable garden for processing, gardens for seed production.
5. Cultivation of the following with reference to planting, irrigation, spacing, aftercare and disease control: Cucurbitaceous (Ash gourd, Little gourd, Bitter gourd) and Solanaceous (Tomato, Brinjal, Chilly) vegetables, Ginger, Colocasia, Tapioca and Musa.
6. Floriculture - Problems and prospects of Floriculture in Kerala. Cultivation and scope of growing Anthurium, Orchids and Jasmine in Kerala.
7. Pomiculture – Study of cultural practices of the following fruit crops, with reference to soil, climate, varieties, methods of propagation, irrigation, training and pruning, post-harvest technology, storage and value-added products – Mango, Banana, Papaya, Sapota, Guava
8. Ornamental Garden designing - Use of different garden components. Lawn preparation by seeds, seedling and turfing. Maintenance of garden by Irrigation, Pruning, Repotting. Disease and Pest control.
9. Flower arrangement. Types - Western, Eastern (Japanese/ Ikebana) and Modern. Vases, Flower Holders and Floral Foam. Vase life of flowers and leaves. After care of flower arrangements – Bouquets. Packing and Maintenance of flowers and leaves.
10. Soil less culture - Hydroponics - Introduction, types, commercial aspects, recent advancement to hydroponics and future prospects.
11. Terrariums - Introduction, relevance, materials required, plants suitable for terrarium, potting media, methods of setting up terrariums, care and maintenance.

Module - IV: Mushroom cultivation and Farming (8 hours)

1. Historical Account, Importance of Mushrooms, – Significance – Nutritive value. Edible and poisonous Mushrooms.
2. Methods of identification of edible and poisonous mushrooms (*Agaricus*, *Pleurotus*, *Volvariella*, *Amanita* and *Inocybe*).

3. Cultivation of *Agaricus, Pleurotus*, and *Volvariella*. Spawn production, storage and marketing. Growth of Mushrooms on Paddy Straw and Saw dust by Poly bag. Mushroom growing structures and maintenance of humidity.
4. Pests and defects of mushrooms. Storage, Transporting and Marketing of Mushrooms.

PRACTICALS:

1. Preparation of pickles, jam, jelly, syrups, sauce, dry fruits, kondattam (any two)
2. Preparation of potting mixtures, polybags
3. Preparation of nursery beds
4. Preparation of compost
5. Preparation of biopesticides - Tobacco and Neem decoction
6. Cultivation of vegetables - Tomato, Brinjal, Chilly
7. Flower arrangement
8. Cultivation of mushrooms
9. Preparation of Terrariums (demonstration only)

REFERENCES:

1. Adams, M.R. and M.O. Moss. (1995). *Food Microbiology*, Panima Publishing.
2. Casida, L.E. (Jr.), (2005). *Industrial Microbiology*, New Age International.
3. Chandha, K.L. (2003). *Handbook of Horticulture*, ICAR. New Delhi.
4. Dunn, Bruce (2013). *Hydroponics*, Oklahoma Cooperative Extension Service, HLA-6442, Oklahoma State University, US
5. Frazier and Westhoff, (1988). *Food Microbiology*, Tata McGraw – Hill.
6. George Acquciah, (2004). *Horticulture – Principles and Practices*, II Edn. Prentice Hall.India.
7. George J. Banwant, (2004). *Basic Food Microbiology*, CBS Publishers and Distributors.
8. Gopal Chandha De. (2002). *Fundamentals of Agronomy*, Oxford and IBH Publishing House.
9. Hudson. T., Hartmann. Dale E. Kester. (2001). *Plant Propagation, Principles and Practices*, 6th Edn. Prentice Hall. India.
10. James M. Jay, (2005). *Modern Food Microbiology*, CBS Publishers and Distributors.
11. Kalian Kumar De (1996). *Plant Tissue Culture*, New Central Book Agency (P) Ltd.
12. Kaul, T.N. (2002). *Biology and Conservation of Mushroom*, Oxford and IBH Publishing Co.

13. Kunte, Kawthalkar and Yawalker, (1997). *Principles of Horticulture and Fruit Growing*. Agri–Horticulture Co.
14. Mathew, Sam & Shereef, S. & Kosy, C. & Ganeshan, S. (2008). History and development of Pomiculture with special reference to the underutilized wild edible fruits of Kerala, India. In: K.V. Peter (eds.) *Under-utilized and under-exploited horticultural crops*, 3: 147-200, New India Publishing Agency, New Delhi
15. Neshamani, S, (2000). *Pazhangal, Pazha Vibhavangal* (Malayalam), Kerala Bhasha Institute.
16. Pandey, R.K and S.K. Ghosh, (1996). *A Hand Book on Mushroom Cultivation,* Emkey Publications.
17. Prem Singh Arya (2004). *Vegetable Seed Production Principles*, Kalyani Publishers.
18. Prince Alex, Rajani A. Nair (2003). *Ayurveda Avshodha Nirmanam – Sidhanthavum Prayogavum* (Malayalam), Kerala Basha Institute.
19. Purohit, S.S. (2005). Plant Tissue Culture, Student Edition.
20. Razdan, M.K. (1995). *Introduction to Plant Tissue Culture*, 2nd Edn. Oxford and IBH Publishing Co.
21. Rema, L.P. (2006. *Applied Biotechnology*. MJP Publishers.
22. Sambo Paolo, Nicoletto Carlo, Giro Andrea, Pii Youry, Valentinuzzi Fabio, Mimmo Tanja, Lugli Paolo, Orzes Guido, Mazzetto Fabrizio, Astolfi Stefania, Terzano Roberto, Cesco Stefano (2019). Hydroponic Solutions for Soilless Production Systems: Issues and Opportunities in a Smart Agriculture Perspective, *Frontiers in Plant Science*, 10 (923): 1-17. https://www.frontiersin.org/article/10.3389/fpls.2019.00923
23. Sharma, R.R, (2005). *Propagation of Horticultural Crops*. Kalyani Publishers.
24. Singh, B.D. (1996). *Biotechnology*, Kalyani Publishers.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Field works:** Preparation of potting mixtures, polybag filling, nursery beds, compost, vegetable cultivation etc
4. **Demonstration**: Mushroom culture, Terrarium preparation, hydroponics etc
5. **Lab preparation:** Of pickles/jam/jelly/syrups/sauce/dryfruits/kondattam (any two), biopesticides etc.

MODE OF ASSESSMENT

<u>Internal Assessment</u> (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

<u>Internal Assessment</u> (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

<u>External Assessment</u> (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

<u>External Assessment</u> (Practicals – Total 80 + 15 + 10 + 5 = 110)

- Based on practical examination, record, submissions and study tour report.

COMPLEMENTARY COURSES

COMPLEMENTARY COURSES

Table 12. COURSE STRUCTURE, WORK LOAD AND CREDIT DISTRIBUTION

Semester	Paper Code	Title of Paper	Hours/ Semester	Hours allotted/ Week	Credit
S I	BBT1C01	COMPLEMENTARY COURSE - 1 **Angiosperm Anatomy & Microtechnique**	36 hrs	2	2
		Complementary Course - 1 Practical	36 hrs	2	*
S II	BBT2C02	COMPLEMENTARY COURSE - 2 **Cryptogams, Gymnosperms & Plant Pathology**	36 hrs	2	2
		Complementary Course – 2 Practical	36 hrs	2	*
S III	BBT3C03	COMPLEMENTARY COURSE - 3 **Morphology, Systematic Botany, Economic Botany, Plant Breeding & Horticulture**	54 hrs	3	2
		Complementary Course - 3 Practical	36 hrs	2	*
S IV	BBT4C04	COMPLEMENTARY COURSE - 4 **Plant Physiology, Ecology & Genetics**	54 hrs	3	2
		Complementary Course - 4 Practical	36 hrs	2	*
	BBT4C05 L	COMPLEMENTARY COURSE - 5 Practical Paper 1 **Angiosperm Anatomy, Microtechnique, Cryptogams, Gymnosperms, Plant Pathology, Morphology, Systematic Botany, Plant Physiology, Ecology, Genetics, Economic Botany, Plant Breeding & Horticulture**			4
TOTAL					**12**
* Credits of practical paper (total credits provided against Practical paper BBT4C05 P)					

Table 13. MARK DISTRIBUTION & SCHEME OF EXAMINATION

Course code & Title of course	Total Hours		Duration of Exams	Marks			
				Theory		Practical	
	Theory	Practical		External	Internal	External	Internal
Semester -1 : **BBT1C01 Anatomy &**	36	36	2 hrs	60	15	--	--
Semester - 2: **BBT2C02 Cryptogams, Gymnosperms**	36	36	2 hrs	60	15	--	--
Semester - 3: **BBT3C03 Morphology, Systematic Botany, Economic Botany, Plant Breeding & Horticulture**	54	36	2 hrs	60	15	--	--
Semester - 4: **BBT4C04 Plant Physiology, Ecology & Genetics**	54	36	2 hrs	60	15	--	--
Semester - 4: **BBT4C05 L Comple. Course Practical** External Practical Exam Record Submission	--	--	3 hrs	--	--	60 15 10	15

Table 14. DISTRIBUTION OF INTERNAL MARKS

Theory: Marks 15 (20% of total)		Practical: Marks 15 (20% of total)	
Components	**Percentage**	**Components**	**Percentage**
Test paper	40%	Practical test	30%
Assignment	20%	Records and submissions	30%
Seminar	20%	Lab involvement	40%
Class room participation based on attendance	20%.		

FIRST SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

COMPLEMENTARY COURSE: 1

ANGIOSPERM ANATOMY AND MICROTECHNIQUE

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
1	BBT1C01	2	4	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Analyze** the types, structure and functions of plant tissues.	Analyze	PSO5
CO2	**Determine** primary and secondary (normal and anomalous) structures of plant organs.	Evaluate	PSO8
CO3	**Identify** plant organs by observing anatomical features.	Apply	PSO4
CO4	**Illustrate** primary and secondary (normal and anomalous) structures of plant organs.	Analyze	PSO5
CO5	**Apply** the histochemical techniques in laboratory works.	Apply	PSO4
CO6	**Compare** the types, structure and functions of plant tissues.	Evaluate	PSO8

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

Sl no	Subject	Theory	Practical	Total
1	Angiosperm Anatomy	27	30	57
2	Microtechnique	9	6	15
Total		**36**	**36**	**72**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Angiosperm Anatomy	Microtechnique	Total
2 marks (total 12)	9	3	Ceiling 20
5 marks (total 7)	5	2	Ceiling 30
10 marks (total 2)	2		1 x 10 = 10
TOTAL			**60**

ANGIOSPERM ANATOMY

Module – I (**9** hrs)

1. Tissues - Definition, Kinds - Meristematic & Permanent. (**8** hrs)

    1. Meristematic tissues - Classification – based on origin & position; Organization of root apex and differentiation of tissue – Histogen theory; Organization of stem apex and

differentiation of tissues - Tunica & Corpus theory.

2. Permanent tissues - Definition - classification; Simple tissues (Parenchyma, Collenchyma and Sclerenchyma), Complex tissues (Xylem & Pholem) Secretory tissues - Glandular tissues (Nectaries in *Euphorbia pulcherrima*, Stinging hairs in *Tragia*) Oil glands in *Citrus*, *Eucalyptus*; Digestive glands in *Nepenthes*; Laticiferous tissues (Non-articulate latex ducts in *Euphorbia* and articulate latex duct – latex vessels in *Hevea*), Hydathodes.

2. Vascular bundles – types: conjoint - collateral, bicollateral, concentric and radial. (**1** hr)

Module – II (**6** hrs)

1. Primary structure of dicot and monocot root, dicot and monocot stem and leaf in dicot and monocot. (**6** hrs)

Module – III (**12** hrs)

1. Normal secondary thickening in dicot stem (*Vernonia*). (**10** hrs)
   a. Intra stelar thickening: formation of cambial ring, its structure, fusiform and ray initials, storied and non - storied cambium, activity of the cambium, formation and structure of secondary wood, secondary phloem and vascular rays.
   b. Extra stelar thickening: formation, structure and activity of the phellogen, formation of periderm in stem and root; bark and lenticel.
   c. Growth rings, ring and diffuse porous wood, sapwood and heart wood, tyloses.
   d. Normal secondary thickening in dicot root (*Tinospora*)

2 Anomalous secondary growth in *Boerhaavia* (**2** hrs)

PRACTICALS (ANGIOSPERM ANATOMY)

1. Identity simple and complex tissues and determine the type of vascular bundles using microscope.
2. Make suitable micro preparations to study the anatomy of the following:
   a. Dicot stem: *Cephalandra*, *Centella* (Primary), *Vernonia* (secondary)
   b. Monocot stem: Bamboo
   c. Dicot root: *Tinospora* (young –Primary; mature–Secondary)
   d. Monocot root: *Colocasia*
   e. Anomalous secondary growth (*Boerhaavia*)
   f. Dicot leaf: *Ixora* and Monocot leaf: grass.

REFERENCES: (ANGIOSPERM ANATOMY)

1. Cutter, EG. (1969). *Plant Anatomy* - Part I, *Cells & Tissue*, Edward Arnold Ltd., London.
2. Cutter, E.G. (1971). *Plant Anatomy*, Part II, *Organs*, Edward Arnold Ltd., London.
3. Esau K. (2006). *Plant Anatomy* (2nd ed.) Wiley Eastern Ltd. New Delhi.
4. Pandey B.P. (2001) *Plant Anatomy*, S. Chand & Co. Delhi.
5. Vasishta P.C. (1974). *Plant Anatomy*, Pradeep Publication, Jalandhar.
6. Tayal M.S. (1979). *Plant Anatomy*. Rastogi Publishers, Meerut.

MICROTECHNIQUE

Module – I (**9** hrs)

1. Microtechnique - Brief introduction
2. Microscopy: simple, compound and electron microscope
3. Microtomy: Rotary type, serial sectioning, paraffin method, significance.
4. Killing and fixing: Killing and fixing agents and their composition (Farmer's fluid and FAA.)
3. Dehydration and clearing - reagents (brief account only)
4. Stains – Safranin and Acetocarmine, preparation and use.

PRACTICALS (MICROTECHNIQUE)

1 Familiarise the structure and working of compound microscope (drawings not required)

2 Preparation of Safranin, FAA and Acetocarmine

REFERENCES (MICROTECHNIQUE)

1. Johansen, D.A. (1940). *Plant Microtehnique*. Mc Graw – Hill Book Company, Inc. New York.
2. Kanika, S. (2007). *Manual of Microbiology* – Tools and Techniques. Ane's student edition.
3. Khasim, S.K. (2002). *Botanical Microtechnique; principles and Practice*, Capital Publishing Company, New Delhi.
4. Prakash, N. (1986). *Methods in plant microtechnique*. University of New England, Department of Botany.
5. Ruzin, S. E. (1999). *Plant microtechnique and microscopy* (Vol. 198). New York: Oxford University Press.
6. Toji, T. (2004). *Essentials of Botanical Microtechnique*. Apex Infotec Publ.
7. Yeung, E. C. T., Stasolla, C., Sumner, M. J., & Huang, B. Q. (Eds.). (2015). *Plant microtechniques and protocols*. Cham, Switzerland: Springer International Publishing.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Demonstration:** Demonstration of free hand-sectioning of plant organs, staining and micro-slide preparation, different types of microscopes.
4. **Microscopic observation:** Various types of plant cells and tissues may be observed using compound microscopes.

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 60 + 15 + 10 = 85)

- Based on practical examination, record and submissions.

SECOND SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

COMPLEMENTARY COURSE: 2

CRYPTOGAMS, GYMNOSPERMS AND PLANT PATHOLOGY

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
2	BBT2C02	2	4	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Understand** the fundamental concepts in the classification of Cryptogams and Gymnosperms	Understand	PSO1
CO2	**Analyze** the evolutionary importance of the lower groups of plants.	Analyze	PSO4
CO3	**Discuss** the ecological significance of lower plants.	Understand	PSO2
CO4	**Determine** the plant diseases and learn the remedial measures to control them.	Evaluate	PSO7

DISTRIBUTION OF TEACHING HOURS (18 hrs/semester = 1hr/week)

Sl no	Subject	Theory	Practical	Total
1	Module I: Virus, Bacteria, BGA	9	5	14
2	Module II: Phycology, Mycology, Lichenology	12	13	25
3	Module III: Bryology, Pteridology, Gymnosperms	12	13	25
4	Plant Pathology	3	5	8
Total		**36**	**36**	**72**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Mod 1	Mod II	Mod III	Mod IV	Total marks
2 marks (total 12)	2	4	4	2	Ceiling 20
5 marks (total 7)	2	2	2	1	Ceiling 30
10 marks (total 2)	2				1 x 10 = 10
TOTAL					**60**

CRYPTOGAMS & GYMNOSPERMS

Module – I: Virus, Bacteria, BGA (**9** hrs)

1. Virus: General account of viruses, including structure of TMV & Bacteriophage (**2** hrs)

2. Bacteria: Classification based on flagellation, structure, nutrition (brief account), reproduction and economic importance - agriculture, industry & medicine (**5** hrs)

3. Cyanobacteria: General account - structure, reproduction and economic importance of *Nostoc* (**2** hrs)

Module – II: Phycology, Mycology, Lichenology (**12** hrs)

1. Phycology: General characters, classification (**1** hr)
2. Structure, reproduction, life history (excluding the developmental stages) and economic importance of the following classes with suitable examples: (**4** hrs)
   a) Chlorophyceae (*Spirogyra*)
   b) Phaeophyceae (*Sargassum*)
   c) Rhodophyceae (*Polysiphonia*)
3. Mycology: General characters, classification (Ainsworth, 1973) (brief mention only), economic importance in fungi. (**2** hrs)
4. Important features of the following divisions (brief account only) (**2** hrs)
   a) Zygomycotina
   b) Ascomycotina
   c) Basidiomycotina.
5. Structure and life history of *Puccinia* (developmental details not required) (**1** hr)
6. Lichenology: General account and economic importance of Lichens with special reference to *Usnea.* (**2** hrs)

Module – III: Bryology, Pteridology, Gymnosperms (**12** hrs)

1. Bryology: General account, morphology and life - history of *Riccia* (**4** hrs)
2. Pteridology: General account, morphology and life history of *Selaginella* (**4** hrs)
3. Gymnosperms: General account, morphology and life history of *Cycas* (**4** hrs)

PRACTICALS (CRYPTOGAMS & GYMNOSPERMS)

1. Make suitable micro preparations of vegetative and reproductive structures of *Sargassum*, *Puccinia*, *Riccia*, *Selaginella* and *Cycas*
2. Identify and draw labeled diagrams of all the types mentioned in the syllabus

REFERENCES (CRYPTOGAMS & GYMNOSPERMS)

1. Alexopoulos C.J., Mims, C.W. and Blackwell, M. (1996). Introductory Mycology, 4th Edn. John Wiley and Sons, New York.

2. Chamberlain C.J., (1935) *Gymnosperms – Structure and Evolution*, Chicago University Press.
3. Chopra R.N. and P.K. Kumar (1988). Biology of Bryophytes. Wiley Eastern Ltd. New Delhi.
4. Fritsch F.E. (1935). *The structure and reproduction of the algae.* Vol. 1 and II, Uni. Press. Cambridge.
5. Mamatha Rao, (2009) – *Microbes and Non-flowering plants. Impact and applications*. Ane Books, New Delhi.
6. Morris, I. (1967) *An Introduction to the algae*. Hutchinson and Co.m London.
7. Papenfuss, G.F. (1955). Classification of the Algae. *A Century of Progress in the Natural Sciences, 1853-1953*. California Academy of Sciences, San Francisco: 115-224.
8. Sanders, W.B. (2001) Lichen interface between mycology and plant morphology. *Bioscience*, 51: 1025-1035.
9. Sreevastava H.N. (1980) *A Text Book of Gymnosperms*, S. Chand and Co. Ltd., New Delhi.
10. Sreevastava, H.N. (1996). *A text book of Pteridophyta*, Pradeep Prakashnan, Meerut, India
11. Vasishta B.R. (1993). *Pteridophyta* – S. Chand and Co., New Delhi.
12. Vasishta B.R. (2011). Bryophyta (Revised edition)., S. Chand and Co., New Delhi.
13. Vasishta B.R., Adarsh Kumar & AK Sinha (1963) *Botany for degree students- Bryophyta*, S. Chand Publishing, 528 p.
14. Vasishta B.R., AK Sinha & Anil kumar (2016) *Botany for degree students- Fungi*, S. Chand Publishing, 808 p.
15. Vasishta B.R., VP Singh & AK Sinha (2012) *Botany for degree students- Algae*, S. Chand Publishing, 624 p.
16. Vasishta P.C. (1980) *Gymnosperms*. S. Chand and Co., Ltd., New Delhi.

PLANT PATHOLOGY

Module – I (**3** hrs)

1. Plant Pathology: Study the following plant diseases with special reference to pathogens, symptoms, method of spreading and control measures.
   1) Leaf mosaic of Tapioca 2) Citrus canker 3) Blast of paddy.

PRACTICALS (PLANT PATHOLOGY)

1. Identify the diseases (mentioned in the theory syllabus) on the basis of symptoms and causal organisms. Draw the diagrams, record the name of the pathogens and symptoms.

REFERENCES: PLANT PATHOLOGY

1. Agrios, G.N. (1997). *Plant Pathology* (4th ed) Academic Press.
2. Bilgrami K.H. & H.C. Dube (1976). *A textbook of Modern Plant Pathology*, International Book Distributing Co. Lucknow.
3. Pandey, B.P. (1999). *Plant Pathology. Pathogen and Plant diseases*, Chand & Co. New Delhi.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Demonstration:** Demonstration of free hand-sectioning of various species mentioned in the syllabus, plant diseases and specimens
4. **Microscopic observation:** Various specimes mentioned in the syllabus.

MODE OF ASSESSMENT

Internal Assessment **(Theory - 15 Marks)**

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment **(Practicals - 20 Marks)**

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

External Assessment **(Theory - 60 Marks)**

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment **(Practicals – Total 60 + 15 + 10 = 85)**

- Based on practical examination, record and submissions.

THIRD SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

COMPLEMENTARY COURSE: 3

MORPHOLOGY, SYSTEMATIC BOTANY, ECONOMIC BOTANY, PLANT BREEDING AND HORTICULTURE

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
3	BBT3C03	2	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Evaluate** the diverse morphology of angiosperms and their evolutionary significance	Evaluate	PSO8
CO2	**Develop** skill to identify and classify plants based on morphological features and taxonomic principles.	Create	PSO10
CO3	**Make** scientific illustrations of vegetative and reproductive structures of plants.	Create	PSO10
CO4	**Identify** the economically important plants and understand their uses.	Analyze	PSO6
CO5	**Explain** the basic principles of plant breeding and their significance.	Apply	PSO4
CO6	**Demonstrate** various horticultural practices in the field and to develop the expertise in it.	Understand	PSO1

DISTRIBUTION OF TEACHING HOURS (18 hrs/semester = 1hr/week)

Sl no	Subject	Theory	Practical	Total
1	Morphology	8	4	12
2	Systematic Botany	28	20	48
3	Economic Botany	4	4	8
4	Plant Breeding	7	4	11
5	Horticulture	7	4	11
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Morphol.	Syst. Bot.	Econ.Bot.	Pl.Br.	Horti.	Total
2 marks (total 12)	2	4	2	2	2	Ceiling 20
5 marks (total 7)	1	3	1	1	1	Ceiling 30
10 marks (total 2)	2					1 x 10 = 10
TOTAL						**60**

MORPHOLOGY

Module - I

1. Leaf – Structure, simple, compound, venation and phyllotaxy (**2** hrs)
2. Inflorescence - racemose, cymose, special types with examples (**3** hrs)
3. Flower - as a modified shoot- structure of flower - floral parts, their arrangement, relative position, cohesion and adhesion of stamens, symmetry of flowers, types of aestivation and placentation (**2½** hrs)
4. Fruits - classification - simple, aggregate & multiple (brief description only) (**½** hr)

PRACTICALS (MORPHOLOGY)

1. Identify the types of inflorescences mentioned in the syllabus. All the types mentioned must be represented in as photos/ colour plates in the practical (No drawings needed).

REFERENCES (MORPHOLOGY)

1. Eames A. J. - Morphology of Angiosperms, McGraw-Hill, New York
2. Sporne, K.R. (1974) *Morphology of Angiosperms*. Hutchinson.
3. Venkateswaralu, V. 1974. Morphology of Angiosperms - Chand & Co., New Delhi

SYSTEMATIC BOTANY

Module- I

1. Introduction, scope and importance (**1** hrs)
2. Herbarium techniques. Significance of herbaria and botanical gardens; important herbaria and botanical gardens in India. (**3** hrs)
3. Nomenclature - Binomial system of nomenclature, basic rules of nomenclature (validity, effectivity and priority), ICN for algae, fungi and plants. (**4** hrs)
4. Systems of classification - Artificial, Natural & Phylogenetic (Brief account only). Bentham & Hooker's system of classification in detail. (**4** hrs)
5. Modern trends in taxonomy - Chemotaxonomy, Numerical taxonomy and Cytotaxonomy (brief account only) (**4**hrs)
6. Study the following families with special reference to major identifying characters and economic importance - Malvaceae, Fabaceae (with sub-families), Rubiaceae, Apocynaceae, Euphorbiaceae and Poaceae. (**12** hrs)

PRACTICALS (SYSTEMATIC BOTANY)

1. Determine the systematic position of local plants coming under the syllabus, based on their vegetative and floral characters.
2. Describe the plants in technical terms and draw the L.S. of flower of any two plants belonging to each family and record the same.
3. Familiarization of herbarium techniques. The students should submit not less than **6** properly identified herbarium specimens of varying taxa along with a field book from the families mentioned in the syllabus during

the time of their practical examination.

4. Every student shall submit original images of plants, at least three from any of the families mentioned in the syllabus, duly certified by HoD, at the time of examination. The images of plants should be properly identified and they should carry details like systematic position, GPS location, date, name and reg. no. of the student etc. Separate images clearly showing habitat, habit, inflorescence type, single flower, floral parts etc. of each plant should be represented. Web sourced and outsourced images should not be used. The images should be submitted along with the photo album containing images of inflorescence mentioned under morphology. Individuality should be strictly maintained while preparing the photo album.

REFERENCES (SYSTEMATIC BOTANY)

1. Gurucharan Singh, (2001). *Plant Systematics*. *Theory and practice.* Oxford & IBH Publications New Delhi.
2. Gurucharan Singh, (2019). *Plant Systematics* - An Integrated Approach, 4th edition. CRC Press. Florida.
3. Jeffrey, C. (1968). *An introduction to Plant Taxonomy,* Cambridge University Press, London.
4. Pandey & Misra. (2008). *Taxonomy of Angiosperms*. Ane Books India, New Delhi.
5. Radford, A.E. (1986). *Fundamentals of Plant Systematics.* Harpor & Row Publishers, New York.
6. Sharma O.P. (1990). *Plant Taxonomy* – Tata McGraw Hills. Publishing company Ltd.
7. Singh V. & Jain. 2010. *Taxonomy of Angiosperms* - Rastogi Publicatyions, Meerut.
8. Sivarajan, V.V. (1991). *Introduction to Principles of Plant Taxonomy.* Oxford & IBH, New Delhi.
9. Subramanyam N.S. (1999). *Modern Plant Taxonomy*. Vikas Publishing House Pvt Ltd.
10. Vasishta P.C (1994). Taxonomy of Angiosperms – R. Chand & Co, Meerut.

ECONOMIC BOTANY

Module –I (**4** hrs)

1 Brief account on the various categories of plants based on their economic importance

2. Study the following plants with special reference to their binomial, family, morphology of the useful part and their uses.
   a) Cereals: Paddy, Wheat
   b) Pulses: Black gram, Green gram
   c) Oil: Coconut, Gingelly
   d) Fibre: Cotton
   e) Latex: Rubber
   f) Beverages: Tea, Coffee
   g) Spices: Pepper, Cardamom, Clove
   h) Medicinal plants: *Rauvolfia serpentina*, *Justicia adhatoda, Santalum album* and *Curcuma longa*.

PRACTICALS (ECONOMIC BOTANY)

1. Identify at sight the economically important plant produces and products mentioned in the syllabus.
2. Learn the binomial and family of the source plants, morphology of the useful parts and uses. (Drawings not required)

REFERENCES (ECONOMIC BOTANY)

1. Hill A.W (1981) - *Economic Botany*, McGraw Hill Publications

2. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
3. Pandey B. P (1978) - *Economic Botany*, S. Chand Publishing, 680 p
4. Verma V. (2009) – *Text book of Economic Botany,* Ane Books, New Delhi, 352 p.

PLANT BREEDING

1. Introduction and objectives of plant breeding (**1** hr)
2. Methods of plant breeding: a) Plant introduction b) Selection - Mass, Pureline and clonal c) Hybridization: General steps in hybridization and types (intervarietal, interspecific and intergeneric hybridization). d) Mutation breeding e) polyploidy breeding and f) breeding for disease resistance.

(**6** hrs)

PRACTICALS (PLANT BREEDING)

1. Demonstration of hybridization techniques.

REFERENCES (PLANT BREEDING)

1. Allard. R.W. (1960) *Principles of Plant breeding*, John Wiley & Sons, Inc, New York.
2. Chaudhari. H.K. (1984) *Elementary Principles of Plant breeding*, Oxford & IBH, 324 p.
3. Singh, B.D. (2005) *Plant Breeding - Principles & methods*, Kalyani Publishers, New Delhi.
4. Satya, P. (2016). Plant breeding – Genetic principles and methodologies, Books and Allied (P) Ltd, Kolkata, 568 pp.
5. Sinha U. & Sunitha Sinha (2000). *Cytogenetics, Plant breeding & Evolution*, Vikas Publishing House.

HORTICULTURE

1. Horticulture- introduction: definition, branches, significance (**1** hr)
2. Methods of plant propagation (**6** hrs)
   a. Media for propagation - Potting mixture, Potting, Depotting, Repotting
   b. Seed propagation
   c. Vegetative propagation
      1. Cutting – stem, root, leaf
      2. Budding: Patch and T- budding
      3. Grafting: Approach grafting, Tongue grafting
      4. Layering – Air layering

PRACTICAL (HORTICULTURE)

1. Demonstration of budding, grafting and layering

REFERENCES (HORTICULURE)

1. George Acquaah (2010). *Horticulture: Principles and Practices*. Pearson Education, Delhi.
2. Kumar, N. (1996). *Introduction to Horticulture – First Edition*, Rajalakshmi Publications, Chennai
3. Manibhushan Rao, K. (2005). *Text book of Horticulture*, Macmillan India Ltd.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Plant collection:** Along with students to identify plants for herbaria preparation and to take photos for preparing photoalbum
4. **Microscopic observations:** To learn micro-morphological features various floral parts
5. **Demonstration**: To study the morphology of leaves, inflorescence, flowers, family characters etc., budding, grafting and layering, hybridization techniques, economic important plants etc.

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

Internal Assessment (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on attendance, classroom participation, timely submissions of practical related works

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment (Practicals – Total 60 + 15 + 10 = 85)

- Based on practical examination, record and submissions.

FOURTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

COMPLEMENTARY COURSE: 4

PLANT PHYSIOLOGY, ECOLOGY AND GENETICS

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
4	BBT4C04	2	5	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Explain** the physiological processes in plants.	Apply	PSO4
CO2	**Understand** the basic principles of heredity and variation.	Understand	PSO2
CO3	**Develop** basic concepts in plant ecology and realize its importance.	Analyze	PSO5
CO4	**Create** awareness about the necessity of conservation of biodiversity and natural resources.	Create	PSO10
CO5	**Solve** problems related to classical genetics	Apply	PSO4

DISTRIBUTION OF TEACHING HOURS (18 hrs/semester = 1hr/week)

Sl no	Subject	Theory	Practical	Total
1	Plant Physiology	36	18	54
2	Ecology	9	9	18
3	Genetics	9	9	18
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Plant physiology	Ecology	Genetics	Total
2 marks (total 12)	8	2	2	Ceiling 20
5 marks (total 7)	4	1	2	Ceiling 30
10 marks (total 2)	2			1x10 = 10
TOTAL				**60**

PLANT PHYSIOLOGY

Module – I (16 hrs)

1. Structure of plant cell and cell organelles (Brief account only)
2. Water relations - Permeability, Imbibition, Diffusion, Osmosis and water potential
3. Absorption of water- Active and passive mechanisms

4. Ascent of sap -Root pressure theory, Transpiration pull or cohesion-tension theory.
5. Transpiration -Types, mechanism of stomatal movement: K^+ ion theory, significance of transpiration, anti-transpirants
6. Mineral nutrition- General account on Micro and macro nutrients. The essential elements - criteria of essentiality. function and deficiency symptoms of the following mineral nutrients: N, P, K, Mg, Fe, Zn, Mn

Module – II (10 hrs)

1. Photosynthesis: Introduction, significance, two pigment systems, red drop, Emerson enhancement effect, action and absorption spectra, Mechanism of photosynthesis - Light reaction, cyclic & non-cyclic photo phosphorylation, Dark reactions–Calvin cycle, C_4 cycle, photorespiration (a brief account only). Factors affecting photosynthesis.

Module – III (10 hrs)

1. Plant growth: Definition, phases of growth, natural plant hormones, synthetic auxins (Brief account only)
2. Senescence and abscission, Photo-periodism & vernalization.
3. Dormancy of seeds- Factors causing dormancy, photoblastin, techniques to break dormancy, physiology of fruit ripening.

PRACTICAL (PLANT PHYSIOLOGY)

Learn the principle and working of the following apparatus/experiments

1. Thistle funnel osmoscope
2. Ganong's potometer
3. Ganong's light-screen
4. Absorbo transpirometer .
5. Kuhne's fermentation vessel
6. Mohl's half-leaf experiment
7. Experiment to show evolution of O_2 during photosynthesis (*Hydrilla* experiment)

REFERENCES (PLANT PHYSIOLOGY)

1. Frank B. Salisbury and Cleon W. Ross (2002). *Plant Physiology* 3rd edition. CBS publishers and distributers.
2. G. Ray Noggle and George J. Fritz (1983). *Introductory Plant Physiology*, Prentice Hall.
3. Goodwin Y.W. and Mercer E.I. (2003). *Introduction to Plant Biochemistry*. 2nd edition.CBS

Publishers and distributors.

4. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A (2015). *Plant Physiology and Developmen*t. Sinauer Associates Inc. USA. 6th edition.
5. William G. Hopkins (1999). *Introduction to Plant Physiology*, 2nd edition, John Wiley & Sons, Inc.

PLANT ECOLOGY

Module – I **(9 hrs)**

1. Ecology - Definition, Ecosystem: ecological factors –biotic and abiotic.
2. Ecological adaptations: Morphological, anatomical and physiological adaptations of the following types: Hydrophyte (*Vallisnaria, Hydrilla*), Xerophyte (*Opuntia, Nerium*), Halophyte (*Avicennia*), Epiphytes (*Vanda*) and parasites. (*Cuscuta*).
3. Ecological succession –Process of succession, types of succession, Hydrosere.

PRACTICALS (PLANT ECOLOGY)

Study the morphological and anatomical adaptations of the hydrophytes, xerophytes, halophytes, epiphytes and parasites mentioned in the syllabus (drawings not required)

REFERENCES (PLANT ECOLOGY)

1. Ahluvalia V.K., Malhotra S. (2009). Environmental Science. Ane Books – New Delhi.
2. Ambasht R.S. (1988). *A text book of Plant Ecology*, Students Friends Co., Varanasi.
3. Dash M.C. (1993). *Fundamentals of Ecology*, Tata McGraw HillPublishing Company Ltd. New Delhi.
4. Kumar H.D. (1977). *Modern Concepts of Ecology*, Vikas Publications, New Delhi.
5. Michael S. (1996). *Ecology*, Oxford University Press, London.
6. Sharma, P.D. (2008-2009). Ecology and Environment. Rastogi Publication.
7. Sharma, P.D. (2008-2009). *Ecology and Environment*, Rastogi Publication.
8. Shukla R.S. & P.S. Chandel (2005). *A Text Book of Plant Ecology,* S. Chand & Co. Ltd. New Delhi.

GENETICS **(9 hrs)**

1. Introduction, common terms in genetics and brief history of genetics
2. Mendel's experiments, symbolisation, terminology, heredity and variation;
3. Monohybrid cross, Dihybrid cross, Laws of Mendel, test cross and back cross.

4. Modified Mendelian ratios: Incomplete dominance in *Mirabilis jalapa.*
5. Gene interactions: Complementary genes -flower colour in *Lathyrus odoratus* (9:7 ratio), Epistasis - Fruit colour in *Cucurbita pepo* (12:3:1 ratio).

PRACTICALS (GENETICS)

Students are expected to work out problems related to Monohybrid, Dihybrid, Test cross, Incomplete dominance and Modified Mendelian ratios and have to be recorded.

REFERENCES (GENETICS)

1. Gupta, P.K. (1990). *Text Book of Genetics*. Rastogi Publications, Meerut, 774 p.
2. RastogiV.B. (2008). *Fundamentals of Molecular Biology*, Ane Books, India.
3. Sinnot, W.L.C. Dunn & J. Dobzhansky (1996). *Principles of Genetics*. Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. Snustad, D.P. and Simmons, M.J. (2010). *Principles of Genetics*. 5th edition, John Wiley and Sons Inc., U.S.A.
5. Verma, P.S. & Agarwal (1999). *Text book of Genetics*. S. Chand & Co., New Delhi.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This invove attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Working out of genetics problems** mentioned in the syllabus.
4. **Observation** of morphological and anatomical adaptations of the hydrophytes, xerophytes, halophytes, epiphytes and parasites mentioned in the syllabus.
5. **Experimentation:** Learn the principle and working of the physiology experiments /apparatus mentioned in the syllabus.

MODE OF ASSESSMENT

<u>Internal Assessment</u> (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

<u>Internal Assessment</u> (Practicals - 20 Marks)

- Based on practical examination, records, submissions, lab involvement based on

attendance, classroom participation, timely submissions of practical related works

External Assessment **(Theory - 60 Marks)**

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

External Assessment **(Practicals – Total 60 + 15 + 10 = 85)**

- Based on practical examination, record and submissions.

OPEN COURSES

OPEN COURSES

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

OPEN COURSE CHOICE: 1

GENERAL BOTANY

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
5	BBT5D01	3	3	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Develop** general awareness on various branches of plant science.	Analyze	PSO5
CO2	**Understand** the fundamental concepts and importance of environmental science.	Understand	PSO2
CO3	**Create** awareness about the various kinds of environment pollution, their impacts on the ecosystem and their control measures	Create	PSO10
CO4	**Discuss** the importance of plants in everyday life.	Understand	PSO1

DISTRIBUTION OF TEACHING HOURS (18 hrs/Semester = 1hr/week)

Sl No	Subject	Total
1	Module 1	4
2	Module 2	6
3	Module 3	6
4	Module 4	12
5	Module 5	7
6	Module 6	7
7	Module 7	12
Total		**54**

QUESTION PAPER PATTERN

Type of questions	No of questions	Total
2 marks	12	Ceiling 20
5 marks	7	Ceiling 30
10 marks	2	1 x 10 = 10
Total		**60**

Module -1: Living World

Living and Non-Living: Plants and Animals; Classification of plants: Eichler's system, general characters of each group with one example; introduction to the Life cycle of plants.

Module - 2: Morphology of Angiosperms

Typical angiosperm plant: Functions of each organ viz. Root, Stem, leaves, inflorescence, flowers, fruit and seed. Flower: Basic structure, essential and non essential parts, symmetry. Pollination, seed dispersal of fruits and seeds.

Module - 3: Anatomy

Definition, general structure, Cell division- mitosis and meiosis, significance, cell cycle. Tissues: simple, compound; structure and functions; Structure and functions of root, stem and leaves. Monocot and Dicot stem- general features; Secondary thickening. Annual rings, heart wood and sap wood.

Module- 4: Plant Physiology

General account on methods of absorption of water and nutrients; Osmosis, Diffusion, Imbibition.Transport of water and nutrients; transpiration and its significance. Mineral nutrients: macro and micro; deficiency symptoms Symbiotic nitrogen fixation and its significance. Photosynthesis- Light and Dark reactions-brief description, Respiration and Growth Hormones.

Module - 5: Genetics

Heredity, variation; Mendelian experiments and principles. Exceptions of Mendelism, Structure and significance of DNA; Mutation. DNA: as the Genetic Material; Blood groupism in man; Sex determination in man.

Module - 6: Plant Biotechnology

Tissue culture - Principle and procedure; Transgenic plants: Scope and applications, BT Cotton, BT Brinjal, Golden Rice; Bioreactors and their significance.

Module – 7: Environmental Science

Ecosystem: Structure - Abiotic and Biotic Factors, Ecosystem, Types of plant interactions; Mutualism, Commensalism, Predation, Symbiosis, Parasitism, Competition. Biodiversity, Conservation, *In situ* and *Ex situ* methods, National Parks, Sanctuaries, IUCN, Threat Categories, Red list. Green House Effect, Ozone depletion, Deforestation and Reforestation, Alternative energy resources, Sustainable development and Utilization of resources.

REFERENCES

1. Pandey B.P. (2001). *Plant Anatomy,* S. Chand & Co. Delhi.

2. Tayal M.S (2012). *Plant Anatomy*. Rastogi Publishers, Meerut.
3. Vasishta P.C. (1974) *Plant Anatomy*, Pradeep Publication, Jalandhar
4. Gangulee, H.C., J.S. Das & C. Dutta. (1982) *College Botany* (5^{th} Ed.) New Central Book Agency, Calcutta.
5. Gupta, P.K. 2018() *Text Book of Genetics*. Rastogi Publications, Meerut.
6. Verma, P.S. & Agarwal (1999). *Text book of Genetics*. S. Chand & Co., NewDelhi
7. John Ringo (2004). *Fundamental Genetics* Cambridge University Press
8. Chawla H.S. (2009). *Introduction to Plant Biotechnology*, Science Publishers, USA, 698 p
9. Das, H.K. (2005). *Text book of Biotechnology* (2^{nd} ed.) Wiley India (Pvt.), Ltd. New Delhi.
10. Dubey RC (2014). *A text book of Plant Biotechnology*; S Chand & Co.
11. Gupta, P.K. (1996) *Elementary Biotechnology*. Rastogi & Company, Meerut.
12. William G. Hopkins, (1999). *Introduction to Plant Physiology*, 2^{nd} edition, John Wiley A Sons, Inc.
13. Frank B. Salisbury and Cleon W. Ross (2002). *Plant Physiology* 3^{rd} edition, CBS publishers and distributers.
14. Ahluvalia V.K. Malhotra S. (2009). *Environmental Science*, Ane Books – New Delhi.
15. Ambasht R.S. (1988). *A text book of Plant Ecology*, Students Friends Co.Varanasi.
16. Dash M.C. (1993). *Fundamentals of Ecology*, Tata McGraw Hill Publishing Company Ltd. New Delhi.
17. Kumar H.D. (1977). *Modern Concepts of Ecology*,.Vikas Publications. New Delhi.

MODE OF TRANSACTION
1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in person discussions and use of ICT tools for the better transaction. 2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher. 3. **Demonstration**: Morphology of leaves, inflorescence, flowers, cells and tissues, examples of plant interactions etc.
MODE OF ASSESSMENT
Internal Assessment (Theory - 15 Marks) 1. *Internal examination*: one Internal examination – 6 Marks. 2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks 3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks 4. *Classroom participation*: based on attendance - 3 Marks
External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper).

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

OPEN COURSE CHOICE- 2

APPLIED BOTANY

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
5	BBT5D02	3	3	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Develop** general awareness on applied aspects of Plant science.	**Analyze**	**PSO5**
CO2	**Examine** the knowledge on plant propagation and steps of growing plants.	**Apply**	**PSO4**
CO3	**Explain** the applications of Botany in everyday life.	**Apply**	**PSO4**
CO4	**Apply** vegetative propagation methods in everyday life.	**Apply**	**PSO4**
CO5	**Identify** the economically important plants.	**Analyze**	**PSO6**

DISTRIBUTION OF TEACHING HOURS (18 hrs/semester = 1hr/week)

Sl no	Subject	Total
1	Module – I Plant Propagation	12
2	Module – II Steps of growing plants	12
3	Module – III. Botany in Everyday life	24
4	Module – IV. Economic Botany	6
Total		**54**

QUESTION PAPER PATTERN

Type of questions	No of questions	Total
2 marks	12	Ceiling 20
5 marks	7	Ceiling 30
10 marks	2	1x10 = 10
Total		**60**

Module –I Plant Propagation

1. Seed propagation – Seed dormancy (causes, methods to overcome seed dormancy), seed treatment (to control pests and diseases & to promote germination), conditions for successful propagation, care of seedling, transplanting seedling, hardening
2. Vegetative propagation:
    (a) Cutting (stem, roots)
    (b) Grafting (approach, cleft)
    (c) Budding (T-budding, patch)
    (d) Layering (simple, air)

3. Micro propagation- types (meristem culture, shoot tip culture, direct &, indirect organogenesis), somatic embryogenesis

(brief account only) advantages and disadvantages.

Module – II. Steps of Growing Plants

1. Soil- Composition, Types, Texture, Soil pH, Correcting pH, Humus
2. Pots & Potting – Earthen, Fiber, Polythene bags, Potting mixture, Potting, Depotting, Repotting.
3. Chemical fertilizers: types, application, merits and demerits
4. Organic manure; types, application, merits and demerits
5. Need of water: Irrigation – Surface, spray, drip irrigation, sprinklers.
6. Plant protection from pests and diseases: Biological, Physical and mechanical, Chemical, biopesticides (Tobacco and neem decoction)

Module – III. Botany in Everyday life

1. Vegetable gardening (Ladies finger, Tomato, Chilli, Brinjal)
2. Mushroom cultivation- Spawn production (brief), Cultivation of Oyster mushroom
3. Vermicomposting - technique
4. Biofertilizer Technology- Mycorrhiza, *Rhizobium*-legume association, Blue-green algae, *Azolla-Anabaena* association.
5. Orchid and Anthurium cultivation
6. Creating Bonsai

Module – IV. Economic Botany

1. General account on various plants of economic importance
2. Study the Binomial, Family, Morphology of the useful part of the following plants.

   Cereals and Millets – Rice, Wheat

   Pulses – Green gram, Bengal gram, Black gram

   Beverages – Coffee, Tea

   Fibre – Coir, Cotton, Jute

   Timber – Teak, Rose wood, Jack

   Spices – Pepper, Ginger, Cardamom

   Medicinal – *Adhatoda, Phyllanthus, Curcuma*

   Oil - Coconut, Gingelly

   Ornamental plants of economic importance – Rose, Jasmine

   Fruit – Mango, Banana

REFERENCES

1. Adriance G.W. and Brison F.R. (1979). *Propagation of Horticultural Plants*, Krieger Publication Company, 298 p.
2. Bal, J.S. (2014). *Fruit growing*, Kalyani Publishers, Delhi.
3. Chadha, K.I. and Choudhury, B. (2014). *Ornamental Horticulture in India*, Indian Council of Agricultural Research
4. George Acquaah (2005). *Horticulture: Principles and Practices*, Pearson Education, Delhi.
5. Hudson, T. Hartmann, Dale K. Kester, Fred T. Davies, Robert L. Geneve, Sandra B. Wilson. (2018). *Plant Propagation, Principles and Practices.* 9th Edition
6. Katyal, S.L. (1977). *Vegetable growing in India*, Oxford, New York

7. Kolay, A.K. (1994). *Basic Concepts of Soil Science*. New Age International Publishers, Delhi.
8. Kumar, U. (1999). *Methods in Plant Tissue Culture*. Agrobios (India), Jodhpur, 471 p.
9. Naik, K.C. (1949). *South Indian Fruits and their Culture*. P. Varadachary & Co. London.
10. Nesamony S. (2012). *Oushadha Sasyangal* (Medicinal plants), State Institute of Languages, Kerala, Trivandrum.
11. Nishi Sinha (1993). *Gardening in India,* Abhinav Publications, New Delhi.
12. Prakash, R and Raj Mohan K. (2005). *Jaivakrishi* (Organic farming), State Institute of Languages, Trivandrum.
13. Prasad, S., and Kumar U. (2012). *Green house Management for Horticultural Crops*, Agrobios, Jodhpur.
14. Prasad, S., and Kumar U. (2012). *Green house Management for Horticultural Crops*, Agrobios, Jodhpur.
15. Premchand (1995). *Agriculture and Forest Pest and their Management*, Oxford Publishing House, New Delhi.
16. Razdan, M.K. (2017). *Introduction to Plant Tissue Culture*, Oxford & IBH Publishing Ltd., NewDelhi.
17. Rekha Sarin (1997). *The Art of flower Arrangement*, UBS Publishers, New Delhi.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Demonstration:** Demonstration of horticultural techniques, economically important plants, mushroom cultivation, bonsai etc

MODE OF ASSESSMENT

Internal Assessment **(Theory - 15 Marks)**

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

External Assessment **(Theory - 60 Marks)**

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper).

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

OPEN COURSE CHOICE: 3

BASIC TISSUE CULTURE

Semester	Course code	Credits	Hrs/wk	Marks (Ext. + Int.)	Duration of exam
5	BBT5D03	3	3	60 + 15	2 hrs

COURSE OUTCOMES (COs)

Course Outcome	Expected course outcome Upon completion of this couse, students will be able to:	Learning Domain	PSO No.
CO1	**Understand** plant tissue culture as a rapid propagation method.	Understand	PSO1
CO2	**Explain** the steps involved in tissue culture.	Apply	PSO4
CO3	**Explain** the applications of plant tissue culture	Apply	PSO4
CO4	**Discuss** about the advanced techniques used in tissue culture.	Understand	PSO1

DISTRIBUTION OF TEACHING HOURS (18 hrs/semester = 1hr/week)

Sl no	Subject	Total
1	Module 1	7
2	Module 2	12
3	Module 3	9

4	Module 4	18
5	Module 5	8
Total		**54**

QUESTION PAPER PATTERN

Type of questions	No of questions	Total
2 marks	12	Ceiling 20
5 marks	7	Ceiling 30
10 marks	2	1 x 10 = 10
Total		**60**

Module - I

1. Introduction; Aims and objectives of Plant Tissue Culture.
2. Organization and facilities of a Tissue culture Laboratory.
3. Equipments and apparatus in a tissue culture lab.
4. Sterilization techniques – Autoclaving Flame sterilization, UV irradiation, Chemical sterilization. Sterilization of instruments and glass wares, medium, explants

Module-II

1. Plant tissue culture – Principles and techniques: Cellular totipotency, *in vitro* differentiation –de differentiation and re-differentiation.
2. Tissue culture medium – Basic components in tissue culture medium – Solid and liquid medium– suspension culture. Murashige and Skoog medium– composition and preparation.
3. Aseptic techniques in tissue culture - preparation of explants – surface sterilization. Inoculation, incubation and subculturing.

Module - III

1. Micropropagation - Different methods – axillary bud proliferation, direct and indirect organogenesis and somatic embryogenesis.
2. Different phases of micropropagation – hardening, transplantation and field Evaluation: Advantages and disadvantages of micro propagation.
3. Somaclonal variation.

Module – IV

1. Applications of plant tissue culture: Micropropagation; Somaticembryogenesis; Artificial seeds, Germplasm conservation, Embryo rescue culture, Protoplast isolation, culture and fusion, Anther, pollen and Ovary culture for production of haploids, Cryopreservation. Shoot apical meristem culture and production of pathogen free stocks and somaclonal variation.

Module –V

1. Transformation technology – Transgenic plant production, Gene transfermethods in plants, Multiple gene transfers, Vector less or direct genetransfer techniques.

REFERENCES

1. Das, H.K. (Ed) (2005). Text book of Biotechnology. Wiley India (Pvt) Ltd. New Delhi.
2. Dixon, R.A. & R.A. Gonzales. (1994). Plant Cell Culture – A Practical Approach 2nd edition. Oxford University Press.

3. Einert & Bajaj Plant Cell, Tissue and Organ Culture.
4. Gamborg, O.L. & G.C. Philips (Eds.) (1995). Plant Cell, Tissue and Organ Culture, Fundamental Methods. Narosa Publishing House, New Delhi.
5. Gupta, P.K. (1996). Elementary Biotechnology. Rastogi & Company, Meerut.
6. Hammond, J., Megary, P.*et al*. (2000). Plant Biotechnology. SpringerVerlag.
7. Mantel & Smith (1983) Plant Biotechnology. Cambridge University Press
8. Mantel, S. H, Mathew, J.A. *et al*. (1985). An introduction to Genetic Engineering in plants. Blackwell Scientific Publishers, London.

MODE OF TRANSACTION

1. **Face to Face Instruction:** This involves attending traditional classroom lectures and participating in discussions and use of ICT tools for the better transaction.
2. **Peer-to-peer interaction:** Student groups are formed and supplied with study materials for discussion, monitored by the teacher.
3. **Demonstration:** Equipments and apparatus in a tissue culture lab, video screening of tissue culture methods.

MODE OF ASSESSMENT

Internal Assessment (Theory - 15 Marks)

1. *Internal examination*: one Internal examination – 6 Marks.
2. *Submission of assignment*: Every student will be assigned a topic by the course instructor. They have to prepare and submit a presentation - 3 Marks
3. *Seminar presentation*: The students have to present the topic assigned to them - 3 Marks
4. *Classroom participation*: based on attendance - 3 Marks

External Assessment (Theory - 60 Marks)

- Short answer type, Paragraph/ Problem type and Essay type questions (Ref: Model question paper)

MODEL QUESTION PAPERS - Core

MODEL QUESTION PAPERS (THEORY)

FIRST SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE: 1 - BBT1B01

ANGIOSPERM ANATOMY, REPRODUCTIVE BOTANY & PALYNOLOGY

Time: 2 Hrs **Max. Marks 60**

……

SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Describe the structure of hydathodes
2. What is tapetum? Add a note on its types and functions.
3. What is protoderm?
4. Give an account of lysigenous ducts in plants.
5. Discuss how the study of pollen grains becomes important in taxonomy.
6. What is a casparian strip? What is its role?
7. What is an embryosac?
8. Where can you find raphides? How is it formed?
9. What is the reason for fragrance of flowers?
10. Write short note on aleurone grains.
11. Explain Histogen theory.
12. What is meant by double fertilization?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Discuss the specialties of meristematic cells.
14. Give an account of cell wall materials.
15. Explain exine ornamentation in angiosperms.
16. Give an account of organisation of root apex in dicots.
17. Describe the structure of a dicot embryo.
18. Describe the structure of collenchyma. Where do you find it in a plant body? Add a note on its functions.
19. Give an account of barriers of fertilization.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Give a detailed account of complex tissues in angiosperms. Discuss the phylogenetic significance of complex tissues. .
21. Give a detailed account of Microsporogenesis with illustrations.

SECOND SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE: 2 - BBT2B02

MICROBIOLOGY, MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

Time: 2 Hrs **Max.Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Differentiate between isidium and soredium.
2. Define facultative saprophyte. Give an example.
3. What are plasmids?
4. Describe Prions.
5. Write a short note on symbiotic associations between algae and fungi with one example.
6. What is dikaryotization?
7. What are heteroecious fungi?
8. Give an account of viral capsid.
9. Differentiate between rust and smut.
10. Describe apothecium in *Peziza*
11. Define systemic fungicide, with an example.
12. Give an account of quarantine measures adopted for disease control

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Write a brief account of the salient features of Ascomycetes.
14. Explain living and non-living characters of virus.
15. Enumerate the economic importance of Fungi.
16. Briefly explain reproduction in lichens.
17. Describe the gene transfer methods in bacteria.
18. Give an account of application of microbes in industry.
19. Explain the symptoms and control measures of citrus canker disease.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Briefly explain the life cycle of the pathogen of damping off disease, with suitable diagrams.
21. Describe the structure and reproduction of Bacteriophages.

THIRD SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE: 3 - BBT3B03

PHYCOLOGY, BRYOLOGY AND PTERIDOLOGY

Time: 2 Hrs **Max. Marks 60**

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SECTION A
Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. What is circinate vernaion? Give an example of a peridophye showing this.
2. Differentiate between conceptacles and receptacles in *Sargassum*.
3. Write notes on Apogamy in pteridophyes.
4. Comment on the role of *Nostoc* in agriculture. Which part of the thallus helps perform the role?
5. Describe the structure of cystocarp in *Polysiphonia*.
6. Critically evaluate the sporophyte of *Riccia*.
7. Explain the cell structure of *Pinnularia*.
8. Give a brief account of the morphology and affinities of Bryophytes.
9. Write noes on the evolutionary importance of Bryophytes.
10. Critically evaluate the synangium in *Psilotum*.
11. Describe the reproduction in *Vaucheria*.
12. What are trabeculae? How are they formed?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Comment on the sporophyte of *Funaria*.
14. Give an account of the algal classification proposed by FE Fritsch.
15. Describe the anatomical features of *Equisetum*.
16. Explain the structure of sporophyte in *Anthoceros*.
17. Critically evaluate the attempt of seed formation observed in *Selaginella*.
18. Describe the economic importance of algae.
19. Describe the structure of strobilus in *Equisetum*.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Critically analyze the thallus variation and types of reproduction seen in Chlorophyceae.
21. Give a detailed account of the stelar evolution in Pteridophytes with diagrams.

FOURTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE: 4 - BBT4B04

METHODOLOGY AND PERSPECTIVES IN PLANT SCIENCE

Time: 2 Hrs **Max.Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Define Shodhganga and elaborate its importance.
2. What does an Impact Factor indicate?
3. Differentiate between Central tendency and Dispersion.
4. How is a Chi-square test used in biological experiments?
5. What are Ogives?
6. Is pH of any solution relevant? Why?
7. What is molecular sieving?
8. What are the different kinds of centrifuges?
9. What is 'ppm'? Why is it commonly used in preparation of solutions?
10. Differentiate TEM from SEM in their principles.
11. Why are vital stains important?
12. Describe the importance of maceration.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Elaborate the steps involved in Scientific methods and preparation of scientific reports
14. Describe the various data collection methods
15. Explain the importance of Correlation and Regression
16. Describe the principle and applications of different photometric methods
17. Write a short note on the importance of buffers in biological experiments
18. Explain the principle of phase contrast microscopy
19. Describe the various killing and fixing agents used in preservation of specimens

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Explain the prospects and limitations of Biostatistics, emphasizing on the different tools used for statistical analysis.
21. Describe the principles and different types of chromatography.

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE: 6 - BBT5B06

GYMNOSPERMS, PALAEOBOTANY, PHYTOGEOGRAPHY, EVOLUTION

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. What is an ovuliferous scale?
2. Describe the features of manoxylic wood. Give an example.
3. Enumerate the angiosperm features of *Gnetum*.
4. Describe the features of the male gametophyte of *Pinus*.
5. Write short note on types of fossils.
6. Describe Geological time scale.
7. What is mean by continental drift? Explain.
8. What are the causes and consequences of glaciation?
9. Give a brief account of phytogeographical zones of India.
10. What is endemism? Explain with an example.
11. What is discontinuous distribution?
12. Describe the Modern concept of evolution.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Comment on the evolutionary position of gymnosperms.
14. Explain the economic importance of gymnosperms.
15. Enumerate the contributions of Birbal Sahni and Savithri Sahni.
16. Define migration. What is its impact on biodiversity of a particular region? Explain with example.
17. Explain the theory of land bridges.
18. Describe the evolution of prokaryotic cells.
19. Explain speciation.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Compare the anatomy of *Cycas* leaflet and *Pinus* needle with suitable diagrams. Add a note on the special types of tissues found in these.
21. Explain the theories on origin and evolution of species.

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE: 7 - BBT5B07

ANGIOSPERM MORPHOLOGY & SYSTEMATICS

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Describe the structure of a coenanthium.
2. Explain the rule of priority.
3. A flower can be considered as a modified shoot. Justify.
4. Describe the vegetative features of Lamiaceae.
5. Differentiate between definable and non-definable families with examples.
6. Briefly describe the contributions of E.K. Janaki Ammal to the field of angiosperm taxonomy.
7. What is caruncle? Where can you find? Describe is function.
8. What is meant by virtual herbarium?
9. What is meant by effective publication?
10. What type of structural adaptations can you find in a coconut seed that helps its easy dispersal?
11. What is resupination? Where can you find his?
12. Give an account of taxonomic hierarchy.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Give an account of the various types of racemose inflorescences with examples.
14. Write notes on typification.
15. Give an account of the APG system of classification. Enumerate is advantages.
16. Describe the concept of species
17. What is numerical taxonomy?
18. Describe the types of flowers based in the relative position of ovary and other floral parts.
19. Give an account of ICN principles.

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Give an account of various types of fruits produced by angiosperms with special reference to the types of placentations observed in these, citing suitable examples.
21. Critically evaluate the reasons for the successful establishment of Asteraceae.

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE: 8 - BBT5B08

TISSUE CULTURE, HORTICULTURE, ECONOMIC BOTANY AND ETHNOBOTANY

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. What is the principle of plant tissue culture?
2. Define organogenesis? Explain the different types.
3. Write a short note on haploids, their production and significance?
4. What are the different branches of horticulture?
5. What is a gelling agent? Give examples.
6. Name two plants of ethnobotanical significance and their uses.
7. Comment on the formation of humus.
8. Explain the different types of green houses.
9. Write the binomial and family of four oil yielding plants.
10. Comment on compost activators.
11. What are the advantages of drip irrigation?
12. Explain the types and advantages of biofertilisers.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Explain the steps involved in creating bonsai.
14. What are the different types of soil?
15. What is a nutrient medium, and what are its components? Cite an example of a commonly used medium.
16. Name four plants used for their medicinal importance, and the chemical constituents responsible for these properties?
17. Give an account of various tribal communities of Kerala.
18. Explain the major stages in micropropagation.
19. Explain how you can obtain virus free plants through tissue culture,

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Explain the different methods of vegetative propagation in plants? Compare nature of such plants with sexually propagated plants.
21. Explain the steps involved in somatic hybridization and the relevance of the technique.

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE: 9 - BBT5B09

CELL BIOLOGY AND BIOCHEMISTRY

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Describe the function of nucleolus
2. Mention the features of nucleosomes.
3. Differentiate between euchromatin and heterochromatin
4. Describe any two features of fluid mosaic model of plasma membrane.
5. What is crossing over? Mention its significance.
6. What are the functions of vacuoles?
7. Give any two properties of amino acids.
8. What are co enzymes? Give examples.
9. Describe zwitter ions.
10. What are peptide bonds? How is it formed?
11. What are polysaccharides? Give two examples.
12. What are allosteric enzymes?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Explain the structure and function of ATP.
14. Write a brief note on polytene chromosome and its significance.
15. Describe the morphology and chemical composition of chromosomes.
16. Analyse the ecological importance of secondary metabolites.
17. Explain the structure and function of Mitochondria.
18. Differentiate between prokaryotic and eukaryotic cell.
19. Comment on denaturation and renaturation of proteins.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Give an account of numerical aberration of chromosomes and its significance.
21. Explain the structure and biological functions of proteins.

CORE COURSE: 10 - BBT6B10

GENETICS AND PLANT BREEDING

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Differentiate between sex chromosomes and autosomes.
2. Define lethal genes. Cite one example.
3. Define heterosis. Write a suitable example
4. Differentiate between pure line and pure breeding.
5. Explain the significance of linkage.
6. What are multiple alleles?
7. Enumerate the characteristics of quantitative inheritance.
8. Explain the complementary gene action.
9. Write an account on clonal selection.
10. What is the significance of crossing over?
11. State Hardey-Weinberg law.
12. Differentiate between back cross and test cross.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Describe extra nuclear inheritance with suitable example.
14. What is the role of polyploidy in plant breeding?
15. What is recessive epistasis? Explain it with example.
16. Explain the genetics of inheritance of Fruit colour in summer squashes.
17. What is incomplete dominance? Explain with examples.
18. Write the achievements of mutation breeding.
19. Explain the various steps involved in pure line selection.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Explain the various steps involved in plant introduction?
21. Explain the pattern of extranuclear inheritance with suitable examples.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE: 11 - BBT6B11

BIOTECHNOLOGY, MOLECULAR BIOLOGY & BIOINFORMATICS

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Write a short note on Bioremediation.
2. Explain the relevance of Flavr Savr tomato.
3. Define Protein databases and highlight the relevance of any one.
4. What are the different types of gene banks?
5. Explain one-gene one-enzyme hypothesis.
6. What are point mutations?
7. Give a short note on pBR322.
8. What are the highlights of Semi-conservative replication?
9. Explain Teminism.
10. Write a note on the future of AI.
11. Define and explain the importance of any one of the Genome projects.
12. What is the importance of ClustalW?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Describe the different gene transfer methods.
14. Explain the process of rDNA synthesis.
15. Explain the various Open access initiatives and discuss the advantages of these.
16. Describe the characteristics of a Genetic Code.
17. How would you differentiate genomics and Proteomics?
18. Explain the various DNA sequencing methods.
19. Explain the process of gene regulation and expression in *lac* operon.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Explain the principle, topology, types and importance of phylogenetic trees.
21. Describe how Biotechnology has been applied for human welfare.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

CORE COURSE: 12 - BBT6B12

PLANT PHYSIOLOGY AND METABOLISM

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Describe facilitated diffusion.
2. What are anti-transpirants? Give examples.
3. Outline the energy yielding steps in glycolysis
4. Differentiate between osmosis and diffusion.
5. Give an account of Ascent of sap.
6. Discuss the role of electron carriers in electron transport chain.
7. Difference between active and passive uptake of mineral ions.
8. What is RUBISCO? What is its importance?
9. Discuss the importance of assimilatory power.
10. Give an account of physiological role of abscisic acid.
11. Comment on fatty acid synthase enzyme complex.
12. Define photosystem. Add a note on its significance.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Critically analyse the significance of photorespitration.
14. Describe the significance of HMP pathway.
15. What is water potential? Explain its components
16. Explain transpiration pull theory. Comment on its merits and demerits
17. Examine the special photosynthetic pathway that helps xerophytic plants to survive in desert condition.
18. Summarise the biological nitrogen fixation in leguminous plants.
19. Phytochromes are the key photomorhogenic pigment in a plant system. Justify.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Describe the pathway and significance of β oxidation of fatty acids.
21. Explain Photosynthetic electron transport and photophosphorylation.

CORE COURSE: 13 - BBT6B13

ENVIRONMENTAL SCIENCE

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Give an account of the biological factors of an ecosystem.
2. Describe the morphological adaptations in epiphytes.
3. What are biogeochemical cycles? Give an example.
4. Comment on biodiversity hotspots.
5. What is a flagship species?
6. Discuss the role of IUCN in biodiversity conservation.
7. Analyze the impacts of water pollution.
8. Give critical analysis of global warming and greenhouse gases
9. Define bio-magnification and explain is biological significance.
10. Write short note on importance value index.
11. Describe he ecological significance of estuarine ecosystem.
12. What is meant by dominance of populations

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Discuss the ecological relevance of Grass lands.
14. Discuss e-waste accumulation. Suggest methods to manage this.
15. What is *el-nino*?
16. Discuss *ex situ* and *in situ* methods of conservation.
17. What is mean by Red data book?
18. Describe Energy flow in an ecosystem.
19. Discuss the anatomical adaptations in hydrophytes

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Discuss the strategies of solid waste management.
21. Give a detailed account of the process and mechanism of ecological succession.

ELECTIVE COURSE - BBT6E01

Elective - 1: GENETIC ENGINEERING

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. How is DNA precipitated after isolation?
2. Distinguish between electroporation and microinjection
3. List out any two GM crops and note down their special feature.
4. Comment on site directed mutagenesis
5. What is CTAB?
6. Define a probe. Mention its use
7. What are reporter genes? Give one example
8. Write critical notes on chromosome walking
9. What is RNase? Mention its use.
10. Mention the buffers used for electrophoresis of nucleic acids?
11. Comment on knock out models
12. Mention two methods adopted for cell lysis.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Give an account on southern blotting.
14. Briefly describe RNAi technology.
15. Mention the use and procedure of blue white selection.
16. How will you alter the gene of interest through site directed mutagenesis?
17. Give an account on Agrobacterium mediated gene transfer.
18. Comment on Type II Restriction endonuclease, alkaline phosphatase and DNA polymerase I.
19. Write a critical note on ethical and social issues associated with rDNA technology.

SECTION C
(Answer any one question, each question carries 10 marks. 1x10 = 10 Marks)

20. Write an account on vectors used in genetic engineering.
21. Give a detailed account on construction and use of genomic DNA library and cDNA library.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

ELECTIVE COURSE - BBT6E02

Elective - 2: ADVANCED ANGIOSPERM SYTEMATICS

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. What is meant by acronym?
2. Define tautonym. Give an example.
3. Write notes on taxonomic indices.
4. Describe obdiplostemony. Give an example.
5. Write short notes on herbalists.
6. Explain virtual herbarium.
7. Enumerate the primitive traits of Nymphaeaceae
8. What is mean by effective publication?
9. Explain character correlation.
10. What are the identifying features of Amaranthaceae?
11. Explain the Rule of priority.
12. Write short note on DNA bar coding.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Differentiate cladistics and phenetics.
14. Give an account of five major databases used in Taxonomic studies.
15. What is meant by character weighing?
16. Explain how phytochemical evidences are utilized in Taxonomy?
17. Give an account of five major herbaria in India.
18. Differentiate between Bignoniaceae and Verbenaceae
19. Enumerate the characteristic features of the family Arecaceae giving special emphasis on its economic value.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Give the structure of ICN. What is typification? Explain the various types used in plant nomenclature.
21. What are botanic gardens? Explain the role of botanic gardens and enumerate the major botanical gardens in India.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

ELECTIVE COURSE - BBT6E03

Elective - 3: GENETICS AND CROP IMPROVEMENT

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Write a note on the origin of Pepper.
2. Expand NPBGR and add a note on its activities.
3. What are *nif* genes?
4. Mention the importance of making saline tolerant crops.
5. Give an account of biopesticides.
6. What are the causes of abiotic stress in plants?
7. Differentiate between vertical and horizontal resistance.
8. Expand ICRISAT and add a note on its activities.
9. What are the methods adopted for emasculation.
10. Write a note on the achievements on rice breeding programmes.
11. Define plant introduction and explain its relevance.
12. Explain the role of somaclonal variations in crop improvement.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Explain the genetics of chloroplast.
14. Write briefly on selection as a method of crop improvement.
15. What is the role of IISR in pepper breeding?
16. Describe the breeding techniques and achievements in Coconut.
17. What is the role of IISc in plant research and development?
18. Give an account on the exploration and documentation of plant genetic resources.
19. Explain the genetics of salt tolerance.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Write an essay on mutation breeding. Comment on its major advantages over the other methods of breeding
21. Explain different types of hybridization and the steps involved the process.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

ELECTIVE COURSE - BBT6E04

Elective - 4: AGRONOMY AND ENTREPRENEURSHIP

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

2. How kondattam is produced?
3. Differentiate between vermiculite and perlite.
4. Give an account of Spawn production.
5. What do you mean by fertigation? What are its advantages?
6. Write notes on Ikebana.
7. List out the principles of food preservation.
8. Explain the significance of the mist chamber.
9. What is integrated pest management?
10. Differentiate between floriculture and pomiculture.
11. What do you mean by hydroponics?
12. Write brief notes on canning.
13. Give examples of any two biopesticides.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

14. Discuss the problems and prospects of floriculture in Kerala.
15. What are the techniques behind the preparation of jams and sauces.
16. Describe the processing and storage methods of Ginger and Garcinia?
17. List out the roles of MSME Training Institute.
18. Give an account of the cultivation of *Agaricus* mushrooms.
19. What do you mean by a Terrarium? How a terrarium could be set up?
20. Describe the cultivation procedures of Tapioca.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

21. Describe te processing, storage and marketing of Cardamom, Coconut and RIce
22. What are biofertilizers? Describe the preparation of the various types of biofertilizers.

MODEL QUESTION PAPERS (PRACTICAL)

FOURTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE PRACTICAL EXAMINATION

Practical Paper - I : BBT4B05 L

(Angiosperm Anatomy, Reproductive Botany, Palynology, Microbiology, Mycology, Lichenology, Plant Pathology, Phycology, Bryology, Pteridology & Methodology and perspectives in Plant Science)

Time: 3 Hours **Max: 80 Marks**

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1. Prepare a T.S. of the given specimen **A, B and C,** draw the ground plan and cellular diagram of a portion enlarged and identify the specimen.
   (*Preparation-4; Drawing-3; Identification-1; Reasons-2*)

   10 x 3 = 30 Marks

2. Identify the given bacteria **D** and submit the micro preparation for valuation.
   (*Preparation-3*)

   3 x 1 = 3 Marks

3. Prepare Histogram/Frequency polygon using the given data **E**

   OR

   Workout the given problem **E** (Chi square test)

   5 x 1 = 5 Marks

5. Identify the disease, pathogen and list out the symptoms from the given specimen **F** & **G.**
   (*Disease identification-1, Pathogen – 1, Symptoms-1*)

   3 x 2 = 6 Marks

5. Determine the pollen viability of the sample **H.**

   6 x 1 = 6 Marks

6. Spot at sight **I** to **W.**

   2 × 15 = 30 Marks

Practical examination:	**80 Marks**
Record:	**15 Marks**
Submission:	**5 Marks**
Total:	**100 Marks**

IVth Semester B.Sc. BOTANY CORE PRACTICAL EXAMINATION, MARCH 2021

Practical Paper - I: BBT4B05 L

(Angiosperm Anatomy, Reproductive Botany, Palynology, Microbiology, Mycology, Lichenology, Plant Pathology, Phycology, Bryology, Pteridology & Methodology and perspectives in Plant Science)

KEY TO THE SPECIMENS

Qn No	Qn Code	Items
1	A	**Anatomy materials** - Dicot stem (*Eupatorium, Cephalandra*), Monocot stem (Grass), Dicot root (*Ficus*), Monocot root (*Musa, Colocasia*), Anomalous Secondary growth (*Boerhaavia*, *Bignonia* and *Dracaena*)
	B	**Algae/ Fungi/ Bryophyte materials** (*Sargassum, Puccinia*, *Riccia*, *Anthoceros*)
	C	**Pteridophyte materials** – (*Selaginella, Equisetum*, *Pteris*)
2	D	**Curd** for bacteria identification
3	E	**Statistical data** – Histogram, Frequency polygon, Chi-square test
4	F & G	**Plant Pathology** Materials - Citrus Canker, Mahali disease of Arecanut, Blast of Paddy, Quick wilt of Pepper, Mosaic disease of Tapioca, Bunchy top of Banana, Grey leaf spot of Coconut
5	H	**Pollen grains of *Vinca***
6	**SPOTTERS**	
	I & J	**Angiosperm Anatomy** – Pictures of Tissues, Vascular bundles
	K	**Reproductive Botany –** Pictures of the Ovules (Orthotropous, Anatropous, Campylotropous), Embryos – Dicot/ Monocot
	L	**Palynology –** Pictures of Pollen, Pollinia
	M	**Microbiology –** Pictures of Bacteria, Virus types
	N & O	**Mycology –** Pictures/Materials of *Rhizopus*, *Xylaria, Aspergillus, Agaricus*, *Puccinia*
	P	**Lichenology –** Pictures/ Materials of lichens
	Q & R	**Phycology –** Pictures/Materials of *Nostoc, Volvox*, *Oedogonium*, *Chara*, *Pinnularia, Sargassum, Polysiphonia*
	S	**Bryology –** Pictures/Materials of *Riccia*, *Anthoceros*, *Bryum*
	T & U	**Pteridology -** Pictures/Materials of *Selaginella*, *Psilotum*, *Equisetum*, *Pteris*
	V & W	**Microtechnique –** Micrometers, Parts of microscope, microtome

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE PRACTICAL EXAMINATION

Practical Paper – II: BBT6B14L

(Gymnosperms, Palaeobotany, Phytogeography, Angiosperm Morphology, Systematics, Tissue culture, Horticulture, Economic Botany, Ethnobotany, Cell Biology & Biochemistry)

Time: 3 Hours **Max: 80**

Marks

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1. Prepare T.S. of the given material **A**, draw labeled diagram and identify the specimen
   (Preparation – 2, Diagram - 2, Identification - 1, Reasons - 2) 7 x 1 = **7 marks**
2. Submit any two stages of mitosis using the given material **B**
   (*Preparation - 2; Identification - 2 × 2 = 4; Diagram – 1 × 2 = 2*) 8 x 1 = **8 marks**
3. Describe the given taxon **C**, determine the family and list out the salient features
   (*Identification - 1; Technical description - 4; Salient features - 3*) 8 x 1 = **8 marks**
4. Draw a labelled diagram of the V.S. of the flower **D**
   4 x 1 = **4 marks**
5. Identify the given sample **E** qualitatively
   (Analysis - 6, Identification - 2) 8 x 1 = **8 marks**
6. Give the binomial, family and morphology of the following: **F, G & H**
   (*Binomial - 1; Family - 1; Morphology - 1*) 3 × 3 = **9 marks**
7. Give the binomial, family and ethnobotanical significance of the following: **I** and **J**
   (*Binomial - 1; Family - 1; Ethnobotanical significance - 1*) 3 × 2 = **6 marks**
8. Write down the binomial and family of **K, L, M** and **N**
   (*Binomial - 1; Family - 1)* 2 × 4 = **8 marks**
9. Comment on the morphology of the specimens **O** and **P**
   2 x 2 = **4 marks**
10. Add critical note on the given specimens **Q** and **R**
    3 x 2 **= 6 marks**
11. Spot at sight **S - X**
    6 x 2 = **12 marks**

Practical examination:	**80 Marks**
Record:	**15 Marks**
Herbarium Submission:	**10 Marks**
Study tour Report + Photo album:	**5 Marks**
TOTAL:	**110 Marks**

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CORE PRACTICAL EXAMINATION

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(Gymnosperms, Palaeobotany, Phytogeography, Angiosperm Morphology, Systematics, Tissue culture, Horticulture, Economic Botany, Ethnobotany, Cell Biology & Biochemistry)

KEY TO THE SPECIMENS

Qn No	Question Code	Items
1	**A**	Fresh or well-preserved material from Gymnosperms – *Cycas* leaflet, *Pinus* needle, *Gnetum* leaf.
2	**B**	Mitotic stages preferably Metaphase, Anaphase or Telophase. Fixed onion root tips should be provided by the centre.
3	**C**	Plants with flowers from families mentioned under theory syllabus (refer record). Avoid monocot families.
4	**D**	Flower and flower buds of *Hibiscus, Crotalaria, Clitorea, Caesalpinia, Ixora, Hamelia, Vinca, Allamanda, Solanum, Thunbergia, Leucas.*
5	**E**	Biochemistry – Glucose, Starch, Protein (lot method – sample given to each student)
6	**F, G & H**	Any 3 Economic botany materials mentioned in the syllabus.
7	**I & J**	Any 2 Ethnobotany materials mentioned in the syllabus.
8	**K & L**	Herbarium Sheets submitted by the student.
	M & N	Campus plants.
9	**O & P**	Morphology specimens - one from inflorescence and one from fruits.
10	**Q & R**	Specimens /Diagrams from Tissue culture & Horticulture
11	**S**	Diagrams / materials from Cell biology
	T	Material from Gymnosperms, not given in **A**
	U	Fossil slide/materials – *Rhynia, Lepidodendron, Calamites*
	V	Any one Phytogeographical zone marked by the examiner on the outline map of India
	W & X	Horticulture implements

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE PRACTICAL EXAMINATION

Practical Paper – III: BBT6B15L

(Genetics, Plant Breeding, Biotechnology, Molecular Biology, Plant Physiology & Environmental Science)

Time: 3 Hours **Max: 80 Marks**

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1. Prepare a unidirectional chromatogram using the given extract **A** and calculate the Rf value of each component

   (Preparation - 4, Calculation and Result - 3, Procedure - 3) 10 x 1 = **10 marks**

2. Workout the genetics problems **B** and **C**.

   (Mendelian problem - 7, Mapping - 8) 7 + 8 = **15 marks**

3. Enumerate aim, procedure and inference of the experiment setup of **D, E** and **F**

   (Aim - ½, Procedure – 2, Inference - ½) 3 × 3 = **9 marks**

4. Calculate the stomatal index of the given leaf **G**

   (Tabulation - 4, Result - 1) 5 x 1= **5 marks**

5. Demonstrate hybridization in Specimen **H**

   (Emasculation - 3, Bagging – 1, Tagging - 2) 6 x 1 = **6 marks**

6. Read the Gel from the diagram provided in **I**

   5 x 1 = **5 marks**

7. Find out the ecological groups of **J** & **K** and add a note on their adaptations

   (Identification - 1, Adaptations - 4) 5 x 2 = **10 marks**

8. Spot at sight **L – U**

   2 × 10 = **20 marks**

Practical examination:	**80 Marks**
Record:	**15 Marks**
Lab visits Report:	**5 Marks**
Elective Record:	**10 Marks**
Total:	**110 Marks**

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE PRACTICAL EXAMINATION

Practical Paper – III: BBT6B15L

(Genetics, Plant Breeding, Biotechnology, Molecular Biology, Plant Physiology & Environmental Science)

KEY TO THE SPECIMENS

Qn No	Question Code	Items
1	A	Chromatography – leaf extract should be provided by the centre
2	B	Genetics problems – Mendelian ratios/ Interaction of genes mentioned in the syllabus.
	C	Chromosome Mapping – 3-point cross
3	D, E & F	Physiology experiments (Thistle funnel osmoscope, Ganong's Potometer, Ganong's light-screen, Ganong's respirometer, Kuhne's fermentation vessel, Mohl's half-leaf experiment, Absorbo-transpirometer) - (Any 3)
4	G	Stomatal index – leaves should be provided by the centre
5	H	Hybridisation (Material given by the centre).
6	I	Electrophoresis gel provided by the centre
7	J & K	Hydrophyte/ Xerophyte/ Epiphyte/ Halophyte/ Parasitic plants
8	L & M	Diagrams/Photographs from Biotechnology
	N & O	Diagrams/Photographs from Molecular Biology
	P & Q	Diagrams from Environmental Science – Food web/ Ecological pyramid (Biomass/ Energy/ Number)
	R & S	Genetics - Mendelian or non-Mendelian ratios mentioned in the syllabus
	T	Forms of DNA
	U	Floral biology

MODEL QUESTION PAPERS - Complementary

MODEL QUESTION PAPERS (THEORY)

FIRST SEMESTER B.Sc. DEGREE PROGRAMME

BOTANY COMPLEMENTARY COURSE: I:

BBT1C01

ANGIOSPERM ANATOMY AND MICROTECHNIQUE

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Differentiate between lateral meristem and intercalary meristem.
2. What is FAA? How is it prepared?
3. Explain Tunica Corpus theory.
4. What is quiescent centre?
5. How do tracheids differ from vessels?
6. What are hydathodes?
7. Explain the structure and function of bulliform cells.
8. What are annual rings? What is its relevance?
9. What are tyloses?
10. Write short note on rotary microtome.
11. Different between protoxylem and metaxylem.
12. What is acetocarmine? What is its use?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Write short note on simple tissues.
14. What are the different types of vascular bundles?
15. Explain the principle and types of electron microscopes.
16. Describe the laticiferous tissues in plants.
17. Explain the structure of a dicot leaf.
18. With a neat labeled diagram, explain the primary structure of monocot root.
19. Explain killing and fixing. Add a note on various agents used for it.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. What are permanent tissues? Explain the major classes with their functions.
21. Explain the secondary growth in dicot stem with the help of a diagram.

SECOND SEMESTER B.Sc. DEGREE PROGRAMME

BOTANY COMPLEMENTARY COURSE: 2

BBT2C02

CRYPTOGAMS, GYMNOSPERMS & PLANT PATHOLOGY

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Differentiate between fimbriae and pili.
2. What are plasmids? Mention the different types.
3. Explain the structure of cell wall of bacteria.
4. Give an account of morphology of *Sargassum* thallus.
5. What are heterocysts? Give its function.
6. Briefly explain scalariform conjugation in *Spirogyra*.
7. Comment on the structure and function of ligule in *Selaginella*.
8. Write a short note about the sporogonium of *Riccia*.
9. What are coralloid roots? What is its function?
10. List out the important symptoms of Leaf mosaic disease of Tapioca.
11. Describe vegetative reproduction in bryophytes.
12. Enumerate the important control measures of citrus canker.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Give an account of the multiplication of bacteriophages.
14. Name the pathogen, symptoms and control measures of Blast of paddy.
15. With the help of a labelled diagram explain the anatomy of *Riccia* thallus.
16. What is the ecological and economic importance of lichens?
17. How are bacteria classified based on flagella? Add a note on bacterial growth.
18. Briefly explain the post fertilization changes in *Polysiphonia.*
19. Write about the sexual reproduction in *Cycas*.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Write an essay on the vegetative, asexual and sexual reproduction of bacteria.
21. With the help of suitable diagrams describe the stages of life cycle of *Puccinia*

THIRD SEMESTER B.Sc. DEGREE PROGRAMME

BOTANY COMPLEMENTARY COURSE: 3

BBT3C03

MORPHOLOGY, SYSTEMATIC BOTANY, ECONOMIC BOTANY, PLANT BREEDING AND HORTICULTURE

Time: 2 Hrs **Max. Marks 60**

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SECTION A

(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Differentiate between stock and scion.
2. Write a short note on the inflorescence of Poaceae.
3. Explain the significance of quarantine.
4. What are the advantages of seed propagation?
5. What is aestivation? What are the different types?
6. Name any two chemicals used for the poisoning of specimens.
7. Differentiate between synandrous stamens and syngenesious anthers.
8. Name any two major herbaria in India.
9. Differentiate between numerical taxonomy and chemotaxonomy?
10. Write the binomial and family of clove and turmeric.
11. What are beverages?
12. Describe emasculation. What are the different types of emasculation?

SECTION B

(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Expand ICN? What are the major rules of ICN?
14. What are the different types of inflorescences?
15. Write short note on cereals and pulses.
16. Enumerate the characteristic features of family Fabaceae.
17. Describe polyploidy breeding. What are their applications in crop improvement?
18. What are the important vegetative propagation methods in plants?
19. Comment on the phylogenetic system of classification

SECTION C

(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. What is a natural system of classification? Explain with an example. Write down the major merits and demerits.
21. Describe the different selection processes in plant breeding? Explain.

FOURTH SEMESTER B.Sc. DEGREE PROGRAMME

BOTANY COMPLEMENTARY COURSE: 4

BBT4C04

PLANT PHYSIOLOGY, ECOLOGY AND GENETICS

Time: 2 Hrs **Max. Marks 60**

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SECTION A

(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. What are antitranspirants? Give examples.
2. Define water potential? Write about its components.
3. Explain vernalization in brief.
4. Give an account of ATPase.
5. What is transpiration pull? Explain its role in plants.
6. Write about senescence and abscission. Add a note their significance.
7. Describe two important adaptations seen in halophytes.
8. What are haustoria? Mention its physiological importance.
9. Differentiate test cross and back cross.
10. What are complementary genes? Give example.
11. Write about Krantz anatomy.
12. Give an account of Hydroponics.

SECTION B

(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Give an account of non-cyclic photophosphorylation.
14. Describe the K^+ ion theory of stomatal movements.
15. Write in detail about the adaptations of xerophytes.
16. List out the roles played by gibberellins in plant development.
17. Give an account of the epistatic interaction found in plants with an example.
18. Briefly explain the dihybrid cross conducted by Mendel and a note on the discovery of law of independent assortment.
19. Give an account of the causes and methods to overcome seed dormancy.

SECTION C

(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Define plant succession. Describe the stages of hydrosere in detail with suitable plant examples
21. With the help of schematic diagram describe the path of carbon in Photosynthesis.

MODEL QUESTION PAPER (PRACTICAL)

FOURTH SEMESTER B.Sc. DEGREE PROGRAMME
COMPLEMENTARY BOTANY PRACTICAL EXAMINATION
BBT4C05L
(Angiosperm Anatomy, Micro technique, Cryptogams, Gymnosperms, Plant Pathology, Morphology, Systematic Botany, Plant Physiology, Ecology, Genetics, Economic Botany, Plant Breeding &Horticulture)

Time: 3 Hrs **Max: 60 marks**

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1. Prepare a T.S. of specimen **A**. Stain and mount in glycerine. Draw cellular diagram and label the parts. Identify giving reasons. Leave the preparation for valuation. (*Preparation-2; Diagram-2; Reasons-2; Identification-1*) 7 x 1 = 7 Marks

2. Refer specimen **B** to its family, giving diagnostic characters (*Identification-1; Reasons-2*) 3 x 1= 3 Marks

3. Take a V.S. of flower **C**. Draw a labeled diagram 2 x 1 = 2 Marks

4. Make suitable micro-preparations of **D**. Draw labeled diagram. Identify giving reasons. Leave the preparation for valuation. (*Preparation-2; Diagram-2; Identification-1; Reasons-1*) 6 x 1 = 6 Marks

5. Determine the ecological group of specimen **E**, with important adaptations. (*Identification-1; Adaptations-2*) 3 x 1 = 3 Marks

6. Identify the experiment **F** and **G**. Explain the aim and working (*Identification-1; Aim-1; Working - 1*) 3 x 2 = 6 Marks

7. Give the binomial, family and morphology of useful parts in **H** and **I** (*Binomial-1; Family- ½; Morphology of useful part- ½*) 2 × 2 = 4 Marks

8. Name the disease, pathogen and important symptoms in **J** (*Name- 1; Pathogen- 1; Symptoms-1*) 3 x 1 = 3 Marks

9. Give the binomial and family of **K** and **L** (*Binomial-1; Family ½*) 2 x 1 ½ = 3 Marks

10. Work out the problem **M** 5 x 1 = 5 Marks

11. Spot at sight **N** to **V** 9 x 2 = 18 marks

Practical examination: 60 Marks
Record: 15 Marks
Submissions: 10 Marks
Total: 85 Marks

BBT4C05L - KEY TO THE SPECIMENS

Qn No	Letter Code	Item
1	A	**Anatomy materials** - Dicot stem (Primary - *Centella, Cephalandra,* Secondary - *Vernonia*), Monocot stem (Grass), Dicot root (Primary/Secondary - *Tinospora*), Monocot root (*Colocasia*), Anomalous Secondary growth (*Boerhaavia*)
2	B	**Twig with flower of dicot plants** (Malvaceae, Leguminosae with subfamilies, Rubiaceae, Apocynaceae, Euphorbiaceae)
3	C	**Flower and flower buds** (*Hibiscus, Crotalaria, Caesalpinia, Ixora, Hamelia, Allamanda, Vinca*)
4	D	**Cryptogams** (*Sargassum, Puccinia, Riccia, Selaginella*)
5	E	**Ecology** (Hydrophyte - *Vallisnaria*, *Hydrilla*; Xerophytes – *Opuntia, Nerium*; Halophyte – *Avicennia*; Epiphyte - *Vanda*; Parasite - *Cuscuta*)
6	F	**Physiology** – Any 2 experiments by lot – Thistle funnel Osmoscope, Ganong's potometer, Ganong's light screen, Absorbo-transpirometer, Kuhne's fermentation vessel, Mohl's half leaf expt., Experiment to show evolution of O_2 during photosynthesis.
	G	
7	H	**Economic Botany** (Cereals – *Paddy, Wheat*; Pulses – *Black gram, green gram*; Oil – *Coconut, Gingelly*; Fibre – *Cotton*; Latex – *Rubber*; Beverages – *Tea, Coffee*; Spices – *Pepper, Cardamom, Clove*; Medicinal plants – *Rauvolfia serpentina, Justicia adhatoda, Santalum album, Curcuma longa*
	I	
8	J	**Pathology specimens** (Leaf Mosaic disease of Tapioca, Blast of Paddy, Citrus Canker)
9	K & L	**Taxonomy** - Two Herbaria sheets submitted by the student
10	M	**Genetics problem** (Monohybrid, Dihybrid, Test cross, Incomplete dominance, Complementary genes, Epistasis)
11	**SPOTTERS**	
	N	**Angiosperm Anatomy** – Pictures of Tissues, Vascular bundles
	O	**Microtechnique** - Parts of microscope/ microtome
	P	**Microbiology –** Pictures of Bacteria, Virus types, Slides of *Nostoc*
	Q	**Phycology –** Pictures/ Materials of *Spirogyra, Sargassum, Polysiphonia*
	R	**Mycology/Lichenology –** Pictures/ Materials of *Puccinia, Usnea*
	S	**Cryptogams–** Pictures/ Materials of *Riccia, Selaginella* not given in D
	T	**Gymnosperm** - *Cycas* materials
	U	**Morphology –** Inflorescence types
	V	**Horticulture –** Pictures of layering, grafting and budding

MODEL QUESTION PAPERS - Open

MODEL QUESTION PAPERS (THEORY)

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

OPEN COURSE - Choice: 1 - BBT5D01

GENERAL BOTANY

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Which plant group is known as 'amphibians of the plant kingdom? Why?
2. Name the first cell of sporophytic generation. Give its genetic constitution.
3. Distinguish between actinomorphic and zygomorphic flowers.
4. Comment on annual rings.
5. Distinguish between diffusion and osmosis.
6. Name any two major nutrients and their deficiency symptoms.
7. Name a gaseous hormone. What is its significance?
8. Write the names of any two alternative energy resources.
9. Distinguish between autosomes and allosomes.
10. Name any two transgenic plants. Mention their special feature.
11. With suitable examples distinguish between commensalism and symbiosis.
12. What is greenhouse effect? Name two major greenhouse gases.

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Comment on symbiotic nitrogen fixation.
14. Compare the internal structure of dicot and monocot stem.
15. Outline Eichler's system of classification of plants.
16. Distinguish between heart wood and sap wood.
17. Give an illustration on mitosis.
18. Discuss the genetics of blood groups in man.
19. Write a critical account on *in situ* and *ex situ* methods of biodiversity conservation.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Give a detailed account on light and dark reactions of photosynthesis.
21. Discuss secondary thickening in a dicot stem with labeled sketches

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

OPEN COURSE - Choice: 2 - BBT5D02

APPLIED BOTANY

Time: 2 Hrs **Max. Marks 60**

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SECTION A
(Answer all questions, each question carries 2 marks. Ceiling: 20 Marks)

1. Distinguish between loamy soil and clay soil.
2. What is the composition of commonly used potting mixture?
3. What is 'Humus'? Give its significance.
4. Comment on legume-rhizobium association
5. Commonly used earthworms for vermin composting technique
6. Give the binomial of medicinal plant used against jaundice
7. Why is *Azolla* grown in paddy fields?
8. Which spice is known as 'queen of spices? Give its binomial.
9. Distinguish between depotting and repotting
10. Name two chemical fertilizers rich in phosphorus
11. Specify the hormones used for root and shoot differentiation in tissue culture.
12. How will you correct soil pH?

SECTION B
(Answer all questions, each question carries 5 marks. Ceiling: 30 Marks)

13. Give an account on *Anthurium* cultivation
14. Write critical notes on seed dormancy
15. Compare the merits and demerits of chemical fertilizers and organic manures.
16. Briefly outline the art of making bonsai
17. Give the binomial, family and morphology of the useful parts of any two pulses.
18. Outline the procedure of cultivation of oyster mushroom.
19. What are biopesticides? Give the composition and procedure for the preparation of any two.

SECTION C
(Answer any one question, each question carries 10 marks. 1 x 10 = 10 Marks)

20. Give a detailed account on various practices of vegetative propagation
21. Discuss various types of irrigation and their significance

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME

OPEN COURSE - Choice: 3 - BBT5D03

BASIC TISSUE CULTURE

Time: 2 Hrs **Max. Marks 60**

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SECTION A

(Answer all questions. Each question carries 2 marks. Ceiling: 20 Marks)

1. What are synseeds?
2. What is cryopreservation? Write examples for cryoprotectants.
3. Write the various instruments/ equipment used in tissue culture lab.
4. Explain the steps involved in hardening?
5. Define organogenesis. What are the different types of organogenesis?
6. What is a Cybrid? How is it produced?
7. What is an autoclave? Explain its principle and use.
8. Explain the role microelements in tissue culture.
9. Define incineration, and its usage in tissue culture?
10. Mention the categories of chemical sterilants used in plant tissue culture
11. What are the principles involved in plant tissue culture?
12. What is meristem culture? Explain its importance.

SECTION B

(Answer all questions. Each question carries 5 marks. Ceiling: 30 Marks)

13. Explain the various steps involved in micropropagation.
14. Define Haploids. What are steps involved in haploid production?
15. What are secondary metabolites? Write its applications.
16. What are the various methods adopted to test protoplast viability.
17. What is LAF? Write the working principle of LAF.
18. Write an account on different sterilization methods adopted in plant tissue culture?
19. What are nutrient media, explain its components and role?

SECTION C

(Answer any one. Each question carries 10 marks. 1 x 10 = 10 Marks)

20. Explain the various gene transfer methods.
21. Describe the applications of plant tissue culture in overcoming specific problems.

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