



**Maharaja's  
College  
Ernakulam**



Re-Accredited by NAAC with 'A Grade'  
Affiliated to Mahatma Gandhi University  
Centre of Excellence under Govt. of Kerala  
Identified by UGC as College with Potential for Excellence

## **POST GRADUATE AND RESEARCH DEPARTMENT OF BOTANY**



Estd. 1875

**Under Graduate Curriculum and Syllabus  
(Choice Based Credit Semester System)**

**B. Sc. BOTANY**

**For 2020 Admission Onwards**

# **MAHARAJA'S COLLEGE, ERNAKULAM**

**(GOVERNMENT AUTONOMOUS)**

**(Affiliated to Mahatma Gandhi University, Kottayam)**



**CURRICULUM AND SYLLABUS**

**UNDER GRADUATE PROGRAMME IN**

**BOTANY**

**(Programme Code: MCUSCBO05)**

**(UGCBCS)**

**(Effective from 2020 admissions)**

## ACKNOWLEDGEMENT

I express my sincere thanks to all stakeholders who rendered suggestions and comments in the preparation of the curriculum and syllabus. On behalf of the Board of studies I extend my gratitude to Dr. Nanda Devi Y, Chief Executive Officer, AVT Biotech, Sri. Paul V Karanthanam, Associate Professor, Dept. of Botany, St. Thomas College, Pala, Dr. Lizzy Mathew, Associate Professor, Dept. of Botany, St. Teresa's College, Ernakulam, Dr. Elsamma Joseph Arakkal, Rtd. Deputy Director of Collegiate Education for their effort and contributions in the preparation of the syllabus.

The department is indebted to Dr. Noushad PM, Associate Professor, Dept. of Commerce, Maharaja's College, Sri. Robin Francis, Asst. Professor, Dept. of Physics for their valuable guidance and suggestions in the completion of the syllabus.

I express my cordial thanks to Prof. Dr. P. K. Raveendran, Chairman Governing Council and Dr. K. Jayakumar, Principal and Chairman, Academic Council, for the support in the revision of the syllabus.

My sincere thanks to Smt. Jess Mary James, Dr. Shyam Kumar S, Sri. Benoy Thomas M P, Dr. Stephen Sequeira and Sri. Abhilash S. the faculty members of the department for their cooperation in the completion of the syllabus. Special thanks to Dr. Stephen Sequeira for his effort in finalizing the DTP work.

This curriculum is designed in such a way that it includes Programme Outcomes, Programme specific outcomes, Programme structure, course outcomes and model question papers with blueprint. Hence the revised curriculum is learner centric.

Ernakulam  
10-01-2020

Dr. Krishnakumar. K  
Associate Professor and Chairman  
Head of the Department of Botany  
Maharaja's College, Ernakulam

## CONTENTS

1.Board of studies.....	05
2.Regulations.....	06
3.Programme outcome .....	20
4.Programme specific outcome .....	21
5.Programme structure .....	22
6.Syllabus	
Core Course	
Semester I .....	25
Semester II .....	28
Semester III .....	32
Semester IV .....	36
Semester V .....	41
Choice Based Courses .....	61
Semester VI .....	73
Choice Based Courses .....	91
Complementary course	
Semester I .....	102
Semester II .....	105
Semester III .....	109
Semester IV .....	113
7.Practical model question papers.....	117

# **Maharaja's College, Ernakulam**

(A Government Autonomous College)

Affiliated to Mahatma Gandhi University, Kottayam

Under Graduate Programme in Botany

(2020 Admission Onwards)

## **Board of Studies in Botany**

<b>Sl.No.</b>	<b>Name of Member</b>	<b>Designation</b>
<b>1.</b>	<b>Dr. KRISHNAKUMAR. K</b> <b>Associate Professor</b>	Chairman, BoS Botany
<b>2.</b>	<b>Dr. Paul V Karanthanam</b> <b>Associate Professor, St. Thomas College</b>	External Member
<b>3.</b>	<b>Dr. Lizzy Mathew</b> <b>Associate Professor, St. Teresa's College</b>	External Member
<b>4.</b>	<b>Smt. Nanda Devi Y</b> <b>CEO, AVT Biotech</b>	External Member [Industry]
<b>5.</b>	<b>Dr. Elsamma Joseph Arakkal</b> <b>Rtd. Deputy Director</b>	External Member [Alumni]
<b>6.</b>	<b>Smt. Jess Mary James</b> <b>Assistant Professor</b>	Internal Member
<b>7.</b>	<b>Dr. Shyam Kumar. S</b> <b>Assistant Professor</b>	Internal Member
<b>8.</b>	<b>Sri. Benoy Thomas M P</b> <b>Assistant Professor</b>	Internal Member
<b>9.</b>	<b>Dr. Stephan Sequeira</b> <b>Assistant Professor</b>	Internal Member
<b>10.</b>	<b>Sri. Abhilash S</b> <b>Assistant Professor</b>	Internal Member
<b>11.</b>		University Nominee

**MAHARAJA'S COLLEGE, ERNAKULAM**  
**(A GOVERNMENT AUTONOMOUS COLLEGE)**  
**REGULATIONS FOR UNDER GRADUATE PROGRAMMES**  
**UNDER CHOICE BASED CREDIT SYSTEM 2020**

**1. TITLE**

- 1.1. These regulations shall be called “**MAHARAJA'S COLLEGE (AUTONOMOUS) REGULATIONS FOR UNDER GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM 2020**”

**2. SCOPE**

- 2.1 Applicable to all regular Under Graduate Programmes conducted by the Maharaja's College with effect from 2020 admissions
- 2.2 Medium of instruction is English except in the case of language courses other than English unless otherwise stated therein.
- 2.3 The provisions herein supersede all the existing regulations for the undergraduate programmes to the extent herein prescribed.

**3. DEFINITIONS**

- 3.1. ‘*Academic Week*’ is a unit of five working days in which the distribution of work is organized from day one to day five, with five contact hours of one hour duration on each day.
- 3.2. ‘**Choice Based Course**’ means a course that enables the students to familiarize the advanced areas of core course.
- 3.3. ‘*College Coordinator*’ is a teacher nominated by the College Council to co-ordinate the continuous evaluation undertaken by various departments within the college. He/she shall be nominated to the college level monitoring committee.
- 3.4. ‘*Common Course I*’ means a course that comes under the category of courses for English.
- 3.5 ‘*Common Course II*’ means additional language.
- ‘*Complementary Course*’ means a course which would enrich the study of core courses.
- 3.6. ‘*Core course*’ means a course in the subject of specialization within a degree programme. It includes a course on environmental studies and human rights.

- 3.7. **'Course'** means a portion of a subject to be taught and evaluated in a semester (similar to a paper under annual scheme).
- 3.8. **'Credit'** is the numerical value assigned to a paper according to the relative importance of the syllabus of the programme.
- 3.9. **'Department'** means any teaching department in a college.
- 3.10. **'Department Coordinator'** is a teacher nominated by a Department Council to co-ordinate the continuous evaluation undertaken in that department.
- 3.11. **'Department Council'** means the body of all teachers of a department in a college.
- 3.12. **'Faculty Advisor'** means a teacher from the parent department nominated by the Department Council, who will advise the student on academic matters.
- 3.13. **Grace Marks** shall be awarded to candidates as per the University Orders issued from time to time.
- 3.14. **'Grade'** means a letter symbol (A, B, C, etc.), which indicates the broad level of performance of a student in a Paper/Course/ Semester/Programme.
- 3.15. **'Grade Point'** (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.
- 3.16. **'Parent Department'** means the department which offers core course/courses within an undergraduate programme.
- 3.17. **'Programme'** means a three year programme of study and examinations spread over six semesters, the successful completion of which would lead to the award of a degree.
- 3.18. **'Semester'** means a term consisting of a minimum **90** working days, inclusive of tutorials, examination days and other academic activities within a period of six months.
- 3.19. **'Vocational Course' (Skill Enhancement Course)** means a course that enables the students to enhance their practical skills and ability to pursue a vocation in their subject of specialization.

#### **4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS**

- 4.1** Eligibility for admissions and reservation of seats for various Undergraduate Programmes shall be according to the rules framed by the University/ State Government in this regard, from time to time.

## **5. DURATION**

- 5.1** The duration of U.G. programmes shall be **6 semesters**.
- 5.2** There shall be two Semesters in an academic year, the “ODD” semester commences in June and on completion, the “EVEN” Semester commences. There shall be two months’ vacation during April and May.
- 5.3** No student shall be allowed to complete the programme by attending more than 12 continuous semesters.

## **6. REGISTRATION**

- 6.1.** The strength of students for each programme shall be as per the existing orders, as approved by the University.
- 6.2.** Those students who possess the required minimum attendance during a semester and could not register for the semester examination are permitted to apply for Notional Registration to the examinations concerned enabling them to get promoted to the next class.

## **7. SCHEME AND SYLLABUS**

- 7.1.** The U.G. programmes shall include **(a)** Common Courses I and II, **(b)** Core Course(s), **(c)** Complementary/Vocational Courses, and **(d)** Choice based course.
- 7.2.** There shall be Two Choice Based course (Elective Course) in the fifth and sixth semesters. In the case of B.Com Programme there shall be an elective stream from third semester onwards.
- 7.3.** Credit Transfer and Accumulation system can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one college to continue their education in another college without break.
- 7.4.** A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a course. For a pass in a programme, a separate minimum of **Grade D** is required for all the



individual courses. If a candidate secures **F Grade** for any one of the courses offered in a Semester/Programme, **only F grade** will be awarded for that Semester/Programme until he/she improves this to **D Grade** or above within the permitted period. The college shall allow credit transfer, subject to the approval of the concerned board of studies and Academic Council.

- 7.5. Students discontinued from previous regulations CBCSS 2016, can pursue their studies under the new regulation “Regulations for Under Graduate Programmes under Choice Based Credit System 2020” after obtaining readmission.
- 7.6. The practical examinations (external/internal) will be conducted only at the end of even semesters for all programmes. Special sanction shall be given for those programmes which need to conduct practical examinations at the end of odd semesters.

## 8. PROGRAMME

### STRUCTURE Model

#### I/II BA/B.Sc.

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	22
d	Credits required from Common Course II	16
e	Credits required from Core course and Complementary courses including Project	74
f	Choice Based Core Course	8
g	Minimum attendance required	75%

#### Model I or Model II B.Com

a	Programme Duration	6 Semesters
---	--------------------	-------------

b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	14
d	Credits required from Common Course II	8
e	Credits required from Core and Complementary/Vocational courses including Project	90
f	Choice Based Core Course	8
g	Minimum attendance required	75%

**Model III BA/B.Sc./B.Com**

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	8
d	Credits required from Core + Complementary + Vocational Courses including Project	112
e	Minimum attendance required	75%

**BA Honours**

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	16
d	Credits required from Common Course II	8

e	Credits required from Core + Complementary + Vocational Courses including Project	93
f	Choice Based Core Course	8
g	Minimum attendance required	75%

## 9. EXAMINATIONS

**9.1** The evaluation of each paper shall contain two parts:

- i. Internal or In-Semester Assessment (ISA)
- ii. External or End-Semester Assessment (ESA)

**9.2.** The internal to external assessment ratio shall be 1:4.  
Both internal and external marks are to be rounded to the next integer.

All papers (theory & practical), grades are given **on a 7-point scale** based on the total percentage of marks, (**ISA+ESA**) as given below:-

Percentage of Marks	Grade	Grade Point
95 and above	S Outstanding	10
85 to below 95	A <sup>+</sup> Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B <sup>+</sup> Good	7
55 to below 65	B Above Average	6
45 to below 55	C Satisfactory	5
35 to below 45	D Pass	4
Below 35	F Failure	0
	Ab Absent	0

## 10. CREDIT POINT AND CREDIT POINT

**AVERAGE Credit Point (CP)** of a paper is

calculated using the formula:-  $CP = C \times GP$ ,

where *C* is the Credit and *GP* is the Grade

point

**Semester Grade Point Average (SGPA)** of a Semester is calculated using the formula:-

$SGPA = TCP/TC$ , where *TCP* is the Total Credit Point of that semester.

**Cumulative Grade Point Average (CGPA)** is calculated using the formula:-

$CGPA = TCP/TC$ , where *TCP* is the Total Credit Point of that programme.

**Grade Point Average (GPA)** of different category of courses viz. Common Course I, Common Course II, Complementary Course I, Complementary Course II, Vocational course, Core Course is calculated using the formula:-

$GPA = TCP/TC$ , where *TCP* is the Total Credit Point of a

category of course. *TC* is the total credit of that category of course

Grades for the different courses, semesters and overall programme are given based on the corresponding CPA as shown below:

GPA	Grade
9.5 and above	<b>S Outstanding</b>
8.5 to below 9.5	<b>A+ Excellent</b>
7.5 to below 8.5	<b>A Very Good</b>
6.5 to below 7.5	<b>B+ Good</b>
5.5 to below 6.5	<b>B Above Average</b>
4.5 to below 5.5	<b>C Satisfactory</b>
3.5 to below 4.5	<b>D Pass</b>
Below 3.5	<b>F Failure</b>

## 11. MARKS DISTRIBUTION FOR EXTERNAL AND INTERNAL EVALUATIONS

The external theory examination of all semesters shall be conducted by the college at the end of each semester. Internal evaluation is to be done by continuous assessment. For all courses without practical total marks of external examination is 80 and total marks of internal evaluation is 20. Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

### 11.1 For all courses without practical

1.a) Marks of external Examination : 80

1.b) Marks of internal evaluation : 20

Components of Internal Evaluation of theory	Marks
Attendance	5
Assignment /Seminar/Viva	5
Test papers (2x5=10)(Marks of test paper shall be average)	10
<b>Total</b>	<b>20</b>

### 11.2 For all courses with practical total marks for external evaluation is 60 and total marks for internal evaluation is 15.

For all courses with practical

2.a) Marks of external Examination : 60

2.b) Marks of internal evaluation : 15

Components of Internal Evaluation	Marks
Attendance	5
Seminar/Assignments/Viva	2
Test paper (2x4)	8
<b>Total</b>	<b>15</b>

**c. For practical examinations total marks for external evaluation is 40 for internal evaluation is 10**

<b>Components of Internal Evaluation (Practicals)</b>	<b>Marks</b>
Attendance	<b>2</b>
Test (1x4)	<b>4</b>
Record*	<b>4</b>
<b>Total</b>	<b>10</b>

\*Marks awarded for Record should be related to number of experiments recorded

### **11.3 Project Evaluation**

<b>Components of Project evaluation</b>	<b>Marks</b>
Internal Evaluation*	20
Dissertation (end semester)	50
Viva Voce( end Semester)	30

#### **Components of Project Internal evaluation \***

<b>Components of internal evaluation</b>	<b>Marks</b>
Relevance and Contents	5
Analysis and Presentation	5
Presubmission Presentation and viva	10

\*Marks awarded for Record should be related to number of experiments recorded and duly signed by the teacher concerned in charge.

All three components of internal assessments are mandatory.

### **11.3 For projects**

**3.a) Marks of external evaluation : 80**

**3.b) Marks of internal evaluation : 20**

**c)**

<b>Components of External Evaluation of Project</b>	<b>Marks</b>
Dissertation (External)	50
Viva-Voce (External)	30
<b>Total</b>	<b>80</b>

\*Marks for dissertation may include study tour report if proposed in the syllabus.

<b>Components of internal Evaluation of Project</b>	<b>Marks</b>
Punctuality	5
Experimentation/data collection	5
Knowledge	5
Report	5
<b>Total</b>	<b>20</b>

#### **Attendance Evaluation for all papers**

<b>% of attendance</b>	<b>Marks</b>
90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1

(Decimals are to be rounded to the next higher whole number)

## **12. ASSIGNMENTS**

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

## **13. SEMINAR/VIVA**

A student shall present a seminar in the 5th semester for each paper and appear for Viva-voce in the 6th semester for each course.

#### **14. INTERNAL ASSESSMENT TEST PAPERS**

Two test papers are to be conducted in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for one year and shall be made available for verification. The responsibility of evaluating the internal assessment is vested on the teacher(s), who teach the course.

##### **14.1. Grievance Redressal Mechanism**

Internal assessment shall not be used as a tool for personal or other type of vengeance. A student has all rights to know, how the teacher arrived at the marks. In order to address the grievance of students, a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

##### **Level 1: Department Level:**

The Department cell chaired by the HOD, Department Coordinator, Faculty Advisor and Teacher in-charge as members.

##### **Level 2: College level**

A committee with the Principal as Chairman, College Coordinator, HOD of concerned Department and Department Coordinator as members.

The College Council shall nominate a Senior Teacher as coordinator of internal evaluations. This coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of I semester

- 14.2. The internal evaluation marks/grades in the prescribed format should reach the Controller of Examination before the 4th week of October and March in every academic year.

#### **15. External Examination**

The external theory examination of all semesters shall be conducted by the Controller of Examinations at the end of each semester.



15.1. Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the subcommittee of the college council on valid grounds. This condonation shall not be counted for internal assessment. Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with condonation of shortage of attendance shall repeat the **semester** along with the next batch after obtaining readmission upon the recommendations of the head of the department and college council

15.2. All students are to do a **project in the area of core course**. This project can be done individually or in groups (not more than three students) for all subjects which may be carried out in or outside the campus. The projects are to be identified during the V semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the College.

15.3. There shall be supplementary exams only for fifth semester. Notionally registered candidates can also apply for the said supplementary examinations. For reappearance/ improvement for other semesters the students can appear along with the next batch.

15.4. A student who registers his/her name for the external exam for a semester will be eligible for promotion to the next semester.

15.5. A student who has completed the entire curriculum requirement, but could not register for the Semester examination can register notionally, for getting eligibility for promotion to the next semester.

15.6. A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the external examination for the same semester, subsequently. **There shall be no improvement for internal evaluation.**

16. All courses shall have unique alphanumeric code.

## 17. PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. She/he shall also submit a detailed scheme of evaluation along with the question paper. A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

### Pattern of questions Papers

#### (a) Without practical

Sl. No.	Pattern	Marks	Choice of questions	Total marks
1	Short Answer/problem type	2	10/12	20
2	Short essay/problem	5	6/9	30
3	Essay/problem	15	2/4	30
<b>Total</b>				<b>80</b>

#### (b) With practical

Sl. No.	Pattern	Marks	Choice of questions	Total marks
1	Short Answer/problem type	1	10/12	10
2	Short essay/problem	5	6/9	30
3	Essay/problem	10	2/4	20
<b>Total</b>				<b>60</b>

Each BOS shall specify the length of the answers in terms of number of words. Pattern of questions for external examination of practical papers will be decided by the concerned Board of Studies/Expert Committees.

## 18. MARK CUM GRADE CARD

The College shall issue to the students a MARK CUM GRADE CARD on completion of the programme.

**Note:** A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a paper. For a pass in a programme, a separate minimum of **Grade D** is required for all the individual papers. If a candidate secures **F Grade** for any one of the paper offered in a Semester/Programme **only F grade** will be awarded for that Semester/Programme until he/she improves this to **D GRADE** or above within the permitted period.

**19.** There shall be **2 level monitoring** committees for the successful conduct of the scheme.

They are -

- 1.** Department Level Monitoring Committee (DLMC), comprising HOD and two senior- most teachers as members.
- 2.** College Level Monitoring Committee (CLMC), comprising Principal, Secretary Academic Council, College Council secretary and A.A/Superintendent as members.

## **PROGRAMME OUTCOMES/ GRADUATE ATTRIBUTES**

**After successfully completing any three-year under graduate program, a student is expected to achieve the following attributes.**

- 1. Scientific temper and critical thinking.** Mindset which enables one to follow a way of life that focuses upon the scientific method of understanding reality and the capability to think rationally and effectively.
- 2. Inclusiveness.** Constant exposure to and interaction with disparate social strata for an inclusive mindset, ethical sensibility and greater social sensitivity and empathy.
- 3. Democratic practice and secular outlook.** As envisioned by the Constitution of India.
- 4. Sense of equality, equity and environment.** Ability to differentiate between pure equality, social equity and a heightened awareness of how humans dialectically interact with environment.
- 5. Synergetic work culture.** Capacity to work in groups and the attitude to consider larger goals greater than personal ones.
- 6. Emancipatory and transformative ideals.** Attainment of cherished ideals of education for the eventual empowerment of humanity.

**DEPARTMENT OF BOTANY**  
(Postgraduate and Research)  
**MAHARAJA'S COLLEGE, ERNAKULAM**

**B.Sc. BOTANY (CBCS)**

**PROGRAMME SPECIFIC OUTCOMES**

- To familiarise different plant groups with emphasis on algae
- to acquire the techniques in microbial culture and identification
- to compare the different plant groups like Bryophytes, Pteridophytes and Gymnosperms
- to infer about the fossils and fossilisation
- to familiarize scientific methods for carrying out a project
- to acquire skills to handle instruments and computers
- to acquire the skills for plant propagation
- to identify and illustrate different plants
- to understand organic farming and micropropagation
- to familiarise functional aspects of plants
- to familiarise different types of ecosystem

**DEPARTMENT OF BOTANY**  
**MAHARAJA'S COLLEGE, ERNAKULAM**  
**PROGRAMME STRUCTURE**

**UG Programme : B.Sc. Botany Model I (Programme code: MCUSCBO05)**

**Total Credits: 120**

	Course Code	Course	Credit	Marks			Weekly Contact Hours		Course Code	Course	Credit	Marks			Weekly Contact Hours
				Internal	External	Total						Internal	External	Total	
Semester I	ENG1CMR01	Common Course: English	4	20	80	100	5	Semester II	ENG2CMR03	Common Course: English	4	20	80	100	5
	ENG1CMR02	Common Course: English	3	20	80	100	4		ENG2CMR04	Common Course: English	3	20	80	100	4
		Common Course: Additional Language	4	20	80	100	4			Common Course: Additional Language	4	20	80	100	4
	ARB1ADL01	Arabic:							ARB2ADL02	Arabic:					
	HIN1ADL01	Hindi:							HIN2ADL02	Hindi:					
	MAL1ADL01	Malayalam:							MAL2ADL02	Malayalam:					
	SKT1ADL01	Sanskrit:							SKT2ADL02	Sanskrit:					
	BOT1COR01	PHYCOLOGY BRYOLOGY	2	15	60	75	2		BOT2COR02	MIROBIOLOGY, MYCOLOGY AND LICHENOLOGY	2	15	60	75	2
	BOT2CORP1	Practical	1				2		BOT2CORP1	Practical	1	10	40	50	2
	ZOO1CMB01	Complementary Zoology	2	15	60	75	2		ZOO1CMP02	Complementary Zoology	2	15	60	75	2
ZOO2CMBP1	Practical: Zoology	1				2	ZOO2CMBP1	Practical: Zoology	1	10	40	50	2		

	CHE1CMP01	Complementary Chemistry	2	15	60	75	2		CHE2CMP02	Complementary Chemistry	2	15	60	75	2	
	CHE2CMBP1	Practical Chemistry	1				2		CHE2CMRP1	Practical Chemistry	1	10	40	50	2	
		TOTAL	20	105	420	525	25			TOTAL	20	105	420	525	25	
Semester III	ENG3CMR05	Common Course: English	3	20	80	100	5	Semester IV	ENG4CMR06	Common Course: English	3	20	80	100	5	
		Common Course: Additional Language	4	20	80	100	5			Common Course: Additional Language	4	20	80	100	5	
	ARB3ADL03	Arabic:							ARB4ADL04	Arabic:						
	HIN3ADL03	Hindi:							HIN4ADL04	Hindi:						
	MAL3ADL03	Malayalam:							MAL4ADL04	Malayalam:						
	SKT3ADL03	Sanskrit:								SKT4ADL04	Sanskrit:					
	BOT3COR03	PTERIDOLOGY GYMNOSPERMS, PALEOBOTANY AND PHYTOGEOGRAPHY	3	15	60	75	3		BOT4COR04	ANATOMY, MICROTECHNIQUE AND REPRODUCTIVE BOTANY OF ANGIOSPERMS	3	15	60	75	3	
	BOT4CORP2	Practical	1				2		BOT4CORP2	Practical	1	10	40	50	2	
	ZOO3CMB03	Complementary Zoology	3	15	60	75	3		ZOO4CMB04	Complementary Zoology	3	15	60	75	3	
	ZOO3CMB03	Practical	1				2		ZOO4CMBP2	Practical	1	10	40	50	2	
	CHE3CML03	Complementary Chemistry	3	15	60	75	3		CHE4CML04	Complementary Chemistry	3	15	60	75	3	
	CHE4CMBP2	Practical	1				2		CHE4CMBP2	Practical	1	10	40	50	2	
		TOTAL	20	105	420	525	25			TOTAL	20	105	420	525	25	
Semester V	BOT5COR05	RESEARCH METHODOLOGY, BIOSTATISTICS, BIOPHYSICS AND BASIC COMPUTER SKILLS	3	15	60	75	3	Semester VI	BOT6COR09	PLANT PHYSIOLOGY AND BIOCHEMISTRY	3	15	60	75	3	
	BOT6CORP3	Practical	1				2		BOT6CORP3	Practical	1	10	40	50	2	

	<b>BOT5COR06</b>	<b>PLANT BREEDING, HORTICULTURE AND PLANT PATHOLOGY</b>	3	15	60	75	3		<b>BOT6COR10</b>	<b>ANGIOSPERM MORPHOLOGY, TAXONOMY, ECONOMIC BOTANY AND ETHNOBOTANY</b>	3	15	60	75	3
	<b>BOT6CORP4</b>	<b>Practical</b>	1				2		<b>BOT6CORP4</b>	<b>Practical</b>	1	10	40	50	2
	<b>BOT5COR07</b>	<b>GENETICS AND EVOLUTION</b>	3	15	60	75	3		<b>BOT6COR11</b>	<b>CELL AND MOLECULAR BIOLOGY</b>	3	15	60	75	3
	<b>BOT6CORP5</b>	<b>Practical</b>	1				2		<b>BOT6CORP5</b>	<b>Practical</b>	1	10	40	50	2
	<b>BOT5COR08</b>	<b>ECOLOGY, ENVIRONMENTAL SCIENCE AND HUMAN RIGHTS</b>	3	15	60	75	3		<b>BOT6COR12</b>	<b>BIOTECHNOLOGY AND BIOINFORMATICS</b>	3	15	60	75	3
	<b>BOT6CORP6</b>	<b>Practical</b>	1				2		<b>BOT6CORP6</b>	<b>Practical</b>	1	10	40	50	2
	<b>BOT5CBC01</b>	<b>AGRIBASED MICROENTERPRISES</b>	3	20	80	100	4		<b>BOT6CBC02</b>	<b>ECOTOURISM</b>	2	20	80	100	3
	<b>BOT6PRJ01</b>	<b>Project</b>					1		<b>BOT6PRJ01</b>	<b>Project and Viva</b>	1	20	80	100	2
		<b>TOTAL</b>	<b>19</b>	<b>80</b>	<b>320</b>	<b>400</b>	<b>25</b>			<b>TOTAL</b>	<b>19</b>	<b>140</b>	<b>560</b>	<b>700</b>	<b>25</b>

**Optional Choice Based Courses [Applicable to 5<sup>th</sup> Semester]:**

1. Plant Genetic resources 2. Horticulture and Nursery Management 3. Agribased Microenterprises

**Optional Choice Based Courses [Applicable to 6<sup>th</sup> Semester]:**

1. Agribusiness 2. Phytochemistry and Pharmacognosy 3. Ecotourism



**SEMESTER I**

**Course 1**

**BOT1COR01 - PHYCOLOGY AND BRYOLOGY**

**(Theory 36 hours, Practical 36 hours)**

**(Theory Credit 2, Practical credit 1)**

**Learning Outcome**

Students will be able to

- Develop understanding on the concept of algal diversity
- Classify algae based on their pigments
- Develop critical understanding of different habitat of algae
- Develop understanding on the concept of diversity of bryophytes
- Develop critical understanding on morphology anatomy and reproduction of bryophytes

**Module1: Introduction to Algae and Economic Importance (6 Hours)**

General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; life-cycles in algae; Classification; criteria, system of Fritsch, and evolutionary classification of Lee (only up to groups); Significant contributions of important phycologists (Desikachary, M.O.P. Iyengar). Economic importance of Algae.

**Module 2: Cyanophyta (2 Hours)**

Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of *Nostoc* and *Oscillatoria*

**Module 3: Chlorophyta and Charophyta (5 Hours)**

General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Chlamydomonas*, *Volvox*, *Oedogonium*, *Cladophora*, *Chara*.

**Module 4. Xanthophyta (2 Hours)**

Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of *Vaucheria*

**Module 4: Phaeophyta and Rhodophyta (5 Hours)**

Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Sargassum*, *Polysiphonia*.

**Module 5: Introduction to Bryophytes (4 Hours)**

General characteristics; Adaptations to land habit; Classification; Range of thallus organization. Ecological and economic importance of Bryophytes

**Module 6: Detailed study of the following Bryophytes (12 Hours)**

Classification (up to family), morphology, anatomy and reproduction of *Riccia*, *Marchantia*, *Anthoceros* and *Funaria*.

**Practicals****(36 hours)****Phycology (18 Hours)**

Study of vegetative and reproductive structures of *Nostoc*, *Oscillatoria*, *Chlamydomonas*, *Volvox*, *Oedogonium*, *Cladophora*, *Chara*, *Vaucheria*, *Sargassum* and *Polysiphonia*

**Bryology (18 Hours)**

Study of vegetative and reproductive structures of *Riccia*, *Marchantia*, *Anthoceros* and *Funaria*

**Suggested Readings**

1. Lee, R.E. 2008. Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
3. Fritsch F E 1945. *Structure and Reproduction of Algae*. Vol.1: Cambridge University Press, London.
4. Sharma O.P. 2004, *Text Book of Algae*, Tata Mc. Graw Hill Co.
5. Parihar, N.S. 1991. An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot Allahabad.
6. Singh, Pande Jain 2007, *Diversity of Microbes and Cryptogam*, Rastogi Publications
7. Vashista B. R 1993. *Bryophyta*,: S Chand & Co., New Delhi.

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)****B.Sc. BOTANY PROGRAMME (CBCS)****SEMESTER I****CORE COURSE: BOT1COR01****PHYCOLOGY AND BRYOLOGY****BLUEPRINT**

Module	Hours Allotted	Part A 1 Mark	Part B 5 Marks	Part C 10 Marks	Total questions
1	6	2	1	1	4
2	2	1	1	-	2
3	5	2	1	1	4
4	2	1	1	-	2
5	2	1	1	-	2
6	3	2	1	-	3
7	4	1	1	1	3
8	12	2	2	1	5
<b>Total</b>	<b>36</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJA'S COLLEGE**  
**(A GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core course - SEMESTER –I**  
**BOT1COR01 - PHYCOLOGY AND BRYOLOGY**  
(2020 Admission onwards)  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Part A**

(Answer any **Ten** questions. Each question carries 1 mark)

1. What are hypnospores ?
2. What is a gemmae cup ?
3. What is aegagropilous habit?
4. What are 'globule' and 'nucule' and in which alga they are found?
5. What are hormogonia? How are they formed?
6. What are bulbils?
7. What are elaters?
8. What is a pyrenoid?
9. What is an antherozoid?
10. What is a cupule?
11. What are synzoospores?
12. What is a glomerule?

**(1 x 10 = 10 Marks)**

**Part B**

(Answer any **Six** questions. Each question carries 5 marks)

13. Compare the gametophytes of *Riccia* with that of *Marchantia* taking the external morphology.
14. Write a note on T.S. of *Sargassum* axis.
15. Describe the structure of mature archegonium of *Marchantia*.
16. Describe the post fertilization changes on *Polysiphonia*.
17. How blue green algae helps to improve the fertility of the soil. Discuss?
18. Describe the structure of mature sporophyte of *Anthoceros*.
19. Is the sporophyte of *Riccia* wholly dependent for its nutrition on the gametophyte? Justify your answer.
20. Write a note on the internal structure of thallus of *Cyathodium*.
21. Describe the T.S of thallus of *Riccia*.

**(5 x 6 = 30 Marks)**

**Part C**

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

22. Write an essay on life cycles in algae.
23. Describe the structure and position of sex organs in different genera of bryophytes studied by you.
24. Give an account on the thallus structure and life- cycle of *Batrachospermum*.
25. Compare the vegetative thalli of *Riccia*, *Marchantia*, *Anthoceros* and *Funaria* and give the importance of the various structures found in them.

**(10 x 2 = 20 Marks)**

---

## SEMESTER II

### Course 2

#### **BOT2COR02 - MICROBIOLOGY, MYCOLOGY AND LICHENOLOGY**

**(Theory 36 hours; Practical 36 hours)**

**(Theory Credit 2, Practical Credit1)**

#### **Learning Outcome**

Students will be able to

- Recognize the diverse and unique nature of microbes.
- Interpret the relevant characteristics of fungi and lichens.
- Appraise the relevance and significance of microbes in our day to day lives.
- Discover the evolutionary trends of these microbes.
- Validate Poisonous and Edible mushrooms and design techniques to cultivate mushrooms.

#### **Module 1 Introduction to microbiology**

**(1 hour)**

Introduction, history of Microbiology, contributions of Louis Pasteur, Robert Koch and Edward Jenner. Scope of Microbiology.

#### **Module 2 Bacteria**

**(5 hours)**

1. General account of Bacteria, Archaeobacteria, Protozoa, Viruses, Mycoplasma and Actinomycetes .( Brief Study only)
2. Bacteria - Morphology and classification based on staining (Gram staining only), morphology and flagellation
3. Fine structure - cell wall – Peptidoglycan (NAG, NAM and amino acid cross linking), capsule, cell membrane, mesosomes, - cytoplasm - Nucleoid, plasmid, Cell surface appendages-Flagella-structure, pili.
4. Reproduction- Binary fission, endospore formation
5. Genetic Material in Bacteria. Extra chromosomal genetic elements in bacteria— Plasmids and Episomes.

#### **Module 3 Virus**

**(5 hours)**

1. General account of Viroids, Virusoids and Prions.
2. Virus- Structure--Capsid, viral envelope and viral genome
3. Classification of viruses
4. Architecture of TMV, HIV.
5. Bacteriophages-structure, Multiplication and transmission (Lytic and lysogenic cycle).

#### **Module 4 Economic importance of Microbes (Brief Account only)**

**(5 hours)**

1. A brief study of common bacterial and viral diseases affecting human beings.
2. Role of microbes in Agriculture (Nitrogen fixation, as Biofertilizers and Biopesticides,)in food industry ( Production of vinegar, curd, yoghurt, wine, bread, SCP, probiotics)Biogas production, Bioremediation. Microbes involved in food borne diseases- Botulism, Traveller's Diarrhea, Salmonellosis.
3. General Principles of food preservation—a) Aseptic Handling b) High Temperature c) Low Temperature d) Dehydration e) Osmotic Pressure f) Chemicals including food additives g) Radiation.

#### **Module 5 Mycology**

**(18 hours)**

1. Introduction, structure, reproduction, life cycle, evolutionary trends. Classification based on Ainsworth (1973).

2. Distinguishing characters of different classes of fungi with special reference to reproductive structures and life history of the genera mentioned in each group
  - a. Myxomycotina – General Characters
  - b. Mastigomycotina – *Albugo*
  - c. Zygomycotina – *Mucor*
  - d. Ascomycotina
    - i. Hemiascomycetes -- *Saccharomyces*
    - ii. Plectomycetes -- *Pencillium*
    - iii. Pyrenomycetes – *Xylaria*
    - iv. Discomycetes -- *Peziza*
  - e. Basidiomycotina
    - i. Teliomycetes ---*Puccinia*
    - ii. Hymenomycetes—*Agaricus*
  - f. Deuteromycotina– *Fusarium*
3. Economic importance of Fungi with special reference to Mycoherbicides, Myconematicides, Mycoparasites.
4. Mycorrhiza--Significance.
5. Mushroom Cultivation
  - a. Mushrooms- An introduction to edible and poisonous types.
  - b. Cultivation technique-Spawn production.
  - c. Cultivation of Oyster mushroom

## Module 6 Lichenology

(2 hours)

General account of Lichens. Classification of lichens based on thallus structure- Economic and Ecological importance of lichens. Structure, Reproduction and Life cycle of *Parmelia*. Major Lichenological centres in India.

## Practical

(36 hours)

### Microbiology (12 hours)

Students are expected to do the following practical

1. Preparation of bacterial smear.
2. Gram staining.
3. Isolation of microbes from soil by Streaking method.

### Mycology and lichenology (24 hours)

1. Students are expected to identify the following types by making suitable micropreparations and make labeled sketches *Rhizopus*, *Albugo*, *Saccharomyces*, *Pencillium*, *Xylaria*, *Peziza*, *Puccinia*, *Fusarium* and *Parmelia*.
2. Isolation and culture of Oyster mushroom mycelium.
3. Preparation of bed for mushroom cultivation.
4. Staining of Endomycorrhiza / fungus.
5. Isolation of fungus from dung, air, fruits, vegetables.
6. Slide culture technique of fungus.
7. Collection and identifications of common lichens

### Suggested Readings

1. Ainsworth G.C., Sparrow K.F & Sussman A.S (eds) 1973. *The Fungi an advanced*
2. Alexopoulos C.J, Mims, C.W & C.W Blackwell, M 1996 *Introductory Mycology*.
3. Aneja K. R. 1996. *Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation*. WishwaPrakasan, Delhi.
4. Campbell R 1987 *Plant Microbiology*, ELBS Edward Arnold, London.
5. Carpenter P L, 1967. *Microbiology*, W. B Saunderson & Co, Philadelphia.

6. Dule.H.C 2008. *Fungi, Bacteria and Viruses*, Agrobios, Meerut.
7. Frazier W C & Westhoff D C 1978. *Food Microbiology*. TMH Edn.
8. Gupta V .K & Paul T.S 2004, *Fungi & Plant diseases*. Kalyani publishers , New Delhi
9. Hale M.E 1983 *The Biology of Lichen*, 3<sup>rd</sup> edition Edward Arnold, London.
10. Hans G Schlegel 1995. *General Microbiology*. Cambridge University Press, London.
11. Jim Deacon 2007 *Fungal Biology* , 4<sup>th</sup> edition , Blackwell Publishing ,Ane Books Pvt. Ltd.
12. Kanika Sharma 2005 *Manual of Microbiology tools & Techniques*. Ane books, Ansari road, New Delhi.
13. Malhotra&Aggarwal Ashok 2003 *Plant Pathology*, Tata McGraw Hill Publishing Co.
14. Misra A and Agrawa P.R 1978 *Lichens* ,New Delhi : Oxford and IBH.
15. Nair M.C (eds) 1990 *Mushroom Technical Bulletin 17* , Kerala Agricultural University Mannuthy
16. Nita Bahl 2002. *Hand book on Mushrooms*, Oxford & IBH Publishing C. Pvt. Ltd. New Delhi.
17. Parihar. L, 2008. *Advances in Applied Microbiology*, Agrobios, Meerut.
18. Peliczar M J. Reid and Chan E C S 1977. *Microbiology*. Tata McGraw-Hill publishing
19. Prescott.S.C, 2009.*Industrial Microbiology*, Agrobios, Meerut.
20. Sharma P D 2005. *Microbiology and Plant Pathology* ,Rastogi publication, Meerut.
21. Sharma P.D 2004 , *The Fungi* , 2<sup>nd</sup> Edition , Rasthogi publication
22. Singh, Pande Jain 2007, *Diversity of Microbes and Cryptogam*, Rastogi Publications.
23. Tripathi D.P 2005. *Mushroom Cultivation*, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
24. Vasishta B.R 1990 *Botany for Degree Students*, Fungi S. Chand &Co, NewDelhi.

Online resources:

[http://www.mushroomexpert.com/major\\_groups.html](http://www.mushroomexpert.com/major_groups.html)

<http://www.fungibank.csiro.au/>

<http://www.in2.dk/fungi/imageintroTxt.htm>

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –II**  
**CORE COURSE—BOT2COR02**  
**MICROBIOLOGY, MYCOLOGY AND LICHENOLOGY**

**BLUEPRINT**

Module	Hours Allotted	Section-A 1 Mark	Section-B 5 Marks	Section-C 10 Marks	Total
1	1	1	0	0	1
2	5	2	1	1	4
3	5	3	1	1	5
4	5	1	2	1	4
5	18	3	4	1	8
6	2	2	1	0	3
<b>Total</b>	<b>36</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJA'S COLLEGE**  
**(A GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core course - SEMESTER –II**  
**BOT2COR02 - MICROBIOLOGY, MYCOLOGY AND LICHENOLOGY**  
*(2020 admission onwards)*  
**Model Question Paper**

**Section A**

*(Answer any **TEN** questions, each question carries **1 mark**)*

1. What is capsid?
2. Name a litmus yielding Lichen.
3. What are fimbriae?
4. Explain coenocytic condition.
5. What are retroviruses?
6. What are Viroids?
7. Who is regarded as the father of Microbiology?
8. Give an example of a coprophilous fungus.
9. Name the microorganism responsible for the production of Vinegar.
10. Name a distinguishing character found only in Basidiomycota and is meant for producing genetic variation within the hypha.
11. Name a Lichenological centre in India.
12. What are Plasmids?

**(10 x 1 = 10 marks)**

**Section B**

*(Answer any **SIX** questions, each question carries **5 marks**)*

13. Give an account on Mycoherbicides with examples.
14. Explain asexual reproduction in *Pencillium* with diagrams.
15. Explain the different types of life cycle patterns in *Saccharomyces cerevisiae*.
16. Give an account of the Structure of TMV with suitable diagrams.
17. Write notes on the ecological importance of Lichens.
18. Explain the different fruiting bodies in Ascomycetes.
19. Describe the role of microbes as biofertilizers.
20. Give an account of the differences of cell wall found in Gram positive and Gram negative bacteria.
21. Explain bioremediation with the help of bacteria with suitable examples.

**(6 x 5= 30marks)**

**Section C**

*(Answer any **TWO** questions, each question carries **10 marks**)*

22. With suitable illustrations, bring out the Lytic and Lysogenic lifecycles in Bacteriophages.
23. Explain the classification of Fungi by Ainsworth and give an outline of the important characteristics of each group.
24. Give an account of the different types of genetic recombination in Bacteria.
25. Give an account of beneficial and harmful aspects of microbes in our day today life.

**(2 x 10= 20marks)**



**SEMESTER III**  
**Course 3**  
**BOT3COR03 - PTERIDOLOGY, GYMNOSPERMS,**  
**PALEOBOTANY&PHYTOGEOGRAPHY**  
**(Theory: 54 hours; Practical: 36 hours)**  
**(Theory Credit 3, Practical Credit1)**

**Learning outcome**

Students will be able to

- Categorize the diversity in habits, habitats and fundamental characteristics of Pteridophytes and Gymnosperms.
- Validate the evolutionary trends in plants with special reference to reproductive and vascular organization in these lower plant groups.
- Evaluate the ecological importance of Pteridophytes.
- Exemplify the economic importance of Pteridophytes and Gymnosperms.
- Conclude the significance of Palaeobotany in determining ancient plant groups and to find out lineages in plant taxonomic disputes.
- Analyse the phytogeography or phytogeographical division of India

**Module 1 Pteridology (20 hours)**

1. Introduction and General Characters of Pteridophytes. Basic life cycle patterns in Pteridophytes ( Homosporous and Heterosporous Pteridophytes). Vascular system in Pteridophytes ; Stelar types and their evolution in Pteridophytes. Classification of Pteridophytes by G. M. Smith. **(4 hours)**
2. Structural organization of sporophyte and gametophyte (development of sex organs not necessary) of the following types with special reference to their stelar structure, Heterospory and seed habit. (General anatomy required only for practicals) **(16 hours)**  
*1. Psilotum, 2. Lycopodium, 3. Selaginella, 4. Equisetum, 5. Pteris, 6. Marsilea*

**Module 2 Gymnosperms (14 hours)**

1. Introduction and General Characters of Gymnosperms. Classification, Origin and Evolutionary significance of Gymnosperms. **(2 hours)**
2. Study of morphology, anatomy and -male and female reproductive structures of *Cycas*, *Pinus* and *Gnetum* (development of sex organs not necessary). **(12 hours)**

**Module 3 Palaeobotany (8 hours)**

1. Introduction, Study of geological time scale, formation of fossil, fossil types & technique of study, fossil as a fuel. **(3 hours)**
2. Detailed study of **(4 hours)**
  - a. Fossil Pteridophyte : *Rhynia*
  - b. Fossil Gymnosperm: *Williamsonia*
  - c. Fossil Angiosperm : *Palmoxylon*
3. Indian contribution to Palaeobotany **(1 hour)**

**Module 4 Phytogeography (12hours)**

1. Definition, Concept, Scope and Significance of Phytogeography. **(1 hour)**



2. Patterns of plant distribution- Continuous distribution and discontinuous distribution, vicarism, migration and extinction. Continental drift—Evidences and impact. Glaciation-causes and consequences. Theory of land bridges. (5 hours)
3. Endemic distribution, Theories on Endemism, age and area hypothesis. (3 hours)
4. Phytogeographical zones (phytochoria) of the world and India. Brief Description of major terrestrial biomes (one each from tropical, temperate and tundra). (3 hours)

### Practicals

(36hours)

#### Pteridology (18 hours)

Make micropreparations to study stelar structure and reproductive structures of the mentioned types.

#### Gymnosperms (8 hours)

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

#### Phytogeography (10 hours)

1. Draw the phytogeographic zones of the world.
2. Draw the phytogeographic zones of India.

### Suggested readings

1. Arnold H.N ,1967. *Introduction to Paleobotany*, Tata McGraw- Hill, New Delhi
2. Biswas& John B .M, 2004.*Gymnosperms*, Naresa Publishing house.
3. Bower F.O ,1935. *Primitive Land Plants*. Cambridge, London.
4. Chopra R.N and Kumar P. K ,1988. *Biology of Bryophytes*, Wiley Eastern Ltd, New Delhi.
5. Coutler J.M & Chamberlain C. J ,1958. *Morphology of Gymnosperms*. Central Book Depot Allahabad.
6. Dutta S.C, 1991, *An Introduction To Gymnosperms*, Kalyan Publishing Co. New Delhi.
7. MamathaRao, 2009, *Microbes and Non flowering plants- impact and application*AneBoopks Pvt Ltd.
8. Rasheed A. 1999, *An Introduction to Pteridophyta*,Vikas Publishing House, New Delhi.
9. Rasheed A. 2000, *An Introduction To Bryophyta*, Vikas Publishing House, New Delhi.
10. Singh, Pande Jain 2007, *Diversity of Microbes and Cryptogam*, Rastogi Publications
11. Vashista B. R ,1993. *Bryophyta*,: S Chand & Co., New Delhi.
12. Vashista B. R ,1993.*Gymnosperms*, S Chand & Co., New Delhi.
13. Vashista B. R, 1993. *Pteridophyta*, S Chand & Co., New Delhi
14. Ronald Good,1947. *The Geography of Flowering Plants*. Longmans Greenand Co.New York.
15. ArmenTakhtajan, 1986.*Floristic Region of the world*. (translated by T J Crovello&A.Cronquist), University of California press, Berkeley.
16. P.D.Sharma,2009, *Ecology and Environment*, Rastogi Publications, Meerut.

#### Online Resources

<http://www.artdata.slu.se/guest/SSCBryo/SSCBryo.html>  
<http://www.northernontarioflora.ca/links.cfm?val=bryophytes>  
<http://bryophytes.plant.siu.edu/>  
<http://worldofmosses.com/>  
<http://www.unomaha.edu/~abls/>  
<http://www.anbg.gov.au/bryophyte/index.html>  
<http://www.bryoecol.mtu.edu/>  
<http://www.mobot.org/MOBOT/tropicos/most/Glossary/glosefr.html>

[http://www.fairhavenbryology.com/Master\\_Page.html](http://www.fairhavenbryology.com/Master_Page.html)  
<http://www.mygarden.ws/fernlinks.htm>  
<http://www.anbg.gov.au/fern/index.html>  
<http://www.bioimages.org.uk/HTML/T77.HTM>  
[http://botany.csdl.tamu.edu/FLORA/gallery/gallery\\_query.htm](http://botany.csdl.tamu.edu/FLORA/gallery/gallery_query.htm)  
<http://homepages.caverock.net.nz/~bj/fern/>  
<http://www.home.aone.net.au/~byzantium/ferns/>  
<http://www.northernontarioflora.ca/links.cfm?val=pteridophytes>  
[http://www.fiu.edu/~chusb001/giant\\_equisetum.html](http://www.fiu.edu/~chusb001/giant_equisetum.html)  
<http://www.mygarden.ws/fernlinks.htm>  
[http://www.nrm.se/en/menu/researchandcollections/departments/cryptogamicbotany/collections/pteridophytes.652\\_en.html](http://www.nrm.se/en/menu/researchandcollections/departments/cryptogamicbotany/collections/pteridophytes.652_en.html)  
<http://www.amerfernsoc.org/>  
<http://www.gymnosperms.org/>  
<http://www.plantapalm.com/vce/toc.htm>  
<http://www.cycad.org/conservation.htm>

**PROGRAMME: B.Sc. BOTANY**  
**SEMESTER –III**  
**CORE COURSE -3**  
**BOT3COR03 - PTERIDOLOGY, GYMNOSPERMS, PALAEOBOTANY &**  
**PHYTOGEOGRAPHY**  
**BLUEPRINT**

Module	Hours Alloted	Section- A 1 Mark	Section- B 5 Marks	Section- C 10 Marks	Total Questions
1	20	4	3	2	9
2	14	3	2	1	6
3	8	2	2	0	4
4	12	3	2	1	6
<b>TOTAL</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJA'S COLLEGE**  
**(A GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Semester III**

**BOT3COR03 - PTERIDOLOGY, GYMNOSPERMS, PALAEOBOTANY &  
PHYTOGEOGRAPHY**  
*(2020 Admission onwards)*

**MODEL QUESTION PAPER**

**Time: Three Hours**

**Maximum: 60 Marks**

**Section A**

(Answer any **TEN** questions, each question carries **1** mark)

1. What are bars of sanio?
2. Name any one endemic plant species of Kerala.
3. What is shower of Sulphur dust?
4. Why *Selaginellas* are referred to as 'resurrection plants'?
5. Name a Gymnosperm which has Pycnoxylic wood.
6. Explain any two objectives of studying Palaeobotany.
7. Name the scientist who proposed the theory of land bridges.
8. Name the father of Indian Palaeobotany.
9. What is the function of indusium?
10. What is Actinostele? Name a Pteridophyte with this type of stele.
11. Who proposed Continental Drift Theory?
12. Why Equisetum is often referred to as 'Scouring rushes'?

**(10x 1 = 10 marks)**

**Section B**

(Answer any **SIX** questions, each question carries **5** marks)

13. Give an account of the different types of fossils studied by you.
14. Describe the synangium of *Psilotum* with suitable illustrations.
15. Explain the angiosperm characters of *Gnetum*.
16. Mention the Indian contribution to Palaeobotany.
17. Rhizophore is regarded as organ-sui-generis. Substantiate with suitable evidences.
18. What is extinction? What are the causes of extinction?
19. Describe the internal structure of sporocarp of *Marsilea*.
20. Bring out the scope and significance of Phytogeography.
21. Mention the economic importance of Gymnosperms.

**(6 x 5 = 30 marks)**

**Section C**

(Answer any **TWO** questions, each question carries **10** marks)

22. Give an account of stellar evolution of Pteridophytes.
23. What do you mean by endemic distribution of a species? Add notes on theories of endemism.
24. Explain the life cycle of *Pinus* with suitable illustrations.
25. 'Heterospory leads to seed habit'. Substantiate with suitable evidences.

**(2x 10 = 20 marks)**

## **SEMESTER IV**

### **Course-4**

#### **BOT4COR04 - ANATOMY, MICRO TECHNIQUE AND REPRODUCTIVE BOTANY OF ANGIOSPERMS**

**(Theory: 54 hours; Practical: 36 hours)**

**(Theory Credit 3, Practical Credit1)**

#### **Learning Outcome**

Enable the students

- to have an insight into the internal structure of cells, tissue systems, secretory tissue systems in Angiosperms.
- to be able to discover the different roles played by Cambium
- To compare the processes behind the normal and anomalous secondary thickening in Angiosperms.
- to help students to Categorize woods based on wood anatomy
- to validate the techniques and processes of Microtechnique and its significance.
- to help to appraise the processes behind reproduction and development of reproductive organs, pollination mechanisms, production of dicot and monocot embryos.
- to be able to interpret causes and prospects of polyembryony and its possible advantages

#### **Module -1: Study of cell wall and cellular inclusions**

**(4 hours)**

1. Gross structure of primary and secondary cell walls, simple and bordered pits, structure and function of plasmodesmata
2. Sub microscopic structure of cell wall- cellulose, micelle, microfibril and macrofibril,  
Different types of Cell wall thickening in tracheary elements
3. Extra cell wall thickening materials: - Lignin, cutin, suberin and callose
4. Origin of cell wall; Growth of Cell wall- Apposition and intussusceptions – cavities & ducts, schizogenous and lysigenous developments
5. Non-living inclusions in plant cell: - Reserve food materials -carbohydrate (starch), protein (Aleurone grain) and lipids (fats and oil), Secretory products and Excretory (waste) products-nitrogenous and non-nitrogenous.

#### **Module-2: Tissues and Tissues system**

**(10 hours)**

1. Tissues—Simple and complex tissues. Meristematic tissue- definition, structure, function and classification based on origin, position and plane of division. Permanent tissues.
2. Structure and organization of root and shoot apex- Apical cell theory, Histogen theory and Tunica-Corpus theory. Root apex-Histogen theory, Korper- Kappe theory, Quiescent Centre Hypothesis.
3. Secretory tissues:
  - a. External secretory tissue- glands (glandular hairs and digestive glands), hydathodes and nectaries

- b. Internal secretory tissues- Resin and mucilage ducts-Gummosis, Kino veins, laticiferous tissue-latex cells and latex vessels.
- 4. Tissue Systems.
  - a. Epidermal Tissue System- Epidermis, Cuticle, Trichome, Stomata, Bulliform cells, Cork and Silica cells.
  - b. Ground Tissue System- Cortex, Endodermis, Pericycle and Pith.
  - c. Vascular Tissue System- Different types of vascular bundles - root and stem.

### **Module-3: Secondary Growth**

**(9 hours)**

- 1. Vascular cambium: - Development, structure and function, Activity of cambium, role of cambium in budding, grafting and wound healing.
- 2. Normal secondary growth in dicot stems and root—stelar and extra stelar growth. Periderm: Structure and development- phellum, phellogen, phelloderm, bark, polyderm, rhytidome and lenticel.
- 3. Anomalous secondary growth in plants with reference to *Bougainvillea* stem, *Bignonia* stem and *Dracaena* stem.
- 4. Stem thickening in monocots (general account only).

### **Module-4: Wood anatomy.**

**(4 hours)**

- 1. Wood anatomy- basic structure, heart wood, sap wood, hard wood, soft wood, growth rings, dendrochronology, porous and non-porous wood, ring porous and diffuse porous wood, tyloses, knots.
- 2. Wood rays: structure - uniseriate and multiseriate rays, heterocellular and homocellular rays (Brief account only).
- 3. Reaction wood- Tension wood and compression wood
- 4. Wood identification

### **Module-5: Microtechnique**

**(9 hours)**

- 1. Definition, importance of microtechnique
- 2. Killing and fixing: - Purpose, Agents used:-
  - a. Killing agents – Formalin, Ethyl alcohol
  - b. Fixing agents - Carnoy's fluid, Farmers' fluid, FAA
- 3. Dehydration: Purpose, Agent used – Ethyl alcohol
- 4. Sectioning: Hand sections, Microtomy: rotary, sledge (application only)
- 5. Staining technique: Principle of staining—single and double staining. Important stains -Safranin, Hematoxylin, Acetocarmine (preparation not required).Vital stains: Purpose, Example: Evan's blue
- 6. Mordants: Purpose and examples.
- 7. Mounting and Mounting Media, Purpose of mounting media, Glycerin, DPX, Canada balsam
- 8. Use of permanent whole mounts, permanent sections
- 9. Maceration
- 10. Smear and squash preparation

### **Module: 6 Reproductive botany of angiosperms**

**(18 hours)**

- 1. Introduction: - General account and interdisciplinary relevance of embryology
- 2. Floral morphology: - parts of flower; androecium-morphology and types of anthers; gynoecium- morphology and types of carpel and types of placentation (brief study only)

3. Structure and development of anther, microsporogenesis, development of male gametophyte, dehiscence of anther, structure of pollen, pollen germination, pollen tube growth and pollen viability.
4. Structure and development of ovule, megasporogenesis, embryosacs-monosporic (*Polygonum* type), bisporic (*Allium* type) and tetrasporic (*Peperomia* type). Structure of mature embryo sac.
5. Pollination mechanisms and agents of pollination; Natural mechanisms to prevent self pollination—Herkogamy, heterostyly, proterandry and protogyny; pollen-stigma interaction; compatibility and incompatibility; syngamy; apomixis.
6. Development of endosperm and embryo in Dicots and Monocots. Types of endosperm-cellular, helobial and nuclear.
7. Polyembryony and its types; Development and general structure of fruits and seeds-Dicot and Monocot

### Practicals

(36 hours)

#### Anatomy, Microtechnique (27 hours)

1. Cell types and tissues
2. Non-living inclusions – starch grains, cystolith, raphides, aleurone grains
3. Primary structure of stem and root. Dicot and Monocot
4. Structure of leaf-Dicot and Monocot
5. Stomatal types: - anomocytic, anisocytic, paracytic, diacytic and grass type.
6. Secondary structure of dicot stem and root
7. Anomalous secondary structure of *Bougainvillea* stem, *Bignonia* stem and *Dracaena* stem
8. Familiarise the reagents and equipment used in microtechnique (killing and fixing agents, dehydrants, clearing agents, stains, embedding agents, mounting agents, microtome etc.).

#### Reproductive Botany of Angiosperms ( 9 hours)

1. Identification of C.S. of anther, embryo sac and embryo with slides or photographs
2. Identification of various anther types-Monothealous, Dithealous
3. Identification of placentation types.
4. Observation of pollen
5. Pollen germination study

#### Suggested Readings

1. Cornquist A. 1968. *The Evolution and Classification of Flowering plants*.
2. Davis P.H. and Heywood V.H. 1967. *Principles of Angiosperm taxonomy*. Oliver and Boyd, Edinburgh.
3. Eames A.J. 1961. *Morphology of Angiosperms* Mc. Graw Hill, New York.
4. Fahn A. 1982. *Plant Anatomy* (3<sup>rd</sup> edition) Pergamon Press Oxford.
5. Foaster A.S and Giffad E.M. 1962. *Comparative Morphology of Vascular Plants*, Allied Pacific Pvt. Ltd., Bombay
6. Henry and Chandrabose 2001. *An Aid to the International Code of Botanical nomenclature*. Botanical Survey of India, Coimbatore.
7. Heywood V.H. 1967. *Plant Taxonomy*. Edward Arnold, London.
8. Jeffery C, 1968. *An Introduction to Plant Taxonomy*, J and A Churchill, London.
9. Johnson DA, 1940. *Plant Microtechnique*, McGraw Hill Co., New York.

10. Maheshwari P. 1971, *An introduction to the Embryology of Angiosperms*. Tata McGraw- Hill Publishing Company Ltd., New Delhi.
11. Prasad M.K & Krishna Prasad M, 1986. *Outlines of Micro Technique*, Emkay Publishers, New Delhi.
12. Shivanna K.R. and B.M. Joshi 1985. *The Angiosperm Pollen Structure & Function*. Wiley Eastern Ltd., New Delhi.
13. Toji Thomas (2005). *Essentials of Botanical Microtechnique* (11 Edn) Apex Infotech Publishing Company.

#### Online Resources

<http://www.mhhe.com/biosci/pae/botany/crang/contents.html>

<http://www.enchantedlearning.com/subjects/plants/plant/>

<http://www.uic.edu/classes/bios/bios100/labs/plantanatomy.htm>

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –IV**  
**CORE COURSE—BOT4COR04**

**ANATOMY, MICROTÉCHNIQUE, AND REPRODUCTIVE BOTANY OF**  
**ANGIOSPERMS**

**BLUEPRINT**

Module	Hours Alloted	Section-A 1 Mark	Section-B 5 Marks	Section-C 10 Marks	Total Questions
1	4	1	1	0	2
2	10	2	2	1	5
3	9	1	1	1	3
4	4	2	1	0	3
5	9	3	1	1	5
6	18	3	3	1	7
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>



**MAHARAJA'S COLLEGE**  
**(A GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. CBCS PROGRAMME DEGREE EXAMINATION**  
**B.Sc. BOTANY PROGRAMME**

**Core Course - Semester IV**  
(2020 admission onwards)

**BOT4COR04- ANATOMY, MICRO TECHNIQUE AND REPRODUCTIVE**  
**BOTANY OF ANGIOSPERMS**

**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Section A**

*(Answer any **TEN** questions, each question carries 1 mark)*

1. What are pits?
2. Give an example of a dehydrating agent commonly used in microtechnique.
3. What are bulliform cells?
4. Name any two plants having diffuse porous wood.
5. State the reason why monocot plants do not have secondary growth.
6. Name the scientist who discovered double fertilization in Angiosperms.
7. Mention the use of a Microtome.
8. What is the significance of Dendrochronology.
9. Name any two fixing agents used in Microtechnique.
10. What is triple fusion?
11. What is Tapetum?
12. Some fruits are gritty. What is the reason for it?

**(10 x 1 = 10 marks)**

**Section B**

*(Answer any **SIX** questions, each question carries 5marks)*

13. Compare the structure and function of apical meristems of stem and root of angiosperms.
14. What seasonal changes do you expect in the cambial activity of temperate plants
15. Interpret the role of wood anatomy in the identification of wood.
16. What is pollination? What are the mechanisms to prevent self pollination in plants? Also add notes on pollen-stigma interactions.
17. Give a detailed account of Microsporogenesis with suitable diagrams.
18. Give an account on polyembryony and causes of polyembryony.
19. Outline the steps involved in the double staining of a dicot stem.
20. 'Presence of secretory tissues are advantage for the plants'. Validate the statement with suitable examples
21. Compare the formation of resin duct of *Pinus* with the secretory cavities in *Eucalyptus*.

**(6 x 5 = 30marks)**

**Section C**

*(Answer any **TWO** questions, each question carries 10 marks)*

22. Explain the different theories associated with the organization of shoot apex in angiosperms.
23. Give an account of the different types of embryo sac found in angiosperms with illustrations.
24. What is Maceration? What is its significance? Also add notes on Smear and Squash techniques employed in microtechnique.
25. Explain anomalous secondary growth in *Bignonia* with the help of suitable diagrams.

**(2x 10 = 20 marks)**



**SEMESTER - 5**

**Course 05**

**BOT5COR05 - RESEARCH METHODOLOGY, BIOSTATISTICS, BIOPHYSICS  
AND BASIC COMPUTER SKILLS**

**(Theory 54 hours, Practical 36 hours)**

**(Theory Credit 3, Practical credit 1)**

**Learning Outcome**

Students will be able to

- Understand Scientific Method.
- Prepare a project proposal.
- Plan and carry out a project.
- Prepare a project report.
- Understand the basic statistical methods for biological research.
- Familiarizes with biological instrumentation.
- Understand the basic computer skills.

**Module 1: Introduction to Research Methodology (5 hours)**

1. Need for research, types of research; Research and scientific method, Criteria of good research. Generation of a research problem, interpretation of results.
2. Research design - Need, features and significance of a good design. Basic principles of experimental design.
3. Sources of reference - (a) Library, journals: Indexing journals, abstracting journals, research journals, review journals, e-journals. Impact factor of journals, Digital library and e-Books b) Other sources of references: (i) Reprints, Internet, open access initiative, INFLIBNET, INSDOC, Google Scholar.

**Module 2: Preparation and Presentation of Research work (9 hours)**

1. Preparation of Project proposal- (a) Title, Introduction, literature review and abstract (b) Aim and scope (c) Present status (d) Location of experiments (e) Materials and methods (f) Justification (g) Expected outcome (h) Time schedule (g) Estimated date of completion (h) budget (i) References (j) Funding agencies.
2. Presentation and publication of research outcomes
  - a. Preparation of a dissertation - (i) Consolidation and analysis of data, photographs, illustration, tables and graphs (ii) Preparation of the outline (iii) Preparation of manuscript - introduction, review of literature, materials and methods, results, discussion, bibliography (methods of citing references, style manuals, arrangement of references), summary (iv) Guidelines for a scientific presentation- Preliminary pages - title page, certificates, acknowledgements, and contents page.
  - b. Research ethics, plagiarism and detection by software's-*ithenticate* and *turniton*

**Module: 3 Biostatistics (12 Hours)**

1. Introduction, statistical terms and symbols
2. Sample:- concept of sample, sampling methods,
3. Collection and representation of data, graphic representation of data( Line graph, bar diagram, Pie diagram & Histogram)
4. Measures of central tendency:- mean, mode, median
5. Measures of dispersion:- mean deviation, standard deviation.
6. Distribution patterns:- normal distribution, binomial distribution

7. Test of hypothesis: t-test - introduction, uses, procedure. chi-square test - introduction, uses, procedure

#### **Module 4: Biophysics**

**(12 hours)**

1. Microscopy:- Working of simple, compound, and electron microscopes, phase contrast, fluorescent, confocal (Application only)
2. Principles and applications of colorimeter, spectrophotometer and centrifuge, Beer-Lambert's Law.
3. Separation methods:- chromatography ; thin layer , paper, column (principle and applications only) , electrophoresis ;(Principle and applications only)
4. pH:- concept of pH, methods to measure pH; pH paper and pH meter, Buffers (Brief account only)

#### **Module5: Basic computer Skills**

**(16 hours)**

1. **Overview of the information technology:** Internet as a knowledge repository, e-mail, search engines (Google,), study of educational sites and Video Channels related to life sciences (DNAi, Scitable. Khan Academy, MIT Open Course Ware), Academic search techniques, (Pub Med, Google Scholar, Science direct and INFLIBNET) Introduction to the use of information technology in teaching and learning **(6 hours)**
2. **Use of computers:** The basic concept of operating system (DOS, WINDOWS and Ubuntu) MS Office Package (Study of MS Word, Excel and PowerPoint) **(10 hours)**
  - a. DOS – The basic concept of operating systems (Study of commands not required).
  - b. MS-WINDOWS:- logging to windows, organizing files and folders, copying, moving, deleting and saving documents, installing software, installing hardware.
  - c. Ubuntu.
  - d. MS-WORD:- word processing using WORD, editing tools (cut, copy, paste) formatting tools (font, paragraph) use of spell check, inserting tables (draw), inserting graphs and pictures
  - e. MS-EXCEL:- Creating a worksheet, data entry, sorting (ascending and descending), use of statistical tools in EXCEL (SUM, MEAN, MODE, MEDIAN), preparation of graphs (bar diagram, pie chart and line graph)
  - f. MS-POWERPOINT:- Creating a presentation, Inserting tables, charts and pictures into slides, Use of animation tools.

#### **Practicals**

**(36 hours)**

##### **Research Methodology (6 hours)**

1. Prepare a project proposal.
2. Prepare an outline of dissertation.
3. Prepare a list of references.
4. Present a project in the class with the help of LCD projector and submit the CD for evaluation.
5. Prepare the Final Project as per this paper.

##### **Biostatistics (12 hours)**

1. Collect numerical data and find out the central tendencies and prepare different types of graph mentioned in the syllabus
2. Familiarize with situations requiring t-test, chi-square test

##### **Biophysics (8 hours)**

1. Preparation of 0.1M sodium phosphate buffer (pH 6 and 7)
2. Measurement of pH using pH meter
3. Paper chromatography of plant pigments (demonstration)

4. Electrophoresis of nucleic acids (demonstration)
5. Column chromatography of plant pigments (demonstration)
6. Determination of the concentration of a given solution of  $\text{CuSO}_4$  using colorimetry

#### **Basic computer Skills (10 hours)**

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

#### **Suggested Readings**

1. Anderson J, Durston B H, Poole, 1970. *Thesis and assignment writing*. Wiley eastern.
2. Bedekar V H ,1982. *How to write assignment and research papers, dissertations and thesis*. Kanak publications.
3. Bercy R, 1994. *The research project, how to write it*. Rutledge, London.
4. Cotteril R, 2002. *Biophysics: An Introduction*. John Wiley and Sons.
5. Dany Spencer Adams, 2004. *Lab Math* I.K. International Pvt. Ltd.
6. Day R.A, 1998. *How to Write and Publish a Scientific Paper*, University Press Cambridge.
7. Holmes D Moody P and D. Dine 2006 *Research Methods for the Biosciences* Oxford University Press
8. Johnson DA, 1940. *Plant Microtechnique*, McGraw Hill Co., New York.
9. Judith Bell. *How to complete your research project successfully*. UBS Publishers and Distributors Ltd.
10. Kothari, 2004. *Research Methodology*. New Age International.
11. Norman T.J Bailey, 2008. *Statistical Methods in Biology*, Cambridge.
12. Norman TJ Baily 1994 *Statistical Methods in Biology*, University Press, Cambridge
13. Parthasarathy A 2008. *Essentials of programming in C for life Sciences*, Ane Books, India.
14. Patki L.R, B.L Bhalchandra, I H Jeevaji 1983 *An Introduction to Micro technique*, Chand and Co.
15. Prasad M.K & Krishna Prasad M, 1986. *Outlines of Micro Technique*, Emkay Publishers, New Delhi.
16. Prasad S. 2003. *Elements of Biostatistics*. Rastogi Publications, Meerut.
17. Sambamurty A.V. S.S. 2005. *A Text Book of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany*. I.K. International Pvt. Ltd. New Delhi.
18. Victoria E McMillan, 1997. *Writing papers in the biological sciences* (II Edn). Bedford books.

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)****B.Sc BOTANY PROGRAMME (CBCS)****SEMESTER –V****CORE COURSE—BOT5COR05****RESEARCH METHODOLOGY, BIOSTATISTICS, BIOPHYSICS AND BASIC  
COMPUTER SKILLS  
BLUEPRINT**

<b>Module</b>	<b>Hours Alloted</b>	<b>Section-A 1 Mark</b>	<b>Section-B 5 Marks</b>	<b>Section-C 10 Marks</b>	<b>Total Questions</b>
1	4	1	1	0	2
2	10	2	2	1	5
3	9	1	1	1	3
4	4	2	1	0	3
5	9	3	1	1	5
6	18	3	3	1	7
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJA'S COLLEGE****(A GOVERNMENT AUTONOMOUS COLLEGE)****B.Sc. Botany Programme****Core course - SEMESTER –V****BOT5COR05-RESEARCH METHODOLOGY, BIOSTATISTICS, BIOPHYSICS  
AND BASIC COMPUTER SKILLS***(2020 Admission onwards)***Model Question Paper****Time: Three Hours****Maximum: 60 Marks****Section A**(Answer any **TEN** questions, each questions carries **1** mark)

1. What are search engines?
2. What is standard error?
3. Define Beer- Lambert's law.
4. What is an e-mail?
5. What is meant by secondary data?
6. What is laboratory etiquette?
7. Name any two national science journals prescribed in your college library.
8. Any two applications of Spectrophotometer.
9. Define Plagiarism.
10. What is an e-Journal.
11. What is the principle behind the working of a centrifuge
12. List any two properties of a normal distribution curve.

**(10 x 1 = 8 marks)****Section B**(Answer any **SIX** questions, each question carries **5** marks)

13. Compare different types of chromatography techniques studied by you?
14. "Internet as a knowledge repository" justify
15. Write a critical account of IMRAD of a research paper.
16. Give an account of INSDOC services.
17. Discuss the steps involved in the preparation of a powerpoint presentation.
18. Evaluate the different means of graphic representation of data.

19. Mention with suitable illustrations, the components of a colorimeter.
20. Bring out the applications and advantages of phase contrast microscopy.
21. Evaluate the merits and demerits of mean and median.

(6x 5 = 30 marks)

### Section C

(Answer any **TWO** questions, each question carries **10** marks)

22. Comment on the principles and applications of Electron Microscopy.
23. Describe 't' test. Mention its uses, procedure and applications in Biostatistics.
24. Discuss the use of I. T in teaching and learning.
25. Enumerate the different steps involved in the preparation of a project proposal.

(2 x 10 = 20 marks)

### Semester V

#### Course 6

### **BOT5COR06 - PLANT BREEDING, HORTICULTURE AND PLANT PATHOLOGY**

(Theory: 54 hours; Practical: 36 hours)

(Theory Credit 3, Practical Credit 1)

#### **Learning Outcome**

Students will be able to

- develop conceptual understanding of plant genetic resources, plant breeding, gene bank and gene pool.
- familiarize with genetic basis of heterosis.
- classify sexual and asexual modes of reproduction.
- understand the concept of different types of horticultural crops, their conservation and management
- examine the various branches of horticulture, fruit and vegetable crops, floriculture, medicinal and aromatic plants.
- critically evaluate different cultivation practices and disease management
- identify the common plant diseases according to geographical locations and devise control measures

#### **Module 1: Nature and Scope of Plant Breeding**

**(5 Hours)**

Introduction and objectives of Plant Breeding, Major International and National Plant Breeding Institutes / Centers, reputed Indian and International Plant Breeders, Significant achievements of plant breeding (Semi-dwarf wheat and rice, Nabilization of Indian Canes, Hybrid Cotton, Hybrid Millets), Undesirable consequences of Plant Breeding (Genetic erosion, Narrow Genetic base, Increased susceptibility to minor diseases). Plant Introduction: Procedure, Acclimatization, Plant Introduction Agencies in India, Major Achievements of Plant Introduction.

#### **Module 2: Methods of Crop Improvement**

**(8 Hours)**

Self Incompatibility: Homo- and hetero-morphic systems, Mechanism of self-incompatibility and its overcoming and utilization in plant breeding

Male Sterility: Genetic, Cytoplasmic and Cytoplasmic Genetic male sterility, chemically induced male sterility, its utilization and limitations

Breeding Methods of Self Pollinated Crops: Pureline Selection, Mass Selection, Pedigree and Bulk Method.

Breeding Methods of Cross Pollinated Crops: Population Breeding, Mass Selection and Ear to Row Methods. Development of Synthetics and Composites

**Module 3: Heterosis and inbreeding depression (2 Hours)**

History, Genetic basis of Heterosis and Inbreeding Depression (Dominance, Over-dominance and Epistasis hypothesis); Application of Heterosis.

**Module 4: Non-conventional Methods in Crop improvement (3 Hours)**

**Mutations:** Spontaneous and Induced Mutations; Artificial Induction of Mutations, Role of mutations in Plant breeding.

**Polyploidy:** Autopolyploidy and Allopolyploidy and their role in Evolution and crop improvement, Induction of Polyploidy, Applications and limitations of polyploidy in crop improvement

**Module 5: Seed Technology in Plant Breeding (2 Hours)**

Indian Seed Act (1966), Classes of Improved Seed, Quality Seed Production, Seed Certification.

**Module 6: Horticulture Introduction (3 hours)**

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

**Module 7: Nursery management (3 hours)**

Nursery Management and Routine garden operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary.

**Module 8: Floriculture (3 hours)**

Ornamental Plants: Flowering annuals; Herbaceous perennials; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Fern allies; Cultivation of plants in pots; Indoor gardening; Bonsai.

**Module 9: Gardening (3 hours)**

Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India.

**Module 10: Commercial floriculture (4 Hours)**

Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Lilium, Orchids).

**Module 11: Diseases and Pests (2 Hours)**

Diseases and Pests of Ornamental Plants

**Module 12: Plant pathology (14 hours)**



1. History of plant pathology, Classification of plant diseases on the basis of causative organism and symptoms , Host parasite interaction , Defense mechanism in host, Mechanism of infection, transmission and dissemination of diseases.
2. **Control of plant diseases**
  - a. Prophylaxis-quarantine measures, seed certification
  - b. Therapeutic – physical therapy, chemotherapy.
  - c. Biological control
3. **Study of following diseases with emphasis on symptoms, disease cycle and control**
  - a. Bunchy top of Banana.
  - b. Bacterial blight of Paddy.
  - c. Root wilt of Coconut.
  - d. Abnormal leaf fall of Rubber
4. **Fungicides** - Bordeaux mixture, Tobacco Neem decoction, preparation. (Brief account only)

### **Practical**

**(36 hours)**

#### **Plant Breeding (5 marks)**

1. Methods of emasculation (Pea, Allamanda)
2. Pollen viability test
3. Seed viability test
4. Floral Biology of Rice and Coconut
5. Visit a Plant Breeding Research Institute and make a report about the Breeding Activities conducted there

#### **Horticulture (12 Hours)**

1. Study of flower with reference to stamens and gynoecium
2. Study of Soil sterilization process
3. Seed sowing and transplantation method
4. Garden designing and hedge preparation methods
5. Patterns of flower arrangement in vase
6. Tongue or wedge or splice grafting, budding ('T' and patch), air layering

#### **Plant Pathology (9 hours)**

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

### **Suggested Readings**

- Adams C.R. 2018. Principles of Horticulture. Amsterdam. Boston.
- Agrios, G.N. (1997). Plant Pathology, 4th edition. Cambridge, U.K.: Academic Press
- Bilgrami K.S and Dube H.C 1976 *A Text book of Modern Plant pathology* ,: Vikas
- Chadha K. L. 2003. Handbook of Horticulture. Indian Council of Agricultural Research.
- Chaudhari, H.K. 1984. Elementary Principles of Plant Breeding. Oxford – IBH. 2<sup>nd</sup> Edition.
- Das, L.D. Vijendra 2006. Plant Breeding. New Age International Publishers, New Delhi.
- George N. Agrios 1988. *Plant Pathology*, Academic Press Ltd., London.
- Greth Jones, D 1989 *Plant Pathology – Principles and Practice* , Aditya books, New Delhi.
- Malhotra & Aggarwal Ashok 2003 *Plant Pathology*, Tata Mc Graw Hill Publishing Co .
- Michael A. Dirr 2009. Manual of Woody and land Plants. Stipes Pub.

Randhawa, G.S., Mukhopadhyay, A. 1986. Floriculture in India. New York, NY: Allied Publishers.

Sharma, J.R. 1994. Principles and practices of Plant Breeding. Tata McGraw-Hill Publishing Company Ltd. , New Delhi

Salaria and Salaria 2013. A2Z Solutions Horticulture at a glance Vol.I. Jain Bros.

Sharma, P.D. 2011. Plant Pathology. Meerut, U.P.: Rastogi Publication.

Singh, B.D. 2012. Plant Breeding: Principles and Methods. Kalyani Publishers. 9<sup>th</sup> Edition.

Singh, P. 1996: Essentials of Plant Breeding. Kalyani Publishers, New Delhi-2

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –V**  
**CORE COURSE— BOT5COR06**  
**PLANT BREEDING, HORTICULTURE AND PLANT PATHOLOGY**  
**BLUEPRINT**

<b>Module</b>	<b>Hours Allotted</b>	<b>Section-A 1 Mark</b>	<b>Section-B 5 Marks</b>	<b>Section-C 10 Marks</b>	<b>Total</b>
1	5	1		1	2
2	8		1	1	2
3	2	1	1		2
4	3	1	1		2
5	2	1	1		2
6	3	1			1
7	3		1		1
8	3	1	1		2
9	3			1	1
10	4	1	1		2
11	4	1	1		2
12	14	4	1	1	6
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>



**MAHARAJA'S COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core course - SEMESTER –V**  
**BOT5COR06- PLANT BREEDING, HORTICULTURE AND PLANT PATHOLOGY**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Part A**

*(Answer any **Ten** questions. Each question carries 1 mark)*

1. What is nobilization?
2. What is roguing?
3. What is Chemotheraphy?
4. What id drip irrigation?
5. What is genetic erosion?
6. What is heterosis?
7. What is Olericulture?
8. How can you produce seedless watermelons?
9. What is self- incompatibility?
10. Write the difference between edge and hedge.
11. What is Topiary?
12. Write the name of the causative organism of 'Root wilt of Coconut'.

**(1 x 10 = 12 Marks)**

**Part B**

*(Answer any **Six** questions. Each question carries 5 marks)*

13. Discuss the applications of mutation breeding in crop improvement.
14. Mention the pathogen, symptoms and control measures of Abnormal leaf fall of rubber.
15. Write about the climate, soil, propagation, manuring and planting of bulbous plants.
16. What are the main features of Indian Seeds Act 1966?
17. How you prepare a landscape plan for an individual house?
18. Compare Pureline Selection and Mass Selection.
19. Write down the procedure of Quarantine.
20. Summarize the various objectives of plant breeding.
21. Write down the steps involved in the cultivation of marigold.

**(5 x 6 = 30 Marks)**

**Part C**

*(Answer any **Two** questions. Each question carries 10 marks)*

22. What is male sterility. Explain the different types of male sterility and its utilization in plant breeding.
23. How plant diseases are classified?
24. Write an essay on the principles of garden design. Which are the famous gardens in India.
25. Which are the different irrigation methods practiced. Add a note on its advantages and disadvantages.

**(2 x 10 = 20 marks)**

**SEMESTER V**

**Course 7**

**BOT5 COR 07 - COURSE TITLE: GENETICS AND EVOLUTION**

**(Theory 54 hours; Practical 36 hours)**

**(Theory Credit 2; Practical credit 1)**

**Learning Outcome**

Students will be able to

- infer the Mendelian and Post Mendelian genetics
- infer the basic principles of inheritance as well as extranuclear inheritance
- outline the mechanism of sex determination in organisms
- understand the concept of origin of life.
- compare the theories and process of evolution
- basic understand the basic human evolution

**Module 1 Mendelian Genetics**

**(14 hours)**

**1. Pre Mendelian and Mendelian Genetics:**

1. Pre Mendelian era: Concept of pangenesis, Preformation theories-homunculus, ovidists and spermists, Contributions of Nehemiah Grew and Kolreuter.
2. Mendelian Genetics- Allele, traits, phenotype, genotype, monohybrid cross, dihybrid cross, test cross, back cross, Mendelian principles of inheritance.

**2. Post Mendelian Genetics**

Modified Mendelian ratios:

1. Incomplete dominance-flower color in *Mirabilis*.
2. Epistasis- (a) dominant epistasis- fruit color in summer squashes (12:3:1)(b) recessive- coat color in mice (9:3:4): Non-epistasis - comb pattern in poultry (9:3:3:1)
3. Complementary genes - flower colour in *Lathyrus* (9:7).
4. Multiple alleles: General account: co dominance- ABO blood group in man; self sterility in *Nicotiana*.
5. Quantitative characters- polygenic inheritance - kernel colour in wheat; ear size in maize.

**Module 2 Linkage, Crossing over and recombination**

**(8 hours)**

1. Definition, significance- linkage and independent assortment. Complete and incomplete linkage. Coupling and repulsion
2. Crossing over - general account, determination of gene order; single and double crossover, interference and coincidence; mapping of chromosomes - two point test cross; three point test cross.

**Module 3 Sex determination and sex linked genes**

**(8 hours)**

1. Sex determination- sex chromosomes and autosomes- chromosomal basis of sex determination; XX-XY, XX-XO mechanism; sex determination in higher plants (*Melandrium album*); genic balance theory of sex determination in *Drosophila*.
2. Sex linked inheritance- eye color in *Drosophila*, Haemophilia in man; Y-linked inheritance.
3. Extra nuclear inheritance - general account- maternal influence - plastid inheritance in *Mirabilis*, Cytoplasmic male sterility in maize, kappa particle in *Paramecium*.

#### **Module 4 Biochemical genetics**

**(3hours)**

Beadle and Tatum experiment with *Neurospora*; Metabolic disorders – Alkaptonuria, Phenylketonuria, Albinism

#### **Module 5 Population genetics**

**(3 hours)**

Genotype frequency, gene frequency, panmictic population, Hardy Weinberg law, Significance.

#### **Module 6 Evolution - Origin of life**

**(4 hours)**

1. Origin of life – A brief account of theories of origin of life (Abiogenesis, Biogenesis and Cosmozoic theories). **1 hour**
2. Biochemical evolution of life - Urey and Miller experiment, synthesis of organic molecules on early earth, abiotic synthesis of macromolecules, protobionts, self-Replicating RNA, primitive cell, photosynthesis and the oxygen revolution. **3 hours**
3. Evidences of evolution – Morphological, anatomical and embryological. **3 hours**

#### **Module 7 Theories and Process of evolution**

**(11 hours)**

1. Theories of evolution -  
Lamarckism, Darwinism (A brief account of Darwin's voyage, Darwin's finches and adaptive radiation) and mutation theory of De Vries.  
Modern synthetic theory, concept of species, sub species, sibling species and deme.
2. Mutation, migration, natural selection and genetic drift.
3. Process of evolution
  1. Sources of variation -gene mutation, chromosome mutation, recombination, role of hybridisation and polyploidy in evolution.
  2. Natural selection – adaptation, differential reproduction. Stabilizing, directional, and disruptive selection
  3. Isolation – isolating mechanisms (geographic and reproductive isolation).
  4. Speciation – allopatric and sympatric speciation.
  5. Patterns of evolution – sequential and divergent evolution. Microevolution and macroevolution.
4. Human evolution – Brief account of human evolution, Cultural evolution of man. Evolution and society.

#### **Practicals**

**(36 hours)**

##### **Genetics**

1. Students should work out the problems in:
  1. Monohybrid , dihybrid cross and back crosses.
  2. All types of modified Mendelian ratios mentioned in the syllabus.
  3. Two point and three point test crosses.

#### **Suggested Readings**

1. Benjamin A P, 2005. *Genetics: a conceptual approach* (II Edn). W H Freeman and Company, New York.
2. Gardner, E.J. and Snustad D.P. (1984) *Principles of Genetics*. John Wiley, New York.
3. Gerald Karp 1985. *Cell Biology*. Mc Graw Hill co.
4. Gupta P.K ,1994. *Genetics* Rastogi Pub.
5. Hartl, D. L., Clark, A. G., & Clark, A. G. (1997). *Principles of population genetics* (Vol. 116). Sunderland, MA: Sinauer associates.

6. John Ringo, 2004. *Fundamental Genetics*. Cambridge University Press India Pvt. Ltd.
7. Klug, W. S., & Cummings, M. R. (2006). *Concepts of genetics*. Upper Saddle River, NJ: Pearson Education.
8. Daniel L. Hartl, Elizabeth W. Jones (1998) *Genetics: principles and analysis [4th ed]* Jones and Bartlett Publishers.
9. Laura Livingston Mays, 1981. *Genetics: A Molecular approach*. Macmillan publishing company.
10. Peter Sunstard & Michael. J. Simmons 2003, *Principles of Genetics* (3<sup>rd</sup> edition) John Wiley & Sonc, Inc.
11. Raven P H, Johnson G B, Losos J B, Singer S R, 2005. *Biology* (VII Edn). Tata McGraw-Hill, New Delhi.
12. Shukla R S, Chandel P S, 2004. *Cytogenetics Evolution and Plant breeding*. S. Chand & Co. Ltd. New Delhi.
13. Shukla R.S., Chandel P.S. 2004. *Cytogenetics Evolution and Plant breeding*. S. Chand&Co.Ltd New Delhi.
14. Sinnott E W, Dunn L C, Dodzhansky T, 1958. *Principles of genetics*.
15. Snustad D P, Simmons M J, 2012. *Principles of genetics* (VI Edn). John Willey and sons, USA.
16. Swanson C.P. 1957. *Cytology and Genetics. Englewood cliffs*, New York.
17. William Hexter, Henry T Yost Jr., 1977. *The science of Genetics*.

#### **On line Resources**

<http://www.ncbi.nlm.nih.gov/omim/>

[http://www.biology.arizona.edu/mendelian\\_genetics/mendelian\\_genetics.html](http://www.biology.arizona.edu/mendelian_genetics/mendelian_genetics.html)

<http://www.mendelweb.org/>

<http://www.dnaftb.org/dnaftb/1/concept/>

<http://learn.genetics.utah.edu/>

[http://www.ornl.gov/sci/techresources/Human\\_Genome/genetics.shtml](http://www.ornl.gov/sci/techresources/Human_Genome/genetics.shtml)

<http://www.brooklyn.cuny.edu/bc/ahp/MGInv/MGI.Inv.html>

<http://www.accessexcellence.org/RC/genetics.php>

<http://flybase.org/>

<http://genethics.ca/>

[http://morgan.rutgers.edu/MorganWebFrames/How\\_To\\_Use/HTU\\_frameset.html](http://morgan.rutgers.edu/MorganWebFrames/How_To_Use/HTU_frameset.html)

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –V**  
**CORE COURSE— BOT5 COR 07**  
**GENETICS AND EVOLUTION**

**BLUEPRINT**

Module	Hours Allotted	Part A 1 Mark	Part B 5 Marks	Part C 10 Marks	Total questions
1	6	2	2	1	5
2	3	1	1	-	2
3	3	1	1	-	2
4	8	3	1	1	5
5	8	3	2	1	6
6	8	2	2	1	5
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJA'S COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core course - SEMESTER –V**  
**BOT5COR07-GENETICS AND EVOLUTION**

(2020 Admission onwards)

**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Part A**

(Answer any **Ten** questions. Each question carries 1 mark)

1. What is protobiont?
2. How scientist predict the age of rocks?
3. What is deme?
4. Define back cross.
5. What is geological time scale?
6. Define genotype frequency
7. What is panmictic population?
8. What is sequential evolution?
9. What are sibling species?
10. What does linkage mean?
11. Outline maternal inheritance.
12. Relate gene order and double cross over.

(10 X 1 = 10 marks)

**Section B**

(Answer any **Six** questions. Each question carries 5 marks)

13. How do we predict the genotype and allele frequencies in a population?
14. Describe one gene one enzyme hypothesis.

15. Explain the principle of independent assortment.
16. Compare interference and coincidence.
17. Differentiate between sympatric and allopatric speciation.
18. Deduct why the marsupial diversity is greater in Australia as compared to South America?
19. Differentiate between micro evolution and macro evolution.
20. Give an account on transformation in bacteria.
21. "Babies with average birth weight are more likely to survive than a baby that is too small or too large". Explain the above statement on the basis of nature of selection  
(6 X 5 = 30 marks)

### Section C

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

22. Give a detailed account on non-allelic gene interaction with suitable examples.
23. Describe the chromosome theory of sex determination.
24. Explain in detail about Lamarckism.
25. Write an account on human evolution.  
(2 X 10 = 20 marks)

## SEMESTER V

Course 8

### **BOT6COR08 - ECOLOGY, ENVIRONMENTAL SCIENCE AND HUMAN RIGHTS**

(Theory: 54 hours; Practical: 36 hours)

(Theory Credit 3, Practical Credit 1)

#### Learning outcomes

The students will be able

- to understand the core concept of biotic and abiotic components and to evaluate and examine the structure, function and energy sources of ecological system
- to analyze the characteristics of different plant communities and to assess the adaptation of plants in relation to different environment
- to understand the concept of different natural resources, their utilization and to evaluate the management and conservation strategies of different natural resources
- to critically analyze the sustainable utilization of land, water, forest and energy resources
- to develop understanding of the concept and scope of plant biodiversity; to identify the causes and implications of loss of biodiversity and to apply skills to manage and conservation of biodiversity
- to develop understanding on the concept and issues of global environmental change and to examine the climate change and its effects on living beings
- to evaluate human influenced driver of climate system and its applications
- to analyse the issues, different sources of environmental problems and mitigation measures of various pollutions
- to evaluate the utility of legislation and policies for environmental protection, and

- to analyse and to develop understanding of the human rights and importance of an individual and public in conservation and protection of natural resources and environment.

**Module 1 Principles of Ecology and Environmental science (7 hours)**

**1. Introduction to Environmental Science**

- a. The Multidisciplinary Nature of Environmental Science
- b. Relevance and Scope of Environmental Studies

**2. Ecosystems**

- a. Structure and function of ecosystem: Ecosystem components- abiotic and biotic, Productivity - primary and secondary-gross and net productivity. Decomposition in nature, homeostasis in ecosystem
- b. Ecological energetics: energy flow, trophic levels, food chain and food web, ecological pyramids
- c. Nutrient cycles: Biogeochemical cycles of C, N and S.
- d. Ecosystem types (forest, grass land, deserts and wet lands)

**Module 2 Population and Community ecology (9 hours)**

1. Population: size, density, natality, mortality.
2. Community characteristics: Species diversity and species richness, dominance, growth forms and structure, trophic structure.
3. Association of communities: plant association, ecotypes, ecotone, edge effect, ecological indicators. keystone species
4. Ecological succession: types of succession, process - migration, ecesis, colonization, stabilization and climax community; hydrosere, xerosere, lithosere.
5. Species - ecosystem interaction: Habitat, ecological niche, microclimate Ecological factors affecting plant growth and response
  - a. Climatic factors: temperature and pressure; water - precipitation, humidity, soil water holding capacity; light - global radiation.
  - b. Topographic factors: altitude and aspects
  - c. Edaphic factors - profile and physical and chemical properties of soil
  - d. Biotic factors: interaction
6. Adaptation of plants to different environment

**Module 3 Natural Resources (9 hours)**

1. Types of resources-renewable and non renewable
2. Energy resources: Bioenergy, Use of alternate energy, Case studies (Eg. CIAL)
3. Water resources: Surface and ground water, drinking water sources, conflict over water – case studies, Water harvesting,
4. Food and Health Care Resources: Concepts of Agro-biodiversity, World food problem, Major food crops in India, Fertilizer-pesticide problem, case studies, Effects of modern agriculture. Traditional Knowledge in Health Care and Medicinal Plant Wealth of India.
5. Forest Resources: Timber and other Non Wood Forest Products (NWFP), Timber extraction, dams-benefits and problems; Effects of various extractions on forest and tribal people.

**Module 4 Biodiversity conservation (6 hours)**

1. Biodiversity: Definition, Levels of biodiversity, India as a mega biodiversity country, Biogeographic Zones of India



2. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values
3. Biodiversity at global, National and local levels, Hot-spots of biodiversity, Endangered and endemic species of India, Species extinction - Red data book
4. Threats: Habitat Loss, Biodiversity depletion, Invasive species, Encroachment, Reclamation, Mining

**Module 5 Global Environmental Changes and impacts (5 hours)**

1. Drivers of change - Population explosion, urbanisation, industrialisation, infrastructure development
2. Pressure - Solid and Liquid Waste, Industrial Waste, Agricultural Waste,
3. Impacts - Global warming and green house gases, Ozone layer depletion, Human loss due to floods, drought and other natural disasters
4. Impacts on Infrastructure Development
5. Resource depletion, Obstruction in navigation (wetlands)

**Module 6. State of Environment (8 hours)**

Environmental Pollution: Definition and general introduction

- a. Air pollution: Causes and sources, types of pollutants-particulates-aerosol, mist, dust, smoke, fume, plume, fog, smog. Acid rain, Effect of air pollution on plants and animals, Air quality monitoring
- b. Water pollution: Sources and types of pollutants. Water quality standards and assessment. Cycling of heavy metals, hydrocarbons. Eutrophication, Ground water pollution, Control measures
- c. Soil pollution: Causes and sources-waste dumps, municipal wastes, agrochemicals, mining, control measures
- d. Noise pollution: Sources, standards and measurements, effect on health, control techniques.
- e. Thermal pollution: Sources, effects and control measures.
- f. Nuclear hazards: Sources, impacts and safety measures.

**Module 7 Environmental Responses and Human Rights (10 hours)**

1. Institutions for Environmental Research and Conservation: Brief mention on International Union for Conservation of Nature and Natural Resources (WCU), MoEFCC, NEERI, BNHS, SACON, KSCSTE.
2. NGO Movements and Individual Contributions: Brief mention on WWF and Green Peace; Introduce personalities like Salim Ali, Sunderlal Bahuguna, Madhav Gadgil, Medha Patkar and Prof. M K Prasad.
3. Environmental Laws, Policies and Protocols: Global Conservation efforts - Brief mention about - Rio Earth Summit; Agenda 21; Inter Governmental Panel for Climate Change (IPCC) Kyoto protocol; COP 15 (15th Conference of the Parties under the UN Framework Convention on Climate Change); Environmental Laws and Policies India and Kerala - Brief accounts on Environment (protection) Act, 1986; Air (Prevention and control of pollution) Act, 1981; Water (Prevention and control of pollution) Act, 1974; Wildlife (protection) Act, 1972; Forest (Conservation) Act, 1980; Biodiversity Act, 2002; Kerala Conservation of Paddy Land and Wetland Act, 2008.
4. Human Rights and wise Use of Ecosystems and Natural Resources: Role of individual in conservation of natural resources; Human Rights and United Nations - contributions; main human rights related organizations - UNESCO, UNICEF, WHO. Three generations of human rights - civil and political rights, economic, social and cultural rights. Conservation issues of Western Ghats – Madhav Gadgil committee report (Brief mention only), Household Waste Management and Organic Farming, Ecotourism.



### Practical

(36 hours )

1. Visiting an ecosystem (grasslands/forest/wetland/urban) and make an assessment of species diversity, abundance, and frequency of plant species by quadrat method.
2. Preparation of the list of Rare and threatened (R&T), invasive alien species in the ecosystem visited (no collection of specimens)
3. Identification of anatomical, morphological, physiological adaptation of plants to the environment (Xerophytic, Hydrophytic, Epiphytic, Halophytic).
4. Identification of major environmental issues and sources of pollution in an area (pond, road side, market, Industrial area, paddy field, plantation etc.
5. Identification and preparation of the list of exotic plants in the locality.
6. Estimation of CO<sub>2</sub>, Cl, and salinity of water samples (Titrimetry)
7. Determination of pH of soil and water
8. Study of the most probable number (MPN) of coliform bacteria in water samples
9. Collection and recording of rain data by using simple rain gauge.
10. Visit to a Ecotourism site managed by Vana Samrakshana Samithi (VSS) under JFM program of Kerala Forest and Wildlife Department, familiarization of activities and making a report.
11. Visit to a model urban home garden, familiarization of activities and making a report

### Suggested readings

1. Ahmedullah, M. & Nayar, M.P 1987. *Endemic Plants of the Indian Region*. Botanical Survey of India, Calcutta.
2. Amal Raj S. 2005 *Introduction to Environmental Science & Technology*; Laxmi Publications Pvt. Ltd., New Delhi.
3. Baillie, J E M, Hilton-Taylor, C and Stuart S N (Edits.) 2004. *IUCN Red List of threatened species: A global species assessment*. Gland, Switzerland and Cambridge UK
4. Bhattacharya, A K 2005. *Ecotourism and Livelihoods*. Concept Publishing Co. New Delhi
5. Bharucha, Erach 2005. *Textbook of Environmental Studies for Undergraduate 7. Courses*, Universities Press, India (Pvt) Ltd
6. Bharucha, Erach 2003. *The Biodiversity of India*. Mapin Publishing Co., New Delhi
7. Ceballos-Lascurian, Hector, 1996. *Tourism, Ecotourism and Protected areas*. IUCN, Cambridge UK.
8. Champion, H.G. & Seth, S.K 1968. *A Revised Survey of the Forest Types of India*. Govt. of India Press, Delhi.
9. Chaudhury, S K 2006. *Culture Ecology and Sustainable Development*. Mittal publications, New Delhi
10. CPREC, 2006. *Environmental Laws of India, an introduction*. CPR Environment Education Centre, Chennai.
11. Garg M.R. Bansal V.K. Tiwana N.S. 2007. *Environmental Pollution and Protection*. Deep and Deep Publishers, New Delhi.
12. Ghosh, A K 2008. *A comprehensive handbook on Biodiversity*. The Energy and Resources Institute, New Delhi.
13. Jain, S.K. & Sastry, A.R.K 1984. *The Indian Plant Red Data Book*. Botanical Survey of India, Calcutta.
14. Khopkar S.M, 1995. *Environmental Pollution Analysis* New Age International (P) Ltd.

15. KSCSTE, 2007. *State of Environment Report of Kerala Vol. I-IV*, Kerala State Council for Science Technology and Environment, Sasthra Bhavan, Pattom, Thiruvananthapuram, 695004 Kerala, India
16. Kumar D . 2006, *Ecology for Humanity Eco Tourism*. Intellectual Book Bureau, Bhopal
17. Kumar, H D 2000. *Modern Concepts of Ecology* Vikas Publishing House, New Delhi
18. Mani, M. S. 1974. *Ecology and Biogeography in India*. W. Junk B.V. Publishers, Netherlands.
19. Misra, D.D. 2008. *Fundamental concepts in Environmental Studies*. S. Chand & Co. Ltd. New Delhi
20. Nayar, M.P. & Sastry. A.R.K 1987, 1988, 1990. *Red Data Book of Indian Plants*, Vols. I-III. Botanical Survey of India, Calcutta.
21. Nayar, M.P. 1996. *Hot Spots of Endemic Plants of India, Nepal and Bhutan*. Tropical Botanic Garden and Research Institute, Trivandrum.
22. Nayar, M.P. 1997. *Biodiversity challenges in Kerala and Science of conservation Biology*. In : P. Pushpangadan & K. S. S. Nair (Eds.), Biodiversity of Tropical Forests the Kerala Scenario. STEC, Kerala, Trivandrum.
23. Odum, E.P. 1971. *Fundamentals of Ecology* WB Saunders.
24. Richard Wright. 2009. *Environmental Science Towards a Sustainable Future* Pearson Education
25. Santhra S.C 2004, *Environmental Science* New Central Book Agency.
26. Sulekha and Chendel. *Plant Ecology and Soil*. S. Chand & Co. Ltd. New Delhi
27. Waxena H.M. 2006. *Environmental Studies* ,Rawat Publications, New Delhi.

### Online Resources

<http://www.kerenvis.nic.in/>  
[www.envfor.nic.in](http://www.envfor.nic.in)  
[www.saconindia.com](http://www.saconindia.com)  
[www.wwfindia.org](http://www.wwfindia.org)  
[www.articlesbase.com/travel-articles/ecotourism-in-india-802808.html](http://www.articlesbase.com/travel-articles/ecotourism-in-india-802808.html)  
[www.ecoindia.com](http://www.ecoindia.com)  
<http://www.marietta.edu/~biol/102/102.html>  
[www.millenniumassessment.org/](http://www.millenniumassessment.org/)  
<http://kids.niehs.nih.gov/>  
<http://www.enviroliteracy.org/>  
<http://www.webdirectory.com/>  
<http://environmentalresearchweb.org/cws/home>  
<http://www.envirolink.org/>  
<http://www.epa.gov/>  
<http://www.biodiversityhotspots.org>  
<http://www.conservation.org>  
<http://ces.iisc.ernet.in/biodiversity>  
<http://www.envirolink.org>  
<http://www.unep-wcmc.org>  
<http://www.biodiversityhotspots.org>  
<http://www.iucnredlist.org>  
<http://www.envfor.nic.in>

<http://www.greenpeace.org>

<http://indiabiodiversity.org>

<http://www.frlht.org.in>

<http://www.worldwildlife.org>

<http://www.ipcc.ch/>

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –V**  
**CORE COURSE— BOT6COR08**  
**ECOLOGY, ENVIRONMENTAL SCIENCE AND HUMAN RIGHTS**

**BLUEPRINT**

<b>Module</b>	<b>Hours</b>	<b>Part A (1 Mark) 10/12</b>	<b>Part B (5 Marks) 6/8</b>	<b>Part C (10 Marks) 2/4</b>	<b>Total No of Questions</b>
1	7	2	1	1	4
2	9	2	2	1	5
3	9	2	1	1	4
4	6	1	1	-	2
5	5	1	1	-	2
6	8	1	1	1	3
7	10	3	2	-	5
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJA'S COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core course - SEMESTER –V**  
**BOT6COR08 - ECOLOGY, ENVIRONMENTAL SCIENCE AND HUMAN RIGHTS**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Part A**

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

1. What is keystone species?
2. Illustrate grazing food chain
3. What is bioenergy?
4. Who is the Chairman of WGEEP?
5. Write note on Invasive species
6. Comment on primary productivity
7. What is IPR?
8. Expand MoEFCC
9. What is natality?
10. Comment on Green House Effect
11. What is decibel?
12. What is COP 15?

**(10 x 1 = 10 Marks)**

**Section B**

*(Answer any **SIX** questions, each question carries 5 marks)*

13. Describe briefly different climatic factors affecting plant growth and response
14. Illustrate the different types of ecological pyramids
15. Explain values of biodiversity. Mention different types of values
14. "Next world war will be on water". Assess the statement giving facts
15. Explain Kerala Conservation of Paddy Land and Wetland Act 2008
16. Comment on the characteristics of a biological community
17. "Drought, flood and other natural disasters are manmade". Critically comment the statement giving special emphasis on Kerala Scenario
18. Assess the effects of soil pollutants on man and his agriculture products?
19. Discuss the salient features of human rights

**(6 x 5 = 30 Marks)**

**Section C**

*(Answer any **TWO** questions each question carries 10 marks)*

22. Write an essay on Air pollution
23. Discuss different types of ecosystems in nature
24. What do you understand by "Natural Resources"? Give examples
25. Write an essay on ecological succession

**(2 x 10 = 20 Marks)**

**Semester V**  
**Core - Choice Based Course-01**  
**BOT5CBC01 - PLANT GENETIC RESOURCES**  
**(Theory 72 Hours)**  
**(Theory credit 4)**

**Learning Outcome**

Students will be able to

- Understand core concepts of Economic Botany and relate with environment, populations, communities, and ecosystems
- Develop critical understanding on the evolution of concept of organization of apex new crops/varieties, importance of germplasm diversity, issues related to access and ownership
- Develop a basic knowledge of taxonomic diversity and important families of useful plants
- Increase the awareness and appreciation of plants & plant products encountered in everyday life
- Appreciate the diversity of plants and the plant products in human use

**Module 1 Origin of Cultivated Plants (6 Hours)**

Concept of Centres of Origin, and diversity. Primary and Secondary Centres. Vavilovian law and Parallel variation. Domestication of crop plants, Selection under domestication, Types of selection, Changes in plant species under domestication. Germplasm, Gene Pool Concept, Genetic Erosion, Activities in Germplasm Conservation. Indian Plant Genetic resource Management System.

**Module 2 Cereals (6 Hours)**

Wheat and Maize (origin and distribution, botanical characters and uses), Rice- origin and distribution, botanical characters, cultivation and uses. Brief account of millets (Peral millet, Sorghum, Finger millet, Foxtail millet, Bread millet- Botanical Name, Family and Uses).

**Module 3 Pulse Crops (4 Hours)**

Origin, distribution, botanical characters and uses of the following Pulse Crops – Pea, Chick Pea, Pigeon Pea, Green gram, Black gram and Soybean .

**Module 4 Sugars & Starches (4 Hours)**

Origin, distribution, botanical characters and uses of the following Sugar Crops and Starches –Sugar Beet, Sugarcane, Sugarcane Cultivation, Processing of Sugar cane, Sugar Industry in India. Starches- Sweet Potato, Tapioca.

**Module 5 Spices (6 Hours)**

Listing of important spices- their native place, botanical name family and part used, (Ginger, Turmeric, Cinnamon, Cloves, Saffron, Allspice, Black pepper, Chillies, Vanilla, Coriander, Celery, Cumin, Fennel, Cardamom, Fenugreek, Black mustard, Indian mustard, Nutmeg, Peppermint)

**Module 6 Beverages (4 Hours)**

Tea, Coffee (Origin, distribution, botanical characters, processing & uses)

### **Module 7 Oils & Fats**

**(8 Hours)**

Essential oils, extraction of essential oils, Fatty oils and fats, Classification of vegetable oils, Extraction of vegetable oils. Origin, distribution, botanical characters and uses of the following oil yielding crops- Groundnut, Coconut, Palm oil, Sesame oil, Castor oil, Mustard oil and Sunflower oil.

### **Module 8 Fumitories and Masticatories**

**(4 Hours)**

Origin, distribution, botanical characters, curing & uses of Tobacco, Arecanut. Health hazards of tobacco. Cannabis-Origin and distribution, botanical characters, kinds of cannabis narcotics and uses. Betel- origin and distribution, botanical characters, bleaching and grading of betel leaves and uses.

### **Module 9 Natural Rubber**

**(3 Hours)**

Para-rubber: tapping, processing and uses.

### **Module 10 Drug-yielding plants**

**(4 Hours)**

Listing of important medicinal plants with special reference to origin, botanical name, family, plant part used and its medicinal uses- Sweet flag, Sarpagandha, Aswagandha, Adathoda, Balladonna, Cinchona, Nuxvomica, Vinca, Glycerhiza, Holarrhena, Aloe, Santalum, Digitalis and Bael.

### **Module 11 Vegetables and Fruits**

**(6 Hours)**

Classification of vegetables, Listing of important vegetables with special reference to origin, botanical name, family, plant part used- Beet, Carrot, Radish, Turnip, Yam, Potato, Onion, Garlic, Cauliflower, Cabbage, Knol khol, Lettuce, Spinach, Amaranthus.

Classification of fruits, Listing of important fruits with special reference to origin, botanical name, family, plant part used- Mango, Custard Apple, Pineapple, Sapota, Mandarin orange, Sweet orange, Sour orange, Lemon, Lime, Banana, Guava, Pappaya, Pomegranate, Litchi, Date palm, Jamun, Grape, Apple, Pear, Peach, Plum, Cherry, Apricot, Mulberry, Strawberry, Blackberry and Watermelon.

### **Module 12 Timber plants**

**(3 Hours)**

Structure of Wood, Properties of Wood, Seasoning of Wood. Important timber yielding plants- Teak – Origin, area under plantation, properties of wood, uses. Dalbergia- Origin, area under plantation, properties of wood, uses

### **Module 13 Fibres**

**(6 Hours)**

Classification based on the origin of fibres, Jute, coir (origin, botanical characters, processing and uses). Cotton- Origin, botanical characters, kinds of cotton, Processing of cotton, uses.

### **Hands on training**

**(8 Hours)**

1. Conduct a Field Trip and collect and identify as much possible plants mentioned in the syllabus.

2. Prepare a Herbarium using the above plants. The number of Herbarium Sheets Submitted at the time of examination consisting of 50 plants containing at least 2 plants from each section.

### Suggested Readings

1. Kochhar, S.L. 2012. Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. 2001. Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. 2003. Plants, Genes and Agriculture. Jones & Bartlett publishers
4. Singh, Pande, Jain 2005. Economic Botany. Rastogi Publications

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –V**  
**CORE - CHOICE BASED COURSE I— BOT5CBC01**  
**PLANT GENETIC RESOURCES**

### BLUEPRINT

Module	Hours	Part A (2 Marks) 10/12	Part B (5 Marks) 6/8	Part C (15 Marks) 2/4	Total No of Questions
1	6	1	1	1	3
2	6	-	1	1	2
3	4	1	-	-	1
4	4	1	1	-	2
5	6	1	1	1	3
6	4	1	1	1	3
7	8	1	1	-	2
8	4	1	1	-	2
9	3	1	-	-	1
10	4	1	-	-	1
11	6	1	-	-	1
12	3	1	1	-	2
13	6	1	1	-	2
<b>Total</b>	<b>72</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core Choice based course I - SEMESTER –V**  
**BOT5CBC01 - PLANT GENETIC RESOURCES**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 80 Marks**

**Part A**

*(Answer any **Ten** questions. Each question carries 1 mark)*

1. Write the botanical name of pigeon pea
2. Which part of pomegranate is edible?
3. Define the term 'fumitories'
4. Name a temperate fruit belonging to family Rosaceae
5. Name a semi-drying oil.
6. Name the centre of origin of clove plant.
7. Give the botanical names of two fibre yielding plants you have studied.
8. What is bailing ?
9. What is Kiln seasoning ?
10. What do you understand by the term 'toughness' in reference to wood?
11. Tea plant under cultivation is a shrub. How is it so?
12. Where is Sugarcane Breeding Institute located in India.

**(10 x 2 = 20 Marks)**

**Part B**

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

13. Write about the mandate of NBPGR. Which are the regional stations of NBPGR?
14. In what way the concept of centres of origin is helpful in crop improvement programmes.
15. Write down the botanical names of five citrus fruits and temperate fruits .
16. Describe the classification and extraction of vegetable oils.
17. Describe the steps involved in the processing of cotton?
18. Describe the processing and use of rubber?
19. Write down the origin, botanical characters and kinds of narcotics obtained from Indian hemp?
20. Give the botanical names, family and uses of the following medicinal plants  
(1) Aswagandha, (2) Adathoda, (3) Balladonia, (4) Cinchona, (5) Nuxvomica,
21. Write the botanical classification and morphological description of pigeon pea.

**(6x 5 = 30 Marks)**

**Part B**

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

22. Define domestication. What are the important changes that have occurred under domestication?
23. What are spices? Give families, botanical names and native place of any ten spices you have studied.
24. Describe the origin, distribution, botanical characters and uses of Wheat.
25. Write an essay on the processing of tea. Compare the qualities of tea with coffee.

**(2x 15 = 30 Marks)**



**Semester V**  
**Core - Choice Based Course-2**  
**BOT5CBC01- HORTICULTURE AND NURSERY MANAGEMENT**  
**(Theory 72 Hours)**  
**(Theory credit 4)**

**Learning Outcome**

Students will be able to

- Understand the different classifications of horticultural crops, nursery management, and use of technology in horticulture.
- Develop their competency on pre and post-harvest technology in horticultural crops
- Analyze the different methods of weed control and harvest treatments of horticultural crops
- Examine the economic implications of cultivation of tropical and sub-tropical vegetable crops
- Evaluate the importance of floriculture and contribution spices and condiments on economy

**Module 1 Horticulture - Introduction (10 hours)**

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

**Module 2 Propagation (10 hours)**

1. Propagation of horticultural plants- by seeds- Seed development and viability, seed dormancy, seed health, seed testing and certification, growing seedlings in indoor containers and field nurseries, seed bed preparation, seedling transplanting; advantages and disadvantages of seed propagation.
2. Vegetative propagation- organs used in propagation- natural and artificial vegetative propagation; methods- cutting, layering, grafting and budding; advantages and disadvantages of vegetative propagation; micropropagation.

**Module 3 Gardening (10 hours)**

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

**Module 4 Floriculture, Olericulture and Pomology (14 hours)**

1. Commercial floriculture- jasmine, orchid, anthurium, rose, gladiolus; production of cut flowers, quality maintenance, packing, marketing. Flower arrangements-basic styles- upright and slanting-japanese ikebana, dry flower arrangement. **6 hours**

2. Olericulture- Types of vegetable growing-home gardens and market gardens; cultivation practices of leafy vegetable (Amarathus), tuber (Potato), fruit (Tomato), flower (Cauliflower). **4 hours**
3. Pomology- Cultivation of fruit crops-mango, banana and pine apple- preparation of land, spacing, planting, irrigation, hormones, harvest and storage. Factors affecting duration of storage. Principles of preservation-temporary and permanent- agents for fruit preservation. Preparation of pickles, jams, jellies and squashes using locally available fruits. **4 hours**

#### **Module 5 Garden pests and insects**

**(4 hours)**

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

#### **Module 6 Nursery management**

**(24 hours)**

1. Nursery - definition, types; management strategies - planning, layout, budgeting-production unit, sales unit. Plant growing structures- green houses, fernery, orchidarium, arboretum. **6 hours**
2. On hand training **18 hours**
  1. Preparation of potting mixture of known combination and potting in earthen pots / poly bags.
  2. Preparation of nursery beds.
  3. Preparation of compost / vermicompost using different substrates.
  4. Working knowledge and identification of garden tools and implements.
  5. Practical knowledge in different plant propagation techniques listed in syllabus.
  6. Cultivation of a vegetable / ornamental plant / fruit crop listed in the syllabus.
  7. Practice of different pruning operations (top dressing , shaping and topiary) in the following plants (1) Bougainvillea (2) Phyllanthus .
  8. Visit a well established nursery and submit report.

#### **Suggested Readings**

1. Adams C.R., Early M.P. 2004. *Principles of Horticulture*. Elsevier, N. Delhi.
2. Barton West R. 1999. *Practical Gardening in India*. Discovery Pub. House, New Delhi
3. Edmond J.B., Senn T.L., Andrews F.S., Halfacre P.G. 1975. *Fundamentals of Horticulture*. 4th Edn.TMH N.Delhi.
4. John Weathers. 1993. *Encyclopaedia of Horticulture*. Discovery Pub. House. New Delhi
5. Jules Janick. 1979 *Horticultural Science*. Surjeet publications, Delhi
6. Kumar N. 1994. *Introduction to Horticulture*. Rajalakshmi Pub. Nagarcoil
7. Linda William 2005, *Ornamental Science*- Demystified, Tata Mc Graw hill Co.
8. Manibhushan Rao K. 1991. *Text Book of Horticulture*. Macmillan India Ltd.
9. Mazundar B.C. and P.M. Mukhopadhyay 2006, *Principles & Practices of Herbal Garden*. Daya Publishing House – Delhi.
10. Percy Lancasher, 2004. *Gardening in India*. Oxford IBH Publishing Co. Pvt. Ltd.

11. Randhawa G.S., Mukhopadhyay A. 1986. *Floriculture in India*. Allied Publishers Pvt. Ltd. Ahmedabad
12. Sadhu M.K., 1996. *Plant Propagation*. New age International publishers, N. Delhi
13. Schilleter J.C., Richey H.W. 1999. *Text Book of General Horticulture*. Biotech Books, New Delhi
14. Vishnu Swarup, 1997. *Ornamental Horticulture*. Mac. Millan India Ltd.

**Online Resources**<http://www.ashs.org/><http://www.ars.org/><http://www.oces.okstate.edu/kay/horticulture><http://www.aos.org><http://www.aos.org//AM/Template.cfm?Section=Home><http://www.horticultureworld.net/><http://www.back-to-basics.net/><http://www.rhs.org.uk/>

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –V**  
**CORE CHOICE BASED COURSE 3— BOT5CBC01**  
**HORTICULTURE AND NURSERY MANAGEMENT**  
**BLUEPRINT**

Module	Hours	Part A (2 Mark)	Part B (5 Marks)	Part C (15 Marks)	Total Questions
1	10	2	1	1	4
2	10	2	2	1	5
3	10	2	2		4
4	14	2	2	1	5
5	4	2	1		3
6	24	2	1	1	4
<b>Total</b>	<b>72</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**CORE CHOICE BASED COURSE 2— SEMESTER –V**  
**BOT5CBC01- HORTICULTURE AND NURSERY MANAGEMENT**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 80 Marks**

**Part A**

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

1. What is Vermicompost?
2. What are biofertilizers?
3. What is micropropagation?
4. What is goottee?
5. What is trophy?
6. What is mowing?
7. What is Olericulture?
8. What is a ladybird?
9. What is self- incompatibility?
10. Write the difference between edge and hedge.
11. What is Topiary?
12. What is orchidarium

**(10 x 2 = 20 Marks)**

**Part B**

*(Answer any **Six** questions. Each question carries 5 marks)*

13. Write a note on the preparation of jams and squashes using locally available fruits.
14. Write about dry flower arrangement.
15. Write about the climate, soil, propagation, manuring and planting of bulbous plants.
16. Write down the cultural practices of Potato?
17. How you prepare a landscape plan for an individual house?
18. Write a note on garden tools and implements used in horticulture.
19. How can you prepare Bonsai using Ficus.
20. Summarize the various management strategies of a nursery.
21. Write down the steps involved in the cultivation of marigold.

**(6 x 5 = 30 marks)**

**Part C**

*(Answer any **Two** questions. Each question carries 15 marks)*

22. Write a detailed essay in the cultivation of Mango and Banana.
23. Write an essay on how weeds can be eliminated from gardens?
24. Write an essay on the principles of garden design. Which are the famous gardens in India.
25. Which are the different irrigation methods practiced. Add a note on its advantages and disadvantages.

**(15 x 2 = 30 Marks)**

**Semester V**  
**Core - Choice Based Course-3**  
**BOT5CBC01 – AGRIBASED MICROENTERPRISES**  
**(Theory 72 Hours)**  
**(Theory credit 4)**

**Learning Outcome**

Students will be able to

- Understand the basic information about the business opportunities and plant sciences
- Learn about sustainable agriculture and organic farming
- Have an idea about ornamental gardening, nursery management and mushroom cultivation
- Understand the preservation techniques of various food products

**Module 1 Organic farming and composting techniques (9 hours)**

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

**Module 2 Horticulture and Nursery management (18 hours)**

1. Soil components. Preparation of potting mixture. Common Garden tools and implements. Methods of plant propagation – by seeds – advantages and disadvantages. Vegetative propagation – advantages and disadvantages. Natural methods of vegetative propagation. Artificial methods – cutting, grafting, budding and layering. Use of growth regulators for rooting. Micropropagation by tissue culture.
2. Gardening – Types of garden – ornamental, indoor garden, kitchen garden, vegetable garden for marketing. Rockery and artificial ponds. Ornamental garden designing – garden components – flower beds, borders, hedges, edges, drives and paths, garden adornments. Lawn - preparation by seeds, by transplanting seedling and by turfing. Annuals, Biennials, Shrubs, Trees, Cycads and Palms. Bonsai preparation. Pruning of plants. Types of Nurseries – Management aspects and Maintenance.
3. Plant growth structures – advantages of green house, polyshed, fernery and orchidarium.
4. Packaging of fruits, vegetables, nursery products and flowers.

**Module 3 Food spoilage and preservation techniques (9 hours)**

1. Causes of spoilage.
2. Preservation techniques – asepsis, removal of microorganisms, anaerobic conditions and special methods – by drying, by heat treatment, by low temperature storage and by chemicals (Food Additives).
3. Preparation of wine, vinegar and dairy products( Milk peda, Khoa, Ice cream and Paneer)

**Module 4 Mushroom cultivation and Spawn production (9 hours)**

1. Significance of Mushrooms, General outline of life cycle.
2. Types of mushrooms - button mushroom, oyster mushroom and milky mushroom, poisonous mushroom – methods of identification.

3. Spawn – isolation and preparation. Cultivation of oyster and milky mushrooms – using paddy straw and saw dust by polybag.
4. Farm design and control of pests and diseases. Value added products from mushroom – pickles, candies, dried mushrooms.

### **Module 5 Plant tissue culture and micropropagation**

**(9 hours)**

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

### **On Hand Training**

**(18 hours)**

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

### **Suggested Readings**

1. Adams , M.R. and M.O. Moss. 1995. Food Microbiology. Panima Publishing.
2. Casida, L.E. (Jr.),2005 Industrial Microbiology. New Age International.
3. Chandha.,K.L 2003. Handbook of Horticulture. ICAR. New Delhi.
4. Frazier and Westhoff. 1988. Food Microbiology. Tata McGraw – Hill.
5. George Acquichah 2004. Horticulture – Principles and Practices. II Edn. Prentice Hall. India.
6. George J. Banwant.2004. Basic Food Microbiology. CBS Publishers and Distributors.
7. Gopal Chandra De2002. Fundamentals of Agronomy. Oxford and IBH Publishing House.
8. Hudson. T., Hartmann., Dale E. Kester 2001. Plant Propagation, Principles and Practices. 6th Edn. Prentice Hall. India.
9. James M. Jay. 2005. Modern Food Microbiology. CBS Publishers and Distributors.
10. Kalia Kumar De. 1996. Plant Tissue Culture. New Central Book Agency (P) Ltd.
11. Kaul, T.N. Biology and Conservation of Mushroom 2002. Oxford and IBH Publishing Co.
12. Kunte, Kawthalkar and Yawalker.1997. Principles of Horticulture and Fruit Growing. Agri –Horticulture Co.
13. Neshamani, S. 2003. Pazhanganal, Pazhavibhavanganal (Malayalam). Kerala Bhasha Institute.
14. Pandey, R.K and S.K. Ghosh.1996. A Hand Book on Mushroom Cultivation. Emkey Publications.

15. Prem Singh Arya. 2004. Vegetable Seed Production Principles. Kalyani Publishers.
16. Prince Alex, Rajani A. Nair. 2003. Ayurveda Avshodha Nirmanam – Sidhanthavum Prayogavum (Malayalam). Kerala Bhasha Institute.
17. Purohit, S.S. 2005. Plant Tissue Culture. Student Edition.
18. Razdan, M.K. 1995. Introduction to Plant Tissue Culture. 2nd Edn. Oxford and IBH Publishing Co.
19. Rema, L.P. 2006 Applied Biotechnology. MJP Publishers.
20. Sharma, R.R. 2005. Propagation of Horticultural Crops. Kalyani Publishers.
21. Singh, B.D. 1996. Biotechnology. Kalyani Publishers.

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –V**  
**CORE CHOICE BASED COURSE 3— BOT5CBC01**  
**AGRIBASED MICROENTERPRISES**  
**BLUEPRINT**

Module	Hours	Part A (2 Marks)	Part B (5 Marks)	Part C (15 Marks)	Total Questions
1	9	2	1	1	4
2	18	4	3	2	9
3	9	2	2		4
4	9	2	2	1	5
5	9	2	1		3
6	18				
<b>Total</b>	<b>72</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>



**MAHARAJAS COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**CORE CHOICE BASED COURSE 3— SEMESTER –V**  
**BOT5CBC01- AGRIBASED MICROENTERPRISES**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 80 Marks**

**Part A**

*(Answer any **Ten** questions. Each question carries 1 mark)*

1. What is organogenesis?
2. What is arboriculture?
3. Differentiate between organic manures and fertilizers.
4. What is pruning?
5. Comment on PGPR
6. Differentiate between edges and hedges
7. What is food additive?
8. Write a note on value added products from mushroom
9. What is topiary?
10. What is totipotency?
11. Explain pasteurization
12. What is Spawn?

**(10 x 2 = 20 marks)**

**Part B**

*(Answer any **SIX** questions, each question carries 5 marks)*

13. 'Plant tissue culture technique involves aseptic condition'. Validate the statement
14. Comment on the different types of Mushrooms
15. 'Organic manure is better than chemical fertilizers'. Give your opinion about the statement on the context of present agriculture situation in Kerala
16. Mushrooms can be used as a source for value added products. Explain
17. Explain the process of wine preparation
18. Analyze the importance of Greenhouse
19. Evaluate the causes of food spoilage
20. What are the steps involved in a lawn preparation?
21. Compare the propagation methods by means of seeds and vegetative condition

**(6 x 5 = 30 marks)**

**Part C**

*(Answer any **Two** questions, each question carries 15 marks)*

22. Explain different steps in plant tissue culture
23. Write an essay on artificial methods of vegetative reproduction.
24. Explain the cultivation of oyster mushroom using paddy straw.
25. Give an account on methods of food preservation

**(2 x 15 = 30 marks)**



**SEMESTER VI**

**Course 9**

**BOT6COR09 - PLANT PHYSIOLOGY AND BIOCHEMISTRY**

(Theory 54 hours; Practical 36 hours)

(Theory Credit 2, Practical credit 1)

**Learning Outcome**

Students will be able to

- understands the basic principles related to various physiological functions in plant life.
- Familiarize the student with the basic skills and techniques related to plant physiology and biochemistry.
- understands the structure and function of the molecules associated with plant life.
- Familiarize the student with applied aspects of plant physiology in other fields like agriculture.

**Module 1 Water relation and Mineral Nutrition**

**(8 hours)**

**1. Water relation 6 hours**

- a. Physical aspects of absorption-Diffusion, imbibition, osmosis. Concept of Water potential, matrix potential, pressure potential.
- b. Absorption of water-active & passive, Ascent of sap-cohesion adhesion theory.
- c. Transpiration-types-mechanism-theories-(starch-sugar, proton-K<sup>+</sup>-ion exchange)-significance – anti-transpirants, Guttation.

**2. Mineral Nutrition and mechanism of absorption 2 hours**

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

**Module 2 Photosynthesis and translocation**

**(11 hours)**

**1. Photosynthesis**

History - Photosynthetic pigments, photo excitation- Fluorescence, Phosphorescence - Absorption and action spectra, Red drop and Emerson enhancement effect, Concept of photo systems (photosystem I and II), Cyclic & Non Cyclic photophosphorylation, Carbon assimilation pathways-C<sub>3</sub>, C<sub>4</sub>, CAM- Photorespiration –factors affecting photosynthesis.

**2. Translocation**

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

**Module 3 Respiration**

**(8 hours)**

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

**Module 4 Growth, Development and Stress Physiology**

**(8 hours)**

**1. Physiology of growth and development 6hours**

- a. Physiological effects and practical application of hormones-Auxins, Giberillins, Cytokinins, ABA, ethylene.
- b. Physiology of flowering–Phytochrome-C.
- c. Photoperiodism-vernalisation.

**2. Stress physiology 2 hours**

Abiotic stress - Plant responses to water, salt and temperature stresses. Biotic stress – pathogens.

### **Module 5 Water, Solutions &pH**

**(2 hours)**

Physical and chemical properties of water, Acid and bases, pH definition, significance, measurement, pH indicators, buffer action, significance of buffers in biological systems.

### **Module 6 Chemistry of biological molecules**

**(16 hours)**

1. **Carbohydrates (4 hours)** - structure and role of mono-di & poly-saccharides- common sugars seen in plants (dihydroxy acetone, glyceraldehyde, ribose, glucose, mannose, galactose, lactose, sucrose, cellobiose, cellulose and starch)
2. **Proteins (3hours)** -peptide bond-essential and non essential amino acids-primary structure-physiologically important proteins.
3. **Lipids (3 hours)** - general features and their roles - fatty acid types and structure - fatty acid derivatives- fats and oils, structure and functions - compound lipids.
4. **Enzymes (6 hours)** - Nomenclature, characteristics mechanism and regulation of enzyme action, enzyme kinetics, factors affecting enzyme action.

### **Practicals**

#### **Physiology (27 hours)**

##### **Core Experiments**

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

##### **Demonstration only- experiments.**

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

##### **Biochemistry (9 hours)**

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

### **Suggested Readings**

1. Datta, S.C.1989. *Plant Physiology*, Central Book Depot, Allahabad.
2. Dayananda, B. (1999). *Experiments in Plant Physiology*, Narosa Publishing House, New Delhi.

3. De Robertis, E.D.P. and De Robertis, E.M.F.Jr. 2002. *Cell and Molecular Biology*, Lipponcott Williams and Wilkins. USA.
4. Hopkins, W.G. 1999. *Introduction to Plant Physiology*. John Wiley and sons, New York.
5. Jain J.L. Sanjay Jain & Nitin Jain 2005. *Fundamentals of Biochemistry*. S. Chand & Company Ltd., New Delhi.
6. Jain, V. K. 1996. *Fundamentals of Plant Physiology*, S Chand and Company, Delhi .
7. Kochar, P.L. 1964. *A Text Book of Plant Physiology*, Atmaram & Sons, Delhi.
8. Lehninger A.L. 1961. *Biochemistry*, Lalyan Publishers, Ludhiana.
9. Leopald, A.C. and Kriedemann, P.E. *Plant Growth and Development*. Tata McGraw Hill, New Delhi.
10. Malik, P.C. 1980. *Plant Physiology*, Kalyani Publishers, New Delhi.
11. Nelson, D.L. and Cox, M.M. 1993. *Principles of Biochemistry*. MacMillan Worth Publications.
12. Pandey, S. N. and Sinha, B. K. 1986. *Plant Physiology*. Vikas Publishing house Pvt. Ltd.
13. Plummer D.T. 1988. *An Introduction to Practical Biochemistry*, Tata McGraw- Hill Publishing Company, New Delhi.
14. Sadasivam, S. & Manickam, A. 1996. *Biochemical Methods*. New Age International (P) Ltd. New Delhi.
15. Salisbury, F.B. & Ross, C.W. 1985. *Plant Physiology*, CBS Publishers and Distributors, Delhi. (should be compulsorily introduced to students)
16. Srivastava H.S. 2005. *Plant Physiology*. Rastogi Publications, Meerut.
17. Taiz, L. and Zeiger, E. 2003. *Plant Physiology* (3<sup>rd</sup> Edition). Panima Publishing Corporation, New Delhi.

#### Online Resources

<http://www.plantphysiol.org/contents-by-date.0.shtml>  
<http://4e.plantphys.net/>  
<http://www.rsc.org/education/teachers/learnnet/cfb/Photosynthesis.htm>  
<http://www.plantstress.com/>  
<http://bioenergy.asu.edu/photosyn/education/learn.html>  
<http://www.biologie.uni-hamburg.de/lehre/bza/eanfang.htm>  
<http://www.ab.ipw.agrl.ethz.ch/~yfracheb/flex.htm>  
<http://www.life.illinois.edu/govindjee/photoweb/subjects.html#ps>  
<http://www.plant-hormones.com>

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –VI**  
**COURSE 9— BOT6COR09**  
**PLANT PHYSIOLOGY AND BIOCHEMISTRY**  
**BLUEPRINT**

Module	Hrs Alloted	Part A 1 Mark 10/12	Part B 5 Marks 6/9	Part C 10 Marks 2/4	Total questions
1	8	4	2		6
2	11	2	2	1	5
3	8	2	1	1	4
4	9	2	1	1	4
5	2	1			1
6	16	1	3	1	5
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE**  
**GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core course - SEMESTER –VI**  
**BOT6COR09 - PLANT PHYSIOLOGY AND BIOCHEMISTRY**  
*(2020 Admission onwards)*  
**Model Question Paper**

Time: Three Hours

Maximum: 60 Marks

**Part A***(Answer any **Ten** questions. Each question carries 1 mark)*

1. What is phytochrome?
2. Name two monosaccharides.
3. Define pH.
4. What is osmosis?
5. Which is the most abundant enzyme in plants?
6. What is deplasmolysis?
7. List the deficiency symptoms of magnesium.
8. What is vernalisation?
9. Who proposed chemiosmotic theory?
10. What is red drop?
11. Name two anti-transpirants.
12. What is RQ?

**(10 x 1 = 10 marks)****Section B***(Answer any **SIX** questions, each question carries 5 marks)*

13. Compare between transpiration and guttation?
14. Explain the structure of galactose.

15. Classify lipids according to their chemical nature?
16. Evaluate the properties of water that make it essential for maintenance of life.
17. What is fermentation? Explain different types.
18. Compare the process of carboxylation in CAM plants. Explain CAM cycle.
19. Evaluate the role of light in flowering.
20. Explain Munch hypothesis.
21. Briefly describe classification of lipids

**(6 x 5 = 30 marks)**

### **Section C**

(Answer any **TWO** questions, each question carries **10** marks)

22. Explain  $C_3$  cycle. Why are  $C_3$  plants less efficient than  $C_4$  plants?
23. With the help of a schematic diagram explain the reactions of Glycolysis.
24. Explain the mechanism of regulation of enzyme action.
25. Give an account on physiological effects of auxins.

**(2 x 10= 20marks)**

**SEMESTER VI**

**Course 10**

**BOT6COR10 ANGIOSPERM MORPHOLOGY, TAXONOMY, ECONOMIC  
BOTANY AND ETHNOBOTANY**

**(Theory 54 hours; Practical: 36 hours)**

**(Theory Credit 3, Practical Credit1)**

**Learning outcomes**

The students will be able

- to understand the aim, objectives, significance and fundamentals of taxonomy
- to describe the plants in its technical terms
- to interpret the rules of ICN and to understand the common plants locally available, their position in the classification and the naming of plants
- to generalize the characters of the families according to Bentham and Hooker system of classification
- to augment the observation capacity and drawing skills
- to learn basic techniques in herbarium preparation and to evaluate the important herbaria and botanical gardens
- to familiarise the core concept of economic botany and increase the awareness of plants and plant products encountered in everyday life
- to categorize various ethnic groups and to understand how plants are useful or related to social, cultural and economic activities of the indigenous society.

**Module 1 Morphology**

**(10 hours)**

1. Leaf Morphology (types, phyllotaxy)
2. Morphology of flower
  - a. Parts of a flower- description of flower and its parts in technical terms.
  - b. Types of flower – Hypogyny, Perigyny and Epigyny, Symmetry of flowers.
  - c. Aestivation, types
  - d. Placentation, types
  - e. Floral Diagram and Floral Formula
3. Inflorescence and Fruits
  - a. Inflorescence:-

*Racemose types*: Simple Raceme, Corymb, Umbel, Spike, Spadix and Head

*Cymose types*: Simple Cyme, Monochasial, Scorpid and Helicoid, Dichasial and Polychasial.

*Special types*: Panicle, Cyathium, Hypanthodium, Verticillaster, Thyrsus
  - b. Fruits: – Simple-Fleshy, Dry- dehiscent, indehiscent, Aggregate, Multiple (Sorosio and Syconus)

**Module 2 Systematic Botany**

**(10 hours)**

1. Aim, Scope, Phases, Principles and Significance of Taxonomy; Functions of Taxonomy – Brief history of plant exploration
2. Types of Classification- Artificial, Natural – Bentham and Hooker (Detailed account) and Phylogenetic system, Angiosperm Phylogeny Group (APG).
3. Binomial Nomenclature, salient features of ICBN, ICN principles and rules, typification, author citation, valid publication, priority of names

4. Interdisciplinary approach in Taxonomy- Evidences from cytology, phytochemistry, palynology and molecular data, Numerical Taxonomy (Brief study)
5. Herbarium technique- Preparation of herbarium, important herbaria (India and World), Role and significance; Botanical Gardens and BSI (Brief study).

### **Module 3 Angiosperm families, an overview**

**(26 hours)**

Study the following families of Bentham and Hooker's System with special reference to their morphological and floral characters. Special attention should be given to common and economically important plants with binomials and useful parts within the families Annonaceae, Nymphaeaceae, Malvaceae, Rutaceae, Anacardiaceae, Leguminosae (Mimosaceae, Caesalpiniaceae and Fabaceae), Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Sapotaceae, Apocynaceae, Asclepiadaceae, Convolvulaceae, Solanaceae, Acanthaceae, Lamiaceae, Amarantaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Arecaceae, Poaceae.

### **Module 4 Economic botany**

**(4 hours)**

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

- a. Timber yielding plants: Teak wood and Rose wood
- b. Beverages: Tea, Coffee
- c. Fibre yielding plants: Coir, Jute, Cotton
- d. Oil yielding plants: Ground nut, Gingely
- e. Rubber yielding plants: Para rubber
- f. Gums and Resins: White dammar, Gum Arabic, Asafoetida
- g. Spices: Cardamom, Pepper, Clove, Ginger
- h. Insecticide yielding Plants: Tobacco and Neem
- i. Medicinal plants: Turmeric, *Aloe*, *Ocimum sanctum*, *Rauvolfia serpentina*, *Withania somnifera*

### **Module 5 Ethnobotany**

**(4 hours)**

1. Ethnobotany: scope and significance.
2. General account on Tribes of Kerala, Brief account on IPR
3. Study of the following plants used in daily life by tribal and village folks for Food, Shelter and Medicine with special reference to Kerala
  - a. Food: Ragi, Thina, and Cholan
  - b. Shelter: *Bambusa*, *Ochlandra* and *Calamus*
  - c. Medicine: *Curcuma*, *Trichopus zeylanicus* and *Alpinia galanga*

### **Practical**

**(36 hours)**

1. Identify the following:
  - a. Leaves: types and phyllotaxy
  - b. Inflorescence –mentioned in the syllabus
  - c. Fruits - mentioned in the syllabus
2. Acquaintance with campus flora
3. Identify the families mentioned in the syllabus by noting their key, vegetative and floral characters.



4. Students must describe the floral parts, draw the L.S., floral diagram and write the floral formula of at least one flower from each family.
5. Study the finished products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
6. Prepare herbarium of 25 plants with field notes.
7. Conduct field work for a minimum of 5 days under the guidance of a teacher
8. Identify and describe the ethno botanical uses of the items mentioned in the syllabus.

### **Suggested Readings**

1. Ashok Bendra and Ashok Kumar ,1980. *Economic botany*.:Rastogi publications, Meerut.
2. CornquistA. ,1968. *The evolution and Classification of FloweringPlants*.
3. Davis P.H and Heywood V.H. 1967 *Principles of Angiosperm Taxonomy*. Edinburgh: Oliver and Boyd.
4. Eames A.J. 1961 *Morphology of Angiosperms*. New York: McGraw Hill.
5. Foaster A.S. and Giffad E.M. 1962 *Comparative Morphology of Vascular Plants*. Allied Pacific Pvt. Ltd. Bombay.
6. Henry and Chandra Bose 2001 *An Aid to the International Code of Botanical Nomenclature*. Botanical Survey of India. Coimbatore.
7. Heywood V.H. 1967. *Plant Taxonomy*. London: Edward Arnold.
8. Hill A.F. 1982. *Economic Botany*.: McGraw Hill ,New York.
9. Jain S. K. 1981. *Glimpses of Indian Ethnobotany*.: Oxford and IBH. New Delhi
10. Jain S. K. 1987. *A Manual of Ethnobotany*. Jodhpur Scientific Publishers.
11. Jain S.K. and Rao R.R. 1976. *A hand book of field and herbarium technique*. Today and Tomorrow's Publishers, New Delhi.
12. Jeffery C. (1968) *An Introduction to Plant Taxonomy*, J and A Churchill. London.
13. Maheshwari P. and Umara Singh. (1965) *Dictionary of Economic Plants in India*, ICAR. New Delhi.
14. Naik V.N. (1984) *Taxonomy of angiosperms*. Tata McGraw- Hill Publishing Company, New Delhi.
15. Rendle A.B. (1979) *Classification of flowering plants*. Vikas Publishing House, U.P. Vols. I & II.
16. Sreemali J.L. (1979) *Economic Botany*. Allahabad :KitabMAhal.
17. Singh V. and Jain D. K. (1989)*Taxonomy of Angiosperms*. Meerut :Rastogi Publication.
18. Sivarajan V.V. (1982) *Introduction to Principles of Taxonomy*, Oxford and IBH Publication. New Delhi
19. Swain T. (1963) *Chemical Plant Taxonomy*. New York: Academic Press.
20. S.P. Misra S.N. Pandey*Taxonomy of Angiosperms* by
21. Sivarajan V.V. 1991, *Introduction to the Principles of Plant taxonomy*. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
22. Jain S K 2004, *A Manual Of Ethnobotany*, Scientific Publishers, India
23. Verma .V. *Text book of Economic Botany* ,Ane Book Pvt. Ltd.
24. Pandey & Misra 2008 *Taxonomy of Angiosperms*. Ane Book Pvt. Ltd.



**Online Resources**APG Poster <http://www2.biologie.fu-berlin.de/sysbot/poster/poster1.pdf>APG [https://en.wikipedia.org/wiki/Angiosperm\\_Phylogeny\\_Group](https://en.wikipedia.org/wiki/Angiosperm_Phylogeny_Group)The Plant List <http://www.theplantlist.org/>International Plant Name Index (IPNI) <http://www.ipni.org/>

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –VI**  
**CORE COURSE— BOT6COR10**  
**ANGIOSPERM MORPHOLOGY, TAXONOMY, ECONOMIC BOTANY AND**  
**ETHNOBOTANY**  
**BLUEPRINT**

Module	Hours	Part A (1 Mark) 10/12	Part B (5 Marks) 6/9	Part C (10 Marks) 2/4	Total No of Questions
1	10	3	2	1	6
2	10	3	2	1	6
3	26	4	3	2	9
4	4	1	1	-	2
5	4	1	1	-	2
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJA'S COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core course - SEMESTER –VI**  
**BOT6COR10- ANGIOSPERM MORPHOLOGY, TAXONOMY**  
**ANECONOMIC BOTANY AND ETHNOBOTANY**

(2020 Admission onwards)

**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Part A**

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

1. Name the characteristic fruit of the family Annonaceae.
2. Obdiplostemonous is found in which family?
3. Name the alkaloid extracted from the plant *Rauvolfia serpentina*.
4. What is hesperidium?
5. Location of the BSI southern Circle
6. What is valid publication?
7. What is perigyny?
8. Name two important herbaria in India and World
9. What is monochasial cyme
10. Name the trade name of the product derived from *Trychopus zeylanicus*
11. What is resupination?
12. Name the inflorescence seen in the genus *Euphorbia*

**(10 x 1 = 10 marks)**

**Section B**

(Answer any **SIX** questions, each question carries 5 marks)

13. Analyse the floral characters of Amaranthaceae and Euphorbiaceae.
14. 'Asteraceae is considered as an advanced family in dicots'. Validate the statement
15. 'Floral diagram and floral formula are necessary for the determination of Taxa'. Defend the statement with appropriate sketching
16. Write the salient features of ICBN
17. Give an account of the placentation types in the family studied by you.
18. Comment on the interdisciplinary approach in taxonomy
19. 'Bamboos and canes are integral part of tribal people's daily life' Critically evaluate the statement.
20. Explain the primitive characters of Annonaceae.
21. Write the binomial, family and useful part of the medicinal plants studied by you.

**(6x 5 = 30 marks)**

**Section C**

(Answer any **TWO** questions each question carries 10 marks)

22. Describe the preparation of Herbarium. Mention the role and significance of Herbarium
23. Describe Bentham and Hookers system of classification with its merits and demerits
24. Compare the vegetative and floral characters of the Mimosaceae, Caesalpiniaceae and Fabaceae
25. With suitable examples, give an account of the different types of inflorescences found in angiosperms.

**(2 x 10 = 20 marks)**

**SEMESTER VI**  
**Course 11**  
**BOT6COR11 - CELL AND MOLECULAR BIOLOGY**  
**(Theory 54 hours; Practical 36 hours)**  
**(Theory Credit 3, Practical Credit1)**

**Learning outcome**

The students will be able to

- understand the Ultra structure and functioning of cell in the sub microscopic and molecular level.
- get an idea of origin, concept of continuity and complexity of life activities.
- familiarize the life process.
- understand the basic and scientific aspect of diversity.
- understand the cytological aspects of growth and development.
- understand DNA as the basis of heredity and variation.

**Module1 Cell Biology – Introduction (9 hours)**

1. Historical account of cell Biology –Cell theory and Protoplasm theory
2. The physio-chemical nature of plasma membrane (Unit membrane and Fluid mosaic model) and cytoplasm, cyclosis, Eukaryotic versus Prokaryotic cell, Animal cell versus Plant cell.
3. The ultra-structure of plant cell and function of the following organelles-Endoplasmic reticulum, Plastids, Mitochondria, Ribosomes, Dictyosome, Microbodies, lysosomes. Vacuole and cell sap, Cytoskeleton (brief account only) Nucleus- structure and functions of Nucleolus, Nuclear membrane, Nucleoplasm and Chromatin.

**Module2 Chromosomes (17 hours)**

1. Morphology of metaphase chromosome-Types of chromosome, Chromatin organization: - Nucleosome model – structure of nucleosome -heterochromatin and euchromatin, karyotype and ideogram, Special type of chromosomes –Giant chromosome-Salivary gland chromosomes and Lamp brush chromosomes. Supernumerary chromosome-B chromosome. Cell cycle and its different stages, mitosis and meiosis: (structure and function of synaptonemal complex) significance of mitosis and meiosis.
2. Change in number of chromosomes –Euploidy – Haploidy, Autopolyploidy and Allopolyploidy (*Solanum*, *Raphano brassica*) and Aneuploidy –Monosomy (Cri du chat, Myelocytic leukemia) Trisomy(Patau syndrome, Edward syndrome) Nullisomy- (*Triticum*).Chromosomal abnormalities in man(Down's syndrome, Klinefelter's syndrome and Turner's syndrome)
3. Change in the structure of chromosomes – Deletion (Notch wing in *Drosophila*), Duplication (Bar eye in *Drosophila*), Inversions and Translocations (Robertsonian translocation).

**Module 3 Mutation (7 hours)**

1. Definition, Importance and types of Mutations- Spontaneous and induced. Mutagens- Physical (non-ionizing and ionizing radiations) and Chemical mutagens-Classification based on mode of action- (base analogues, alkylating agents, deaminating agents, acridine dyes, hydroxylating agents (brief description only).

2. Chromosomal and point mutations. Molecular mechanism of mutation – Frame shift mutations, Transition, Transversion and Substitution

**Module 4: Molecular Biology - DNA and RNA (12 hours)**

1. Identification of DNA as Genetic material: Transformation Experiment, Hershey and Chase Experiment-RNA as genetic material in some viruses
2. Watson and Crick model of DNA- Basic features, Chargaff rule, alternate forms of DNA – A & Z, structure and function of different types of RNA- tRNA, mRNA and rRNA
3. Replication of DNA - Meselson-Stahl experiment-semiconservative replication of DNA, DNA repair (photolyase).

**Module 5 Gene Expression (8 hours)**

1. Gene expression - concept of gene, definitions, central dogma and reverse transcription - details of transcription in prokaryotes and eukaryotes - mRNA processing, Genetic code features- Wobble hypothesis-details of translation
2. Control of gene expression – Inducible and Repressible system- Operon model- lac operon and trp operon.

**Module 6 Genetics of Cancer (1 hour)**

1. Genetic basis of cancer - oncogenes - tumor suppressor genes - metastasis

**Practicals (36hours)**

1. Make acetocarmine squash preparation of onion root tip to identify mitotic stages.
2. Study the Mitotic Index of onion root tip cells
3. Study of meiosis in any flower bud by smear preparation of PMC's
4. Demonstration of cytokinesis
5. Identify and study photographs and diagrams of cell division anomalies like lagging chromosomes, chromosome bridge.
6. Aneuploidy, polyploidy. Study the chromosomal patterns/ Karyotype in auto-, allo-, and aneuploids
7. Work out elementary problems based on DNA structure, replication, transcription and translation (Minimum 15 problems)

**Suggested readings**

1. Agarwal SK, 2009. *Foundation Course in Biology*, 2nd Edition, Ane Books Pvt. Ltd.
2. Avinash & Kakoli Upadhyay 2005. *Basic Molecular Biology*. Himalaya Publishing House, Mumbai.
3. Cohn, N.S. 1964. *Elements of Cytology*. Brace and World Inc., New Delhi.
4. Darlington, C.D, 1965. *Cytology*, Churchill, London.
5. Darnel, J. Lodish, Hand Baltimore, D, 1991. *Cell and molecular biology*. Lea and Fibiger, Washington.
6. De Robertis, E.D.P. and Robertis, E.M.P, 1991. *Cell and molecular biology* Scientific American books.
7. Dobzhansky, B, 1961. *Genetic and origin of species*, Columbia university Press New York.
8. Gardner, E.J. and Snustad, D.P. 1984, *Principles of Genetics*. John wiley, New York.
9. Gerald Karp, 1985. *Cell Biology*, 2006. McGraw Hill company.
10. Gupta, P.K. *Genetics*, Rastogi Publications.
11. Lewin, B, 1999. *Genes*, Oxford University Press, New York
12. Lewis, W.H, 1980. *Polyploidy*. Plenum Press, New York

13. Roy S.C. and Kalyan Kumar De, 1997. *Cell biology*. New central Boos Calcutta
14. SandhyaMitra, 1998. *Elements of Molecular biology*. Macmillan, India Ltd.
15. Sharma, A.K. and Sharma a 1980. *Chromosome technique Theory and practice*, Aditya Books, New York.
16. Veer Bala Rastogi, 2008. *Fundamentals of Molecular Biology* Ane Books Pvt. Ltd.
17. Wayne M. Beecker Lewis J, Klein Smith and Jeffharden 2004. *The World of Cell*. Pearson Education.
18. Waseem Ahammed (faridi) 2013. *Genetics and Genomics* (Pearson)

### Online Resources

<http://homepages.gac.edu/~cellab/index-1.html>  
<http://www.cellsalive.com/index.htm>  
<http://zygote.swarthmore.edu/>  
<http://www.pathology.washington.edu/galleries/Cytogallery/main.php>  
[http://biog-101-104.bio.cornell.edu/BioG101\\_104/tutorials/cell\\_division/CDCK/cdck.html](http://biog-101-104.bio.cornell.edu/BioG101_104/tutorials/cell_division/CDCK/cdck.html)  
[http://www.pbs.org/wgbh/nova/baby/divi\\_flash.html](http://www.pbs.org/wgbh/nova/baby/divi_flash.html)  
<http://www.hhmi.org/genetictrail/index.html>  
<http://www.learner.org/interactives/dna/index.html>  
<http://www.nature.com/scitable>  
<http://www.dnalc.org/home.html>

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –VI**  
**CORE COURSE— BOT6COR11**  
**CELL AND MOLECULAR BIOLOGY**  
**BLUEPRINT**

Module	Hours	Part A (1 Mark) 10/12	Part B (5 Marks) 6/9	Part C (10 Marks) 2/4	Total No of Questions
1	9	2	2	1	5
2	15	3	3	1	7
3	5	1	1	-	2
4	14	3	2	1	6
5	10	2	1	1	4
6	1	1	0	-	1
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE**  
**GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core course - SEMESTER –VI**  
**BOT6COR11 - CELL AND MOLECULAR BIOLOGY**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Part A**

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

1. Define cell theory.
2. Comment on Unit Membrane model.
3. What is salivary gland Chromosome.
4. Differentiate between Heterochromatin and euchromatin.
5. What is Down's Syndrome?
6. Comment on Frame Shift Mutation.
7. Describe m- RNA.
8. Differentiate between A and Z form of DNA.
9. Write any two enzymes used in DNA replication.
10. What is genetic code?
11. Define reverse transcription.
12. What are Oncogenes?

**(10 X 1 = 10**

**marks)**

**Part B**

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

13. Describe Nucleosome model.
14. Describe the structure and function of Mitochondria.
15. Write the importance of Rhabanobrassica in Genetics.
16. Comment on cell cycle.
17. Describe ultra-structure of Nucleus.
18. Define chromosomal point mutations.
19. Draw a neat labelled diagram of t- RNA.
20. Write the importance of Meselson and –Stahl experiment.
21. Describe lac operon.

**(6 X 5 = 30**

**marks)**

**Part C**

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

22. Describe prokaryotic and Eukaryotic cell with labelled diagram.
23. Describe the change in structure and Number of Chromosome.
24. Comment on Watson and Crick model of DNA.
25. Describe central dogma and its Importance.

**(2 X 10 = 20 marks)**

**SEMESTER VI**  
**Course: 12**  
**BOT6COR12 - BIOTECHNOLOGY AND BIOINFORMATICS**  
**(Theory 54 hours; Practical: 36 hours)**  
**(Theory credit 3, Practical Credit 1)**

**Learning outcome**

Students will be able to

- infer the fundamental principles of Biotechnology
- understand the techniques in tissue culture
- explain the methods in recombinant DNA technique
- identify the applications of biotechnology

**Module 1 Biotechnology – Introduction, Tissue Culture (18 hours)**

1. Introduction – The concept of biotechnology, Old and New Biotechnology, landmarks in biotechnology, Biotechnology research institutes and companies in India (Brief account only)
2. Plant tissue culture – Principles and techniques. Cellular totipotency, *in vitro* differentiation – de differentiation and re-differentiation, callus induction, organogenesis and somatic embryogenesis.
3. Tissue culture medium – Basic components in tissue culture medium – Solid and liquid media – suspension culture. Murashige and Skoog medium – composition and preparation. Aseptic techniques in tissue culture – sterilization – different methods – sterilization of instruments and glass wares, medium, explants; working principle of laminar air flow and autoclave; preparation of explants – surface sterilization. Inoculation, incubation, subculturing.
4. Micropropagation - Different methods – axillary bud proliferation, direct and indirect organogenesis and somatic embryogenesis. Different phases of micropropagation – hardening, transplantation and field evaluation Advantages and disadvantages of micropropagation. Somaclonal variation and application (brief study only).
5. Methods and Applications of tissue culture - Shoot tip and meristem culture Synthetic seed production, embryo culture, Protoplast isolation culture and regeneration – Somatic cell hybridization- cybrids. *In vitro* secondary metabolite production — cell immobilization, bioreactors *In vitro* production of haploids – anther and pollen culture, *In vitro* preservation of germplasm.

**Module 2 Recombinant DNA Technology (12 hours)**

1. Gene cloning strategies – recombinant DNA construction – cloning vectors – plasmids - pBR322, bacteriophage based vectors - Lambda phage, hybrid vectors-cosmid, *Agrobacterium* Ti plasmid based vector. Restriction endonucleases-Type I, II (Eco R1-, Alu I restriction sequence only) and III, exonucleases and ligases –transformation and selection of transformants – using antibiotic resistance markers, Southern, Northern and Western blotting (brief study only); PCR-Steps and Applications (Variants not required).
2. Different methods of gene transfer –I) Direct gene transfer methods- 1) Chemical-PEG, CaCl<sub>2</sub> mediated transformation 2) Physical-electroporation, microinjection, biolistics II) Vector mediated-*Agrobacterium* mediated gene transfer, transduction-Vector based on plant viruses-Caulimovirus, Gemini virus (brief account only). Genomic library, cDNA library.



**Module 3 Application of Biotechnology (brief account only) (3 hours)**

1. Medicine - Production of human insulin, human growth hormone and vaccines, gene therapy, monoclonal antibodies, biopharming.
2. Forensics - DNA finger printing.
3. Agriculture - Genetically modified crops – Bt crops, Golden rice, Flavr Savr Tomato, Virus herbicide resistant crops, Edible vaccines.
4. Environment - Bioremediation- use of genetically engineered bacteria - super bug.
5. Industry - Horticulture and Floriculture Industry, production of vitamins, amino acids and alcohol.

**Module 4 Scope and relevance of the following technologies (3 hours)**

- a. Tissue Engineering technology, embryonic stem cell culture, animal cloning, Terminator technology. (Methodology not required).
- b. Social and ethical issues, biosafety, biowar, patenting and IPR issues. (Methodology not required)

**Module 5 Bioinformatics introduction (9 hours)**

1. Introduction to Bioinformatics, scope and relevance, genome, transcriptome, proteome.
2. Biological data bases – Nucleotide sequence database –ENA, Gen Bank, DDBJ. Protein sequence database – PDB, SWISS PROT. Organismal database – *Saccharomyces* genome database, *Arabidopsis* genome database
3. Information retrieval from Biological database, sequence alignment types and tools: pair wise sequence alignment, multiple sequence alignment, use of BLAST, FASTA.

**Module 6 Genomics, Proteomics and softwares (9 hours)**

1. Genomics : DNA sequencing- Sanger's procedure-automation of DNA sequencing, Pyrosequencing, genome sequence assembly,
2. Genome projects – Major findings of the following genome projects – Human, *Arabidopsis thaliana*, Rice, *Haemophilus influenza*, Application of genome projects.
3. Proteomics : Protein sequencing- Edman degradation method, automation of sequencing, protein structure prediction and modeling (Brief account only)
4. Bioinformatics Software's and Tools- A brief account on
  - Molecular phylogeny and phylogenetic trees-MEGA.
  - Molecular visualization – use of Rasmol.
  - Molecular docking-AutoDock and computer aided drug design (CADD).

**Practicals (36 hours)****Biotechnology (26 hours)**

1. Preparation of nutrient medium – Murashige and Skoog medium, sterilization, preparation of explants, inoculation.
2. Extraction of DNA from plant tissue.
3. Immobilization of whole cells or tissues in sodium alginate.
4. Study of genetic engineering tools and techniques using photographs/diagram (Agarose gel electrophoresis, pBR 322, EtBr, Agarose, SDS, Southern blotting, DNA finger printing, PCR, *Agrobacterium* as natural genetic engineer)
5. Visit a well equipped biotechnology lab and submit a report along with the practical record.

**Bioinformatics (10 hours)**

1. Familiarizing with the different data bank mentioned in the syllabus.



2. Molecular visualization using Rasmol.
3. BLAST search.

### Suggested Readings

1. Attwood TK & Parry, Smith DJ. 2003. *Introduction to Bioinformatics*. Pearson Education.
2. Balasubramanian, D. – Bryce CFA, Dharmalingam K. Green J, Kunthala Jayaraman, 2007. *Concepts in Biotechnology* – University Press India Pvt. Ltd.
3. Becker JM, Coldwell GA and Zachgo EA. 2007. *Biotechnology – A Laboratory Course* Academic Press.
4. Bhojwnis abd Razdan Mk 2000 *Plant Tissue Culture – Theory and practice* Elsevier India Pvt. Ltd.
5. Brown T.A. *Gene cloning and DNA analysis*. Black Well publishing.
6. Colin Ratledge and Bjorn Krishansen, 2008. *Basic Biotechnology*, Cambridge University Press.
7. Dixon R.A, 2003. *Plant Cell Culture*, IRC Press
8. Dubey R.C 2006. *A Text Book of Biotechnology* S.Chand and Company, New Delhi
9. Gupta PK. ,2006. *Biotechnology and Genomics*. Rastogi Publications.
10. Jogdand S.N. 1999. *Advances in Biotechnology*, Himalaya Publishers, Mumbai.
11. John E Smith 2006. *Biotechnology*, Cambridge University Press
12. Lewin. B. 2008 *Gene IX*. Jones and Barlett Publications.
13. Rastogi SC, Mendiratta M and Rastogi P. 2004. *Bioinformatics: concepts, Skills and Application* CBS.
14. Razdan M.K. 2000. *An introduction to Plant Tissue Culture*, Oxford IBH Publications, New Delhi.
15. Reinert and Bajaj YPS. 1989. *Applied and Fundamental Aspects of Plant Cell Tissue and Organ Culture*. Narora Publications, New Delhi.
16. Singh BD.2007. *Biotechnology*, Expanding Horizon, Kalyani Publications, Ludhiana.
17. Sobti RC and Suparna S. Panchauri. 2009. *Essentials of Biotechnology*, Ane Books Pvt. Ltd.
18. Timir Baran Jha and Biswajith Ghosh 2007, *Plant Tissue Culture*, University Press.
19. Veer Bala Rastogi 2008. *Fundamentals of Molecular Biology*, Ane Books Pvt. Ltd.
20. Kalyan De Kumar,2006. *Plant Tissue Culture*, New Central Book Agency, Culcutta.
21. Narayana Swami S. 2005 *Plant Cell & Tissue culture*. Mc Graw Hill Company.
22. Rastogi S.C. Mandiratta N. Rastogi P. 2005. *Bioinformatics Methods & Application- Genomics, Proteomics & Drug Discovery* Prentice Hall of India Pvt. Ltd., New Delhi.
24. Desmond S.T. Nicholl 1994. *An Introduction to Genetic engineering* (second edition) Cambridge University Press, Foundation Books Pvt. Ltd., New Delhi.
25. Jeremy W. Dale and Malcolm Von Schantz 2003, *From Genes to Genomes*. John Wiley & Sons, Ltd. New York.
26. Richard M. Twyman 2003 *Instant notes Bioinformatics* Viva Books, New Delhi.
27. Remawat K.G. 2006. *Plant Biotechnology* S. Chand & Company Ltd., New Delhi.
28. Purohit S S 2004. *A Laboratory Manual of Plant Biotechnology*. Agro bios India .
29. Thiel T. Bussen S. Lyons E M 2004. *Biotechnology DNA to protein- A Laboratory Project in Molecular biology*. Tata Mc Graw Hill Publishing Co.Ltd. New Delhi
30. Prasad. S, 2004, *Impact of Plant Biotechnology on Horticulture*. Agrobios India
31. Jin XIong, 2009, *Essential Bioinformatics*, Cambridge.
32. P Baldi and S Brunak 2000, *Bioinformatics : A Machine Learning Approach..* MIT Press,

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –VI**  
**CORE COURSE— BOT6COR12**  
**BIOTECHNOLOGY AND BIOINFORMATICS**

**BLUEPRINT**

<b>Module</b>	<b>Hours Allotted</b>	<b>Part A 1 Mark</b>	<b>Part B 5 Marks</b>	<b>Part C 10 Marks</b>	<b>Total questions</b>
1	18	3	2	2	7
2	12	3	2	1	6
3	3	3	1	-	4
4	3	1	1	-	2
5	9	1	1	1	3
6	9	1	2	-	3
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core course - SEMESTER –VI**  
**BOT6COR12 - BIOTECHNOLOGY AND BIOINFORMATICS**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Part A**

*(Answer any **Ten** questions. Each question carries **1 mark**)*

1. Illustrate totipotency?
2. Differentiate between de-differentiation and re-differentiation?
3. What is SWISSPORT?
4. Write any two applications of somatic embryogenesis.
5. What is cDNA?
6. Mention the significance of soma clonal variations.
7. What is transcriptome?
8. What is cosmid?
9. What does “superbug” mean?
10. Name the organism where the genes were isolated for the production of vitamin-A enriched golden rice?
11. Outline genome library.
12. Define IPR.

**(10 X 1 = 10 marks)**

**Section B**

*(Answer any Six questions. Each question carries 5 marks)*

13. Compare endonuclease and exonuclease with example.
14. Illustrate the different phases of micro propagation of a non-seed setting plant.
15. Construct a procedure for *invitro* production of haploids.
16. Why can't seeds from GM crops be reused in the next generation?
17. Differentiate stirred type and sparged tank bioreactor.
18. "Tissue culture helps the production of virus free grape wines" Write your comments.
19. Write potential applications of pyrosequencing.
20. Give an account on immobilization of cells.
21. Build the different steps in *Agrobacterium* mediated gene transfer.

**(6 X 5 = 30 marks)**

**Section D**

*(Answer any Two questions. Each question carries 10 marks)*

22. Give a detailed account on proteomics.
23. Briefly describe different types of biological databases.
24. Explain the applications of biotechnology.
25. Describe the steps of recombinant DNA technology.

**(2 X 10 = 20 marks)**

**SEMESTER VI**  
**Core Choice Based Course 1**  
**BOT6CBC02 - AGRIBUSINESS**  
**(Theory 54 hours)**  
**(Theory Credit 3)**

**Learning Outcome**

Students will be able to

- Get an idea about the business opportunities in the field of plant sciences.
- Develop an entrepreneurial mindset among the botany students
- Get an idea about the need of sustainable development, organic farming, olericulture and floriculture
- Have an opportunities in the field of mushroom cultivation, processing technology and food science

**Module 1 Entrepreneurship, Value added Food products & Processing techniques (16 hours)**

1. Types, Basic qualities of an Entrepreneur. Financial assistance from Banks, Role of Institutions like MSME Training Institute, Khadi and Village Industries Board, Self Help Groups, Co-operative Sector, Kudumbasree projects and Microenterprises.

2. Preparation and Preservation Techniques. Causes of Spoilage of Food. Principles of preservation – asepsis, removal of microorganisms, anaerobic situation and special methods – drying, thermal processing – pasteurization, sterilization and canning – low temperature, use of chemical preservatives and food additives. Preparation of wine, vinegar, sauerkraut, pickles, jam, jelly, syrups, sauce, dry fruits, dairy products – (cheese, butter, yoghurt, paneer), candies, chocolates, payasam, kondattam.
3. Processing of latex – Centrifuged latex products and galvanized rubber products. Processing, storage and marketing of Cocoa, Coconut (Copra, Coir and Tender coconut), Rice (par boiled, raw rice and rice flour), Pepper, Cardamom, Ginger, Arrowroot, Tapioca, Cashew, Mango, Jack fruit, Guava, Grapes, Lemon, Papaya, Musa, Garcinia. Basic principles of preparation of Lehyam and Decoction.

## **Module 2 Nursery Management, Organic farming and Composting Techniques (11 hours)**

1. Definition and importance, management aspects of nurseries, planning, budgeting, lay out and types of nurseries, maintenance of nurseries Preparation of potting mixtures, polybags. Plant Growth structures – green houses, hot beds, cold frames, shade houses, polyshed, mist chamber. Media for the propagation of nursery plants—soil, sand, peat, sphagnum moss, vermiculite, soil mixture. Preparation of nursery beds. Marketing- packaging and transporting of nursery products.
2. Organic manures and fertilizers, Composition of fertilizers. NPK content of various fertilizers and preparation of fertilizer mixtures. Common organic manures – bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost – aerobic and anaerobic- advantages and limitations. Vermicompost – preparation - Vermiwash. – preparation. Biofertilizers – Definition and preparation of different types – Trichoderma, Rhizobium, PGPR, PSB, Mycorrhiza. Application of Biofertilizers. Biopesticides – Tobacco and Neem decoction. Biological control of diseases and pests. Organic traps – Natural dyes.

## **Module 3 Introduction to horticulture (19 hours)**

1. Definition, history, classification of horticultural plants, disciplines of horticulture; Garden tools and implements. Irrigation methods- surface, sub, drip and spray irrigations. Propagation of horticultural plants- by seeds- Seed viability, seed dormancy, seed testing and certification, seed bed preparation, seedling transplanting, hardening of seedling; advantages and disadvantages of seed propagation. Vegetative propagation- organs used in propagation- natural and artificial vegetative propagation; methods- cutting, layering, grafting and budding; advantages and disadvantages of vegetative propagation.
2. **Olericulture – Types of vegetable growing**, Home gardening, Market gardening, Truck gardening, Vegetable garden for processing, gardens for seed production. Cultivation of The following with reference to planting, irrigation, spacing, aftercare and disease control: Cucurbitaceous (Ash gourd, Little gourd, Bitter gourd) and Solanaceous (Tomato, Brinjal, Chilly) vegetables, Ginger, Colocasia, Tapioca and Musa.
3. **Floriculture** - Problems and prospects of Floriculture in Kerala. Cultivation and scope of growing Anthurium, Orchids and Jasmine in Kerala.
4. **Ornamental Garden designing** - Use of different garden components. Lawn preparation by seeds, seedling and turfing. Maintenance of garden by Irrigation, Pruning, Repotting. Disease and Pest control.
5. **Flower arrangement**. Types - Western, Eastern (Japanese/ Ikebana) and Modern. Vases, Flower Holders and Floral Foam. Vase life of flowers and leaves. After care of flower arrangements – Bouquets. Packing and Maintenance of flowers and leaves.

#### **Module 4 Mushroom cultivation and Farming**

**(8 hours)**

Historical Account, Importance of Mushrooms, – Significance – Nutritive value. Edible and poisonous Mushrooms. Methods of identification of edible and poisonous mushrooms (*Agaricus*, *Pleurotus*, *Volvariella*, *Amanita* and *Inocybe*) Cultivation of *Agaricus*, *Pleurotus*, and *Volvariella*. Spawn production, storage and marketing. Growth of Mushrooms on Paddy Straw and Saw dust by Poly bag. Mushroom growing structures and maintenance of humidity. Pests and defects of mushrooms. Storage, Transporting and Marketing of Mushrooms.

#### **Suggested Readings**

1. Adams, M.R. and M.O. Moss, 1995. Food Microbiology. Panima Publishing.
2. Casida, L.E. (Jr.), 2005. Industrial Microbiology. New Age International.
3. Chandha, K.L., 2003. Handbook of Horticulture. ICAR. New Delhi.
4. Frazier and Westhoff, 1988. Food Microbiology. Tata McGraw – Hill.
5. George Acquichah, 2004. Horticulture – Principles and Practices. II Edn. Prentice Hall. India.
6. George J. Banwant, 2004. Basic Food Microbiology. CBS Publishers and Distributors.
7. Gopal Chandha De, 2002. Fundamentals of Agronomy. Oxford and IBH Publishing House.
8. Hudson. T., Hartmann. Dale E. Kester, 2001. Plant Propagation, Principles and Practices. 6th Edn. Prentice Hall. India.
9. James M. Jay, 2005. Modern Food Microbiology. CBS Publishers and Distributors.
10. Kalian Kumar De, 1996. Plant Tissue Culture. New Central Book Agency (P) Ltd.
11. Kaul, T.N, 2002. Biology and Conservation of Mushroom, Oxford and IBH Publishing Co.
12. Kunte, Kawthalkar and Yawalker, 1997. Principles of Horticulture and Fruit Growing. Agri –Horticulture Co.
13. Neshamani, S, 2000. Pazhangal, Pazhavibhavangal (Malayalam). Kerala Bhasha Institute.
14. Pandey, R.K and S.K. Ghosh, 1996. A Hand Book on Mushroom Cultivation. Emkey Publications.
15. Prem Singh Arya, 2004. Vegetable Seed Production Principles. Kalyani Publishers.
16. Prince Alex, Rajani A. Nair, 2003 Ayurveda Avshodha Nirmanam – Sidhanthavum Prayogavum Malayalam. Kerala Bhasha Institute.
17. Purohit, S.S, 2005. Plant Tissue Culture. Student Edition.
18. Razdan, M.K, 1995. Introduction to Plant Tissue Culture. 2nd Edn. Oxford and IBH Publishing Co.
19. Rema, L.P, 2006. Applied Biotechnology. MJP Publishers.
20. Sharma, R.R, 2005. Propagation of Horticultural Crops. Kalyani
21. Singh, B.D, 1996. Biotechnology. Kalyani Publishers.

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –VI**  
**CORE CHOICE BASED COURSE— BOT6CBC02**  
**AGRIBUSINESS**  
**BLUEPRINT**

Module	Hours Allotted	Section-A 2 Mark	Section-B 5 Marks	Section-C 15 Marks	Total
1	16	3	2	1	6
2	11	3	3	1	7
3	19	4	3	2	9
4	8	2	1		3
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core Choice Based course - SEMESTER –VI**  
**BOT6CBC02 - AGRIBUSINESS**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 80 Marks**

**Part A**

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

1. How Paneer is produced?
2. Give an account of Spawn production.
3. Differentiate between Home garden and Market Garden.
4. Write notes on Ikebana.
5. List out the principles of Food Preservation.
6. What is the significance of Mist Chamber.
7. List out the role of Khadi and Village Industries Board.
8. Write brief notes on Canning.
9. Give examples of any two Bio pesticides.
10. Mention Botanical names of Two Grass Species to make a Lawn.
11. What is Integrated Pest Management?.
12. Define Sustainable Development.

**(10 x 2 = 20 marks)**

**Section B**

*(Answer any **SIX** questions, each question carries 5 marks)*

13. Write a short note on the different types of flower arrangements studied by you.
14. Briefly explain preparation and composition of organic manures.
15. Discuss the problems and prospects of Floriculture in Kerala.
16. Give an account of processing and Storage of Cashew.
17. List the role of MSME Training Institute.
18. Give an account of the different types of mushrooms and the procedure of production of mushrooms.

19. What is an Apiarium? Give an account of the installation of an apiarium. Also add notes on the handling and processing of honey in an apiarium.
20. What are the techniques behind the preparation of Lehyam and Decoction?
21. Describe the floriculture scope of Kerala

(6 x 5 = 30 marks)

### Section C

(Answer any **TWO** questions each question carries **15** marks)

22. Give an account of the different components of Ornamental Garden Designing.
23. Give a short account of different types of plant growing structures employed in horticulture
24. Explain the processing, storage and marketing of Cocoa, Coconut and Rice
25. Explain the role of various organizations in imparting financial assistance to entrepreneurs

(2x15 = 30 marks)

**SEMESTER VI**  
**Core Choice Based Course 2**  
**BOT6CBC02 – PHYTOCHEMISTRY AND PHARMACOGNOSY**  
**(Theory 54 hours)**  
**(Theory Credit 3)**

### Learning Outcome

Students will be able to

- understand the structure and function of basic secondary metabolites in medicinal and aromatic plants.
- familiarise the extraction and separation procedures
- infer the role of Alkaloids, Terpenoids and Phenolics
- familiarising a variety of medicinal plants and its pharmacological value
- understand the concepts of Pharmacognosy
- make use of cultural practices of medicinal and aromatic plants

### Module 1 Introduction

(2 hours)

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

### Module 2 Extraction and characterisation techniques

(4 hours)

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

### Module 3 Study of the drug plants and their active principles

(10 hours)

1. Alkaloids – introduction, properties, occurrence, structure, classification, functions, and pharmacological uses.



2. Triterpenoids. Introduction, properties, occurrence, classification, functions and pharmacological uses.
3. Phenolics. Quinone- benzoquinones, naphthoquinones, anthraquinones, and coumarins.

**Module 4 Study of the following plants with special reference to (20 hours)**

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

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

**Module 5 Study of the following aromatic plants – volatile oils and methods of extraction (10 hours)**

*Vetiveria zizanoides*, *Cinnamomum zeylanica*, *Syzygium aromaticum*, *Santalum album*, *Eucalyptus*, *Ocimum basilicum*, *Rosa*, *Mentha piperita*.

**Module 6 Pharmacognosy (8 hours)**

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

**Cultivation of drug and aromatic plants (4 hours)**

1. Soil as growth medium: formation of soil, physical and chemical nature, soil organisms, soil fertility, soil types.
2. Fertilizers and manures: NPK, organic manures, green manure, farm yard manure, and vermicompost.
3. Plant protection methods- insect and pest control measures: physical, chemical biological methods.
4. Plant propagation methods.

**Suggested additional topics**

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

**Suggested Readings**

1. Ashutosh Kar, 2006. *Pharmacognosy and Pharmacobiotechnology*, New Age International, New Delhi
2. Atal.C.K. and Kapur, B.M. 1982. *Cultivation and Utilization of Medicinal Plants*.
3. Bhattacharjee S K, 2003. *Hand Book of Medicinal Plants*, Pointer Publishers, Jaipur
4. Daniel, M.,1991. *Methods in Plant Chemistry and Economic Botany*, Kalyani publishers, New Delhi.
5. Glossary of *Indian Medicinal Plants with Active Principles* Part I & II, 1980. CSIR, New Delhi.
6. *Indian Medicinal Plants* (5Vols) 1994. Arya Vaidya Sala Kottackal, Orient longoman New Delhi.
7. Irfan Ali Khan, 2008. *Medicinal and Aromatic plants of India*, Ukaaz Publishers, Hyderabad



8. Jain S K 2004. *A Manual Of Ethnobotany*, Scientific Publishers, India
9. Khory R N 1999. *Materia Medica of India and their Therapeutics*, Komal Prakashan, Delhi
10. Krishnaswamy N R 2003. *Chemistry of Natural Products*, Universities press, Hyderabad
11. Pushpangaden P Nyman ULF George V Glimpses of of Indian Ethno Pharmacology. The Royan Danish School of Pharmacy Copenhagen, Denmark.
12. Trivedi P C, 2007. *Medicinal Plants Utilisation and Conservation*, Avishkar Publishers, Jaipur
13. Upadhyaya R C. 2008. *The treatise on Aromatic plants*, Anmol Publications, New Delhi
14. Wallis T.E . 1997.*Text Book of Pharmacognosy*. CBS Publication & Distribution.

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –VI**  
**CORE CHOICE BASED COURSE— BOT6CBC02**  
**PHYTOCHEMISTRY AND PHARMACOGNOSY**  
**BLUEPRINT**

Module	Hours Alloted	Section-A 1 Mark	Section-B 5 Marks	Section-C 10 Marks	Total
1	2	1	-	-	3
2	4	1	1	-	2
3	10	2	2	1	5
4	20	3	3	1	7
5	10	3	1	1	5
6	8	2	2	1	5
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core Choice Based course - SEMESTER –VI**  
**BOT6CBC02 - PHYTOCHEMISTRY AND PHARMACOGNOSY**  
(2020 Admission onwards)  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 80 Marks**

**Part A**

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

1. What is organoleptic method?
2. Distinguish cold and hot extraction
3. Write any two plant alkaloids.
4. Write any two classes of alkaloids
5. *Aloe vera* belongs to which family?
6. Name any ayurvedic preparation contains *Phyllanthus niruri*
7. Name any compound that present in *Datura*
8. Ocimum contains which volatile oil.
9. Name the aromatic oil present in Eucalyptus.
10. Comment on green manure.
11. What is adulteration?
12. Write any two phytochemicals present in Papaver.

(10 X 2 = 20 marks)

**Section B**

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

13. Compare column and thin layer chromatography.
14. Comment on the function and pharmacological uses of alkaloids.
15. How phenolics are classified?
16. Adhatoda is called Vasaka. Comment.
17. Critically evaluate the therapeutic potential of Tinospora.
18. Deduct the ethanomedicinal uses of *Asparagus*.
19. Enumerate the pharmacological significance of *Santalum*.
20. What are the different types of soil types?
21. Outline the biological methods for plant protection.

(6 X 5 = 30 marks)

**Section C**

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

22. Write an account on Triterpenoids.
23. Elaborate any two Ayurvedic preparations using *Sida*.
24. Summarise the volatile oils of *Vetiveria* and its extraction procedure.
25. Explain the different methods in pharmacognosy?

(2 X 15 = 30 marks)

**SEMESTER VI**  
**Core Choice Based Course 3**  
**BOT6CBC02 – ECOTOURISM**  
**(Theory 54 hours)**  
**(Theory Credit 3)**

**Learning Outcome**

Students will be able to

- opt various ecotourism programmes as a self employment stream
- aware about the usefulness of ecotourism in the conservation of natural resources
- assess various ecotourism programmes
- learn about the responsible tourism

**Module 1 Eco-tourism**

**(6 hours)**

1. Definition, concept, introduction, history, relevance and scope.
2. Key Principles and Characteristics of Ecotourism  
Nature area focus, interpretation, environmental sustainability practice, contribution to conservation, benefiting local communities, cultural respect, customer satisfaction, responsible marketing.

**Module 2 Components of Ecotourism**

**(8 hours)**

Travel, tourism industry, biodiversity, local people, cultural diversity, resources, environmental awareness, interpretation, stake holders, capacity building in ecotourism.

**Module 3 Eco Tourism Terms**

**(12 hours)**

Adventure tourism, certification, commercialization chain, cultural tourism, canopy walkway, conservation enterprises, ecosystem, ecotourism activities, ecotourism product, ecotourism resources, ecotourism services, endemism, ecolabelling, ecotourism “lite”, geotourism, greenwashing, stakeholders, sustainable development, sustainable tourism, leakages.

**Module 5 Ecotourism Resources and Forms**

**(14 hours)**

**1. Resources and Forms in India and Kerala 10 hours**

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

**2. Forms of Ecotourism in India and Kerala 4 hours**

Eco regions, eco places, waterfalls in Kerala and India, eco travel, do's and don't on eco travel, eco trips. Potentials of ecotourism in Kerala. Community based ecotourism, ecotourism and NGO's.

**Module 5 Planning and security****(14 hours)****b.i.1. Ecotourism planning 10 hours**

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

**2. Livelihood security 4 hours**

Community, biodiversity conservation and development – Eco-development committees

**Suggested Readings**

1. A K Bhattacharya, 2005. *Ecotourism and Livelihoods*. Concept Publ. company, New Delhi.
2. Batta, A., 2000. *Tourism and environment*. Indus Publishing Co., New Delhi
3. Cater and G. Lowman (Ed.) *Ecotourism: a sustainable option*, Wiley, Chichester.
4. Cater, E., 1994. *Ecotourism in the third world: Problems and prospects for sustainability*. In: E.
5. Croall, J., 1995. *Preserve or Destroy: Tourism and Environment*, Calouste Gulbenkian Foundation, London.
6. Kreg Lindberg, Deonal E. Hawkins, 1999. *Ecotourism: A guide for planners and managers*. Natraj Publishers, Dehradun.

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)****B.Sc BOTANY PROGRAMME (CBCS)****SEMESTER –VI****CORE CHOICE BASED COURSE- BOT6CBC02****ECOTOURISM****BLUEPRINT**

<b>Module</b>	<b>Hours Alloted</b>	<b>Section-A 1 Mark</b>	<b>Section-B 5 Marks</b>	<b>Section-C 10 Marks</b>	<b>Total</b>
1	6	3	2		5
2	8	1	1	1	3
3	12	5	3		8
4	14	1	1	2	4
5	14	2	2	1	5
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Core Choice Based course - SEMESTER –VI**  
**BOT6CBC02 - ECOTOURISM**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 80 Marks**

**Part A**

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

1. Define Ecotourism.
2. Name two environmentally sustainability practices in ecotourism.
3. Write about responsible marketing.
4. What is meant by interpretation?
5. Define endemism.
6. What is meant by commercialisation chain?
7. What is ecotourism 'lite'?
8. Explain geotourism.
9. Comment on ecolabelling.
10. Name the first bird watching site in Kerala.
11. What is green report card?
12. What is ecotourism auditing?

**(10x2=20 Marks)**

**Part B**

*(Answer any **Six** questions. Each question carries 5 marks)*

13. Give the relevance and scopes of ecotourism.
14. What are the characteristics of ecotourism?
15. Explain the importance of biodiversity in ecotourism.
16. Differentiate green tourism and green washing.
17. Write about ecotourism activities.
18. How do leakages affect ecotourism industry? Suggest various methods to prevent leakage in tourism.
19. Write short essay on tribal arts, tribal medicine and tribal museums.
20. What is Eco-development committees, Explain with an example.
21. Write a short essay on ecotourism planning.

**(6x5=30 Marks)**

**Part C**

*(Answer any **Two** question. Each question carries 10 marks)*

22. Write short essay on the components of ecotourism.
23. Write an essay on ecotourism resources in Kerala.
24. State the role of NGO's in ecotourism.
25. Explain the importance of ecotourism in livelihood security.

**(2x15=30 Marks)**

**B.Sc. BOTANY PROGRAMME**  
**SEMESTER –I**  
**COMPLEMENTARY COURSE –I**  
**BOT1COMP01 – CRYPTOGRAMS AND GYMNASPERMS**  
(Theory: 36 hrs; Practical: 36 hrs)  
(Theory credit 2 Practical Credit 1)

**Learning Outcome**

Students will be able to

- understand the diversity of plants with respect to Algae, Fungi, Lichens, Bryophytes, Pteridophytes and Gymnosperms
- associate plant group with their characteristic features
- recognizes economic importance of different plant groups.
- identify the different plant types included in the syllabus with reason.

**Module 1 Phycology (22hours)**

1. Algae - Classification, main features of structure, and life history of the following groups

Cyanophyceae: *Nostoc*

Chlorophyceae: *Volvox*, *Oedogonium*

Phaeophyceae: *Ectocarpus*

Rhodophyceae: *Polysiphonia*

Economic importance of Algae (general account)

**Module 2 Mycology & Lichenology (11 Hours)**

**b.i.1.a. Mycology 9 hours**

Fungi - Classification, main features of structure, and life history of the following groups

Phycomycetes: *Rhizopus*

Ascomycetes: *Peziza*

Basidiomycetes: *Puccinia*

Economic importance of Fungi (general account)

**2. Lichenology 2 hours**

Lichens (Lichenology): Classification and general account

Type: *Usnea*

**Module 3 Bryology and Pteridology (8 hours)**

**Bryology 4 hours**

Bryophytes - General account of Bryophytes

Type: *Riccia*

**Pteridology 4 hours**

Pteridophytes - General account of Pteridophytes

Type: *Selaginella*

**Module 4 Gymnosperms (5 hours)**

General account of Gymnosperms

Type: *Cycas*

**Practical****(36 hours)**

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

**Suggested readings**

1. Ahamdijan, Vernon and Mason H. E 1973. The Lichens. New York: Academic press.
2. Alexopoulou C. J. and Mims C. W. 1983. Introductory Mycology, New York: Wiley Eastern
3. Bhatia K. N 1975. A treatise on Algae. New Delhi. S. Chand and Co. Publishing, New Delhi, Vikas publishing House Pvt.Ltd.
4. Chopra R.N and Kumar P. K 1988. Biology of Bryophytes. New Delhi, Wiley Eastern Ltd.
5. Fritsch F. B 1945. Structure and Reproduction of Algae Vol. I & II. Cambridge University Press.
6. Gangulee H. C and Kar A. K 1993. College Botany Vol. II Calcutta, New Central Book Agency.
7. Pandey S. N and Trivedi P. S 1994. A Textbook of College Botany Vol I
8. Pandey S. N. and Trivedi P. S .1998. A text Book of College Botany Vol.II
9. Pandey B.P 2007. College Botany Vol. I, S. Chand and Company
10. Pandey B. P 2007., College Botany Vol II, S. Chand and Company
11. Vasishta B. R. Bryophyta – S. Chand and Co. New Delhi

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –I**  
**COMPLIMENTARY COURSE - BOT1CMP01**  
**CRYPTOGAMS, GYMNOSPERMS AND PLANT PATHOLOGY**  
**BLUEPRINT**

Module	Hours Alloted	Section-A 1 Mark	Section-B 5 Marks	Section-C 10 Marks	Total
1	12	5	3	1	9
2	11	3	3	1	7
3	8	2	2	1	5
4	5	2	1	1	4
<b>Total</b>	<b>36</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Complimentary course - SEMESTER –I**  
**BOT1COMP01 - CRYPTOGRAMS, GYMNOSPERMS AND PLANT PATHOLOGY**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Part A**

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

1. What is thallus?
2. Explain coenobium.
3. What are pyrenoids?
4. What is apothecium?
5. Name two edible Fungi.
6. What are gemmae?
7. Define heterospory.
8. What is the role of coralloid root?
9. What are cap cells?
10. What is Transfusion tissue?
11. Name the red pigments in algae
12. What is carpogonium?

**(10x1=10 Marks)**

**Part B**

*Answer any **Six** questions. Each question carries 5marks*

13. Explain asexual reproduction in *Volvox*.
14. Illustrate the cell structure of *Cladophora*.
15. Compare the general characteristics of Basidiomycetes with Ascomycetes.
16. Evaluate the morphology of rhizophore in *Selaginella*.
17. Describe asexual mode of reproduction in *Phytophthora*.
18. Illustrate the thallus structure of *Riccia*.
19. Explain the structure of a typical cell of Bacteria.
20. Differentiate between Bryophytes and Pteridophytes.
21. Explain asexual reproduction in *Cladophora*

**(6x5=30 Marks)**

**Part C**

*Answer any two question. Each question carries 10 marks*

22. Elaborate the life cycle of *Puccinia*.
23. List out the economic importance of Bacteria.
24. Explain sexual reproduction in *Oedogonium*.
25. Describe the post fertilization changes in *Polysiphonia*.

**(2x10=20 Marks)**



**B.Sc. BOTANY PROGRAMME**  
**SEMESTER –II**  
**COMPLEMENTARY COURSE –2**  
**BOT2CMP02 – PLANT PHYSIOLOGY AND PLANT PATHOLOGY**  
**(Theory: 36 hrs; Practical: 36 hrs)**  
**(Theory credit 2 Practical Credit 1)**

**Learning Outcome**

Students will be able to

- understands the basic principles related to various physiological functions in plant life.
- familiarize the student with the basic skills and techniques related to plant physiology.
- familiarize the student with applied aspects of plant physiology in other fields like agriculture

**Module 1 Water Relations (10 hours)**

1. Water relations of plants: (a) Physical aspects of water absorption –imbibition, diffusion and osmosis. Plant cell as an osmotic system. Diffusion pressure deficit, water potential, plasmolysis (b) Mechanism of absorption of water. Active and passive absorption. **4 hours**
2. Transpiration – types, and mechanism of stomatal, opening and closing (proton  $K^+$  exchange) significance and factors affecting transpiration, anti-transpirants, Guttation. **4 hours**
3. Stress Physiology – Water, salt and cold stress **2 hours**

**Module 2 Photosynthesis (9 hours)**

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

**Module 3 Translocation of organic solutes & Stress physiology (12 hours)**

1. Translocation of organic solutes: phloem transport, Phloem loading, Munch mass flow hypothesis. **3 hours**
2. Nitrogen Cycles, Nitrogen fixation **2 hours**
3. Dormancy of seeds, factors causing dormancy, techniques to break dormancy, photoblastism, germination – mobilization of food reserves, physiology of fruit ripening. **2 hours**
4. Growth and Movements: Sigmoid curve, measurement of growth. A brief account of natural and synthetic growth hormones. Physiologic effects and practical applications of growth hormones. Senescence and Abscission. Tropic and nastic movements. Photoperiodism and Vernalization. **5 hours**

**Module 3 Plant pathology (5 hours)**

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

2. Study of the following diseases with name of disease, causative organism, symptoms and control measures:
  - a. Nut fall of Arecanut
  - b. Bacterial blight of Rice
  - c. Leaf mosaic of Tapioca

### **Practical**

**(36 hours)**

#### **Core Experiments:**

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

#### **Demonstration Experiments:**

1. Determination of transpiration under different environmental conditions using Ganong's / Farmer's Potometer
2. Relation between transpiration and absorption
3. Evolution of O<sub>2</sub> during photosynthesis
4. Light screen experiments.
5. Mohl's experiment
6. Experiment with variegated leaf
7. Measurement of growth using Arc Auxanometer
8. Experiment with Clinostat.
9. Effect of hormones on growth

#### **Plant pathology**

Study the symptoms of plant diseases mentioned in the syllabus with help of fresh/preserved specimens.

#### **Suggested Readings**

1. Devlin and Witham - Plant Physiology, C B S Publishers
2. Jain V. K., 2008. Fundamentals of Plant Physiology, S. Chand and Co.
3. Kochhar P. L. & Krishnamoorthy H. N. Plant Physiology, Atmaram and Sons, Delhi, Lucknow.
4. Kumar & Purohit Plant Physiology – Fundamentals & Applications, Agrobotanical Publishers
5. Malik C. P. 2002. Plant Physiology, Kalyani Publishers
6. Malik C. P. and Srivastava A. K- Text Book of Plant Physiology – Kalyani Publishers, New Delhi.
7. Mukherjee. S. & Ghosh A.K, 2005. Plant Physiology, Calcutta New Central Book Agency.
8. Noggle G. R. & Fritz G.J- Introductory Plant Physiology- Prentice Hall of India.
9. Pandey S. N & Sinha B.K – Plant Physiology- Vikas Publishing House, New Delhi.
10. Salisbury F.B & Ross C.W – Plant Physiology- Wadsworth Publishing Co.
11. Sinha A.K 2004. Modern Plant Physiology, Narosa Publishing House, New Delhi.
12. Srivastava H. S., 2004. Plant Physiology & Biochemistry, Rasthogi Publications.

13. Verma S. K. & Mohit Verma, 2006. A Text book of Plant Physiology, Biochemistry & Biotechnology, S. Chand and Co.
14. Verma V. 2007. Text Book of Plant Physiology, Ane Books Pvt Ltd.
15. William G. Hopkins- Introduction to Plant Physiology –John Wiley & Sons, New York.
16. Bilgrami K. S and Dube H. C (1976). Text Book of Modern Plant Pathology. New Delhi. Vikas Publishing House Pvt. Ltd
17. Chaube H. S. and Ramji S. (2000) Introductory Plant Pathology, International Book Distributing Co. Lucknow.
18. Sharma P. D (2003) Microbiology and Plant Pathology and Biochemistry, Rasthogi Publications.

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –II**  
**COMPLIMENTARY COURSE—BOT2CMP02**  
**PLANT PHYSIOLOGY AND PLANT PATHOLOGY**

**BLUEPRINT**

<b>Module</b>	<b>Hours Alloted</b>	<b>Section-A 1 Mark</b>	<b>Section-B 5 Marks</b>	<b>Section-C 10 Marks</b>	<b>Total</b>
1	10	5	3	1	9
2	9	4	2	1	7
3	12	2	2	2	6
4	5	1	2	-	3
<b>Total</b>	<b>36</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE  
(GOVERNMENT AUTONOMOUS COLLEGE)**

**B.Sc. Botany Programme  
Complimentary course - SEMESTER –II  
BOT2CMP02 – PLANT PHYSIOLOGY  
(2020 Admission onwards)**

**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Part A**

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

1. What are grana?
2. Define osmosis.
3. What is imbibition?
4. Mention the site of dark reactions in Photosynthesis.
5. What is Rubisco?
6. Mention a practical application of plasmolysis.
7. What is photoperiodism?
8. Define guttation.
9. What is Emerson enhancement effect?
10. Name the causative agent of tapioca mosaic disease
11. Why is abscisic acid known as a stress hormone in plants?
12. What are antitranspirants?

**(10 x 1 = 10 marks)**

**Section B**

*(Answer any **Six** questions, each question carries 5 marks)*

13. Some plants are able to survive if flooded for long time. Comment.
14. Describe causative agent, symptoms and control measures of nut fall of arecunut.
15. Describe water potential and the components that affect it.
16. Explain the external factors that affect photosynthesis
17. Justify the physiological role of auxins in plant growth and development.
18. Describe causative agent, symptoms and control measures of bacterial blight of rice.
19. Illustrate the structure of a typical chloroplast.
20. 'Transpiration is a necessary evil'. Evaluate the statement.
21. Classify the different types of movement in Plants

**(6x 5 = 30 marks)**

**Section C**

*(Answer any **Two** questions each question carries 10 marks)*

22. Explain the different adaptations of Plants to combat salt stress and Water stress.
23. What is seed dormancy? Explain the factors that cause seed dormancy. What are steps taken to overcome seed dormancy?
24. Describe the theories connected with the opening and closing of stomata.
25. Explain Non cyclic photophosphorylation with the help of a schematic diagram.

**(2 x 10=20 marks)**

**B.Sc. BOTANY PROGRAMME**  
**SEMESTER –III**  
**COMPLEMENTARY COURSE –3**  
**BOT3CMP03 – ANGIOSPERM MORPHOLOGY, TAXONOMY, ECONOMIC**  
**BOTANY AND ETHNOBOTANY**  
**(Theory: 54 hrs; Practical: 36 hrs)**  
**(Theory credit 3 Practical Credit 1)**

**Learning outcomes**

The students will be able

- to understand the aim, objectives, significance of taxonomy
- to understand the position of locally available plants in the Bentham and Hooker system of classification
- to learn basic techniques in herbarium preparation and to evaluate the importance of botanical gardens
- to familiarize the concept of economic botany and increase the awareness of locally available plants and plant products
- to understand the scope and importance of various ethnic groups in Kerala

**Module 1 Morphology**

**(14 hours)**

1. Root systems and root modifications (for food storage)
2. Shoot system (shoot modifications for reproduction and storage)
3. Leaf Morphology (types and phyllotaxy)
4. Morphology of flower
  - a. Parts of a flower- description of flower and its parts in technical terms.
  - b. Types of flower – Hypogyny, Perigyny and Epigyny, Symmetry of flowers.
  - c. Aestivation, types
  - d. Placentation, types
  - e. Floral Diagram and Floral Formula
5. Inflorescence:-
  - a. Racemose types: Simple Raceme, Corymb, Umbel, Spike, Spadix and Head
  - b. Cymose types: Simple Cyme, Monochasial, Scorpioid and Helicoid, Dichasial and Polychasial
  - c. Special type: Panicle, Cyathium, Hypanthodium, Thyrsus, Verticillaster
6. Fruits: – Simple-Fleshy, Dry- dehiscent, indehiscent, Aggregate, Multiple (Sorosis and Syconus)

**Module 3 Systematics**

**(15hours)**

1. Importance of plant classification, types of classification, artificial, natural and phylogenetic system of classification (brief account with example), Bentham and Hooker's system of classification (detailed study)
2. Binomial nomenclature; ICBN principles (Mention about ICN)
3. Interdisciplinary approaches in taxonomy: cytotaxonomy, chemotaxonomy.
4. Modern trends in taxonomy: Brief account of molecular systematics, Angiosperm Phylogeny Group (APG system)

5. Herbarium techniques: Preparation and significance, importance of herbarium, Names of at least one International, National and State herbaria
6. Botanical garden, Significance of botanical gardens.

#### **Module 4 Angiosperm families:**

**(15 hours)**

Study of the following families of Bentham and Hooker's system of classification with special reference to major identifying characters and economic importance:

Annonaceae, Malvaceae, Rutaceae, Leguminosae (Fabaceae, Caesalpiniaceae and Mimosaceae) Apiaceae, Rubiaceae, Asteraceae, Apocynaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Arecaceae, Poaceae.

#### **Module 5 Economic Botany**

**(7 hours)**

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

- |                           |  |
|---------------------------|--|
| a. Cereals and millets    | : Paddy, Wheat, Ragi   |
| b. Pulses                 | : Green gram, Bengal gram.   |
| c. Tuber crops            | : Tapioca, Potato  |
| d. Spices                 | : Pepper, Cardamom, Clove  |
| e. Beverages              | : Tea, Coffee.   |
| f. Oil yielding plants    | : Coconut, Groundnut, Sunflower  |
| g. Fibre yielding plants  | : Cotton, Coir, Jute   |
| h. Timber yielding plants | : Teak, Rose wood.   |
| i. Latex yielding plants  | : Para rubber.   |
| j. Bio pesticides         | : Neem, Tobacco  |
| k. Ornamental plants      | : Rose, Orchids, Anthurium, Jasmine  |
| l. Medicinal Plant        | : <i>Adhatoda</i> , <i>Aloe</i> , <i>Brahmi (Bacopa)</i> , <i>Eclipta</i> ,<br><i>Ocimum sanctum</i> , <i>Phyllanthus amarus</i> , <i>Sida rhombifolia</i> . |

#### **Module 6 Ethnobotany**

**(3 hours)**

Ethnobotany: Scope and significance

Ethno botanical significance of Bamboo, Turmeric and *Trichopus zeylanicus* (Botanical name, family, morphology of useful part and ethnobotanical uses should be included)

#### **Practical (36 hours)**

1. Students should study the morphological terms of leaves, stem, inflorescences and fruits mentioned in the syllabus
2. Students should be able to identify typical plants belonging to the families prescribed in the syllabus. They should be able to describe the floral parts in technical terms.

3. Students should study the botanical name, family, morphology of the useful part and the uses of the economically and ethnobotanically important plants listed in the syllabus.

### Suggested Readings

1. Eames, A. J. 1969. *Morphology of Angiosperms*. McGraw – Hill, New York.
2. Hill, A.F. 1952. *Economic Botany: A Text book of Useful Plants and Plant Products*. Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Jain S K 2004, A Manual Of Ethnobotany, Scientific Publishers, India
4. Kochhar, S.L. 1981. *Economic Botany in the Tropics*. Macmillan India Limited, Delhi.
5. Lawrence, G.H.M. 1951. *Taxonomy of Vascular Plants*. Oxford & IBH, New Delhi.
6. Naik, V.N. 1984. *Taxonomy of Angiosperms*. Tata McGraw – Hill Publishing Co; New Delhi.
7. Sharma, O.P. 1993. *Plant Taxonomy*. Tata McGraw – Hill Publishing Co Ltd., New Delhi.
8. Simpson, B.S and M. Conner – Ogorzaly. 1986. *Economic Botany: Plants in Our World*. McGraw – Hill Book Company, New York.
9. Singh, G. 1999. *Plant Systematics – Theory and Practice*. Oxford & IBH, New Delhi.

### Online Resources

Digital Flowers - <http://www.life.illinois.edu/help/digitalflowers/>

APG Poster - <http://www2.biologie.fu-berlin.de/sysbot/poster/poster1.pdf>

APG - [https://en.wikipedia.org/wiki/Angiosperm\\_Phylogeny\\_Group](https://en.wikipedia.org/wiki/Angiosperm_Phylogeny_Group)

The Plant List - <http://www.theplantlist.org/>

International Plant Name Index (IPNI) - <http://www.ipni.org/>

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –III**  
**COMPLIMENTARY COURSE—BOT3CMP03**  
**ANGIOSPERM MORPHOLOGY, TAXONOMY, ECONOMIC BOTANY AND**  
**ETHNOBOTANY**  
**BLUEPRINT**

Module	Hours	Part A (1 Mark)	Part B (5 Marks)	Part C (15 Marks)	Total Questions
1	14	4	2	1	7
2	15	3	3	1	7
3	15	3	2	1	6
4	7	1	1	1	3
5	3	1	1	-	2
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Complimentary course - SEMESTER –III**  
**BOT3CMP03– ANGIOSPERM MORPHOLOGY, TAXONOMY, ECONOMIC**  
**BOTANY AND ETHNOBOTANY**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Part A**

*(Answer any **Ten** questions. Each question carries 1 mark)*

1. What is hypogyny?
2. Write the ethnobotanical uses of Turmeric
3. What is monochasial cyme?
4. In which family ray floret is seen?
5. Differentiate between paripinnate and imparipinnate leaves
6. Write the binomial and family of pepper
7. What is sorosis?
8. Name two botanical gardens in India
9. Name the Inflorescence of the family Poaceae
10. Expand ICBN
11. What is vasculum?
12. Name the family which is having a characteristic feature of 'resupination'

**(10 x 1 = 10 Marks)**

**Section B**

*(Answer any **SIX** questions, each questions carries 5 marks)*

13. Write the significance of Botanical gardens. Write the name of at least two Botanical gardens each from India and abroad
14. Bamboo is considered as 'poor mans timber'. Comment on it
15. Briefly describe different types of Aestivation
16. 'Herbariums are necessary for the plant taxonomic work'. Comment on it
17. Describe different types of Racemose Inflorescence
18. Write the Binomial, family and useful part of three fibre yielding plants you have studied
19. 'Interdisciplinary approaches in taxonomy are necessary for the delimitation of taxa'. Comment on the above statement
20. 'Asteraceae is considered as an advanced family in dicots'. Validate this statement
21. Write the diagnostic characters of the family Rubiaceae

**(6 x 5 = 30 Marks)**

**Section C**

*(Answer any **TWO** questions, each questions carries 10 marks)*

22. Describe the medicinal importance of the plants you have studied. Mention their binomial and Family
23. Describe Bentham and Hooker's system of plant classification. Write the merits and demerits.
24. Classify different types of fruits in angiosperms
25. Compare the characters of the families Fabaceae, Caesalpiniaceae and Mimosaceae.

**(2 x 10 = 20 Marks)**



**B.Sc. BOTANY PROGRAMME  
SEMESTER –IV  
COMPLEMENTARY COURSE –4  
BOT4CMP04 – ANATOMY AND APPLIED BOTANY**

**(Theory 54 hrs; Practical 36 hrs)  
(Theory credit 3 Practical Credit 1)**

**Learning outcomes**

The students will be able

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

**Module 1 Cell, Tissues and Cambium**

**(8 hours)**

1. Cell types, electron microscopic studies on plant cell – living and non living inclusions, cell wall – ultra structure of cell wall (brief account only) **4 hours**
2. Tissues: simple and complex; meristems, secretory tissues. **3 hours**
3. Cambium: origin, structure, function. **1 hour**

**Module 2 Primary and Secondary structure**

**(10 hours)**

1. Primary structure of stem and root in dicots and monocots. **3 hours**
2. Secondary thickening in dicot stem and dicot root; growth rings, heart wood and sap wood; hard wood and soft wood; ring porous wood and diffuse porous wood, Anomalous secondary thickening in *Bignonia*. **5 hours**
3. Anatomy of monocot and dicot leaf. **2 hours**

**Module 3 Ecological Anatomy**

**(6 hours)**

Study of the morphological and anatomical adaptations of the following groups

1. Hydrophytes (*Nymphaea*)
2. Xerophytes (*Nerium*)
3. Epiphytes (*Vanda*)
4. Halophytes (*Avicennia/ Rhizophora*).

**Module 4 Plant breeding**

**(14 hours)**

1. Plant breeding: Objectives, sexual and asexual reproduction. **2 hours**
2. Methods of plant improvement **6 hours**
  - a. Plant introduction, acclimatization plant quarantine.
  - b. Selection: Mass selection, pure line selection and clonal selection.

- c. Hybridization; intervarietal, interspecific and intergeneric; procedure of hybridization.
- 3. Special methods of plant breeding. **6hours**
  - a. Mutation breeding.
  - b. Polyploidy breeding.
  - c. Breeding for disease resistance

### **Module 5 Horticultural practices**

**(5 hours)**

Propagation through

1. Cutting- Stem cutting
2. Layering- Mount layering, Air layering, Simple layering, Trench layering.
3. Budding- T budding, patch budding
4. Grafting – Splice grafting, Tongue grafting.

### **Module 6 Tissue culture**

**(8hours)**

1. Principles, techniques and applications
2. Culture media, asepsis
3. Callus, organogenesis
4. Somatic embryogenesis
5. Anther culture
6. Artificial seeds

### **Practical**

**(36 hours)**

1. Types of tissue – simple and complex.
2. Primary structure of stem and root of dicots and monocots.
3. Structure of dicot stem and dicot root after secondary thickening.
4. Anomalous secondary thickening in *Bignonia*.
5. Anatomy of monocot and dicot leaf.
6. Morphological and anatomical adaptations of Hydrophytes (*Nymphaea* petiole), Xerophytes (*Nerium* leaf), Epiphytes (Velamen root of *Vanda*), Halophyte (Pneumatophore and vivipary of *Avicennia* or *Rhizophora*).
7. Emasculation of pea or *Caesalpinia* flower.
8. 'T'budding , approach grafting, air layering.
9. Demonstration of tissue culture techniques: culture media, callus induction and organogenesis.

### **Suggested Readings**

1. Christopher, E.P. 1958. *Introductory Horticulture*. McGraw – Hill, New York.
2. Esau, K. 1965. *Plant Anatomy*. Wiley, New York.
3. Fahn. 1985. *Plant Anatomy*. Pergamon Press, Oxford.
4. Hartman, H.T. and D.E. Kester. 1991. *Plant Propagation – Principles and Practices*. Prentice – Hall of India, New Delhi.
5. Kumar, N. 1994. *Introduction to Horticulture*. Rajalakshmi Publications, Nagercoil.
6. Pandey, B.P. 1984. *Plant Anatomy*. S. Chand and Company , New Delhi.
7. Vasishta, V.C. 1978. *Plant Anatomy*. S. Nagin and Company, Jalandhar.

**MAHARAJA'S COLLEGE, ERNAKULAM (AUTONOMOUS)**  
**B.Sc BOTANY PROGRAMME (CBCS)**  
**SEMESTER –IV**  
**COMPLIMENTARY COURSE—BOT4CMP04**  
**ANATOMY AND APPLIED BOTANY**

**BLUEPRINT**

<b>Module</b>	<b>Hours Alloted</b>	<b>Part A 1 Mark</b>	<b>Part B 5 Marks</b>	<b>Part C 10 Marks</b>	<b>Total questions</b>
1	8	2	1	1	4
2	10	3	2	1	6
3	6	1	1	-	2
4	14	1	2	1	4
5	8	2	1	1	4
6	8	3	2	-	5
<b>Total</b>	<b>54</b>	<b>12</b>	<b>9</b>	<b>4</b>	<b>25</b>

**MAHARAJAS COLLEGE**  
**(GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. Botany Programme**  
**Complimentary course - SEMESTER –IV**  
**BOT4CMP04 - ANATOMY AND APPLIED BOTANY**  
*(2020 Admission onwards)*  
**Model Question Paper**

**Time: Three Hours**

**Maximum: 60 Marks**

**Part A**

*(Answer any **Ten** questions. Each question carries 1 mark)*

1. What are Raphides?
2. Comment on Apical meristem.
3. Define inter fascicular Cambium.
4. Differentiate between heartwood and sap wood.
5. What is exarch xylem?
6. Write any two adaptations of Halophytes.
7. What is mass selection?
8. Comment on splice grafting.
9. Define Scion.
10. Name any two plant growth Regulators.
11. What are artificial seeds?
12. Write the importance of  $HgCl_2$  in tissue culture.

**(10 X 1 = 10 marks)**

**Section B**

*(Answer any **Six** questions. Each question carries 5 marks)*

13. Comment on complex tissue in plants.
14. Describe the anatomy of monocot leaf with labelled diagram.
15. Describe the primary structure of Dicot stem.
16. Comment on plant Quarantine.
17. Describe the procedure of Hybridization.
18. Write the steps in mutation breeding.
19. Write a note on different types of budding in plants.
20. Describe the applications of plant tissue culture.
21. Write the steps in somatic embryo genesis.

**(6 X 5 = 30 marks)**

**Section D**

*(Answer any **Two** questions. Each question carries 10 marks)*

22. Write an essay on tissue systems in plants.
23. Describe anomalous secondary thickening in bignonia.
24. Describe special methods in plant breeding.
25. Write an essay on artificial propagation methods in plants.

**(2 X 10 = 20 marks)**

## **PRACTICAL MODEL QUESTION PAPERS**

**MAHARAJA'S COLLEGE, ERNAKULAM**  
**(A GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. DEGREE EXAMINATION**  
Programme: **B. Sc. Botany**

**Semester I & II Combined Practical Examination**

**BOT2CORP1-Phycology, Bryology, Microbiology and Mycology**

**Time: 3 Hours**

**Maximum Marks: 40**

1. Make micropreparation of A. Identify giving key characters. Submit the preparation for valuation **5 Marks.**  
(Preparation -2, Identification with class/ sub division- 1, Key characters - 2 Marks)
2. Make micropreparation of B. Identify giving key characters. Submit the preparation for valuation **5 Marks.**  
(Preparation -2, Identification with class/ sub division- 1, Key characters - 2 Marks)
3. Make micropreparation of C. Identify giving key characters. Submit the preparation for valuation. **5 Marks**  
(Preparation -2, Identification with class/ sub division- 1, Key characters - 2 Marks)
4. Perform Gram staining of bacterial solution D. Show the result and write the procedure **5 Marks**  
(Preparation – 3 Marks, Procedure – 2 Marks)
5. Identify material E. Write down the type of association with critical notes **3 Marks**  
(Identification – 1 Mark, Type of association with Critical notes – 2 Marks)
6. Write critical notes on F **4 Marks**  
(Identification – 1 Mark, Notes / Explanation – 3 Marks)
7. Spot at sight G, H, I, J and K **5 Marks**
8. Practical Record **8 Marks**

**MAHARAJA'S COLLEGE, ERNAKULAM**  
**(A GOVERNMENT AUTONOMOUS COLLEGE)**  
**B.Sc. DEGREE EXAMINATION**  
Programme: **B. Sc. Botany**

**Semester III & IV Combined Practical Examination**

**BOT4CORP2- Pteridology, Gymnosperms, Paleobotany, Phytogeography, Anatomy,  
Microtechnique and Reproductive Botany of Angiosperms**

**Time: 3 Hours**

**Maximum Marks: 40**

1. Make stained transverse section of specimen A and B, mount in glycerine and identify by giving reasons
  - a. Preparation 2
  - b. Diagram 1
  - c. Identification with Reasons 2

**5x2=10 marks**
2. Make stained transverse section of specimen C, mount in glycerine and identify giving reasons
  - a. Preparation 2
  - b. Diagram 1
  - c. Identification with Reasons 2

**5x1=5 marks**
3. Make stained transverse section of specimen D, mount in glycerine and identify by giving reasons
  - a. Preparation 2
  - b. Diagram 1
  - c. Identification with Reasons 2

**5x1=5 marks**
4. Spot at sight E, F, G, H **1x4=4 marks**
5. Write critical notes on I, J and K **1x3=3 marks**
6. Identify the stomatal type L
  - a. Preparation 2
  - b. Diagram with identification 1

OR

Calculate the pollen germination percentage M

- a. Preparation 2
  - b. Calculation 1
- 3x1= 3 marks**
4. Viva voce (based on the practicals) **2 marks**
  5. Record **8 marks**

**MAHARAJA'S COLLEGE, ERNAKULAM**

**(A GOVERNMENT AUTONOMOUS COLLEGE)**

**B.Sc. DEGREE EXAMINATION**

**Programme: B. Sc. Botany**

**Semester V & VI Combined Practical Examination**

**BOT6CORP3- Research Methodology, Biostatistics, Biophysics, Informatics, Ecology and Environmental Science**

**Time: 3 Hours**

**Total Marks: 40**

1. Estimate the (Salinity/ Chloride) in the given water sample **A**.  
Write the Procedure (7 Marks)  
(Procedure-2; Experiment-3; Result-2)
2. Find out the Abundance/Density/ Percentage Frequency from the given data **B** (3 Marks)
3. Identify and write critical note on the given Photograph/Material **C** (2 Marks)
4. Prepare a neat hand section of the given material **D** and write the anatomical/Morphological adaptation. Draw Labelled Diagrams (4 Marks)  
(Preparation-2; Diagram-1; Adaptation-1)
5. Determine the concentration of the given solution **E** using Colorimeter. Prepare a Standard Graph from the given values. (4 Marks)  
(Principle 1; Procedure – 1; Standard Graph - 1; Determination of Concentration-2)
6. Find the pH of the given solution **F** using pH meter (1 Mark)
7. Examine the compound leaf supplied and measure the length of the leaflets. (a) Group them into Frequency classes according to their Length (b) Calculate the Mean and Standard Deviation of the data (c) Prepare a Histogram using EXCEL to represent the data. Make a print out and submit (5 Marks)  
(Construction of the frequency class – 1; Mean -1; Standard Deviation – 2; Histogram – 1)
8. Submit a report on Field Visit to a Forest with Ecotourism Significance (3 Marks)
9. Find out the defects in the given Reference **E** (1 Mark)
10. Viva-Voce (Based on practicals) (2 Marks)
11. Record (8 Marks)



**MAHARAJA'S COLLEGE (A GOVT. AUTONOMOUS COLLEGE), ERNAKULAM**

**B.SC. DEGREE BOTANY PROGRAMME (2020 Admission onwards)**

**Semester VI – 5 & 6 (Combined) Practical**

**Semester V & VI Combined Practical Examination**

**BOT6CORP4 -Plant breeding, Horticulture, Plant Pathology, Plant Physiology and Biochemistry**

**Time: 3 hours**

**Total marks- 40**

1. Detect the presence of organic compounds in the given sample **A**.

Requirements	1 mark	
Aim	1 mark	
Procedure	2 marks	
Result	2 marks	(6×1 = 6 marks)
2. Conduct the experiment **B**. Write the requirements, aim and procedure.

Requirements	1 mark	
Aim	1 mark	
Procedure	2 marks	
Result	2 marks	(6×1 = 6 marks)
3. With suitable diagram, write the aim and working of experiment **C**.

Diagram	2 marks	
Aim	1 mark	
Working	2 mark	(5×1 = 5 marks)
4. Write note on pathological interest **D**.

Name of the disease	1 mark	
Causative organism	1 mark	
Symptoms	1 mark	(3×1 = 3 marks)
5. Conduct emasculation and bagging on material **E** and draw a diagram and label it.

Emasculation and Bagging	2 marks	
Labelling	1 mark	(3×1 = 3 marks)
6. Conduct budding/grafting/on material **F** and draw a diagram and label it.

Working	2 marks	
Diagram	1 mark	(3×1 = 3 marks)
7. Prepare Bordeaux mixture **G**.

Concentration of ingredients	1 mark	
Preparation	1 mark	(2×1 = 2 marks)
8. Identify garden implement/garden component **H** comment on it. (1×1 = 1 marks)
9. Pathology herbarium (1 mark)
10. Viva voce (based on practical) (2 marks)
11. Record (8 marks)

**MAHARAJA'S COLLEGE (A GOVT. AUTONOMOUS COLLEGE), ERNAKULAM**  
**B.SC. DEGREE BOTANY PROGRAMME (2020 Admission onwards)**  
**Semester VI – 5 & 6 (Combined) Practical**  
**BOT6CORP5 – Angiosperm Morphology, Taxonomy, Economic Botany,**  
**Cell and Molecular Biology**

**Time: 3 Hours**

**Marks: 40**

1. Identify the specimen (**A**) to the respective family giving key characters at each steps  
(Identification – 1; Characters up to series – 2; Family characters – 2) **(5 marks)**
2. Take the L.S. of flower (**B**). Draw labelled L.S., construct the floral diagram and write the floral formula **(3 marks)**  
(L.S – 1; Floral diagram – 1; Floral formula – 1)
3. Identify the Inflorescence and fruit of (**C&D**) **(1/2 x 2 = 1 mark)**
4. Identify the herbarium specimens (**E<sub>1</sub> & E<sub>2</sub>**) by their binomial and family **(1.5 x 2 = 3 marks)**
5. Identify the product/part by binomial, family & morphology of the useful part of (**F**) **(1 x 2 = 2 marks)**
6. Write the binomial and ethnobotanical use of the material (**G**) **(1 mark)**
7. Make acetocarmine squash preparations of the root tips (**H**) supplied and identify any two stages of mitosis **(7 marks)**  
(Preparation – 2; Identification – 1½ x 2 = 3; Labelled diagrams - 1 x 2 = 2)
8. Identify the meiotic stage in the figure/photograph (**I**). Write a note on the stage. **(1 mark)**
9. Work out the problems (**K & L**) **(4 marks)**  
(K – 2; L – 2)
10. Comment on (**M**) **(1 mark)**
11. Submit 25 herbarium and a duly certified field book **(2 marks)**
12. Viva voce (based on practical) **(2 marks)**
13. Record **(8 marks)**

**MAHARAJA'S COLLEGE, ERNAKULAM**  
(A GOVERNMENT AUTONOMOUS COLLEGE)  
**B.Sc. DEGREE EXAMINATION (2020 Admission onwards)**  
Programme: **BSc Botany**

**Semester V & VI Combined Practical Examination**  
**BOT6CORP6- GENETICS, EVOLUTION, BIOTECHNOLOGY AND**  
**BIOINFORMATICS**

**Time: 3 hours**

**Max. Marks: 40**

1. Work out the Genetics problem **A, B, C** **2 + 4 + 4 = 10 marks**
2. Extract the DNA from plant material (**D**) using suitable methods.  
(Requirements- 1, Working – 2, Results – 1) **1 x 4 = 4 marks**
3. Sterilize the given explant (**E**) and inoculate in to the medium supplied. Write down the sequential steps you have followed including the concentration of sterilant and time of sterilization and final size of the inoculum used.  
(Procedure - 2, Working - 2) **1 x 4 = 4 marks**
4. Immobilize whole cells / plant tissue (**F**) in alginate beads.  
(Requirements and Procedure - 1, Working - 1) **1 x 2 = 2 marks**
5. Using molecular visualization tool Rasmol show the information of given protein **G**  
(Insulin/ Haemoglobin) **1 x 4 = 4 marks**  
Set up the colour of background (Rasmol – Background colour) – 1 mark  
Display H<sub>2</sub> bond /Disulphide bond - 1 mark  
Display the labels specified (amino acids) - 1 mark  
Display the protein structure in model specified - 1 mark
6. Identify and make critical notes on **H, I, J**.  
(Identification - 1, Critical notes - 1) **3 x 2 = 6 marks**
7. Viva (Based on practicals) **2 marks**
8. Practical Record **8 marks**

**MAHARAJA'S COLLEGE (A GOVT. AUTONOMOUS COLLEGE), ERNAKULAM**

**B.Sc. DEGREE ZOOLOGY PROGRAMME (2020 Admission onwards)**

**Semester II – I & II (Combined) Practical**

**BOT2CMBP1 – Cryptogams, Gymnosperms, Plant pathology and Plant Physiology**

**Time: 3 Hours**

**Max.Marks: 40**

1. Make suitable micropreparation of A and B and mount in glycerine. Draw, label the parts and identify giving reasons (2 x 5 = 10)  
(Preparation – 2, labelled diagram 1, identification ½, reason 1½)
2. Identify given material C with reason and draw diagram. (1 x 3 = 3)  
(labelled diagram 1, identification 1, reason 1)
3. Identify at sight D, E, F and G (1 x 4 = 4)
4. Write note on pathological interest of H. (1 x 2 = 2)  
(Name of disease ½, causative agent ½, Symptoms 1)
5. Write requirement, aim, procedure and conduct the experiment **I** (1 x 7 = 7)  
(Requirement 1, aim 1, procedure 2, Working of experiment 3)
6. With suitable diagram aim and procedure of the experiment **J**. (1 x 4 = 4)  
(Aim 1, procedure 2, diagram 1)
7. Viva (based on practical) (2 marks)
8. Record. (8 marks)

**MAHARAJA'S COLLEGE (A GOVT. AUTONOMOUS COLLEGE), ERNAKULAM**

**B.SC. DEGREE ZOOLOGY PROGRAMME (2020 Admission onwards)**

**Semester IV – 3 & 4 (Combined) Practical**

**BOT4CMCBP2 – Angiosperm Taxonomy, Economic Botany,**

**Anatomy and Applied Botany**

**Time: 3 Hours**

**Marks: 40**

1. Assign **(A)** to its family giving diagnostic characters **(4 marks)**  
(Name of the Family – 1; Diagnostic characters - 3)
2. Draw L.S. Construct floral diagram and write the floral formula of **(B)** **(4 marks)**  
(L.S. – 2; Floral diagram – 1; Floral formula – 1)
3. Identify **(C&D)** write notes **(1 x 2 = 2 marks)**  
(Identification – ½ ; Reason – ½)
4. Write binomial, family & morphology of the useful part of **(E & F)** **(2x 2 = 4 marks)**  
(Binomial – 1; Family – ½; Morphology – ½)
5. Make stained transverse section of specimen **(G)**, mount in glycerine and identify giving diagnostic characters **(6 marks)**  
(Preparation – 2; Diagram – 2; Identification with characters – 2)
6. Identify the given T.S. of the material **(H)** **(1 mark)**
7. Identify cell inclusion **(I)** with reasons **(2 marks)**
8. Assign **(J)** to the ecological group with reasons **(3 marks)**  
(Ecological group 1; Reasons – 2)
9. Carry out emasculation/budding/grafting/layering in **(K)** **(4 marks)**  
Demonstration – 2; Aim & Procedure – 2)
10. Viva voce (based on practical) **(2 marks)**
11. Record **(8 marks)**

\*\*\*\*\*



