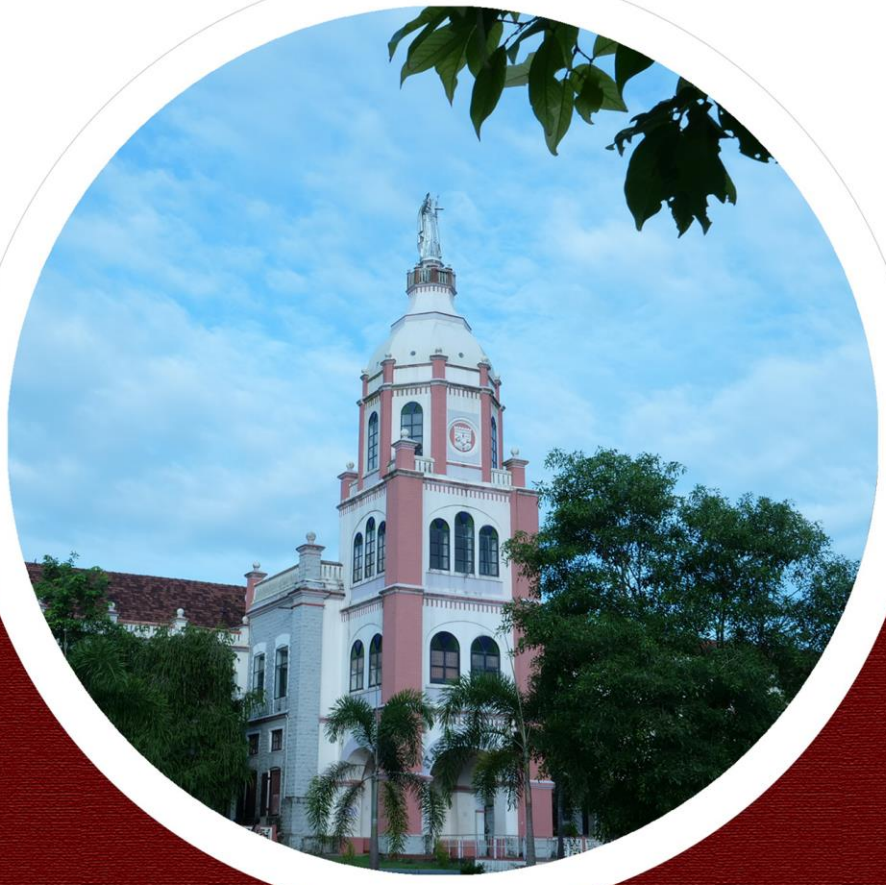
DEPARTMENT OF
BOTANY



Curriculum and Syllabus for
Undergraduate Programmes
Under Credit Semester System
(with effect from 2019 admissions)

St Berchmans College
Founded 1922
AUTONOMOUS | College with Potential for Excellence | Reaccredited by NAAC with A Grade
Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India-686101

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Board of Studies

Dr. Scaria K Varghese (Chairman), Associate Professor, Dept. of Botany, St. Berchmans College, Changanassery – 686101

Dr. J G Ray, Professor, School of Biosciences, MG University Priyadarshini Hills P.O Kottayam - 686 560

Dr. Jos T. Puthur, Associate Professor, Dept. of Botany, Calicut University

Dr. Dennis Thomas, Professor and Head, Department of Biotechnology, Central University, Kerala

Dr. Anumol Jose, Assistant Professor, UC College, Aluva

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Mr. Tom Joseph, Assistant Professor, Dept of Botany, St. Berchmans College, Changanassery – 686101

BSc Botany Programme

Aims and Objectives

To acquaint the learners with the basic elements of Botany and its sub disciplines

To acquaint the students of the methods of enquiry in Botany and its sub disciplines

To enable the student to synthesize the basic elements of the sub discipline within the larger motif of Botany and the pursuits of science

To make judgments on the basis of criteria and standards

To enable students to put ideas and experiments together to create new dimensions to the discipline of Botany

REGULATIONS FOR UNDERGRADUATE (UG) PROGRAMMES UNDER CREDIT SEMESTER SYSTEM (SB-CSS-UG) 2019

1. SHORT TITLE

1.1 These Regulations shall be called St. Berchmans College (Autonomous) Regulations (2019) governing undergraduate programmes under Credit Semester System.

1.2 These Regulations shall come into force with effect from the academic year 2019 - 20 onwards.

2. SCOPE

2.1 The regulation provided herein shall apply to all regular undergraduate programmes, BA/BSc/BCom/BCA, conducted by St. Berchmans College (Autonomous) with effect from the academic year 2019 - 20.

3. DEFINITIONS

3.1 'University' means Mahatma Gandhi University, Kottayam, Kerala.

3.2 'College' means St. Berchmans College (Autonomous).

3.3 There shall be an Academic Committee nominated by the Principal to look after the matters relating to the SB-CSS-UG system.

3.4 'Academic Council' means the Committee consisting of members as provided under section 107 of the University Act 2014, Government of Kerala.

3.5 'Parent Department' means the Department, which offers a particular undergraduate programme.

3.6 'Department Council' means the body of all teachers of a Department in the College.

3.7 'Faculty Mentor' is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities of the undergraduate programme undertaken in the Department.

3.8 '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.

3.9 'Duration of Programme' means the period of time required for the conduct of the programme. The duration of an undergraduate programme shall be six (6) semesters.

3.10 '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.

3.11 'Course' means a portion of a subject to be taught and evaluated in a semester.

3.12 'Course Teacher' means the teacher who is taking classes on the course.

3.13 'Core Course' means a course in the subject of specialization within a degree programme. It includes a course on environmental studies and human rights.

3.14 'Complementary Course' means a course, which would enrich the study of core courses.

3.15 'Common Course I' means a course that comes under the category of courses for English.

3.16 'Common Course II' means additional language, which can be opted by a student, from among the languages offered by the College.

3.17 The Common Course I and II is compulsory for all students undergoing undergraduate programmes.

3.18 'Open Course' means a course offered by the departments other than the parent department outside the field specialization of the student, which can be opted by a student.

3.19 'Elective Course' means a course, which can be substituted, by equivalent course from the same subject.

3.20 'Vocational Course' means a course that enables the students to enhance their practical skills and ability to pursue a vocation in their subject of specialization.

3.21 'Audit Course' means a course opted by the students, in addition to the compulsory courses, in order to develop their skills and social responsibility.

3.22 'Extra Credit Course' means a course opted by the students, in addition to the compulsory courses, in order to gain additional credit that would boost the performance level and additional skills.

3.23 Extra credit and audit courses shall be completed by working outside the regular teaching hours.

3.24 There will be two categories of extra credit courses, mandatory and optional. If a student fails to complete the mandatory course, he/she shall complete the same within the tenure of the programme.

The details of the extra credit and audit courses are given below:

Semester	Course	Type
I	Course on Basic Life Support System and Disaster Management	Compulsory, audit course, Grades shall be given
I to VI	Value Education	Compulsory, extra credit
	Virtual Lab experiments/MOOC	Optional, extra credit
II & III	Add on Course	Compulsory, extra credit, Grades shall be given
Summer vacation following semester II	50 hours (10 days) Social Awareness Programme	Compulsory, extra credit, Grades shall be given
IV	Internship/Skill Training	Compulsory, audit course, Grades shall be given
V	Finishing School	Compulsory, audit course

3.25 'On the Job Training' means a job training course given to the students to acquaint them with various industrial skills.

3.26 'Project' means a regular project work with stated credits on which the student conducts a project under the supervision of a teacher in the parent department/any appropriate research centre in order to submit a dissertation on the project work as specified.

3.27 'Dissertation' means a minor thesis to be submitted at the end of a research work carried out by each student on a specific area.

3.28 'Plagiarism' is the unreferenced use of other authors' material in dissertations and is a serious academic offence.

3.29 'Seminar' means a lecture expected to train the student in self-study, collection of relevant matter from books and internet resources, editing, document writing, typing and presentation.

3.30 'Improvement Examination' is an examination conducted to improve the performance of a student in the courses of a particular semester as per the exam manual.

3.31 'Supplementary Examination' is an examination conducted for students who fail in the courses of a particular semester as per the exam manual.

3.32 The minimum credits, required for completing an undergraduate programme is one hundred and twenty (120).

3.33 'Credit' (C) of a course is a measure of the weekly unit of work assigned for that course in a semester.

3.34 'Course Credit': One credit of the course is defined as a minimum of one (1) hour lecture/minimum of two (2) hours lab/field work per week for eighteen (18) weeks in a semester. The course will be considered as completed only by conducting the final examination.

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

3.36 'Grade Point' (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.

3.37 'Credit Point' (CP) of a course is the value obtained by multiplying the grade point (GP) by the credit (C) of the course.

3.38 'Semester Grade Point Average' (SGPA) of a semester is calculated by dividing total credit points obtained by the student in a semester by total credits of that semester and shall be rounded off to two decimal places.

3.39 'Cumulative Grade Point Average' (CGPA) is the value obtained by dividing the sum of credit points in all the courses obtained by the student for the entire programme by the total credits of the whole programme and shall be rounded off to two decimal places.

3.40 'Institution Average' is the value obtained by dividing the sum of the marks obtained by all students in a particular course by the number of students in the respective course.

3.41 'Weighted Average Score' means the score obtained by dividing sum of the products of marks secured and credit of each course by the total credits of that semester/programme and shall be rounded off to two decimal places.

3.42 'Grace Marks' means marks awarded to course/courses as per the choice of the student, in recognition of meritorious achievements of a student in NCC/NSS/sports/arts and cultural activities.

3.43 First, Second, Third, Fourth and Fifth position shall be awarded to students who come in the first five places based on the overall CGPA secured in the programme in the first chance itself.

4. PROGRAMME STRUCTURE

4.1. The programme shall include core courses, vocational courses, complementary courses, common courses, open course and elective courses. There shall be a project/dissertation to be undertaken by all students. The programme will also include assignments, seminars, practical, viva-voce, OJT, field visit, industry visit etc., if they are specified in the curriculum.

4.2. Total credits for a programme is one hundred and twenty (120). The credit distribution for various UG programmes is shown below.

Model I BA/BSc

i.	Programme duration	6 Semesters
ii.	Total credits required for successful completion of the programme	120
iii.	Minimum credits required from Core + Elective + Project + Complementary courses	79
iv.	Minimum credits required from Common courses	38
v.	Minimum credits required from Open course	3
vi.	Minimum attendance required	75%

4.3. **Project/Dissertation**

All students shall do a project/research work in the area of core course in the sixth semester. The project/ research work shall be done individually or as a group of maximum five (5)

students. The projects/research work shall be identified during the fourth semester of the programme with the help of the supervising teacher. The report of the project/research work shall be submitted to the department during sixth semester and shall be produced before the examiners appointed by the College. The project report/dissertation shall be subject to internal and external evaluation followed by a viva-voce/defence.

4.4. **Evaluations**

The evaluation of each course shall contain two parts.

i Internal or In-Semester Assessment (ISA)

ii External or End-Semester Assessment (ESA)

Both ISA and ESA shall be carried out using indirect grading. The ISA:ESA ratio shall be 1:4, for courses with or without practical. There shall be a maximum of eighty (80) marks for external evaluation and twenty (20) marks for internal evaluation.

4.5. **In-semester assessment**

The components of the internal or in-semester assessment and their marks are as below.

Courses other than common courses without practical

Component	Marks
Attendance	2
Viva	4
Assignment/Seminar	4
Class test	4
Model examination	6
Total	**20**

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

Courses other than common courses with practical

Component	Marks
Attendance	2
Viva	3
Assignment/Seminar	2
Class test	3
Model examination	5
Total	**15**

Marks for attendance

% of Attendance	Marks
Above 90	2
75 – 90	1

(Decimals shall be rounded off to the next higher whole number)

Internal assessment of practical courses

The internal assessment of practical courses shall be conducted either annually or in each semester. The components for internal assessment are given below.

Internal assessment of practical courses evaluated in each semester

Component	Marks
Attendance	1
Lab Test	2
Record*	2
Total	**5**

*Marks awarded for Record shall be related to number of experiments/practicals recorded.

Marks for attendance

% of Attendance	Marks
Above 75	1

(Decimals shall be rounded off to the next higher whole number)

4.6. **Assignments**

Assignments shall be submitted for every course in the first four semesters. At least one assignment for each course shall be submitted in each semester.

4.7. **Seminar**

A student shall present a seminar in the fifth and sixth semesters.

4.8. **In-semester examination**

Every student shall undergo at least two in-semester examinations as class test and model examination as internal component for every course.

4.9. To ensure transparency of the evaluation process, the ISA mark awarded to the students in each course in a semester shall be published on the notice board according to the schedule in the academic calendar published by the College. There shall not be any chance for improvement of ISA. The course teacher and the faculty mentor shall maintain the academic record of each student registered for the course which shall be forwarded to the office of the Controller of Examinations through the Head of the Department and a copy shall be kept in the office of the Head of the Department for at least two years for verification.

4.10. A student who has not secured minimum marks in internal examinations can redo the same before the end semester examination of the semester concerned.

4.11. **End-semester assessment**

The end-semester examination in theory and practical courses shall be conducted by the College.

4.12. The end-semester examinations shall be conducted at the end of each semester. There shall be one end-semester examination of three (3) hours duration in each lecture based course.

4.13. The question paper shall be strictly on the basis of model question paper set by Board of Studies.

4.14. A question paper may contain short answer type/annotation, short essay type questions/problems and long essay type questions. Marks for each type of question can vary from programme to programme, but a general pattern may be followed by the Board of Studies.

4.15. End-semester Examination question pattern shall be as given below.

Courses without practical

Section	Total No. of Questions	Questions to be Answered	Marks	Total Marks for the Section
A	12	10	2	20
B	9	6	5	30
C	4	2	15	30
			Maximum	**80**

Courses with practical

Section	Total No. of Questions	Questions to be Answered	Marks	Total Marks for the Section
A	12	10	2	20
B	9	6	4	24
C	4	2	8	16
			Maximum	**60**

4.16. Photocopies of the answer scripts of the external examination shall be made available to the students for scrutiny as per the regulations in the examination manual.

4.17. Practical examination shall be conducted annually or in each semester. The duration and frequency of practical examination shall be decided by the respective Board of Studies.

4.18. Practical examination shall be conducted by one external examiner and one internal examiner.

4.19. The marks for end-semester theory and practical examinations are given below

Course	Marks
Courses without practical	80
Course with practical	60
Practical (assessment in each semester)	20
Practical (odd and even semester combined)	40

4.20. The project report/dissertation shall be subject to internal and external evaluation followed by a viva-voce at the end of the programme. Internal Evaluation is to be done by the supervising teacher and external evaluation by an external evaluation board consisting of an examiner appointed by the Controller of Examinations and the Head of the Department or his nominee. A viva-voce/defence related to the project work shall be conducted by the external evaluation board and students have to attend the viva-voce/defence individually.

Components of Project Evaluation	Marks
Internal Evaluation	20
Dissertation (External)	50
Viva-Voce (External)	30
Total	**100**

4.21. If the student fails in project evaluation, he or she shall submit the project report/dissertation after modifying it on the basis of the recommendations of the examiners.

4.22. For all courses (theory and practical) an indirect grading system based on a seven (7) point scale according to the percentage of marks (ISA + ESA) is used to evaluate the performance of the student in that course. The percentage shall be rounded mathematically to the nearest whole number.

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

5. CREDIT POINT AND GRADE POINT AVERAGE

5.1. **Credit Point**

Credit Point (CP) of a course is calculated using the formula

CP = C × GP

where C is the credit and GP is the grade point

5.2. **Semester Grade Point Average**

Semester Grade Point Average (SGPA) is calculated using the formula

SGPA = TCP/TCS

where TCP is the total credit point of all the courses in the semester and TCS is the total credits in the semester

GPA shall be rounded off to two decimal places.

5.3. **Cumulative Grade Point Average**

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

CGPA = TCP/TC

where TCP is the total credit point of all the courses in the whole programme and TC is the total credit in the whole programme

GPA shall be rounded off to two decimal places.

5.4. **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 etc. are calculated using the formula

GPA = TCP/TC

where TCP is the Total Credit Point of a category of course and TC is the total credit of that category of course

Grades for the different courses, semesters, Semester Grade Point Average (SGPA) and grades for overall programme, Cumulative Grade Point Average (CGPA) are given based on the corresponding Grade Point Average (GPA) as shown below:

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

5.5. 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 in a course.

5.6. For a pass in a programme, a separate minimum of grade 'D' is required for all the individual courses.

5.7. 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 the student improves this to D grade or above within the permitted period.

5.8. Candidate who secures D grade and above will be eligible for higher studies.

6. SUPPLEMENTARY/IMPROVEMENT EXAMINATION

6.1 There will be supplementary examinations and chance for improvement. Only one chance will be given for improving the marks of a course.

6.2 There shall not be any improvement examination for practical examinations and examinations of the final year.

7. ATTENDANCE

7.1. The minimum requirement of aggregate attendance during a semester for appearing the end semester examination shall be 75%. Condonation of shortage of attendance to a maximum of ten (10) days in a semester subject to a maximum of two times during the whole period of undergraduate programme may be granted by the College. This condonation shall not be counted for internal assessment.

7.2. Benefit of attendance may be granted to students representing the College, University, State or Nation in Sports, NCC, NSS or Cultural or any other officially sponsored activities such as College union/University union activities etc., on production of participation/attendance certificates, within one week from competent authorities, for the actual number of days participated, subject to a maximum of ten (10) days in a semester, on the specific recommendations of the Faculty Mentor and Head of the Department.

7.3. A student who does not satisfy the requirements of attendance shall not be permitted to appear for the end-semester examinations.

7.4. Those students who are not eligible even with condonation of shortage of attendance shall repeat the course along with the next batch after obtaining readmission.

8. BOARD OF STUDIES AND COURSES

8.1. The Board of Studies concerned shall design all the courses offered in the UG programme. The Board shall design and introduce new courses, modify or re-design existing courses and replace any existing courses with new/modified courses to facilitate better exposure and training for the students.

8.2. The syllabus of a programme shall contain programme objectives and programme outcome.

8.3. The syllabus of a course shall contain the title of the course, course objectives, course outcome, contact hours, the number of credits, reference materials and model questions.

8.4. Each course shall have an alpha numeric code which includes abbreviation of the course in two letters, the semester number, course code and the serial number of the course.

8.5. Every programme conducted under Credit Semester System shall be monitored by the Academic Council.

9. REGISTRATION

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

9.2. 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.

9.3. A student may be permitted to complete the programme, on valid reasons, within a period of twelve (12) continuous semesters from the date of commencement of the first semester of the programme.

9.4. The minimum strength of students for open courses is 15 and the maximum is 75 per batch.

9.5. Each student shall register for the open courses in the prescribed registration form in consultation with the faculty mentor during fourth semester. Faculty mentor shall permit registration on the basis of the preferences of the student and availability of seats.

10. ADMISSION

10.1. The admission to all UG programmes shall be as per the rules and regulations of the College/University.

10.2. The eligibility criteria for admission shall be as announced by the College/University from time to time.

10.3. Separate rank lists shall be drawn up for seats under reservation quota as per the existing rules.

10.4. There shall be an academic and examination calendar prepared by the College for the conduct of the programmes.

11. MARK CUM GRADE CARD

11.1. The College under its seal shall issue to the students, a Mark cum Grade Card on completion of each semester, which shall contain the following information.

i. Name of the Student
ii. Register Number
iii. Photo of the student
iv. Degree
v. Programme
vi. Semester and Name of the Examination
vii. Month and Year of Examination
viii. Stream
ix. Course Code, Title and Credits of each course opted in the semester
x. Marks for ISA, ESA, Total Marks (ISA + ESA), Maximum Marks, Letter Grade, Grade Point (GP), Credit Point (CP) and Institution Average in each course opted in the semester
xi. Total Credits, Marks Awarded, Credit Point, SGPA and Letter Grade in the semester
xii. Weighted Average Score
xiii. Result
xiv. Credits/Grade of Extra Credit and Audit Courses

11.2. The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the entire programme including those taken over and above the prescribed minimum credits for obtaining the degree. The final Mark Cum Grade Card shall show the CGPA and the overall letter grade of a student for the entire programme.

11.3. A separate grade card shall be issued at the end of the final semester showing the extra credit and audit courses attended by the student, grade and credits acquired.

12. AWARD OF DEGREE

The successful completion of all courses other than extra credit and audit courses with ‘D’

grade shall be the minimum requirement for the award of the degree.

13. MONITORING COMMITTEE

There shall be a Monitoring Committee constituted by the Principal to monitor the internal evaluation conducted by the College. The Course Teacher, Faculty Mentor, and the College Coordinator shall keep all the records of the continuous evaluation, for at least a period of two years, for verification.

14. GRIEVANCE REDRESS MECHANISM

14.1. In order to address the grievance of students regarding ISA, a two-level grievance redress mechanism is envisaged.

14.2. A student can approach the upper level only if grievance is not addressed at the lower level.

14.3. Department level: The Principal shall form a Grievance Redress Committee in each Department comprising of course teacher and one senior teacher as members and the Head of the Department as Chairman. The Committee shall address all grievances relating to the internal assessment of the students.

14.4. College level: There shall be a College level Grievance Redress Committee comprising of Faculty Mentor, two senior teachers and two staff council members (one shall be an elected member) and the Principal as Chairman. The Committee shall address all grievances relating to the internal assessment of the students.

15. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Principal shall, for a period of three years from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any programme with such modifications as may be necessary.

REGULATIONS FOR ADD ON COURSES FOR UNDERGRADUATE PROGRAMMES

1. DEFINITIONS

1.1 'Add On Course General Coordinator' is a senior teacher nominated by the Principal to coordinate and monitor the Add On courses conducted by various departments.

1.2 'Add On Course Coordinator' is a teacher nominated by a Department Council to coordinate the evaluation and other academic activities of the Add On Course undertaken in the Department.

2. COURSE STRUCTURE

2.1 Add On Course shall be completed outside the regular teaching hours of the undergraduate programmes and shall be completed within the first four semesters of the programme.

2.2 The credit will be awarded only if the student get D grade (35% marks) and above.

2.3 A student can earn any number of extra credits according to his/her choice.

2.4 The minimum credits for an Add On Course shall be two (2).

3. EVALUATIONS

The evaluation of each course shall be done internally and contain two parts.

i. Continuous evaluation
ii. Final evaluation

Both continuous evaluation and final evaluation shall be carried out using indirect grading. The marks for continuous evaluation is twenty (20) and that of final evaluation is eighty (80).

Continuous evaluation

The components of the continuous evaluation and their marks are as below.

For all courses without practical

There are two components for continuous evaluation, which include attendance and assignment. All the components of the continuous evaluation are mandatory.

Components	Marks
Attendance	10
Assignment	10
Total	**20**

Marks for attendance

% of Attendance	Marks
90 and above	10
85 - 89	8
80 – 84	6
76 – 79	4
75	2

(Decimals shall be rounded mathematically to the nearest whole number)

For all courses with practical

The components for continuous evaluation of courses with practical are given below.

Components	Marks
Attendance	10
Lab involvement	10
Total	**20**

Marks for attendance

% of Attendance	Marks
90 and above	10
85 - 89	8
80 – 84	6
76 – 79	4
75	2

(Decimals shall be rounded mathematically to the nearest whole number)

Assignments

At least one assignment shall be submitted for each course.

4. **FINAL EVALUATION**

The final evaluation of theory and practical courses shall be conducted by the College/Department. It can be eighty marks written examination or eighty marks project/practical examination or eighty marks written and project/practical examination combined, as decided by the Board of Studies.

4.1 The question paper shall be strictly on the basis of model question paper set by Board of Studies.

4.2 A question paper may contain objective type, short answer type/annotation, short essay type questions/problems and long essay type questions.

4.3 The duration of written examination shall be decided by the respective Board of Studies and the duration of the practical examination shall be decided by the concerned course coordinator.

4.4 Practical examination shall be conducted by one internal examiner.

4.5 For all courses (theory and practical) an indirect grading system based on a seven (7) point scale according to the percentage of marks (ISA + ESA) is used to evaluate the performance of the student in that course. The percentage shall be rounded mathematically to the nearest whole number.

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

4.6 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 in a course.

5. **ATTENDANCE**

The minimum requirement of aggregate attendance for appearing the final evaluation shall be 75%.

6. **BOARD OF STUDIES AND COURSES**

6.1 The Board of Studies concerned shall design the Add On Course offered by the department. The Board shall design and introduce new Add On Course, modify or redesign existing Add On

Course and replace any existing Add On course with new/modified Add On course to facilitate better exposure and training for the students.

6.2 The syllabus of an Add On course shall also include the title of the course, contact hours, the number of credits, reference materials and question paper pattern.

6.3 Each course shall have an alpha numeric code which includes programme code, abbreviation of the course in two letters, course code and serial number of the course

6.4 The Add On courses conducted under Credit Semester System shall be monitored by the Academic Council.

6.5 For redressing the complaints in connection with the conduct of Add On course, students shall approach the Grievance Redress Committee functioning in the college.

REGULATIONS FOR CERTIFICATE COURSE IN VALUE EDUCATION FOR UNDERGRADUATE PROGRAMMES

Value Education is a compulsory extra credit course for all the students admitted to the undergraduate programmes.

i. **Duration**

The duration of the course shall be three academic years (six semesters) spanning 60 hrs. There shall be minimum 20 hours in an academic year.

ii. **Evaluation**

The evaluation of each course shall contain two parts.

i. Continuous evaluation
ii. Final evaluation

There shall be a maximum of forty (40) marks for external assessment and ten (10) marks for internal assessment.

Continuous Evaluation

Assignment

The students are supposed to submit at least one assignment in every year and five (5) marks will be given for a submitted assignment

Attendance

The minimum requirement of aggregate attendance during a semester for appearing the end final examination shall be 75%.

Marks for attendance

Maximum of five (5) marks will be given for attendance as follows.

% of Attendance	Marks
90 and above	5
85-89	4
80-84	3
76-79	2
75	1

(Decimals shall be rounded off to the next higher whole number)

Final evaluation

The final examination shall be conducted by the course coordinator. The final assessment examination shall be conducted at the end of every year. There shall be an annual written examination of one and a half hours (1½) duration. The question paper shall be strictly on the basis of model question paper set by Expert Committee. A question paper consists of short answer type, short essay type and long essay type questions.

A separate minimum of 30% marks each for internal and external assessment (continuous and final evaluation) and aggregate minimum of 35% are required for a pass in a course.

iii. **Grading**

The total marks of the course shall be one hundred and fifty (150). The grading of the course is as follows:

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

iv. **Award of certificate**

The course is envisaged with three levels in three academic years. There shall be examination in every year. If a student does not acquire minimum marks he/she can continue with further levels. But he/ she shall be eligible to get certificate only after completing all the levels successfully. The certificate will be issued after completing all the levels with minimum grade D for the pass. On successful completion of the course, grade card shall be issued to the students indicating the grade. The college issues the certificate on value education to all the undergraduate students who successfully complete the course. The course shall be completed during the tenure of the programme.

REGULATIONS FOR COURSE ON BASIC LIFE SUPPORT SYSTEM AND DISASTER MANAGEMENT (BLS & DM)

i. The course on BLS & DM shall be conducted by a nodal centre created in the college.

ii. The nodal centre shall include at least one teacher from each department. A teacher shall be nominated as the Director of BLS & DM.

iii. The team of teachers under BLS & DM shall function as the trainers for BLS & DM.

iv. The team of teachers under BLS & DM shall be given intensive training on Basic Life Support System and Disaster Management and the team shall be equipped with adequate numbers of mannequins and kits for imparting the training to students.

v. Each student shall under go five (5) hours of hands on training in BLS & DM organised by the Centre for BLS & DM.

vi. The training sessions shall be organised on weekends/holidays/vacation during the first semester of the programme.

vii. After the completion of the training, the skills acquired shall be evaluated using an online test and grades shall be awarded.

viii. Nodal centre for BLS & DM shall conduct online test and publish the results.

ix. The grading of the course is as follows:

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

x. Students who could not complete the requirements of the BLS & DM training shall appear for the same along with the next batch. There shall be two redo opportunity.

xi. For redressing the complaints in connection with the conduct of BLS & DM students shall approach the Grievance Redress Committee functioning in the college.

REGULATIONS FOR SOCIAL AWARENESS PROGRAMME (SAP)

i. Social Awareness Programme shall be conducted by a nodal centre created in the college.

ii. The nodal centre shall include at least one teacher from each department. A teacher shall be nominated as the Director of the SAP.

iii. The centre shall identify the areas where the students can serve the society through the SAP.

iv. During the first semester itself, the centre for SAP shall organise programmes to sensitize the students about the significance and relevance of SAP and publish a list of different areas where they can work as volunteers. Students shall register their preferences (three) with the centre for SAP. The centre shall allot students to various areas based on their preference. For the preparation of the allotment list, the marks obtained in the higher secondary examination shall also be used as a criterion. Centre for SAP shall take the help of the Head of the concerned department and the mentor(s) of the concerned batch at the time of finalization of the allotment list.

v. Students shall carry out the voluntary work allotted to them after the regular class hours/weekends/holidays falling in the second semester or the summer vacation following the second semester.

vi. Evaluation of the SAP activity shall be based on the hours of work put in by a student. A minimum of 50 hours of social work (corresponding to 50 marks) is required for the successful completion of SAP. Every additional work beyond the minimum 50 hours shall fetch five (5) marks per hour. Maximum marks shall be 100. Students who donate blood during the second semester shall be given 10 marks upon the production of the certificate from the medical officer. However, Marks earned through blood donation shall not be counted for a pass in the programme. Mark for blood donation shall be awarded only once during the SAP.

vii. Upon completion of SAP, the marks earned and the grades awarded shall be published by the Director of SAP. The grading is as follows:

Percentage of Marks	**Grade**	**Performance**
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

viii. Two credits shall be awarded to students who complete the requirements of SAP.

ix. Students who could not complete the requirements of the SAP shall appear for the same with the next batch. There shall be two redo opportunity.

x. For redressing the complaints regarding allotment, harassment at the place of work, and the marks and grades awarded students shall approach the Grievance Redress Committee functioning in the college.

xi. Director of SAP has the right to exclude students who are physically handicapped from SAP.

REGULATIONS FOR INTERNSHIP/SKILL TRAINING PROGRAMME

i. Every UG student shall undergo an internship for a minimum period of five days (25 hours) at a centre identified by the concerned department. In the case of disciplines where internship opportunities are scanty (eg. Mathematics) special skill training programmes with duration of five days (25 hours) shall be organised.

ii. Each department shall identify a teacher in charge for internship/skill training programme.

iii. The department shall select institutions for internship/organising skill training programme.

iv. Internship/skill training programme shall be carried out preferably during the summer vacation following the fourth semester or during the Christmas vacation falling in the fourth semester or holidays falling in the semester.

v. At the end of the stipulated period of internship each student shall produce an internship completion cum attendance certificate and an illustrated report of the training he/she has underwent, duly certified by the tutor and Head of the institution where the internship has been undertaken.

vi. Students undergoing skill training programme shall submit a training completion cum attendance certificate and a report of the training he/she has underwent, duly certified by the trainer, teacher co-ordinator of the programme from the concerned department and the head of the department concerned.

vii. Upon receipt of the internship completion cum attendance certificate and illustrated report of the training or a training completion cum attendance certificate and a report of the training, the teacher in charge of internship/skill training programme shall prepare a list of students who have completed the internship/skill training programme and a list of students who failed to complete the programme. Head of the department shall verify the lists and forward the lists to the Controller of Examinations.

viii. Students who could not complete the requirements of the internship/skill training programme shall appear for the same with the next batch. There shall be only one redo opportunity.

REGULATIONS FOR FINISHING SCHOOL

i. The training to help students develop their soft skills and interview skills, 'the finishing school', shall be coordinated by a nodal centre.

ii. The nodal centre shall include at least one teacher from each department. A teacher shall be nominated as the Director of the nodal centre.

iii. The training shall impart soft skills comprising of language skills, personal presentation and grooming, resume preparation, group discussion techniques, and interview skills among the undergraduate students.

iv. This course shall be conducted during the fifth semester for all the undergraduate students.

v. There will be a total of 20 contact hours which shall be handled by a team of professional members/faculty. In addition, a one-day outbound training session by a team of professional trainers that touches on the aspects of creativity, problem solving and team building shall also be organized.

vi. The students shall be assessed and grades shall be awarded based on the components as shown below.

Component	Marks
Attendance	5
Class Test	10
Assignments	10
Group discussion	10
Interview	15
Total	**50**

vii. The grading of the course is as follows:

Percentage of Marks	Grade	Performance
95 and above	S	Outstanding
85 to below 95	A+	Excellent
75 to below 85	A	Very Good
65 to below 75	B+	Good
55 to below 65	B	Above Average
45 to below 55	C	Satisfactory
35 to below 45	D	Pass
Below 35	F	Failure

viii. For redressing the complaints in connection with the conduct of finishing school students shall approach the Grievance Redress Committee.

VIRTUAL LAB EXPERIMENTS/MOOC COURSES

i. There shall be a Nodal officer and a team of teachers to coordinate the logistics for conducting Virtual Lab experiments and MOOC courses and to authenticate the claims of the students regarding the successful completion of the Virtual Lab experiments and or MOOC courses.

ii. Students who are desirous to do Virtual Lab experiments and or MOOC courses shall register with the Nodal officer at the beginning of the experiment session/MOOC course. Students also shall submit proof of successful completion of the same to the Nodal officer.

iii. Upon receipt of valid proof, the nodal officer shall recommend, to the Controller of Examinations, the award of extra credits. In the case of Virtual Lab experiments, 36 hours of virtual experimentation shall equal one credit and in the case of MOOC courses 18 hours of course work shall equal one credit.

iv. College shall arrange infrastructure for taking up Virtual Lab experiments and/or MOOC courses.

Model Mark cum Grade Card

St Berchmans College
Founded 1922
AUTONOMOUS | College with Potential for Excellence | Reaccredited by NAAC with A Grade
Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India-686101

MARK CUM GRADE CARD

Date:

Name of the Candidate :

Permanent Register Number (PRN) :

Degree :

Programme :

Stream :

Name of Examination :

Photo

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (CP)	Institution Average	Result
			ISA		ESA		Total						
			Awarded	Maximum	Awarded	Maximum	Awarded	Maximum					
	Common Course I												
	Common Course II												
	Core Course												
	Complementary Course												
	Complementary Course												
	Total												
	Weighted Average Score												
	Semester Result												
	SGPA												
	End of Statement												

Entered by:

Verified by:

Controller of Examinations **Principal**

St Berchmans College
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Affiliated to Mahatma Gandhi University, Kottayam, Kerala
Changanassery, Kottayam, Kerala, India - 686101, Tel: 91-481-2420025, 9961231314
E-mail: sbc@sbcollege.org Web: www.sbcollege.ac.in

CONSOLIDATED MARK CUM GRADE CARD

Photo

Name of the Candidate :

Permanent Register Number (PRN) :

Degree :

Programme :

Stream :

Date :

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (CP)	Institution Average	Result
			ISA		ESA		Total						
			Awarded	Maximum	Awarded	Maximum	Awarded	Maximum					
SEMESTER I													
	Common Course I Common Course II Core Course Complementary Course Complementary Course												

SEMESTER II													
	Common Course I **Common Course II** **Core Course** **Complementary Course** **Complementary Course**												
SEMESTER III													
	Common Course I **Common Course II** **Core Course** **Complementary Course** **Complementary Course**												
SEMESTER IV													
	Common Course I **Common Course II** **Core Course** **Complementary Course** **Complementary Course**												
SEMESTER V													
	Core Course **Open Course**												
SEMESTER VI													
	Core Course **Project**												

SEMESTER RESULTS

Semester	Marks Awarded	Maximum Marks	Credits	SGPA	Grade	Month & Year of Passing	Result
I II III IV V VI							

PROGRAMME PART RESULTS

Programme Part	Marks Awarded	Maximum Marks	Credits	CGPA	Grade
Common Course I: Common Course II: Core Course: Complementary Course: Complementary Course: Open Course:					
Total					

FINAL RESULT

CUMULATIVE GRADE POINT AVERAGE (CGPA) =

GRADE =

*** Separate grade card is issued for Audit and Extra Credit courses.**
**** Grace Mark awarded.**

Entered by:

Verified by:

Controller of Examinations **Principal**

Reverse side of the Mark cum Grade Card (COMMON FOR ALL SEMESTERS)

Description of the Evaluation Process

Grade and Grade Point

The evaluation of each course comprises of internal and external components in the ratio 1:4 for all Courses. Grades and Grade Points are given on a seven (7) point scale based on the percentage of Total Marks (ISA + ESA) as given in Table 1. Decimals are corrected to the nearest whole number.

Credit Point and Grade Point Average

Credit Point (CP) of a course is calculated using the formula

CP = C × GP

where C is the Credit and GP is the Grade Point

Grade Point Average of a Semester (SGPA) or Cumulative Grade Point Average (CGPA) for a Programme is calculated using the formula

SGPA or CGPA = TCP/TC

where TCP is the Total Credit Point for the semester/programme and TC is the Total Credit for the semester/programme

GPA shall be rounded off to two decimal places.

The percentage of marks is calculated using the formula;

$$\% \text{ Marks} = \left(\frac{\text{total marks obtained}}{\text{maximum marks}}\right) \times 100$$

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

Table 1

Grades for the different Semesters and overall Programme are given based on the corresponding GPA, as shown in Table 2.

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

Table 2

Weighted Average Score (WAS) is the score obtained by dividing sum of the products of marks secured and credit of each course by the total credits of that semester/programme and shall be rounded off to two decimal places.

Note: Course title followed by (P) stands for practical course. A separate minimum of 30% marks each for internal and external assessments (for both theory and practical) and an aggregate minimum of 35% marks is required for a pass in each course. For a pass in a programme, a separate minimum of Grade D for all the individual courses and an overall Grade D or above are mandatory. If a candidate secures Grade F for any one of the courses offered in a Semester/Programme, only Grade F will be awarded for that Semester/Programme until the candidate improves this to Grade D or above within the permitted period.

PROGRAMME STRUCTURE

Semester I

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course I	4	3	100
3	Common Course II	4	4	100
4	Core Course	2	2	75
5	Core Course Practical	2	1	25
6	Complementary Course: Zoology	2	2	75
7	Complementary Course Practical: Zoology	2	Evaluation in Semester II	
8	Complementary Course: Chemistry	2	2	75
9	Complementary Course Practical: Chemistry	2	Evaluation in Semester II	
	Total	**25**	**18**	**550**

Semester II

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
2	Common Course I	4	3	100
3	Common Course II	4	4	100
4	Core Course	2	2	75
5	Core Course Practical	2	1	25
6	Complementary Course: Zoology	2	2	75
7	Complementary Course Practical: Zoology	2	2	50
8	Complementary Course: Chemistry	2	2	75
9	Complementary Course Practical: Chemistry	2	2	50
	Total	**25**	**22**	**650**

Semester III

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
3	Common Course II	5	4	100
4	Core Course	3	3	75
5	Core Course Practical	2	1	25
6	Complementary Course: Zoology	3	3	75
7	Complementary Course Practical: Zoology	2	Evaluation in Semester IV	
8	Complementary Course: Chemistry	3	3	75
9	Complementary Course Practical: Chemistry	**2**	Evaluation in Semester IV	
	Total	**25**	**18**	**450**

Semester IV

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Common Course I	5	4	100
3	Common Course II	5	4	100
4	Core Course	3	3	75
5	Core Course Practical	2	1	25
6	Complementary Course: Zoology	3	3	75
7	Complementary Course Practical: Zoology	2	2	50
8	Complementary Course: Chemistry	3	3	75
	Complementary Course Practical: Chemistry	2	2	50
	Total	**25**	**22**	**550**

Semester V

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Core Course	3	3	75
2	Core Course	3	3	75
3	Core Course	3	3	75
4	Core Course	3	3	75
5	Open Course	3	3	100
6	Core Course Practical	3	1	25
7	Core Course Practical	2	1	25
8	Core Course Practical	2	1	25
9	Core Course Practical	3	1	25
	Total	**25**	**19**	**500**

Semester VI

Sl. No.	Course	Hours/ Week	Credit	Marks
1	Core Course	3	3	75
2	Core Course	3	3	75
3	Core Course	3	3	75
4	Core Course	3	3	75
5	Elective Course	4	4	100
6	Core Course Practical	3	1	25
7	Core Course Practical	2	1	25
8	Core Course Practical	2	1	25
9	Core Course Practical	2	1	25
10	Project	-	1	100
	Total	**25**	**21**	**600**
	Grand Total			**3300**

OUTLINE OF CORE COURSES FOR BSc BOTANY PROGRAMME

Course Code	Course Title	Hours/ Week	Total Hours	Credits	ISA	ESA	Total
Semester I							
BBBO101	Introductory Botany and Angiosperm Morphology	2	36	2	15	60	75
BBBO1P01	Introductory Botany and Angiosperm Morphology (P)	2	36	1	5	20	25
Semester II							
BBBO202	Plant Anatomy, Microtechniques and Embryology	2	36	2	15	60	75
BBBO2P02	Plant Anatomy, Microtechniques and Embryology (P)	2	36	1	5	20	25
Semester III							
BBBO303	Microbiology, Mycology and Plant Pathology	3	54	3	15	60	75
BBBO3P03	Microbiology, Mycology and Plant Pathology (P)	2	36	1	5	20	25
Semester IV							
BBBO404	Phycology and Bryology	3	54	3	15	60	75
BBBO4P04	Phycology and Bryology (P)	2	36	1	5	20	25
Semester V							
BBBO505	Pteridology, Gymnosperms and Paleobotany	3	54	3	15	60	75
BBBO506	Ecology, Environmental Science and Human Rights	3	54	3	15	60	75
BBBO507	Research Methodology, Biophysics and Biostatistics	3	54	3	15	60	75
BBBO508	Angiosperm Taxonomy and Economic Botany	3	54	3	15	60	75
BBBO5P05	Pteridology and Gymnosperms and Paleobotany (P)	3	54	1	5	20	25
BBBO5P06	Ecology, Environmental Science and Human rights (P)	2	36	1	5	20	25
BBBO5P07	Research Methodology, Biophysics and Biostatistics (P)	2	36	1	5	20	25
BBBO5P08	Angiosperm Taxonomy and Economic Botany (P)	3	54	1	5	20	25
Semester VI							
BBBO609	Plant Physiology and Biochemistry	3	54	3	15	60	75
BBBO610	Cytology, Molecular Biology and Biological Evolution	3	54	3	15	60	75
BBBO611	Plant Biotechnology and Bioinformatics	3	54	3	15	60	75

BBBO612	Genetics, Plant Breeding and Horticulture	3	54	3	15	60	75
BBBO6P09	Plant Physiology and Biochemistry (P)	3	54	1	5	20	25
BBBO6P10	Cytology, Molecular Biology and Biological Evolution (P)	2	36	1	5	20	25
BBBO6P11	Plant Biotechnology and Bioinformatics (P)	2	36	1	5	20	25
BBBO6P12	Genetics, Plant Breeding and Horticulture (P)	2	36	1	5	20	25
BBBO6PJ	Project			1	20	80	100

OUTLINE OF CORE COURSES FOR BSc BOTANY & BIOTECHNOLOGY PROGRAMME

Course Code	Course Title	Hours/ Week	Total Hours	Credits	ISA	ESA	Total
Semester I							
BBBO1B01	Introductory Botany and Angiosperm Morphology	2	36	2	15	60	75
BBBO1B02	Plant Anatomy, Microtechniques and Embryology	2	36	2	15	60	75
BBBO1PB01	Introductory Botany and Angiosperm Morphology (P)	2	36	1	5	20	25
BBBO1PB02	Plant Anatomy, Microtechniques and Embryology (P)	2	36	1	5	20	25
Semester II							
BBBO2B03	Plant Diversity, Conservation and Applied Botany	2	36	2	15	60	75
BBBO2PB03	Plant Diversity, Conservation and Applied Botany (P)	2	36	1	5	20	25
Semester III							
BBBO3B04	Plant Physiology and Biochemistry	3	54	3	15	60	75
BBBO3B05	Phycology and Bryology	3	54	3	15	60	75
BBBO3PB04	Plant Physiology and Biochemistry (P)	2	54	1	5	20	25
BBBO3PB05	Phycology and Bryology (P)	2	36	1	5	20	25
Semester IV							
BBBO4B06	Evolution, Plant Breeding and Horticulture	3	54	3	15	60	75
BBBO4B07	Microbiology, Mycology and Plant Pathology	3	54	3	15	60	75
BBBO4PB06	Evolution, Plant Breeding and Horticulture (P)	2	36	1	5	20	25
BBBO4PB07	Microbiology, Mycology and Plant Pathology (P)	2	36	1	5	20	25
Semester V							
BBBO5B08	Angiosperm Taxonomy and Economic Botany	3	54	3	15	60	75
BBBO5B09	Ecology, Environmental Science and Human rights	3	54	3	15	60	75
BBBO5B10	Pteridology, Gymnosperms and Paleobotany	3	54	3	15	60	75
BBBO5PB08	Angiosperm Taxonomy and Economic Botany (P)	3	54	1	5	20	25

BBBO5PB09	Ecology, Environmental Science and Human Rights (P)	2	36	1	5	20	25
BBBO5PB10	Pteridology and Gymnosperms and Paleobotany (P)	3	54	1	5	20	25
Semester VI							
BBBO6B11	Research Methodology, Biophysics and Biostatistics	3	54	3	15	60	75
BBBO6PB11	Research Methodology, Biophysics and Biostatistics (P)	2	36	1	5	20	25

ELECTIVE COURSES

Course Code	Course Title	Hours/ Week	Total Hours	Credits	ISA	ESA	Total
BBBO6E01	Plant Diversity, Conservation and Applied Botany	4	72	4	20	80	100
BBBO6E02	Phytochemistry and Pharmacognosy	4	72	4	20	80	100

COMPLEMENTARY COURSES

Course Code	Course Title	Hours/ Week	Total Hours	Credits	ISA	ESA	Total
Semester I							
BDBO101	Cryptogams and Gymnosperms	2	36	2	15	60	75
BDBO1P01	Cryptogams and Gymnosperms (P)	2	36	1	5	20	25
Semester II							
BDBO202	Plant Physiology	2	36	2	15	60	75
BDBO2P02	Plant Physiology (P)	2	36	1	5	20	25
Semester III							
BDBO303	Angiosperm Morphology, Taxonomy and Economic Botany	3	54	3	15	60	75
BDBO3P03	Angiosperm Morphology and Taxonomy (P)	2	36	1	5	20	25
Semester IV							
BDBO404	Plant Anatomy and Applied Botany	3	54	3	15	60	75
BDBO4P04	Plant Anatomy and Applied Botany (P)	2	36	1	5	20	25

OPEN COURSE

Course Code	Course Title	Hours/ Week	Total Hours	Credits	ISA	ESA	Total
BOBO501	Agribusiness	3	54	3	20	80	100

ADD ON COURSE

Course Code	Course Title	Total Hours	Credits	ISA	ESA	Total
BBOEX01	Plant Tissue Culture	36	2	40	-	40

SEMESTER I

BBBO101: INTRODUCTORY BOTANY AND ANGIOSPERM MORPHOLOGY

Total Hours: 36

Credit: 2

Course Objectives:-

- Introducing the students to the fascinating realms of Botany
- To provide basic knowledge of the diversity of morphological forms of various plant organs

Course Outcome:-

- Students will be able to identify the major groups plants
- Students will be able to compare and contrast the characteristics of different groups of plants that differentiate them from each other
- Students will be able to identify the modified forms of plant organs and their specific adaptive objective

Module 1 – Introduction to Botany (12 hours)

Definition of science and Botany –History of Botany (brief study only)

Indian Botanist and their contributions: J.C Bose, Birbal Sahni, M.O.P. Iyengar, Itty Achudan Vaidyan, S.R. Kashyap, P. Maheshwari, Janaki Ammal; scope of Botany, opportunities in Botany; Compound and dissection microscope, Haemocytometer, micrometry

Module 2 – Classification (4 hours)

Classification; purpose and significance, two kingdoms, five kingdoms. Approaches in plant classification; artificial, natural, phyletic naming; polynomial to binomial

Module 3 – Introduction to Plant diversity (5hours)

Salient features of plants, Adaption in land plants against that of an aquatic plant. Plant distribution; endemism and cosmopolitan. Definitions and salient features of algae, fungi, bryophyte, pteridophyta, gymnosperms, and angiosperms (major distinguishable features only no need of explanation of each features).

Module 4 - Plant habit and Morphology of Vegetative Parts (5hours)

Diverse Plant habits; herbs, shrubs, trees, twiners, climbers, lianas Morphology of vegetative

parts; Leaf – compound and simple; leaf modifications; stem modifications, root modifications (at least one examples and binomial). Importance of leaf, stem and root modification in human diets (brief description only)

Module 5 – Inflorescences (5 hours)

Racemose types-simple raceme, corymb, umbel, spike, catkin, spadix, head; Cymose types-simple cyme, monochasial cyme -scorpoid and helicoid, dichasialcyme, Special type-cyathium, hypanthodium, verticillaster, thyrsus, coenanthium, Panicle.

Module 6 – Fruits (5 hours)

Different types of fruits belonging to Simple, fleshy, dry dehiscent, indehiscent, aggregate, multiple categories with examples. Different types of fruit as food- staple food, vegetable, fruit and medicine.

References

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5. Harold C Bold, (1999) The Plant Kingdom. Prentice Hall of India Pvt. Ltd.
6. Harrison H J (1971) New Concepts in Flowering Plant Taxonomy. Heiman Educational Books Ltd.
7. Holmes D Moody P and D. Dine (2006) Research Methods for the Biosciences Oxford University Press
8. Jeffrey A. Lee (2009) The Scientific Endeavor Methodology and Perspectives of sciences, Pearson
9. Radford A E (1986) Fundamentals of Plant Systematics. Harper & Row Publ.

PRACTICAL

BBBO1P01: INTRODUCTORY BOTANY AND ANGIOSPERM MORPHOLOGY

Total Hours: 36

Credit: 1

1. Compare the adaptations in land plants, against that of an aquatic plant
2. Identify the inflorescence and fruit mentioned in the syllabus.
3. Identify the stem, root and leaf modifications mentioned in the syllabus.
4. Study the diagnostic features of algae, fungi, bryophyte, Pteridophyta, gymnosperms and angiosperms
5. Measure the size of any microscopic organism or structure or spores or pollen grains using micrometry
6. Count the number of any microscopic organism or spores or pollen grains using Haemocytometer.
7. Conduct a field trip of minimum 1 day in Kerala to vegetation or Botanical garden or Research institute. Write an illustrated report of the work in 750 words
8. Prepare a biographical sketch of great botanists (at least two botanists) with special emphasis on the scientific methodology involved in their experiments and submit for evaluation.

SEMESTER II

BBBO202: PLANT ANATOMY, MICROTECHNIQUES AND EMBRYOLOGY

Total Hours: 36

Credit: 2

Course Objectives:-

- Introducing the basic plant architecture
- To provide basic knowledge of the development of plant embryos
- Introducing the techniques used in anatomical studies of plants

Course Outcome:-

- Students will be able to identify the major tissues in plants
- Students will be able to appreciate the perfection in the sexual reproduction of plants
- Students will be able apply the different techniques learned to study the anatomy of plants

Plant Anatomy and Microtechniques

Module 1 – Microtechniques (9 hours)

Preservation of plant specimens: Killing and fixing, important fixatives-FAA, Carnoy's fluid, Slide preparation: whole mounts, squashes, smears, maceration. Sectioning: hand sections, serial section; Microtome- rotary, sledge (application only). Staining techniques: Single and double staining; Safranin,Haematoxylin, Acetocarmine, Fast Green. Mounting; important mountants- Glycerine, DPX.

Module 2 – Plant cell and tissues (5 hours)

The plant cell wall, gross structure , primary and secondary cell walls, channels of intercellular transport; pits , plasmodesmata. Non-living inclusions in plant cells: foodproducts, secretory products, excretory (waste) products –nitrogenous and nonnitrogenous.

Tissues- simple, complex, composition of xylem and phloem, meristematic tissue, types. Tissue Systems; Epidermal tissue -epidermis, cuticle, trichome, stomata, hydathodes, bulliform cells, cork and silica cells. Ground Tissue - cortex, endodermis, pericycle, pith and pith rays. Vascular Tissue - different types of vascular bundles and their arrangement in root and stem.

Module 3 – Structure and Organisation of Root and Shoot Apices (2 hours)

Histogen theory, Tunica-Corpus theory and Korper- Kappe theory

Module 4 – Plant Body and Secondary Growth (5hours)

Primary structure of stem, root and leaf (dicot and monocot). Cambium; Development, structure and function, Normal secondary growth in dicot stem and root; stelar and extrastelar, periderm, bark, polyderm, rhytidome and lenticels. Anomalous secondary growth in Bougainvillea stem, Bignonia stem and Dracaena stem.

Module 5 –Wood Anatomy (3 hours)

Wood; basic structure, heart wood, sap wood, hard wood, soft wood, tyloses, growth rings and dendrochronology, porous and non-porous wood, ring porous and diffuse porous wood, wood rays; structure and cell types, uniseriate and multiseriate rays; heterocellular and homocellular rays. Wood anatomy in wood identification

Angiosperm Reproductive Botany

Module 6 – Microsporogenesis (3hours)

Anther; structure, different types, pollinium, development, dehiscence. Development of male gametophyte, pollen germination and viability.

Module 7 – Megasporogenesis (3hours)

Structure and development of ovule, placentaion types, Structure of matureembryo sac.- monosporic (polygonum type), bisporic (Allium type) and tetrasporic (Peperomiatype).

Module 8 – Pollination and fertilization (3hours)

Pollination, mechanisms and agencies, natural Mechanisms to prevent self- pollination- herkogamy, heterostyly, protrandry and protogyny, Special types of pollination mechanism, Fertilisation; syngamy, triplefusion.

Module 9 –Embryo development (3hours)

Development of endosperm, Types cellular, nuclear and helobial endosperms. Structure of embryo in dicots and monocots, polyembryony and apomixes- apogamy and apospory, parthenocarpy. Development and general structure of fruits (dry and fleshy) and seed (pea and paddy)

References

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2. Foaster A.S. and Giffad E.M. (1962) Comparative Morphology of Vascular Plants. Allied Pacific Pvt. Ltd. Bombay.

3. Gray (1964) Handbook of Basic Microtechnique. McGraw Hill co.
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5. Krishnamurthy K V (1987) Methods in Plant Histochemistry. S Viswanathan printers, Anand book depot, Madras.
6. Maheshwari P. (1971) An introduction to the Embryology of Angiosperms. Tata McGraw- Hill Publishing Company Ltd., New Delhi.
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10. Shivanna K.R. and B.M. Joshi (1985) The Angiosperm Pollen Structure & Function. Wiley Eastern Ltd., New Delhi.
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PRACTICAL

BBBO2P02: PLANT ANATOMY, MICROTECHNIQUES AND EMBRYOLOGY

Total Hours: 36

Credit: 1

1. Cell types and tissues
2. Non-living inclusions – starch grains, cystolith, raphides, aleuronegrains.
3. Anther (Monothecous and Dithecous), embryo sac , embryo and Placentation types
4. Primary structure of stem, root and leaf-Dicots and Monocots.
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. Pollen germination study
9. Field work for a minimum of 1 day under the guidance of a teacher

SEMESTER III

BBBO303: MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY

Total Hours: 54

Credit: 3

Course Objectives:-

- Introducing the characteristics of microbes and fungi
- To provide basic knowledge of the diversity of plant pathogens

Course Outcome:-

- Students will be able to identify the major groups bacteria and fungi
- Students will be able to compare and contrast the characteristics of different groups of fungi that differentiate them from each other
- Students will be able to identify the major fungal plant pathogens in their locality

Microbiology

Module 1 - Introduction to Microbiology (4 hours)

History of microbiology-Theory of spontaneous generation, Germ theory of diseases. Brief classification and general characters of microbes: - bacteria, archaea, protozoa, viruses. Introduction to microbial classification (Bacteria and Virus) - Taxonomic ranks, Characters used; Three domain system and Bergey's Manual.

Module 2 - Structure of Prokaryotic Cell (4 hours)

Structures external to cell wall: Cell wall: composition, structure, function, cell wall and Gram staining mechanism, Flagella: structure of flagella, different types of arrangements of flagella, Fimbriae and pili. Structures internal to cell wall: Plasma membrane, composition, structure and function Spheroplast, cytoplasm, ribosome, nucleoid, plasmid, inclusions, endospores.

Variation in cell structure: Archaea and Eubacteria

Module 3 - Genetic Material in Bacteria (4 hours)

Genetic material in bacteria. Bacterial chromosome. Extrachromosomal genetic elements, plasmid, mechanism of genetic recombination – transformation, transduction and conjugation. Reproduction by binary fission

Module 4 - Virology (3 hours)

Characteristics of viruses, size range, host range. Classification of viruses, Structure of viruses: general morphology, nucleic acids, capsid and envelope, Ultra structure of TMV and T4 bacteriophage.

Module 5 - Applied Microbiology (3 hours)

Brief study on the most common bacterial and viral diseases in Humans,

Economic Importance of microbes in Food (baking, brewing and food spoilage), medicine (production of antibiotics), Industry, Agriculture (role in N2 fixation, as biofertilizers or PGPR) and mineral cycling.

Mycology and Lichenology

Module 6 – General Introduction (5 hours)

Introduction to fungi, structure, basic life cycle patterns, evolutionary trends, Classification based on Ainsworth (1973).Economic importance of Fungi–useful and harmful aspects, Fungi of Agricultural importance mycoherbicides, myconematicides, mycoparasites; Mycorrhiza – diversity, functionand significance.

Module 7 - Detailed Type Study (16 hours)

Distinguishing characters of different classes of fungi (as per Ainsworth) with special reference to reproductive structures and life history of the following genera

a. Myxomycotina – General Characters Mastigomycotina – *Albugo* Zygomycotina - *Rhizopus*
b. Ascomycotina
   Hemiascomycetes -*Saccharomyces* Plectomycetes -*Pencillium* Ascomycetes -*Peziza* Pyrenomycetes –*Xylaria*
c. Basidiomycotina
   Teliomycetes - *Puccinia*
   Hymenomycetes -*Agaricus*
d. Deuteromycotina –*Cercospora*

Module 8 - Lichenology (6 hours)

Lichenology- General account, crustose, foliose and fruticose lichens, economic and ecological importance of lichen, thallus structure, reproduction and life cycle of *Parmelia and Usnea*

Plant Pathology

Module 9 - General Introduction (2 hours)

History of plant pathology, Classification of plant diseases on the basis of causative organism; fungi, bacteria, virus, insect pest; symptoms and dissemination of diseases.

Module 10 - Control of Plant Diseases (2 hours)

Physical, chemical and biological control. Bordeaux mixture preparation.

Module 11 - Detailed Study of Plant Diseases (5 hours)

Study of following diseases with emphasis on causative organism, symptoms, and control. Bunchy top of Banana, leaf mosaic of tapioca, root wilt of Coconut, abnormal leaf fall of Rubber, quick wilt of pepper, leaf roller of rice, Pseudostem borer of banana.

References

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17. Singh, Pande Jain (2007), Diversity of Microbes and Cryptogam, Rastogi

Publications.

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PRACTICAL

BBBO3P03: MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY

Total Hours: 36

Credit: 1

Mycology (18 hours)

1. Detailed study of the thallus anatomy and morphology of reproductive structures of the fungal and lichen genera mentioned in the syllabus
2. Staining of VAM
3. Familiarizing the slide culture technique of fungus.

Microbiology (12 hours)

1. Gram staining technique
2. Isolation of microbes from soil through serial dilution and streak plate method.
3. Prepare a bacterial colony from human hand (demonstration only)

Plant Pathology (6 hours)

1. Identify the diseases mentioned in the syllabus with respect to causative organisms and symptoms
2. Prepare an illustrated report on the prevalence of the diseases and pest in your locality.
3. Preparation of Bordeaux mixture (demonstration only)
4. Familiarize with the various kinds of biocontrol agents

SEMESTER IV

BBBO404: PHYCOLOGY AND BRYOLOGY

Total Hours: 54

Credit: 3

Course Objectives:-

- Introducing the characteristics of algae and bryophytes
- To provide basic knowledge of the lifecycle patterns exhibited by algae and bryophytes

Course Outcome:-

- Students will be able to identify the major groups algae and bryophytes
- Students will be able to compare and contrast the characteristics of different groups of algae and bryophytes
- Students will be able to identify the algae and bryophytes in their locality

Phycology

Module 1 – Introduction (7 hours)

General characters – habitat, habit, pigmentation, reproduction and life cycles of algae. Classification by Fritsch F. E.

Module 2 - Detailed Type Study **(**20 hours)

General characters of the following major classes with special reference to the systematic position, habitat, thallus structure, reserve food, reproduction (excluding developmental stages) and life cycle of the following types:- Cyanophyceae: *Nostoc*; *Oscillatoria*, Chlorophyceae: *Chlamydomonas*, *Chlorella*, *Volvox*, *Oedogonium*, *Cladophora*,*Scenedesmus*,*Chara*; Xanthophyceae: *Vaucheria* Bacillariophyceae: *Pinnularia*; Phaeophyceae: *Sargassum;* Rhodophyceae: *Polysiphonia*

Module 3 - Economical and Ecological Significance **(**6 hours)

Algae as pollution indicator and in waste water treatment; Algae as primary producers – Oxygen liberators; Algae in soil fertility, cyanobacteria and nitrogen fixation, soil algae; Toxic algae – Algal blooms and red tides; Role of algae in aquaculture; Commercial products and their applications: Agar, Alginates, Diatomaceous earth; Algae as a source of fuel - Hydrogen.

Module 4 - Experimental Phycology (3 hours)

Recent trends in Algal research; Diatoms and Nanotechnology; Cyanobacteria as a source of

restriction endonuclease; Algal culture: scope and methods; Indian contribution to algal research.

Bryology

Module 5 – Introduction (5 hours)

General characters – habitat, habit, reproduction, and life cycle of Bryophytes; alternation of generation. Classification; Kasyap and Smith and evolution of sporophyte and gametophyte in Bryophytes. Indian contribution in bryology

Module 6 – Detailed Type Study (10 hours)

General characters of the following major groups with special reference to the systematic position, occurrence, structure (morphology and anatomy), reproduction -vegetative, asexual, and sexual (excluding developmental stages) and life cycle of the following types: Hepaticopsida: *Riccia*, *Marchantia*; Anthocerotopsida: *Anthoceros*; Bryopsida: *Funaria*.

Module 7 - Ecological and Economical Importance (3 hours)

Bryophytes as ecological indicators, role in plant succession, prevention of soil erosion, water retention, Economic importance of Bryophytes: Antibiotics, Horticultural importance.

References

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3. Mamatha Rao, 2009, *Microbes and Non flowering plants- impact and application.* Ane Boopks PvtLtd.
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7. Smith GM Cryptogamic Botany vol.1
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PRACTICAL

BBBO4P04: PHYCOLOGY AND BRYOLOGY

Total Hours: 36

Credit: 1

Phycology (24 hours)

1. Detailed study of the thallus anatomy of the algal genera mentioned in the syllabus
2. Detailed study of the morphology and anatomy of reproductive structures of the algal genera mentioned in the syllabus
3. Collect and submit any five genera of algae mentioned in the syllabus
4. Familiarize with algal culture

Bryology (12 hours)

5. Detailed study of the thallus morphology and anatomy of the genera mentioned in the syllabus.
6. Detailed study of the Reproductive structures of the genera mentioned in the syllabus.

SEMESTER V

BBBO505: PTERIDOLOGY, GYMNOSPERMS AND PALEOBOTANY

Total Hours: 54

Credit: 3

Course Objectives:-

- Introducing the characteristics of Pteridophytes and Gymnosperms
- To provide basic knowledge of the lifecycle patterns exhibited by Pteridophytes and Gymnosperms

Course Outcome:-

- Students will be able to identify the major Pteridophytes and Gymnosperms
- Students will be able to compare and contrast the characteristics of different groups of Pteridophytes and Gymnosperms
- Students will be able to identify the Pteridophytes and Gymnosperms in their locality

Pteridophytes (27 hours)

Module 1 - General Characters of Pteridophytes (4 hours)

General characters of Pteridophytes, basic life cycle patterns in pteridophytes; life cycles of homosporous and heterosporus pteridophytes, vascular tissues in Pteridophytes, stelar types and their evolution, Classification of Pteridophytes by Smith

Module 2 – Detailed Type Study (19 hours)

Structural organization of sporophyte and gametophyte (development of sex organs not necessary) of *Psilotum , Lycopodium , Selaginella , Equisetum , Pteris , Marsilea*

Module 3 – General topics (4 hours)

Heterospory and seed habit, Economic importance of Pteridophytes, ecological importance of Pteridophytes

Gymnosperms (18 hours)

Module 4 - General characters of Gymnosperms (4 hours)

General characters, Classification (Sporne's system)

Module 5 – Detailed Type Study (10 hours)

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

Module 6 – General Topics (4 hours)

Affinities of Gymnosperms, Economic importance of Gymnosperms

Palaeobotany (9 hours)

Module7 - Introduction (5 hours)

Study of geological time scale, formation of fossil, fossil types & technique of study, fossil as a fuel. Indian contribution to Palaeobotany: Birbal Sahni Institute of Palaeobotany

Module 8 - Fossil Type Study (4 hours)

Detailed study of Fossil Pteridophyte: Rhynia Fossil Gymnosperm: Williamsonia Fossil Angiosperm: Palmoxylon

References

1. Bhatnagar S P & Moitra A., (2003) Gymnosperms, New Age International (P)Ltd., New Delhi.
2. Coutler J.M & Chamberlain C. J (1958) Morphology of Gymnosperms. Central Book Depot Allahabad.
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PRACTICAL

BBBO5P05: PTERIDOLOGY, GYMNOSPERMS AND PALEOBOTANY

Total Hours: 54

Credit: 1

Pteridophytes (27 hours)

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

Gymnosperms and Paleobotany (27 hours)

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

BBBO506: ECOLOGY, ENVIRONMENTAL SCIENCE AND HUMAN RIGHTS

Total Hours: 54

Credit: 3

Course Objectives:-

- To provide basic knowledge of the significance of ecological balance and significance of environmental science
- To enable the students to explore the interactions of life forms at cellular and molecular level
- To inspire the students to apply the acquired knowledge to create a better environment

Course Outcome:-

- Students will be able to identify the major ecosystems and the components of different types of ecosystems
- Students will be able to compare and contrast the characteristics of different types of ecosystems
- Students will be able identify the major causes of environmental problems
- Students will be able to explicate the ecological interconnectedness of life on earth.

Module 1 - General Introduction (2 hours)

Relevance and scope of ecology, Ecology and Environmental Science, Interdisciplinary nature of environmental science, Types of resources-Renewable and non-renewable, Sustainable development and ecological footprints.

Module 2 - Ecosystems: Structure and Function (8 hours)

Ecosystem components- abiotic and biotic**,** Energy flow: Ecological energetics, trophic levels, food chain and food web and ecological pyramids. Productivity – primary, secondary and net productivity

Nutrient cycles: Biogeochemical cycles of C, N and S. Habitat, ecological niche and microclimate.

Module 3 - Population and Community Ecology (8 hours)

Population characteristics, population growth, Metapopulations, Ecotypes and Ecads, Biotic interactions – positive and negative,

Community characteristics: Quantitative (eg. frequency, density and abundance), Qualitative (eg. physiognomy and phenology), Synthetic (eg. dominance), ecotone and edge effect.

Ecological succession: types of succession, process of succession. Hydrosere and xerosere.

Adaptation of plants to environment: Xerophytes, Hydrophytes, epiphytes and halophytes.

Module 4 - Environmental Issues (18 hours)

Global and local environmental issues: global warming and climate change (use case studies to illustrate the points);ozone depletion; greenhouse effect; acid rain; carbon trading, carbon credit; carbon sequestration; IPCC/UNFCC; nuclear accidents and nuclear holocaust, sand mining; wetland reclamation; landscape changes; deforestation; soil erosion. Flood and drought, desertification, overexploitation, threats to fresh water resources of Kerala; tourism and its impact on environment.

Pollution: air pollution; water pollution; soil pollution; noise pollution; pesticide pollution, solid waste management: causes, effects and control measures of urban and industrial waste-biodegradable and non-degradable

Disaster management : introduction to hazards; hazards classification; natural and anthropogenic, disaster management - earthquakes; cyclone; tsunami; floods; landslides; droughts

Module 5 - Human Rights (18 hours)

National and International Perspectives: Definitions of Human Right, Relevance of Human Rights in India-Social Aspects-Economic Aspects-Political Aspects, Human Rights International Norms, UDHR-Civil and political rights- Economic, social and cultural rights-Rights against torture, Discrimination and forced labour-Rights of the child, Human Rights and duties in India- Preamble to the Indian constitution-Human Rights and Duties in Indian constitution

Deprivation of Human Rights-The core issues: Poverty-Overpopulation- Illiteracy-Unsustainable Development, Disadvantageous Groups (Women, Children, SC/ST, Homeless and slum dwellers, physically and mentally handicapped, refugees and internally displaced persons.

Redressal Mechanisms against Human Rights Violation: Judiciary - Government systems for Redressal - NHRC and other Statutory Commissions- Media advocacy-Creation of Human Rights Literacy and Awareness

References

1. Chapman JL, Reiss MJ (2005) Ecology: Principles and Applications. Cambridge University Press.
2. Elton C S (1958) The Ecology of Invasion by Plants and Animals. Methuem, London.

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6. Krishnamurthy K V (2004) An Advanced Textbook on Biodiversity: Principles and practice. Oxford and IBH. Publ. Co.
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PRACTICAL

BBBO5P06: ECOLOGY, ENVIRONMENTAL SCIENCE AND HUMAN RIGHTS

Total Hours: 36

Credit: 1

Ecology and Environmental Studies

1. Estimation of CO_2, Dissolved O_2 and total alkalinity of water samples (Titrimetry)
2. Determination of pH of soil and water
3. Assessment of diversity, abundance, and frequency of plant species by quadrate method (Grasslands, forests)
4. EIA studies in degraded areas (Sampling – line transect, Quadrate)
5. Visit to any forests types including grasslands and preparation of the list of Rare and threatened (R&T) plants (no collection of specimens) OR Visit to any ecotourism centre in Kerala and prepare a report on the project.
6. Collection, identification and preparation of the list of exotic species in the locality.
7. Study of anatomical, morphological, physiological adaptation of plants to the environment (Xerophytic, Hydrophytic, Epiphytic and Halophytic)

BBBO507: RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

Total Hours: 54

Credit: 3

Course Objectives:-

- To make the students acquainted with the method of research and design of experiments
- To introduce the tools and techniques required for research in life science

Course Outcome:-

- Students will be familiar with the principles of scientific research
- Students will become familiar with the tools and techniques used in research

Module 1 - Basic Concepts of Research (11 hours)

Research-Meaning, purpose of research and Qualities of a good research; Types of research - Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical; Research process – An over view of the process of research - identification of problem, literature survey, identification of variables, formation of hypothesis, experiment and collection of data, analysis and interpretation of data, testing of hypothesis.

Report writing - Components of research thesis. Bibliographic management software: Mendely; Research ethics, plagiarism, plagiarism checking softwares

Module 2 - General Laboratory Practices (2 hours)

Basic rules of laboratory and fieldwork, biosafety regulations and biosafety levels

Module 3 - Imaging and Related Techniques (12 hours)

Principles of microscopy; Fluorescence microscopy; Electron microscopy; Use of fluorochromes: Applications of fluorescence microscopy; Transmission and Scanning electron microscopy – sample preparation for electron microscopy.

Module 4 - Principle and Application (5 hours)

Centrifuge, pH meter, Colorimeter, UV-Vis spectrometer.

Module 5 – Chromatography (3 hours)

Principle and application: Paper chromatography; Column chromatography, TLC, HPLC.

Module 6 - Information Technology (3 hours)

MS word, MS Excel and MS PowerPoint and their applications in research field

Module 7 - Biostatistics (18 hours)

Data, population, samples, Variable, Quantitative Variable: Discrete and Continuous

Variable, Qualitative Variable; Sampling- concept of sample, sampling methods - random and non-random sampling; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi- square test for goodness of fit. Application of statistics in research

References

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9. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995) Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.

PRACTICAL

BBBO5P07: RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

Total Hours: 36

Credit: 1

1. Collect numerical data and find out the central tendencies and prepare different types of graph mentioned in the syllabus
2. Determination of the concentration of a given solution of $CuSO_4$ using colorimetry
3. Paper chromatography of plant pigments
4. Measurement of pH using pH meter
5. Familiarize with biosafety levels

BBBO508: ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY

Total Hours: 54

Credit: 3

Course Objectives:-

- To make the students acquainted with the plant taxonomy
- To make the students informed about plant wealth of our state

Course Outcome:-

- Students will be familiar with rules and tools of plant taxonomy
- Students will be equipped with the skill of plant identification and documentation
- Students will become aware of the status of plant diversity in the state

Taxonomy (45 hours)

Module 1 – Different Taxonomic Approaches (4 hours)

Objectives of taxonomy, research scope and opportunities in taxonomy, .Types of Classification- Linnean sexual system (Brief account), Bentham and Hooker (Detailed account), APG system (Brief account), Binomial Nomenclature, Interdisciplinary approach in Taxonomy; Cytotaxonomy, Chemotaxonomy, Molecular taxonomy, Numerical taxonomy.

Module 2 – Herbarium (3 hours)

Herbarium technique- Preparation of herbarium, preservation, Acronymn, ICBN, Botanical, gardens and BSI (Brief account)

Module 3 - Angiosperm Plant Body – Reproductive Parts (2 hours)

Flower – flower as a modified shoot, whorls of flower – calyx, corolla, androecium, Gynoecium; symmetry of flower- actinomprphic, zygomorphic.

Module 4 – Detailed Study of Angiosperm Families (36 hours)

Study of the following families of Bentham and Hooker's System with special reference to their morphological and floral characters. Special attention shall be given to common and economically important plants within the families.

Annonaceae, Nymphaeaceae, Capparidaceae, Malvaceae, Rutaceae, Anacardiaceae, Leguminosae (Mimosaceae, Caesalpiniaceae and Fabaceae), Combretaceae, Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Compositae (Asteraceae), Sapotaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Convolvulaceae, Acanthaceae, Verbenaceae, Lamiaceae (Labiatae), Amaranthaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Arecaceae, Graminae (Poaceae)

Economic Botany

Module 1 – Economic Botany (6 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,

Cereals- Rice, Wheat, Maize

Millets- Ragi

Pulses- Green gram, Bengal gram, Black gram

Fruits- Apple, Pineapple, Grape, Mango and Banana

Vegetables- Bittergourd, Snake gourd, Ash gourd, Ladies finger, Carrot and Cabbage.

Sugar- Sugar cane, Sugar beet

Timber yielding plants- Teak wood and Jack wood, Rose wood

Beverages- Tea, Coffee

Oil yielding plants- Ground nut, Gingelly

Rubber yielding plants- Para rubber

Gums and Resins- White damer, Gum Arabic, Asafoetida **Spices** – Cardamom, cloves, ginger, star anise, nutmeg, pepper

Insecticide yielding Plants- Tobacco and Neem

Module 2 – Ethanobotany (3 hours)

Ethnobotany and its significance. Methodology of ethnobotanical studies, Study of the following plants used in daily life by tribals and village folks for Food, Shelter and Medicine

Food-*Artocarpus, Corypha*

Shelter - *Bamboosa, Ochlandra and Calamus*

Medicine – *Scoparia dulcis, Aegle marmalose, Saraca ashoka, Coleus umbonicus*

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PRACTICAL

BBBO5P08: ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY

Total Hours: 54

Credit: 1

1. Preparation of floral formula from floral description.
2. Identify the member plants belonging to the families mentioned in the syllabus
3. 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.
4. Study the finished products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
5. Prepare herbarium of 25 plants with field notes.
6. Conduct field work for 5 days under the guidance of a teacher

SEMESTER VI

BBBO609: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Total Hours: 54

Credit: 3

Course Objectives:-

- To introduce the basics of Plant physiology and biochemistry
- To make the students acquainted with the biochemical principles of life

Course Outcome:-

- Students will be familiar with the history and advance of ideas in plant physiology and biochemistry
- Students will understand life at the biochemical level
- Students will be able to appreciate the uniformity in the biochemistry in various forms of life

Plant Physiology (36 hours)

Module 1 - Water Relation of Plants (5 hours)

Physical aspects of absorption-Diffusion, imbibition, osmosis, OP, DPD, TP, WP, Concept of Water potential, Permeability and its importance. Absorption of water- active and passive, pathway of water movement, symplast, apoplast, transmembrane pathways Ascent of sap, cohesion and adhesion, Transpiration- types, mechanism, theories- (starch-sugar, H^+-K^+ion exchange), significance, anti- transpirants, guttation.

Module 2 - Mineral Nutrition and Absorption (3 hours)

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

Module 3 - Photosynthesis and Photorespiration (9 hours)

Structure of chloroplast - Photosynthetic pigments, antenna complexes and reaction centre, details of electromagnetic spectrum, photo excitation and energy transfer, conversion of light energy to chemical energy, Fluorescence, Phosphorescence - absorption and action spectra, red drop and Emerson effect, concept of two photosystems, Cyclic and Non Cyclic photophosphorylation (Z- scheme), Carbon assimilation pathways-C3, C4, CAM. Photorespiration, significance, factors affecting photosynthesis.

Module 4 - Translocation of Organic Solutes (2 hours)

Direction of translocation, mechanism of translocation - pressure flow, Munch hypothesis and protoplasmic streaming theory, role of p proteins, phloem loading and unloading.

Module 5 – Respiration (6 hours)

Structure of mitochondria, aerobic respiration- Glycolysis, Krebs cycle, Electron transport system & Oxidative phosphorylation, ATPases - chemi osmotic theory, anaerobic respiration-Fermentation, RQ and its significance, respiratory inhibitors, factors affecting respiration.

Module 6 - Nitrogen Metabolism (2 hours)

Assimilation of nitrate by plants, biological nitrogen fixation, ammonification, nitrification and denitrification.

Module 7 - Physiology of Growth and Development (4 hours)

Phases and measurement of growth, physiological effects and practical application of plant growth substances and hormones: Auxins, gibberellins, cytokinins, abscisic acid, ethylene. Seed dormancy and germination: Seed dormancy, causes of seed dormancy, dormancy breaking methods, Seed germination- types, factors affecting seed germination.

Module 8: Physiology of Flowering and Plant Movements (3 hours)

Phytochrome mediated flowering, photoperiodism, vernalisation. Plant movements- classification, movements of curvature and movements of variation (paratonic and nastic movements)

Module 9 - Stress Physiology and Plant Responses to Environment (2 hours)

Abiotic- plant responses to water, temperature and salt stresses. Biotic- pathogens and insects, Allelochemicals and herbivory

Biochemistry (18 hours)

Module 10 - Water, Solutions and pH (3 hours)

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

Module 11 - Chemistry of Biomolecules (10 hours)

Carbohydrates- structure of common monosaccharaides, disaccharides and poly- saccharides seen in plants.

Proteins –Basic structure of amino acids, Essential and non-essential amino acids; peptide bond formation; primary, secondary, tertiary and quaternary structure of proteins.

Lipids - general features and biological role - fatty acid types and structure - fatty acid

derivatives- fats and oils, structure and functions - compound lipids

Module 12 – Enzymes (5 hours)

Classification, nomenclature, concepts of holoenzyme, apoenzyme, coenzyme and Cofactors; Mechanism of action, Regulation of enzyme activity, enzyme kinetics, factors affecting enzyme action.

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PRACTICAL

BBBO6P09: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Total Hours: 54

Credit: 1

Plant Physiology Practical (27 hours) Core Experiments

1. Determination of osmotic pressure of plant cell sap by weight lose method.
2. Measurement of transpiration rate using Ganong'spotometer/Farmer's potometer.
3. Separation of leaf pigments by thin layer chromatography/paper chromatography.
4. Measure the effect of environmental conditions on photosynthetic rate using Willmott's bubbler or any suitable method.
5. Estimation of plant pigments by colorimeter.

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_2 in phytosynthesis.
5. Simple respiroscope
6. Respirometer and measurement of R.Q.
7. Fermentation- Kuhne's tube

Biochemistry – Practical. (27 hours)

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

BBBO610: CYTOLOGY, MOLECULAR BIOLOGY AND BIOLOGICAL EVOLUTION

Total Hours: 54

Credit: 3

Course Objectives:-

- To introduce the basics of cell biology, molecular biology and evolutiuon
- To make the students acquainted with the components of living systems at the cellular and sub-cellular levels
- To enable the students to explore the intricacies of life forms at the level of cells
- **Course Outcome:-**
- Students will be familiar with the history and advance of ideas in cell biology and molecular biology
- Students will be able to appreciate the architecture of life at the cellular level
- Students will be able appreciate the process of evolution

Cytology (18 hours)

Module 1 - Cell architecture and Membrane Structure (4 hours)

Cell Architecture: prokaryotic and eukaryotic cells. Biomembrane structure: The Phospholipid Bilayer: Composition and structural Organization. Movement of molecules across the membrane- pumps and channels (brief study only)

Module 2 - Cell Structure (4 hours)

The detailed structure of plant cell. Structure and function of the following organelles- nucleus, endoplasmic reticulum, Chloroplast, mitochondria, dictyosome, vacuole. Differences between animal cell and plant cell. Cytoskeleton: components and functions (brief study only)

Module 3 – Cell Cycle and Cell Division (4 hours)

Overview of the Cell Cycle and its Control, Details of mitosis and meiosis

Module 5 – Chromosomes (4 hours)

Morphology - fine structure Nucleosome model , karyotype and idiogram; Special type of chromosomes - salivary gland, Lamp brush and B chromosome ; Change in number of chromosomes -Aneuploidy and Euploidy, Down’s, Klinefelter’s and Turner’s syndromes, Change in the structure of chromosomes , deletion, duplication, inversions and translocations.

Module 6 - Stem Cells (2 hours)

Stem cells; definition, sources and applications

Molecular Biology (27 hours)

Module 7 - Genetic Material (3 hours)

Introduction to heredity and the genetic material, characteristics of genetic material, Early studies on DNA [works of F. Miescher, Albert Kossel, Phoebus Levene, Erwin Chargaff], The discovery of transforming principle [Griffith's experiment], Identification of the transforming principle[Avery, MacLeod and McCarty's experiment]; [Hershey and Chase experiment], Watson and Crick's discovery of the structure of DNA

Module 8 - Structure of DNA (5 hours)

The structure of DNA, Primary structure; structure of ribose and deoxyribose sugars, Structure of N bases, structure of nucleosides and nucleotides, phosphodiester bond and structure of a polynucleotides, Secondary Structure; structure of DNA double helix, different secondary structures [A, B and Z] , circular DNA

Module 9 - DNA Replication and DNA Repair (6 hours)

Suspected forms of DNA replication, conservative, dispersive and semi- conservative, Meselson and Stahl's experiment, Requirements for replication; template, raw materials, enzymes and other proteins, direction of replication, mechanism of replication, Bacterial DNA replications, eukaryotic DNA replication. DNA repair, mismatch repair, direct repair, base-excision repair, nucleotide excision repair, photoreactivation, SOS response

Module 10 – **Transcription** (5 hours)

Concept of gene, Transcription, the structure of RNA, types of RNA, mRNA, tRNA, rRNA, snRNA, snoRNA, miRNA, requirements for transcription, the template and non-template strands of DNA, experiments by Julius Marmur, Promoters; bacterial and eukaryotic, RNA polymerase; bacterial and eukaryotic, the process of bacterial transcription, the process of eukaryotic transcription, RNA processing; addition of 5' cap and 3' polyA tail, split genes, exons, introns, RNA splicing.

Module 11 – **Translation** (5 hours)

Structure of tRNA, clover leaf and 'inverted L' models of tRNA, the genetic code, characteristics of the code, process of translation, polyribosomes, translation inhibitors

Module 12 – **Gene Regulation** (3hours)

Levels of gene regulation, gene regulation in bacterial cells; operon concept, negative and positive control, inducible and repressible operons, *lac* operon of *E.coli*, *trp* operon of *E.coli*,

Gene regulations in eukaryotes; chromatin remodelling, histone acetylaltion, DNA methylation, alternative splicing of mRNA, RNA silencing, epigenetics

Biological Evolution (9 hours)

Module 13 – Concept of Evolution (2 hours)

Nature's war -the evolution of the concept of evolution from de Candollee, Malthus Darwin and Wallace, Hooker

Module 14 – Theories of Evolution and Origin of Life on Earth (5 hours)

Theories of evolution Lamarck, Charles Darwin, Hugo De Vries

Origin of life on earth, Oparins hypothesis and Miller's exp. from molecules to life; origin of cells and the first organisms, geological time scale

Module 15 – Forces of Evolution (2 hours)

Mutation, migration, selection and genetic drift; Evolution of species, populations reproductive and geographic isolation and mechanisms

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BBBO6P10: CYTOLOGY, MOLECULAR BIOLOGY AND BIOLOGICAL EVOLUTION

Total Hours: 36

Credit: 1

Cytology (18 hours)

1. Study of plant cell structure using Onion epidermal peel
2. Study of the different stages of mitosis using onion root tip squash
3. Study of the different stages of meiosis using permanent slides
4. Study of normal human karyotype and differentiating it with the karyotypes of Down's, Klinefelter's and Turner's syndromes

Molecular Biology (18 hours)

1. Work out problems based on DNA structure, replication, transcription and translation
2. Isolation of DNA from plant tissue

BBBO611: PLANT BIOTECHNOLOGY AND BIOINFORMATICS

Total Hours: 54

Credit: 3

Course Objectives:-

- To make the students acquainted with the basic concepts and tools in bioinformatics
- To make the students informed about the developments in plant biotechnology

Course Outcome:-

- Students will become informed about the recent researches going on in the fields of bioinformatics and plant biotechnology
- Students will be equipped to brainstorm about the ethical, legal and social issues associated with the developments in biotechnology

Biotechnology (36 hours)

Module 1 – History and Basic Concepts (3 hours)

Experiments of Gottlieb Haberlandt, P R White, Gautheret, Nobecourt, Skoog and Steward, Cellular totipotency, *in vitro* differentiation–de differentiation and re- differentiation

Module 2 – Tissue Culture Media (6 hours)

Basic components of tissue culture media, inorganic nutrients, carbon source, vitamins, organic supplements, chelating agents, plant hormones, gelling agents, adsorbents, pH of medium, general methodology of medium preparation with special reference to MS medium

Module 3 – Sterilization Techniques (6 hours)

Sterilization of equipments, glasswares, medium end explant. sterilization using hot air, steam, filter, UV, alcohol and chemicals . Working of hot air oven, autoclave and laminar air flow chamber, layout of a tissue culture lab

Module 4 – Micropropagation (11hours)

Micropropagation- different methods – axillary bud proliferation, meristem and shoot tip culture, direct and indirect organogenesis, somatic embryogenesis, subculturing, hardening, transplantation and field evaluation, advantages and disadvantages of micropropagation, somaclonal variation, production of haploids through tissue culture; androgenic methods, gynogenic methods, uses of haploids, cryopreservation of plant cells

Module 5 – Recombinant DNA Technology (10 hours)

Gene cloning strategies – recombinant DNA construction – cloning vectors – plasmids pBR322, bacteriophage based vectors, Ti plasmids. Restriction endonucleases and ligases – Ligation techniques, transformation and selection of transformants – using antibiotic resistances markers, PCR.

Bioinformatics (18 hours)

Module 1 – Bioinformatics Introduction (3 hours)

An Introduction to bioinformatics. Scope and relevance of bioinformatics. Elementary commands and Protocols, Formats: FASTA format, ASN.1 format, PDB flat file format

Module 2 - Biological Databases **(**8 hours)

Online databases and search tools, data organization, NCBI .Biological databases, structural databases, DNA and RNA sequence databases.

Nucleic acid sequence databases: Gene Bank, ENA, DDBJ Protein sequence databases: Gen Bank, SWISS-PROT Protein structure database: Protein Data Bank Bibliographic databases: PubMed

Module 3 - Alignment (4 hours)

Sequence comparison, Pair wise sequence alignment, Global alignment: Use of ALIGN, Local alignment: Use of BLAST.

Module 4 - Molecular Visualization Tools (3 hours)

Molecular structure viewers: RasMol, SWISS-PDB Viewer.

References

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PRACTICAL

BBBO6P11: PLANT BIOTECHNOLOGY AND BIOINFORMATICS

Total Hours: 36

Credit: 1

Plant Biotechnology (27 hours)

1. Preparation of nutrient medium – Murashige and Skoog medium
2. Establishing shoot tip, axillary bud cultures
3. Immobilization of whole cells or tissues in sodium alginate.
4. Determination of appropriate flower bud containing uninucleate pollen for anther culture using cytological techniques

Bioinformatics (9 hours)

1. Analysis of Nucleotide sequence using GENBANK
2. Analysis of structural features of proteins using protein data bank and RASMOL
3. BLAST - homology search

BBBO612: GENETICS, PLANT BREEDING AND HORTICULTURE

Total Hours: 54

Credit: 3

Course Objectives:-

- To introduce the concepts of genetics and basic techniques of plant breeding
- To provide basic knowledge f the principles of heredity
- To enable the students to explore the intricacies of life forms at the level of chromosomes and genes

Course Outcome:-

- Students will be able follow the symbols, notations and statistical tools used in classical genetics
- Students will become familiar with the patterns of inheritance of qualitative and quantitative traits
- Students will be able to use the basic knowledge in genetics in solving problems based on various patterns of inheritance
- Students will be able to perform simple breeding experiments using plants

Genetics (27 hours)

Module 1 – Mendelism and its Extension (5 hours)

Experiment of Mendel with *Pisum sativum*, recessive and dominant traits, alleles, principles of inheritance, incomplete dominance and codominance; Lethal alleles, Epistasis; dominant and recessive, multiple alleles; Pleiotropy, Polygenic inheritance, pedigree analysis, Chromosome theory of inheritance.

Module 2 – Linkage (6 hours)

Linkage, crossing over and chromosome mapping, Linkage and crossing over- Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Sex Linkage, eye color in Drosophila, Haemophilia in man

Module 3 - Extrachromosomal Inheritance (4 hours)

Extrachromosomal Inheritance**,** Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; Maternal effects -shell coiling in snail; Infective heredity-Kappa particles in Paramecium.

Module 4 – Sex Determination (4 hours)

Sex determination- sex chromosomes and autosomes- chromosomal basis of sex determination; XX-XY, XX-XO mechanism; sex determination in higher plants (*Melandrium album*)

Module 5 – Mutation (4 hours)

Mutations, definition, importance of mutation, types of mutations, gene mutations, types of gene mutations, causes of mutations; Mutagens- physical and chemical, spontaneous and induced mutations.

Module 6 – **Population Genetics** (4 hours)

Gene pool, gene frequency, genotype frequency, Hardy Weinberg law and its applications

Plant Breeding (18 hours)

Module 7 - History and Objectives (3 hours)

History and objectives of plant breeding. Centers of origin of cultivated plants. Plant introduction- procedure, quarantine regulations, acclimatization. Agencies of plant introduction in India. Achievements.

Module 8 – Selection (3 hours)

Selection- mass, pureline, clonal, achievements.

Module 9 – Hybridization (7 hours)

Hybridization: procedure- intergeneric, interspecific and intervarietal hybridization with examples. Composite and synthetic varieties. Heterosis in plant breeding, inbreeding depression; Single cross: pedigree method, bulk population method, multiple cross, back cross, polyploidy breeding, male sterility in plant breeding. Use of apomixis in plant breeding.

Module 10 – Mutation Breeding (2 hours)

Mutation breeding: methods of mutation breeding. Gamma gardens and its working.

Module 11 – Modern Trends (3 hours)

Modern trends in plant breeding; Somaclonal variations in crop improvement, genetically modified crops Breeding for Biotic (disease)and abiotic (drought) stress resistance

Horticulture (9 hours)

Module 12 – Basics of Horticulture (2 hours)

Scope and importance, Divisions of horticulture, Global scenario of horticultural crops, export and import, Horticulture Zones of India and Kerala, Horticultural developmental agencies in India

Module 13 – Plant Propagation and Introduction to Gardening (7 hours)

Propagationofhorticulturalplants-byseeds-advantagesanddisadvantagesof Seed propagation.

Vegetative propagation- natural and artificial vegetative propagation; methods- cutting,

layering, grafting and budding; stock scion union, advantages and disadvantages of vegetative propagation

Garden tools and implements, Irrigation methods- surface, sub, drip and spray irrigations, mist chambers- advantages and disadvantages. Ornamental gardens, indoor gardens, kitchen gardens- terrestrial and aquatic gardens.

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PRACTICAL

BBBO6P12: GENETICS, PLANT BREEDING AND HORTICULTURE

Total Hours: 36

Credit: 1

Genetics (18 hours)

1. Work out problems in:
    a. Monohybrid, dihybrid and backcrosses.
    b. All types of modified Mendelian ratios mentioned in the syllabus.
    c. Multiple alleles and their inheritance
    d. Sex linked inheritance
    e. Population genetics (Mendelian traits with typical dominant and recessive relations only)

Plant Breeding (9 hours)

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

Horticulture (9 hours)

1. Tongue grafting, budding (‘T’ and patch), air layering
2. Identification of different garden tools and their uses
3. List out the garden components in the photograph of the garden given

ELECTIVE COURSES

BBBO6E01: PLANT DIVERSITY, CONSERVATION AND APPLIED BOTANY

Total Hours: 72

Credit: 4

Module 1: Introduction to Plant Diversity (8 hours)

Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses ofmicrobes.

Module 2 Plants and Environment (5 hours)

Ecological complexes and factors affecting plants growth and response:

Climatic factors: temperature and pressure; water - precipitation, humidity, soil water holding capacity; light - global radiation.

Topographic factors: altitude and aspects

Edaphic factors - profile and physical and chemical properties of soil Biotic factors: interactions – positive and negative.

Species – ecosystem interaction: Habitat, ecological niche, microclimate

Module 3 - Biodiversity and Conservation of Resources (12 hours)

Biodiversity general introduction, Endemism: Definition, types, Hotspots in India, IUCN-threat categories, Red data book, Biodiversity loss: Causes and rate of biodiversity loss, extinction causes; habitat destruction, invasive species, over exploitation and pollution, Conservation efforts: In situ and ex situ conservation methods, National parks and wild life sanctuaries of Kerala. Social approaches to conservation: Joint Forest Management (JFM), Community reserves (Kadalundi vallkunnu Community reserves) Ecotourism.

Organizations associated with biodiversity management-IUCN, UNEP, UNESCO, WWF, NBPGR, TBGRI. Western Ghats – a brief study

Module 4 - Environmental Legislation and Laws: (1 hour)

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

Module 5 - Ecotourism (6 hours)

Definition, concept, introduction, history, relevance and scope. Components of ecotourism:

Forms and types of ecotourism in India and Kerala, ecotourism resources- biological, historical, cultural, and geographical. Ecotourism centers in Kerala. Positive and negative impacts of ecotourism.

Module 6: Role of Plants in Relation to Human Welfare (6 hours)

Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance.

Applied Botany

Module 7 - Floriculture, Gardening and Nursery Management (18 hours)

Introduction: Importance and scope of floriculture and landscape gardening.

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; Role of plant growth regulators.

Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Bonsai.

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

Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Diseases and Pests of Ornamental Plants.

Module 8 - Organic Farming and Biofertilizers (8 hours)

General account about the microbes used as biofertilizer – Trichoderma, Rhizobium, PGPR, Rhizobium, Cyanobacteria, Mycorrhizal association– colonization of VAM and its influence on growth and yield of crop plants.

Green manuring and organic fertilizers, Recycling of bio- degradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting –field Application. Biological control of disease and pests. Integrated pest management

Module 9 - Mushroom Culture Technology (8 hours)

Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous

mushrooms. Types of edible mushrooms available in India - Volvariella, Pleurotus, Agaricus bisporus.

Cultivation Technology: Oyster mushroom cultivation; Composting technology in mushroom production.

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1. Agrawal, P.K. (1993) Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
2. Bose T.K. & Mukherjee, D. (1972) Gardening in India, Oxford & IBH Publishing Co., New Delhi.
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16. Sandhu, M.K., (1989) Plant Propagation, Wiley Eastern Ltd., Bangalore, Madras.
17. 28. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
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20. Subha Rao, N.S. (2000) Soil Microbiology, Oxford & IBH Publishers, New Delhi.
21. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore -560018.
22. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
23. Vayas, S.C, Vayas, S. and Modi, H.A. (1998) Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

BBBO6E02: PHYTOCHEMISTRY AND PHARMACOGNOSY

Total Hours: 72

Credit: 4

Module 1 (8 hours)

Herbal medicines: history and scope; cultivation - harvesting - processing – storage - marketing and utilization of medicinal plants. Introduction to phytochemical approaches – morphological-organoleptic-microscopic- to study drug and aromatic plants

Module 2 (14 hours)

Analytical pharmacognosy and Phytochemistry: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)

Extraction and characterization techniques: Cold extraction- hot extraction— soxhlet-clevenger apparatus. Separation technique: TLC, Column, HPLC. Characterization technique: GC/MS, HPTLC, UV Spectra, IR Spectra.

Module 3 (11 hours)

Study of the drug plants and their active principles

a. Alkaloids – introduction, properties, occurrence, structure, classification, functions, and pharmacological uses.
b. Triterpenoids. Introduction, properties, occurrence, classification, functions and pharmacologicaluses.
c. Phenolics. Quinines- benzoquinones, napthoquinones, anthraquinone, and coumarins.

Module 4 (27 hours)

Study of the following plants with special reference to

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

Tinospora cordifolia, Aegle marmelos, Plumbago rosea, Adhatoda vasica, Withania somnifera, Achyranthes aspera, Asparagus racemosus, Kaempheria galanga, , Sida acuta, Carica papaya, Azadirachta indica, Glycirrhiza glabra, Phyllanthus neruri, Datura stramonium, , Hemidesmus indicus, Aloe vera, Tylophora indica, , Acorus calamus, Gmelina arborea, Premna Latifolia, Vitex nigundo, Eclipta alba

Module 5 (12 hours)

Study of the following aromatic plants – volatile oils and methods of extraction *Vetiveria*

zizanoides, Cinnamomum zeylanica, Sysygium aromaticum, Santalum album, Eucalyptus, Ocimum bacilicum, Rosa, Mentha piperita.

References

1. Agnes Arber,(1999) Herbal plants and Drugs Mangal Deep Publications.
2. Anne Green (2000) Principles of Ayurveda, Thomsons, London.
3. Ashutosh Kar (2006) Pharmacognosy and Pharmaco biotechnology, New Age International, NewDelhi
4. Atal.C.K. and Kapur, B.M. (1982) Cultivation and Utilization of Medicinal Plants.
5. Bhattacharjee S K (2003) Hand Book of Medicinal Plants, Pointer Publishers, Jaipur
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7. Dr.C.K.Kokate etal. (1999) Pharmacognosy, Nirali Prakashan.
8. Glossary of Indian Medicinal Plants with Active Principles Part I & II, 1980. CSIR, New Delhi.
9. Indian Medicinal Plants (5Vols) (1994) Arya Vaidya Sala Kottackal, Orient Longman New Delhi.
10. Irfan Ali Khan (2008) Medicinal and Aromatic plants of India, Ukaaz Publishers, Hyderabad
11. Jain S K (2004) A Manual of Ethnobotany, Scientific Publishers ,India
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13. Khory R N (1999) Materia Medica of India and their Therapeutics, Komal Prakashan, Delhi
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18. Upadhyaya R C (2008) The treatise on Aromatic plants, Anmol Publications, New Delhi

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20. Wallis T.E, (1997) Text Book of Pharmacognosy. CBS Publication & Distribution

Botany Core Courses for
Botany and Biotechnology Programme

SEMESTER I

BBBO1B01: INTRODUCTORY BOTANY AND ANGIOSPERM MORPHOLOGY

Total Hours: 36

Credit: 2

Course Objectives

- Introducing the students to the fascinating realms of Botany
- To provide basic knowledge of the diversity of morphological forms of various plant organs

Course Outcome

- Students will be able to identify the major groups plants
- Students will be able to compare and contrast the characteristics of different groups of plants that differentiate them from each other
- Students will be able to identify the modified forms of plant organs and their specific adaptive objective

Module 1 – Introduction to Botany (12 hours)

Definition of science and Botany –History of Botany (brief study only)

Indian Botanist and their contributions: J.C Bose, Birbal Sahni, M.O.P. Iyengar, Itty Achudan Vaidyan, S.R. Kashyap, P. Maheshwari, Janaki Ammal; scope of Botany, opportunities in Botany; Compound and dissection microscope, Haemocytometer, micrometry

Module 2 – Classification (4 hours)

Classification; purpose and significance, two kingdoms, five kingdoms. Approaches in plant classification; artificial, natural, phyletic naming; polynomial to binomial

Module 3 – Introduction to Plant diversity (5hours)

Salient features of plants, Adaption in land plants against that of an aquatic plant. Plant distribution; endemism and cosmopolitan. Definitions and salient features of algae, fungi, bryophyte, pteridophyta, gymnosperms, and angiosperms (major distinguishable features only no need of explanation of each features).

Module 4 - Plant habit and Morphology of Vegetative Parts (5 hours)

Diverse Plant habits; herbs, shrubs, trees, twiners, climbers, lianas Morphology of vegetative

parts; Leaf-compound and simple; leaf modifications; stem modifications, root modifications (at least one examples and binomial). Importance of leaf, stem and root modification in human diets (brief description only)

Module 5 – Inflorescences (5 hours)

Racemose types-simple raceme, corymb, umbel, spike, catkin, spadix, head; Cymose types-simple cyme, monochasial cyme -scorpoid and helicoid, dichasialcyme, Special type-cyathium, hypanthodium, verticillaster, thyrsus, coenanthium, Panicle.

Module 6 – Fruits (5 hours)

Different types of fruits belonging to Simple, fleshy, dry dehiscent, indehiscent, aggregate, multiple categories with examples. Different types of fruit as food- staple food, vegetable, fruit and medicine.

References

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2. Collins H.and T Pinch (1993) The Golem: What everyone should know about science, University Press, Cambridge.
3. Eames A.J. (1961) Morphology of Angiosperms Mc. Graw Hill, New York.
4. GW Stout, DJ Taylor, (2008) Biological Sciences. NPO Green, University Press, Cambridge.
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PRACTICAL

BBBO1PB01: INTRODUCTORY BOTANY AND ANGIOSPERM MORPHOLOGY

Total Hours: 36

Credit: 1

1. Compare the adaptations in land plants, against that of an aquatic plant
2. Identify the inflorescence and fruit mentioned in the syllabus.
3. Identify the stem, root and leaf modifications mentioned in the syllabus.
4. Study the diagnostic features of algae, fungi, bryophyte, Pteridophyta, gymnosperms and angiosperms
5. Measure the size of any microscopic organism or structure or spores or pollen grains using micrometry
6. Count the number of any microscopic organism or spores or pollen grains using Haemocytometer.
7. Conduct a field trip of minimum 1 day in Kerala to vegetation or Botanical garden or Research institute. Write an illustrated report of the work in 750 words
8. Prepare a biographical sketch of great botanists (at least two botanists) with special emphasis on the scientific methodology involved in their experiments and submit for evaluation.

BBBO1B02: PLANT ANATOMY, MICROTECHNIQUES AND EMBRYOLOGY

Total Hours: 36

Credit: 2

Course Objectives

- Introducing the basic plant architecture
- To provide basic knowledge of the development of plant embryos
- Introducing the techniques used in anatomical studies of plants

Course Outcome

- Students will be able to identify the major tissues in plants
- Students will be able to appreciate the perfection in the sexual reproduction of plants
- Students will be able apply the different techniques learned to study the anatomy of plants

Plant Anatomy and Microtechniques

Module 1 – Microtechniques (9 hours)

Preservation of plant specimens: Killing and fixing, important fixatives-FAA, Carnoy's fluid, Slide preparation: whole mounts, squashes, smears, maceration. Sectioning: hand sections, serial section; Microtome- rotary, sledge (application only). Staining techniques: Single and double staining; Safranin, Haematoxylin, Acetocarmine, Fast Green. Mounting; important mountants - Glycerine, DPX.

Module 2 – Plant Cell and Tissues (5 hours)

The plant cell wall, gross structure, primary and secondary cell walls, channels of intercellular transport; pits, plasmodesmata. Non-living inclusions in plant cells: food products, secretory products, excretory (waste) products –nitrogenous and nonnitrogenous.

Tissues- simple, complex, composition of xylem and phloem, meristematic tissue, types. Tissue Systems; Epidermal tissue -epidermis, cuticle, trichome, stomata, hydathodes, bulliform cells, cork and silica cells. Ground Tissue - cortex, endodermis, pericycle, pith and pith rays. Vascular Tissue - different types of vascular bundles and their arrangement in root and stem.

Module 3 – Structure and Organisation of Root and Shoot Apices (2 hours)

Histogen theory, Tunica-Corpus theory and Korper- Kappe theory

Module 4 – Plant Body and Secondary Growth (5 hours)

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

structure and function, Normal secondary growth in dicot stem and root; stelar and extrastelar, periderm, bark, polyderm, rhytidome and lenticels. Anomalous secondary growth in Bougainvillea stem, Bignonia stem and Dracaena stem.

Module 5 – Wood Anatomy (3 hours)

Wood; basic structure, heart wood, sap wood, hard wood, soft wood, tyloses, growth rings and dendrochronology, porous and non-porous wood, ring porous and diffuse porous wood, wood rays; structure and cell types, uniseriate and multiseriate rays; heterocellular and homocellular rays. Wood anatomy in wood identification

Angiosperm Reproductive Botany

Module 6 – Microsporogenesis (3 hours)

Anther; structure, different types, pollinium, development, dehiscence. Development of male gametophyte, pollen germination and viability.

Module 7 – Megasporogenesis (3 hours)

Structure and development of ovule, placentaion types, Structure of matureembryo sac.- monosporic (polygonum type), bisporic (Allium type) and tetrasporic (Peperomiatype).

Module 8 – Pollination and fertilization (3 hours)

Pollination, mechanisms and agencies, natural Mechanisms to prevent self- pollination- herkogamy, heterostyly, protrandry and protogyny, Special types of pollination mechanism, Fertilisation; syngamy, triplefusion.

Module 9 –Embryo development (3 hours)

Development of endosperm, Types cellular, nuclear and helobial endosperms. Structure of embryo in dicots and monocots, polyembryony and apomixes- apogamy and apospory, parthenocarpy. Development and general structure of fruits (dry and fleshy) and seed (pea and paddy)

References

1. Fahn A. (1982). Plant Anatomy (3rd edition) Pergamon Press Oxford.
2. Foaster A.S. and Giffad E.M. (1962) Comparative Morphology of Vascular Plants. Allied Pacific Pvt. Ltd. Bombay.
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PRACTICAL

BBBO1PB02: PLANT ANATOMY, MICROTECHNIQUES AND EMBRYOLOGY

Total Hours: 36

Credit: 1

1. Cell types and tissues
2. Non-living inclusions – starch grains, cystolith, raphides, aleuronegrains.
3. Anther (Monothecous and Dithecous), embryo sac , embryo and Placentation types
4. Primary structure of stem, root and leaf-Dicots and Monocots.
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. Pollen germination study
9. Field work for a minimum of 1 day under the guidance of a teacher

SEMESTER II

BBBO2B03: PLANT DIVERSITY, CONSERVATION AND APPLIED BOTANY

Total Hours: 36

Credits: 2

Module 1 - Introduction to Plant Diversity (3 hours)

Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.

Module 2 - Plants and Environment (7 hours)

Ecological complexes and factors affecting plants growth and response:

Climatic factors: temperature and pressure; water - precipitation, humidity, soil water holding capacity; light - global radiation.

Topographic factors: altitude and aspects

Edaphic factors - profile and physical and chemical properties of soil Biotic factors:

interactions – positive and negative.

Species – ecosystem interaction: Habitat, ecological niche, microclimate

Module 3 - Biodiversity and Conservation of Resources (10 hours)

Biodiversity general introduction, Endemism: Definition, types, Hotspots in India, IUCN-threat categories, Red data book, Biodiversity loss: Causes and rate of biodiversity loss, extinction causes; habitat destruction, invasive species, over exploitation and pollution, Conservation efforts: In situ and ex situ conservation methods, National parks and wild life sanctuaries of Kerala. Social approaches to conservation: Joint Forest Management (JFM), Community reserves (Kadalundi vallkunnu Community reserves) Ecotourism.

Organizations associated with biodiversity management-IUCN, UNEP, UNESCO, WWF, NBPGR, TBGRI. Western Ghats – a brief study

Module 4 - Environmental Legislation and Laws (1 hour)

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

Module 5 – Ecotourism (3 hours)

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

Module 6 - Role of Plants in relation to Human Welfare (3 hours)

Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance.

Applied Botany (9 hours)

Module 7 - Organic Farming and Biofertilizers (5 hours)

General account about the microbes used as biofertilizer – Trichoderma, Rhizobium, PGPR, Rhizobium, Cyanobacteria, Mycorrhizal association– colonization of VAM and its influence on growth and yield of crop plants.

Green manuring and organic fertilizers, Recycling of bio- degradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application. Biological control of disease and pests. Integrated pest management

Module 8 - Mushroom Culture Technology (4 hours)

Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - Volvariella, Pleurotus, *Agaricus bisporus*. Cultivation Technology: Oyster mushroom cultivation; Composting technology in mushroom production.

References

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23. Vayas, S.C, Vayas, S. and Modi, H.A. (1998) Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

PRACTICAL

BBBO2PB03: PLANT DIVERSITY, CONSERVATION AND APPLIED BOTANY

Total Hours: 36

Credits: 1

1. Investigating the effect of minerals on plant growth using any weed collected from ponds, or algal cultures
2. Study the biodiversity of an ecosystem using Bean Biodiversity method.
3. Familiarize Biofertilizers
4. Demonstrate Mushroom cultivation
5. Calculate soil water holding capacity
6. Study of chemical properties of soil such as pH/Electric conductivity/ Organic Carbon/available nitrogen/ phosphorous
7. Familiarize with biotic factors

SEMESTER III

BBBO3B04: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Total Hours: 54

Credit: 3

Course Objectives:-

- To introduce the basics of Plant physiology and biochemistry
- To make the students acquainted with the biochemical principles of life

Course Outcome:-

- Students will be familiar with the history and advance of ideas in plant physiology and biochemistry
- Students will understand life at the biochemical level
- Students will be able to appreciate the uniformity in the biochemistry in various forms of life

Plant Physiology (36 hours)

Module 1 - Water Relation of Plants (5 hours)

Physical aspects of absorption-Diffusion, imbibition, osmosis, OP, DPD, TP, WP, Concept of Water potential, Permeability and its importance. Absorption of water- active and passive, pathway of water movement, symplast, apoplast, transmembrane pathways Ascent of sap, cohesion and adhesion, Transpiration- types, mechanism, theories- (starch-sugar, H^+-K^+ion exchange), significance, anti- transpirants, guttation.

Module 2 - Mineral Nutrition and Absorption (3 hours)

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

Module 3 - Photosynthesis and Photorespiration (9 hours)

Structure of chloroplast - Photosynthetic pigments, antenna complexes and reaction centre, details of electromagnetic spectrum, photo excitation and energy transfer, conversion of light energy to chemical energy, Fluorescence, Phosphorescence - absorption and action spectra, red drop and Emerson effect, concept of two photosystems, Cyclic and Non Cyclic photophosphorylation (Z- scheme), Carbon assimilation pathways-C3, C4, CAM. Photorespiration, significance, factors affecting photosynthesis.

Module 4 - Translocation of Organic Solutes (2 hours)

Direction of translocation, mechanism of translocation - pressure flow, Munch hypothesis and protoplasmic streaming theory, role of p proteins, phloem loading and unloading.

Module 5 – Respiration (6 hours)

Structure of mitochondria, aerobic respiration- Glycolysis, Krebs cycle, Electron transport system & Oxidative phosphorylation, ATPases - chemi osmotic theory, anaerobic respiration-Fermentation, RQ and its significance, respiratory inhibitors, factors affecting respiration.

Module 6 - Nitrogen Metabolism (2 hours)

Assimilation of nitrate by plants, biological nitrogen fixation, ammonification, nitrification and denitrification.

Module 7 - Physiology of Growth and Development (4 hours)

Phases and measurement of growth, physiological effects and practical application of plant growth substances and hormones: Auxins, gibberellins, cytokinins, abscisic acid, ethylene. Seed dormancy and germination: Seed dormancy, causes of seed dormancy, dormancy breaking methods, Seed germination- types, factors affecting seed germination.

Module 8: Physiology of Flowering and Plant Movements (3 hours)

Phytochrome mediated flowering, photoperiodism, vernalisation. Plant movements- classification, movements of curvature and movements of variation (paratonic and nastic movements)

Module 9 - Stress Physiology and Plant Responses to Environment (2 hours)

Abiotic- plant responses to water, temperature and salt stresses. Biotic- pathogens and insects, Allelochemicals and herbivory

Biochemistry (18 hours)

Module 10 - Water, Solutions and pH (3 hours)

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

Module 11 - Chemistry of Biomolecules (10 hours)

Carbohydrates- structure of common monosaccharaides, disaccharides and poly- saccharides seen in plants.

Proteins –Basic structure of amino acids, Essential and non-essential amino acids; peptide bond formation; primary, secondary, tertiary and quaternary structure of proteins.

Lipids - general features and biological role - fatty acid types and structure - fatty acid

derivatives- fats and oils, structure and functions - compound lipids

Module 12 – Enzymes (5 hours)

Classification, nomenclature, concepts of holoenzyme, apoenzyme, coenzyme and Cofactors; Mechanism of action, Regulation of enzyme activity, enzyme kinetics, factors affecting enzyme action.

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PRACTICAL

BBBO3PB04: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Total Hours: 36

Credit: 1

Plant Physiology Practical (18 hours) Core Experiments

1. Determination of osmotic pressure of plant cell sap by weight lose method.
2. Measurement of transpiration rate using Ganong's potometer/Farmer's potometer.
3. Separation of leaf pigments by thin layer chromatography/paper chromatography.
4. Measure the effect of environmental conditions on photosynthetic rate using Willmott's bubbler or any suitable method.
5. Estimation of plant pigments by colorimeter.

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_2 in phytosynthesis.
5. Simple respiroscope
6. Respirometer and measurement of R.Q.
7. Fermentation- Kuhne'stube

Biochemistry – Practical. (18 hours)

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

BBBO3B05: PHYCOLOGY AND BRYOLOGY

Total Hours: 54

Credit: 3

Course Objectives

- Introducing the characteristics of algae and bryophytes
- To provide basic knowledge of the lifecycle patterns exhibited by algae and bryophytes

Course Outcome

- Students will be able to identify the major groups algae and bryophytes
- Students will be able to compare and contrast the characteristics of different groups of algae and bryophytes
- Students will be able to identify the algae and bryophytes in their locality

Phycology

Module 1 – Introduction (7 hours)

General characters – habitat, habit, pigmentation, reproduction and life cycles of algae. Classification by Fritsch F. E.

Module 2 - Detailed Type Study **(**20 hours)

General characters of the following major classes with special reference to the systematic position, habitat, thallus structure, reserve food, reproduction (excluding developmental stages) and life cycle of the following types:- Cyanophyceae: *Nostoc*; *Oscillatoria*, Chlorophyceae: *Chlamydomonas*, *Chlorella*, *Volvox*, *Oedogonium*, *Cladophora*, *Scenedesmus*, *Chara*; Xanthophyceae: *Vaucheria* Bacillariophyceae: *Pinnularia*; Phaeophyceae: *Sargassum;* Rhodophyceae: *Polysiphonia*

Module 3 - Economical and Ecological Significance **(**6 hours)

Algae as pollution indicator and in waste water treatment; Algae as primary producers – Oxygen liberators; Algae in soil fertility, cyanobacteria and nitrogen fixation, soil algae; Toxic algae – Algal blooms and red tides; Role of algae in aquaculture; Commercial products and their applications: Agar, Alginates, Diatomaceous earth; Algae as a source of fuel - Hydrogen.

Module 4 - Experimental Phycology (3 hours)

Recent trends in Algal research; Diatoms and Nanotechnology; Cyanobacteria as a source of restriction endonuclease; Algal culture: scope and methods; Indian contribution to algal research.

Bryology

Module 5 – Introduction (5 hours)

General characters – habitat, habit, reproduction, and life cycle of Bryophytes; alternation of generation. Classification; Kasyap and Smith and evolution of sporophyte and gametophyte in Bryophytes. Indian contribution in bryology

Module 6 – Detailed Type Study (10 hours)

General characters of the following major groups with special reference to the systematic position, occurrence, structure (morphology and anatomy), reproduction -vegetative, asexual, and sexual (excluding developmental stages) and life cycle of the following types: Hepaticopsida: *Riccia*, *Marchantia*; Anthocerotopsida: *Anthoceros*; Bryopsida: *Funaria*.

Module 7 - Ecological and Economical Importance (3 hours)

Bryophytes as ecological indicators, role in plant succession, prevention of soil erosion, water retention, Economic importance of Bryophytes: Antibiotics, Horticultural importance.

References

1. Bilgrama K. S & Saha L. C. 1996. *Text Book of Algae*, C B S Publishers & Distributors.
2. Fritsch F E. 1945. *Structure and Reproduction of Algae*. Vol.1: Cambridge University Press, London.
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10. Vasishta B R, Sinha A.K, Singh V.P. 2004. *Botany for Degree Students- Algae*, S. Chand & Co. Ltd. New Delhi.

PRACTICAL

BBBO3PB05: PHYCOLOGY AND BRYOLOGY

Total Hours: 36

Credit: 1

Phycology (24 hours)

1. Detailed study of the thallus anatomy of the algal genera mentioned in the syllabus
2. Detailed study of the morphology and anatomy of reproductive structures of the algal genera mentioned in the syllabus
3. Collect and submit any five genera of algae mentioned in the syllabus
4. Familiarize with algal culture

Bryology (12 hours)

1. Detailed study of the thallus morphology and anatomy of the genera mentioned in the syllabus.
2. Detailed study of the Reproductive structures of the genera mentioned in the syllabus.

SEMESTER IV

BBBO4B06: EVOLUTION, PLANT BREEDING AND HORTICULTURE

Total Hours: 54

Credit: 3

Plant Breeding (28 hours)

Module 1 - History and Objectives (5 hours)

History and objectives of plant breeding. Centers of origin of cultivated plants. Plant introduction- procedure, quarantine regulations, acclimatization. Agencies of plant introduction in India. Achievements.

Module 2 – Selection (7 hours)

Selection- mass, pureline, clonal, achievements.

Module 3 – Hybridization (10 hours)

Hybridization: procedure- intergeneric, interspecific and intervarietal hybridization with examples. Composite and synthetic varieties. Heterosis in plant breeding, inbreeding depression; Single cross: pedigree method, bulk population method, multiple cross, back cross, polyploidy breeding, male sterility in plant breeding. Use of apomixis in plant breeding.

Module 4– Mutation Breeding (3 hour)

Mutation breeding: methods of mutation breeding. Gamma gardens and its working.

Module 5 – Modern Trends (3 hour)

Modern trends in plant breeding; Somaclonal variations in crop improvement, genetically modified crops Breeding for Biotic (disease)and abiotic (drought) stress resistance

Horticulture (12 hours)

Module 6 – Basics of Horticulture (2 hours)

Scope and importance, Divisions of horticulture, Global scenario of horticultural crops, export and import, Horticulture Zones of India and Kerala, Horticultural developmental agencies in India

Module 7 – Plant Propagation and Introduction to Gardening (10 hours)

Propagation of horticultural plants- by seeds- advantages and disadvantages of seed propagation.

Vegetative propagation- natural and artificial vegetative propagation; methods- cutting,

layering, grafting and budding; stock scion union, advantages and disadvantages of vegetative propagation

Garden tools and implements, Irrigation methods- surface, sub, drip and spray irrigations, mist chambers- advantages and disadvantages. Ornamental gardens, indoor gardens, kitchen gardens- terrestrial and aquatic gardens.

Evolution (14 hours)

Module 8 – Concept of Evolution (2 hours)

Nature's war -the evolution of the concept of evolution from de Candollee, Malthus Darwin and Wallace, Hooker

Module 9 – Theories of Evolution and Origin of Life on Earth (7 hours)

Theories of evolution Lamarck, Charles Darwin, Hugo De Vries

Origin of life on earth, Operins hypothesis and Miller's exp. from molecules to life; origin of cells and the first organisms, geological time scale

Module 10 – Forces of Evolution (5 hours)

Mutation, migration, selection and genetic drift; Evolution of species, populations reproductive and geographic isolation and mechanisms

References

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PRACTICAL

BBBO4PB06: EVOLUTION, PLANT BREEDING AND HORTICULTURE

Total Hours: 36

Credit: 1

Plant breeding and Horticulture

1. Emasculation and bagging
2. Comparison of percentage of seed germination and the effect of any one
3. chemical on the rate of elongation of radicle in any three crop seeds
4. Tongue grafting, budding ('T' and patch), air layering
5. Identification of different garden tools and their uses
6. List out the garden components in the photograph of the garden given
7. Preparation of potting mixture in the given proportion

BBBO4B07: MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY

Total Hours: 54

Credit: 3

Course Objectives

- Introducing the characteristics of microbes and fungi
- To provide basic knowledge of the diversity of plant pathogens

Course Outcome

- Students will be able to identify the major groups bacteria and fungi
- Students will be able to compare and contrast the characteristics of different groups of fungi that differentiate them from each other
- Students will be able to identify the major fungal plant pathogens in their locality

Microbiology

Module 1 - Introduction to Microbiology (4 hours)

History of microbiology-Theory of spontaneous generation, Germ theory of diseases. Brief classification and general characters of microbes: - bacteria, archaea, protozoa, viruses. Introduction to microbial classification (Bacteria and Virus) - Taxonomic ranks, Characters used; Three domain system and Bergey's Manual.

Module 2 - Structure of Prokaryotic Cell (4 hours)

Structures external to cell wall: Cell wall: composition, structure, function, cell wall and Gram staining mechanism, Flagella: structure of flagella, different types of arrangements of flagella, Fimbriae and pili. Structures internal to cell wall: Plasma membrane, composition, structure and function Spheroplast, cytoplasm, ribosome, nucleoid, plasmid, inclusions, endospores.

Variation in cell structure: Archaea and Eubacteria

Module 3 - Genetic Material in Bacteria (4 hours)

Genetic material in bacteria. Bacterial chromosome. Extrachromosomal genetic elements, plasmid, mechanism of genetic recombination – transformation, transduction and conjugation. Reproduction by binary fission

Module 4 - Virology (3 hours)

Characteristics of viruses, size range, host range. Classification of viruses, Structure of viruses: general morphology, nucleic acids, capsid and envelope, Ultra structure of TMV and T4 bacteriophage.

Module 5 - Applied Microbiology (3 hours)

Brief study on the most common bacterial and viral diseases in Humans,

Economic Importance of microbes in Food (baking, brewing and food spoilage), medicine (production of antibiotics), Industry, Agriculture (role in N2 fixation, as biofertilizers or PGPR) and mineral cycling.

Mycology and Lichenology

Module 6 – General Introduction (5 hours)

Introduction to fungi, structure, basic life cycle patterns, evolutionary trends, Classification based on Ainsworth (1973).Economic importance of Fungi–useful and harmful aspects, Fungi of Agricultural importance mycoherbicides, myconematicides, mycoparasites; Mycorrhiza – diversity, functionand significance.

Module 7 - Detailed Type Study (16 hours)

Distinguishing characters of different classes of fungi (as per Ainsworth) with special reference to reproductive structures and life history of the following genera

a) Myxomycotina – General Characters Mastigomycotina – Albugo Zygomycotina - Rhizopus
   Ascomycotina
b) Hemiascomycetes -Saccharomyces Plectomycetes -Pencillium Ascomycetes -Peziza Pyrenomycetes –Xylaria
   Basidiomycotina
c) Teliomycetes - Puccinia
   Hymenomycetes -Agaricus
d) Deuteromycotina –*Cercospora*

Module 8 - Lichenology (6 hours)

Lichenology- General account, crustose, foliose and fruticose lichens, economic and ecological importance of lichen, thallus structure, reproduction and life cycle of *Parmelia and Usnea*

Plant Pathology

Module 9 - General Introduction (2 hours)

History of plant pathology, Classification of plant diseases on the basis of causative organism; fungi, bacteria, virus, insect pest; symptoms and dissemination of diseases.

Module 10 - Control of Plant Diseases (2 hours)

Physical, chemical and biological control. Bordeaux mixture preparation.

Module 11 - Detailed Study of Plant Diseases (5 hours)

Study of following diseases with emphasis on causative organism, symptoms, and control. Bunchy top of Banana, leaf mosaic of tapioca, root wilt of Coconut, abnormal leaf fall of Rubber, quick wilt of pepper, leaf roller of rice, Pseudostem borer of banana.

References

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2. Ahamadjian Vernon and Hale M.E (eds) (1973) The Lichens, Academic press, New Delhi.
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15. Michael J Pelczar et al. (2000) TATA McGraw Hill
16. Sharma P.D (2004) , The Fungi , 2nd Edition , Rasthogi publication
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PRACTICAL

BBBO4PB07: MICROBIOLOGY, MYCOLOGY AND PLANT PATHOLOGY

Total Hours: 36

Credit: 1

Mycology (18 hours)

1. Detailed study of the thallus anatomy and morphology of reproductive structures of the fungal and lichen genera mentioned in the syllabus
2. Staining of VAM
3. Familiarizing the slide culture technique of fungus.

Microbiology (12 hours)

1. Gram staining technique
2. Isolation of microbes from soil through serial dilution and streak plate method.
3. Prepare a bacterial colony from human hand (demonstration only)

Plant Pathology (6 hours)

1. Identify the diseases mentioned in the syllabus with respect to causative organisms and symptoms
2. Prepare an illustrated report on the prevalence of the diseases and pest in your locality.
3. Preparation of Bordeaux mixture (demonstration only)
4. Familiarize with the various kinds of biocontrol agents

SEMESTER V

BBBO5B08: ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY

Total Hours: 54

Credit: 3

Course Objectives

- To make the students acquainted with the plant taxonomy
- To make the students informed about plant wealth of our state

Course Outcome

- Students will be familiar with rules and tools of plant taxonomy
- Students will be equipped with the skill of plant identification and documentation
- Students will become aware of the status of plant diversity in the state

Taxonomy (45 hours)

Module 1 – Different Taxonomic Approaches (4 hours)

Objectives of taxonomy, research scope and opportunities in taxonomy, .Types of Classification- Linnean sexual system (Brief account), Bentham and Hooker (Detailed account), APG system (Brief account), Binomial Nomenclature, Interdisciplinary approach in Taxonomy; Cytotaxonomy, Chemotaxonomy, Molecular taxonomy, Numerical taxonomy.

Module 2 – Herbarium (3 hours)

Herbarium technique- Preparation of herbarium, preservation, Acronymn, ICBN, Botanical, gardens and BSI (Brief account)

Module 3 - Angiosperm Plant Body – Reproductive Parts (2 hours)

Flower – flower as a modified shoot, whorls of flower – calyx, corolla, androecium, Gynoecium; symmetry of flower- actinomprphic, zygomorphic.

Module 3 – Detailed Study of Angiosperm Families (36 hours)

Study of the following families of Bentham and Hooker's System with special reference to their morphological and floral characters. Special attention shall be given to common and economically important plants within the families.

Annonaceae, Nymphaeaceae, Capparidaceae, Malvaceae, Rutaceae, Anacardiaceae, Leguminosae (Mimosaceae, Caesalpiniaceae and Fabaceae), Combretaceae, Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Compositae (Asteraceae), Sapotaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Convolvulaceae, Acanthaceae, Verbenaceae, Lamiaceae

(Labiatae), Amaranthaceae, Euphorbiaceae, Orchidaceae, Liliaceae, Arecaceae, Graminae (Poaceae)

Economic Botany (9 hours)

Module 1 – Economic Botany (6 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,

Cereals- Rice, Wheat, Maize

Millets- Ragi

Pulses- Green gram, Bengal gram, Black gram

Fruits- Apple, Pineapple, Grape, Mango and Banana

Vegetables- Bittergourd, Snake gourd, Ash gourd, Ladies finger, Carrot and Cabbage.

Sugar- Sugar cane, Sugar beet

Timber yielding plants- Teak wood and Jack wood, Rose wood

Beverages- Tea, Coffee

Oil yielding plants- Ground nut, Gingelly

Rubber yielding plants- Para rubber

Gums and Resins- White damer, Gum Arabic, Asafoetida **Spices** – Cardamom, cloves, ginger, star anise, nutmeg, pepper

Insecticide yielding Plants- Tobacco and Neem

Module 2 – Ethanobotany (3 hours)

Ethnobotany and its significance. Methodology of ethnobotanical studies, Study of the following plants used in daily life by tribals and village folks for Food, Shelter and Medicine

Food-*Artocarpus, Corypha*

Shelter - *Bamboosa, Ochlandra and Calamus*

Medicine – *Scoparia dulcis, Aegle marmalose, Saraca ashoka, Coleus umbonicus*

References

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PRACTICAL

BBBO5PB08: ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY

Total Hours: 54

Credit: 1

1. Preparation of floral formula from floral description.
2. Identify the member plants belonging to the families mentioned in the syllabus
3. 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.
4. Study the finished products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
5. Prepare herbarium of 25 plants with field notes.
6. Conduct field work for 5 days under the guidance of a teacher

BBBO5B09: ECOLOGY, ENVIRONMENTAL SCIENCE AND HUMAN RIGHTS

Total Hours: 54

Credit: 3

Course Objectives:-

- To provide basic knowledge of the significance of ecological balance and significance of environmental science
- To enable the students to explore the interactions of life forms at cellular and molecular level
- To inspire the students to apply the acquired knowledge to create a better environment

Course Outcome:-

- Students will be able to identify the major ecosystems and the components of different types of ecosystems
- Students will be able to compare and contrast the characteristics of different types of ecosystems
- Students will be able identify the major causes of environmental problems
- Students will be able to explicate the ecological interconnectedness of life on earth.

Module 1 - General Introduction (2 hours)

Relevance and scope of ecology, Ecology and Environmental Science, Interdisciplinary nature of environmental science, Types of resources-Renewable and non-renewable, Sustainable development and ecological footprints.

Module 2 - Ecosystems: Structure and Function (8 hours)

Ecosystem components- abiotic and biotic**,** Energy flow: Ecological energetics, trophic levels, food chain and food web and ecological pyramids. Productivity – primary, secondary and net productivity

Nutrient cycles: Biogeochemical cycles of C, N and S. Habitat, ecological niche and microclimate.

Module 3 - Population and Community Ecology (8 hours)

Population characteristics, population growth, Metapopulations, Ecotypes and Ecads, Biotic interactions – positive and negative,

Community characteristics: Quantitative (eg. frequency, density and abundance), Qualitative (eg. physiognomy and phenology), Synthetic (eg. dominance), ecotone and edge effect.

Ecological succession: types of succession, process of succession. Hydrosere and xerosere.

Adaptation of plants to environment: Xerophytes, Hydrophytes, epiphytes and halophytes.

Module 4 - Environmental Issues (18 hours)

Global and local environmental issues: global warming and climate change (use case studies to illustrate the points);ozone depletion; greenhouse effect; acid rain; carbon trading, carbon credit; carbon sequestration; IPCC/UNFCC; nuclear accidents and nuclear holocaust, sand mining; wetland reclamation; landscape changes; deforestation; soil erosion. Flood and drought, desertification, overexploitation, threats to fresh water resources of Kerala; tourism and its impact on environment.

Pollution: air pollution; water pollution; soil pollution; noise pollution; pesticide pollution, solid waste management: causes, effects and control measures of urban and industrial waste-biodegradable and non-degradable

Disaster management : introduction to hazards; hazards classification; natural and anthropogenic, disaster management - earthquakes; cyclone; tsunami; floods; landslides; droughts

Module 5 - Human Rights (18 hours)

National and International Perspectives: Definitions of Human Right, Relevance of Human Rights in India-Social Aspects-Economic Aspects-Political Aspects, Human Rights International Norms, UDHR-Civil and political rights- Economic, social and cultural rights-Rights against torture, Discrimination and forced labour-Rights of the child, Human Rights and duties in India- Preamble to the Indian constitution-Human Rights and Duties in Indian constitution

Deprivation of Human Rights-The core issues: Poverty-Overpopulation- Illiteracy-Unsustainable Development, Disadvantageous Groups (Women, Children, SC/ST, Homeless and slum dwellers, physically and mentally handicapped, refugees and internally displaced persons.

Redressal Mechanisms against Human Rights Violation: Judiciary - Government systems for Redressal - NHRC and other Statutory Commissions- Media advocacy-Creation of Human Rights Literacy and Awareness

References

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14. Smith T. M. and Smith R. L. (2012) Elements of ecology, Pearson publication, New Delhi
15. Smith T M, Smith R L (2006) Elements of Ecology (VI Edn).Pearson.

PRACTICAL

BBBO5PB09: ECOLOGY, ENVIRONMENTAL SCIENCE AND HUMAN RIGHTS

Total Hours: 36

Credit: 1

Ecology and Environmental Studies

1. Estimation of CO_2, Dissolved O_2 and total alkalinity of water samples (Titrimetry)
2. Determination of pH of soil and water
3. Assessment of diversity, abundance, and frequency of plant species by quadrate method (Grasslands, forests)
4. EIA studies in degraded areas (Sampling – line transect, Quadrate)
5. Visit to any forests types including grasslands and preparation of the list of Rare and threatened (R&T) plants (no collection of specimens) OR Visit to any ecotourism centre in Kerala and prepare a report on the project.
6. Collection, identification and preparation of the list of exotic species in the locality.
7. Study of anatomical, morphological, physiological adaptation of plants to the environment (Xerophytic, Hydrophytic, Epiphytic and Halophytic)

BBBO5B10: PTERIDOLOGY, GYMNOSPERMS AND PALEOBOTANY

Total Hours: 54

Credit: 3

Course Objectives

- Introducing the characteristics of Pteridophytes and Gymnosperms
- To provide basic knowledge of the lifecycle patterns exhibited by Pteridophytes and Gymnosperms

Course Outcome

- Students will be able to identify the major Pteridophytes and Gymnosperms
- Students will be able to compare and contrast the characteristics of different groups of Pteridophytes and Gymnosperms
- Students will be able to identify the Pteridophytes and Gymnosperms in their locality

Pteridophytes (27 hours)

Module 1 - General Characters of Pteridophytes (4 hours)

General characters of Pteridophytes, basic life cycle patterns in pteridophytes; life cycles of homosporous and heterosporus pteridophytes, vascular tissues in Pteridophytes, stelar types and their evolution, Classification of Pteridophytes by Smith

Module 2 – Detailed Type Study (19 hours)

Structural organization of sporophyte and gametophyte (development of sex organs not necessary) of *Psilotum, Lycopodium, Selaginella , Equisetum , Pteris , Marsilea*

Module 3 – General topics (4 hours)

Heterospory and seed habit, Economic importance of Pteridophytes, ecological importance of Pteridophytes

Gymnosperms (18 hours)

Module 4 - General characters of Gymnosperms (4 hours)

General characters, Classification (Sporne's system)

Module 5 – Detailed Type Study (10 hours)

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

Module 6 – General Topics (4 hours)

Affinities of Gymnosperms, Economic importance of Gymnosperms

Palaeobotany (9 hours)

Module7 - Introduction (5 hours)

Study of geological time scale, formation of fossil, fossil types & technique of study, fossil as a fuel. Indian contribution to Palaeobotany: Birbal Sahni Institute of Palaeobotany

Module 8 - Fossil Type Study (4 hours)

Detailed study of Fossil Pteridophyte: Rhynia Fossil Gymnosperm: Williamsonia Fossil Angiosperm: Palmoxylon

References

1. Bhatnagar S P & Moitra A., (2003) Gymnosperms, New Age International (P)Ltd., New Delhi.
2. Coutler J.M & Chamberlain C. J (1958) Morphology of Gymnosperms. Central Book Depot Allahabad.
3. Dutta S.C, (1991) An Introduction To Gymnosperms, Kalyan Publishing Co. New Delhi.
4. Pandey S.N. (2006) A text book of Botany, Vikas Publishing House, New Delhi.
5. Rasheed A. (1999) An Introduction to Pteridophyta, Vikas Publishing House, New Delhi.
6. Vashista B. R (1993) Gymnosperms, S Chand & Co., New Delhi.
7. Vashista B. R, (1993) Pteridophyta, S Chand & Co., New Delhi
8. Smith GM Cryptogamic botany Vol. II
9. Sporne KR Morphology of Gymnoperm
10. Arnold H.N (1967) Introduction to Paleobotany, Tata Mc Graw- Hill, New Delhi
11. Biswas & John B .M (2004) Gymnosperms, Narosa Publishing house.
12. Bower F.O (1935) Primitive Land Plants. Cambridge, London.

PRACTICAL

BBBO5PB10: PTERIDOLOGY, GYMNOSPERMS AND PALEOBOTANY

Total Hours: 54

Credit: 1

Pteridophytes (27 hours)

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

Gymnosperms and Paleobotany (27 hours)

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

SEMESTER VI

BBBO6B11: RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

Total Hours: 54

Credit: 3

Course Objectives

- To make the students acquainted with the method of research and design of experiments
- To introduce the tools and techniques required for research in life science

Course Outcome

- Students will be familiar with the principles of scientific research
- Students will become familiar with the tools and techniques used in research

Module 1 - Basic Concepts of Research (11 hours)

Research-Meaning, purpose of research and Qualities of a good research; Types of research - Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical; Research process – An over view of the process of research - identification of problem, literature survey, identification of variables, formation of hypothesis, experiment and collection of data, analysis and interpretation of data, testing of hypothesis.

Report writing - Components of research thesis. Bibliographic management software: Mendely; Research ethics, plagiarism, plagiarism checking softwares

Module 2 - General Laboratory Practices (2 hours)

Basic rules of laboratory and fieldwork, biosafety regulations and biosafety levels

Module 3 - Imaging and Related Techniques (12 hours)

Principles of microscopy; Fluorescence microscopy; Electron microscopy; Use of fluorochromes: Applications of fluorescence microscopy; Transmission and Scanning electron microscopy – sample preparation for electron microscopy.

Module 4 - Principle and Application (5 hours)

Centrifuge, pH meter, Colorimeter, UV-Vis spectrometer.

Module 5 – Chromatography (3 hours)

Principle and application: Paper chromatography; Column chromatography, TLC, HPLC.

Module 6 - Information Technology (3 hours)

MS word, MS Excel and MS PowerPoint and their applications in research field

Module 7 - Biostatistics (18 hours)

Data, population, samples, Variable, Quantitative Variable: Discrete and Continuous Variable, Qualitative Variable; Sampling- concept of sample, sampling methods - random and non-random sampling; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi- square test for goodness of fit. Application of statistics in research

References

1. Col Ruxton R, S N. Colegrave. (2006) Experimental Design for the life Science, Oxford University Press
2. Cotteril R, (2002) Biophysics an Introduction .John Wiley and Sons.
3. Dany Spencer Adams, (2004) Lab Math I.K. International Pvt. Ltd. New Delhi.
4. Dawson, C. (2002) Practical research methods. UBS Publishers, New Delhi.
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7. Norman T.J Bailey, (2008) Statistical Methods in Biology, Cambridge.
8. Prasad S. (2003) Elements of Biostatistics. Rastogi Publications, Meerut.
9. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995) Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.

PRACTICAL

BBBO6PB11: RESEARCH METHODOLOGY, BIOPHYSICS AND BIOSTATISTICS

Total Hours: 36

Credit: 1

1. Collect numerical data and find out the central tendencies and prepare different types of graph mentioned in the syllabus
2. Determination of the concentration of a given solution of $CuSO_4$ using colorimetry
3. Paper chromatography of plant pigments
4. Measurement of pH using pH meter
5. Familiarize with biosafety levels

COMPLEMENTARY COURSES

BDBO101: CRYPTOGAMS AND GYMNOSPERMS

Total Hours: 36

Credit: 2

Module 1 - Classification (3 hours)

Classification and naming, purpose and significance, 2 kingdoms, 5 kingdoms, 3 domains.

Module 2 - Algae (9 hours)

General features, classification based on pigments, salient features of thallus and life cycle of the following,

Cyanophyceae: *Nostoc* Chlorophyceae: *Spirogyra* Phaeophyceae: *Ectocarpus* Rhodophyceae: *Polysiphonia*

Economic importance of Algae (general account)

Module 3 – Fungi (6 hours)

General features, classification, salient features of hyphae, and life cycle of the following groups.

Phycomycetes: *Phytophthora* Ascomycetes: *Peziza* Basidiomycetes: *Agaricus*

Economic importance of Fungi (general account)

Module 4 – Lichens (2 hours)

Symbiosis of algae and fungi in lichen, classification based on thallus form and economic importance, Thallu morphology and anatomy of *Parmelia*

Module 5 – Bryophytes (4 hours)

General features, classification, salient features of the thallus and life cycle of *Riccia*, Economic importance of Bryophytes

Module 6 – Pteridophytes (4 hours)

General features, classification, salient features of the sporophytes and gametophyte and life cycle of *Pteris*, Economic importance of Pteridophytes

Module 7 – Gymnosperms (4 hours)

General features, classification, salient features of the life cycle of *Cycas* , Economic importance of Gymnosperms

Module 8 - Plant Pathology (4 hours)

Plant - pathogen interaction, host defense mechanisms, Control of plant diseases; physical, chemical & biological methods. Study of the following diseases (causative organism,

symptoms and control measures); Nut fall of Arecanut, Abnormal leaf fall of Rubber, Leaf mosaic of Tapioca

References

1. Ahamdijan, Vernon and Mason H. E (1973) The Lichens. New York: Academic press.
2. Alexopoulose C. J. and Mims C. W. (1983) Introductory Micology, 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. Bilgramic K. S and Dube H. C (1976) Text Book of Modern Plant Pathology. New Delhi. Vikas Publishing House Pvt. Ltd
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16. Sharma P. D(2003) Microbiology and Plant Pathology and Biochemistry, Rasthogy Publications
17. Vasishta B. R. Bryophyta – S. Chand and Co. New Delhi

PRACTICAL

BDBO1P01: CRYPTOGAMS AND GYMNOSPERMS

Total Hours: 36

Credit: 1

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

SEMESTER II

BDBO202: PLANT PHYSIOLOGY

Total Hours: 36

Credit: 2

Module 1 - Plant and Water (10 hours)

Physical aspects of water absorption –imbibition, diffusion and osmosis. Plant cell as an osmotic system. Diffusion pressure deficit, water potential, plasmolysis, Mechanism of water absorption, active and passive absorption. Transpiration – types, structure and mechanism of stomtal transpiration, theories, significance and factors affecting transpiration, antitranspirants, guttation.

Module 2 – Photosynthesis (12 hours)

Structure of chloroplast, Pigments, two pigments systems, light and dark reaction, Cyclic & Non Cyclic photophosphorylation, C3, C4 and CAM mechanisms, photo respiration, Factors affecting Photosynthesis: External and Internal.

Module 3 - Translocation of Solute (2 hours)

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

Module 4 - Nitrogen Metabolism (3 hours)

Symbiotic nitrogen fixation, Nitrogen Cycle, Carnivorous plants

Module 5 - Seed Physiology (3 hours)

Dormancy of seeds, factors causing dormancy, photoblastisms, techniques to break dormancy, germination – mobilization of food reserves

Module 5 - Plant Growth and Movement (6 hours)

Growth and Movements: Sigmoid curve, measurement of growth, regions of growth, general account of growth hormones, effect of ABA. Senescence and Abscission. Tropic and nastic movements with reference to geotropism, phototropism, Photoperiodism and Vernalization.

References

1. Jain V. K. (2008) Fundamentals of Plant Physiology, S. Chand and Co.
2. Malik C. P (2002) Plant Physiology, Kalyani Publishers
3. Mukherjii. S. & Ghosh A.K (2005) Plant Physiology, Calcutta New Central Book Agency.
4. Sinha A.K (2004) Modern Plant Physiology, Narosa Publishing House, New Delhi.

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7. Verma V. (2007) Text Book of Plant Physiology, Ane Books Pvt Ltd.

PRACTICAL

BDBO2P02: PLANT PHYSIOLOGY

Total Hours: 36

Credit: 1

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. 1 Determination of transpiration under different environmental conditions using Ganong's / Farmer's Potometer
2. Relation between transpiration and absorption
3. Evolution of O2 during photosynthesis
4. Light screen expt.
5. Mohl's experiment
6. Experiment with variegated leaf
7. Measurement of growth using Arc Auxanometer
8. Experiment with Kleinostat.
9. Effect of hormones on growth

SEMESTER III

BDBO303: ANGIOSPERM MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Total Hours: 54

Credit: 3

Module 1 – Introduction (4 hours)

Importance of plant taxonomy, types of classification, binomial nomenclature; ICB N, cytotaxonomy, chemotaxonomy.

Module 2 – Herbarium (3 hours)

Herbarium techniques: Field study, field note, vasculum, plant press, disinfecting and mounting, labelling, importance of herbarium.

Module 3 – Classification System (3 hours)

Bentham and Hooker's system of classification.

Module 4 – Morphology (4 hours)

Morphology of Angiosperms, Plant habits, leaf, stem and root modifications, flowers, inflorescence, fruits

Module 5 – Detailed Study of Angiosperm Families (22 hours)

Study of the following families of Bentham and Hookers system of classification with special reference to major identifying characters and economic importance: Annonaceae, Malvaceae, Rutaceae, Leguminosae, Apiaceae (Umbelliferae), Rubiaceae, Asteraceae, Apocynaceae, Lamiaceae (Labiatae), Euphorbiaceae, Arecaceae (Palmae), Poaceae (Gramineae).

Module 6 – Economic Botany (18 hours)

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

Cereals: Paddy,Wheat.

Pulses : Green gram, Bengalgram.

Tuber crops: Tapioca.

Spices : Pepper, Cardamom.

Beverages: Tea, Coffee.

Oil yielding plants: Coconut, Groundnut

Fiber yielding plants: Cotton, Coir.

Timber yielding plants: Teak, Rosewood.

Latex yielding plants: Pararubber.

Biopesticides: Neem, Tobacco.

Ornamental plants: Rose, Orchids,Anthurium.

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

1.*Adhatoda vasica* 2. *Aloe vera*, 3.Bacopa moniri, 4.*Catharanthus* roseus 5.*Eclipta alba*, 6. *Azadirachta indica*, 7. *Ocimum sanctum*, 9.*Phyllanthus amarus*, 9.*Rauvolfia serpentina*, 10.*Sida*. *acuta*

References

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. Kochhar, S.L. (1981) Economic Botany in the Tropics. Macmillan India Limited, Delhi.
4. Lawrence, G.H.M. (1951) Taxonomy of Vascular Plants. Oxford & IBH, New Delhi.
5. Naik, V.N. (1984) Taxonomy of Angiosperms. Tata McGraw – Hill Publishing Co; New Delhi.
6. Sharma, O.P. (1993) Plant Taxonomy. Tata McGraw – Hill Publishing Co Ltd., New Delhi.
7. Simpson, B.S and M. Conner – Ogorzaly. (1986) Economic Botany: Plants in Our World. .McGraw – Hill Book Company, New York.
8. Singh, G. (1999) Plant Systematics – Theory and Practice. Oxford & IBH, New Delhi

PRACTICAL

BDBO3P03: ANGIOSPERM MORPHOLOGY AND TAXONOMY

Total Hours: 36

Credit: 1

1. Practice to identify typical plants belonging to the families prescribed in the syllabus. Learn to describe the floral parts in technical terms, draw floral diagrams and write floral formula.
2. Learn to identify the economic products obtained from the plants included in the syllabus (Module 6). Should record and study the botanical name, family, morphology of the useful part and the uses of the plants mentioned in module

SEMESTER IV

BDBO404: PLANT ANATOMY AND APPLIED BOTANY

Total Hours: 54

Credit: 3

Plant Anatomy (27 hours)

Module 1 – Plant Cell (4 hours)

Plant cell – living and non living inclusions, cell wall – ultra structure of cell wall (brief account only)

Module 2 – Plant Tissues (5 hours)

Tissues: simple and complex; structure and function, meristems, secretary tissues.

Module 3 – Primary Structure of plant organs (6 hours)

Primary structure of leaf, stem and root in dicots and monocots.

Module 4 – Secondary Growth (8 hours)

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

Module 5 – Ecological Anatomy (4 hours)

Study of the morphological and anatomical adaptations of the following groups; Hydrophytes , Xerophytes, Epiphytes and Halophytes

Applied Botany (27 hours)

Module 1 – Introduction to Plant Breeding (2 hours)

History and objectives

Module 2 – Methods of Plant Improvement (6 hours)

Plant introduction, acclimatization, plant quarantine: Selection: Mass selection; pureline selection and clonal selection: Hybridization; intervarietal, interspecific and intergeneric; procedure of hybridization.

Module 3 – Special Methods of Plant Breeding. (7 hours)

Mutation breeding, Polyploidy breeding, Apomixis, apogamy, apospory, amphimixis, parthenogenesis, parthenocarpy, polyembryony.

Module 4 – Horticultural Practices (6 hours)

Propagation through cutting, layering, budding and grafting

Module 4 – Plant Tissue Culture (6 hours)

Principles, techniques and applications; culture media, asepsis, callus, organogenesis,

somatic embryogenesis, anther culture, artificial seeds.

References

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.
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7. Vasishta, V.C. (1978) *Plant Anatomy*. S. Nagin and Company, Jallundhur.

PRACTICAL

BDBO4P04: PLANT ANATOMY AND APPLIED BOTANY

Total Hours: 36

Credit: 1

a. Using suitable micro preparations observe the different tissue types in the plant organs mentioned in the syllabus
b. Observe the structure of stem and root of dicots and monocots.
c. Learn the structure of dicot stem and dicot root after secondary thickening.
d. Learn the secondary thickening in *Bignonia.*
e. Observe the anatomy of monocot and dicotleaf.
f. Find out the morphological and anatomical adaptations of Hydrophytes (*Nymphaea* petiole), Xerophytes (*Nerium* leaf), Epiphytes (Velamen root of *Vanda*), Halophyte (Pneumatophore and vivipary of *Avicinia* or*Rhizophora*).
g. Practice emasculation using pea or *Caesalpinia* flowerbuds.
h. Practice 'T' budding, approach grafting and air layering.

OPEN COURSE

BOBO501: AGRIBUSINESS

Total Hours: 54

Credit: 3

Module 1 - Entrepreneurship (4 hours)

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.

Module 2: Floriculture, Gardening and Nursery Management (18 hours)

Introduction: Importance and scope of floriculture.

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; Role of plant growth regulators.

Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Bonsai.

Module 3 - Organic Farming and Biofertilizers (12 hours)

General account about the microbes used as biofertilizer – Trichoderma, Rhizobium, PGPR, Rhizobium, VAM and its influence on growth and yield of crop plants.

Green manuring and organic fertilizers, Recycling of bio- degradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.

Module 4 - Value Added Food Products (10 hours)

Preparation and Preservation Techniques. Causes of Spoilage of Food.

Preparation of wine, vinegar, pickles, jam, jelly, syrups, sauce, dry fruits, dairy products – (cheese, butter, paneer).

Module 5 – Mushroom Culture Technology (10 hours)

Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India -Volvariella, Pleurotus, Agaricus bisporus.

Oyster mushroom Cultivation Technology

References

1. Agrawal, P.K. (1993) Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
2. Bose T.K. & Mukherjee, D. (1972) Gardening in India, Oxford & IBH Publishing Co., New Delhi.
3. Chandha. K. L, (2003) Handbook of Horticulture. ICAR. New Delhi.
4. Frazier and Westhoff, (1988) Food Microbiology. Tata McGraw –Hill.
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15. Randhawa, G.S. and Mukhopadhyay, A. (1986) Floriculture in India. Allied Publishers.
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23. Vayas, S.C, Vayas, S. and Modi, H.A. (1998) Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

ADD ON COURSE

BBOEX01: PLANT TISSUE CULTURE

Total Hours: 36

Credit: 2

Course Objectives

The student should be able:

1. To familiarize with the tools and techniques of plant tissue culture
2. To understand the possibility for the production of elite plants
3. To apply the technique in micro propagation of plants
4. To establish a commercial micro propagation unit

Theory - 18 hours - 1 credit

Fundamentals of plant tissue culture

1. Introduction and historical background of Plant Tissue Culture.
2. General Laboratory Techniques.-Maintenance of Laboratory.-Laboratory Space.-Culture Room Culture vessels and washing
3. Equipments Principle and working - pH meter, Hot air oven, Autoclave, LAF, Rotary Shaker.
4. Sterilization techniques- Dry heat sterilization, Wet Heat sterilization and Surface sterilization of explants-Surface sterilants -different Methods.
5. Media preparation, Composition of Nutrient Media, Role of components, Method of preparation of Stock solution, preparation of Growth regulators. Calculations
6. Inoculation -Laminar Air Flow, Procedure of inoculation
7. Incubation -Maintenance of inoculation record, subculture and temperature control, Humidity
8. Hardening Techniques.

Applications of Plant Tissue Culture

1. Callus culture, suspension culture- choice of explants subculture Estimation of growth of cells in culture.
2. Regeneration -Shoot regeneration, Somatic embryogenesis.
3. Brief study of - Anther culture, Ovary culture, Meristem culture, Embryo culture, Protoplast culture and somatic hybridization.
4. Somaclonal variation - genetic basis of somaclonal variation.

5. Synthetic seeds - Preparation and Importance.

Practical - 18 hours - 1 credit

1. Preparation of Standard tissue culture media -MS and White's. Preparation of Stock solution, Preparation of hormones, cotton bungs.
2. Method of preparation of Media, Sterilization of media.
3. Collection of explants Sterilization, inoculation of explants-leaf; root, shoot, anther, ovary and embryo.
4. Preparation of synthetic seeds
5. Maintenance of cultures, Sub culturing at periodical intervals.
6. Hardening of rooted plantlets.

References

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Question Paper Pattern of Written Exam (Time: 1.5 hrs)

Part	Type	Total Questions	Marks	No of Questions to be Answered	Total Marks
Part A	Very Short Answer	10	1	10	10
Part B	Short Answer	20	2	15	30

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