ST. ALBERT‟S COLLEGE (AUTONOMOUS),

Banerji Road, Ernakulam, Kochi-682018

KERALA

Affiliated to the Mahatma Gandhi University

Kottayam, Kerala.

SYLLABUS FOR UNDER GRADUATE PROGRAMME

BACHELOR OF SCIENCE IN BOTANY

CHOICE BASED CREDIT AND SEMESTER SYSTEM (UGCBCS)

(WITH EFFECT FROM 2016 ADMISSION)

Proposed by the Board of Studies in Botany (UG) on 3-06-2016

Approved by the Academic Council on 19-06-2017

Adopted by the Governing body on 1-07-2017

ST. ALBERT"S COLLEGE (AUTONOMOUS),
Banerji Road, Ernakulam, Kochi-682018
KERALA

A.M.D.G.

Affiliated to the Mahatma Gandhi University

Kottayam, Kerala.

SYLLABUS FOR UNDER GRADUATE PROGRAMME

BACHELOR OF SCIENCE IN BOTANY

UNDER THE RESTRUCTURED CURRICULUM

IN

CHOICE BASED CREDIT AND SEMESTER SYSTEM (UGCBCS)

(WITH EFFECT FROM 2016 ADMISSION)

Approved by Board of Studies in Botany (UG) on 3-06-2016

ST. ALBERT"S COLLEGE (AUTONOMOUS), ERNAKULAM

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Preface

As envisaged in the recent regulations of Autonomous colleges in India by University Grants Commission, autonomous colleges enjoy the academic freedom to enrich the curriculum by incorporating recent trends and needs. Curriculum and syllabus of each academic program has to be revised periodically to impart major objectives like global competency, skill component, values and regional relevance. Academicians and scholars in the respective area of knowledge have to express a missionary zeal for this great purpose.

In 2016, when St. Albert's College was granted autonomy, we adopted the curriculum and syllabus followed by the Mahatma Gandhi University, Kottayam for the year 2016.

BOARD OF STUDIES - 2016-2018

(As per UGC Regulations)

Sl.No:	Name	Designation	Qualification
1.	Dr. L. Jose	Associate Professor	Ph.D
a) Entire faculty of each specialization			
1.	Dr. J Jameson	HOD and Associate Professor	Ph.D
2.	Dr. Siju M. Varghese	Assistant Professor	Ph.D
3.	Dr. K. Madhusudanan	Assistant Professor	Ph.D
4.	Smt .Drishya K Reghuvaran	Assistant Professor	M.Sc
5.	Smt. Mary joseph	Assistant Professor	M.Sc
6.	Dr. Anna Ancy Antony A	Assistant Professor	Ph.D
7.	Dr. Anisha S	Assistant Professor	Ph.D
b) Experts in the Subject: *(two experts in the subject from outside the parent university to be nominated by Academic Council)*			
1.	Dr.Sarita G Bhatt	Head department of Biotechnology, CUSAT Ernakulam	Ph.D
c) Nominee of Vice Chancellor: *one expert to be nominated by the Vice-Chancellor from a panel of six experts recommended by the Principal*			
1.	Dr Sunil C. N Associate Professor	Associate Professor, Department of Botany, SNM College ,*Maliankara*	Ph.D
d) Placement Representatives: *(one representative each from industry, corporate sector or allied area relating to placement)*			
	Mr Antony Tharian	Managing director,Trust Pharmaceuticals and Herbominerals	M D
e) Meritorious alumnus: *(one meritorious alumnus to be nominated by the Principal/Chairman Board of Studies with the approval of Principal)*			
	Dr. Basil George	Assistant Professor, Department of Botany, CMS College, Kottayam	PhD

DEPARTMENT OF BOTANY
ST.ALBERT"S COLLEGE, (Autonomous) ERNAKULAM

Introduction

In order to facilitate student mobility across institutions within and across countries and also to enable potential employers to assess the performance of students, the University Grants Commission insisted to introduce uniform grading system in the Universities. And as all are aware plant science is once again assuming a prominent role in research. Renewed emphasis on developing medicinal products from native plants has encouraged ethno-botanical endeavors. The destruction of the rain forests has made the need for research more imperative and has spurred efforts to catalog the plant biodiversity in these environments. Efforts to feed the growing populations in developing nations have also gave plant scientists a cutting edge with genetic engineering and the creation of transgenic crops. However, in botany courses have seen a decline in enrollment. By taking a multidisciplinary approach to studying the relationship between plants and people, we can hope to stimulate interest in plant science and encourage students to further study. Also by exposing students to society's historical connection to plants, we hope to instill a greater appreciation for the botanical world.

Established in 1947 Department of Botany St Albert's College Ernakulam is preparing knowledge seekers in Botany for the past 72 years. In 2016 as the College was granted academic autonomy by the University Grant's Commission, the department has also vested with the power of framing the curriculum to cater the needs of students in Botany.

We wish to acknowledge most gratefully the helpful criticisms, comments and suggestions received from the Teachers, Friends, Botanists and Educationists who have helped during the preparation of the syllabus.

In conclusion, we place on record our greatest gratitude to Chairman, Principal and all the associating staff of the College and every member of the Board of Studies in UG Botany who were sincerely involved in the preparation and finalization of this syllabus.

"Live as if you were to die tomorrow. Learn as if you were to live forever."
--Mahatma Gandhi

PROGRAMME STRUCTURE & OUTCOME

The Board of Studies in Botany (UG) recognizes that curriculum, course content and assessment of scholastic achievement play complementary roles in shaping education. The restructured Curriculum for Undergraduate Programme of Botany envisages Undergraduate Education as a combination of general and specialized education, simultaneously introducing the concepts of breadth and depth in learning. It also stresses learning to learn rather than learning of specific lessons. The attempt is to prepare the students for lifelong learning by drawing attention to the vast world of knowledge of plants and introducing him/her to the methodology of systematic academic enquiry. With this in mind, we aim to provide a firm foundation in every aspect of Botany and to explain a broad spectrum of modern trends in Botany and to develop experimental, observational, computational skills also which lead him as an ambassador of sustainable development of our country. The programme is hence designed with the following outcomes in 10 diverse spheres of human development and truth searching through plant sciences.

PO1. Knowledge and understanding of:

1. The range of plant diversity in terms of structure, function and environmental relationships.
2. The evaluation of plant diversity.
3. Plant classification and the flora of Kerala, vs India and the World.
4. The role of plants in the functioning of the global ecosystem.
5. A selection of more specialized, optional topics.
6. Statistics as applied to biological data.
7. Basic life science and fundamental process of plants and analyze any plant form.

PO2. Intellectual skills – able to:

1. Think logically and organize tasks into a structured form.
2. Assimilate knowledge and ideas based on wide reading, through books, journals, internet etc.
3. Transfer of appropriate knowledge and methods from one topic to another within the subject.
4. Understand the evolving state of knowledge in a rapidly developing field.
5. Construct and test hypothesis.
6. Plan, conduct and write a report on an independent term project.

PO3. Practical skills in:

Students learn to carry out practical work, in the field and in the laboratory, with minimal risk. They gain introductory experience in applying each of the following skills and gain greater proficiency in a selection of them depending on their choice of optional modules.

1. Interpreting plant morphology and anatomy.
2. Plant identification.
3. Mastery of vegetation analysis techniques.
4. A range of physiochemical analyses of plant materials in the context of plant physiology and biochemistry.
5. Analyze data using appropriate statistical methods and computer packages.
6. Working towards the direction of developing plant clinics and farm support.

PO4. Transferable skills in:

1. Use of IT (word-processing, use of internet, statistical packages and databases).
2. Communication of scientific ideas in writing and oral presentation.
3. Ability to work as part of a team.
4. Ability to use library resources.

5. Time management.
6. Career planning.
7. Local resource management in terms of plants

PO5. Design /development of solutions in investigation and management of complex problems:

Design solutions from medicinal plants for health problems, disorders and disease of human beings and estimate the phytochemical content of plants which meet the specified needs to appropriate consideration for the public health

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and development of the information to provide valid conclusions.

PO6. Modern tool usage:

Create, select, and apply appropriate techniques, resources, and modern instruments and equipments for biochemical estimation, molecular biology, biotechnology, plant tissue culture experiments, cellular and physiological activities of plants with an understanding of the application and limitations.

PO7. The Botanist and society:

Apply reasoning informed by the contextual knowledge to assess plant diversity, its importance for society, health, safety, legal and environmental issues and the consequent responsibilities relevant to the biodiversity conservation practice.

PO8. Environment and sustainability and ethics:

Understand the impact of the plant diversity in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development with a right insight to apply ethical principles and commit to environmental ethics and responsibilities and norms of the biodiversity conservation.

PO 9. Project management and finance:

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO10. Life-long learning:

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

REGULATIONS FOR UNDER GRADUATE PROGRAMMES UNDER CHOICE BASED COURSE-CREDIT-SEMESTER SYSTEM AND GRADING, 2016.

Preamble

The committee of experts constituted by the Kerala State Higher Education Council headed by Prof. B Hridayakumari, to study and make recommendations for the improvement of the working of the Choice Based Credit and Semester System in colleges affiliated to the Universities in the State had submitted a comprehensive report. After reviewing the entire scenario this committee recommended to the Higher Education Council that CBCSS may be maintained with some basic reforms. The old system was lacking in innovativeness and in the capacity to come to grips with fast changing global conditions. A few changes in the course and examination pattern may improve the situation to some extent. The Performance Grading of the learner shall be on the Seven Point Grading System. The absolute grading

system of 07 points is the most popular grading system and has been accepted by the UNESCO, the Committee suggested that the overall structure of the 07 point grading system may be considered by all affiliating Universities of the State. It should be a simple and clear method; easy for the teacher to operate and the student to understand. There should be a clear distinction between letter grades so that the assessment is as precise as possible and just to the student. If necessary for the final grading at the end of the programme proper software could be devised to ensure exactitude as well as speed of evaluation. Teachers should use the marking system for each question for each course. Cumulative Grading will be done during the preparation of the final mark list of the programme. It is not claimed that the Seven Point Range Indirect Grading is the last word in grading, but it is a well thought out pattern for all the affiliating Universities to consider, within the limits of the present system. The State Government has accepted the recommendations of the Committee and the Syndicate of the Mahatma Gandhi University has resolved to reform the existing CBCSS regulations. Hence it becomes necessary to modify the existing CBCSS regulation as following.

1. TITLE

These regulations shall be called –Regulations for Under Graduate Programmes under Choice Based Course Credit Semester System and Grading, **2016**

2. SCOPE

Applicable to all regular non-professional Under Graduate Programmes conducted by the University with effect from 2013-14 admissions.

The courses conducted in distance/off-campus and private registration shall not come under the purview of this regulation.

The provisions herein supersede all the existing regulations for the regular non-professional undergraduate programmes to the extent herein prescribed.

3. DEFINITIONS

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

„Additional Course" is acourse registered by a student over and above the minimum required courses.

'Audit Course' is a course for which no credits are awarded.

'College Co-ordinator' is a teacher nominated by the College Council to co-ordinate the continuous evaluation undertaken by various departments within the college. He/she shall be nominated to the college level monitoring committee.

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

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

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

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

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

'Department' means any teaching department in a college.

'Department Co-ordinator' is a teacher nominated by a Department Council to co-ordinate the continuous evaluation undertaken in that department.

'Department Council' means the body of all teachers of a department in a college.

'Faculty Advisor' means a teacher from the parent department nominated by the Department Council, who will advise the student in the choice of his/her courses and other academic matters.

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

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

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

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

'***Parent Department'*** means the department which offers core courses within a degree programme.

'Programme' means a three/four year programme of study and examinations spread over six/eight semesters, according to the regulations of the respective programme, the successful completion of which would lead to the award of a degree

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

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

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

Eligibility of admission, Norms for admission, reservation of seats for various Degree Programmes shall be according to the rules framed by the University from time to time.

5. DURATION

The duration of U.G. programmes shall be ***6/8 semesters*** (*the semesters* defined under 3.20, above).

The duration of odd semesters shall be from **June to October** and that of even semesters from **November to March.** There shall be three days*semester break after*

odd semesters and two months vacation during April and May in every academic year.

A student may be permitted to complete the Programme, on valid reasons, within a period of 12/16 continuous semesters from the date of commencement of the first semester of the programme.

6. REGISTRATION

The strength of students for each course shall remain as per existing regulations, except in case of open courses for which there shall be aminimum of 15 and maximum of 75 students per batch, subject to a marginal increase of 10.

Each student shall register for the courses in the prescribed registration form in consultation with the Faculty Advisor within two weeks from the commencement of each semester. Faculty Adviser shall permit registration on the basis of the preferences of the student and availability of seats.

The number of courses/credits that a student can take in a semester is governed by the provisions in these regulations pertaining to the minimum and maximum number of credits permitted.

A student can opt out of a course/courses registered subject to the minimum credits requirement, within seven days from the commencement of the semester.

The college shall send a list of students registered for each programme in each semester giving the details of courses registered including repeat courses to the University in the prescribed form within 20 days from the commencement of the Semester.

Those students who possess the required minimum attendance and progress during an academic year/semester and could not register for the annual/semester examination are permitted to apply for Notional Registration to the examinations concerned enabling them to get promoted to the next class.

7. SCHEME AND SYLLABUS

The U.G. programmes shall include (a) Common courses I & II, (b) Core courses, (c) Complementary Courses, (d) Open Course.

Credit Transfer and Accumulation system can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one University to continue their education in another University without break.

8. PROGRAMME STRUCTURE

There shall be a maximum of three credits for the open course and remaining one credit should be shifted to choice based course or any other core course.

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the programme	120
c	Minimum credits required from common courses	38
d	Minimum credits required from Core + complementary + vocational* courses including Project	79
e	Minimum credits required from Open course	3
f	Minimum attendance required	75%

*The credit distribution for vocational courses is to be decided separately.

COMBINATION OF CORE AND COMPLEMENTARY COURSES AND SEMESTER-WISE DISTRIBUTION

Sem.	Course category	Course code	Course title	Instr. hrs.*		Credits
				Th.	Pr.	
I	Core	BOT1CRT0116	METHODOLOGY AND PERSPECTIVES OF SCIENCE & AN INTRODUCTION TO THE WORLD OF PLANT DIVERSITY	36	36	2 +1
II	Core	BOT2CRT0116	GENERAL INFORMATICS AND METHODOLOGIES IN PLANT SCIENCES	36	36	2 + 1
III	Core	BOT3CRT0116	MICROBIOLOGY AND PHYCOLOGY	54	36	3 + 1
IV	Core	BOT4CRT0116	ANATOMY AND REPRODUCTIVE BOTANY OF ANGIOSPERMS	54	36	3 + 1
V	Core	BOT5CRT0116	MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY	36	45	2 +2
	Core	BOT5CRT0216	ENVIRONMENTAL SCIENCE AND ECOTOURISM	54	45	3 + 1
	Core	BOT5CRT0316	GENETICS, PLANT BREEDING AND HORTICULTURE	54	45	3 + 1
	Core	BOT5CRT0416	CELL MOLECULAR BIOLOGY AND EVOLUTION	54	45	3 + 1
	Open	BOT5COT0116	AGRIBASED MICROENTERPRISES	72	--	
VI	Core	BOT6CRT0116	PLANT PHYSIOLOGY AND BIOCHEMISTRY	54	45	2 + 2
	Core	BOT6CRT0216	BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS & PALEOBOTANY	54	45	3 + 1
	Core	BOT6CRT0316	ANGIOSPERM MORPHOLOGY, SYSTEMATIC BOTANY AND ECONOMIC BOTANY	54	45	3 + 1
	Core	BOT6CRT0416	BIOTECHNOLOGY AND BIOINFORMATICS	54	45	3 + 1
	Elective	BOT6CBT016	AGRIBUSINESS	54	--	3
	Project	BOT6CPR0116	INVESTIGATORY PROJECT WORK DONE INDIVIDUALLY OR IN GROUPS	--	--	2
I	Compl. 1	BOT1CMT0116	Cryptogams, Gymnosperms and Plant Pathology	36	36	2 + 1
II	Compl. 2	BOT2CMT0116	Plant Physiology	36	36	2 + 1
III	Compl. 3	BOT3CMT0116	Angiosperm Taxonomy and Economic Botany	54	36	3 + 1
IV	Compl. 4	BOT4CMT0116	Anatomy and Applied Botany	54	36	3 + 1

* 18 instructional hours is equal to one teaching hour per wee

9. EXAMINATIONS.

The evaluation of each course shall contain two parts:

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

The internal to external assessment ratio shall be 1:4, for both courses with or without practical. There shall be a maximum of 80 marks for external evaluation and maximum of **20** marks for internal evaluation. For all courses (theory & practical), grades are given on a 07-point scale based on the total percentage of marks. ***(ISA+ESA)*** as given below

Percentage of marks	Grade	Grade Point
90 and above	A+ - Outstanding	10
80-89	A – Excellent	9
70-79	B - Very Good	8
60-69	C – Good	7
50-59	D - Satisfactory	6
40-49	E – Adequate	5
Below 40	F – Failure	4

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

10. CREDIT POINT AND CREDIT POINT AVERAGE

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

CP = C x GP, where C = Credit; GP = Grade point

Credit Point Average (CPA) of a Semester/Programme is calculated using the formula

CPA = TCP/TC, where TCP = Total Credit Point; TC = Total Credit

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

CPA	Grade
Above 9	**A+ - Outstanding**
Above 8, but below or equal to 9	**A - Excellent**
Above 7, but below or equal to 8	**B -Very Good**
Above 6, but below or equal to 7	**C - Good**
Above 5, but below or equal to 6	**D - Satisfactory**
Above 4, but below or equal to 5	**E - Adequate**
4 or below	**F - Failure**

Note: A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 40% are required for a pass for a course. For a pass in a programme, a separate minimum of Grade E is required for all the individual courses. If a candidate secures **F** Grade for any one of the courses offered in a Semester/Programme only **F** grade will be awarded for that Semester/Programme until he/she improves this to **E** grade or above within the permitted period. Candidate who secures **E** grade and above will be eligible for higher studies.

11. MARKS DISTRIBUTION FOR EXTERNAL EXAMINATION AND INTERNAL EVALUATION

The external examination of all semesters shall be conducted by the University at the end of each semester. Internal evaluation is to be done by continuous assessment. Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

Components of the internal evaluation and their marks are as below.

For all courses without practical

a) **Marks of external Examination : 80**

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

All the three components of the internal assessment are mandatory. For common course English in I Semester, internal oral examination shall be conducted instead of test paper.

Components of Internal Evaluation	**MARKS**
Attendance	**5**
Assignment /Seminar/Viva	**5**
Test paper(s) **(1 or 2)** **(1x10=10; 2x5=10)**	**10**
Total	**20**

For all courses with practical

a) **Marks of theory –External Examination : 60**

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

Components of Theory – Internal Evaluation	Marks
Attendance	**3**
Assignment/Seminar/Viva	**2**
Test paper(s) **(1 or 2)** **(1x5=5; 2x2.5=5)**	**5**
Total	**10**

c) Marks of Practical –External Examination: 40
(only in even semesters)

d) Marks of Practical- Internal Evaluation: 20
(odd and even semesters combined annually)

Components of Practical-Internal evaluation	**Marks**
Attendance	4
Record*	10
Lab involvement	6
Total	**20**

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

Project Evaluation: (Max. marks100)

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

12. Attendance Evaluation

1) For all courses without practical

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

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

2) For all courses with practical

% of Attendance	**Marks for theory**		**% of Attendance**	**Marks for practical**
90 and above	3		90 and above	4

80--89	2		85—89	3
75--79	1		80—84	2
			75—79	1

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

13. ASSIGNMENTS

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

14. SEMINAR/VIVA

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

15) INTERNAL ASSESSMENT TEST PAPERS

At least one internal test-paper is to be attended in each semester for each course.The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for two years and shall be made available for verification by the University. The responsibility of evaluating the internal assessment is vested on the teacher(s), who teach the course.

Grievance Redressal Mechanism

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

Level 1:Dept. Level: The department cell chaired by the Head; and Dept. coordinator and teacher in-charge,as members.

Level 2: **College level**: A committee with the Principal as Chairman, Dept. Coordinator, HOD of concerned Department and a senior teacher nominated by the College council as members.

Level 3: **University Level**: A Committee constituted by the Vice-Chancellor as Chairman and Pro-Vice-Chancellor, Convener - Syndicate sub-committee on Students Discipline and Welfare, Chairman- Board of Examinations as members and the Controller of Examination as member-secretary.

The college council shall nominate a senior teacher as coordinator of internal evaluations. This coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of I semester

The internal evaluation report in the prescribed format should reach the University before the 4th week of October and March in every academic year.

16. External examination

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

Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days or 50 hours in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the University on valid grounds. This condonation shall notbe counted for internal assessment.

Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also.

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

All students are to do a **project**. This project can be done individually or as a group of 3 students. The projects are to be identified during the II semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the University.

There will be no supplementary exams. For reappearance/ improvement, the students can appear along with the next batch.

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

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.

A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the University examination for the same semester, subsequently.

17. All programmes and courses shall have unique alphanumeric code. Each teacher working in affiliated institutions shall have a unique identification number and this number is to be attached with the codes of the courses for which he/she can perform examination duty.

18. PATTERN OF QUESTIONS

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

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

Pattern of questions for external examination for theory paper without practical.

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	10	10	1	10
	12	8	2	16
	9	6	4	24
	4	2	15	30
TOTAL	**35**	**26**	X	**80**

Pattern of questions for external examination for theory papers with practical

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	8	8	1	8
TOTAL	10	6	2	12
	6	4	4	16
	4	2	12	24
	28	**20**	X	**60**

19. MARK CUM GRADE CARD

The University under its seal shall issue to the students a MARK CUM GRADE CARD on completion of each semester, which shall contain the following information:

(a) Name of the University
(b) Name of the College
(c) Title & Model of the
(d) Under-Graduate Programme
(e) Name of the Semester
(f) Name and Register Number of the student
(g) Code, Title, Credits and Max. Marks (Int., Ext. &Total) of each course opted in the semester.
(h) Internal, External and Total Marks awarded, Grade, Grade point and Credit point in each course opted in the semester

(i) Institutional average of the Internal Exam and University Average of the External Exam in each course.
(j) The total credits, total marks (Max. & Awarded) and total credit points in the semester
(k) Semester Credit Point Average (SCPA) and corresponding Grade.
(l) Cumulative Credit Point Average (CCPA) corresponding to Common courses, Core and Complementary (separately and together) and whole programme, as the case may be.
(m) The final mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the final semester examination and shall include the final grade/marks scored by the candidate from **1st to 5th** semester, and the overall grade/marks for the total programme.

20. There shall **be 3 level monitoring** committees for the successful conduct of the scheme. They are -

1. Department Level Monitoring Committee (DLMC), comprising HOD and two senior-most teachers as members.

2. College Level Monitoring Committee (CLMC), comprising Principal, Controller of Examination and A.O/Superintendent as members.

3. Governing Council.

21. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Governing Council shall, for a period of one year 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.

22. The Governing Council is authorized to make necessary criteria for eligibility for higher education in the grading scheme, if necessary, in consultation with affiliating University and other Universities. The Governing Council is also authorized to issue orders for the perfect realization of the regulations.

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 7-point Scale based on the percentage of Total Marks (Internal + External) as given in Table 1
(Decimals are to be corrected to the next higher whole number)

Table 1

%Marks	Grade	Grade Point
90 and above	A+ - Outstanding	10
80-89	A - Excellent	9
70-79	B - Very Good	8
60-69	C - Good	7
50-59	D - Satisfactory	6
40-49	E - Adequate	5
Below 40	F - Failure	4

Credit point and Credit point average Grades for the different Semesters and overall Programme are given based on the corresponding CPA, as shown in

Table 2

Credit point (**CP**) of a Course is calculated using the formula

$CP = C \times GP$, **where C = Credit; GP = Grade Point**

Credit Point Average (**CPA**) of a Semester or Programme etc. is calculated using the formula

CPA = $\frac{TCP}{TC}$**, where TCP = Total Credit Point; TC = Total Credit**

CPA	Grade
above 9	A+ - Outstanding
above 8 but ≤ 9	A - Excellent
above 7 but ≤ 8	B - Very Good
above 6 but ≤ 7	C - Good
above 5 but ≤ 6	D - Satisfactory
above 4 but ≤ 5	E - Adequate
≤ 4	F - Failure

NOTE

A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 40% are required for a pass for a course. For a pass in a programme, a separate minimum of **Grade E** is required for all the individual courses. If a candidate secures **F Grade** for any one of the courses offered in a Semester/Programme **only F grade** will be awarded for that Semester/Programme until he/she improves this to **E GRADE** or above within the permitted period. Candidates who secure **E grade** and above will be eligible for higher studies.

SEMESTER I Course 1 BOT1CRT01

Methodology and Perspectives of Science & An Introduction to the World of Plant Diversity

(Theory 36 hours, Practical 36 hours) (Theory Credit 2, Practical credit 1)

Methodology and Perspectives of Science (Theory 18hours, Practical 18 hours)

Module 1. 8 hours

Introduction to science and scientific methods

-Introduction to science

-Steps in scientific methods

- observation and thoughts
- formulation of a hypothesis
- designing of experiments
- testing of hypothesis
- formulation of theories
- Revision of scientific theories with the advent of new technologies

Module 2. 10 hours

Experimentation in science

- Selection of a problem

- Searching the literature
- Selection of variables, study area, and a suitable design
- Necessity of units and dimensions
  Units of length, volume, area, concentration, temperature, pressure
- Setting of hypothesis, Null- hypothesis and alternative hypothesis
- Need of control, treatments and replication
- Analysis, presentation and interpretation of data
- Testing of hypothesis, need of statistical tools (study of specific tools is not required)
- Examples of great experiments in life sciences
  - An example of moving from a question to hypothesis and then to an experimental design
  - Contributions and the great experiments of Louis Pasteur, and Robert Koch

-Ethics in science

Practical **18 hours**

1. Design and perform a simple experiment to familiarize with the methodology of science
2. Select an important classical experiment and find out the different elements of scientific method
3. Prepare a biographical sketch of great scientists with special emphasis on the scientific methodology involved in their experiments
4. Prepare $CuSO_4$. H_2O solution of different molarity using a stock solution
5. Determination of the area of different types of leaves using graph paper

An Introduction to the World of Plant Diversity **(Theory 18 hours, Practical 18 hours)**

Module 1 **3 hours**

- Plants, their uniqueness and importance as
  - Primary producers
  - Source of oxygen
  - Source of materials for food and shelter
  - Medicines and other compounds derived from plants
  - Source of fuel (fossil fuel, biofuel)
  - Recreational value

  (a brief account with examples alone is required)

Module 2. **3 hours**

Unity of living organisms

Unity in,

- Cellular organization
- Cell structure
- Metabolism
- Genetics
- Cell division
- Sexual reproduction (Only a preliminary study about the unity of different live forms in the above mentioned aspects alone is required)

Module 3. **12 hours**

1. Diversity of living organisms [No type study is expected)

- **Prokaryotes**
  - Bacteria – general characteristics, variation in form (bacillus, coccus, vibrio, spirillum)
  - Cyanobacteria / BGA (No type study is intented) – general characteristics, pigments in Cyanobacteria, variation in form
- **Eukaryotes**
  - Eichler's Classification
  - **Cryptogams**

-Algae:-

- General characteristics
- Diversity in thallus morphology (Unicellular, colonial, unbranched filamentous, branched filamentous)
- Diversity in pigments (Pigments characteristic of Chlorophyceae, Rhodophyceae and Phaeophyceae)

- Fungi

General characteristics

- Diversity in thallus morphology (unicellular forms, aseptate and septate hyphal forms)

- Lichens

General characteristics

- Diversity in thallus morphology (crustose, foliose and fruticose forms)

- Bryophytes
  - General characteristics
  - Diversity in thallus morphology
  - Alternation of generation, prominence of gametophyte
  - Concept of embryo

-Pteridophytes

- General characteristics
- Diversity in morphology
- Concept of vasculature (study of different types of steles is not required)
- Alternation of generation, prominence of sporophyte

-Phanerogams

-Gymnosperms

- General characteristics
- Diversity in morphology
- As the first plant group exhibiting seed habit, advantages of seed
- Special structures which contributed to the development of seed (ovule, integuments of ovule, endosperm)

-Angiosperms

- General characteristics
- Diversity in morphology (dicots, monocots, herbs, shrubs, trees, climbers, twiners, branched, unbranched)
- Concept of fruit, advantages of fruit
- Special structures which contributed to the development of fruit (ovary, placenta)

-**Animals**

- Major differences between plants and animals

(Detailed study of different classes not required)

- **Habitat Diversity** (Brief study only)
  - Aquatic:- Fresh water, marine, mangrove
  - Terrestrial:- Evergreen forest, deciduous forest, grass land
  - Epiphytic
- **Evolutionary trends in the plant world** (shift in habitat from aquatic to terrestrial, shift in prominence of gametophyte to sporophyte, shift from thalloid forms to differentiated forms, evolution of conducting tissue; tracheids to vessels, origin of seed and fruit)
- Interactions in the plant world. Examples of,
  - Plant – plant interactions (Brief account of Parasitic plants and epiphytes)
  - Plant – microbe interactions (Brief account of root nodules and Micorrhiza)
  - Plant – animal interactions (Brief account of Leaf and stem galls and mermicophylly)

Practical **18 hours**

1. Collect, identify, record and submit 3 genera each from algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms. Use appropriate preservation techniques.
2. Study and submit a report on any one of the interactions observed in the plant world
3. Conduct a field visit to any one of the ecosystems/ botanic gardens to experience the plant diversity. Submit a report with photographs.
4. From a lot of given materials identify a particular plant group
5. From a lot of given materials identify plants with vascular elements, plants which can produce seeds, fruits, embryos

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SEMESTER II Course 2 BOT2CRT0116

General Informatics and Methodologies in Plant Sciences

A. General Informatics

(Theory 36 hours, Practical 36 hours) (Theory Credit 2, Practical credit 1)

General Informatics (Theory 18 hours, Practical 18 hours)

Module 1.

Overview of the information technology 3 hours

-Features of the modern personal computers and peripherals.

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

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

Module 2.

Use of computers 15 hours

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

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

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

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

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

Practicals 18 hours

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

B. Methodologies of Plant Science (Theory 18 hours, Practical 18 hours)

Module 1.

Microtechnique 6 hours

- Introduction
- Microscopy:- simple, compound, phase contrast, fluorescent, confocal and electron microscopes (working principle and application only)
- Microtome:- rotary, sledge (application only)
- Killing and fixing :- Purpose,
  Agents used:-
  Killing agents – Formalin, Ethyl alcohol
  Fixing agents - Carnoy's fluid, Farmers' fluid, FAA
- Dehydration:- Purpose, Agent used – Ethyl alcohol
- Sectioning:- Hand sections, microtomy
- Staining technique:- Principle of staining
  Stains:- Safranin, Hematoxylin, Acetocarmine
  Vital stains: Purpose, Examples: Neutral red and Evan's blue
  Mordents: Purpose and examples
  Single staining and Double staining
- Mounting and Mounting Media, Purpose of mounting media, Glycerin, DPX, Canada balsam
- Use of permanent whole mounts, permanent sections
- Maceration
- Smear and squash preparation

Practicals 2 hours

1.Maceration and identification of tracheary elements

Module 2

Biophysics 3 hours

- Principles and applications of colorimeter, spectrophotometer and centrifuge, Beer-Lambert's Law,
- Separation methods:- chromatography; thin layer, paper, column (principle and applications only), electrophoresis; PAGE, Agarose gel electrophoresis (Principle and applications only)
- pH:- concept of pH, methods to measure pH; pH paper and pH meter,

- Buffers:- definition, functions of buffers in biological systems, use of buffers in biological research, examples of commonly used buffers

Practicals 6 hours

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

Module 3

Biostatistics 8 hours

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

Practicals 10 hours

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

Module 4

Research Methodology 1 Hour

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

Reference:

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Semester III Course-3 BOT3CRT0116
MICROBIOLOGY AND PHYCOLOGY

(Theory: 54 hours; Practical: 36) (Theory Credit 3, Practical Credit1)

Course objectives

Enable the student to

1. Understand the world of microbes
2. Understand the identifying characters of the lower groups of plants
3. Have an idea on diverse groups of plants
4. Understand the application of microbiology in different fields.

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

Module 1 **1 hour**

Introduction, Scope of Microbiology

Module 2 6 **hours**

- Bacteria - Morphology and classification based on staining, morphology and flagellation
- Fine structure - cell wall - Peptido glycan- cytoplasm - Nucleoid, Flagella
- Reproduction- Binary fission
- Genetic recombination - Conjugation, transformation & transduction
- Archaebacteria, Mycoplasma - general characters

Module 3 6 **hours**

Virus- General Composition and properties - Architecture of TMV, HIV and Bacteriophages, Multiplication and transmission.

Module 4 5 **hours**

Applied Microbiology

1. Role in Nitrogen cycle.
2. Biofertilizers & Bio pesticides.
3. Biogas production.
4. Reconvertion of waste products.
5. Bioremediation.
6. Spoilage and preservation of food.
7. Antibiotics.
8. Production of Vinegar, curd, Yoghurt, single cell protein and Probiotics.
9. Bio reactors.

PRACTICAL 12 **hours**

Students are expected to do the following practical

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

PHYCOLOGY (Theory: 36 hours; Practical: 24 hours)

Module 1 **3 hours**

Introduction - General characters of algae. Classification (Fritsch F. E, 1935; 1945)

Module 2 **22 hours**

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

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

Module 3 **9 hours**

Economic importance

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

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

Module 4 **2 hours**

Algal culture: scope and methods

Praticals **24 hours**

1. Make micro preparation of vegetative and reproductive structures of the types mentioned in the syllabus.
2. Identify the algal specimens up to the generic level by noting their key characters.
3. Make labeled sketches of the specimens observed.

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websites

http://www.phycology.net/
http://www.algaebase.org/

http://www.seaweed.ie/
http://www.brphycsoc.org/ (the british phycological society)
http://www.intphycsoc.org/ (international phycological society)
http://www.isaseaweed.org/ (the international seeweed association)
http://botany.si.edu/projects/algae/
http://botany.si.edu/projects/algae/ (Smithsonian national museum of natural history

Semester IVCourse-4 BOT4CRT0116
ANATOMY AND REPRODUCTIVE BOTANY OF ANGIOSPERMS
(Theory: 54 hours; Practical: 36 hours) (Theory Credit 3, Practical Credit1)

Course Objectives

1. This course aims to impart an insight into the internal structure and reproduction of the most evolved group of plants, the Angiosperm.
2. Identifies role of anatomy in solving taxonomic and phylogenetic problems.
3. Understand the structural adaptations in plants growing in different environment.
4. Understand the life cycle pattern of Angiosperms.
5. Understand the morphology and development of reproductive parts.
6. Get an insight in to the fruit and seed development.

ANATOMY (Theory: 36 hours. Practical: 27 hours)

Module-1 **2 hours**

Scope and importance of Plant Anatomy

Interdisciplinary applications: - Histotaxonomy, Histochemistry, Pharmacognosy, Physiological Anatomy, Ecological Anatomy, Evolutionary trends in plant anatomy

Module -2 **6 hour**

Study of Cell wall: Gross structure of primary and secondary cell walls, simple and bordered pits. Structure and function of plasmodesmata.

Submicroscopic structure of cell wall- Cellulose, micelle, micro fibril and macro fibril. Different types of Cell wall thickening in tracheary elements

Extra cell wall thickening materials: - Lignin, cutin, suberin and callose.

Origin of cell wall; Growth of Cell wall- Apposition and intussusceptions – cavities & ducts, schizogenous & lysigenous developments

Nonliving inclusions in plant cell: - Reserve food materials -carbohydrate (starch), protein (Aleurone grain) and lipids (fats and oil);

Secretory products- pigments, enzymes and nectar.

Metabolic byproducts: - tannin, gums, resins, essential oils, mucilage, latex, mineral crystals and alkaloids

Module-3 **7 hours**

Tissues

Meristematic tissue- definition, structure, function and classification

Apical organization and theories; Shoot apex- Apical cell theory, Histogen theory and Tunica-Corpus theory.

Root apex - Histogen theory and Korper- Kappe theory.
Permanent Tissue: - Structure and function of simple and complex tissues.
Distribution and function of mechanical tissues in plants.
Plant fibres-economic importance.
Secretory tissues: - a). External secretory tissue- glands and nectaries, b). Internal secretory tissues- laticifers.

Module-4 **7hours**

Tissue System- Structure and Function in root, stem and leaves.

a) Epidermal Tissue System- Epidermis, Cuticle, Trichome, Stomata, Bulliform cells,Cork and Silica cells.
b) Ground Tissue System- Cortex, Endodermis, Pericycle, Pith and Pith rays.
c) Vascular Tissue System- Different types of vascular bundles and their arrangement in root and stem

Module-5. **3 hours**

Vascular cambium: - Development, structure and function, Activity of cambium, role of cambium in budding, grafting and wound healing.

Module-6. **8 hours**

Normal secondary growth in dicot stem and root.
Wood anatomy- basic structure, heart wood, sap wood, hard wood, soft wood, growth rings and dendrochronology, porous and non porous wood, ring porous and diffuse porous wood, tyloses, knots.
Wood rays: Structure and cell types, uniseriate and multiseriate rays; heterocellular and homocellular rays.
Reaction wood- Tension wood and compression wood.
Properties, defects and seasoning of wood.
Stem thickening in monocots.
Periderm: Structure and development- phellum, phellogen, phelloderm, bark, polyderm, rhytidome and lenticel.

Module-7. **3 hours.**

Anomalous secondary structure: *Bougainvillea* stem, *Bignonia* stem and *Dracaena* stem

Practicals **27 hours**

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

Reproductive Botany **(Theory-18 hrs. Practical -9 hrs,)**

Module-1 **2 hours**

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

Module-2 **2 hours**

Life cycle of Angiosperms.

Floral morphology- parts of flower; androecium-morphology and types of anthers; gynoecium- morphology and types of carpel and types of placentation.

Module-3 **4 hours**

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

Module-4 3 hours

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

Module-5 **3 hours**

Pollination mechanisms and agencies of pollination; pollen stigma interaction; compatibility and incompatibility; syngamy and fusion; apomixis.

Module-6 **4 hours**

Development of endosperm and embryo in Dicots and Monocots;

Polyembryony; Development and general structure of fruits(dry and fleshy) and seed.

Practicals 9 hours

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

Suggested Additional Topics

Applied Anatomy: Wood anatomy and identification of wood;
Wood fibres and Economic uses, Food fibers
Internal Structure of fruits, seeds and vegetables.
Cellulose fibre source and use in paper industry- Pulp and paper manufacture.
Fruit and leaf abscission
Electron microscopic structure of plant parts and their application in different branches of plant science

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Semester V Course-5 BOT5CRT0116

MYCOLOGY, LICHENOLOGY AND PLANT PATHOLOGY

(Theory: 36 hours; Practical: 45 hours) (Theory Credit 2, Practical Credit 2)

Course Objectives

Enable the student to

1. Understand the diversity of fungal and lichen world and its significance.
2. Understand the various plant diseases and their impact on agriculture.
3. Familiarize with the various measures adopted to control plant diseases.

I MYCOLOGY (Theory 24 hours; Practical : 36 hours)

Module 1 15 hours

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

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

Module 2 7 hours

1. Economic importance of Fungi –useful and harmful aspects.
2. Fungi of Agricultural importance – mycoherbicides, myconematicides, mycoparasites, Mycorrhiza –diversity, function and significance.
3. Fungal biotechnology- Fundamental principles.
   Mushrooms- edible and poisonous types.

cultivation technique-Spawn production .
Cultivation of Oyster mushroom.

II LICHENOLOGY 2 hours

Module 1

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

PRACTICALS 36 hours

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

III PLANT PATHOLOGY (Theory 12 hours; Practical: 9 hours)

Module 1 4 hours

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

Module 2 2 hours

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

Module 3 5 hours

Study of following diseases with emphasis on symptoms, disease cycle and control
Bunchy top of Banana.
Bacterial blight of Paddy.
Root wilt of Coconut.
Abnormal leaf falls of Rubber.
Fungicides - Bordeaux mixture, Tobacco Neem decotion, preparation. (Brief account only)

Module 4 1 hours

Medical mycology- Mention about fungal infections of man – Fungal allergens Athelet's foot, aspergillosis, candidiosis, aflatoxin

Practicals 9 hours

Students are expected to:

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

Suggested Additional Topics

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

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Semester V Course 6 BOT5CRT0216
ENVIRONMENTAL SCIENCE AND ECOTOURISM

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

Course Objectives:

1. Acquaint the student with the significance of Environmental Science.
2. Help the students to understand the extent, limitations and depletion of natural resources
3. Help the student to design novel mechanism for the sustainable utilization of natural resources.
4. Enable the students to understand the structure and function of the Ecosystems
5. Make the students to identify the nature and interactions of populations in the ecosystem
6. Enable the students to understand various kinds of pollution in the environment, their impacts on the ecosystem and their control measures
7. Make the students aware about the nature and structure of various environmental laws in India
8. Make the students aware about the role of various movements in the protection of nature and natural resources.
9. Make the students aware about the extent of the total biodiversity and their conservation.
10. Make the students to assess the positive and negative impacts of Ecotourism and its role in the sustainable utilization of resources for tourism.

ENVIRONMENTAL SCIENCE 48 hours

Module 1 1 hour

Environmental science and its multidisciplinary nature

Introduction, relevance and scope, public awareness

Module 2 **6 hours**

Natural Resources

- Types of resources-renewable and non renewable
- Forest resources: Timber extraction, mining, dams, over exploitation, deforestation, MFP (minor Forest products) , Joint Forest Management (JFM)
- Water resources: surface and ground water, drinking water, dams-benefits and problems, conflict over water, Rain water harvesting, Water shed conversation
- Food resources: major food crops in India. Causes of food shortage. Food security, world food problems.
- Energy resources: Energy plantation, - *Jatropha*
- Land resources: Land use, land degradation, desertification, EFL(Ecologically Fragile Land)
- Conservation of Biodiversity, ecological footprints

Module 3 **10 hours**

Ecosystems:

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

Module 4 **4 hours**

Community ecology

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

Module 5 **4 hours**

Plants and environment

Ecological complexes and factors affecting plants growth and response:

- Climatic factors: temperature and pressure; water - precipitation, humidity, soil water holding capacity; light - global radiation.
- Topographic factors: altitude and aspects
- Edaphic factors - profile and physical and chemical properties of soil
- Biotic factors: interactions – positive and negative.

Species – ecosystem interaction: Habitat, ecological niche, microclimate

Adaptation of plants to environment: To Water- Xerophytes, Hydrophytes; Temperature – thermo periodicity, vernalization; light – photoperiodism, heliophytes, sciophytes; salinity – halophytes, mangroves.

Module 6

Environmental pollution and Management 12 hours

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

Module 7

Social issues and the environment: **2 hours**

Climate change, global warming and green house gases, IPCC, Acid rain, Ozone layer depletion, nuclear accidents and nuclear holocaust.

Module 8

Environmental legislation and laws: **1 hour**

(1) 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 9 6 hours

Biodiversity and Conservation biology:

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

Module 10 2 hours

Organizations, movements and contributors of Ecological studies

- *Organizations*: BNHS, WWF, CSE, NEERI, , MoEF, Green Peace, Chipko

- *Famous contributors of Ecology in India:* Salim Ali, M.S. Swaminathan, Madhav Gadgil, M.C. Mehta, Anil Agarwal, Medhapatkar, John C. Jacob, Sunderlal Bahuguna

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.

Practicals – **45 hours**

1. Estimation of CO_2, Cl, and salinity of water samples (Titremetry)
2. Determination of pH of soil and water
3. Assessment of diversity, abundance, and frequency of plant species by quadrate method (Grasslands, forests)
4. Study of the most probable number (MPN) of coliform bacteria in water samples
5. EIA studies in degraded areas (Sampling – line transect, Quadrate)
6. Visit to any forests types including grasslands and preparation of the list of Rare and threatened (R&T) plants (no collection of specimens)
7. Collection, identification and preparation of the list of exotic species in the locality.
8. Identification of pollutant to respective pollution types.
9. Study of anatomical, morphological, physiological adaptation of plants to the environment (Xerophytic, Hydrophytic, Epiphytic, Halophytic).
10. Collection and recording of rain data by using simple rain gauge.

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Semester V Course 7 BOT5CRT0316
GENETICS, PLANT BREEDING AND HORTICULTURE

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

Course Objectives

1. Understand the basic principles of heredity
2. Understand the inheritance pattern of nuclear and extra nuclear genes
3. Understand the methods of crop improvement
4. Understand the importance of horticulture in human welfare

GENETICS (Theory 25 hrs)

Module 1. **2 hours**

Origin of a new branch of Biology- Genetics- Mendelian era; basic laws of inheritance, Mendelian ratios

Module 2. **8 hours**

Growth of Genetics- post Mendelian period- modified Mendelian ratios; incomplete dominance-flower color in *Mirabilis*: Interaction of genes- comb pattern in poultry (9:3:3:1): Epistasis- recessive- coat color in mice (9:3:4); dominant epistasis- fruit color in summer squash (12:3:1): complementary genes- flower color in *Lathyrus* (9:7).

Module3. **2 hours**

Multiple alleles- general account: ABO blood group in man; co dominance; self sterility in *Nicotiana*.

Module 4 **2 hours**

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

Module 5 4 hours

Linkage and crossing over - importance of linkage, linkage and independent assortment. Complete and incomplete linkage. Crossing over- general account, cytological basis of crossing over- two point test cross; determination of gene sequences; interference and coincidence; mapping of chromosomes.

Module 6 **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*); genic balance theory of sex determination in *Drosophila*; sex chromosomal abnormalities in man- Down's syndrome, Klinefelter's syndrome, Turner's syndrome- Sex linked inheritance- eye color in Drosophila, Haemophilia in man; Y-linked inheritance.

Module 7 **2 hours**

Extra nuclear inheritance- general account- maternal influence- plastid inheritance in *Mirabilis*, cytoplasmic male sterility in plants, kappa particle in *Paramecium*.

Module 8 **1 hour**

Population genetics-Hardy Weinberg law

PLANT BREEDING **(Theory: 15 hours)**

Module 1 **1hours**

Introduction and objectives of plant breeding.

Module 2 **1 hours**

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

Module 3 **2 hour**

Selection- mass, pureline, clonal- genetic basis of selection-achievements.

Module 4 **5 hours**

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

Module 5 **2 hours**

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

Module 5 **2 hours**

Modern tools for plant breeding; Genetic Engineering and products of genetically modified crops

Module 6 **2 hours**

Modern tools for plant breeding; Genetic engineering and products of Genetically modified crops

HORTICULTURE **(Theory: 14 hours)**

Module 1 **2 hours**

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

Module 2 **6 hours**

Propagation of horticultural plants- by seeds- Seed viability, seed dormancy, seed testing and certification, seed bed preparation, seedling transplanting, hardening of seedling; advantages and disadvantages of seed propagation. Vegetative propagation- organs used in propagation- natural and artificial vegetative propagation; methods- cutting, layering, grafting and budding; advantages and disadvantages of vegetative propagation.

Module 3 **6 hours**

Gardening- ornamental gardens, indoor gardens, kitchen gardens- terrestrial and aquatic gardens- garden adornments; garden designing- garden components- lawns, shrubs and trees, borders, hedges, edges, walks, drives- famous gardens of India; Landscape architecture- home landscape design, parks. Physical control of plant growth- training and pruning; selection of plant for bonsai, bonsai containers and method of bonsai formation

Practical **45 hours**

A. Genetics **27 hours**

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

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

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

B. 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

C. Horticulture **18 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
4. Preparation of potting mixture in the given proportion

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Semester V Course 8 BOT5CRT04
CELL MOLECULAR BIOLOGY AND EVOLUTION

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

Objectives

1. Understand the Ultra structure and functioning of cell in the submicroscopic and molecular level.
2. Get an idea of origin, concept of continuity and complexity of life activities.

3. Familiarization of life process.
4. Understand the basic and scientific aspect of diversity.
5. Understand the cytological aspects of growth and development.
6. Understand DNA as the basis of heredity and variation.
7. Understand the concept of evolution as the basis of biodiversity.

Module – I

CELL BIOLOGY **28 hours**

Unit 1. Historical account of cell Biology **1hours**

Cell theory

Protoplasm theory

Unit 2. Cell **8 hours**

The physio-chemical nature of plasma membrane and cytoplasm Eukaryotic, Prokaryotic cell.

The ultra structure of plant cell with brief description and function of the following organelles-Endoplasmic reticulum, Plastids, Mitochondria, Ribosomes, Dictyosome, Microbodies, lysosomes. Vacuole and cell sap, Nucleus - ultra structure, nucleolus structure and function.

Unit 3 Chromosomes **15 hours**

Morphology - fine structure Dupraw model - Nucleosome model – chemical organization of nucleosome – nucleoproteins, karyotype and idiogram; Special type of chromosomes - salivary gland, Lampbrush and B chromosome. Cell cycle, mitosis, meiosis: significance of mitosis and meiosis. Change in number of chromosomes -Aneuploidy and Euploidy

Change in the structure of chromosomes - Chromosomal abberations deletion, duplication, inversions and translocations. Meiotic Behaviour of chromosomes. Lagging of chromosomes and Chromosome Bridge

Unit 4 Mutations **2 hours**

Spontaneous and induced. Mutagens- Physical and Chemical mutagens.

Chromosomal and point mutations. Molecular mechanism of mutation - Transition, Transvesion and Substitution.

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

Module – II **17 hours**

MOLECULAR BIOLOGY

Unit 1. Nucleic acids - structure of DNA and RNA - basic features, alternate forms of DNA - types and structure of RNA **3hrs.**

Unit 2. Replication of DNA - Meselson-Stahl experiment - details of semiconservative replication of DNA **3 hrs**.

Unit 3. Gene expression - concept of gene, definitions - the central dogma - details of

transcription in procaryotes and eucaryotes - RNA prosessing.details of translation - genetic cod features **6hrs.**

Unit 4. Control of gene expression - positive and negative control - operon model - lac operon, trp operon -attenuation **3hrs**

Unit 5. Genetic basis of cancer - oncogenes - tumor suppressor genes - metastasis - **2hrs**

Module – III

EVOLUTION **9 hours**

Unit 1 Introduction, Progressive, Retrogressive, Parallel and Convergent evolution. Theories of evolution -Lamark's, Darwin's, Weisman's and De Vries. **4 hours**

Unit 2 Neo Darwinism **5 hours**

Reproductive isolation, Mutation, Genetic drift, Speciation. Variation and evolution, hybridization and evolution, Polyploidy and evolution. Mutation and evolution.

Practicals **45 hours**

1. Make acetocarmine squash preparation of onion root tip to identify mitotic stages.
2. Study the Mitotic Index of onion root tip cells
3. Study of meioses in any flower bud by smear preparation of PMC's
4. Identification of Barr body
5. PTC Testing
6. Identification of salivary gland chromosome.
7. Identify and study photographs and diagrams of cell division anomalies like lagging chromosomes, chr. bridge, aneuploidy, polyploidy. study the chromosomal patterns/ Karyotype in auto-, allo-, and aneuploids
8. Work out elementary problems based on DNA structure and replication

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Semester VI Course 9 BOT6CRT0116
PLANT PHYSIOLOGY AND BIOCHEMISTRY

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

Course objectives

1. Understand the basic principles related to various physiological functions in plant life.
2. Familiarize with the basic skills and techniques related to plant physiology.
3. Understand the role, structure and importance of the bio molecules associated with plant life.
4. Familiarize with the recent trends in the field of plant physiology.
5. Familiarize with applied aspects of plant physiology in other fields like agriculture.

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

MODULE -I 6 hours

Water relations

A. Physical aspects of absorption-Diffusion, imbibition, osmosis, OP, DPD, TP, WP, Concept of Water potential, matrix potential, pressure potential.

B. Absorption of water-active & passive, Ascent of sap-cohesion adhesion theory, Transpiration-types-mechanism-theories-(starch-sugar, proton-K+ion exchange)-significance – antitranspirants, Guttation

MODULE II **3hours**

Mineral Nutrition and mechanism of absorbtion.

Essential and non essential elements- macro& micro- role- deficiency symptoms.

Absorption of minerals– active & passive-ion exchange, carrier concept.

MODULE III **10 hours**

Photosynthesis

History - Photosynthetic pigments, photo exitation- Fluorescence, Phosphorescence - Absorbtion and action spectra, Red drop and Emerson enhancement effect, Concept of photo systems, Cyclic & Non Cyclic photophosphorylation, Carbon assimilation pathways-C_3, C4, CAM- Photorespiration –factors affecting photosynthesis.

MODULE - IV **2 hours**

Translocation of solutes

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

MODULE – V **8 hours**

Respiration

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

MODULE – VI **1hour**

Plant responses to environment

Allelochemicals- herbivory

MODULE – VII **4hours**

Physiology of growth and development

A. Physiological effects and practical application of hormones-Auxins, Giberillins, Cytokinins, ABA, ethylene.

B. Physiology of flowering–phytochrome-photoperiodism-vernalisation

MODULE – IX **2 hours**

Stress physiology

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

BIO-CHEMISTRY **(Theory 18: hours; Practical: 12 hours)**

MODULE - I **2 hours**

Water, Solutions & pH

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

MODULE – II **10 hours**

Chemistry of biological molecules

Carbohydrates- structure and role of mono-di & poly-saccharides-common sugars seen in plants

Proteins-peptide bond-essential and non essential amino acids-primary structure-physiologically important proteins.

lipids - general features and their roles - fatty acid types and structure - fatty acid derivatives-fats and oils, structure and functions - compound lipids

MODULE – III

Enzymes 6 hours

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

Plant physiology Practical (33 hours)

Core Experiments

1. Determination of osmotic pressure of plant cell sap by plasmolytic method.
2. Compare the stomatal indices of hydrophytes, xerophytes and mesophytes.
3. Separation of plant pigments by thin layer chromatography (TLC) and paper chromatography.
4. Measurement of photosynthesis by Willmott's bubbler/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.
8. Measurement of transpiration rate using Ganong's photometer/ Farmer's Potometer.

Biochemistry – Practical. 12 hours

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

Suggested additional topics

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

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Semester VI Course 10 BOT6CRT0216
BRYOLOGY, PTERIDOLOGY, GYMNOSPERMS & PALEOBOTANY

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

Course objectives

1. Understand the diversity in habits, habitats and organization of various groups of plants.
2. Understand the evolutionary trends in plants.

3. Identify the anatomical variations in lower groups of plants.
4. Understand the significance of Paleobotany.

BRYOLOGY (Theory: 16 hours;Practical:15 hours)

Module 1 2 hours

Introduction, general characters, classification, Evolution of Bryophytes.

Module 2 12 hours

Morphology, anatomy and reproduction in *Riccia, Marchantia, Anthoceros* and *Funaria.*

Evolution of sporophyte and gametophyte (Development of sex organs not necessary).

Module 3 2 hours

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

Practical 15 hours

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

PTERIDOLOGY (Theory:16 hours ; Practical :18 hours)

Module 1 2 hours

Introduction, general characters, classification, evolution of Pteridophytes.

Module 2 14 hours

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

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

Practicals 18 hours

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

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

Module 1 2 hours

Introduction, general characters, classification, origin and evolutionary significance

Module 2 12 hours

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

Practical 12 hours

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

PALAEOBOTANY (Theory: 8 hours)

Module 1 3 hours

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

Module 2 **4 hours**

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

Indian contribution to Palaeobotany **1 hour**

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Semester VI Course 11
BOT6CRT0316

ANGIOSPERM MORPHOLOGY, SYSTEMATIC BOTANY AND ECONOMIC BOTANY

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

Course objectives:-

1. Acquaint with the aims, objectives and significance of taxonomy.
2. Identify the common species of plants growing in Kerala and their systematic position.
3. Develop inductive and deductive reasoning ability.
4. Acquaint with the basic technique in the preparation of herbarium.
5. Familiarizing with the plants having immense economic importance.

Module-1. **(Theory 6 hours; Practical: 6 hours)**

Morphology .

Unit 1 Leaf Morphology (types, venation, phyllotaxy),

Unit 2 Morphology of flower

1. Parts of a flower- description of flower and it's parts in technical terms.
2. Flower as modified shoot.
3. Types of flower – Hypogyny, Perigyny and Epigyny, Symmetry of flowers.
4. Aestivation types.
5. Placentation types.
6. Floral Diagram and Floral Formula.

Unit 2

1. Inflorescence:-
   (a) Racemose types-Simple Raceme, Corymb, Umbel, Spike, Spadix and Head.
   (b) Cymose types-Simple Cyme, Monochasial- Scorpoid and Helicoid, Dichasial
   (c) Special type- Cyathium, Hypanthodium
2. Fruits: – Simple-Fleshy, Dry- dehiscent, indehiscent, Aggregate, Multiple(Sorosis and Syconus)

Module- 2. **(Theory 40 hours)**

Systematic Botany

Unit 1 Aim, Scope and Significance **1 hour**

Unit 2. Types of Classification- Artificial (Brief account), Natural – Bentham and Hooker(Detailed account) and Phylogenetic (Brief account) **3 hours**

Unit 3. Binomial Nomenclature, ICBN- Brief account **1 hour**

Unit 4. Interdiciplinary approach in Taxonomy- Cytotaxonomy and Chemotaxonomy. **1 hour**

Unit 5. Herbarium technique- Preparation of herbarium, their preservation. Important herbaria, Botanical Gardens and BSI**.** **2 hours**

Unit 6. Family studies: - **32 hours**

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

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

Module- 3 (Theory 8 hours)

Economic botany 6 hours

Unit 1. 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
Millets- Ragi
Pulses- Green gram, Bengal gram, Black gram
Sugar yielding plants – Sugarcane
Fruits:- Apple, Pineapple, Orange, Mango and Banana
Vegetables:-Bittergourd, Ladies finger, Carrot and Cabbage.
Timber yielding plants:- Teak wood and Jack wood
Beverages- Tea, Coffee
Fibre yielding plants- Coir, Jute, Cotton
Oil yielding plants- Ground nut, Gingelly
Rubber yielding plants- Para rubber
Gums and Resins- White damer, Gum Arabic, Asafoetida
Spices – Cardamom, Pepper, Cloves , Ginger
Insecticide yielding Plants- Tobacco and Neem

Unit 2. Ethnobotany and it's significance. **2 hours.**

Study of the following plants used in daily life by tribals and village folks for Food, Shelter and Medicine

Food :- *Artocarpus, Corypha, Phoenix*
Shelter - *Bamboosa, Ochlandra and Calamus*
Medicine - *Curcuma, Trichopuszeylanicus and Alpinia galangal*

Practicals 45 hours.

1. Identify the following inflorescence and fruits:-
   (a) Inflorescence - Simple raceme, Spike, Corymb, Head, Dichasial cyme and Cyathium.
   (b) Fruits - Simple: - Nut, Legume, Berry and Drupe Multiple and Aggregate
2. Preparation of floral formula from floral description.
3. Identify the families mentioned in the syllabus by noting their key, vegetative and floral characters.
4. Students must describe the floral parts, draw the L.S., floral diagram and write the floral formula of at least one flower from each family.

5. Study the finished products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
6. Prepare herbarium of 25 plants with field notes.
7. Conduct field work for a minimum of 5 days under the guidance of a teacher
8. Identify and describe the ethno botanical uses of the items mentioned in the syllabus.

Suggested additional topics

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

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Semester VI Course 12 BOT6CRT0416
BIOTECHNOLOGY AND BIOINFORMATICS

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

COURSE OBJECTIVES

1. Familiarize with the fundamental principles of biotechnology, various developments in biotechnology and potential applications.
2. Make aware that the life forms and activities can be exploited for human advancement.
3. Impart an introductory knowledge about bio informatics to the students.
4. Use of computers to handle biological data base.

BIOTECHNOLOGY (Theory 36 hours ; Practical 26 hours)

Module-1 10 hours

1. Introduction – The concept of biotechnology, landmarks in biotechnology.

2. Plant tissue culture – Principles and techniques.
   Cellular totipotency, *in vitro* differentiation –de differentiation and re-differentiation , callus induction, organogenesis and somatic embryogenesis.
3. Tissue culture medium – Basic components in tissue culture medium – Solid and liquid medium – suspension culture. Murashige and Skoog medium – composition and preparation. Aseptic techniques in tissue culture – sterilization – different methods – sterilization of instruments and glass wares, medium, explants; working principle of laminar air flow and autoclave; preparation of explants – surface sterilization. Inoculations, incubation, sub culturing.
4. Micro propagation - Different methods – axillary bud proliferation, direct and indirect organogenesis and somatic embryogenesis. Different phases of micropropagation – hardening, transplantation and field evaluation Advantages and disadvantages of micropropogation. Somaclonal variation.

Module – 2 10 hours

1. *Methods and Applications* of tissue culture - Shoot tip and meristem culure Synthetic seed production, embryo culture, I*n vitro* mutagenesis, Protoplast isolation culture and regeneration – transformation and transgenics, Somatic cell hybridization- cybrids. I*n vitro* secondary metabolite production — cell immobilization, bioreactors *In vitro* production of haploids – anther and pollen culture, *In vitro* preservation of germplasm.

Module – 3 8 hours

Recombinant DNA Technology

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

Different methods of gene transfer – chemically stimulated DNA uptake by protoplast, transduction, electroporation, microinjection, microprojectiles, *Agrobacterium* mediated gene transfer gene library, gene banks.

Module – 4 **3 hours**

Application of Biotechnology in :

Medicine - Production of human insulin, human growth hormone and vaccines, gene therapy, monoclonal antibodies, biopharming.

Forensics - DNA finger printing.

Agriculture- Genetically modified crops – Bt crops, Golden rice, FlavrSavr Tomato, Virus herbicide resistant crops, Edible vaccines.

Environment- Bioremediation- use of genetically engineered bacteria- super bug.

Industry - Horticulture and Floriculture Industry, production of vitamins, amino acids and alcohol.

Module – 5 **3 hours**

Scope and relevance of the following technologies(Methodology not required)

Microbial biotechnology, Tissue Engineering technology, Embryonic stem cell culture, animal cloning, Micro array technology, Bionanotechnology.

Module-6 **2 hours**

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

PRACTICALS **32 hours**

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

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

Module-1 **7 hours**

1. Introduction to Bioinformatics, scope and relevance, genome, transcriptome, proteome.
2. Biological data bases –
   Nucleotide sequence database – EMBL, Gen Bank, DDBJ.
   Protein sequence database – PDB, SWISS PROT
   Organismal database – *Saccharomyces* genome database
   Biodiversity database – Species 2000
3. Information retrieval from Biological database, sequence alignment types and tools: pair wise sequence alignment multiple sequence alignment, use of BLAST, FASTA.

Module-2 **6 hours**

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

Module-3 **5 hours**

A brief account on

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

PRACTICALS **13 hours**

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

Suggested additional topics

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

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Semester VI Core Course Choice Based - BOT6CBT01
AGRIBUSINESS (54 hours)

Course objectives

1. Inculcate and impart an idea about the business opportunities in the field of plant sciences.
2. Develop an entrepreneurial mindset and also to stick on to the core subject among the Botany students.
3. Give an idea about the need of sustainable development and organic farming.
4. Harness the opportunities and potentials in the field of ecotourism, processing technology and food sciences.

Module 1. **2 hours**

Entrepreneurship

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. **8 hours**

Value added Food products

Preparation and Preservation Techniques. Causes of Spoilage of Food. Principles of preservation – asepsis, removal of microorganisms, anaerobic situation and special methods – drying, thermal processing – pasteurization, sterilization and canning – low temperature, use of chemical preservatives and food additives. Preparation of wine, vinegar, pickles, jam, jelly, syrups, sauce, dry fruits, dairy products – (cheese, butter, yoghurt, paneer), candies, chocolates, payasam, kondattum.

Module 3. **8 hours**

Processing techniques.

Processing of latex – Centrifuged latex products and galvanized rubber products. Processing, storage and marketing of Cocoa, Coconut (Copra ,Coir and Tender coconut), Rice (par boiled, raw rice and rice flour), Pepper, Cardamom, Ginger, Arrowroot, Tapioca, Cashew, Mango, Jack fruit, Guava, Grapes, Lemon, Papaya, Musa, Garcinia. Basic principles of preparation of Lehyam and Decoction.

Module 4. **6 hours**

Nursery Management.

Preparation of potting mixtures, polybags. Plant Growth structures – green houses, shaded houses, polyshed, mist chamber, sprinkling system, drip irrigation. Modern strategies in propagation by root initiation of cutting, layering technique, budding and grafting technique – Micropropagation; Planting, Transplanting and Hardening of seedlings, After care of seedlings. Packing and transporting of seedlings.

Module 5. **6 hours**

Organic farming and Composting Techniques.

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

Module 6. **6 hours**

Cultivation of Vegetables, Fruits and Medicinal Plants.

Types – Home gardening, Market gardening and Truck gardening. Packing and Transporting of Vegetables.

Organic farming of fruit crops – Packing and Transporting of fruits.

Induction of flowering and weed control.

Cultivation of Medicinal and Aromatic plants of common use and great demand.

Module 7. **6 hours**

Floriculture and Apiculture.

Problems and prospects of Floriculture in Kerala.

Scope of growing Anthurium, Orchids and Jasmine in Kerala.

Common cut flowers – Rose, Gerbera, Gladiolus, Aster, *Chrysanthemum*, Daisys, Carnation, Golden rod, Anthurium, Orchids, Lilium and Limolium.

Common leaves used in flower arrangement – *Cyprus, Podocarpus*, *Asparagus*, Palms, Cycads, Ferns and *Eucalyptus.*

Apiculture – Scope and Significance.

Structure, Installation and maintenance of an Apiarium.

Extraction, Processing, preservation and Marketing of Honey.

Module 8. **4 hour**

Flower arrangement.

Types -Western, Eastern (Japanese/ Ikebana) and Modern.

Wases, Flower Holders and Floral Foam.

Wase life of flowers and leaves.

After care of flower arrangements – Bouquets.

Packing and Maintenance of flowers and leaves.

Module 9. **4 hours**

Ornamental Garden designing.

Use of different garden components.

Lawn preparation by seeds, seedling and turfing.

Maintenance of garden by Irrigation, Pruning, Repotting.

Disease and Pest control.

Module 10. **4 hours**

Mushroom cultivation and Farming.

Mushrooms – Significance – Nutritive value.

Types of Mushrooms – Button – *Pleurotus, Volvorella*.

Spawn production, storage and marketing.

Growth of Mushrooms on Paddy Straw and Saw dust by Poly bag.

Mushroom growing structures and maintenance of humidity.

Pests and defects of mushrooms.

Storage, Transporting and Marketing of Mushrooms.

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14. Pandey, R.K and S.K. Ghosh, 1996 A Hand Book on Mushroom Cultivation. Emkey Publications.
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16. Prince Alex, Rajani A. Nair, 2003 Ayurveda Avshodha Nirmanam – Sidhanthavum Prayogavum Malayalam. Kerala Bhasha Institute.
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Semester V Open Course

BOT5COT011

6 AGRIBASED MICROENTERPRISES(72 Hours)

Course objectives

1. A basic information about the business opportunities in plant sciences.
2. Inform the student about sustainable agriculture and organic farming.
3. Inculcate an enthusiasm and awareness about ornamental gardening, nursery management and mushroom cultivation.

Module 1. 9 hours

Organic farming and composting techniques

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

Module 2. 18 hours

Horticulture and Nursery management.

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

products and flowers.

Module 3. **9 hours**

Food spoilage and preservation techniques.

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

Module 4. **9 hours**

Mushroom cultivation and Spawn production.

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

Module.5. **9 hours**

Plant tissue culture and micropropagation

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

On Hand Training **18 hours**

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

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SEMESTER –I COMPLEMENTARY COURSE –I

BOT1CMT0116 CRYPTOGAMS, GYMNOSPERMS AND PLANT PATHOLOGY

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

Course objectives

1. Acquire fundamental knowledge in plant science and to make the student to understand that Botany is an integral part of the human life and developments.
2. Foster and encourage an attitude of curiosity, appreciation and enquiry of various life forms of plants
3. Understand the indentifying characters of the different types included in the syllabus
4. Understand the diversity of microbes and plants with respect to Viruses ,Bacteria, Algae, Fungi, Lichens, Bryophytes , Pteridophytes and Gymnosperms

Module-1 Cryptogams **28 hours**

1.Viruses: General account, structure of Tobacco Mosaic Viruses (TMV), mode of infection- T phages **2 hrs**

2.Bacteria: Classification, structure, nutrition chemosynthesis, respiration, reproduction(binary fission). Economic importance – agriculture, industry and medicine. Archaebacteria. **2 hrs**

3.Algae (Phycology)Classification, main features of structure, and life history of the following groups

Cyanophyceae : *Nostoc*
Chlorophyceae: *Volvox*
Oedogonium
Cladophora
Phaeophyceae : *Ectocarpus*
Rhodophyceae : *Polysiphonia*
Economic importance of Algae (general account) **8 hrs**

4.Fungi (Mycology**):**Classification, main features of structure, and life history of the following groups.

Phycomycetes : *Phytophthora*
Ascomycetes : *Peziza*
Basidiomycetes: *Puccinia*
Economic importance of Fungi (general account) **7 hrs**

5. Lichens (Lichenology**):** Classification and general account.
Type *Usnea* : **2 hrs**

6. Bryophytes (Bryology): General account of Bryophytes
Type: *Riccia* **3 hrs**

7. Pteridophytes (Pteridology)**: G**eneral account of Pteidophytes
Type: *Selaginella* **4 hrs**

Module- 2 Gymnosperms **4 hrs**
General account of Gymnosperms
Type: *Cycas*

Module- 3 Plant Pathology **4hrs**

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

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

PRACTICAL **36 Hrs**

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

Suggested additional topics

1. The five kingdom classification – proposed by Whittaker (1969)
2. Advanced anatomical and reproductive characters of Gnetum

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
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7. Chopra R.N and Kumra P. K (1988) Biology of Bryophytes. New Delhi, Wiley Eastern 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

SEMESTER –II COMPLEMENTARY COURSE –II

BOT2CMT0116 PLANT PHYSIOLOGY

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

Course objectives

Understand the mechanism of various physiological processes related to plant life.

Module 1 **(10 hrs)**

1. Water relations of plants: (a) Physical aspects of water absorption –imbibition, diffusion and osmosis. Plant cell as an osmotic system. Diffusion pressure deficit, water potential, plasmolysis (b) Mechanism of absorption of water. Active and passive absorption. **(4 hrs)**
2. Transpiration – types, structure and mechanism of stomtal transpiration, (theories) significance and factors affecting transpiration, antitranspirants, Guttation. **(4 hrs)**
3. Stress Physiology – Water and salt stress,adaptations **(2 hrs)**

Module 2 **(14 hrs)**

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

Module 3 **(12 hrs)**

1. Translocation of organic solutes: Path and mechanism of Translocation, Munch mass flow hypothesis. **(3 hrs)**

2. Nitrogen fixation, Nitrogen Cycles. **(2 hrs)**

3. Dormancy of seeds, factors causing dormancy, photoblastisms, techniques to break dormancy, germination – mobilization of food reserves, physiology of fruit ripening. **(2 hrs)**

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

PRACTICAL **36 hours**

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

Core Experiments:

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

Demonstration Experiments:

1. Determination of transpiration under different environmental conditions using Ganong's / Farmer's Potometer
2. Relation between transpiration and absorption
3. Evolution of O_2 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 **(36 hrs)**

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SEMESTER –III COMPLEMENTARY COURSE –III
BOT3CMT0116 ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY

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

Course objectives

1. Acquaint the student with the objectives and components of Taxonomy.
2. Help the student to understand the systems of classification of angiosperms.
3. Help the student to identify the common angiosperm species of Kerala.
4. Familiarize the student with plants of immense economic importance.

Module 1.Angiosperm Taxonomy (Theory 36 hours; Practical 24 hours)

1. Importance of plant classification, types of classification, binomial nomenclature; ICBN, cytotaxonomy, chemotaxonomy. **4 Hrs**

2. Herbarium techniques :Field study, field note, vasculum, plant press, disinfecting and mounting, labeling, importance of herbarium. **3 Hrs**

3. Bentham and Hooker's system of classification. **3 Hrs**

4. Morphology of Angiosperms – flowers, inflorescence, fruits **4 Hrs**

5. 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).* **22 Hrs**

Module 2.Economic Botany (Theory 18 hours, Practical 12 hours)

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

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

Cereals	: Paddy, Wheat.
Pulses	: Green gram, Bengal gram.
Tuber crops	: Tapioca.
Spices	: Pepper, Cardamom.
Beverages	: Tea, Coffee.
Oil yielding plants	: Coconut, Groundnut
Fibre yielding plants	: Cotton, Coir.
Timber yielding plants	: Teak, Rose wood.
Latex yielding plants	: Para rubber.
Bio pesticides	: Neem, Tobacco.
Ornamental plants	: Rose, Orchids, Anthurium.

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

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

Practicals 36 hours

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

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

Suggested additional topics

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

Reference

1. Eames, A. J. 1969. *Morphology of Angiosperms*. Mc Graw – 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.
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SEMESTER –IVCOMPLEMENTARY COURSE –IV BOT4CMT01
ANATOMY AND APPLIED BOTANY

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

Course objectives

To help the student

1. Understand different types of plant tissues.
2. Understand the internal structure of different plant organs with reference to their functions.
3. Understand the process of normal and anomalous secondary thickening in plants.
4. Know the morphological and anatomical adaptations of plants growing in different habitats.
5. Understand the applications of botanical knowledge in the field of crop improvement for human prosperity.

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

1. Cell types, electron microscopic studies on plant cell – living and non living inclusions, cell wall– ultra structure of cell wall (brief account only) **4 Hrs**
2. Tissues: simple and complex; meristems, secretary tissues. **4 Hrs**
3. Cambium: origin, structure, function, role in budding and grafting. **2 Hrs**
4. Primary structure of stem and root in dicots and monocots. **3 Hrs**

5. Secondary thickening in dicot stem and dicot root; growth rings, heart wood and sap wood; hard wood and soft wood; ring porous wood and diffuse porous wood, Anomalous secondary thickening in *Bignonia*. **5 Hrs**
6. Anatomy of monocot and dicot leaf. **3 Hrs**
7. Ecological anatomy: Study of the morphological and anatomical adaptations of the following groups; Hydrophytes (*Nymphaea*), Xerophytes (*Nerium*), Epiphytes (*Vanda*) and Halophytes (*Avicinia/ Rhizophora*). **9 Hrs**

Module 2: Applied Botany (Theory 24 hours)

1. Plant breeding: Objectives, sexual and asexual reproduction; apomixis, apogamy, apospory,amphimixis, parthenogenesis, parthenocarpy, polyembryony. **5 Hrs**

2. Methods of plant improvement
    a. Plant introduction, acclimatization plant quarantine.
    b. Selection: Mass selection; pureline selection and clonal selection.

b. Hybridization; intervarietal, interspecific and intergeneric; procedure of hybridization. **5 Hrs**

3. Special methods of plant breeding.
   a. Mutation breeding.
   b. Polyploidy breeding. **3 Hrs**

4. Horticultural practices
   Propagation through cutting, layering, budding and grafting **5Hrs**

5. Tissue culture
   Principles, techniques and applications; culture media, asepsis, callus, organogenesis, somatic embryogenesis, anther culture, artificial seeds. **6Hrs**

Practicals

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

Suggested additional topics

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

Reference.

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