ST. THOMAS' COLLEGE (AUTONOMOUS), THRISSUR KAERALA – 680001

Affiliated to University of Calicut
Nationally reaccredited with 'A' Grade

CURRICULUM AND SYLLABUS FOR UNDERGRADUATE PROGRAMME IN BOTANY

UNDER CHOICE BASED CREDIT AND SEMESTER SYSTEM
(w.e.f. 2020 ADMISSION ONWARDS)

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UG PROGRAMME IN BOTANY

PREFACE

The revised Curriculum for Undergraduate Programme of B.Sc. Botany 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 with the speed with which technology advances. Formulation of the syllabubs has been done by revamping the existing syllabus, with an understanding that the syllabus is addressing the 'digital native' generation. 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 an 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 critical 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.
- The major thrust given here is to develop an environmental concern in all activities performed by the students. 'Go green' has been taken as the motto of the syllabus. The syllabus has been designed in a way to help creating awareness of environmental impacts due to development of science and technology and the urgent need of conservation of nature without destruction of natural resources.
- Creating scientific temper is another major objective of this curriculum. Incorporating research components along with a sound academic foundation enables students to develop independent critical thinking. Sufficient emphasis is given for training in laboratory skills and instrumentation.

PROGRAMME OUTCOMES (POs)

PO1 Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Effective Citizenship: Demonstrate empathetic social concern and equity-centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO4. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO5. Ethical Living: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO7. Problem Solving and Analytical Skills: Understand and solve problems of relevance to society to meet the specified needs using the knowledge, skills and attitudes acquired from humanities/ sciences/mathematics/social sciences.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Understand the principles of identification, classification and evolution of various plant groups according to their morphology, anatomy and palynology.
2. Understand the principles life processes, biomolecules, and heredity.
3. Evaluate biodiversity loss, and develop conservation strategies.
4. Classify plants according to the principles of plant systematics, apply techniques of plant breeding, plant propagation and genetic engineering.

UG PROGRAMME - AN OVERVIEW

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. Total credit allotted for open course is 3 and the hours allotted is 3.

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. At the end of each semester there shall be examination conducted by the college from a pool of questions (Question Bank) set by the College. The students can also attain these credits through online courses like SWAYAM, MOOC etc. (optional).

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	4

4	4	*Gender Studies/ Gerontology	4
Total			16

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 that 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 Voluntary Social Service Programme. Extra credits are not counted for SGPA or CGPA.

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

Semester	Common		Core course	Complementary course		Open course	Audit course	Extra credits	Total
	English	Additional Language		Chemistry	Zoology				
I	4+3	4	3	2	2		4		18
II	4+3	4	3	2	2		4		18
III	4	4	3	2	2		4		15
IV	4	4	3+4**	2+4**	2+4**		4		27
V			3+3+3+3			3			16
VI			3+3+3+3+3					4	26
Total	**22**	**16**	**55**	**12**	**12**	**3**	**16**	**4**	**140**

Credits of Project Work **Credits of practical paper

ATTENDANCE:

A student shall be permitted to appear for the semester examination, only if he/she secures 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 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).

PROJECT WORK/ THEORY COURSE ON RESEARCH METHODOLOGY:

Every student of a UG degree programme shall have to work on a project. 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).

EXAMINATION

There shall be Semesterly examinations at the end of each semester.

PRACTICAL EXAMINATION

There will be practical examinations at the end of 4th semester and 6th semester. Practical examination of 4^{th} semester will be of 3 hrs duration. Practical examination of 5^{th} and 6^{th} semesters will be of 4 hrs duration.

VIVA-VOCE

Viva voce, shall be conducted along with the project evaluation.

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 College. The students can also attain the credits through online courses like SWAYAM, MOOC etc.

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.

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 ASSESSMENT:

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, Class room participation based on attendance in respect of theory courses and lab involvement/records attendance in respect of Practical Courses.

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

	Component	Percentage of marks
Theory	Test paper	40%
	Assignment	20%
	Seminar	20%
	Class room participation based on attendance	20%
Practical	Record	60%
	lab involvement	40%

(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, average mark of the test papers 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.

EXTERNAL EVALUATION

External evaluation carries 80% of marks. All question papers shall be set by the College. The external question papers may be of uniform pattern with 80/60 marks.

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

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

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

The semetreral examination in practical courses shall be conducted by two examiners - **one internal** and **an external,** the latter appointed by the Controller of Examinations. The project evaluation with viva can be conducted either internal or external which may be decided by the Board of Studies concerned.

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 semesteral examinations. The fee for this shall be as decided by the College.

EVALUATION OF AUDIT COURSES:

The examination shall be conducted by the college from the Question Bank. The Question paper shall be of 100 marks of 3 hour duration.

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

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

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.

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

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 students grade/marks card (by online) on completion of each semester including 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 PROJECTS

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 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 External examiner 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. 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 Department. External examination may be conducted along with the subsequent batch.

PRACTICAL RECORD

The entire experiments mentioned in the practical syllabus are expected to be done. A certified record book is an evidence of the practical works done by the candidate during the course. Therefore, it must be treated seriously and valued properly. Moreover, the genuine work should be appropriately rewarded. The total marks set apart for the record of the programme are 40 i.e., 15 marks for the record of practical papers I & II, 10 marks for paper III.

External evaluation of Record - Parameters

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

SUBMISSIONS

Submissions are mandatory for each practical paper and it carries 55 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 Head of the department.

Practical Paper - II

Every student has to submit a photo album containing images of properly identified types of fruits and inflorescence and plants at least one each from all families mentioned in the syllabus, with specifications on systematic position, location, date, name of the student etc. and tour report duly certified by the Head of the department. Individuality should be strictly maintained while submitting the photo album.

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, certified and to be submitted on the day of Practical examination of Paper III.

Study Tour Report

Every student has to submit a report of study tour conduced as per the conditions mentioned in the syllabus of Systematics under Core Course 6, duly certified by HoD.

Table - 8: MARK DISTRIBUTION OF SUBMISSIONS

Submission	Items	Marks
Pract. P-I	Pathology herbarium sheets	5
Pract. P-II	Photo album of Morphology and Systematics	10
Pract. P-III	Report of visits to (i) Plant breeding station (ii) Research station (Biotech / Molecular Biol. Lab)	5
Record / Photo album of Elective Paper		10
Study tour report		5

QUESTION PAPERS

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 x10 = 20

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

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 I: 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 II: 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 III: 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 IV: Methodology and Perspectives in Plant Science	3
	Core Course Practical- 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**

Semester	Course	Credit
V	Core Course V: Gymnosperms, Palaeobotany, Phytogeo. & Evolution	3
	Core Course VI: Angiosperm Morphology & Systematics	3
	Core Course VII: Tissue Culture, Horticulture, Econ. Bot& Ethanobotany	3
	Core Course VIII: Cell Biology & Biochemistry	3
	Open course	3
	Total credits acquired in the semester	**15**
VI	Core Course IX: Genetics & Plant Breeding	3
	Core Course X: Biotech., Molecular Biology & Bioinformatics	3
	Core Course XI: Plant Physiology & Metabolism	3
	Core Course XII: Environmental Science	3
	Core Course XIII: Elective	3
	Core Practical – Paper- II	5
	Core Practical – Paper- III	5
	Core Course: Project Work/ Research methodology paper	2
	Total credits acquired in the semester	**27**
	Total credits acquired in all semesters	**120**
	Audit courses (Sem 1, II, III & IV)	16
	Extra Credits	4
	Grant Total	**140**

B.Sc. PROGRAMME IN BOTANY
CORE & OPEN COURSES

Total credits 58 (Core courses: 55 + Open course 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	BOT1B01 T	CORE COURSE I. **Angiosperm Anatomy, Reproductive Botany & Palynology**	36	72	2	4	3
	-	Core Course -I Practical	36		2		*
S -II	BOT2B02 T	CORE COURSE II. **Microbiology, Mycology, Lichenology & Plant Pathology**	36	72	2	4	3
	-	Core Course -II Practical	36		2		*
S-III	BOT3B03 T	CORE COURSE III. **Phycology, Bryology & Pteridology**	54	90	3	5	3
	-	Core Course -III Practical	36		2		*
S-IV	BOT4B04 T	CORE COURSE IV **Methodology and perspectives in Plant Science**	54	90	3	5	3
	-	Core Course -IV Practical	36		2		*
	BOT4B05 P	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

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
BOT5B06 T	CORE COURSE V **Gymnosperms, Palaeobotany, Phytogeography & Evolution**	54	90	3	5	3
-	Core Course –V Practical	36		2		*
BOT5B07 T	CORE COURSE VI **Angiosperm Morphology & Systematics**	54	90	3	5	3
-	Core Course-VI. Practical	36		2		*
BOT5B08 T	CORE COURSE VII **Tissue culture, Horticulture, Economic Botany & Ethnobotany**	54	90	3	5	3
-	Core Course VII. Practical	36		2		*
BOT5B09 T	CORE COURSE. - VIII **Cell Biology & Biochemistry**	54	90	3	5	3
-	Core Course-VIII. Practical	36		2		*
BOT5D01 T	OPEN COURSE - CHOICE I **General Botany**	54	54	3	3	3
BOT5D02 T	OPEN COURSE - CHOICE II **Applied Botany**	54	54	3	3	3
BOT5D03 T	OPEN COURSE - CHOICE III **Tissue Culture**	54	54	3	3	3
	PROJECT WORK / RESEARCH METHODOLOGY	36	36	2	2	
TOTAL					**25**	**15**
*credits of Practical paper						

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
BOT6B10 T	CORE COURSE IX **Genetics & Plant Breeding**	54	90	3	5	3
-	Core Course IX. Practical	36		2		*
BOT6B11 T	CORE COURSE – X **Biotechnology, Molecular biology & Bioinformatics**	54	90	3	5	3
-	Core Course- X. Practical	36		2		*
BOT6B12 T	CORE COURSE -XI **Plant Physiology & Metabolism**	54	90	3	5	3
-	Core Course- XI. Practical	36		2		*
BOT6B13 T	CORE COURSE – XII **Environmental Science**	54	90	3	5	3
-	Core Course– XII. Practical	36		2		*
BOT6B14 T (E1)	ELECTIVE- CHOICE - I **Genetic Engineering**	54	90	3	5	3
-	Elective Choice – I. Practical	36		2		*
BOT6B14 T (E2)	ELECTIVE- CHOICE II **Genetics and Crop Improvement**	54	90	3	5	3
-	Elective Choice – II.	36		2		*
BOT6B14 T (E3)	ELECTIVE - CHOICE III **Advanced Angiosperm Systematics**	54	90	3	5	3
-	Elective Choice – III. Practical	36		2		*
BOT6B15 P	PRACTICAL PAPER- II: **Gymnosperms, Palaeobotany, Phytogeography, Angiosperm Morphology, Systematics, Tissue culture, Horticulture, Econ. Botany, Ethnobot. Cell Biol. & Biochemistry**					5
BOT6B16 P	PRACTICAL PAPER- III: **Genetics, Pl. Breeding, Biotechnology, Molecular Biology, Plant Physiology & Environmental Science**					5
BOT6B17 Pr BOT6B17 T	PROJECT WORK / RESEARCH METHODOLOGY	-	-	-	-	2
TOTAL					**25**	**27**
*credits of Practical paper						

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

Course Code	Instructional Hours		Duration of Exams (hrs)	Marks				Total marks
	Theory	Practical		Theory		Practical		
				External	Internal	External	Internal	
BOT1B01 T	36	36	2	60	15	--	--	75
BOT2B02 T	36	36	2	60	15	--	--	75
BOT3B03 T	54	36	2	60	15	--	--	75
BOT4B04 T	54	36	2	60	15	--	--	75
BOT4B05 P (Practical)	--	--	3	--	--	80	20	100
Record	--	--		--	--	15	--	15
Submission	--	--		--	--	5	--	5
BOT5B06 T	54	36	2	60	15	--	--	75
BOT5B07 T	54	36	2	60	15	--	--	75
BOT5B08 T	54	36	2	60	15	--	--	75
BOT5B09 T	54	36	2	60	15	--	--	75
BOT5D01/02/03 T	54	---	2	60	15	--	--	75
BOT6B10 T	54	36	2	60	15	--	--	75
BOT6B11 T	54	36	2	60	15	--	--	75
BOT6B12 T	54	36	2	60	15	--	--	75
BOT6B13 T	54	36	2	60	15	--	--	75
BOT6B14 T (E1/E2/E3)	54	36	2	60	15	--	--	75
BOT4B15 P (Practical)	--	--	4	--	--	80	20	100
Record	--	--		--	--	15	--	15
Submission	--	--		--	--	10	--	10
Study tour	--	--		--	--	5	--	5
BOT4B16 P (Practical)	--	--	4	--	--	80	20	100
Record	--	--		--	--	10	--	10
Submission	--	--		--	--	5	--	5
Record of Elective	--	--	--	--	--	10	--	10
BOT6B17 Pr (Project)		36		--	--	60	15	75
BOT6B17 T (Theory)	36*		2*	60*	15*	--	--	
TOTAL				**840**	**210**	**375**	**75**	**1500**

*Applicable only if the Centre is opting research methodology paper instead of project work

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

Course Code	Instructional Hours		Duration of Exams (hrs)	Marks				Total marks
	Theory	Practical		Theory		Practical		
				External	Internal	External	Internal	
BOT1B01 T	36	36	2	60	15	--	--	75
BOT2B02 T	36	36	2	60	15	--	--	75
BOT3B03 T	54	36	2	60	15	--	--	75
BOT4B04 T	54	36	2	60	15	--	--	75
BOT4B05 P (Practical)	--	--	3	--	--	80	20	100
Record	--	--		--	--	15	--	15
Submission	--	--		--	--	5	--	5
BOT5B06 T	54	36	2	60	15	--	--	75
BOT5B07 T	54	36	2	60	15	--	--	75
BOT5B08 T	54	36	2	60	15	--	--	75
BOT5B09 T	54	36	2	60	15	--	--	75
BOT5D01/02/03 T	54	---	2	60	15	--	--	75
BOT6B10 T	54	36	2	60	15	--	--	75
BOT6B11 T	54	36	2	60	15	--	--	75
BOT6B12 T	54	36	2	60	15	--	--	75
BOT6B13 T	54	36	2	60	15	--	--	75
BOT6B14 T (E1/E2/E3)	54	36	2	60	15	--	--	75
BOT4B15 P (Practical)	--	--	4	--	--	80	20	100
Record	--	--		--	--	15	--	15
Submission	--	--		--	--	10	--	10
Study tour	--	--		--	--	5	--	5
BOT4B16 P (Practical)	--	--	4	--	--	80	20	100
Record	--	--		--	--	10	--	10
Submission	--	--		--	--	5	--	5
Record of Elective	--	--	--	--	--	10	--	10
BOT6B17 Pr (Project)		36		--	--	60	15	75
BOT6B17 T (Theory)	36*		2*	60*	15*	--	--	
TOTAL				**840**	**210**	**375**	**75**	**1500**

*Applicable only if the Centre is opting research methodology paper instead of project work

FIRST SEMESTER B.Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT1B01T**			
Name of the course	**ANGIOSPERM ANATOMY, REPRODUCTIVE BOTANY & PALYNOLOGY**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
01	**CORE**	**3**	**4**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand the significance of non-living inclusions in the cells.	5	U	Factual	PO1	PSO1
CO2	Differentiate tissues in the plant body and their functions.	7	U	Factual	PO1	PSO1
CO3	Compare primary and secondary anatomical structure of plants	5	U	Factual	PO7	PSO1
CO4	Distinguish normal and anomalous growth by anatomical features	5	U	Factual	PO7	PSO1
CO5	Develop sectioning skill for anatomical studies	14	Ap	Procedural	PO7	PSO1
CO6	Recognize the micro and megaspore development in angiosperms	7	U	Factual	PO1	PSO1
CO7	Analyse the structure of embryo and pollen of angiosperms.	7	An	Factual	PO7	PSO1
CO8	Perform hand sectioning of plant parts, and viability tests of pollen grains.	9	Ap	Procedural	PO7	PSO1

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				Reproductive Botany & Palynology		Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	1	3	2	2	2	2	Ceiling 20
5 marks (Total 7)	1	1	1	1	2	1	Ceiling 30
10 marks (Total 2)	1				1		1 x 10 = 10
TOTAL							60

ANGIOSPERM ANATOMY (Theory 22 hrs)			**Hrs**
MODULE - I (5 hrs)	Chapter 1	Cell Wall - Structure and development; Growth of Cell wall; cell wall materials	2
	Chapter 2	Non-living inclusions 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.	1.5
	Chapter 3	Secretory materials	0.5
	Chapter 4	Waste materials - Nitrogenous - alkaloids, Non-nitrogenous- gums, resins, tannins, organic acids, essential oils; Mineral crystals - Calcium oxalate, Drusses, Raphides, Calcium carbonate - Cystoliths with examples	1
MODULE - II (7 hrs)	Chapter 1	Tissues:- Definition -Types	0.5
	Chapter 2	Meristematic tissues - classification. i. Theories on apical organization - Apical cell theory, Histogen theory, Tunica corpus theory ii. Organization of shoot apex and differentiation of tissues - (protoderm, 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	1.5
	Chapter 3	Mature tissues - definition classification- simple complex and secretory i. Simple tissues - structure occurrence and function. ii. Complex tissues - Xylem & Phloem -structure, origin and function iii. Secretory tissues - glands, glandular hairs, nectaries, hydathodes, schizogenous and lysigenous ducts, resin ducts, laticifers - articulated and non-articulated	3
	Chapter 4	Vascular bundles - Origin and types - conjoint, collateral, bi-collateral, open closed, radial, concentric - amphicribral and amphivasal.	2

MODULE - III (5 hrs)	Chapter 1	Primary structure of root, stem & leaf (brief account only)	2
	Chapter 2	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
MODULE - IV (5 hrs)	Chapter 1	Extra stelar Secondary thickening in stem and root - Periderm formation. Structure - phellogen, phellem, phelloderm, bark, lenticels - structure & function.	2
	Chapter 2	Anomalous secondary growth - general account with special reference to the anomaly in Dicot stem - Boerhaavia, Bignonia and Monocot stem - Draceana.	3
PRACTICAL	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 c. Monocot stem - Bamboo d. Monocot root - Musa e. Dicot leaf - Ixora f. Monocot leaf - Grass 3. Secondary structure of Dicot stem and root - Vernonia 4. Anomalous secondary thickening in Boerhaavia, Bignonia and Draceana		27
REFERENCES (Angiosperm Anatomy)	1. Cuttler, E.G. (1969). Plant Anatomy, Part I: Cells & Tissue. Edward Arnold Ltd., London. 2. Cuttler, E.G. (1971). Plant Anatomy, Part III: Organs. Edward Arnold Ltd., London. 3. Eames, A.J. & L.H. MacDaniels (1987). An Introduction to Plant Anatomy. Tata MacGrew Hill Publishing Company Ltd. New Delhi. 4. Esau K. (1985). Plant Antomy (2nd ed.). Wiley Eastern Ltd. New Delhi. 5. Fahn A. (2000). Plant Anatomy. Permagon Press. 6. Pandey B.P. (2001). Plant Anatomy. S. Chand & Co. Delhi. 7. Tayal M.S. (2012). Plant Anatomy. Rastogi Publishers. Meerut. 8. Vasishta P.C. (1974). Plant Anatomy. Pradeep Publication, Jalandhar		
REPRODUCTIVE BOTANY & PALYNOLOGY (Theory 14 hrs)			**Hrs**
MODULE - V (7 hrs)	Chapter 1	Introduction to angiosperm embryology with special reference to Indian embryologists, floral morphology – parts of a flower (Brief account)	1
	Chapter 2	Microsporogenesis - Structure and function of wall layers - Development of male gametophyte - dehiscence of anther	3
	Chapter 3	Megasporogenesis - development of female gametophyte, embryosac- development and types- monosporic: Polygonum type, bisporic: Allium type, tetrasporic: Adoxa type.	3
MODULE - VI (7 hrs)	Chapter 1	Pollination, fertilization, barriers of fertilization germination of pollen grains, double fertilization.	2
	Chapter 2	Structure of embryo dicot (Cypsella), monocot (Sagittaria) and endosperm types	2
	Chapter 3	Palynology - Pollen morphology- Structure of pollen wall, Shape of pollen grains, Apertural morphoforms, Exine	3

		ornamentation; Pollen allergy, Economic and taxonomic importance	
PRACTICAL	1. Datura anther T.S. (mature) 2. Types of ovules: Orthotropous, Anatropous and Campylotropous (Slides only, drawing not required) 3. Dicot and monocot embryo of Angiosperms (Slides only, drawing not required) 4. Viability test for pollen: a. In vitro germination using sugar solution. (Cavity slide method) b. Acetocarmine test (Acetocarmine & Glycerine 1:1)		9
REFERENCES (Reproductive Botany & Palynology)	1. Agarwal S.B. (1984). Embryology of Angiosperms - a fundamental approach. Sahithya Bhavan, Hospital Road, Agra 2. Bhojwani S.S., Bhatnagar S.P. & Dantu P.K. (2015). The Embryology of Angiosperms. 6th edition, Vikas Publishing House (P) Ltd. 3. Davis C.L. (1965). Systematic Embryology of Angiosperms. John Wiley, New York. 4. Erdtman G. (1969). Hand Book of Palynology. National Botanical Gardens Publication, Lucknow. 5. Johri B.D., (ed.) (1984). Embryology of Angiosperms. Springer - Verlag, Berlin. 6. Maheswari P. (1985). Introduction to Embryology of Angiosperms. McGraw Hill, New York. 7. Nair P.K.K. (1970). Pollen Morphology of Angiosperms. Vikas Publishing House, Delhi. 8. Raghavan V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands. 9. Saxena M.R. (1993). Palynology - A treatise. Oxford, I.B.H. New Delhi. 10. Shivanna K.R. & Johri B.M. (1985). Pollen Biology: A Laboratory Manual. Springer - Verlag New York. 11. Shivanna K.R. &. Rangaswami N.S. (1993). Pollen Biology. Narosa Publishing House, Delhi. 12. Singh V., P.C. Pande & D.K. Jain (2001). Embryology of Angiosperms. Rastogi Publications, Meerut.		

SECOND SEMESTER B.Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT2B02T**			
Name of the course	**MICROBIOLOGY, MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
02	**CORE**	**3**	**4**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand the structure and lifecycles of bacteria and viruses.	8	U	Factual	PO1	PSO1

CO2	Realize the economic importance of bacteria in industry.	3	U	Factual	PO1	PSO1
CO3	Demonstrate bacterial staining and culture.	9	E	Procedural	PO7	PSO1
CO4	Recognise characters, distribution and biology of major fungal groups.	10	U	Factual	PO1	PSO1
CO5	Comprehend ecological and economic importance of fungi.	2	U	Factual	PO1	PSO1
CO6	Demonstrate fungal micro slide preparation.	14	E	Procedural	PO7	PSO1
CO7	Know the structure, reproduction and importance of Lichens.	4	U	Factual	PO7	PSO1
CO8	Examine thallus and fruiting body for identification of lichens.	4	An	Factual	PO7	PSO1
CO9	Comprehend the symptoms of plant diseases and control measures	8	U	Factual	PO1	PSO1
CO10	Analyze the symptoms of local plant diseases.	9	An	Factual	PO7	PSO1

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

Sl. No.	Subject	Theory	Practical	Total
1	Microbiology	9	9	18
2	Mycology	13	14	27
3	Lichenology	5	4	9
4	Plant Pathology	9	9	18
Total		**36**	**36**	**72**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Microbiology		Mycology		Lichenology	Pathology	Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (total 12)	3	1	4	1	1	2	Ceiling 20
5 marks (total 7)	1	1	2	1	1	1	Ceiling 30
10 marks (total 2)	1		1				1 x 10 =10
TOTAL							60

MICROBIOLOGY (12 hours)			Hrs
MODULE - I (9 hrs)	Chapter 1	Introduction to Microbiology	1
	Chapter 2	Bacteria - Classification based on morphology and staining, Ultra structure of bacteria; Bacterial growth, growth curve, Nutrition, Reproduction (Asexual only), Endospores.	5
	Chapter 3	Viruses - Classification (Based on genetic material), Bacteriophages - structure and lytic cycle, TMV - structure, retroviruses - HIV, Viriods, Prions - general account.	3
MODULE - II (3 hrs)	Chapter 1	Microbial ecology - Rhizosphere and Phyllosphere.	1
	Chapter 2	Industrial microbiology - alcohol, acids, milk products single cell proteins	1
	Chapter 3	Economic importance of bacteria, Vaccines.	1
PRACTICAL	1. Simple staining 2. Gram staining - Curd, root-nodules 3. Culture and isolation of bacteria using nutrient agar medium (demonstration only)		9
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. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology. McGraw Hill, India. 6th edition. 7. Rangaswami, R & C.K.J. Paniker (1998). Textbook of Microbiology. Orient Longman. 8. Ross, F.C. (1983). Introductory Microbiology. Charles E. Merill Publishing Company. 9. Schlegel (2008). General Microbiology. Cambridge University press India Pvt. Ltd 10. Sharma P.D. (2004). Microbiology and Plant Pathology. Rastogi Publication. 11. Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. Pearson Benjamin Cummings, San Francisco, U.S.A. 9th edition.		
MYCOLOGY (12 hours)			**Hrs**
MODULE - III (10 hrs)	Chapter 1	General characters and phylogeny of the kingdom Fungi, the concept of anamorph and teleomorph.	2
	Chapter 2	General characters, distribution, and biology of the following groups of fungi: a) Mastigomycotina. Type: Pythium b) Zygomycotina. Type: Rhizopus c) Ascomycotina. Types: Xylaria, Aspergillus d) Basidiomycotina. Types: Agaricus, Puccinia e) Deuteromycotina. Type: Cercospora.	8
MODULE - IV (2 hrs)	Chapter 1	Economic importance of fungi: Medicinal, industrial, Agricultural, Food, Genetic Studies and fungal toxins.	1
	Chapter 2	Ecological importance of fungi: different modes of nutrition (pathogenic/parasitic, saprobic, symbiotic)	1

PRACTICAL	Micropreparation - Lactophenol cotton blue - Slides of the above mentioned types.		14
REFERENCES (Mycology)	1. Alexopoulos C.J., Mims, C.W. & Blackwell, M. (1996). Introductory Mycology. 4th Edn., John Wiley and Sons, New York. 2. Alexopoulos, C.J. & Mims C.W. (1979) Introductory Mycology. 3rd Edn., John Wiley and Sons, New York. 3. Jim Deacon (2007). Fungal Biology. 4th Edn., Blackwell Publishing, Ane Books Pvt. Ltd 4. Mehrotra R.S. & Aneja K.R. (1990). An Introduction to Mycology. Wiley, Eastern Limited, New Delhi. 5. Sethi, I.K. & Walia, S.K. (2011). Text book of Fungi and Their Allies. Macmillan Publishers India Ltd.		
LICHENOLOGY (4 hours)			**Hrs**
MODULE - V (4 hrs)	Chapter 1	Introduction: Type of Interaction between the components symbiosis - mutualism.	1
	Chapter 2	Classification, growth forms, Structure, Reproduction, Economic importance. Type: Usnea	2
	Chapter 3	Toxicology, Lichens as food, Bioremediation, Ecological indicators, Pollution indicators, Lichen in Soil formation and pioneers of Xerosere.	1
PRACTICAL	1. Identification of different forms of Lichens. 2. Usnea: structure of thallus, fruiting body		4
REFERENCES (Lichenology)	1. Gilbert, O. (2004). Lichen Hunters. The Book Guild Ltd. England 2. Kershaw, K.A. (1985). Physiological Ecology of Lichen. 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 (8 hours)			**Hrs**
MODULE - VI (8 hrs)	Chapter 1	Introduction - Concepts of plant disease, pathogen, causative agents, symptoms	1
	Chapter 2	Symptoms of diseases: spots, blights, wilts, rots, galls, canker, gummosis, necrosis, chlorosis, smut, rust, damping off.	1
	Chapter 3	Control measures: Chemical, biological and genetic methods, quarantine measures.	1
	Chapter 4	Brief study of Plant diseases in South India (Name of disease, pathogen, symptom and control measures need to be studied): 1. Citrus Canker 2. Mahali disease of Arecanut 3. Blast of Paddy 4. Quick wilt of Pepper 5. Mosaic disease of Tapioca 6. Bunchy top of Banana 7. Grey leaf spot of Coconut	5

PRACTICAL	Identification of the disease, pathogen, symptoms and control measures of the following: (drawing not required) a. Citrus canker b. Mahali disease c. Tapioca mosaic disease d. Blast of Paddy e. Quick wilt of pepper f. Bunchy top of Banana g. Grey leaf spot of coconut	9
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. Agros, 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. Mehrotra, R.S. (1980). Plant Pathology. TMH, New Delhi. 4. Pandey, B.P. (1999). Plant Pathology: Pathogen and Plant diseases. Chand & Co., New Delhi. 5. Rangaswami, G. (1999). Disease of Crop plants of India. Prentice Hall of India Pvt. Ltd. 6. Sharma P.D. (2004). Plant Pathology. Rastogi Publishers.	

THRD SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT3B03T**			
Name of the course	**PHYCOLOGY, BRYOLOGY AND PTERIDOLOGY**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
03	**CORE**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand structure, pigmentation, reproduction and lifecycle of algae.	3	U	Factual	PO1	PSO1
CO2	Understand morphology, anatomy and reproduction of Algae	18	U	Factual	PO1	PSO1
CO3	Distinguish the economic importance and commercial products of algae.	2	E	Factual	PO1	PSO1
CO4	Differentiate the vegetative and	9	U	Factual	PO1	PSO1

	reproductive structures of algae.					
CO5	Comprehend morphology, anatomy, reproduction and lifecycle of bryophytes.	2	U	Factual	PO1	PSO1
CO6	Describe the characters, distribution and economic importance of bryophytes.	7	U	Factual	PO1	PSO1
CO7	Analysis the morphology and anatomy of bryophyte thallus and reproductive organs	9	An	Factual	PO7	PSO1
C08	Recognize the morphology, anatomy, reproduction and life cycle of pteridophytes.	14	U	Factual	PO1	PSO1
CO9	Understand the evolution, ecology and economic importance of pteridophytes	8	U	Factual	PO1	PSO1
CO10	Examine the anatomy of stem and reproductive organ of pteridophytes.	18	An	Factual	PO7	PSO1

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

Sl. No.	Subject	Theory	Practical	Total
1	Phycology	23	9	32
2	Bryology	9	9	18
3	Pteridology	22	18	40
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Phycology			Bryology	Pteridology		Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	1	4	1	2	2	2	Ceiling 20
5 marks (Total 7)	1	2	1	1	1	1	Ceiling 30
10 marks (Total 2)	1				1		1 x 10 =10
TOTAL							60

PHYCOLOGY (23 hours)			Hrs
MODULE - I (2 hrs)	Chapter 1	Introduction to Algae, Range of thallus structure, Pigments, Reproduction, Life cycle.	1
	Chapter 2	Classification of Algae proposed by F.E. Fritsch (1935).	2
MODULE - II (18 hrs)	Chapter 1	General features, Occurrence, thallus structure, reproduction, and life cycle of the types given below: a. Cyanophyceae: Nostoc b. Chlorophyceae: Chlorella, Volvox, Oedogonium, Chara. c. Xanthophyceae: Vaucheria. d. Bacillariophyceae: Pinnularia. e. Phaeophyceae: Sargassum. f. Rhodophyceae: Polysiphonia.	18
MODULE - III (2 hrs)	Chapter 1	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 - Algal blooms, eutrophication, neurotoxins, parasitic algae.	2
	Chapter 2	Phylogeny and evolution of Algae (brief account only)	
Practical	Identification of the vegetative and reproductive structures of the types studied.		9
REFERENCES (Phycology)	1. Anand, N. (1989). Culturing and cultivation of BGA. Handbook of Blue Green Algae. Bishen Sing Mahendra Pal Sing. 2. Fritsch, F.E. (1935). The structure and reproduction of the Algae. Vol. 1 and II, Uni. Press. Cambridge. 3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi. 4. Lee, R.E. (2008). Phycology. Cambridge University Press, Cambridge. 5. Mamatha Rao. (2009). Microbes and Non flowering plants: Impact and application. Anne Books Pvt. Ltd., New Delhi. 6. Morris, I. (1967) An Introduction to the algae. Hutchinson and Co. London. 7. Papenfuss, G.F. (1955). Classification of Algae: A Century of Progress in the Natural Sciences, 1853-1953. California Academy of Sciences, San Francisco: 115-224. 8. Robert Edward Lee (2008). Phycology. Cambridge University Press India Pvt. Ltd., New Delhi 9. Sahoo, D. (2000). Farming the ocean: Seaweeds cultivation and utilization. Aravali International, New Delhi. 10. Van Den Hoek, D.G. Mann and H.M. Jahns (2009). Algae: An Introduction to Phycology. Cambridge University Press, Cambridge.		
BRYOLOGY (9 hours)			**Hrs**
MODULE - IV (9 hrs)	Chapter 1	Introduction, general characters and classification by Stotler & Stotler (2008)	2
	Chapter 2	Study the distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details are not required) a. Riccia (Marchantiophyta) b. Anthoceros (Anthocerotophyta) c. Funaria (Bryophyta)	6
	Chapter 3	Economic importance of Bryophytes	0.5
	Chapter 4	Fossil Bryophytes	0.5

PRACTICAL	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 except at higher altitudes) - Habit, structure of antheridial cluster, archegonial cluster, L.S. of sporophyte.		9
REFERENCES (Bryology)	1. Alain Vanderpoorten and Bernard Goffinet (2009) Introduction to Bryophytes. Cambridge University Press. 2. Campbell H.D. (1940). The Evolution of land plants (Embryophyta). Univ. Press, Stanford. 3. Chopra R.N. and P.K. Kumar (1988). Biology of Bryophytes. Wiley Eastern Ltd. New Delhi. 4. Crandall-Stotler, B. and R. E. Stotler (2008). In A. J. Shaw and B. Goffinet, Bryophyte Biology, Cambridge University Press. 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. Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad. 8. Shaw, J.A. and Goffinet B. (2000). Bryophyte Biology. Cambridge University Press. 9. Smith G.M. (1938) Crytogramic Botany Vol. II. Bryophytes and Pteridophytes. McGraw Hill Book Company, London. 10. Sporne K.R. (1967). The Morphology of Bryophytes. Hutchinson University Library, London. 11. Vander-Poorteri (2009). Introduction to Bryophytes. COP. 12. Vasishta B.R. (2011). Bryophyta. S. Chand and Co. New Delhi. 13. Watson E.V. (1971). The structure and life of Bryophytes. Hutchinson University Library, London.		
PTERIDOLOGY (22 hours)			**Hrs**
MODULE - V (14 hrs)	Chapter 1	Introduction, general characters and classification (Smith et al., 2008 - brief outline only)	2
	Chapter 2	Study the distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details are not required) a. Selaginella (Lycopsida) b. Psilotum (Psilotopsida) c. Equisetum (Equisetopsida) d. Pteris (Polypodiopsida).	12
MODULE - VI (8 hrs)	Chapter 1	Apogamy and apospory in Pteridophytes; Stelar evolution in Pteridophytes; Heterospory and seed habit; Affinities of Pteridophytes; Economic importance of Pteridophytes.	8
PRACTICAL	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		18
REFERENCES (Pteridology)	1. Bower, F.O. (1935). Primitive Land Plants. Cambridge, London. 2. Chandra S. & Srivastava M. (2003) Pteridology in new millennium. 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 Pteridopyta. Vikas Publ. 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 University 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. Vasishta B.R. (1993). Pteridophyta. S. Chand and Co., New Delhi.

FOURTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT4B04T**			
Name of the course	**METHODOLOGY AND PERSPECTIVES IN PLANT SCIENCE**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
04	**CORE**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand the nature of science and steps in scientific method.	9	U	Factual	PO1	PSO1
CO2	Develop skills in ICT tools and bibliography.	9	Ap	Factual	PO7	PSO1
CO3	Recognise the basic tools for data collection and its interpretation.	7	An	Factual	PO7	PSO1
CO4	Comprehend the basic biostatistical tools and its applications.	8	U	Factual	PO1	PSO1

CO5	Apply biostatistical tool in research projects and derive conclusions.	9	Ap	Factual	PO7	PSO1
CO6	Understand the properties of biological solutions and separation techniques.	15	U	Factual	PO1	PSO1
CO7	Preparation and analysis of solutions and buffers.	9	An	Factual	PO7	PSO1
CO8	Describe the principles of microscopy and micrometry.	9	U	Factual	PO7	PSO1
CO9	Explain the paraffin method of permanent slide preparation.	5	U	Factual	PO7	PSO1
CO10	Demonstrate experiments in microscopy, micrometry and microtomy.	9	Ap	Factual	PO7	PSO1

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		Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	2	2	2	3	2	1	Ceiling 20
5 marks (Total 7)	1	1	1	2	1	1	Ceiling 30
10 marks (Total 2)	1			1			1 x 10 = 10
TOTAL							60

SCIENTIFIC METHODS (9 hours)			**Hrs**
MODULE - I (9 hrs)	Chapter 1	Nature of Science, Pseudoscience (Self study)	
	Chapter 2	Steps in scientific methods: Observation, Hypothesis, Experimental design, Data collection, Data analysis, Interpretation, Conclusion	2
	Chapter 3	Structure of Research report, Style of citation, Biological journals, Impact Factor, Sources of reference: Google Scholar, Shodhganga, NCBI, Inflibnet, e-pathshala.	5

	Chapter 4	Latest methods of presentation.	2
PRACTICAL	1. Bibliography searches using online tools 2. Familiarizing latest methods of ICT based presentations		9
REFERENCES (Scientific Methods)	1. Paul G. Hewitt; Suzanne A Lyons; John A. Suchocki and Jennifer Yeh (2006). Conceptual integrated science. Pearson New International Edn. 2. R.G. Newton (1997) The truth of Science Physical theories and reality. Viva Books, New Delhi, II Edn.		
BIOSTATISTICS (15 hours)			**Hrs**
MODULE - II (7 hrs)	Chapter 1	Introduction to Biostatistics: Importance and limitations of Biostatistics	1
	Chapter 2	Observations: direct and indirect observations, controlled and uncontrolled observations, human and machine observations.	1
	Chapter 3	Data collection: Introduction; Sampling; random and non-random.	1
	Chapter 4	Representation of data; Tables, Bar diagram, Pie diagram, Histogram, Frequency polygon, Ogive, Frequency curve [both manual and using computer].	3
	Chapter 5	Interpretation and deduction of data, significance of statistical tools in data interpretation, errors and inaccuracies.	1
MODULE - III (8 hrs)	Chapter 1	Measures of central tendency: mean, median and mode	2
	Chapter 2	Measures of dispersion: Range, Mean Deviation, Variance, Standard Deviation, Coefficient of variation.	2
	Chapter 3	Correlation and regression (brief account).	2
	Chapter 4	Test of hypothesis: Null hypothesis, Alternate hypothesis Chi-square test.	2
	Chapter 5	ANOVA, Ordination techniques (Brief account only).	
PRACTICAL	Work out problems under all types mentioned in the syllabus. One example each from all categories should be recorded. Familiarize the technique of data representation (bar diagram, histogram, pie-diagram and frequency curve (both manual and using computer).		9
REFERENCES (Biostatistics)	1. Jasra. P.K. and Raj Gurdeep (2000). Biostatistics. Krishna Prakashan Media Pvt Ltd. 2. Irfan Ali Khan & Atiya Khanum (2009). Fundamentals of Biostatistics. UKaaz Publications, Hyderabad. 3. Prasad, S. (2003). Elements of Biostatistics. Rastogi Publications. 4. Ramakrishnan, P. (2015), Biostatistics, Saras Publishers. 5. Rastogi, V.B. (2009). Fundamentals of Biostatistics. Ane Book Pvt. Ltd. 6. Norman T.J. Bailey (2007). Statistical Methods in Biology. Low Priced Edn., Cambridge University Press. 7. Zar, J.H. (2012) Biostatistical Analysis. Pearson Publication. U.S.A.		
BIOPHYSICS (15 hours)			**Hrs**
MODULE - IV (15 hrs)	Chapter 1	Solutions: representing concentrations: Molarity, Normality, Percentage and ppm.	2
	Chapter 2	Acids and bases, buffers and pH, measurement of pH. Preparation and use of buffers in biological studies.	3
	Chapter 3	Photometry: Colorimetry and Spectrophotometry, principle, working and uses.	3
	Chapter 4	Centrifugation: Principle, types of centrifuges and their applications	2

	Chapter 5	Chromatography: Principle and types - Adsorption chromatography, Partition chromatography, Ion exchange chromatography, Molecular sieving.	5
PRACTICAL	1. Preparation of solutions of known concentrations using pure samples and stock solutions 2. Preparation of buffers 3. Measurement of pH using pH meter. 4. Demonstration of the working of different kinds of centrifuges		9
REFERENCES (Biophysics)	1. Keith Wilson and John Walker (2008). Principles and techniques of Biochemistry and Molecular Biology 6th Edn. Cambridge University Press. 2. Hoppe, W. (1983). Biophysics. Springer Verlag. 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. Wong. C.H. (1965). Radiation Tracer Methodology in Biophysical Sciences. Prentice Hall.		
MICROTECHNIQUE (15 hours)			**Hrs**
MODULE - V (9 hrs)	Chapter 1	Principles of microscopy and parts of microscopes	1
	Chapter 2	Types of microscopes: Light microscope, Compound microscope, Phase contrast microscope, Fluorescent microscope, Electron microscope: Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM)	6
	Chapter 3	Micrometry: Stage micrometer, Ocular micrometer, Calibration and working.	1
	Chapter 4	Illustrations using digital camera and photomicrography, Camera lucida	1
MODULE - VI (6 hrs)	Chapter 1	General account of Killing and fixing, agents used for killing and fixing. Common fixatives Formalin - Acetic acid - Alcohol (FAA), Carnoy's fluids I & II, Chromic acid - Acetic acid - Formation (CRAF)	2
	Chapter 2	Dehydration and infiltration - general account of dehydration (Ethanol, Isopropyl alcohol, Acetone, Glycerine). Ethanol - Xylene series and Tertiary Butyl Alcohol Series.	1
	Chapter 3	Infiltration - paraffin wax method, embedding.	0.5
	Chapter 4	Free hand sectioning; Microtome (Rotary and sledge) serial sectioning and its significance.	1
	Chapter 5	Staining - General account, Classification: natural dyes, coal tar dyes, Mordant, Double staining, Vital staining	1
	Chapter 6	Mounting - Temporary, Permanent, DPX, Canada balsam	0
	Chapter 7	Whole mounting, maceration, squash and smears	0.5

PRACTICAL	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 / thickness of algal filament using micrometer. 4. Demonstration of dehydration, infiltration, embedding and microtoming.	9
REFERENCES (Microtechnique)	1. Johansen, D.A. (1940). Plant Microtehnique. McGraw -Hill Book Co., Inc. New York. 2. John Sass (1958). Botanical Microtechnique, Iowa State College Press. 3. Khasim, S.K. (2002). Botanical Microtechnique; Principles and Practice, Capital Publishing Company, New Delhi. 4. Toji, T. (2004). Essentials of botanical Microtechnique. Apex Infotec Publ. 5. Prasad, M.K. & M. Krishna Prasad (2000). Outlines of Microtechnique. EMKAY Publications	

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT5B06T**			
Name of the course	**GYMNOSPERMS, PALAEOBOTANY, PHYTOGEOGRAPHY, EVOLUTION**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
05	**CORE**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand morphology, anatomy, reproduction and life cycle of gymnosperms.	9	U	Factual	PO1	PSO2
CO2	Demonstrate anatomy of stem, leaf and reproductive organs of gymnosperms.	18	Ap	Factual	PO7	PSO2
CO3	Describe the formation and types of fossils with geological time scale.	8	U	Factual	PO1	PSO2
CO4	Discuss the Indian contributions in paleobotany.	1	U	Factual	PO1	PSO2
CO5	Analyze the anatomy of fossils pteridophytes and gymnosperms.	9	An	Factual	PO7	PSO2

CO6	Explain the phytogeography and its significance.	10	U	Factual	PO1	PSO2
CO7	Understand the endemism and phytochoria.	8	U	Factual	PO7	PSO3
CO8	Differentiate the phtogeographical zones of India.	9	U	Conceptual	PO7	PSO2
CO9	Comprehend the theories of evolution.	8	U	Conceptual	PO1	PSO2
CO10	Evaluate the process of organic evolution of species and speciation.	10	E	Factual	PO7	PSO2

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		Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	2	2	2	2	2	2	Ceiling 20
5 marks (Total 7)	1	1	2	1	1	1	Ceiling 30
10 marks (Total 2)	1		1				1 x 10 = 10
TOTAL							60

GYMNOSPERMS (9 hours)			**Hrs**
MODULE - I (9 hrs)	Chapter 1	Introduction, General characters and classification of Gymnosperms (Sporne, 1965).	1
	Chapter 2	Distribution, morphology, anatomy, reproduction, life cycle and affinities of the following types (Developmental details not required): Cycas, Pinus and Gnetum	6
	Chapter 3	Evolutionary trends in Gymnosperms; Affinities of Gymnosperms with Pteridophytes and Angiosperms	1
	Chapter 4	Economic importance of Gymnosperms.	1
PRACTICAL	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.		18

	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. Allahabd. 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 (9 hours)			**Hrs**
MODULE - II (9 hrs)	Chapter 1	Introduction and objectives	0.5
	Chapter 2	Fossil formation and types of fossils	1
	Chapter 3	Geological time scale - sequence of plants in geological time	2
	Chapter 4	Fossil Pteridophytes - Rhynia, Lepidodendron and Calamites	2
	Chapter 5	Fossil gymnosperms - Williamsonia	1
	Chapter 6	Important Indian Paleobotanical Institutes.	1
	Chapter 7	Indian Palaeobotanists: Birbal Sahni and Savithri Sahni	1
	Chapter 8	Applied aspects of Palaeobotany - exploration of fossil fuels	0.5
PRACTICAL	1. 1 Fossil Pteridophytes - Rhynia stem, Lepidodendron, and Calamites 2. Fossil gymnosperms - Williamsonia (Drawings may be replaced by photos with critical notes in the record)		9
REFERENCES (Palaeobotany)	1. Andrews H.N. (1961). Studies in Paleobotany. John Wiley and Sons Inc., New York. 2. Arnold C.A. (1947). Introduction to Paleobotany, 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). Palaeootany, Pradeep Publishing Company, Jalandhar. 5. Sewart, W.N. (1983). Palaeobotany and the Evolution of Plants. Cambridge Uni. Press, London. 6. Taylor, T.N. (1981). Paleobotany. An Introduction to Fossil Plant Biology. McGraw Hill, New York. 7. Steward A.C. (1935). Fossil Plants Vol. I to IV. Cambridge University Press, Cambridge. 8. Watson J. (1953). An introduction to study of fossil plants. Adams and Charles Black Ltd. London.		
PHYTOGEOGRAPHY (18 hours)			**Hrs**
MODULE - III (10 hrs)	Chapter 1	Definition, concept, scope and significance of phytogeography.	2
	Chapter 2	Patterns of plant distribution - continuous distribution and discontinuous distribution, vicarism, migration and extinction	3
	Chapter 3	Continental drift - Evidences and impact.	3
	Chapter 4	Glaciation: Causes and consequences.	2

MODULE - IV (8 hrs)	Chapter 1	Theory of land bridges.	2
	Chapter 2	Endemic distribution, theories on endemism, age and area hypothesis.	3
	Chapter 3	Phytogeographical zones (phytochoria) of India.	3
PRACTICAL	Mark the phytogeographic zones of India.		9
REFERENCES (Phytogeography)	1. Ronald Good (1947). The Geography of Flowering Plants. Longmans, Green and Co, New York 2. Armen Takhtajan (1986). Floristic Regions of the World. (Translated by T.J. Crovello & A. Cronquist). University of California Press, Berkeley. 3. Sharma, P.D. (2009). Ecology and Environment, Rastogi Publications, Meerut		
EVOLUTION (18 hrs)			**Hrs**
MODULE - V (8 hrs)	Chapter 1	Theories on Origin of Universe, Earth and Origin of life. Condensation and Polymerization; Protenoids and Prions – Oparin's concept; Miller's experiment.	3
	Chapter 2	Evolution of prokaryotic and eukaryotic cells, archaebacteria, early fossilized cells.	2
	Chapter 3	Theories on origin and evolution of species: Darwinism; Neo-Darwinism and its objection; Arguments and support for Darwinism, Modern concept of evolution.	3
MODULE - VI (10 hrs)	Chapter 1	Evidences of organic evolution from Morphology, Anatomy, Embryology, Palaeontology, Genetics and Molecular Biology.	3
	Chapter 2	Genetic Constancy and Creation of Variability: Cell divisions and genetic constancy; Genetic variability by recombination, Chromosomal variations, Gene mutations, Selection and genetic drift.	4
	Chapter 3	Speciation: Isolating mechanism, Modes of speciation: sympatric and allopatric	3
REFERENCES (Evolution)	1. Crick F. (1981). Life itself: Its origin and Nature. Simon and Schuster, New York. 2. Drake J.W. (1970). The molecular basis of mutation. Holden – Day, San Francisco. 3. Dott R.H. & R.L. Batten, (1981). Evolution of the earth 3rd ed. McGraw Hill New York. 4. Fox S.W. & Dose, K. (1972). Molecular evolution and the origin of life. W.H. Freeman & Co., San Francisco. 5. Gould S.J. (1977). Ontogeny and Phylogeny. Harvard Univ. Press, Cambridge. 6. Jardine N., & D. Mc Kenzie (1972). Continental drift and the dispersal and evolution of organisms. Nature, 234. 20-24. 7. Miller, S.L. (1953). A production of aminoacids under possible primitive earth conditions. Science, 117, 528-529. 8. Strickberger, (1990). Evolution. Jones and Bastlett Publishers International, England.		

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT5B07T**			
Name of the course	**ANGIOSPERM MORPHOLOGY& SYSTEMATICS**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
06	**CORE**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand the morphology of an angiosperm plant.	7	U	Factual	PO1	PSO4
CO2	Recognize the types of fruits in angiosperms.	7	U	Factual	PO1	PSO4
CO3	Identify the morphological parts of the angiosperm plant for taxonomy.	9	An	Factual	PO7	PSO4
CO4	Understand the components of taxonomy and systems of classification.	6	U	Factual	PO1	PSO4
CO5	Identify the diagnostic features and economic importance of angiosperm families	14	An	Factual	PO7	PSO4
CO6	Realize the taxonomic structure, hierarchy and character.	8	U	Factual	PO1	PSO4
CO7	Elaborate the modern trends in taxonomy.	8	U	Factual	PO1	PSO4
CO8	Comprehend the process of identification and nomenclature in plant taxonomy.	9	U	Factual	PO1	PSO4
CO9	Differentiate and illustrate plants based on taxonomic keys.	7	Ap	Factual	PO7	PSO4
CO10	Prepare herbarium specimens and artificial keys.	10	Ap	Factual	PO7	PSO4

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	Morphology		Systematics				Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	2	2	1	3	2	2	Ceiling 20
5 marks (Total 7)	1	1	1	2	1	1	Ceiling 30
10 marks (Total 2)	1		1				1 x 10 = 10
TOTAL							60

ANGIOSPEM MORPHOLOGY (14 hours)			**Hrs**
MODULE - I (7 hrs)	Chapter 1	Technical description of a flowering plant (Self study)	
	Chapter 2	Inflorescence: racemose, cymose and specialized (cyathium, hypanthodium, coenanthium verticillaster, thyrsus)	3
	Chapter 3	Flower: Flower as a modified shoot - detailed structure of flowers - floral parts -their arrangement, relative position, cohesion and adhesion - symmetry of flowers	4
MODULE - II (7 hrs)	Chapter 1	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
	Chapter 2	Botanical Illustrations, floral diagram and floral formula	2
PRACTICAL	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 photo album. (All drawings in records are replaced by photo album submission).		9
REFERENCES (Angiosperm morphology)	1. Gangulee, H.C., J.S. Das & C. Dutta. (1982) College Botany (5th Edn.) New Central Book Agency, Calcutta. 2. Lawrence, George, H.M. (1955). An Introduction to Plant Taxonomy. MacMillan comp. 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 (40 hours)			**Hrs**
MODULE - III (6 hrs)	Chapter 1	Components of systematics: identification, description nomenclature and classification; objectives and importance of systematics	2
	Chapter 2	Systems of classification: Artificial - Linnaeus; Natural - Bentham and Hooker; Phylogenetic - Hutchinson; Angiosperm Phylogeny Group system	4

MODULE - IV (14 hrs)	Chapter 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, Poaceae.	14
MODULE - V (8 hrs)	Chapter 1	Taxonomic structure - Hierarchy; Concepts of taxa: Species - Biological, Phenetic and Phylogenetic; Genus; Family.	2
	Chapter 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
	Chapter 3	Contributions of eminent Taxonomists viz. Hendrich Van Rheed, William Roxburg, Robert Wight, J.S. Gamble and E.K. Janaki Ammal.	2
MODULE - VI (12 hrs)	Chapter 1	Plant Nomenclature - Polynomial system, Binomial system, Common name, Limitations of Common name, Vernacular Name, ICN - Principles (brief); Typification (holotype, isotype, paratype, syntype and lectotype); Priority - merits and demerits; Effective and valid publication; Author citation, Rejected names, Conserved names.	3
	Chapter 2	Plant identification - Keys; indented and bracketed, construction and applications.	2
	Chapter 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 Thiruvanathapuram and MBGIPS, Kozhikode.	4
	Chapter 4	Taxonomic literature - Floras, e-Flora, Revisions, Monographs, Journals and online resources & Databases.	3
PRACTICAL	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 artificial key to segregate any five given plants. This must be recorded. 3. Familiarization of herbarium techniques. 4. Mounting of a properly dried and pressed specimen of 10 plants from any of the families mentioned in the syllabus, with proper herbarium label (to be submitted in the record book). 5. Every student shall submit 5 images of plants, at least 5 families (except the submitted herbarium) 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		27

	should be represented. The images can be submitted along with the photo album containing images of inflorescence and fruits mentioned under morphology. Individuality should be strictly maintained while preparing the photo album. 6. It is compulsory that every student has to undertake field study trips of 3 - 5 days to study vegetation of ecologically different 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. Submit a field visit report countersigned by the Head of the department during the practical examination. If a student fails to undergo the study tour he /she may not be permitted to attend the examination.	
REFERENCES (Systematics)	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. Delhi. 3. Clive A. Stace (1991). Plant Taxonomy and Biosystematics. Cambridge University Press. 4. Davis, P.H. & V.H. Heywood, (1963). Principles of Angiosperm Taxonomy. Oliver & Boyd Ltd., London. 5. Gurucharan Singh, (2012). Plant Systematics - Theory and Practice. Oxford & IBH, New Delhi. 6. Jeffrey, C. (1968). An introduction to Plant Taxonomy, London. 7. Mondal A.K. (2009). Advanced Plant Taxonomy. New Central Book agency Pvt. Ltd. Kolkota. 8. Nicholas J. Turland *et al.* (2018). International Code of Nomenclature for algae, fungi, and plants - Shenzhen Code (printed/ electronic version) Koeltz Botanical Books. 9. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper & Row Publishers, New York. 10. Sambamurthy A.S.S. (2005). Taxonomy of Angiosperms. I.K. International Pvt. Ltd, New Delhi. 11. Sharma, B.D. *et al.* (Eds.) (1996). Flora of India vol. I. Botanical Survey of India, Calcutta. 12. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, London 13. Sivarajan, V.V. (1991). Introduction to Principles of Plant Taxonomy. Oxford & IBH, New Delhi. 14. Stuessy, T.F. (1990). Plant Taxonomy - The systematic evaluation of Comparative data. Columbia University Press, New York.	

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT5B08T**			
Name of the course	**TISSUE CULTURE, HORTICULTURE, ECONOMIC BOTANY & ETHNOBOTANY**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
07	**CORE**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand the principles and techniques plant tissue culture.	10	U	Factual	PO1	PSO3
CO2	Explain the applications of tissue culture.	8	U	Factual	PO1	PSO3
CO3	Demonstrate culture medium preparation, sterilization and inoculation.	12	Ap	Factual	PO7	PSO3
CO4	Demonstrate potting, manuring, irrigation and seed propagation in horticulture.	8	Ap	Factual	PO7	PSO3
CO5	Comprehend the methods of gardening and production of horticultural crops.	9	U	Factual	PO1	PSO3
CO6	Demonstrate cutting, grafting, layering and create indoor and outdoor gardens.	12	Ap	Factual	PO7	PSO3
CO7	Recognize the binomial, family and useful part major economic crops of India.	9	U	Factual	PO1	PSO3
CO8	Identify the economically important local plants and their useful parts.	9	Ap	Factual	PO7	PSO3
CO9	Understand the significance of traditional botanical knowledge and its scope.	9	U	Factual	PO1	PSO3
CO10	Identify local plants with ethnobotanical significance.	3	Ap	Factual	PO7	PSO3

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		Horticulture		Economic Botany	Ethnobotany	Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	2	2	2	2	2	2	Ceiling 20
5 marks (Total 7)	2	1	1	1	1	1	Ceiling 30
10 marks (Total 2)	1		1				1 x 10 = 10
TOTAL							60

TISSUE CULTURE (18 hours)			**Hrs**
MODULE - I (10 hrs)	Chapter 1	Plant tissue culture - Principles and techniques; Cellular totipotency; in vitro differentiation - de differentiation and re-differentiation.	1
	Chapter 2	Tissue culture medium - Basic components in tissue culture medium - Solid and liquid medium; Murashige and Skoog medium - composition and preparation.	2
	Chapter 3	Aseptic techniques in in vitro culture - sterilization - different methods - sterilization of instruments and glassware, medium, explants; working principle of laminar air flow and autoclave.	1
	Chapter 4	Preparation of explants - surface sterilization, inoculation, incubation, sub culturing.	2
	Chapter 5	Micropropagation - Different methods - apical, axillary bud proliferation, direct and indirect organogenesis and somatic embryogenesis.	2
	Chapter 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 micropropogation. Somaclonal variation.	2
MODULE - II (8 hrs)	Chapter 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 germplasm	8
PRACTICAL	1. Preparation of nutrient medium - Murashige and Skoog medium using stock solutions, 2. Familiarize the technique of preparation of explants, surface sterilization, inoculation and sub culturing. 3. Preparation of synthetic seeds 4. Demonstration of anther culture		12

REFERENCES (Tissue culture)	1. Gamborg, O.L. & G.C. Philips (Eds.) (1995). Plant Cell, Tissue and Organ Culture: Fundamental Methods. Narosa Pulishing House, New Delhi. 2. Razdan M.K. (1995). Introduction to Plant Tissue Culture. Oxford & IBH publishing Co. Pvt. Ltd. 3. Reinert, J. and Y.P.S. Bajaj (1977). Plant Cell, Tissue and Organ Culture. Springer-Verlag, Berlin, Heidelberg, New York. 4. Edwin F. George, Michael A. Hall and Geert-Jan De Klerk. (2008). Plant propagation by tissue culture Volume 1. The Background. Springer, Netherlands. 5. Nagar Santosh and Adhav Madhavi (2010). Practical book of Biotechnology and Plant Tissue culture. S. Chand, New Delhi. 6. Bhojwani, S.S. & Danu, P.K. (2013). Tissue Culture: An Introductory Text. Springer.		
HORTICULTURE (18 hours)			**Hrs**
MODULE - III (8 hrs)	Chapter 1	Introduction, scope and significance; branches of horticulture	1
	Chapter 2	Soil - components of soil, types of soil.	1
	Chapter 3	Fertilizers - Chemical, organic, biofertilizer, compost.	1
	Chapter 4	Pots & potting - earthen, fibre, polythene bags, potting mixture, potting, repotting, top dressing.	1
	Chapter 5	Irrigation - Surface, sprinkle, drip and gravity irrigation.	1
	Chapter 6	Seed propagation - seed quality tests, seed treatment, essential condition for successful propagation - raising of seed beds, transplanting techniques.	3
MODULE - IV (10 hrs)	Chapter 1	Vegetative propagation: a) Cutting (stem, roots) b) Grafting (approach, cleft) c) Budding (T-budding, patch) d) Layering (simple, air).	4
	Chapter 2	Gardening - site selection; propagating structure: green house, poly house, moist chamber, net frame - Garden tools and implements.	1
	Chapter 3	Indoor gardening - selection of indoor plants, care and maintenance of indoor plants, Bonsai - Principle, creating the bonsai, terrarium making, flower arrangement.	1
	Chapter 4	Outdoor gardening; landscaping- goals, types.	1
	Chapter 5	Cultivation and post-harvest management of vegetables and ornamental plants.	1
	Chapter 6	Protection of Horticultural plants: Precautions to avoid pests and diseases. Bio pesticides.	1
	Chapter 7	Mushroom cultivation - Oyster mushroom.	1
PRACTICAL	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.		12
REFERENCES (Horticulture)	1. Adriance, G.W. and Brison F.R. (1971). Propagation Horticultural Plants. Krieger Pub Co. 2. Chanda, K.L. and Choudhury, B. (2014). Ornamental Horticulture in India. Indian Council of Agricultural Research, New Delhi.		

	3. George Acquaah, (2005). Horticulture: Principles and Practices. Pearson Education, Delhi. 4. Hartmann, H.T., Kester, D.E., Davies Jr., F.T., Geneve, R.L (2010). Plant Propagation, Principles and Practices. Pearson. 5. Katyal, S.C., (1977). Vegetable growing in India, Oxford, New York. 6. Kolay, A.K. (2002). Basic Concepts of Soil Science. New Age International Publishers, Delhi. 7. Naik, K.C., (1949). South Indian Fruits and their Culture. P Varadachary, Madras, India 8. Nishi Sinha (2002). Gardening in India, Abhinav Publications, New Delhi. 9. Prakash, R and K. Raj Mohan, (2005). Jaivakrishi (Organic farming), State Institute of Languages, Trivandrum. 10. Prasad, S., and U. Kumar (2012). Green house Management for Horticultural Crops, Agrobios, Jodhpur.		
ECONOMIC BOTANY (9 hours)			**Hrs**
MODULE - V (9 hrs)	Chapter 1	Study the different category of economically important plants their Binomial, Family and Morphology of useful part, products and uses: 1. Cereals and Millets - Rice, Wheat, Maize and 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, Sun flower. 12. Latex - Rubber. 13. Gums and Resins - Dammar, Gum Arabic, Asafetida. 14. Spices - Pepper, Ginger, Cardamom, Clove, Nutmeg, Allspice, Cinnamon. 15. Medicinal - Adhatoda, Catharanthus, Phyllanthus, Rauvolfia, Aloe.	9
PRACTICAL	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.		9
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. 3. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi.		

ETHNOBOTANY (9 hours)			Hrs
MODULE – VI (9 hours)	Chapter 1	Introduction, scope and significance	1
	Chapter 2	Major tribes of South India, Importance of Traditional Botanical Knowledge, TBGRI model of Benefit Sharing.	2
	Chapter 3	Ethnobotanic significance of the following: 1. *Aegle marmelos* 2. *Ficus religiosa* 3. *Curcuma longa* 4. *Cynadon dactylon* 5. *Ocimum sanctum* 6. *Trichopus zeylanica*	6
PRACTICAL	Students are expected to identify the plants mentioned in the Ethnobotany syllabus and it must be given as a table showing Common name, Binomial, Family and Ethnobotanical significance in the record book. (Drawing not required)		3
REFERENCES (Ethnobotany)	1. Baker, H.G. (1970). Plant and Civilization. Macmillan & Co. 2. Jain, S.K. (1995). A Manual of Ethnobotany. Scientific Publishers, Jodhpur. 3. Cotton, C.M. (1996). Ethnobotany - Principles and Applications. Wiley and Sons.		

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT5B09T**			
Name of the course	**CELL BIOLOGY AND BIOCHEMISTRY**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
08	**CORE**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand the ultra-structure of a plant cell and its functions.	6	U	Factual	PO1	PSO2
CO2	Recognize the structure of nucleus and chromosomes.	9	U	Factual	PO1	PSO2
CO3	Identify the cell cycle and chromosomal aberrations.	12	U	Factual	PO1	PSO2
CO4	Prepare slides of meiotic and mitotic stages.	9	Ap	Factual	PO7	PSO2

CO5	Comprehend the structure and function of carbohydrates and lipids.	11	U	Factual	PO1	PSO2
CO6	Explain the structure and function of acids and proteins.	10	U	Factual	PO7	PSO2
CO7	Discuss the structure and function of nucleotides and nucleotides derivatives.	10	U	Factual	PO1	PSO2
CO8	Understand the structure and function of secondary metabolites and enzymes.	6	U	Factual	PO1	PSO2
CO9	Test the presence of macromolecules from samples.	12	Ap	Factual	PO7	PSO2
CO10	Demonstrate colorimetry and spectrophotometry	8	Ap	Factual	PO7	PSO2

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 marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	1	2	3	3	2	1	Ceiling 20
5 marks (Total 7)	1	1	2	1	1	1	Ceiling 30
10 marks (Total 2)	1			1			1 x 10 = 10
TOTAL							60

CELL BIOLOGY (27 hours)			**Hrs**
MODULE - I (6 hrs)	Chapter 1	Architecture of cells. Prokaryotic and Eukaryotic cells.	1
	Chapter 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
MODULE - II (9 hrs)	Chapter 3	Nucleus - Nuclear membrane; Nuclear pore complex; organization of interphase Nucleus; Euchromatin and heterochromatin; Nucleolus.	4
	Chapter 4	Chromosomes - Morphology, classification, Centromere and Telomere, Chemical Composition and organization.	4

	Chapter 5	Special types of chromosomes - Polytene chromosomes, Lampbrush chromosomes.	1
MODULE - III (12 hrs)	Chapter 6	Cell division - Cell cycle - Mitosis & Meiosis - significance-molecular control of cell division	5
	Chapter 7	Chromosomal changes - structural aberrations: deletion, duplication, inversion, translocation - their meoitic consequences and significance	3
	Chapter 8	Numerical aberration - Defintion - Basic chromosome number (Genomic Number) Aneuploidy, Haploidy and Polyploidy - their meiotic behaviour and significance.	4
PRACTICAL	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.		9
REFERENCE (Cell biology)	1. Arumugham N. (2014). Cell Biology. Sara Publication, Nagercoil. 2. Avinash Upadhyaya & Kakoli Upadhayayo (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. Lewis. J. Kleinsmith & Valerie M. Kish (1995). Principles of Cell & Molecular Biology. Harper Collins. 6. Lewin B. (2017). Genes XII. Oxford University Press. 7. Lodish. H. *et. al.,* (2000). Molecular Cell Biology. Freeman & Company. 8. Powar C.B. (1988). Essentials of Cytology. Himalaya Publishing House. 9. Rastogi S.C. (2019). Cell Biology. New Age International (P) Ltd., New Delhi. 10. Rastogi. V.B. (2008). Fundamentals of Molecular Biology, Ane Books India.		
BIOCHEMISTRY (27 hours)			**Hrs**
MODULE - IV (11 hrs)	Chapter 1	Macromolecules - building block biomolecules - metabolic intermediates-precursors.	2
	Chapter 2	Carbohydrates: Classification; structure and functions of simple sugars and compound carbohydrates.	5
	Chapter 3	Lipids: Classification, Complex lipids, Simple lipids and derived lipids; Fatty acids saturated and unsaturated, triacyl glycerols, phospholipids, sphingolipids.	4
MODULE - V (10 hrs)	Chapter 4	Amino acids, peptides and proteins. Amino acids: classification based on polarity; zwitter ions, Dipeptides.	3
	Chapter 5	Proteins: Primary, secondary, tertiary and quaternary structures of proteins. Native comformation and biological functions of proteins. Denaturation and renaturation.	3
	Chapter 6	Nucleotides structure of nucleotides. Functions of nucleotides and nucleotide derivatives.	4
MODULE - VI (6 hrs)	Chapter 7	Secondary metabolites. A brief account of secondary metabolites, physiological roles. Significance: ecological importance.	2
	Chapter 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

PRACTICAL	a) 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. Seliwanoffs test for ketoses 5. Fearson's test (methyl amine test) for reducing disaccharides 6. Iodine test for starch 7. Ninhydrin test for amino acids and protein 8. Xanthoproteic test for amino acids with aromatic R-groups 9. Millon's test for tyrosine 10. Hopkins - Cole test for tryptophan 11. Biuret test for peptide linkage and proteins b) Quantitative estimation of protein by Biuret method. (Demonstration only) c) Quantitative estimation of DNA and RNA by colorimetric / spectrophotometric method (Demonstration only) d) Colorimetric estimation of reducing sugars in germinating seeds (Demonstration only)	27
REFERENCES (Biochemistry)	1. David L., Nelson and Michael M. Cox (2000). Lehninger. Principles of Biochemistry. 3rd edition. Macmillon, Worth U.K. 2. Sadasivam and Manickam, (2007) Biochemical methods. New Age International Publishers. New Delhi. 3. Bell, E. A. and B.V. Charlwood (Eds.) (1980). Secondary plant products, vol.8. Encyclopedia of Plant Physiology. Springer -Verlag, Berlin. 4. Goodwin Y.W. and Mercer E.I. (2003) Introduction to Plant Biochemistry. 2nd edition. CBS Publishers and distributors. 5. Donald Voet and Judith Voet (2004). Biochemistry. 3rd Edition. Wiley International Edition. 6. Keith Wilson and John Walker (2008). Principles and techniques of Biochemistry and Molecular Biology. 6th edition. Cambridge University Press. 7. Trevor Palmer (1991). Enzymes - Biochemistry, Biotechnology and Clinical Chemistry. Norwood Publishing, Chichester.	

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT6B10T**			
Name of the course	**GENETICS AND PLANT BREEDING**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
9	**CORE**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand the Mendelian heredity and variations.	11	U	Factual	PO1	PSO4

CO2	Comprehend the interaction of genes and multiple alleles.	9	U	Factual	PO1	PSO4
CO3	Explain the quantitative inheritance, linkage and crossing over.	10	U	Factual	PO1	PSO4
CO4	Identify the extra nuclear inheritance and population genetics.	6	U	Factual	PO1	PSO4
CO5	Analyze and solve problems in gene inheritance.	27	E	Factual	PO7	PSO4
CO6	Apprehend the plant genetic resources and plant introduction.	6	U	Factual	PO1	PSO4
CO7	Recognise the various plant breeding techniques.	12	U	Factual	PO1	PSO4
CO8	Comprehend modern tools for plant breeding.	2	U	Factual	PO1	PSO4
CO9	Undertake hybridization experiments in plants.	4	Ap	Factual	PO7	PSO4
CO10	Examine the floral biology of common crops.	3	Ap	Factual	PO7	PSO4

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 marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	3	2	3	1	1	2	Ceiling 20
5 marks (Total 7)	1	1	2	1	1	1	Ceiling 30
10 marks (Total 2)	1			1			1 x 10 = 10
TOTAL							60

GENETICS (36 hours)			Hrs
MODULE - I (11 hrs)	Chapter 1	Introduction- Brief account of Mendel's life history: Mendelian experiments: Monohybrid cross and dihybrid cross, Mendelian ratios, Laws of inheritance; Back cross, test cross.	5
	Chapter 2	Modified Mendelian ratios: 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
MODULE - II (9 hrs)	Chapter 1	Interaction of genes: Non epistatic - 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
	Chapter 2	Multiple alleles- general account: ABO blood group in man, Self sterility in Nicotiana, Coat colour in Rabbits.	3
MODULE - III (10 hrs)	Chapter 1	Quantitative inheritance / polygenic inheritance / continuous variation- Skin color in human beings, Ear size in maize.	3
	Chapter 2	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
MODULE - IV (6 hrs)	Chapter 1	Extra nuclear inheritance - general account – maternal influence - plastid inheritance in Mirabilis, Shell coiling in snails.	3
	Chapter 2	Population genetics; Hardy -Weinberg law and equation.	3
PRACTICAL	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		27

<table>
<tr><td>REFERENCE
(Genetics)</td><td colspan="3">1. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., & Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A.
2. Gunther, S. Spend & Richard Calender (1986). Molecular Genetics. CBS Publishers Delhi.
3. Gupta, P.K. (2019). Genetics. Rastogi Publications, Meerut.
4. John Ringo (2004). Fundamental Genetics. Cambridge University Press.
5. Klug, W.S., Cummings, M.R. & Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th Edn.
6. Lewin B. (2000). Genes VII. Oxford University Press.
7. Rastogi V.B. (2008). Fundamentals of Molecular Biology. Ane Books, India.
8. Sinnot, W.L.C. Dunn & J. Dobzhansky (1996). Principles of Genetics. Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
9. Snustad, D.P. & Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th Edn.
10. Verma, P.S. & Agarwal (1999). Text book of Genetics. S. Chand & Co., New Delhi.</td></tr>
<tr><td colspan="3">PLANT BREEDING (18 hrs)</td><td>Hrs</td></tr>
<tr><td rowspan="3">MODULE - V (6 hrs)</td><td>Chapter 1</td><td>Definition and objectives of Plant breeding - Organization of ICAR and its role in plant breeding.</td><td>2</td></tr>
<tr><td>Chapter 2</td><td>Plant Genetic Resources - Components of Plant Genetic Resources.</td><td>2</td></tr>
<tr><td>Chapter 3</td><td>Breeding techniques - a. Plant introduction: Procedure, quarantine regulations, acclimatization - agencies of plant introduction in India, major achievements.</td><td>2</td></tr>
<tr><td rowspan="2">MODULE - VI (12 hrs)</td><td>Chapter 1</td><td>b. Selection - mass selection, pureline selection and clonal selection, genetic basis of selection, significance and achievements.
c. Hybridization - procedure; intergeneric, interspecific and inter varietal hybridization with examples; composite and synthetic varieties.
d. Heterosis breeding - genetics of heterosis and inbreeding depression.
e. Mutation breeding - methods - achievements.
f. Polyploidy breeding
g. Breeding for disease and stress resistance</td><td>10</td></tr>
<tr><td>Chapter 2</td><td>Modern tools for plant breeding: Genetic Engineering and products of genetically modified crops (brief account only).</td><td>2</td></tr>
<tr><td>PRACTICAL</td><td colspan="2">1. Techniques of emasculation and hybridization of any bisexual flower.
2. Floral biology of Paddy, any one Pulse and Cashew.
3. Visit to a plant breeding station and submission of its report.</td><td>9</td></tr>
<tr><td>REFERENCES
(Plant breeding)</td><td colspan="3">1. Allard, R.W. (1960). Principles of Plant breeding. John Wiley & Sons, Inc, New York.
2. Chaudhari, H.K. (1971). Elementary Principles of Plant breeding. Oxford & IBH Publishers.
3. Singh, B.D. (2005). Plant Breeding - Principles & Methods. Kalyani Publishers, New Delhi.
4. Sinha, U. & Sunitha Sinha (2000). Cytogenetics, Plant breeding & Evolution, Vikas Publishing House.
5. Swaminathan, Gupta & Sinha (1983). Cytogenetics of Crop plants. Macmillan India Ltd.</td></tr>
</table>

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT6B11T**			
Name of the course	**BIOTECHNOLOGY, MOLECULAR BIOLOGY & BIOINFORMATICS**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
10	**CORE**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand the recombinant DNA technology.	8	U	Factual	PO1	PSO2
CO2	Recognize the application of biotechnology.	10	U	Factual	PO1	PSO2
CO3	Demonstrate the DNA extraction of plants.	12	Ap	Factual	PO7	PSO2
CO4	Describe the structure of Nucleic acids.	10	U	Factual	PO7	PSO2
CO5	Explain the gene expression and regulation.	8	U	Factual	PO1	PSO2
CO6	Elaborate types of mutation and significance.	6	U	Factual	PO1	PSO2
CO7	Comprehend role and application of bioinformatics.	8	U	Factual	PO1	PSO2
CO8	Understand the procedure of genomics and proteomics.	6	U	Factual	PO1	PSO2
CO9	Describe the molecular phylogeny and drug designing.	4	U	Factual	PO1	PSO2
CO10	Demonstrate the use of biological database for genomics.	12	Ap	Factual	PO7	PSO2

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 marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	2	2	2	2	2	2	Ceiling 20
5 marks (Total 7)	1	1	2	1	1	1	Ceiling 30
10 marks (Total 2)	1		1				1 x 10 = 10
TOTAL							60

BIOTECHNOLOGY (18 hours)			**Hrs**
MODULE - I (8 hrs)	Chapter 1	Introduction, concept, history of biotechnology	1
	Chapter 2	Recombinant DNA Technology: Gene cloning strategies - recombinant DNA construction - cloning vectors - plasmids pBR322, bacteriophage based vectors, Ti plasmids. Restriction endonucleases and ligases transformation and selection of transformants - using antibiotic resistances markers, southern blotting; PCR.	7
MODULE - II (10 hrs)	Chapter 1	Different methods of gene transfer - chemically stimulated DNA uptake by protoplast, electroporation, microinjection, biolistics. Agrobacterium mediate gene transfer gene library, gene banks.	5
	Chapter 2	Application of Biotechnology in: a. Medicine - Production of human insulin, human growth hormone b. Forensics - DNA finger printing. c. Agriculture - Genetically modified crops - BT crops, Golden rice, Flavr Savr Tomato, Virus, herbicide resistant crops, Edible vaccines. d. Environment- Bioremediation- use of genetically engineered bacteria-super bug. e. Industry - Horticulture and Floriculture Industry, production of vitamins, amino acids and alcohol.	5
PRACTICAL	1. Extraction of DNA from plant tissue. 2. Study of genetic engineering tools and techniques using photographs/diagram (Southern blotting, DNA finger printing, PCR).		12
REFERENCES (Biotechnology)	1. Brown T.A. (2006). Gene cloning and DNA analysis. Blackwell scientific publishers 2. Chawla H.S. (2000.) Introduction to Plant Biotechnology 3. Das, H.K. (Ed) (2005). Text book of Biotechnology (2nd ed) Wiley India (Pvt.), Ltd. New Delhi. 4. Gupta, P.K. (1996). Elementary Biotechnology. Rastogi & Company, Meerut.		

	5. Hammond, J., Megary, P *et al.* (2000). Plant Biotechnology. Springer-Verlag. 6. Ignacimuthu S. (1997.) Plant Biotechnology. New Hampshire Science Publishers. 7. Lewin B. (2004). Genes VIII. Oxford University Press 8. Purohit S.S. (2003). Agricultural Biotechnology. Agrobios (India) 9. Sobti R.C. & Pachauri S.S. (2009). Essentials of Biotechnology. Ane Books, New Delhi.		
MOLECULAR BIOLOGY (18 hours)			**Hrs**
MODULE - III (10 hrs)	Chapter 1	Nucleic acids - DNA - the genetic material; the discovery of DNA as the genetic material; bacterial transformation (Griffith's & Avery's experiments); Hershey and Chase experiment; Structure of DNA, Watson & Crick's Model, Types of DNA-(A,B,Z); Replication -semi conservative replication - Meselson and Stahl's experiment; Molecular mechanism of Replication, RNA- structure, types and properties.	6
	Chapter 2	Gene action - One gene - one enzyme hypothesis, one cistron one polypeptide hypothesis; concept of colinearity; modern concept of gene-cistorns, recons and mutons	2
	Chapter 3	Genetic code - Characters of genetic code	2
MODULE - IV (8 hrs)	Chapter 1	Central dogma, protein synthesis; Transcription, post-transcriptional modification of RNA, translation; Teminism.	3
	Chapter 2	Gene regulation in prokaryotes - operon concept - (*lac* operon, *trp* operon)	1
	Chapter 3	Gene regulation in eukaryotes (brief account)	1
	Chapter 4	Mutation-spontaneous and induced; causes and consequences. Types of mutagens and their effects. Point mutations - molecular mechanism of mutation - Transition, Transversion and substitution	3
SUBMISSION	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 T.A. (2003). Genomes. John Willey and Sons. 2. Hawkins, J.D. (1996). Gene Structure and Expression. Cambridge University Press 3. Lewin Benjamin (2017). Gene XII. Oxford University Press 4. Russell, P.J. (2010). Genetics - A Molecular Approach. Benjamin Cummings, U.S.A. 3rd Edn. 5. Malathi, V. (2010). Essentials of Molecular Biology, Pearson Education Inc. 6. Waseem Ahmad (2009). Genetics and Genomics. Pearson Education Inc. 7. 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, U.S.A. 6th Edn.		
BIOINFORMATICS (18 hours)			**Hrs**
MODULE - V (8 hrs)	Chapter 1	IT in teaching, learning and research: Web page designing and web hosting. Academic web sites, e-journals, Open access initiatives and open access publishing, education software, academic services - INFLIBNET, NICNET, BRNET.	3
	Chapter 2	e-wastes and green computing.	
	Chapter 3	Futuristic IT - Artificial intelligence, virtual reality, bio-computing.	

	Chapter 4	Introduction to Bioinformatics, brief history, scope and relevance, wet lab to web lab	5
	Chapter 5	Basics of Genomics, Proteomics and comparative genomics	
	Chapter 6	Biological data bases: Nucleotide sequence database - EMBL, GenBank, DDBJ. Protein database - SwissProt, PDB, Organismal database / Biodiversity database - Species 2000 / Human genome database	
	Chapter 7	Information retrieval from Biological database, sequence alignment types and tools: pair wise sequence alignment multiple sequence alignment, BLAST, Clustal W	
MODULE - VI (10 hrs)	Chapter 1	Genomics: DNA sequencing Sangers procedure-automation of DNA sequencing, genome sequence assembly.	6
	Chapter 2	Genome projects - Major findings and relevance of the following genome projects - Human, Rice.	
	Chapter 3	Proteomics : Protein sequencing- automation of sequencing, protein structure prediction and modelling (Brief account only)	
	Chapter 4	A brief account on 1. Molecular phylogeny and phylogenetic trees. 2. Molecular visualization - use of Rasmol. 3. Molecular docking and computer aided drug design.	4
PRACTICAL	1. Familiarizing with the different data bases mentioned in the syllabus. 2. Molecular visualization using Rasmol. 3. Blast search of nucleotide sequences.		12
REFERENCE (Bioinformatics)	1. Jin Xiong (2006). Essential Bioinformatics. Cambridge University Press, Replika Press Pvt. Ltd. 2. Ghosh Z. and Bibekanand M. (2008). Bioinformatics: Principles and Applications. Oxford University Press. 3. Pevsner J. (2009). Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell. 4. Campbell A. M., Heyer L.J. (2006). Discovering Genomics, Proteomics and Bioinformatics. 2nd Edn. Benjamin Cummings.		

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT6B12T**			
Name of the course	**PLANT PHYSIOLOGY AND METABOLISM**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
11	**CORE**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Recognise the water relationships of plants and	9	U	Factual	PO1	PSO2

	transpiration.					
CO2	Understand the ascent of sap and transpiration.	6	U	Conceptual	PO1	PSO2
CO3	Comprehend the process of absorption and mineral nutrition.	8	U	Factual	PO1	PSO2
CO4	Explain the process of photosynthesis and its significance.	8	U	Factual	PO1	PSO2
CO5	Recognize the process of nitrogen fixation and phloem transport.	7	U	Factual	PO1	PSO2
CO6	Discuss the plant growth and development.	9	E	Factual	PO7	PSO2
CO7	Elucidate the seed dormancy and germination.	3	U	Factual	PO1	PSO2
CO8	Describe the process of glycolysis.	5	U	Factual	PO1	PSO2
CO9	Comprehend the oxidative phosphorylation.	5	U	Factual	PO1	PSO2
CO10	Demonstrate plant physiological experiments.	18	Ap	Factual	PO7	PSO2

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

Sl. No.	Subject	Theory	Practical	Total
1	Plant Physiology	39	36	90
2	Metabolism	15		
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Plant Physiology					Metabolism	Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	2	1	2	1	2	4	Ceiling 20
5 marks (Total 7)	1	1	1	1	1	2	Ceiling 30
10 marks (Total 2)	1					1	1 x 10 = 10
TOTAL							60

PLANT PHYSIOLOGY (39 hours)			Hrs
MODULE - I (9 hrs)	Chapter 1	Properties of water (Self study)	
	Chapter 2	Plant cell and Water. Water as a solvent; cohesion and adhesion. Diffusion, osmosis, osmotic pressure, concept of water potential, components of water potential, osmotic potential, turgor pressure, imbibition, matric potential.	4
	Chapter 3	Transpiration. Types and process. Mechanism of guard cell movement. K+ ion mechanism. Why transpiration? Antitranspirants.	3
	Chapter 4	Absorption of water by transpiration pull and cohesion of water molecules. Radial movement of water through root. Soil-plant-atmosphere continuum.	2
MODULE - II (6 hrs)	Chapter 1	The ascent of sap; Transpiration pull and cohesion of water molecules. Merits and demerits of cohesion-tension theory.	2
	Chapter 2	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
MODULE - III (8 hrs)	Chapter 1	Photosynthesis in higher plants: Photosynthetic apparatus. Electromagnetic radiation. Absorption of light. Fluorescence and phosphorescene. Organization of light harvesting antenna pigments. Photochemical and chemical phases of photosynthesis and its evidences. Red drop and Emerson enhancement effect. 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
MODULE - IV (7 hrs)	Chapter 1	Biological nitrogen fixation, symbiotic nitrogen fixation in leguminous plants. Biochemistry of Nitrogen fixation. Genetics of nitrogen fixation, nif genes Ammonia assimilation, assimilation of nitrate. Biosynthesis of amino acids.	4
	Chapter 2	Translocation and distribution of photo assimilates. Mechanism of phloem transport. Phloem loading and unloading; pressure flow hypothesis.	3
MODULE - V (9 hrs)	Chapter 1	Plant growth and development. Auxins, gibberellins, cytokinins, abscisic acid and ethylene, their physiological roles. Photoperiodism and vernalization.	3
	Chapter 2	Plant movements - Phototropism, gravitropism. Nyctinastic and seismonatic movements.	3
	Chapter 3	Photomorphogenesis: Phytochrome: chemistry and physiological effects.	2
	Chapter 4	Seed dormancy and germination.	1

METABOLISM (15 hrs)			Hrs
MODULE - VI (15 hrs)	Chapter 1	Intermediary metabolism: anabolism, catabolism, amphibolic pathways and anapleurotic reactions.	3
	Chapter 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
	Chapter 3	Oxidation of fatty acids. P oxidation of saturated fatty acids in plants.	2
	Chapter 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
PRACTICAL	Students should familiarize experiments and details must be recorded. (Drawing 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. Absorbotranspirometer 12. Demonstration of gravitropism using Klinostat.		36
REFERENCES	1. Frank B. Salisbury and Cleon W. Ross (2002). Plant Physiology 3rd Edn. CBS publishers and distributers. 2. Noggle G. R and Fritz G J (1983). Introductory Plant Physiology. Prentice Hall. 3. Goodwin Y.W., and Mercer E.I. (2003). Introduction to Plant Biochemistry. 2nd Edn. CBS Publishers and distributors. 4. Hopkins WG (1999). Introduction to Plant Physiology, 2nd Edn, John Wiley A Sons, Inc. U.S.A. 4th Edn. 5. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. 6. Lincoln Taiz and Eduardo Zeiger (2002). Plant Physiology 2nd Edn, Sinauer Associates, Inc. Publishers. Sunderland, Massachusetts 7. Taiz, L., Zeiger, E., M0ller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th Edn. 8. Goodwin Y.W. and Mercer E.I. (2003). Introduction to Plant Biochemistry. 2nd edition. CBS Publishers and distributors. 9. David L; Nelson and Michael M Cox (2000). Lehninger. Principles of Biochemistry. 3rd Edn. Macmillon, Worth U.K. 10. Donald Voet and Judith Voet. (2004). Biochemistry. 3rd Edition. Wiley International Edn.		

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT6B13T**			
Name of the course	**ENVIRONMENTAL SCIENCE**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
12	**CORE**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Comprehend the structure and functions of ecosystems.	7	U	Factual	PO1	PSO3
CO2	Understand the ecological adaptations of plants and succession.	7	U	Factual	PO1	PSO3
CO3	Discuss the biodiversity and its conservation strategies.	9	E	Factual	PO1	PSO3
CO4	Recognize the environmental pollution and its management.	5	U	Factual	PO1	PSO3
CO5	Explain global environmental changes in climate.	5	U	Factual	PO1	PSO3
CO6	Recognize the phyotechnological approaches in pollution management.	5	U	Factual	PO1	PSO3
CO7	Elaborate the environmental legislations in India.	5	U	Factual	PO1	PSO3
CO8	Understand the ecosystems and communities of biosphere.	13	U	Factual	PO1	PSO3
CO9	Construct food web and ecological pyramids.	9	Ap	Factual	PO7	PSO3
CO10	Conduct plant community and diversity studies.	9	Ap	Factual	PO7	PSO3

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

Sl. No.	Subject	Theory	Practical	Total
1	Environmental Science	54	36	90
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Environmental Science						Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	1	1	4	2	1	3	Ceiling 20
5 marks (Total 7)	1	1	2	1	1	1	Ceiling 30
10 marks (Total 2)	1			1			1 x 10 = 10
TOTAL							60

ENVIRONMENTAL SCIENCE (54 hrs)			**Hrs**
MODULE – I (7 hrs)	Chapter 1	Ecosystem - Definition; abiotic and biotic factors; trophic structure; Food chain and food web; Ecological pyramids; Energy flow, Productivity of ecosystems.	4
	Chapter 2	Biogeochemical cycles (Carbon, Nitrogen, Phosphorous)	3
MODULE - II (7 hrs)	Chapter 3	Plant adaptations: Adaptations in Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites.	3
	Chapter 4	Plant Succession: Definition - Primary and Secondary succession; Autogenic and allogenic succession; Mechanism of plant succession - Xerosere and Hydrosere	4
MODULE - III (13 hours)	Chapter 1	Biodiversity and Conservation: Definition; Biodiversity - Global and Indian Scenario; Megadiversity nations and hotspots - Western Ghats and Sri Lanka: Biosphere reserves; Biodiversity centres in India.	5
	Chapter 2	Threats to biodiversity; Endangered and endemic plant species - Red data book - Exotic and indigenous plant species - Keystone species - Flagship species.	4
	Chapter 3	Conservation strategies ex situ and in situ methods. Organizations-IUCN, UNEP & WWF; (NBPGR) Biodiversity Board of Kerala (KSBDB).	4
MODULE - IV (9 hours)	Chapter 1	Pollution: Sources and types of pollution - air, water, soil, thermal and noise; biodegradable and non-biodegradable pollutants; biomagnifications; BOD.	4
	Chapter 2	Global environmental changes - climatic changes - global warming and greenhouse gases - acid rains - el-nino - Efforts of world organizations in the regulation of greenhouse gases emission.	5
MODULE - V (5 hours)	Chapter 1	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).	5
MODULE - VI (13 hours)	Chapter 1	Major ecosystems of the Biosphere; Sea; Estuarine ecosystem; Lentic ecosystem: lake, Pond; Lotic ecosystem: river; Desert; Forest; grass land.	5

	Chapter 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.	8
PRACTICAL	1. Construct a food web from the given set of data, (Representative of a natural ecosystem). (Drawing not required). 2. Construct ecological pyramids of number, biomass, energy from the given set of data (Representative of a natural ecosystem). (Drawing not required). 3. Study of plant communities: Determination of density, abundance, dominance, frequency by quadrat method. 4. Demonstration of determination of Dissolved Oxygen by Winkler's method. 5. Study of morphological and anatomical characteristics of plant groups: Hydrophytes, Xerophytes, halophytes, epiphytes, parasites. (Drawing not required). 6. Estimation of solid waste generated by a domestic system (biodegradable and non biodegradable) and its impact on land degradation.		36
REFERENCES	1. Beeby A. & Brennan A.M. (2004). First Ecology. Ecological Principles and Environmental Issues. Oxford University Press. 2. Cunninghan W.P. and M.A. Cunningham (2003). Principles of Environmental Science: Inquiry and Applications. Tata McGraw Hill Pub. 3. Dash M.C. (1993). Fundamentals of Ecology. Tata McGraw Hill Publishing Company Ltd. New Delhi. 4. Dix J.H. (1989). Environmental Pollution. Atmosphere, Land, Water and Noise. Wiley Chichester. 5. Khitoliya R.K. (2007). Environmental Pollution - Management and Control for Sustainable development. S. Chand and Company Ltd., New Delhi. 6. Mishra D.D (2008). Fundamental Concepts in Environmental Studies. S. Chand & Co., New Delhi. 7. Mishra S.P. & S.N. Pandey (2008). Essential Environmental Studies. Ane Books Pvt. Ltd. Thiruvananthapuram. 8. Odum E.P. (1983). Basics of Ecology. Saunders International UN Edition. 9. Shukla R.S. & P.S. Chandel (2005). A Text Book of Plant Ecology. S. Chand & Co. Ltd. New Delhi. 10. Wise D.L. (2005). Global Environmental Biotechnology. Ane Books. Trivandrum. 11. Bharucha E. (2005). Text Book of Environmental Studies for UG courses. University Press (India) Private Limited, Hyderabad. 12. Diamond, J., T.J. Case (1986). Community ecology. Harper & Row, New York. 13. Futuyma P.J., & Slatkin M. (1983) Co-evolution. Sinauer Associates, Sunderland. 14. Krebs, C.J. (1985). Ecology 3rd Edn. Harper & Row New York. 15. Sharma, P.D. (2008-2009). Ecology and Environment. Rastogi Publication. 16. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.		

ELECTIVE PAPERS

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT6B14T(E1)**			
Name of the course	**Elective-1: GENETIC ENGINEERING**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
13	**Elective**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Comprehend the method of gene cloning.	4	U	Factual	PO1	PSO2
CO2	Understand protocols for preparation of genomic DNA.	4	U	Procedural	PO1	PSO2
CO3	Explain the process of Isolation and purification of RNA.	4	U	Procedural	PO1	PSO2
CO4	Recognize the principle and method of electrophoresis.	4	U	Factual	PO1	PSO2
CO5	Discuss the method of molecular hybridization.	4	U	Procedural	PO1	PSO2
CO6	Describe the procedure of gene cloning and gene transfer.	4	U	Procedural	PO1	PSO2
CO7	Understand the production of transgenic plants.	4	U	Procedural	PO1	PSO2
CO8	Understand the applications of recombinant DNA technology.	2	U	Factual	PO1	PSO2
CO9	Discuss the ethical, social and legal issues on recombinant DNA technology.	2	E	Factual	PO7	PSO2
CO10	Demonstrate the spectrophotometry and electrophoresis.	6	Ap	Procedural	PO7	PSO2

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

Sl. No.	Subject	Theory	Practical	Total
1	Module 1	12	36	48
2	Module II	15		15
3	Module II1	15		15
4	Module 1V	12		12
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN

Type of questions	Genetic Engineering						Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	3	1	2	3	2	1	Ceiling 20
5 marks (Total 7)	2	1	1	1	1	1	Ceiling 30
10 marks (Total 2)	1			1			1 x 10 = 10
TOTAL							60

GENETIC ENGINEERING (54 hours)			**Hrs**
MODULE - I (12 hrs)	Chapter 1	Introduction to gene cloning	12
	Chapter 2	DNA isolation; DNA isolation solutions, isolation buffer pH, concentration and ionic strength, DNase inhibitors, detergents used for isolation, methods for breaking the cells	
	Chapter 3	Removal of proteins from cell homogenate; using organic solvents, Kirby method and Marmur method, using CTAB Removal of RNA; using RNase A, RNase T1	
	Chapter 4	Concentrating the isolated DNA; precipitating with alcohols, salts added along with alcohol	
	Chapter 5	Determination of the concentration and purity of DNA; using UV spectrophotometry	
	Chapter 6	Storage of DNA samples	
	Chapter 7	Commercially available kits for genomic and plasmid DNA isolation	
	Chapter 8	Preparation of genomic DNA from animal cells, plant cells and bacterial cells; protocol for small scale and large scale preparations	
	Chapter 9	Isolation of plasmid DNA; protocol for small scale and large scale preparations	
	Chapter 10	Isolation and purification of RNA; purification of total RNA, RNase inhibitors, preparation of cell material, preparation of glass wares, guanidinium hot phenol method, high salt lithium chloride method, isolation of poly A RNA	
MODULE - II (7 hrs)	Chapter 1	Agarose Gel electrophoresis of DNA and RNA	7
	Chapter 2	Principles of electrophoresis	
	Chapter 3	Buffers used for electrophoresis of nucleic acids	
	Chapter 4	Gel concentration, sample concentration, sample loading solutions	
	Chapter 5	Gel staining	

MODULE - III (8 hrs)	Chapter 1	Determination of molecular weight using molecular weight markers, special precautions and treatments required for electrophoresis of RNA, Elution of DNA from agarose gels; electroelution, using low-melting point agarose.	8
	Chapter 2	Nucleic acid transfer and hybridization; Southern blot transfer, dot-blot transfer, plaque and colony transfer, Southern blot hybridization, Northern blot transfer and hybridization, in situ hybridization	
	Chapter 3	Preparation of probes for hybridization, radioactive labeling, digoxigenin labeling, nick translation, preparation of primer using PCR, RNA probes	
MODULE – IV (12 hrs)	Chapter 1	Principle of DNA cloning	12
	Chapter 2	Cloning vectors; essential features of a cloning vector, plasmid derived vectors, bacteriophage derived vectors, hybrid vectors, high capacity cloning vectors; BACs, PACs and YACs, Agrobacterium based vectors, shuttle vectors, expression vectors	
	Chapter 3	Enzymes used in recombinant DNA technology; type II restriction endonucleases, ligases, S1 nuclease, alkaline phosphatase, terminal transferase, DNA polymerase I, reverse transcriptase, exonuclease III, bacteriophages X exonuclease,	
	Chapter 4	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, in silico gene discovery, cloning of the gene of interest, altering the gene of interest through site directed mutagenesis,	
	Chapter 5	Preparation of recombinant DNA molecule, blunt ends and sticky ends, using tailing method, using polylinkers	
	Chapter 6	Methods to transfer the recombinant DNA molecule into the cloning host; transformation, transfection, transduction, electroporation, microinjection, microprojectiles and DNA gun, Agrobacterium mediated transfer.	
	Chapter 7	6. Methods to select the recombinants; antibiotic markers, insertional inactivation, replica plating, blue-white selection, use of reporter genes; GUS, luciferase and GFP genes	
MODULE - V (8 hrs)	Chapter 1	Transgenesis; introduction to transgenic organisms and their applications.	8
	Chapter 2	Mechanism of gene transfer into eukaryotic cells, transfection methods; using polyetheleneglycol, chemical transfection using lithium acetate, calcium phosphate, and DEAE-dextran, lipofection, electroporation, microinjection, DNA gun, fate of DNA transferred to eukaryotic cells, random integration transgenesis - gain of function effects and loss of function effects, gene targeting.	
	Chapter 3	Examples of transgenic crop plants and animals	
MODULE - VI (7 hrs)	Chapter 1	Antisense and RNAi technology	7
	Chapter 2	Production of knock out models and their use	
	Chapter 3	Applications of recombinant DNA technology	
	Chapter 4	Ethical, Social and legal issues associated with recombinant DNA technology	

PRACTICAL	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.	36
REFERENCES	1. Watson, J.D. (1992). Recombinant DNA. Scientific American Books. 2. Watson, J.D. *et al*., (2006). Recombinant DNA: genes and genomes - a short course. WH Freeman & Co. 3. Alex Prokop *et al*., (1997). Recombinant DNA technology and applications. McGraw Hill. 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.	

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT6B14T(E2)**			
Name of the course	**Elective-2: ADVANCED ANGIOSPERM SYSTEMATICS**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
13	**Elective**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Discuss the history of plant taxonomy.	4	U	Factual	PO1	PSO4
CO2	Understand the methods in plant taxonomy.	6	U	Factual	PO1	PSO4
CO3	Elaborate the taxonomic characters and its utilization in	10	U	Factual	PO1	PSO4

	systematics.					
CO4	Prepare herbarium specimens and taxonomic keys.	3	Ap	Procedural	PO7	PSO4
CO5	Utilize the plant taxonomic resources for plant identification.	7	Ap	Factual	PO7	PSO4
CO6	Understand and practice ICN rules in plant nomenclature.	5	U	Factual	PO1	PSO4
CO7	Review on the Angiosperm phylogeny group system of classification.	6	E	Factual	PO7	PSO4
CO8	Recognize major plant families and their evolutionary trends.	9	Ap	Factual	PO7	PSO4
CO9	Identify plants with flora and taxonomic keys.	8	Ap	Procedural	PO7	PSO4
CO10	Conduct floristic surveys for plant checklists.	8	Ap	Procedural	PO7	PSO4

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

Sl. No.	Subject	Theory	Practical	Total
1	Advanced Angiosperm Systematics	54	36	90
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN

Type of questions	Advanced Angiosperm Systematics						Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	3	3	1	1	2	2	Ceiling 20
5 marks (Total 7)	1	2	1	1	1	1	Ceiling 30
10 marks (Tsotal 2)	1			1			1 x 10 = 10
TOTAL							60

ADVANCED ANGIOSPERM SYSTEMATICS (54 hrs)			**Hrs**
MODULE - I (12 hours)	Chapter 1	Scope and importance of Taxonomy.	2
	Chapter 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	4

	Chapter 3	Modern Phenetic methods (Numerical taxonomy); Modern Phylogenic methods (Cladistics). APG system of classification	6
MODULE - II (12 hours)	Chapter 1	The material basis of Systematics, Concept of character; Correlation of characters; character weighting; Character variation, isolation and speciation.	4
	Chapter 2	Sources of Taxonomic characters: Morphology, Anatomy, Palynology, Embryology, Cytology, Phytochemistry, Molecular Taxonomy. Role of the above mentioned branches in taxonomic studies	6
	Chapter 3	Identification techniques: Taxonomic literature: Flora, Revision, monograph, use and construction of taxonomic keys.	2
MODULE - III (10 hrs)	Chapter 1	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	3
	Chapter 2	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
	Chapter 3	Digital resources in taxonomy: Softwares, Databases, Online tools; use of TROPICOS, IPNI, Virtual herbaria, Digital flora / databases of Flora of Kerala.	4
MODULE - IV (5 hrs)	Chapter 1	Plant Nomenclature, History of nomenclature - Polynomial and binomial systems	2
	Chapter 2	Brief outline of ICN, Major rules; Typification; Rule of priority; Effective and valid publication; Author citation	3
MODULE - V (6 hrs)	Chapter 1	Taxonomic review of selected families as per APG system of classification. Critical study of the following families with emphasis on identification of local members, economic importance, inter relationships and evolutionary trends: Nymphaceae, Capparidaceae, Malvaceae, Rutaceae, Combretaceae, Lythraceae, Vitaceae	6
MODULE - VI (9 hrs)	Chapter 1	Critical study of the following families with emphasis on identification of local members, economic importance, inter relationships and evolutionary trends: Scrophulariaceae, Convolvulaceae, Bignoniaceae, Apocynaceae, Lamiaceae, Amaranthaceae, Urticaceae, Amaryllidaceae, Arecaceae, Cyperaceae.	9
PRACTICAL	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 the every families 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.		36

REFERENCES	1. Gurucharan Singh (2012). Plant Systematics - Theory and Practice. Oxford & IBH, New Delhi. 2. Gurucharan Singh (2019). Plant Systematics - An Integrated Approach. 4th edition. CRC Press. Florida. 3. Henry & Chandrabose (1997). An aid to International code of Botanical Nomenclature. BSI. 4. Heywood, V H & Moore, D M. (Eds) (1984). Current concepts in Plant Taxonomy 5. Lawrance, G H M. (1951). Taxonomy of Vascular Plants. Oxford & IBH 6. Mondal A.K. (2009). Advanced Plant Taxonomy, New Central Book agency Pvt Ltd. Kolkata. 7. Nicholas J. Turland *et al*. (2018). International Code of Nomenclature for algae, fungi, and plants- Shenzhen Code (printed/ electronic version) Koeltz Botanical Books. 8. Pandey, S.N. & S.P. Misra. (2008). Taxonomy of Angiosperms. Ane Books India, New Delhi. 9. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, London. 10. Singh, V & D K Jain. (1997). Taxonomy of Angiosperms. Rastogi Publications, Meerut. 11. Sivarajan, V.V. (1991). Introduction to principles of plant Taxonomy. Oxford & IBH.

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME				
Course code	**BOT6B14T(E3)**			
Name of the course	**Elective-3: GENETICS AND CROP IMPROVEMENT**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
14	**Elective**	**3**	**5**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand crop genetics and breeding in economic plants	12	U	Factual	PO1	PSO4
CO2	Discuss the plant genetic resources.	2	E	Factual	PO2	PSO4
CO3	Recognize the crop improvement institutes in the world.	4	U	Factual	PO1	PSO4
CO4	Apply the process of plant breeding by selection.	2	Ap	Factual	PO7	PSO4

CO5	Recognize the process of plant breeding by hybridization.	2	U	Factual	PO1	PSO4
CO6	Explain the methodology of ploidy and mutation breeding	4	U	Factual	PO1	PSO4
CO7	Understand the breeding methodology for stress and drought resistance.	8	U	Factual	PO1	PSO4
CO8	Describe the breeding methodology for disease and insect resistance.	10	U	Factual	PO1	PSO4
CO9	Demonstrate the hybridization techniques in local plants.	8	Ap	Factual	PO7	PSO4
CO10	Illustrate the floral biology of common crop plants.	8	E	Factual	PO2	PSO4

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

Sl. No.	Subject	Theory	Practical	Total
1	Module 1	11	36	47
2	Module II	10		10
3	Module 1II	4		4
4	Module 1V	7		7
5	Module V	22		22
Total		**54**	**36**	**90**

QUESTION PAPER PATTERN

Type of questions	Genetics and Crop Improvement						Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	3	2	1	1	2	3	Ceiling 20
5 marks (Total 7)	1	1	1	1	1	2	Ceiling 30
10 marks (Total 2)	1			1			1 x 10 = 10
TOTAL							60

GENETICS AND CROP IMPROVEMENT (54 hrs)			**Hrs**
MODULE - I (11 hrs)	Chapter 1	Crop genetics - General account of origin, genetic variability, floral biology, breeding techniques and achievements in: Rice, Coconut, Rubber, Arecanut, Cashew and Pepper	11
MODULE - II (10 hrs)	Chapter 1	Plant genetic resources - Definition; Classification of Plant Genetic resources. Activities - exploration, conservation, evaluation, documentation and utilization.	2
	Chapter 2	Agencies involved in plant genetic resources activities - NBPGR and IPGRI	4

	Chapter 3	International institutes for crop improvement - IRRI, ICRISAT, CPMMYT, IITA. Brief account on research activities and achievements of national institutes - IARI, CCMB, IISc, BARC, CPCRI, IISR, RRII, CTCRI, KFRI, TBGRI	4
MODULE - III (4 hrs)	Chapter 1	Methods of crop Improvement: a. Plant introduction b. Selection - Principles, Selection of segregating populations, achievements c. Hybridization - Interspecific hybridization; intergeneric - achievements. Genetics of back crossing, Inbreeding, Inbreeding depression, Heterosis and Heterobeltiosis.	4
MODULE - IV (7 hrs)	Chapter 1	Heteroploidy in crop improvement - achievements and future prospects -Significance of haploids and polyploids	2
	Chapter 2	Mutations in crop improvement - achievements and future prospects	2
	Chapter 3	Genetics of nitrogen fixation - Use of biofertilizers in crop improvement	2
	Chapter 4	Genetics of photosynthesis	1
MODULE - V (10 hrs)	Chapter 1	Breeding for resistance to abiotic stresses - Introduction, importance of abiotic and biotic stresses and its characteristics.	2
	Chapter 2	Breeding for drought resistance - Genetics of drought resistance; Breeding methods and approaches; Difficulties in breeding for drought resistance.	4
	Chapter 3	Breeding for mineral stress resistance - Introduction - Salt affected soils - Management of salt affected soils: Salinity resistance - General account.	4
MODULE - VI (12 hrs)	Chapter 1	Breeding for resistance to biotic stresses	2
	Chapter 2	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.	6
	Chapter 3	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.	4
PRACTICAL	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.		36
REFERENCES	1 Singh, B.D. (2000). Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi. 2 Sharma, J.R. (1994). Principles and Practice of Plant Breeding. Tata Mcgraw - Hill Publishing Company, New Delhi.		

	3	Benjamin Levin. (2007). Genes VIII.
	4	Allard, R W. (1960). Principles of Plant Breeding. John Wiely & Sons, New York.
	5	Chahal, G.S. & S.S. Gosal (1994). Principles and procedures of Plant Breeding. Narosa Publishing House, New Delhi.
	6	Chrispeels M.J. and Sadava, D.E. (1994). Plants, Genes and Agriculture. Jones and Bartlet Publishers, Boston, USA.

MODEL QUESTION PAPERS (THEORY)

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 1

BOT1B01T: ANGIOSPERM ANATOMY, REPRODUCTIVE BOTANY & PALYNOLOGY

Contact Hours per Week : 2

Number of Credits : 3

Number of Contact Hours : 36

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 5	Hour: 7	Hour: 5	Hour: 5	Hour: 7	Hour: 7
			Marks: 7	Marks: 21	Marks: 9	Marks: 9	Marks: 14	Marks: 19
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.		2				
		8.			2			
		9.				2		
		10.					2	
		11.						2
		12.		2				
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.					5	
C	10	20.		10				
		21.						10
Total Marks >> >>			7	21	9	9	14	19

FIRST SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 1
BOT1B01T
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. What is Aleurone grains? Give example
2. Define Amphicribral and Amphivasal vascular bundles
3. Describe the Heart wood and Sapwood with example
4. What is Phellogen and Phelloderm?
5. Distinguish the reproductive parts of a flower
6. Enumerate the major types of Apertural morphoforms
7. Examine the Organization of shoot apex in dicots
8. Sketch the Primary structure of leaf
9. Explain the structure and function of Lenticels
10. Analyse the development of female gametophyte
11. Differentiate the types of endosperm found in plants
12. Compare the types of Vascular bundles in Angiosperms

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

13. Summarise the different types of Mineral crystals with examples.
14. Describe the Histogen theory and Tunica corpus theory.
15. Explain the formation of and structure of Vascular cambium.
16. Evaluate the anomalous secondary growth in Bignonia with suitable illustration.
17. Elaborate the different the types of Anther dehiscence in angiosperms.
18. Compare and evaluate the Dicot embryo and Monocot embryo.
19. Differentiate the types of Embryosac found in plants with examples.

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

20. Write an essy on Complex tissues in angiosperms. Discuss the phylogenetic significance of complex tissues.
21. Explain the process of Microsporogenesis with illustrations.

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 2

BOT2B02T: MICROBIOLOGY, MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

Contact Hours per Week : 2

Number of Credits : 3

Number of Contact Hours : 36

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 9	Hour: 3	Hour:10	Hour: 2	Hour: 4	Hour: 8
			Marks: 21	Marks: 7	Marks: 26	Marks: 7	Marks: 7	Marks: 11
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.			2			
		9.						2
		10.	2					
		11.			2			
		12.						2
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.			5			
C	10	20.	10		10			
		21.						
Total Marks >> >>			21	7	26	7	7	11

SECOND SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 2
BOT2B02T
MICROBIOLOGY, MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

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

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

1. Describe the nature of Prions
2. What are Vaccines?
3. Describe Anamorph and Teleomorph
4. What are Fungal toxins? Give example
5. What is Symbiosis? give example
6. Define Necrosis and Chlorosis
7. Distinguish between Virus and Viriods
8. Differentiate between Xylaria and Aspergillus
9. Distinguish between Chemical and biological control of disease
10. Summarise the Bacterial growth curve
11. Examine the general characters of Pythium
12. Differentiate between Isidium and Soredium

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

13. Explain the structure of Bacteriophage and lytic cycle with suitable diagram.
14. Explain microbial ecology and distinguish between Rhizosphere and Phyllosphere.
15. Explain the lifecycle of Cercospora with suitable diagrams.
16. Differentiate the different modes of nutrition in fungi with examples.
17. Elaborate the economic importance of Lichens.
18. Enumerate Name of disease, pathogen, symptom and control measures of any five plant diseases.
19. Differentiate the reproductive characters of Rhizopus and Agaricus.

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

20. Write an essay on the Economic importance of bacteria with special reference in Industrial uses
21. Write an essay on general characters, distribution and life cycle of the Puccinia with suitable illustrations

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 3

BOT3B03T: PHYCOLOGY, BRYOLOGY AND PTERIDOLOGY

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 2	Hour: 18	Hour: 2	Hour: 9	Hour: 14	Hour: 8
			Marks: 7	Marks: 28	Marks: 7	Marks: 9	Marks: 19	Marks: 9
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.		2				
		8.				2		
		9.					2	
		10.						2
		11.		2				
		12.		2				
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.		5				
C	10	20.		10				
		21.					10	
Total Marks >> >>			7	28	7	9	19	9

THIRD SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 3
BOT3B03T
PHYCOLOGY, BRYOLOGY AND PTERIDOLOGY

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

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

1. Define Haplonitic life cycle with example
2. Describe the structure of female reproductive organ of Chara
3. What is parasitic algae? Give one example
4. Enumerate any four Economic importance of Bryophytes
5. Define Apogamy and Apospory
6. What is Rhizophore? Where it is found?
7. Examine the thallus structure of Volvox
8. Examine Fossil Bryophytes with an example
9. Evaluate the primitive features of Psilotum
10. Evaluate the Economic importance of Pteridophytes
11. Differentiate between conceptacles and receptacles in Sargassum
12. Discuss the role of Heterocyst and its role in agriculture

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

13. Differentiate the types of Reproduction in Algae.
14. Explain the reproduction in Vaucheria.
15. Evaluate the major lines of evolution in Algae.
16. Evaluate the structure of sporophyte of Anthoceros.
17. Evaluate the anatomical features of Equisetum.
18. Examine Heterospory leading to seed habit.
19. Explain the life cycle of Polysiphonia with suitable diagram.

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

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

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 4

BOT4B04T: METHODOLOGY AND PERSPECTIVES IN PLANT SCIENCE

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 9	Hour: 7	Hour: 8	Hour: 15	Hour: 9	Hour: 6
			Marks: 19	Marks: 9	Marks: 9	Marks: 26	Marks: 9	Marks: 7
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.			2			
		10.				2		
		11.					2	
		12.				2		
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.				5		
C	10	20.	10					
		21.				10		
Total Marks >> >>			19	9	9	26	9	7

FOURTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 4
BOT4B04T
METHODOLOGY AND PERSPECTIVES IN PLANT SCIENCE

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

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

1. What is Impact Factor? What does it indicate?
2. Compare Random and Non-random sampling?
3. Describe Hypothesis and Null Hypothesis?
4. What is buffer? State its role in biological solutions
5. What is Camera lucida?
6. What is maceration?
7. Distinguish between Science and Pseudoscience
8. Distinguish between Direct and Indirect observations
9. Differentiate Mean and Median
10. Differentiate Molarity and Normality
11. Compare Light microscope and Electron microscope
12. Explain the principle of Centrifugation

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

13. Explain the Sources of reference for a scientific research
14. Explain the methods of Representation of data
15. Elaborate the statistical tools used in Measures of dispersion
16. Differentiate Colorimetry and Spectrophotometry and explain principle and uses.
17. Elaborate the Principles of microscopy and parts of microscopes
18. Discuss the types of stains with suitable examples
19. Explain the principles and different types of chromatography

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

20. Elaborate the Steps in scientific methods and describe the different sources of reference
21. Write an essay on the Paraffin wax method for preparation of permanent slides

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 5

BOT5B06T: GYMNOSPERMS, PALAEOBOTANY, PHYTOGEOGRAPHY, EVOLUTION

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 9	Hour: 9	Hour: 10	Hour: 8	Hour: 8	Hour: 10
			Marks: 19	Marks: 9	Marks:14	Marks: 9	Marks: 9	Marks: 19
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.			2			
		10.				2		
		11.					2	
		12.						2
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.			5			
C	10	20.	10					
		21.						10
Total Marks >> >>			19	9	14	9	9	19

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 6
BOT5B06T
GYMNOSPERMS, PALAEOBOTANY, PHYTOGEOGRAPHY, EVOLUTION

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

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

1. What is an Ovuliferous scale? Where it is found?
2. Describe the Geological time scale
3. Summarise Migration and Extinction
4. Define Endemism? Give one example of endemic plant
5. Write short note on Archaebacteria
6. What is Genetic drift?
7. Interpret the Angiosperm features of Gnetum
8. Compare the different types of fossils
9. Evaluate Vicarism
10. Elaborate the Theory of land bridges
11. Evaluate Protenoids and Prions with regards to the evolution of life
12. Distinguish between Sympatric and Allopatric speciation

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

13. Comment on the Evolutionary trends in Gymnosperms and its relationships
14. Evaluate the anatomy of Rhynia, Lepidodendron and Calamites
15. Explain the causes and consequences of Glaciation
16. Elaborate the Phytogeographical zones of India
17. Evaluate Darwinism, Neo-Darwinism and Modern concept of evolution
18. Elaborate the process of Speciation with Isolating mechanisms
19. Explain the Evidences and impact of Continental drift

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

20. Evaluate the anatomy of Cycas leaflet and Pinus needle with suitable diagrams and elaborate the special types of tissues found in them.
21. Justify Organic evolution with evidences

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 5

BOT5B07T: ANGIOSPERM MORPHOLOGY& SYSTEMATICS

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 7	Hour: 7	Hour: 6	Hour: 14	Hour: 8	Hour: 12
			Marks: 19	Marks: 9	Marks: 7	Marks:16	Marks: 9	Marks: 19
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.				2		
		10.					2	
		11.						2
		12.				2		
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.				5		
C	10	20.	10					
		21.						10
Total Marks >> >>			19	9	7	16	9	19

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 7
BOT5B07T
ANGIOSPERM MORPHOLOGY & SYSTEMATICS

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

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

1. Define Actinomorphic and Zygomorphic flowers with examples
2. What is Aril and Caruncle?
3. Enumerate the Components of systematics
4. What are the distinguishing features of Myrtaceae?
5. Enumerate the contributions of J. S. Gamble
6. What is a Botanic Garden? List any two botanical gardens in India
7. Distinguish between Albuminous and Exalbuminous seeds with examples
8. Evaluate Angiosperm Phylogeny Group system of classification
9. Differentiate the families Apocynaceae and Solanaceae
10. Differentiate the Biological and Phylogenetic concepts of species
11. Elaborate Dichotomous Keys for plant identification
12. Evaluate the Economic importance of Malvaceae

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

13. Explain the different types of Placentation found in Angiosperms
14. Distinguish the different types of Fruits with examples
15. Evaluate the merits and demerits of Bentham and Hookers system of classification
16. Compare and contrast the sub families of Fabaceae
17. Elaborate the Modern trends in taxonomy
18. Explain the Herbarium preparation and maintenance and enumerate major herbaria of the world
19. Critically evaluate the reasons for the successful establishment of Asteraceae and Poaceae

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

20. Write an essay on the Racemose and Cymose types of Inflorescence with suitable examples and diagrams
21. How plants are named? Elaborate the principles and rules of ICN

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 5

BOT5B08T: TISSUE CULTURE, HORTICULTURE, ECONOMIC BOTANY & ETHNOBOTANY

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 10	Hour: 8	Hour: 8	Hour: 10	Hour: 9	Hour: 9
			Marks: 19	Marks: 9	Marks: 9	Marks:19	Marks: 9	Marks: 9
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.			2			
		10.				2		
		11.					2	
		12.						2
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.	5					
C	10	20.	10					
		21.				10		
Total Marks >> >>			24	9	9	19	9	9

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 8
BOT5B08T
TISSUE CULTURE, HORTICULTURE, ECONOMIC BOTANY AND ETHANOBOTANY

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

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

1. What is Cellular Totipotency?
2. What is Cybridization?
3. Comment on the formation of Humus
4. What is Bio pesticides? Give one example
5. Give Binomial, Family and Morphology of useful part of any two Beverages
6. Enumerate any four plants of Ethnobotanical significance and their uses
7. Explain somatic embryogenesis
8. Evaluate transgenic plants with examples
9. Distinguish between Chemical and Organic fertilizers
10. Differentiate between Budding and Grafting
11. Give Binomial, Family and Morphology of useful part of any two medicinal plant
12. Write short note on TBGRI model of Benefit Sharing

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

13. Elaborate the basic components of Tissue culture medium and types
14. Explain in vitro secondary metabolite production and bioreactors
15. Explain the different types of irrigation types
16. Explain the methods of post-harvest management of vegetables and ornamentals
17. Enumerate five spices with Binomial, Family and Morphology of useful part
18. Evaluate the Ethnobotanical information of any two tribes of South India
19. Explain the Preparation of explants for tissue culture technique

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

20. Elaborate the Methods and Applications of Tissue culture
21. Explain the Methods of Gardening and Bonsai creation

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 5

BOT5B09T: CELL BIOLOGY AND BIOCHEMISTRY

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 6	Hour: 9	Hour: 12	Hour: 11	Hour: 10	Hour: 6
			Marks: 7	Marks: 9	Marks: 26	Marks: 21	Marks: 9	Marks: 7
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.		2				
		8.			2			
		9.				2		
		10.					2	
		11.			2			
		12.				2		
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.			5			
C	10	20.			10			
		21.				10		
Total Marks >> >>			7	9	26	21	9	7

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 9
BOT5B09T
CELL BIOLOGY AND BIOCHEMISTRY

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

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

1. Describe the structure of fluid mosaic model of Plasmamembrane
2. What is Euchromatin and Heterochromatin?
3. Describe Aneuploidy
4. Define Sphingolipids
5. What are Zwitter ions? Give example
6. What are Co-enzymes?
7. Distinguish between Polytene chromosomes and Lampbrush chromosomes
8. Distinguish between mitosis and meiosis
9. Differentiate between Lipids and Fatty acids
10. How to induce Denaturation and Renaturation of protein
11. Examine the significance of Polyploidy
12. How polysaccharides are formed?

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

13. Elaborate Structure and function of any five cell organelles
14. Discuss the organization of interphase Nucleus
15. Elaborate the Cell cycle
16. Explain the classification of Carbohydrates
17. Evaluate the structure and functions of nucleotides and nucleotide derivatives
18. Elucidate the Mechanism of enzyme action
19. Explain the process of Meiosis and evaluate its significance

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

20. Evaluate the structural and numerical aberrations of Chromosomes
21. Evaluate the structure and biological functions of proteins

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 6

BOT6B10T: GENETICS AND PLANT BREEDING

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 11	Hour: 9	Hour: 6	Hour: 6	Hour: 6	Hour:12
			Marks: 7	Marks: 9	Marks: 16	Marks: 7	Marks: 7	Marks: 19
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.			2			
		10.						2
		11.	2					
		12.			2			
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.			5			
C	10	20.	10					
		21.						10
Total Marks >> >>			21	9	16	7	7	19

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 10
BOT6B10T
GENETICS AND PLANT BREEDING

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

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

1. Enumerate the Mendelian Laws of inheritance
2. Define Epistasis
3. What is polygenic inheritance?
4. Define Hardy -Weinberg law
5. What is Acclimatization?
6. Define Pureline selection
7. Distinguish between Monohybrid cross and Dihybrid cross
8. Solve Self sterility in Nicotiana
9. Evaluate the inheritance of Ear size in maize
10. Briefly explain the use of Genetic Engineering in plant breeding
11. Differentiate between Back cross and test cross.
12. Examine Quantitative inheritance

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

13. Analyse Incomplete dominance with suitable example
14. Analyse the complementary gene interaction of flower colour in Lathyrus
15. Examine the process of Mapping of chromosomes
16. Evaluate Extra nuclear inheritance with examples
17. Elaborate the Components of Plant Genetic Resources
18. Evaluate the significance of different types of Hybridization
19. How can you determine of Gene sequences?

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

20. Elaborate the process of Linkage and crossing over
21. Write an essay on the special Breeding techniques and its significance

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 6

BOT6B11T: BIOTECHNOLOGY, MOLECULAR BIOLOGY & BIOINFORMATICS

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 8	Hour: 10	Hour: 10	Hour: 8	Hour: 8	Hour:10
			Marks: 9	Marks: 19	Marks: 14	Marks: 9	Marks: 9	Marks: 19
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.			2			
		10.				2		
		11.					2	
		12.						2
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.			5			
C	10	20.		10				
		21.						10
Total Marks >> >>			9	19	14	9	9	19

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 11
BOT6B11T
BIOTECHNOLOGY, MOLECULAR BIOLOGY & BIOINFORMATICS

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

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

1. Define Restriction endonucleases and Ligases
2. What is Biolistics?
3. Explain the Watson & Crick's Model of DNA
4. What is Central dogma?
5. What is Virtual reality?
6. List out Major findings of Rice genome project
7. Elaborate PCR
8. Define Gene banks
9. Evaluate the Characters of genetic code
10. Briefly explain the Operon concept
11. Elaborate Proteomics
12. Describe the use of Rasmol

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

13. Elaborate Gene cloning strategies
14. Evaluate the Transgenic plants
15. Examine Semi conservative mode of replication
16. Explain the Molecular mechanism of mutation
17. Elaborate Biological data bases in the internet
18. Explain Molecular phylogeny and phylogenetic trees
19. Elaborate One gene - One enzyme hypothesis

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

20. Evaluate the Application of Biotechnology in different fields
21. Write an essay on Transcription and post-transcriptional modification of RNA

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 6

BOT6B12T: PLANT PHYSIOLOGY AND METABOLISM

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 9	Hour: 6	Hour: 8	Hour: 7	Hour: 9	Hour:15
			Marks: 9	Marks: 7	Marks: 19	Marks: 7	Marks: 9	Marks: 28
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.			2			
		9.					2	
		10.						2
		11.						2
		12.						2
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.						5
C	10	20.			10			
		21.						10
Total Marks >> >>			9	7	19	7	9	28

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 12
BOT6B12T
PLANT PHYSIOLOGY AND METABOLISM

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

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

1. What are Antitranspirants? Give example
2. What is RUBISCO? Explain its role
3. What are Quantasomes? Explain its role
4. Define Biological nitrogen fixation
5. Define Phloem loading and unloading
6. Define Chemiosmotic hypothesis
7. Distinguish between Diffusion and Osmosis
8. Explain Symbiotic nitrogen fixation
9. Define Vernalization
10. Explain Anapleurotic reactions
11. Distinguish between Anabolism and Catabolism
12. Comment on fatty acid synthase enzyme complex

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

13. Explain K+ ion mechanism with suitable illustration
14. Elaborate Facilitated diffusion and Carrier concept
15. Differentiate between C3 and C4 cycles
16. Explain the mechanism of Phloem transport
17. Explain Seed dormancy and methods to break seed dormancy
18. Elaborate Chemiosmotic hypothesis
19. Explain the fate of pyruvate under aerobic and anaerobic conditions

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

20. Evaluate the Photosynthetic Electron Transport and Photophosphorylation
21. Write an essay on the two phases of Glycolysis with suitable diagrams

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 6

BOT6B13T: ENVIRONMENTAL SCIENCE

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 7	Hour: 7	Hour: 13	Hour: 9	Hour: 5	Hour:13
			Marks: 7	Marks: 7	Marks: 28	Marks: 9	Marks: 7	Marks: 21
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.			2			
		8.				2		
		9.						2
		10.			2			
		11.						2
		12.			2			
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.			5			
C	10	20.			10			
		21.						10
Total Marks >> >>			7	7	28	9	7	21

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 13
BOT6B13T
ENVIRONMENTAL SCIENCE

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

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

1. What is Food chain and food web?
2. What are Halophytes? Give two examples
3. What is Biodiversity hotspots
4. What is Biomagnification?
5. Comment on Phytotechnological approach of Environmental pollution
6. Define Species area curve method
7. Explain the significance of Red data book
8. Explain Biological Oxygen Demand
9. Define Density and Frequency of plant communities
10. Explain Acid rains and el-Nino effect
11. Briefly explain the construction of Phytographs
12. What are greenhouse gases? Give example

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

13. Explain Nitrogen cycle with suitable diagram
14. Explain the mechanism of plant succession
15. Elaborate the Global and Indian scenario of Biodiversity
16. Explain biodegradable and non-biodegradable pollutants
17. Briefly explain the Environmental legislations in India
18. Explain Quadrat and transect methods for biodiversity assessment
19. Elaborate ex situ and in situ conservation strategies

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

20. Evaluate the Sources and types of air pollution and suggest abatement strategies
21. Evaluate the major ecosystems of the Biosphere

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 6

BOT6B14T(E1): GENETIC ENGINEERING

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 12	Hour: 7	Hour: 8	Hour: 12	Hour: 8	Hour: 7
			Marks: 26	Marks: 7	Marks: 9	Marks: 21	Marks: 9	Marks: 7
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.			2			
		9.				2		
		10.					2	
		11.	2					
		12.				2		
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.	5					
C	10	20.	10					
		21.				10		
Total Marks >> >>			26	7	9	21	9	7

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 14
BOT6B14T (E1)
Elective - 1: GENETIC ENGINEERING

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

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

1. How is DNA precipitated after isolation?
2. Elaborate the Buffers used for electrophoresis
3. What is Southern blot?
4. What are Restriction endonucleases?
5. Explain the Lipofection and electroporation,
6. Enumerate the applications of recombinant DNA technology
7. How can you store of DNA samples?
8. Elaborate RNA probes
9. Distinguish between Transfection and Transduction
10. Enumerate major transgenic crop plants
11. Elaborate RNase inhibitors
12. Differentiate Genomic DNA library and cDNA library

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

13. Explain the methods of Isolation and purification of RNA
14. Enumerate the Buffers used for electrophoresis of nucleic acids
15. Explain the Preparation of probes for DNA hybridization
16. Enumerate the vectors used in genetic engineering
17. Explain transfection methods for gene transfer
18. Explain Antisense and RNAi technology
19. Elaborate the methods of Removal of RNA

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

20. Elaborate the methods to transfer the recombinant DNA molecule into the cloning host.
21. Give a detailed account on construction and use of genomic DNA library and cDNA library.

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 6

BOT6B14T(E2): ADVANCED ANGIOSPERM SYSTEMATICS

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 12	Hour: 12	Hour: 10	Hour: 5	Hour: 6	Hour: 9
			Marks: 21	Marks: 16	Marks: 9	Marks: 17	Marks: 9	Marks: 9
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.					2	
		10.						2
		11.	2					
		12.		2				
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.		5				
C	10	20.	10					
		21.				10		
Total Marks >> >>			21	16	9	17	9	9

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 14
BOT6B14T (E2)
Elective - 2: ADVANCED ANGIOSPERM SYTEMATICS

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

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

1. Enumerate the contributions of Carl Linnaeus
2. Distinguish between Correlation of characters and character weighting
3. What is Virtual herbarium?
4. Explain Polynomial and binomial systems
5. Distinguish between the families Combretaceae and Lythraceae
6. Compare and contrast the families Scrophulariaceae and Convolvulaceae
7. Who are the herbalists? Give names of any two herbalists
8. Distinguish between Flora, Revision and monograph
9. Enumerate the Economic importance of Malvaceae
10. Evaluate the general characters of Bignoniaceae and Apocynaceae
11. Define Cladistics
12. Briefly explain the method of Numerical taxonomy

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

13. Elaborate APG system of classification
14. Explain the Sources of Taxonomic characters
15. Elaborate the Digital resources in taxonomy
16. Explain the process of Typification
17. Enumerate the primitive traits of Nymphaeceae and evolutionary trends
18. Explain economic importance and evolutionary trends in Amaranthaceae and Urticaceae
19. Explain the Taxonomic keys and elaborate the types

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

20. Evaluate Botanic gardens and their importance in taxonomic studies
21. Enumerate the Principles of ICN and explain details the major rules of ICN

PATTERN OF QUESTION PAPER (BSc BOTANY)

SEMESTER: 6

BOT6B14T(E3): GENETICS AND CROP IMPROVEMENT

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 11	Hour: 10	Hour: 4	Hour: 7	Hour: 10	Hour: 12
			Marks: 11	Marks: 19	Marks: 7	Marks: 7	Marks: 19	Marks: 16
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.					2	
		10.						2
		11.	2					
		12.						2
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.						5
C	10	20.		10				
		21.					10	
Total Marks >> >>			11	19	7	7	19	16

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE COURSE: 14
BOT6B14T (E3)
Elective - 3: GENETICS AND CROP IMPROVEMENT

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

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

1. What is Genetic variability?
2. What is Interspecific hybridization? Give example
3. What is Inbreeding depression?
4. Enumerate the application of Heteroploidy
5. How can attain Salinity resistance?
6. Distinguish between Oligogenic and Polygenic resistance
7. Write notes on the role of NBPGR in Crop improvement
8. Distinguish between Heterosis and Heterobeltiosis
9. Enumerate the difficulties in breeding for drought resistance
10. Enumerate the Achievements of Insect resistance
11. Write a note on the origin of Pepper
12. Evaluate Vertical and horizontal resistance

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

13. Evaluate the contributions of any five International institutes for crop improvemet
14. Elaborate the process of Plant introduction
15. Enumerate the contributions of RRII and CTCRI in crop improvement research
16. Discuss the Genetics of nitrogen fixation
17. Explain the Breeding for drought resistance
18. Discuss the Biotic stress resistance breeding
19. Evaluate the breeding methods for insect resistance

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

20. Write an essay on mutation breeding. Comment on its major advantages over the other methods of breeding
21. Write an essay on breeding for insect resistance - Mechanisms and methods

MODEL QUESTION PAPERS (PRACTICAL)

FOURTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE PRACTICAL EXAMINATION
Practical Paper-I: BOT4B05P
(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**

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 × 3 = 30 Marks

2. Identify the given bacteria **D** and submit the micro preparation for valuation.
   (Preparation-3) 3 x1 = 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

4. Identify the disease, pathogen and list out the symptoms from the given specimen **F** and **G**
   (Disease identification-1, Pathogen – 1, Symptoms-1)
   3 × 2 = 6 Marks

5. Determine the pollen viability of the sample **H**
   6 x1 = 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

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE PRACTICAL EXAMINATION
Practical Paper – II: BOT6B15P
(Gymnosperms, Palaeobotany, Phytogeography, Angiosperm Morphology, Systematics, Tissue culture, Horticulture, Economic Botany, Ethnobotany Cell Biology & Biochemistry)

Time: 4 Hours **Max: 80 Marks**

1. Prepare T.S. of the given material **A**, draw labelled diagram and identify the specimen
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 labeled diagram of the V.S. of the flower **D**
4 x 1 = 4 Marks
5. Identify the given sample **E** qualitatively
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 ½)
1.5 × 4 = 6 Marks
9. Comment on the morphology of the specimen **O** and **P**
2.5 x 2 = 5 Marks
10. Add critical note on the given specimen **Q** and **R**
1.5 x 2 = 3 Marks
11. Spot at sight **S - Z**
8 x 2 = 16 Marks

Practical: 80 Marks
Record: 15 Marks
Submission: 10 Marks
Study tour: 5 Marks
Total: 110 Marks

SIXTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
CORE PRACTICAL EXAMINATION
Practical Paper – III: BOT6B16P
(Genetics, Plant Breeding, Biotechnology, Molecular Biology, Plant Physiology & Environmental Science)

Time: 4 Hours **Max: 80 Marks**

1. Prepare a unidirectional chromatogram using the given extract **A** and calculate the Rf value of each component 10 x 1 = 10 marks

2. Workout the genetics problems **B** and **C** 8 + 7 = 15 marks

3. Enumerate aim, procedure and inference of the experiment setup of **D, E** and **F** 3 × 3 = 9 marks

4. Isolate the DNA from the given sample **G** 10 x 1 = 10 marks

5. Demonstrate hybridization in Specimen **H** 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 group of **J** and add a note on its adaptations 5 x 1 = 5 marks

8. Spot at sight **K** – **T** 2 × 10 = 20 marks

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

B.Sc. PROGRAMME IN BOTANY

COMPLEMENTARY COURSE

Table 12. COURSE STRUCTURE, WORK LOAD AND CREDIT DISTRIBUTION

Semester	Paper Code	Title of Paper	Hours/ Semester	Hours allotted / Week	Credit
S I	BOT1C01 T	COMPLEMENTARY COURSE I. **Angiosperm Anatomy & Micro technique**	36 hrs	2	2
	-	Complementary Course -I Practical	36 hrs	2	*
S II	BOT2C02 T	COMPLEMENTARYCOURSE II. **Cryptogams, Gymnosperms & Plant Pathology**	36 hrs	2	2
	-	Complementary Course –II Practical	36 hrs	2	*
S III	BOT3C03 T	COMPLEMENTARY COURSE - III. **Morphology, Systematic Botany, Eco. Botany, Plant Breeding & Horticulture**	54 hrs	3	2
	-	Complementary Course-III Practical	36 hrs	2	*
S IV	BOT4C04 T	COMPLEMENTARY COURSE - IV. **Plant Physiology, Ecology & Genetics**	54 hrs	3	2
	-	Complementary Course -IV Practical	36 hrs	2	*
	BOT4C05 P	COMPLEMENTARY PRACTICAL PAPER 1 **Angiosperm Anatomy, Microtechnique, Cryptogams, Gymnosperms, Plant Pathology, Morphology, Systematic Botany, Plant Physiology, Ecology, Genetics, Eco. Botany, Plant Breeding & Horticulture**			4
	TOTAL				**12**

- Credits of practical paper

Table 13. COURSE STRUCTURE, MARK DISTRIBUTION, SCHEME OF EXAMINATION

Course code & Title of course	Total Hours		Duration of Exams	Marks				Total Marks
				Theory		Practical		
	Theory	Practical		External	Internal	External	Internal	
Semester –I BOT1C01 T **Anatomy & Microtechnique**	36	36	2 hrs	60	15	--	--	75
Semester-II BOT2C02 T **Cryptogams, Gymnosperms & Plant Pathology**	36	36	2 hrs	60	15	--	--	75
Semester-III BOT3C03 T **Morphology, Syst. Botany, Economic Botany, Plant Breeding & Horticulture**	54	36	2 hrs	60	15	--	--	75
Semester-III BOT4C04 T **Plant Physiology, Ecology & Genetics**	54	36	2 hrs	60	15	--	--	75
Comple. Course Practical BOT4C05 P External Practical Exam Record Submission	--	--	3 hrs	--	--	60 15 10	15	100
Total	180	144		240	60	85	15	**400**

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%	Record	60%
Assignment	20%,	Lab involvement	40%
Seminar	20%		
Class room participation based on attendance	20%.		

FIRST SEMESTER B. Sc. BOTANY COMPLEMENTARY PROGRAMME				
Course code	**BOT1C01**			
Name of the course	**ANGIOSPERM ANATOMY AND MICROTECHNIQUE**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
1	**Complimentary**	**2**	**4**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand the types and functions of plant tissues.	7	U	Factual	PO1	PSO1
CO2	Identify primary and secondary structure of plant organs with vascular bundles.	7	Ap	Factual	PO7	PSO1
CO3	Illustrate primary and secondary anatomical structure of plant organs.	7	Ap	Factual	PO7	PSO1
CO4	Sketch the normal secondary thickening of plants.	7	Ap	Factual	PO7	PSO1
CO5	Identify the anomalous secondary growth in plants.	7	Ap	Factual	PO7	PSO1
CO6	Explain the extra stelar thickening in plants.	5	U	Factual	PO1	PSO1
CO7	Make anatomical micro-preparations of different plant parts.	12	Ap	Procedural	PO7	PSO1
CO8	Comprehend the basic botanical microtechnique.	1	U	Procedural	PO1	PSO1
CO9	Discuss the steps in paraffin method.	5	E	Procedural	PO2	PSO1
CO10	Demonstrate the preparation of preservatives and stains.	6	Ap	Procedural	PO7	PSO1

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 marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	3	2	2	2	2	1	Ceiling 20
5 marks (Total 7)	2	1	1	1	1	1	Ceiling 30
10 marks (Total 2)	1				1		1 x 10 = 10
TOTAL							60

ANGIOSPERM ANATOMY (27 hours)			**Hrs**
MODULE - I (8 hrs)	Chapter 1	Gross structure of primary and secondary cell walls; structure and function of plasmodesmata; non-living inclusions - Cystolith, Raphides.	1
	Chapter 2	Tissues - Definition, Kinds - Meristematic & Permanent; 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.	7
MODULE - II (7 hrs)	Chapter 1	Vascular bundles - types: conjoint - collateral, bicollateral, concentric and radial.	1
	Chapter 2	Primary structure of dicot and monocot root, dicot and monocot stem and leaf in dicot and monocot.	6
MODULE - III (7 hrs)	Chapter 1	Normal secondary thickening in dicot stem (Vernonia). 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.	7
MODULE - IV (5 hrs)	Chapter 1	d. Normal secondary thickening in dicot root (Tinospora) e. Anomalous secondary growth in Boerhaavia.	5

PRACTICAL	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	30
REFERENCES (Angiosperm anatomy)	1. Cuttler, EG. (1969). Plant Anatomy - Part I: Cells & Tissue. Edward Arnold Ltd., London. 2. Cuttler, E.G. (1971). Plant Anatomy, Part III: Organs. Edward Arnold Ltd., London. 3. Esau K. (1985). Plant Anatomy. Wiley Eastern Ltd. New Delhi. 4. Pandey B.P. (2012). Plant Anatomy, S. Chand & Co. Delhi. 5. Vasishta P.C. (1974). Plant Anatomy, Pradeep Publication, Jalandhar. 6. Tayal M.S. (2004). Plant Anatomy. Rastogi Publishers, Meerut.	

MICROTECHNIQUE (9 hrs)			**Hrs**
MODULE - V (5 hrs)	Chapter 1	Microtechnique - Brief Introduction	1
	Chapter 2	Microscopy: simple, compound and electron microscope	2
	Chapter 3	Microtomy: Rotary type, serial sectioning, paraffin method, significance.	2
MODULE - VI (4 hrs)	Chapter 1	Killing and fixing: Killing and fixing agents and their composition (Farmer's fluid and FAA.)	2
	Chapter 2	Dehydration and clearing - reagents.	2
	Chapter 3	Stains - Saffranin and acetocarmine, preparation and use.	
PRACTICAL	1. Familiarize the structure and working of compound microscope (drawings not required). 2. Preparation of Safranin, FAA and Acetocarmine.		6
REFERENCES (Microtechnique)	1. Johansen, D.A. (1940). Plant Microtehnique. McGraw - 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. Toji, T. (2004). Essentials of Botanical Microtechnique. Apex Infotec Publ.		

SECOND SEMESTER B. Sc. BOTANY COMPLEMENTARY PROGRAMME				
Course code	**BOT2C02**			
Name of the course	**CRYPTOGAMS, GYMNOSPERMS & PLANT PATHOLOGY**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
2	**Complimentary**	**2**	**4**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand the structure, nutrition, reproduction of bacteria and viruses.	9	U	Factual	PO1	PSO1
CO2	Demonstrate the bacterial staining technique.	5	Ap	Procedural	PO7	PSO1
CO3	Recognise the diagnostic features and evolutionary trends of major classes of Algae.	6	U	Factual	PO1	PSO1
CO4	Comprehend the diagnostic features of major classes of fungi and lichens.	6	U	Factual	PO1	PSO1
CO5	Demonstrate the structure and life history major groups of fungi.	13	U	Factual	PO1	PSO1
CO6	Explain the morphology and life history of Riccia and Selaginella.	8	U	Factual	PO1	PSO1
CO7	Familiarise the morphology and life history of Cycas.	4	U	Factual	PO1	PSO1
CO8	Illustrate anatomical features of lower group of plants.	13	Ap	Factual	PO7	PSO1
CO9	Elaborate common plant diseases and its control measures.	3	U	Factual	PO2	PSO1
CO10	Identify common plant diseases based on symptoms.	5	Ap	Factual	PO7	PSO1

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

Sl. No.	Subject	Theory	Practical	Total
1	Module I: Virus, Bacteria, BGA	7	2	9
2	Module II: Phycology, Mycology, Lichenology	11	10	21
3	Module III: Bryology, Pteridology, Gymnosperms	15	10	25
4	Module IV: Plant Pathology	3	4	7
Total		**36**	**36**	**72**

QUESTION PAPER PATTERN & SUBJECT WISE DISTRIBUTION OF MARKS

Type of questions	Cryptogams				Gymnosperms	Plant Pathology	Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	3	2	3	2	1	1	Ceiling 20
5 marks (Total 7)	2	1	2	1	1		Ceiling 30
10 marks (Total 2)	1		1				1 x 10 = 10
TOTAL							60

CRYPTOGAMS & GYMNOSPERMS			**Hrs**
MODULE - I (9 hrs)	Chapter 1	Virus: General account of viruses, including structure of TMV & Bacteriophage.	2
	Chapter 2	Bacteria: Classification based on shape of flagella, structure, nutrition (brief account), reproduction and economic importance - agriculture, industry and medicine	5
	Chapter 3	Cyanobacteria: General Account structure, life - history and economic importance of Nostoc	2
PRACTICAL			5
MODULE - II (6 hrs)	Chapter 1	Phycology: General characters, classification, evolutionary trends in algae.	2
	Chapter 2	Structure, reproduction, life history and economic importance of the following classes with suitable examples: a) Chlorophyceae (Spirogyra) b) Phaeophyceae (Sargassum) c) Rhodophyceae (Polysiphonia)	4
MODULE - III (9 hrs)	Chapter 3	Mycology: General characters, classification (Alexopoulos, 1979) (brief mention only) and evolutionary trends in fungi. Important features of the following divisions: a) Mastigomycotina b) Ascomycotina c) Basidiomycotina	3
	Chapter 4	Structure and life history of Puccinia (developmental details not required)	2
	Chapter 5	Lichenology: General account and economic importance of Lichens with special reference to Usnea.	1
PRACTICAL			13
MODULE - IV (8 hrs)	Chapter 1	Bryology: General account, morphology and life - history of Riccia	4
	Chapter 2	Pteridology: General account, morphology and life history of Selaginella	4
MODULE - V (4 hrs)	Chapter 1	Gymnosperms: General account, morphology and life history of Cycas	4
PRACTICAL	1. Make suitable micro preparations of vegetative and reproductive structures of Sargassum, Puccinia, Riccia, Selaginella and Cycas. 2. Identify and draw labelled diagrams of the types mentioned in the syllabus		13

REFERENCES (Cryptogams & Gymnosperms)	1. Fritsch, F.E. (1935). The structure and reproduction of the algae. Vol. 1 and II, Uni. Press. Cambridge. 2. Morris, I. (1967). An Introduction to the algae. Hutchinson and Co. London. 3. 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. 4. Vasishta, B.R. (2010). Botany for Degree Students: Algae. S. Chand Pvt. Ltd, New Delhi. 5. Mamatha Rao (2009). Microbes and Non-flowering plants: Impact and applications. Ane Books, New Delhi. 6. Sanders, W.B. (2001) Lichen interface between mycology and plant morphology. Bioscience, 51: 1025-1035. 7. Vasishta, B.R., Sinha, A.K. & Anil Kumar (2016). Botany for Degree Students: Fungi. S. Chand Publications. 8. Vasishta B.R. *et. al*. (2010). Botany for Degree Students: Bryophyta. S. Chand Publications. 9. Rashid A. (1999). An Introduction to Pteridophyta, Diversity, Development & Differentiation. Vikas Publishing House Pvt Ltd. 10. Chamberlain C.J. (1935). Gymnosperms - Structure and Evolution, Chicago University Press. 11. Sreevastava H.N. (1980). A Text Book of Gymnosperms. S. Chand and Co. Ltd., New Delhi. 12. Vasishta P.C. (1980). Gymnosperms. S. Chand and Co., Ltd., New Delhi.		
PLANT PATHOLOGY			**Hrs**
MODULE - VI (3 hrs)	Chapter 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	3
PRACTICAL	Identify the diseases (mentioned in the theory syllabus) on the basis of symptoms and causal organisms. (Drawings can be replaced by photos pasted in the record)		5
REFERENCES (Plant Pathology)	1. Agros, 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.		

THIRD SEMESTER B. Sc. BOTANY COMPLEMENTARY PROGRAMME				
Course code	**BOT3C03**			
Name of the course	**MORPHOLOGY, SYSTEMATIC BOTANY, ECONOMIC BOTANY, PLANT BREEDING AND HORTICULTURE**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
3	**Complimentary**	**2**	**4**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Identify the types of inflorescences and floral morphology.	4	U	Factual	PO1	PSO4
CO2	Understand the herbarium techniques, nomenclature and systems of classification.	8	U	Factual	PO1	PSO4
CO3	Recognize the trends in taxonomy and characters of common plant families.	16	E	Factual	PO1	PSO4
CO4	Illustrate morphology of common plant families and preparation of herbarium.	20	Ap	Procedural	PO7	PSO4
CO5	Understand the binomial and family of economically important plants.	4	U	Factual	PO1	PSO4
CO6	Identify the economically important plants using its morphology.	4	Ap	Procedural	PO7	PSO4
CO7	Understand the different plant breeding techniques.	7	U	Factual	PO1	PSO4
CO8	Demonstrate hybridization technique in plants.	4	Ap	Procedural	PO7	PSO4
CO9	Explain the methods of plant propagation and plant growth control.	7	E	Factual	PO2	PSO4
CO10	Demonstrate budding, grafting and layering.	4	Ap	Procedural	PO7	PSO4

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	Morphology	Systematic Botany		Economic Botany	Plant Breeding	Horticulture	Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	2	2	3	1	2	2	Ceiling 20
5 marks (Total 7)	1	1	2	1	1	1	Ceiling 30
10 marks (Total 2)	1			1			1 x 10 = 10
TOTAL							60

MORPHOLOGY (8 hours)			**Hrs**
MODULE - I (8 HRS)	Chapter 1	Leaf - Structure, simple, compound, venation and phyllotaxy.	1
	Chapter 2	Inflorescence - racemose, cymose, special, types with examples	3
	Chapter 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.	3
	Chapter 4	Fruits: outline on the classification; Simple: Fleshy - Drupe, Berry, Hesperidium; Dry - Dehiscent - Legume, Capsule; Indehiscent - Caryopsis, Cypsella, Schizocarpic - Lomentum, Carcerulus, Regma, Cremocarp with examples, Aggregte. Multiple fruit.	1
PRACTICAL	Identify the types of inflorescence mentioned in the syllabus. All the types mentioned must be represented in the photo album. (All drawings in records are replaced by photo album submission).		4
REFERENCE (Morphology)	1. Sporne, K.R. (1974). Morphology of Angiosperms. Hutchinson & Co., London.		
SYSTEMATIC BOTANY (28 hours)			**Hrs**
MODULE - II (12 hrs)	Chapter 1	Introduction, scope and importance	1
	Chapter 2	Herbarium techniques: collection, drying, poisoning, mounting & labeling. Significance of herbaria and botanical gardens; important herbaria and botanical gardens in India.	3
	Chapter 3	Nomenclature - Binomial system of nomenclature, basic rules of nomenclature (effective and valid publication, and priority of publication), International Code of Nomenclature for algae, fungi and plants (ICN).	4
	Chapter 4	Systems of classification - Artificial, Natural of Phylogenetic (Brief account only). Bentham & Hooker's system of classification in detail.	4
MODULE - III (16 hrs)	Chapter 1	Modern trends in taxonomy - Chemotaxonomy, Numerical taxonomy and Cytotaxonomy (brief account only)	4
	Chapter 2	Study the following families: Malvaceae, Fabaceae (with sub-families) Rubiaceae, Apocynaceae, Euphorbiaceae and Poaceae.	12

PRACTICAL	1. Determine the systematic position of local plants comes under the syllabus based on their vegetative and floral characters. 2. Students shall be able to describe the plants in technical terms and draw the L.S. of flower of two plants belong to each family and record the same. 3. Familiarization of herbarium techniques (Demonstration only). 4. Students shall submit images of plants, at least one from each family mentioned in the syllabus duly certified by HoD, at time of examination. The images of plants should be properly identified and they should carry details like systematic position, GPS location, date, morphometric details of floral parts, name of the student etc. Separate images clearly showing habitat, habit, inflorescence type, single flower etc. of the plant should be represented. The images can be submitted along with the photo album containing images of inflorescence mentioned under morphology. Individuality should be strictly maintained while preparing the photo album.	20
REFERENCES (Systematic Botany)	1. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper & Row Publishers, New York. 2. Sivarajan, V.V. (1991). Introduction to Principles of Plant Taxonomy. Oxford & IBH, New Delhi. 3. Jeffrey, C. (1968). An introduction to Plant Taxonomy, London. 4. Gurucharan Singh, (2001). Plant Systematics. Theory and practice. Oxford & IBH Publications New Delhi. 5. Sharma O.P. (1990). Plant Taxonomy - Tata McGraw Hills. Publishing company Ltd. 6. Subramanyam N.S. (1999). Modern Plant Taxonomy. Vikas Publishing House Pvt. Ltd. 7. Pandey & Misra (2008). Taxonomy of Angiosperms. Ane books Pvt. Ltd.	

ECONOMIC BOTANY (4 hours)			**Hrs**
MODULE - IV (4 hrs)	Chapter 1	Brief account on the various categories of plants based on their economic importance	1
	Chapter 2	Study the following plants with special reference to their binomial, family, morphology of the useful part and their uses: 1. Cereals: Paddy, Wheat 2. Pulses: Black gram, Green gram 3. Oil: Coconut, Gingelly 4. Fibre: Cotton 5. Latex: Rubber 6. Beverages: Tea, Coffee 7. Spices: Pepper, Cardamom, Clove 8. Medicinal plants: *Rauvolfia serpentina*, *Justicia adhatoda*, *Catharanthus roseus* and *Curcuma longa*.	3
PRACTICAL	1. Identify at sight the economically important plant produces and products mentioned in module III, and learn the binomial and family of the source plants, morphology of the useful parts and uses. (Drawing not required)		4
REFERENCES (Economic Botany)	1. Pandey, B.P. (1999). Economic Botany. 5th Revised edition, S. Chand & Company. 2. Verma, V. (2009). A text book of Economic Botany. ANE Books. Hill, A.W. (1981). Economic Botany, McGraw Hill Publications.		

PLANT BREEDING (7 hours)			Hrs
MODULE - V (7 hrs)	Chapter 1	Objectives of plant breeding	1
	Chapter 2	Methods of plant breeding: a) Plant introduction b) Selection - Mass, Pure line and clonal c) Hybridization: interparietal, interspecific and intergeneric hybridization, heterosis and inbreeding depression. d) Mutation breeding e) Polyploidy breeding f) Breeding for disease resistance	6
PRACTICAL	Demonstration of hybridization technique		4
REFERENCES (Plant Breeding)	1. Allard, R.W. (1960). Principles of Plant breeding. John Wiley & Sons, Inc, New York. 2. Singh, B.D. (2005). Plant Breeding - Principles & Methods. Kalyani Publishers, New Delhi. Chaudhari, H.K. (1984). Elementary Principles of Plant breeding. Oxford & IBH Publishers.		
HORTICULTURE (7 hours)			**Hrs**
MODULE - VI (7 hrs)	Chapter 1	Horticulture- introduction: definition, branches, significance	1
	Chapter 2	Physical control of plant growth: training and pruning, Bonsai- method of bonsai formation.	1
	Chapter 3	Methods of plant propagation: a. Seed propagation b. Vegetative propagation 1. Cutting - stem, root, leaf 2. Layering -air layering 3. Grafting: Approach grafting, Tongue grafting 4. Budding: Patch and T-budding	5
PRACTICAL	1. Demonstration of layering, grafting and budding		4
REFERENCES (Horticulture)	1. Manibhushan R.K. (2005). Text book of Horticulture. Macmillan India Ltd. 2. Kumar, N. (1996). Introduction to Horticulture. Rajalakshmi Publication.		

FOURTHM SEMESTER B. Sc. BOTANY COMPLEMENTARY PROGRAMME				
Course code	**BOT4C04**			
Name of the course	**PLANT PHYSIOLOGY, ECOLOGY AND GENETICS**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
4	**Complimentary**	**2**	**4**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Explain the water relations in plants.	8	U	Factual	PO1	PSO2

CO2	Understand the process of transpiration and absorption in plants.	8	U	Factual	PO1	PSO2
CO3	Recognize the process of photosynthesis and respiration	10	U	Factual	PO1	PSO2
CO4	Comprehend the growth, development and senescence of plants.	10	U	Factual	PO1	PSO2
CO5	Demonstrate various physiological experiments in plants.	18	Ap	Procedural	PO7	PSO2
CO6	Understand the Ecological adaptations of plants and succession.	9	U	Factual	PO1	PSO2
CO7	Identify the morphological and anatomical adaptations of ecological groups.	9	U	Factual	PO1	PSO2
CO8	Discuss the Mendelian genetics and modified Mendelian ratios.	5	U	Factual	PO1	PSO2
CO9	Explain the gene interactions in plants.	4	E	Factual	PO1	PSO2
CO10	Solve problems in classical genetics.	9	Ap	Procedural	PO7	PSO2

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 marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	2	2	2	2	2	2	Ceiling 20
5 marks (Total 7)	1	1	2	1	1	1	Ceiling 30
10 marks (Total 2)	1				1		1 x 10 = 10
TOTAL							60

PLANT PHYSIOLOGY (36 hours)			Hrs
MODULE - I (8 hrs)	Chapter 1	Structure of plant cell and cell organelles (Brief account only)	8
	Chapter 2	Water relations - Permeability, Imbibition, Diffusion, Osmosis and water potential	
	Chapter 3	Absorption of water- Active and passive mechanisms	
MODULE - II (8 hrs)	Chapter 1	Ascent of sap -Root pressure theory, Transpiration pull or cohesion-tension theory.	8
	Chapter 2	Transpiration -Types, mechanism of stomatal movement: K+ ion theory, significance of transpiration, antitranspirants.	
	Chapter 3	Mineral nutrition- General account on Micro and macro nutrients. Methods of studying plant nutrition- solution culture-The essential elements - criteria of essentiality Function and deficiency symptoms of the following mineral nutrients: N, P, K, Mg, Fe, Zn, Mn.	
MODULE - III (10 hrs)	Chapter 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, C4 cycle, C photorespiration (a brief account only). Factors affecting photosynthesis.	10
	Chapter 2	Respiration: Definition, Kinds of respiration-aerobic and anaerobic; Glycolysis, Krebs cycle, Terminal oxidation, Fermentation.	
MODULE - IV (10 hrs)	Chapter 1	Plant growth: Definition, phases of growth, natural plant hormones, synthetic auxins (Brief account only)	10
	Chapter 2	Senescence and Abscission, Photoperiodism & Vernalization	
	Chapter 3	Dormancy of seeds - Factors causing dormancy, photoblastin, techniques to break dormancy, physiology of fruit ripening.	
PRACTICAL	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 O2 during photosynthesis		18
REFERENCES (Plant physiology)	1. William G. Hopkins (1999). Introduction to Plant Physiology. 2nd Edn., John Wiley A Sons, Inc. 2. Salisbury F.B. and C.W. Ross (2002). Plant Physiology. 3rd Edn., CBS publishers and distributers. 3. Noggle G. Ray and George J. Fritz (1983). Introductory Plant Physiology. Prentice Hall. Goodwin Y.W. and Mercer E.I. (2003). Introduction to Plant Biochemistry. 2nd Edn., CBS Publishers and distributors.		
PLANT ECOLOGY (9 hours)			**Hrs**
MODULE - V (9 hrs)	Chapter 1	Ecology-Definition, Ecosystem: ecological factors - biotic and abiotic.	9
	Chapter 2	Ecological adaptations: Morphological, anatomical and physiological adaptations of the following types: Hydrophyte (Vallisnaria, Hydrilla), Xerophyte (Opuntia, Nerium), Halophyte (Avicennia), Epiphytes (Vanda), Parasites (Cuscuta).	

	Chapter 3	Ecological succession - Process of succession, types of succession, Hydrosere.	
PRACTICAL	Study the morphological and anatomical adaptations of the hydrophytes, xerophytes, halophytes, epiphytes and parasites mentioned in the syllabus (drawing not required).		9
REFERENCES (Plant Ecology)	1. Ambasht R.S. (1988). A text book of Plant Ecology. Students Friends Co., Varanasi. 2. Dash M.C. (1993). Fundamentals of Ecology. Tata McGraw Hill Publishing Company Ltd., New Delhi. 3. Michael S. (1996). Ecology. Oxford University Press, London. 4. Sharma, P.D. (2008-2009). Ecology and Environment. Rastogi Publication. 5. Kumar H.D. (1977). Modern Concepts of Ecology. Vikas Publications, New Delhi.		
GENETICS (9 hours)			**Hrs**
MODULE - VI (9 hrs)	Chapter 1	Introduction and brief history of genetics	9
	Chapter 2	Mendel's experiments, symbolisation, terminology, heredity and variation;	
	Chapter 3	Monohybrid cross, Dihybrid cross, Laws of Mendel, test cross and back cross.	
	Chapter 4	Modified Mendelian ratios: 1) Incomplete dominance in *Mirabilis jalapa*	
	Chapter 5	Gene interactions: Complementary genes - flower colour in *Lathyrus odoratus* (9:7 ratio), Epistasis - Fruit colour in *Cucurbita pepo* (12:3:1 ratio).	
PRACTICAL	Students are expected to work out problems related to Monohybrid, Dihybrid, Test cross, Incomplete dominance and Modified Mendelian ratios and has to be recorded.		9
REFERENCES (Genetics)	1. Sinnot, W.L.C. Dunn & J. Dobzhansky (1996). Principles of Genetics. Tata Mc Graw Hill Publishing Company Ltd., New Delhi. 2. Verma, P.S. & Agarwal (1999). Text book of Genetics. S. Chand & Co., New Delhi. 3. RastogiV.B. (2008), Fundamentals of Molecular Biology. Ane Books, India. 4. Gupta, P.K. (2018). Genetics. 5th Revised Edition, Rastogi Publications, Meerut.		

MODEL QUESTION PAPERS: (THEORY)

PATTERN OF QUESTION PAPER (B.Sc.)

SEMESTER: 1 (COMPLEMENTARY)

BOT1C01T: ANGIOSPERM ANATOMY AND MICROTECHNIQUE

Contact Hours per Week : 2

Number of Credits : 3

Number of Contact Hours : 36

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 8	Hour: 7	Hour: 7	Hour: 5	Hour: 5	Hour: 4
			Marks: 16	Marks: 19	Marks: 9	Marks: 9	Marks: 19	Marks: 7
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.			2			
		10.				2		
		11.					2	
		12.	2					
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.	5					
C	10	20.		10				
		21.					10	
Total Marks >> >>			16	19	9	9	19	7

FIRST SEMESTER B.Sc. DEGREE PROGRAMME
BOTANY COMPLEMENTARY COURSE: I
BOT1C01T
ANGIOSPERM ANATOMY AND MICROTECHNIQUE

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

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

1. What is the structure and function of Plasmodesmata?
2. Distinguish between collateral and Bicollateral vascular bundles
3. What are Tyloses?
4. Define Periderm
5. Write notes on Electron microscope
6. What are the components of FAA
7. What are Hydathodes?
8. What are Bulliform cells? Give example
9. Distinguish between Sapwood and Heart wood
10. What are Vascular rays?
11. Define Microtomy
12. Elaborate Histogen theory

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

13. Give a detailed account of simple permanent tissues
14. Explain the primary structure of a dicot stem with suitable illustrations
15. Explain the types of Vascular bundles with diagrams
16. Explain the Normal secondary thickening in dicot root with suitable diagram
17. Elaborate the paraffin method for serial sectioning
18. Explain the types of Stains with examples
19. Explain the major types of Secretory tissues with examples

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

20. Discuss the Anomalous secondary growth in Boerrhavia with suitable illustrations
21. Explain paraffin wax method for preparation of serial sections

PATTERN OF QUESTION PAPER (B.Sc.)

SEMESTER: 2 (COMPLEMENTARY)

BOT2C02T: CRYPTOGAMS, GYMNOSPERMS & PLANT PATHOLOGY

Contact Hours per Week : 2

Number of Credits : 3

Number of Contact Hours : 36

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 9	Hour: 6	Hour: 9	Hour: 8	Hour:4	Hour: 3
			Marks: 16	Marks: 19	Marks: 16	Marks: 19	Marks: 7	Marks: 2
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.			2			
		10.				2		
		11.	2					
		12.			2			
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.	5					
		19.			5			
C	10	20.		10				
		21.				10		
Total Marks >> >>			16	19	16	19	7	2

SECOND SEMESTER B.Sc. DEGREE PROGRAMME
BOTANY COMPLEMENTARY COURSE: 2
BOT2C02T
CRYPTOGAMS, GYMNOSPERMS & PLANT PATHOLOGY

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

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

1. Differentiate between Fimbriae and Pili
2. Enumerate any four features of Spirogyra
3. Enumerate the ecological importance of Lichens
4. Comment on the structure and function of ligule in Selaginella.
5. What are coralloid roots? What is its function?
6. List out the important symptoms of Leaf mosaic disease of Tapioca.
7. What are Heterocysts? Give its function
8. What is Heterotrichous habit?
9. Enumerate any four features of Basidiomycotina
10. What are Rhizophores?
11. What is bacterial growth curve?
12. What is Apothecium?

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

13. Explain the Lytic cycle with suitable illustrations
14. Elaborate the structure of reproductive organs in Sargassum
15. Explain the reproduction in Ascomycotina
16. With the help of a labelled diagram explain the anatomy of Riccia thallus
17. Explain the sexual reproduction in Cycas.
18. Classify bacteria based on shape of flagella, structure and nutrition
19. Elaborate the Economic importance of Lichens

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

20. Elaborate the reproduction and life history of Polysiphonia with diagrams
21. Explain the Structure and life history of Puccinia with suitable illustrations

PATTERN OF QUESTION PAPER (B.Sc.)

SEMESTER: 3 (COMPLEMENTARY)

BOT3C03T: MORPHOLOGY, SYSTEMATIC BOTANY, ECONOMIC BOTANY, PLANT BREEDING AND HORTICULTURE

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 8	Hour:12	Hour: 16	Hour: 4	Hour:7	Hour: 7
			Marks: 9	Marks: 19	Marks: 16	Marks: 7	Marks: 19	Marks: 9
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.			2			
		10.					2	
		11.						2
		12.			2			
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.			5			
C	10	20.		10				
		21.					10	
Total Marks >> >>			9	19	16	7	19	9

THIRD SEMESTER B.Sc. DEGREE PROGRAMME
BOTANY COMPLEMENTARY COURSE: 3
BOT3C03T
MORPHOLOGY, SYSTEMATIC BOTANY, ECONOMIC BOTANY, PLANT BREEDING AND HORTICULTURE

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

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

1. Enumerate the different placentation types
2. What is Binomial system of nomenclature?
3. Enumerate any four diagnostic features of Euphorbiaceae
4. Give the binomial, family, morphology of the useful part and uses of Cotton
5. What is mutation breeding?
6. What is Bonsai?
7. Distinguish between Regma and Cremocarp
8. Enumerate any four importance of Botanical gardens
9. Enumerate any four chemicals used in Chemotaxonomy
10. What is Interspecific hybridization? Give example
11. What is training and pruning?
12. Define the type of inflorescence of Poaceae

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

13. Explain the special types of Inflorescence with examples
14. Explain the methods of Herbarium preparation
15. Explain the characters used in Cytotaxonomy
16. Enumerate the binomial, family, morphology of the useful part and uses of medicinal plants
17. Explain Heterosis and inbreeding depression
18. Explain the grafting and layering methods in detail
19. Explain the method of numerical taxonomy

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

20. Elaborate the International Code of Nomenclature for algae, fungi and plants (ICN) with major rules
21. Explain in detail the methods of plant breeding

PATTERN OF QUESTION PAPER (B.Sc.)

SEMESTER: 4 (COMPLEMENTARY)

BOT4C04T: PLANT PHYSIOLOGY, ECOLOGY AND GENETICS

Contact Hours per Week : 3

Number of Credits : 3

Number of Contact Hours : 54

Course Evaluation : External 60 Marks + Internal 15 Marks

Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 8	Hour:8	Hour: 10	Hour: 10	Hour:9	Hour:9
			Marks: 9	Marks: 19	Marks: 14	Marks: 9	Marks: 19	Marks: 9
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.			2			
		10.				2		
		11.					2	
		12.						2
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.			5			
C	10	20.		10				
		21.					10	
Total Marks >> >>			9	19	14	9	19	9

FOURTH SEMESTER B.Sc. DEGREE PROGRAMME
BOTANY COMPLEMENTARY COURSE: 4
BOT4C04T
PLANT PHYSIOLOGY, ECOLOGY AND GENETICS

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

SECTION A

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

1. Define Chloroplast and enumerate the functions
2. What are Antitranspirants? Give example
3. What are Quantasomes
4. What is Vernalization?
5. Enumerate the adaptations of a Xerophyte
6. What is Test cross?
7. Distinguish between Diffusion and Osmosis
8. Distinguish between Cohesion and Adhesion
9. What is Terminal oxidation?
10. Enumerate the Factors causing dormancy
11. What are the abiotic factors of an ecosystem?
12. What is Epistasis?

SECTION B

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

13. Explain the active mechanisms of Water absorption
14. Explain the K+ ion theory
15. Explain the process of Glycolysis
16. What are plant growth regulars? Explain the role of Auxins and Cytokinins?
17. Explain the Morphological, anatomical and physiological adaptations of Hydrophytes and Halophytes
18. Explain the Incomplete dominance in Mirabilis jalapa
19. Explain Krebs cycle with suitable diagram

SECTION C

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

20. Explain Cyclic & Non-cyclic photo phosphorylation with suitable diagrams
21. Write an essay on the Process and types of Ecological succession emphasizing Hydrosere

MODEL QUESTION PAPER: (PRACTICAL)

FOURTH SEMESTER B.Sc. DEGREE PROGRAMME
COMPLEMENTARY BOTANY PRACTICAL EXAMINATION
BOT4C05P
(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**

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 × 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: 60 Marks
Record: 15 Marks
Submission: 10 Marks
Total: 85 Marks

FIFTH SEMESTER B. Sc. BOTANY PROGRAMME - OPEN COURSE				
Course code	**BOT5D02**			
Name of the course	**APPLIED BOTANY**			
Course No	**Course Category Core/Compli/ Elective**	**Number of Credits**	**Number of hours of Lectures/week**	**Total marks (Int+Ext)**
1	**Open**	**3**	**3**	**75** (Internal 15+ External 60)

COURSE OUTCOMES

CO	CO Statement	Hrs	Cognitive Level (CL)	Knowledge Category (KC)	PO	PSO
CO1	Understand the plant propagation methods	12	U	Factual	PO1	PSO4
CO2	Understand the properties of soil, irrigation and manuuring	12	U	Factual	PO1	PSO4
CO3	Construct vegetable garden and mushroom cultivation	8	C	Procedural	PO7	PSO4
CO4	Produce vermicompost and bioifertilizer	8	Ap	Procedural	PO7	PSO4
CO5	Cultivate orchid, anthurium and bonsai	8	C	Procedural	PO7	PSO4
CO6	Understand binomial, family and useful part of major economic plants	6	U	Factual	PO1	PSO4

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	Applied Botany						Total marks
	Module I	Module II	Module III	Module IV	Module V	Module VI	
2 marks (Total 12)	3	2	2	2	2	1	Ceiling 20
5 marks (Total 7)	1	2	1	1	1	1	Ceiling 30
10 marks (Total 2)	1		1				1 x 10 = 10
TOTAL							60

PLANT PROPAGATION			**Hrs**
MODULE - I (12 hrs)	Chapter 1	Seed propagation: Seed dormancy, seed treatment, conditions for propagation, rising of seed beds, care of seedling, transplanting techniques.	2
	Chapter 2	Vegetative propagation: (a) Cutting (stem, roots) (b) Grafting (approach, cleft) (c) Budding (T-budding, patch) (d) Layering (simple, air)	8
	Chapter 3	3. Micro propagation: General account	2
STEPS OF GROWING PLANTS			**Hrs**
MODULE - II (12 hrs)	Chapter 1	Soil: Composition, Types, Texture, Soil pH, Correcting pH, Humus.	2
	Chapter 2	Pots & Potting - Earthen, Fibre, Polythene bags, Potting mixture, Potting, Depotting, Repotting.	2
	Chapter 3	Chemical fertilizers: types, application, merits and demerits.	2
	Chapter 4	Organic manure; types, application, merits and demerits.	2
	Chapter 5	Need of water: Irrigation - Surface, spray, drip irrigation, sprinklers.	2
	Chapter 6	Plant protection: Biological, Physical and mechanical, Chemical, biopestcide.	2
BOTANY IN EVERYDAY LIFE			**Hrs**
MODULE - III (8 hrs)	Chapter 1	Vegetable gardening	8
	Chapter 2	Mushroom cultivation	
MODULE - IV (8 hrs)	Chapter 1	Vermi composting- technique	8
	Chapter 2	Biofertlizer Technology	
MODULE - V (8 hrs)	Chapter 1	Orchid and Anthurium cultivation	8
	Chapter 2	Creating Bonsai	

ECONOMIC BOTANY			Hrs
MODULE - VI (6 hrs)	Chapter 1	General account on various plants of economic importance	1
	Chapter 2	Study the Binomial, Family, Morphology of the useful part of the following plants: a) Cereals and Millets - Rice, Wheat. b) Pulses - Green gram, Bengal gram, Black gram. c) Beverages - Coffee, Tea, Cocoa. d) Fibre - Coir, Cotton. e) Timber - Teak, Rose wood, Jack. f) Spices - Pepper, Ginger, Cardamom. g) Medicinal - Adhatoda, Phyllanthus, Rauvolfia. h) Oil - Coconut, Gingelly. i) Ornamental pants of economic importance - Rose, Jasmine. j) Fruit - Mango, Banana.	5

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MODEL QUESTION PAPERS: OPEN COURSES

PATTERN OF QUESTION PAPER (BA/BSc/BVC/BBA/B.Com)
SEMESTER: 5 (OPEN COURSE)
BOT5D02: APPLIED BOTANY

Contact Hours per Week : 3
Number of Credits : 3
Number of Contact Hours : 54
Course Evaluation : External 60 Marks + Internal 15 Marks
Duration of Exam : 2hr

Module Blue Print For Question Paper Setting / Scrutiny								
Maximum Mark: 60								
Question Paper			Syllabus					
Sections or Parts	Mark	Question Numbers	MODULE:I	MODULE:II	MODULE:III	MODULE:IV	MODULE:V	MODULE:VI
			Hour: 12	Hour:12	Hour: 8	Hour: 8	Hour: 8	Hour:6
			Marks: 11	Marks: 24	Marks: 9	Marks: 9	Marks: 19	Marks: 7
Expected Marks >> >>								
A	2	1.	2					
		2.		2				
		3.			2			
		4.				2		
		5.					2	
		6.						2
		7.	2					
		8.		2				
		9.			2			
		10.				2		
		11.					2	
		12.	2					
B	5	13.	5					
		14.		5				
		15.			5			
		16.				5		
		17.					5	
		18.						5
		19.		5				
C	10	20.		10				
		21.					10	
Total Marks >> >>			11	24	9	9	19	7

FIFTH SEMESTER B. Sc. BOTANY DEGREE PROGRAMME
OPEN COURSE - Choice: 1
BOT5D01T
APPLIED BOTANY

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

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

1. What is Seed dormancy?
2. What is Humus? Give its significance
3. Enumerate the merits of Organic manure
4. What is a Biofertlizer?
5. What is a Bonsai?
6. Give the Binomial, Family of Coir and Cotton
7. What is Micro propagation?
8. Write notes on Air Layering
9. What is Soil pH? What is its significance?
10. What is Vermi wash?
11. Give names of any two Anthurium varities
12. Give the Binomial, Family of Pepper and Cardamom

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

13. Explain the practice of Grafting and Budding
14. Explain the Pots & the process of Potting in detail
15. Elaborate the process of Mushroom cultivation
16. Explain the technique of Vermicomposting in detail
17. How can you cultivate Orchids commercially?
18. Give Binomial, Family and Morphology of the useful part of Adhatoda, Rauvolfia, Green gram, Coffee and Gingelly
19. Explain the types of Irrigation

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

20. Explain the protection of plants by Biological, Physical, mechanical and Chemical methods
21. Elaborate the process of cultivation of Anthurium in detail