1. Model-I, Model-II & Model-III

METHODOLOGY AND PERSPECTIVES OF SCIENCE
&
AN INTRODUCTION TO THE WORLD OF PLANT DIVERSITY

Core Course Choice Based

Open Course

COMPLEMENTARY COURSE I

Vocational Subject - ENVIRONMENTAL MONITORING AND MANAGEMENT

B.Sc. BOTANY AND BIOTECHNOLOGY (DOUBLE CORE)

B. Sc Zoology (Vocational) Degree - COMPLEMENTARY COURSE BOTANY

MAHATMA GANDHI UNIVERSITY
PRIYADARSHINI HILLS, KOTTAYAM 686 560

CHOICE BASED COURSE CREDIT SEMESTER SYSTEM AND GRADING

SCHEME & SYLLABI

For
Under Graduate Course

IN
BOTANY

B. Sc Botany Programme

1. *Model I*
2. *Model II (Vocational) &*
3. *Model III (Double core)*

BOARD OF STUDIES IN BOTANY (U G)
2009

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c. Open course
d. Complementary course

2. Model 2 (Vocational) (Model II)
3. Botany Biotechnology (Double Core)programme (Model III)
4. Zoology (Vocational) Complementary

MAHATMA GANDHI UNIVERSITY, KOTTAYAM
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1. Dr. K. Danielkutty, Reader & Head of the Department ,Department of Botany, St. Thomas College, Kozhencherry (Chairman).
2. Smt. P. Sreekumari, LSG, Dept. of Botany, D.B. College, Thalayolapparambu.
3. Dr. P. K. Padmakumar, Reader, Dept. of Botany, NSS Hindu College, Changanacherry.
4. Smt. R. Rajalekshmi, LSG, Dept. of Botany, SVRNSS College, Vazhoor.
5. Dr. Johnson Joseph, LSG, Dept. of Botany, Deva Matha College, Kuruvilangad.
6. Mr. C. M. Sreejith, LSG, Dept. of Botany, SNM College, Maliankara.
7. Dr. P. Thomas Mathew, LSG, Dept . of Botany, UC College, Aluva.
8. Dr. N. Valsalakumar, LSG, Dept. of Botany, Govt. College, Kottayam.
9. Dr. Elizabeth Thomas, LSG, Dept. of Botany, St. Thomas College, Kozhencherry.
10. Dr. Abiss V. Cherrussery, LSG, Dept. of Botany, St. Joseph s College, Devagiri, Calicut
11. Dr. Ashlatha S. Nair, Professor, Dept. of Botany, University of Kerala, Thiruvananthapuram.

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WE THANK ALL THE ESTEEMED

MAHATMA GANDHI UNIVERSITY KOTTAYAM
B. Sc. BOTANY PROGRAMME
UNDER COURSE CREDIT SEMESTER SYSTEM
AIMS AND OBJECTIVES OF THE PROGRAMME

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 life long 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.

1. Know the importance and scope of the discipline
2. Inculcate interest in and love of nature with its myriad living forms
3. Impart knowledge of Science as the basic objective of Education
4. Develop a scientific attitude to make students open minded, critical and curious
5. Develop an ability to work on their own and to make them fit for the society
6. Expose themselves to the diversity amongst life forms
7. To develop skill in practical work, experiments, equipments and laboratory use along with collection and interpretation of biological materials and data
8. Make aware of natural resources and environment and the importance of conserving it.
9. Develop ability for the application of the acquired knowledge in the fields of life so as to make our country self reliant and self sufficient
10. Appreciate and apply ethical principles to biological science research and studies

COURSE STRUCTURE

The U .G. Programme in Botany must include (a) Common courses, (b) Core courses, (c) Complementary Courses, (d) Open Courses and (e) Project. No course shall carry more than 4 credits. The student shall select any Choice based course offered by the department which offers the core courses, depending on the availability of teachers and infrastructure facilities of in the institution. Open course shall be offered in any subject and the student shall have the option to do courses offered by other departments.

The number of Courses for the restructured Programme should contain 12 core courses and 1 choice based course from the frontier area of the core courses, 8 complementary courses, or otherwise specified, from the relevant subjects for complementing the core of study. There should be 10 common courses, or otherwise specified, which includes the first and second language of study.

Course coding:

Every course in the programme is coded according to the following criteria.

1. The first two letter from the Programme i.e., **BO**
2. One digit to indicate the semester, **i.e., BO1 (Botany, 1st semester)**
3. One letter from the type of courses such as common course A, core courses B, Complementary courses C, Open courses D, BO1B **(Botany , 1st semester Core course)**
4. Two digits to indicate the course number of that semester, i.e.., BO1B01 **(Botany, 1st semester, Core course, courses number is 01)**
5. The letter U to indicate for Under Graduate Programme . i.e.., **BO1B01U (Botany , 1st semester, Core course, courses number is 01, U for UG Programme)**

OPEN COURSES FOR OTHER STREAMS 5TH SEMESTER

Botany Department can offer any of the Five Open courses to other streams

Horticulture and Nursery Management/

Agribased Microenterprises/

Ecotourism /

Biotechnology /

Bioinformatics.

CORE CHOICE BASED COURSE 6TH SEMESTER

The students of Botany Programme of each College can select any of the three in consultation with the Faculty of the Department

Plant Genetic Resources Management/

Phytochemistry/

Agribusiness

B. Sc BOTANY PROGRAMME

CORE COURSE

SCHEME OF DISTRIBUTION OF INSTRUCTIONAL HOURS

Name of Semester	Theory	Practical
First semester	2	2
Second semester	2	2
Third semester	3	2
Fourth semester	3	2
Fifth semester	15	10
Sixth semester	15	10

B. Sc Programme in Botany (Core courses):

The following table shows the structure of the programme which indicate Code of the courses, Title of the courses, Instructional hours Credits, university examination time and the components for internal and external evaluation

Semester	CODE	NAME OF CORE COURSE	INST.HRS/ WEEK	CREDIT	Tot. CREDITS	Total Hours/ seme	University exam	Weightage	
								IA	EA
1	BO1B01U	Methodology and Perspectives of Science & Introduction to the World of Plant Diversity PRACTICAL 1	2 2	2 1	3	72	3hrs	1	3
2	BO2B02U	General Informatics and Methodologies in Plant Sciences PRACTICAL 2	2 2	2 1	3	72	3	1	3
3	BO3B03U	Anatomy & Reproductive Botany of Angiosperms PRACTICAL 3	3 2	3 1	4	90	3	1	3
4	BO4B04U	Microbiology and Phycology PRACTICAL 4	3 2	3 1	4	90	3	1	3
5	BO5B05U	Mycology, Lichenology and Pathology PRACTICAL 5	2 4	2 2	4	108	3	1	3
	BO5B06U	Bryology, Pteridology, Gymnosperms and Palaeobotany PRACTICAL 6	3 2	3 1	4	90	3	1	3
	BO5B07U	Angiosperm Morphology, Taxonomy and Eco. Botany PRACTICAL 7	3 2	3 1	4	90	3	1	3
	BO5B08U	Cell and Molecular Biology and Evolution PRACTICAL 8	3 2	3 1	4	90	3	1	3
	BO5D01U	**OPEN COUESE:** Horticulture and Nursery Management/ Agribased Microenterprises / Biotechnology / Bioinformatics	4	4	4	72	3	1	3
6	BO6B09U	Plant Physiology and Biochemistry PRACTICAL 9	3 4	2 2	4	126	3	1	3
	BO6B10U	Environmental Studies and Ecotourism PRACTICAL 10	3 2	3 1	4	90	3	1	3
	BO6B11U	Genetics, Plant Breeding and Horticulture PRACTICAL 11	3 2	3 1	4	90	3	1	3
			3						

	BO6B12 U	Biotechnology and Bioinformatics PRACTICAL 12	2	3 1	4	90	3		3
	BO6B13 U	**CORE- CHOICE BASED COURSE :-** Plant Genetic Resource / Phytochemistry / Agribusiness	3	3	3	54	3	1	3
		Project & Viva		1	1			1	3

RESTRUCTURED CURRICULUM FOR B. Sc DEGREE IN BOTANY PROGRAMME
COURSE STRUCTURE

Total Credits 120

Total instructional hours 150

Semester I

No	Course Title	Hrs/ week	Credit
1	Common Course English -1	5	4
2	Common Course English -2	4	3
3	Common Course Sec. language -1	4	4
4	Core Course -1 Methodology and Perspectives of Science and Introduction to the World of Plant Diversity + practical	4	3
5	1st Complementary – Chemistry/Biochemistry- I	2	2
6	1st Complementary - Chemistry/Biochemistry- I practical	2	1
7	2nd Complementary- Zoology -1	2	2
8	2nd Complementary- Zoology - 1 Practical	2	1
	Total	25	20

Semester 2

No	**Course Title**	**Hrs/ week**	**Credit**
1	Common Course -English -3	5	4
2	Common Course -English -4	4	3
3	Common Course - Sec. language -2	4	4
4	Core Course -2 General Informatics and Methodologies in Plant Sciences + practical	4	3
5	1st Complementary - Chemistry/Biochemistry- 2	2	2
6	1st Complementary - Chemistry/Biochemistry- 2 practical	2	1
7	2nd Complementary -Zoology -2	2	2
8	2nd Complementary Zoology – 2 practical	2	1
	Total	**25**	**20**

Semester 3

No	Course Title	**Hrs/ week**	**Credit**
1	Common Course English -5	5	4

2	Common Course Sec. language -3	5	4
3	Core Course -3 Anatomy and Reproductive Botany of Angiosperms + practical	5	4
4	1st Complementary - Chemistry/Biochemistry- 3	3	3
5	1st Complementary - Chemistry/Biochemistry- 3 practical	2	1
6	2nd Complementary -Zoology -3	3	3
7	2nd Complementary Zoology ◆ 3 practical	2	1
	Total	**25**	**20**

Semester 4

No	Course Title	Hrs/ Week	Credit
1	Common Course -English - 6	5	4
2	Common Course Sec. language -4	5	4
3	Core Course- 4 - Microbiology and Phycology + practical	5	4
4	1st Complementary - Chemistry/Biochemistry- 4	3	3
5	1st Complementary - Chemistry/Biochemistry- 4 practical	2	1
6	2nd Complementary -Zoology -4	3	3
7	2nd Complementary Zoology ◆ 4 practical	2	1
	Total	**25**	**20**

Semester 5

No	Course Title	Hrs/ Week	Credit
1	Core Course-5 Mycology, Lichenology and Pathology + Two Practical including practicals of project	6	4
2	Core Course-6 Bryology, Pteridology, Gymnosperms and Paleobotany + practical	5	4
3	Core Course-7 Angiosperm morphology, Taxonomy and Economic Botany + practical	5	4
4	Core Course-8 Cell and Molecular Biology and Evolution + practical	5	4
5	Open Course Horticulture and Nursery Management/Agri. Based Microenterprises/ Ecotourism/ Biotechnology/ Bioinformatics	4	4
	Total	**25**	**20**

Semester 6

No	Course Title	Hrs/ Week	Credit
1	Core Course -9 Plant Physiology and Biochemistry +Two Practicals ◆including practicals of project	7	4
2	Core Course -10 Environmental Studies and Ecotourism + Practical	5	4
3	Core Course -11 Genetics, Plant Breeding and Horticulture + practical	5	4
4	Core Course-12 Biotechnology and Bioinformatics +Practical	5	4
5	Core Choice based ◆ 13 Plant Genetic Resources Management/Phytochemistry/Agribusiness	3	3
6	Project	-	1
7	**Total**	**25**	**20**

Examinations :

The evaluation of the course shall contain two part such as Internal or In Semester Assessment (IA) and External or End Semester Assessment (EA). The ratio between internal and external examination shall be 1:3. The internal and external examination shall be evaluated using Direct Grading system based on 5- point scale

Internal or In Semester Assessment (IA):

Internal evaluation is to be done by continuous assessments on the following components. The components of the internal evalution for theory and their weights are as below.

% age of Attendance	Grade
≥ 90%	A
≥ 85 and 90	B
≥ 80 and 85	C
≥ 75 and 80	D
<75	E

Theory

***Attendance**

Component	Weight
*Attendance	1
**Assignment	1
***Seminar	1
Best of two test papers	2

Components	Weightage
Innovation of Topic	1
Review/ Reference	1
Content	2
Conclusion	1
Presentation	2

****Assignment Components**

***** Seminar Components**

Components	Weightage
Punctuality	1
Review	1
Content	2
Conclusion	1
Refference	1

The student has to take a minimum of 1 assignment 1 seminar per course. A minimum of 2 class testes are to be attended and the grade of best 2 tests are to be taken.

Pratical : Internal ***Attendance & **Laboratory Involvement**

Component	Weightage
Attendance *	1
Laboratory Involvement **	2
Test	2
Record	2
Viva- Voce / Quiz	1
Total	8

Attendance*	****Laboratory Involvement**
>90% = A > 85 and <90 = B > 80 and <85 = C >75 and <80 = D < 75 = E	Punctually + Handing Equipments + Skill in Laboratory Work + Group Interation =A

The evaluation of all components is to be published and is to be acknowledged by the candidate. All documents of internal assessment are to be kept in the institution for 2 years and shall be made available for verification by the University. The responsibility of evaluating the internal assessment is vested in the teacher(s) who teach the course.

External or End - Semester Assessment (EA):

The external examination of all semesters shall be conducted by the University on the close of each semester. There will be no supplementary exams. For reappearance / improvement, students can appear along with the next batch.

Examinations (Practical):

The practical examinations for the core courses at the end of semester 1, semester 2, semester 3 and semester 4 should be conducted by the University with a common time-table and questions set by the University, of two hours duration. The one of the examiners shall be selected from a panel of examiners published by the University and the other shall be internal . The external examiner may provide the specimens for examinations. The same external examiner should not be selected consecutively. The graded score sheet, duly certified by the head of the institution, should be sent to the University before the commencement of the end semester University examinations on theory courses. The practical examinations for the core courses at the end of semester 5 and semester 6 should be conducted as the other semesters and by arranging two practical examinations in a session of three hours duration. The setting of question paper and scheme of examination and valuation of the practicals shall be decided by a Board of examination constituted for the purpose.

The practical examinations for the complementary courses at the end of semester 1, semester 2 and semester 3 and semester 4 should be conducted by the university with a common time-table and questions set by the University. The one of the examiners shall be selected from a panel of examiners published by the University and the other one internal. The graded score sheet, duly certified by the head of the institution, should be sent to the university before the commencement of the end semester university examinations on theory courses.

Pattern of Questions (Theory):

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. Different types of questions shall be given different weights to quantify their range.

For all semesters:

1. The examination has duration of 3 hours
2. Each question paper has four parts A, B, C & D.
3. Part A contains 16 objective type questions of which the candidate has to answer all. Each bunch of 4 questions carries a weightage of 1
4. Part B contains 8 short answer type questions spanning the entire syllabus and the candidate has to answer 5 questions. Each question carries a weightage of 1.
5. Part C contains 4 compulsory short essay/ problem type questions with internal choice. Each question carries a weightage of 2.
6. Part D contains 2 compulsory essay type questions with internal choice. Each question carries a weightage of 4.

SCHEME OF EXAMINATIONS

Theory Examinations will be conducted by the University at the end of the respective semester in which the course is conducted. **Duration 3 hrs**

Of the total weightage, **25% is for internal evalution and 75% for external evaluation**

SCHEME OF EXAMINATION THEORY (CORE COURSE)

semester	Code	Course	Hrs	Internal weightage	External weightage	Credits
1	BO1B01U	Methodology and Perspectives of Science and Introduction to the World of Plant Diversity	3	25%	75%	2
2	BO2B02U	General Informatics and Methodologies in Plant Sciences	3	25%	75%	2
3	BO3B03U	Anatomy and Reproductive Botany of Angiosperms	3	25%	75%	3
4	BO4B04U	Microbiology and Phycology	3	25%	75%	3
5	BO5B05U	Mycology, Lichenology and Pathology	2	25%	75%	2
	BO5B06U	Bryology, Pteridology, Gymnosperms and Paleobotany	3	25%	75%	3
	BO5B07U	Angiosperm Morphology, Taxonomy and Economic Botany	3	25%	75%	3
	BO5B08U	Cell and Molecular Biology and Evolution	3	25%	75%	3
	BO5D01U	**OPEN COUESE** :-Horticulture and Nursery Management / Agribased Microenterprises / Biotechnology/ Bioinformatics	4	25%	75%	4
6	BO6B09U	Plant Physiology and Biochemistry	3	25%	75%	2
	BO6B10U	Environmental Studies and Ecotourism	3	25%	75%	3
	BO6B11U	Genetics, Plant Breeding and Horticulture	3	25%	75%	3
	BO6B12 U	Biotechnology and Bioinformatics	3	25%	75%	3
	BO6B13 U	*Plant Genetic Resources Management/*Phytochemistry/ *Agribusiness*	3	25%	75%	3

SCHEME OF PRACTICAL EXAMINATIONS

The Practical examinations for the core courses at the end of semester 1,2,3 and 4 shouldbe conducted by the university with a common time table and questions set by University.

Weightage

SEMESTER	Practical	CODE		Internal	external	credit
1	Practical 1 2 hrs	BO1B01U	Methodology and Perspectives of Science and Introduction to the World of Plant Diversity	25%	75%	1
2	Practical 2 2 hrs	BO2B02U	General Informatics and Methodologies in Plant Sciences	25%	75%	1
3	Practical 3 2 hrs	BO3B03U	Anatomy and Reproductive Botany of Angiosperms	25%	75%	1
4	Practical 4 2 hrs	BO4B04U	Microbiology and Phycology	25%	75%	1

The Practical Examination for the Core courses at the end of semesters 5 & 6 should be conducted in two days by arranging two practical examinations in a session.

5	Practical 5 & Practical 6 3hrs	BO5B05U	Mycology, Lichenology and Pathology	25%	75%	2
		BO5B06U	Bryology, Pteridology, Gymnosperms and Paleobotany	25%	75%	1
5	Practical 7 &	BO5B07U	Angiosperm Morphology, Taxonomy and Economic Botany	25%	75%	1

	Practical 8 3 Hrs	BO5B08U	Cell and Molecular Biology and Evolution	25%	75%	1
6	Practical 9 & Practical 10 3Hrs	BO6B09U	Physiology and Biochemistry	25%	75%	2
		BO6B10U	Environmental studies& Ecotourism	25%	75%	1
6	Practical 11 & Practical 12 3 Hrs	BO6B11U	Genetics, Plant Breeding and Horticulture	25%	75%	1
		BO6B12 U	Biotechnology and Bioinformatics	25%	75%	1
	Project			25%	75%	1

TOTAL CREDIT

Theory

Core	32
Core Choice based	3
Open Course	4
Total	**39**

Practical

Semester I	1
Semester II	1
Semester III	1
Semester IV	1
Semester V	5
Semester VI	5
Project	1
Total	15
Total	**54**

RECORDS - 7

1. Methodology and Perspectives of Science and Introduction to the World of Plant Diversity
2. General Informatics and Methodologies in Plant Sciences
3. Anatomy and Reproductive Botany of Angiosperms
4. Microbiology and Phycology
5. Mycology, Lichenology and Pathology & Bryology, Pteridology, Gymnosperms and Paleobotany
6. Angiosperm Morphology, Taxonomy and Economic Botany & Cell and Molecular Biology and Evolution
7. Physiology and Biochemistry, Environmental Studies and Ecotourism,

Genetics, Plant Breeding and Horticulture & Biotechnology and Bioinformatics

Each Record will be having external and internal evaluation. Of the total weightage, 25% for internal and 75% for external

PROJECT

Each student must do a project. The project can be done individually or as a group of maximum three students. However the viva on the project will be conducted individually. The project is to be identified during the second semester of the programme, with the help of the supervising teacher. The lab work / fieldwork / data collection regarding the project should be done during the fifth and sixth semester. The report of the project in duplicate is to be submitted to the department and are to be produced before external the examiners appointed by the university for valuation at the sixth semester.

Evaluation of Projects:

The internal to external component of the project is on the ratio of 1: 3. The different weightages for assessment of different components is shown below.

Internal :

Components	Weightage
Punctuality	1
Experimentation	1
Data Collection	1
Compilation	1
Group Involvement	1

External:

Components	Weightage
Innovation of Topic	1
Objective	1
Review	1
Materials & methods	1
Result	1
Discussion	1
Conclusion /application	1
Presentation	2

COMPLEMENTARY COURSES FOR B. Sc ZOOLOGY OFFERED BY BOTANY DEPARTMENT

(Common for B. Sc Botany programme and model 2- vocational)

SEMESTER	CODE	TITLE OF THE PAPER	Tot. Hrs	HRS/ WEEK	CREDIT	TOTAL CREDIT	UNI.EXAM DURATION	WEIGHTAGE	
								IA	**EA**
1	BO1C01 U	Cryptogams, Gymnosperms and Plant Pathology Practical	36 hrs 36 hrs	2 2	2 1	3	3	1	3
2	BO2C02 U	Plant Physiology Practical	36 hrs 36 hrs	2 2	2 1	3	3	1	3
3	BO3C03U	Angiosperm Taxonomy and Economic Botany Practical	54 hrs 36 hrs	3 2	3 1	4	3	1	3
4	BO4C04 U	Anatomy and Applied Botany Practical	54 hrs 36 hrs	3 2	3 1	4	3	1	3

SCHEME OF EXAMINATION FOR COMPLEMENTRY COURSE

Theory

Theory Examinations will be conducted by the University at the end of the respective semester in which the course is conducted. **Duration 3 hrs**

Of the total weightage, **25% is for internal evolution and 75% for external evaluation**

SEMESTER	CODE	TITLE OF THE PAPER	Hrs	Internal weightage	External weightage	TOTAL CREDIT
1	BO1C01 U	Cryptogams, Gymnosperms and Plant Pathology Practical	3	25%	75%	2
2	BO2C02 U	Plant Physiology Practical	3	25%	75%	2
3	BO3C03U	Angiosperm Taxonomy and Economic Botany Practical	3	25%	75%	3
4	BO4C04 U	Anatomy and Applied Botany Practical	3	25%	75%	3

SCHEME OF EXAMINATION FOR COMPLEMENTRY COURSE

Practical

The practical examination for the complementary courses at the end of semester 1,2,3 and 4 should be conducted by the University with a common time table and questions set by University.

SEMESTER	CODE	TITLE OF THE PAPER	Hrs	Internal weightage	External weightage	TOTAL CREDIT
1	BO1C01 U	Cryptogams, Gymnosperms and Plant Pathology Practical	2	25%	75%	1
2	BO2C02 U	Plant Physiology Practical	2	25%	75%	1
3	BO3C03U	Angiosperm Taxonomy and Economic Botany Practical	2	25%	75%	1
4	BO4C04 U	Anatomy and Applied Botany Practical	2	25%	75%	1

Common Course -ENGLISH**:**

Seme ster	Title of the Course	Number of hours per week	Number of credits	Total Credits	Tot. hour s/ semester	University Exam Dura	Weightage	
							IA	EA
1	English I	5	4	4	90	3hrs	1	3
	English/Common course I	4	3	3	72	3	1	3
2	English II	5	4	4	90	3	1	3
	English/Common course II	4	3	3	72	3	1	3
3	English III	5	4	4	90	3	1	3

4	English - IV	5	4	4	90	3	1	3

Common Course -SECOND LANGUAGE:

Semester	Title of the Course	Number of hours per week	Number of credits	Total Credits	Tot. hours /semester	Uni. Exam Duration	Weightage	
1	Second Language I	4	4	4	72	3hrs	1	
2	Second Language II	4	4	4	72	3	1	3
3	Sec. Lang./Common course I	5	4	4	90	3	1	3
4	Sec. Lang./Common course II	5	4	4	90	3	1	3

ZERO CREDIT COURSES

Zero Credit courses shall be included in the programme to encourage advanced learners and shall be indicated in the score sheet. Permission for obtaining zero credit courses is limited in accordance with the rules of the University and shall not exceed one credit per semester. The Zero credit courses shall be done only under the supervision of a University approved permanent faculty member of the Department which offers the core courses

SYLLABUS OF COURSES

The detailed syllabus of the courses for core, open, choice based, Complementary, model II (Vocational), Botany ♦ Biotechnology (Double Core) programme and Zoology (Vocational) Complementary and Model question papers are appended

For the Board of Studies in Botany

Dr. K.

Danielkutty (Chairman)

18-6-2009

MODEL II (Vocational)
B. Sc. BOTANY PROGRAMME

AIMS AND OBJECTIVES OF THE PROGRAMME

Vocational education aims to develop skilled man power through diversified courses to meet the requirements of the nation and to instill self-employment skills in people. Vocational courses prepare learners for a career that are based on manual or practical activities. These activities are related to a particular trade or a business. In today's world, the need for the vocational courses is rising due to several reasons. More population has resulted in lack of employment opportunities for the people. A trade or self-employment can help to reduce this pressure on the government or private sector. This programme helps the learner to develop expertise in a particular field.

1. Know the importance and scope of the discipline
2. Vocationalize the existing programme without compromising academic standards and theoretical content.
3. Impart knowledge of Science as the basic objective of Education
4. Develop a scientific attitude to make students open minded, critical and curious
5. Develop an ability to work on their own and to make them fit for the society
6. Expose themselves to the diversity amongst life forms
7. To develop skill in practical work, experiments equipments and laboratory use along with collection and interpretation of biological materials and data
8. Make aware of natural resources and environment and the importance of conserving it.
9. Develop ability for the application of the acquired knowledge in the fields of life so as to make our country self reliant and self sufficient
10. Appreciate and apply ethical principles to biological science research and studies

COURSE STRUCTURE

The U .G. Programme in Botany (Vocational) must include (a) Common courses, (b) Core courses, (c) Vocational courses, (d) Complementary Courses, (e) Open Courses and (f) On the job training and Project. The student shall select any Choice based course offered by the department which offers the core courses depending

on the availability of teachers and infrastructure facilities in the institution. Open course shall be offered in any subject and the student shall have the option to do courses offered by other departments.

The number of Courses for the restructured vocational Programme should contain 12 core courses and 1 choice based course from the frontier area of the core courses, 8 vocational courses, and 4 complementary courses from the relevant subjects for complementing the core of study. There should be 6 common courses, or otherwise specified, which includes the first and second language of study.

Vocational Streams offered

The Vocational subject may be selected from the list given below in tune with the relevance of the area regarding job potential or self employment. All the vocational subjects presented are originally related to the core subject **•** Botany. It contains in addition to the theoretical and practical components, field visits, on the job training and project report. On the job training can be organized in recognized firms for a total period of 4 weeks between second and third semesters and between fourth and fifth semesters. The study of the vocational subject shall consist of eight theory and six practical courses including lab records, dissertation, and report of field visits and on the job training.

1. Environmental Monitoring and Management (E)
2. Food Microbiology (F)
3. Horticulture and Nursery Management (H)
4. Plant Biotechnology (P)

Course coding:

Every course in the programme is coded according to the following criteria.

2. The first two letter from the Programme i.e., **BO(V)**

2. One digit to indicate the semester, **i.e., BO (V)1 (Botany, Vocational) 1st semester)**

3. One letter from the type of courses such as common course **A**, core courses **B,** Complementary courses **C, O**pen courses **D. BO (V) 1B (Botany, Vocational) 1st semester Core course)**

4. Two digits to indicate the course number of that semester, i.e.., **BO (V) 1B14 (Botany, Vocational) 1st semester, Core course, courses number is 14)**

5. The letter **U** to indicate for Under Graduate Programme. i.e.., **BO (V) 1B14U (Botany, Vocational) 1st Semester, Core course, courses number is 14, U for UG Programme)**

OPEN COURSES FOR OTHER STREAMS 5TH SEMESTER

Botany Department can offer any of the Five Open courses to other streams

Horticulture and Nursery Management/

Agribased Microenterprises/

Ecotourism /

Biotechnology /

Bioinformatics.

CORE CHOICE BASED COURSE 6TH SEMESTER

The students of Botany Programme of each College can select any of the three in consultation with the Faculty of the Department

Plant Genetic Resources Management

Phytochemistry

Agribusiness

RESTRUCTURED CURRICULUM FOR B.Sc (MODEL II VOCATIONAL) DEGREE IN BOTANY PROGRAMME

COURSE STRUCTURE

Total Credits 120
Total instructional hours 150

Semester 1

Sl. No	Course Title	Hrs/Week	Credit
1	Common Course English - 1	5	4
2	Common Course Sec. Language- 1	5	4
3	Core Course- 1 **Methodology and Perspectives of Science and Introduction to the World of Plant**	2 2	3

	Diversity **+ Practical**		
4	Vocational Course - 1	2	2
5	Vocational Course – II + Practical I	2 2	3
6	Complementary Course – 1 + Practical	3 2	3
	Total	25	19

Semester 2

Sl.No	Course Title	Hrs/Week	Credit
1	Common Course English - 2	5	4
2	Common Course Sec. Language- 2	5	4
3	Core Course - 2 **General Informatics and Methodologies in Plant Science**s + Practical	2 2	3
4	Vocational Course - 3	2	2
5	Vocational Course – 4 + Practical II	2 2	3
6	Complementary Course - 2 + Practical	3 2	3
	Total	**25**	**19**

Semester 3

Sl. No	Course Title	Hrs/Week	Credit
1	Common Course English - 3	5	4
2	Core Course - 3 Anatomy and Reproductive Botany of Angiosperms + Practical	3 2	4
3	Vocational Course - 5 + Practical III	3 2	4
4	Vocational Course - 6 + Practical IV	3 2	4
5	Complementary Course - 3 + Practical	3 2	4
	Total	25	20

Semester 4

Sl. No	Course Title	Hrs/Week	Credit
1	Common Course English - 4	5	4
2	Core Course - 4 Microbiology and Phycology + Practical	3 2	4
3	Vocational Course - 7 Practical V	3 2	4
4	Vocational Course - 8 +Practical VI	3 2	4
5	Complementary Course - 4 + Practical	3 2	4
	Total	25	20

-
-
-
-

Semester 5

Sl. No	Course Title	Hrs/Week	Credit
1	Core Course - 5 Mycology , Lichenology, and Pathology + 2 Practical	2 4	4
2	Core Course – 6 Bryology, Ptridology,Gymnosperms and Palaeobotany + Practical	3 2	4
3	Core Course – 7 Angiosperm Morphology, Taxonomy and Economic Botany + Practical	3 2	4
4	Core Course – 8 Cell and Molecular Biology and Evolution + Practical	3 2	4
5	Open Course: Horticulture and Nursery Management/ Agribased Micro enterprises/ Ecotourism/ Biotechnology/ Bioinformatics.	4	4
	Total	25	20

Semester 6

Sl. No	Course Title	Hrs/Week	Credit
1	Core Course - 9 Plant Physiology and Biochemistry + 2 Practical	3 4	4
2	Core Course – 10 Environmental Studies and Eco Tourism + Practical	3 2	4
3	Core Course – 11 Genetics, Plant Breeding and Horticulture + Practical	3 2	4
4	Core Course – 12 Biotechnology and Bioinformatics + Practical	3 2	4
5	Core Choice based – 13 Plant Genetic Resources Management/ Phytochemistry/ Agribusiness	3	3
6	On the job training	-	2
7	Project	-	1
	Total	25	22

B. Sc Programme in Botany (Vocational) - Core courses:

The following table shows the structure of the programme which indicate Code of the courses, Title of the courses, Instructional hours Credits, university examination time and the components for internal and external evaluation

Semester	CODE	NAME OF CORE COURSE	INST.HRS/ WEEK	CREDIT	Tot. CREDITS	Total Hours/ seme	University exam	Weightage	
								IA	EA
1	BO(V)1B01U	Methodology and Perspectives of Science & Introduction to the World of Plant Diversity PRACTICAL 1	2 2	2 1	3	72	3hrs	1	3
2	BO(V)2B02U	General Informatics and Methodologies in Plant Sciences PRACTICAL 2	2 2	2 1	3	72	3	1	3
3	BO(V)3B03U	Anatomy & Reproductive Botany of Angiosperms PRACTICAL 3	3 2	3 1	4	90	3	1	3
4	BO(V)4B04U	Microbiology and Phycology PRACTICAL 4	3 2	3 1	4	90	3	1	3
5	BO(V)5B05U	Mycology, Lichenology and Pathology PRACTICAL 5	2 4	2 2	4	108	3	1	3
	BO(V)5B06U	Bryology, Pteridology, Gymnosperms and Palaeobotany PRACTICAL 6	3 2	3 1	4	90	3	1	3
	BO(V)5B07U	Angiosperm Morphology,	3	3					

		Taxonomy and Eco. Botany PRACTICAL 7	2	1	4	90	3	1	3
	BO(V)5B08U	Cell and Molecular Biology and Evolution PRACTICAL 8	3 2	3 1	4	90	3	1	3
	BO(V)5D01U	**OPEN COUESE**:Horticulture and Nursery Management/ Agribased Microenterprises / Biotechnology /Bioinformatics	4	4	4	72	3	1	3
6	BO(V)6B09U	Physiology and Biochemistry PRACTICAL 9	3 4	2 2	4	126	3	1	3
	BO(V)6B10U	Environmental Studies and Ecotourism PRACTICAL 10	3 2	3 1	4	90	3	1	3
	BO(V)6B11U	Genetics, Plant Breeding and Horticulture PRACTICAL 11	3 2	3 1	4	90	3	1	3
	BO(V)6B12 U	Biotechnology and Bioinformatics PRACTICAL 12	3 2	3 1	4	90	3		3
	BO(V)6B13 U	CORE- CHOICE BASED COURSE :- Plant Genetic Resource / Phytochemistry / Agribusiness	3	3	3	54	3	1	3
		Project & Viva		1	1			1	3

Vocational Courses

Semester	CODE	NAME OF CORE COURSE	INST.HRS/ WEEK	CREDIT	Tot. CREDITS	Tot. Hours/ seme	University exam	Weightage	
								IA	EA
1	BO(V)1BE14U BO(V)1BF14U BO(V)1BH14U BO(V)1BP14U	Course I Environmental Biology Part I Microbial World Part I Fundamentals of Horticulture General Microbiology.	2	2	2	36	3	1	3
	BO(V)1BE15U BO(V)1BF15U BO(V)1BH15U BO(V)1BP15U	Course II Environmental Biology Part II Microbial World Part ll Plant propagation Applied Microbiology. +PRACTICAL- 1	2 2	2 1	3	72	3	1	3
2	BO(V)2BE16U BO(V)2BF16U BO(V)2BH16U BO(V)2BP16U	Course III Environmental Micro Biology Applied Microbiology Part ll Orna. Horticulture and landscaping Biotechniques and instrumentation	2	2	2	36	3	1	3
	BO(V)2BE17U BO(V)2BF17U BO(V)2BH17U BO(V)2BP17U	Course IV Environmental hygiene and Human Health Applied Microbiology-II Nursery Management Fundamentals of Enzymology and Radio biology +PRACTICAL 2	3 2	2 1	3	90	3	1	3
3	BO(V)3BE18U BO(V)3BF18U BO(V)3BH18U BO(V)3BP18U	Course V Environmental monitoring Part I Principles of Food Microbiology Floriculture Basics of Molecular Cloning Techniques +PRACTICALS 3	3 2	2 1	3	90	3	1	3
	BO(V)3BE19U BO(V)3BF19U BO(V)3BH19U BO(V)3BP19U	Course VI Environmental Conservation and Management Part I/ Contamination, spoilage and preservation of food-I Olericulture Plant Tissue Culture +PRACTICALS 4	3 2	2 1	3	90	3	1	3

4	BO(V)4BE20U BO(V)4BF20U BO(V)4BH20U BO(V)4BP20U	Course VII Environmental monitoring Part II Contamination, spoilage and preservation of food-II Pomology, Food Technology and post harvest management of horticultural crops Genetic Engineering +PRACTICAL 5	3 2	2 1	3	90	3	1	3
	BO(V)4BE21U BO(V)4BF21U BO(V)4BH21U BO(V)4BP21U	Course VIII Environmental Conservation and Management Part II/ Food Fermentation, Food infection and Food born diseases Cultivation of Medicinal and aromatic plants, spices and plant crops Biotechnology for crop improvement +PRACTICAL 6	3 2	2 1	3	90	3	1	3

MODEL 2 (VOCATIONAL)

B Sc. Degree Programme in Botany

The course has three units in addition to open courses. The details regarding work distribution of the units and open courses are given in the following table

TABLE: 1

YEAR	1	2	3	TOTAL
SEMESTER	1 & 2	3 & 4	5 & 6	1 TO 6
CORE SUBJECT COURSES	4	5	25	35
VOCATIONAL SUBJECT COURSE	6	10	-	15
COMPLEMENTARY SUBJECT COURSE	5	5	-	10
COMMON COURSES- 1	5	5	-	10
COMMON COURSES-2	5	-	-	5
TOTAL	25	25	25	75 X 2=150

MODEL 2- (VOCATIONAL)
B Sc. Degree Programme in Botany
Semester wise and Subject wise Distribution of credits

TABLE: 2

SEMESTER	CORE COURSES	VOCATIONAL COURSES	COMPLEMENTARY COURSES	COMMON COURSES-1	COMMON COURSES-2	TOTAL
	3	5	3	4	4	19
	3	5	3	4	4	19
	4	8	4	4	-	20
	4	8	4	4	-	20
	20	-	-	-	-	20
	19	-	-	-	-	19
PROJECT	1					1
ON THE JOB TRAINING		2	-	-	-	2
TOTAL	54	28	14	16	8	120

MODEL 2 (VOCATIONAL)
B Sc. Degree Programme in Botany

TABLE: 3
SCHEME OF DISRIBUTION OF INSTRUCTIONAL HOURS

Sem	Core courses		Vocational courses		Complementary courses	
	Theory	Practical	Theory	Practical	Theory	Practical
	2	2	4	2	3	2
2.	2	2	4	2	3	2
3.	3	2	6	4	3	2
4.	3	2	6	4	3	2
5.	15	10	-	-	-	-
6.	15	10	-	-	-	-

Examinations :

The evaluation of the course both internal and external shall be as in the case of programme one, for both theory and practicals.

Practical examination for the vocational coursers should be conducted semester wise. In the third semester practicals, three and four shall be conducted in a session of three hours duration. ($1^1/_2$ hours each). Likewise, in the fourth semester practicals five and six shall be conducted in a session of three hours duration. ($1^1/_2$ hours each).

MAHATMA GANDHI UNIVERSITY, KOTTAYAM
CURRICULUM SCHEME FOR
BOTANY-BIOTECHNOLOGY (DOUBLE CORE) PROGRAMME
UNDER COURSE CREDIT SEMESTER SYSTEM (2009 ADMISSION ONWARDS)

Sem.	**Course Code and Course Title**	Number of Hrs./ Week		Number of Credit	Total Credit	Total Hrs/ Sem.	Univ. Exam (Hrs)	Weightage	
								IA	EA
I	English foundation course I (English board)	5		3	3	90	3	1	3
	BO&BT 1A 01U - Operating systems and Office automation Practical	2 2	4	2 1	3	72	3	1	3
	BO1BO1U - Methodology and Perspective of science & an introduction to the world of plant diversity (Syllabi of Botany board UBC 1) Practical	2 2	4	2 1	3	72	3	1	3
	BO&BT1B$_{BT}$ 01U - Molecular biology and methods in molecular biology Practical	2 2	4	2 1	3	72	3	1	3
	OJT* in methods in molecular biology	0	*	2	2				
	Complimentary Biochemistry I (Syllabi of biochemistry board) Practical	2 2	4	2 1	3	72	3	1	3
	ZY1 CO1U - Complimentary Zoology I: Animal diversity - Non chordate (Syllabi of zoology board) Practical	2 2	4	2 1	3	72	3	1	3
	Total	25			20				
II	English foundation course II (English board)	5		3	3	90	3	1	3
	BO&BT2B$_{BO}$ 02U - Biostatistics (modified syllabus)	4	4	4	4	72	3	1	3
	BO&BT2B$_{BT}$ 02U - Biophysics and Instrumentation Practical	3 1	4	2 1	3	72	3	1	3
	BO&BT2B$_{BT}$ 03U - Recombinant DNA technology Practical	2 2	4	2 1	3	72	3	1	3
	***OJT** in Recombinant DNA technology	0	*	1	1				
	Complimentary biochemistry II (Syllabi of biochemistry board) Practical	2 2	4	2 1	3	72	3	1	3
	ZY2CO2U - Complimentary Zoology II: Animal diversity- Chordate (Syllabi of zoology board) Practical	2 2	4	2 1	3	72	3	1	3
	Total	25			20				
	BO3B03U - Anatomy and reproductive botany of angiosperms (Syllabi of botany board UBC 03) Practical	3 2	5	3 1	4	90	3	1	3

III	**BO&BT3B$_{BT}$ 04U** ◆ Microbiology and microbial biotechnology Practical	3 2	5	3 1	4	90	3	1	3
	BO&BT3B$_{BT}$ 05U ◆ Plant Biotechnology Practical	3 2	5	3 1	4	90	3	1	3
	Complimentary biochemistry III (Syllabi of biochemistry board) Practical	3 2	5	3 1	4	90	3	1	3
	ZY3CO3U - Complimentary Zoology III: Human Physiology and Immunology (Syllabi of zoology board) Practical	3 2	5	3 1	4	90	3	1	3
	Total	25			20				
IV	**BO&BT4B$_{BO}$ 04U**- Phycology (modified syllabus) Practical	3 2	5	3 1	4	90	3	1	3
	BO&BT4B$_{BT}$ 06U - Animal Biotechnology and Nano Biotechnology Practical	3 2	5	3 1	4	90	3	1	3
	BO&BT4B$_{BT}$ 07U - Bioinformatics Practical	3 2	5	3 1	4	90	3	1	3
	Complimentary biochemistry IV (Syllabi of biochemistry board) Practical	3 2	5	3 1	4	90	3	1	3
	ZY4CO4U - Complimentary Zoology IV: Applied Zoology Practical	3 2	5	3 1	4	90	3	1	3
	Total	25			20				
V	**BO5B05U -** Mycology, Lichenology and Pathology (Syllabi of botany board UBC 05) Practical	3 2	5	3 1	4	90	3	1	3
	BO5B06U - Bryology, Pteridology, Gymnosperms and Paleobotany (Syllabi of botany board UBC 06) Practical	3 2	5	3 1	4	90	3	1	3
	BO5B07U -Angiosperm morphology, Taxonomy and Economic botany (Syllabi of botany board UBC 07) Practical	3 2	5	3 1	4	90	3	1	3
	BO&BT5B$_{BT}$ 08U - Cell biology, Developmental Biology and Evolution (modified syllabus) Practical	3 2	5	3 1	4	90	3	1	3
	BO&BT5D$_{BT}$ 01U (Open Course) Environmental biotechnology Practical (demonstration only)	5	5	4	4	90	3	1	3
	Total	25			20				
VI	**BO6B09U -** Plant Physiology and Biochemistry (Syllabi of botany board UBC 08) Practical	3 2	5	3 1	4	90	3	1	3
	BO6B10U - Environmental studies and Ecotourism (Syllabi of botany board UBC 10) Practical	3 2	5	3 1	4	90	3	1	3
	BO6B11U ◆ Genetics, plant breeding and horticulture (Syllabi of botany board UBC 11) Practical	3 2	5	3 1	4	90	3	1	3
	BO6B13U - Phytochemistry (Choice based course) (Syllabi of botany board)	5	5	4	4	90	3	1	3
	Project**		5		4	90	3	1	3
	Total	25			20				

* On the Job Practical training (OJT) for not less than 36 hours each should be given to students in the I and II semesters (during voation or weekends) in the field of modern techniques in molecular biology and recombinant DNA technology

**** Project work**

Each student of the botany- biotechnology double core programme should undergo a project work (4 credits) for four weeks (160 hrs) under the supervision and guidance of recognized research guide / faculty member with minimum 10 years teaching experience in any one of the recognized research departments / institutions. The student should submit two bound copies of the dissertation certified by the supervising teacher (research guide) together with two copies of the summary before the commencement of the sixth semester theory examination.

B.Sc. BOTANY AND BIOTECHNOLOGY (DOUBLE MAIN) PROGRAMME
CORE COURSES OFFERED IN BIOTECHNOLOGY

Semester	Courses	Core Course Name
I	BT Core 1	Molecular Biology and Methods in Molecular Biology
II	BT Core 2 BT Core 3	Biophysics and Instrumentation Recombinant DNA Technology
III	BT Core 4 BT Core 5	Microbiology and Microbial Technology Plant Biotechnology
IV	BT Core 6 BT Core 7	Animal Biotechnology and Nano Biotechnology Bioinformatics
V	BT Core 8 BT Open course	Cell biology, Developmental Biology and Evolution Environmental Biotechnology (Open Course)

CORE COURSES OFFERED IN BOTANY

Semester	Courses	Core Courses
I	BOT Core 1	Methodology and Perspective of Science and an introduction to Plant Diversity
II*	BOT Core 2*	Biostatistics* (revised for B.Sc. Botany & Biotechnology)
III	BOT Core 3	Anatomy and Reproductive biology of Angiosperms
IV*	BOT Core 4*	Phycology* (revised for B.Sc. Botany & Biotechnology)
V	BOT Core 5 BOT Core 6 BOT Core 7	Mycology, Lichenology and Pathology Bryology, Pteridology, Gymnosperms and Paleobotany Angiosperm Morphology, Taxonomy and Economic Botany
VI	BOT Core 8 BOT Core 9 BOT Core 10 BOT Choice based Course Project	Plant Physiology and Biochemistry Environmental studies and Ecotourism Genetics, Plant Breeding and Horticulture Phytochemistry (Choice based Course)

* These two core courses of Botany are revised for B.Sc. Botany & Biotechnology (Double Main) programmme. Rest of the courses are same as in B.Sc. Botany Board

Details of the courses of Botany and Biotechnology (Double Core) programme
(2009 admission onwards)

No.	Course details	No. of courses	No. of credits
	English Foundation course I Foundation course II	2	6
	Information Technology (BO&BT1A01U) Operating systems and Office automation	1	3
	Core A: Botany courses Core botany course I : Methodology and perspectives of science and an Introduction to Plant Diversity Core botany course II : Biostatistics*(BO&BT2BBO02U) Core botany course III : Anatomy and reproductive botany of angiosperms Core botany course IV : Phycology*(BO&BT4BBO04U) Core botany course V : Mycology, Lichenology and Plant Pathology Core botany course VI : Bryology, Pteridology, Gymnosperms and Paleobotany Core botany course VII : Angiosperm Morphology, Taxonomy and Economic Botany Core botany course VIII : Plant Physiology and Biochemistry Core botany course IX : Environmental Studies and Ecotourism Core botany course X : Genetics, Plant Breeding and Horticulture **Choice based course** : Phytochemistry	10	38
	Core B : Biotechnology courses Core Biotechnology course Ia : Molecular Biology and methods in Molecular Biology (BO&BT1BBT01U) Core Biotechnology course Ib : OJT in methods in molecular biology		

	Core Biotechnology course II : Biophysics and Instrumentation(BO&BT2BBT02U) Core Biotechnology course IIIa : Recombinant DNA Technology(BO&BT2BBT03U) Core Biotechnology course IIIb : OJT in Recombinant DNA technology Core Biotechnology course IV : Microbiology and Microbial Technology(BO&BT3BBT04U) Core Biotechnology course V : Plant Biotechnology(BO&BT3BBT05U) Core Biotechnology course VI : Animal Biotechnology and Nano Biotechnology(BO&BT4BBT06U) Core Biotechnology course VII : Bioinformatics(BO&BT4BBT07U) Core Biotechnology course VIII : Cell Biology, Developmental Biology and Evolution(BO&BT5BBT08U) BT Open course : Environmental Biotechnology(open course) (BO&BT5BBT01U)	9	37
	Core C : Project	1	4
	Complimentary : Biochemistry Biochemistry I Biochemistry II Biochemistry III Biochemistry IV	4	14
	Complimentary : Zoology Animal Diversity- Non chordata Animal Diversity- Chordata Human Physiology and Immunology Applied Zoology	4	14
	Total	32	120

* Revised Botany core papers of Botany Board

MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester I Course 1 BO1B01U

METHODOLOGY AND PERSPECTIVES OF SCIENCE

&

AN INTRODUCTION TO THE WORLD OF PLANT DIVERSITY

(Theory 36 hours; Practical : 36 hours) (Theory Credit 2, Practical Credit1)

METHODOLOGY AND PERSPECTIVES OF SCIENCE

(Theory 18 hours; 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, selection of variables, study area and a suitable design, necessity of units and dimensions, units of length, volume, area, concentration, Molar, molal, normal, percentage solution temperature, pressure, 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- Darwin's theory, DNA structure, Mendelism. An example of moving from a question to hypothesis and then to an experimental design. 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 and make a report.
3. Prepare a biographical sketch of great scientists with special emphasis on the scientific methodology involved in their experiments.
4. Prepare $CuSO_4$ solution of different normality, molality and percentage.
5. Find out the area of the different type of leaves using graph papers.

INTRODUCTION TO THE WORLD OF PLANT DIVERSITY

(Theory 18 hours; Practical : 18 hours)

Module 1. 3 hours

Plants, their uniqueness and importance, 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. **3hours** **Unity of living organisms**

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

Module 3. **12 hours**

1.Diversity of living organisms

Prokaryotes Bacteria – general characteristics, variation in form, Cyanobacteria general characteristics, variation in form.

Eukaryotes, Eichler's Classification.

Cryptogams

Algae General characteristics, Diversity in thallus morphology

Diversity in pigments.

Fungi General characteristics, Diversity in mycelium morphology.

Lichens General characteristics, Diversity in thallus morphology.

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, Alternation of generation, prominence of sporophyte.

Phanerogams

Gymnosperms

General characteristics, Diversity in morphology, Concept of seed, its advantages, Special structures which contributed to the development of seed.

Angiosperms

General characteristics, Diversity in morphology:- dicots, monocots, herbs, shrubs, trees, climbers, twiners, branched, unbranched, Concept of fruit, its advantages, Special structures which contributed to the development of fruit.

Animals

Major differences between plants and animals.

(Detailed study of different classes not required)

2. Habitat Diversity

Aquatic:- Fresh water, marine, mangrove, Terrestrial:- Evergreen forest, deciduous forest, grass land, Epiphytic

3. Evolutionary trends in the plant world-

Algac- unicellular, colonial, thallus- Bryophytes- thallus in hepaticae - Musi – Ptendophytes – Gymnosperm – Angiosperm.

4. Interactions in the plant world

Plant – plant interactions, plant – microbe interactions, plant – animal interactions.

Practicals **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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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester II Course 2 BO2B02U

GENERAL INFORMATICS AND METHODOLOGIES

IN PLANT SCIENCES

(Theory 36 hours; Practical : 36 hours) (Theory Credit 2, Practical Credit1)

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, study of educational sites related to life sciences, academic search techniques, 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.
- 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, formatting tools, use of spell check, inserting tables, graphs and pictures.

- MS-EXCEl:- Creating a worksheet, data entry, sorting, use of formulas for sorting, 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 presentation based on the 1& 2 exercises.

Methodologies of Plant Science (Theory 18 hours; Practical : 18 hours)

Module 1.

Microtechnique **6 hours**

- Introduction
- Microscopy:- simple, compound, phase contrast, fluorescent, electron microscopes.
- Microtome:- rotary, sledge.
- 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: Neutral red, Evan's blue.
- Mordents, Single staining, 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 **4 hours**

1. Maceration and identification of tracheary elements.
2. Preparation of double stained sections.

Module 2

Biophysics **3 hours**

- Principles and applications of colorimeter, spectrophotometer and centrifuge
- Separation methods :- chromatography, electrophoresis.
- pH:- concept of pH, methods to measure pH
- Buffers:- definition, functions of buffers in biological systems, use of buffers in biological research.

Practicals **4 hours**

1. Preparation of buffer.
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)

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.
- 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-square test:- introduction, uses, procedure.

Practicals **10 hours**

1. Collect numerical data and find out the central tendencies.
2. Familiarize with situations requiring t-test, chi-square 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, Lab safety laboratory hygiene, identification of symbols on different classes of chemicals.

Reference:

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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester III Course-3 BO3B03U

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 hours

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

Non living 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 7 hours

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

Nodal anatomy- Leaf Trace, Leaf gap, Branch trace and Branch gap.

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

References

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B.Sc. BOTANY PROGRAMME

Semester IV Course-4 BO4B04U

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: 20hours; Practical: 12 hours)

Module 1 **1 hour**

Introduction, Scope of Microbiology

Module 2 8 **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 (Dilution plate method).

PHYCOLOGY (Theory: 34 hours ; Practical: 24 hours)

Module 1 **3 hours**

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

Module 2 **20 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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16. . Mamatha Rao, 2009, *Microbes and Non flowering plants- impact and application* Ane Boopks Pvt Ltd.

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

MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester V Course-5 BO5B05U

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 fall 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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http://www.britmycolsoc.org.uk/ (British mycological society)

http://www.mycokey.com/

http://www.bgbm.fu-berlin.de/sipman/keys/default.htm (lichen)

http://www.bspp.org.uk/

http://www.fs.fed.us/r6/nr/fid/coolpath.shtml

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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester V Course 6 BO5B06U

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, Lunularia, 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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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester V Course 7 BO5B07U

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)**

Floral morphology .

Unit 1

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, Trichopus zeylanicus 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 ethnobotanical 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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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester V Course 8 BO5B08U

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 1 hours

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: significanceof 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.

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

Unit1. Nucleic acids - structure of DNA and RNA - basic features, alternate forms of DNA - types and structure of RNA 3hrs.

unit2. Replication of DNA - Meselson-Stahl experiment - details of semiconservative replication of DNA 3 hrs.
unit3. 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.
unit4. Control of gene expression - positive and negative control - operon model - lac operon, trp operon -attenuation 3hrs
unit5. 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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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester VI Course 9 BO6B09

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 – Iodine test.
3. Colour tests for proteins in solution. Biuret test, Million–s test, Ninhydrin test.

4. Detect the presence of any three major organic compounds in the given food stuff/material viz. reducing /non-reducing sugar/fat proteins/starch.sucrose.
5. Action of various enzymes in plant tissues: peroxides, dehydrogenase.
6. 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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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester VI Course 10 BO6B010U

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 natural resources, 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, Medha patkar, 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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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester VI Course 11 BO6B011

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).

Module 3. 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: 15hours)

Module 1 2 hours

Introduction and objectives of plant breeding; methods of plant breeding

Module 2 3 hours

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

Module3 2 hour

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

Module 4 6 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

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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MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY PROGRAMME

Semester VI Course 12 BO6B012

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. Inoculation, incubation, subculturing.
4. Micropropagation - Different methods • axillary bud proliferation, direct and indirect organogenesis and somatic embryogenesis. Different phases of micropropagation • hardening, transplantation and field evaluation Advantages and disadvantages of 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, Flavr Savr 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:

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 a well 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, *Arabidopsis thaliana*, 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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B.Sc. BOTANY PROGRAMME

Semester VI **Core Course Choice Based -BO6B13 U**

AGRIBUSINESS
(54 hours) Theory Credit 3

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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B.Sc. BOTANY PROGRAMME

Semester VI Core Course Choice Based **- BO6B13 U**

PHYTOCHEMISTRY AND PHARMACOGNOSY

(54 Hours) Theory Credit 3

Course objectives

1. Understand the structure and function of basic secondary metabolites in medicinal and aromatic plants.

2. Familiarize with the common separation and characterization techniques used in phytochemistry

3. Understand the basic officinal part present in the common medical plants and their use in ayurvedic formulations

Module 1. 2 hours

Introduction

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

Module 2 4 hours

Extraction and chacterisation techniques

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

Module 3. 10 hours

Study of the drug plants and their active principles

A. Alkaloids ⁄ introduction, properties, occurrence, structure, classification, functions, and pharmacological uses.

B. Triterpenoids. Introduction, properties, occurrence, classification, functions and pharmacological uses.

C. Phenolics. Quinines- benzoquinones, napthoquinones, anthraquinone, and coumarins.

Module 4. 20 hours

Study of the following plants with special reference to

(1) Habit, habitat and systematic position and morphology of the useful part.

(2) Organoleptic, anatomical and chemical evaluation of the officinal part.

(3) Phytochemistry and major pharmacological action of plant drugs.

(4) Ayurvedic formulations using the plant

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

Module 5. 10 hours

Study of the following aromatic plants ⁄ volatile oils and methods of extraction *Vetiveria zizanoides, Cinnamomum zeylanica, Sysygium aromaticum, Santalum album, Eucalyptus, Ocimum bacilicum, Rosa, Mentha piperita.*

Module 6.

Pharmocognosy. 4 hours

Introduction, tools for identifying adulteration; methods in pharmocognosy- microscopy, phytochemical methods- study of starch grains of maize, wheat, rice, potato, curcuma

Cultivation of drug and aromatic plants 4 hours

I. Soil as growth medium: formation of soil, physical and chemical nature, soil organisms, soil fertility, soil types.

II. Fertilizers and manures: NPK, organic manures, green manure, farm yard manure, and vermicompost.

III. Plant protection methods- insect and pest control measures: physical ,chemical biological methods.

IV. Plant propagation methods.

Suggested additional topics

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

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B.Sc. BOTANY PROGRAMME

Semester VI Core - Course Choice Based **- BO6B13 U**

PLANT GENETIC RESOURCES MANAGEMENT (54 hours) Theory Credit 3

Objectives

1. Acquaint the student with the history and evolution of crop plants, and their diversity.
2. Familiarize the student with the available plant genetic wealth and the measures adopted for the conservation of these resources.
3. Help the student to identify the crop plants and their wild relatives.
4. Help the student to explore the potentialities of various underutilized plants to project as the future food prospects.
5. Understand the significance of modern technology to locate the distribution of endangered species.

Module 1. 3 hours

Historical developments in crop botany. Centres of origin and diversity of crop plants, primary and secondary centres, Vavilovian concept.

Module 2. 2 hours

Exploration and collection of genetic resources- importance of wild relatives of crop plants and their genetic diversity in crop improvement.

Module 3. 4 hours

Conservation of genetic resources. (i) in situ: biosphere reserves, national parks and wild life sanctuaries; (ii) ex situ- (a) in vivo: botanic gardens, field gene banks; (b) in vitro: seed banks (short term, medium term and long term storage of seeds), tissue culture storage and cryopreservation.

Module 4. 3 hours

Role of Governmental and non-governmental organizations in Plant Genetic Resources Management: Governmental Organisations• Regional • TBGRI and KFRI; National - BSI and NBPGR; International - IPGRI(IBPGR) and ICRISAT.

Non Governmental Organisations • Herbal gardens and Nurseries.

Module 5. 5 hours

Major threat to the genetic resources: human interference and deforestation, over exploitation of resources. Endemism and Hot Spots. Documentation of endangered and threatened plants- red data book. Remote sensing : principle • concept of remote sensing and components of remote sensing. Application of remote sensing in conservation of endangered plants and habitat studies. IUCN- role and activities.

Module 6. 4 hours

Ethnobotany its significance and scope with respect to food, shelter and medicine.

Ethnobotany in relation to conservation of genetic resources: mythology and conservation of eco-systems, sacred groves and their role in the conservation of gene pool; taboos for conservation of selected plant species.

Module 7. 18 hours

Important food, medicinal and aromatic plants of Kerala state – taxonomy, cultivation and uses of rice, tapioca, elephant foot yam, cow pea, bitter gourd, ginger, black pepper, nutmeg, cardamom, coffee, vasaka, Aloe and lemon grass.

Module 8. 5 hours

Plantation crops – scope and importance of plantation crops; taxonomy, cultivation and useful products of rubber, cashew, coconut and tea.

Module 9. 3 hours

Importance of fruits: classification of fruits, role of fruits in Indian economy, taxonomy and cultivation of banana, pineapple and mango.

Module 10. 3 hours

Underutilised plants and its importance for future food requirements. Botany and uses of the following under exploited edible plants.

Vegetables; winged bean, sword bean, cluster bean, ridge gourd, bottle gourd, little gourd, lesser yam, Chinese potato.

Fruits; Artocarpus heterophyllus , Artocarpus hirsutus, Anona, Rambutan, rose apple.

Module 11. 4 hours

Mushroom cultivation and spawn production – paddy straw, oyster and milky mushrooms.

Suggested additional topics

Study the origin and diversity of various crop plants.

Plant Introduction and its importance in creating genetic diversity.

Ethnobotany in relation to crop improvement. Linking it with food,

shelter, cloth and medicine to human.

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B.Sc. BOTANY PROGRAMME

Semester V **Open Course** BO5D01U

HORTICULTURE AND NURSERY MANAGEMENT

(72 Hours) Theory Credit 4

Course objectives

1. Understand the importance of horticulture in human welfare.
2. Understand the propagation and cultural practices of useful vegetable, fruit and garden plants.
3. Understand the impact of modern technologies in biology on horticultural plants.
4. Understand the basic concepts of landscaping and garden designing.
5. Inculcate interest in landscaping, gardening and flower and fruit culture.

Horticulture 48 hours

Module 1 10 hours

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

Module 2 10 hours

Propagation of horticultural plants- by seeds- Seed development and viability, seed dormancy, seed health, seed testing and certification, growing seedlings in indoor containers and field nurseries, seed bed preparation, seedling transplanting; advantages and disadvantages of seed propagation.

Vegetative propagation- organs used in propagation- natural and artificial vegetative propagation; methods- cutting, layering, grafting and budding; advantages and disadvantages of vegetative propagation; micropropagation.

Module 3 10 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, drives, walks, topiary, trophy, rockery- famous gardens of India. Landscape architecture- home landscape design, urban planning, parks, landscaping and public buildings, industrial and highway landscaping.

Physical control of plant growth- training and pruning- selection of plant, bonsai containers and method of bonsai formation.

Module 4 6 hours

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

Module 5 4 hours

Olericulture- Types of vegetable growing-home gardens and market gardens; cultivation practices of leafy vegetable (Amarathus), tuber (Potato), fruit (Tomato), flower (Cauliflower).

Module 6 4 hours

Pomology- Cultivation of fruit crops-mango, banana and pine apple- preparation of land, spacing, planting, irrigation, hormones, harvest and storage. Factors affecting duration of storage. Principles of preservation-temporary and permanent- agents for fruit preservation. Preparation of pickles, jams, jellies and squashes using locally available fruits.

Module 7 4 hours

Garden friends -honey bees, ladybirds, frogs, spiders, earthworms, centipedes and millipedes. Garden foes- pests, pathogenic fungi, bacteria, virus. Control measures-pesticides and fungicides; neem tobacco decoction. Hazards of chemical pesticides; equipments used in controlling horticultural pests-sprayers, dusting equipments-sterilization, fumigation.

Weeds- annual, perennial; weed control-prevention, eradication - hand weeding, tillage, burning, mowing, biological control, use of herbicides- selective and non selective- mechanisms involved in herbicidal actions.

Nursery management 6 hours

Module 1

Nursery-definition, types; management strategies- planning, layout, budgeting- production unit, sales unit.

Plant growing structures- green houses, fernery, orchidarium, arbetorium.

On hand training **18 Hours**

1. Preparation of potting mixture of known combination and potting in earthern pots / poly bags.
2. Preparation of nursery beds.
3. Preparation of compost / vermicompost using different substrates.
4. Working knowledge and identification of garden tools and implements.
5. Practical knowledge in different plant propagation techniques listed in syllabus.
6. Cultivation of a vegetable / ornamental plant / fruit crop listed in the syllabus.
7. Practice of different pruning operations (top dressing , shaping and topiary) in the following plants (1) Bougainvillea (2) Phyllanthus .
8. Visit a well established nursery and submit report.

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B.Sc. BOTANY PROGRAMME

Semester V **Open Course** **BO5D01U**

AGRIBASED MICROENTERPRISES

(72 Hours) Theory Credit 4

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.

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 cell

concept of totipotency- differentiation and dedifferentiation. Infra structure of a tissue culture laboratory .Solid and liquid media- composition and preparation. Sterilization- dry, wet and filter sterilization. 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 V **Open Course** **BO5D01U**

ECOTOURISM

(72 Hours) Theory Credit 4

Objectives

1. Make the students to opt various ecotourism programmes as a self employment stream
2. Make the students to aware about the usefulness of ecotourism in the conservation of natural resources.
3. Help the students to assess various ecotourism programmes

Module 1 **4 hours**

Eco-tourism

Definition, concept, introduction, history, relevance and scope

Module 2 **4 hours**

Key Principles and Characteristics of Ecotourism:

Nature area focus, interpretation, environmental sustainability practice, contribution to conservation, benefiting local communities, cultural respect, customer satisfaction, responsible marketing

Module 3 **12 hours**

Components of Ecotourism:

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

Module 4: **10 hours**

Eco Tourism Terms:

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

Module 5: **14 hours**

Ecotourism resources in India and Kerala:

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

Module 6: **8 hours**

Forms of Ecotourism in India and Kerala:

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

Module 7 **16 hours**

Ecotourism Planning:

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

Module 8 **4 hours**

Ecotourism and livelihood security:

Community, biodiversity conservation and development • Eco-development committees

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Semester V **Open Course** **BO5DB01U**

BIOTECHNOLOGY

(72 hours) Theory Credit 4

OBJECTIVE

1. Familiarize the students with the fundamental principles and various developments in biotechnology and potential applications.
2. Make the students aware that the life forms and activities can be exploited for human advancement.

Module-1 **8 hours**

Cell biology

General structure and constituents of cell, structure and functions of major organelles - nucleus, chloroplast, mitochondria, ribosomes, endoplasmic reticulum, golgi apparatus. Nucleic acids as genetic material - chemistry, structure and properties of DNA, RNA and proteins. Genome organization in prokaryotes and eukaryotes, DNA replication, protein synthesis.

Module-2 **10 hours**

1. Biotechnology-concept of biotechnology, landmarks in biotechnology.
2. Plant tissue culture • Concept of totipotency, organogenesis and embryogenesis. General facilities for tissue culture, constituents and role of different components in tissue culture medium, media preparation, sterilization techniques - inoculation and incubation.
3. Principles and applications of tissue culture : Micropropagation • different methods and phases - propagation of ornamentals and horticultural crops, synthetic seeds, callus and suspension culture, meristem culture, somaclonal variations, anther culture, embryo culture, somatic hybridization, production of phytochemicals in culture, bioreactors, cryopreservation.

Module-3 **10 hours**

Recombinant DNA Technology

1. Strategies in gene cloning, procedures in recombinant DNA technology • vectors in gene cloning; enzymes • restriction endonucleases and ligases, ligation techniques; transformation and selection of transformants, gene library.
2. Brief account of different gene transfer techniques • chemically stimulated uptake of DNA, micro injection, electroporation, gene guns, Agrobacterium mediated gene transfer. Transgenics

Module-4 **8 hours**

Methods in Biotechnology

1. Isolation and purification of DNA
2. Gel electrophoresis
3. PCR, RFLP, DNA finger printing, DNA sequencing and genome projects - human genome projects Blotting techniques, ELISA.

Module-5 **10 hours**

Application of Biotechnology in :

Medicine - Production of human insulin, human growth hormone and vaccines, genetherapy, monoclonal antibodies, biopharming.
Forensics - Identification of crime suspects, personal identification.

Agriculture - Genetically modified crops • Bt crops, Golden rice, Flavr Savr Tomato, virus and herbicide resistant crops, edible vaccines.

Environment - Bioremediation, super bug.

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

Module-6 **6 hours**

Scope and Relevance of the following Technologies:

Microbial biotechnology, tissue engineering technology, embryonic stem cell culture, animal cloning, micro array technology, bionanotechnology.

Module-7 **2 hours**

Social and ethical issues, bio-safety, bio-war, patenting and IPR issues.

On hand training **18 hours**

1. Laboratory setup
2. Use of equipments and glass wares - Petri dishes, pipettes, autoclave, pH meter and laminar air flow system.
3. Preparation of media-MS medium, sterilization, inoculation callus induction and regeneration(demonstration only)
4. Visit to a well equipped biotechnology laboratory. Submit a brief report of the visit alongwith the practical record

Suggested additional topics (not for exams)

Genetic transformation and transgenics, 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,Bioinformatics ,Micro array, Biosensors.

References

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4. Colin Ratledge and Bjorn Krishansen, 2008. Basic Biotechnology, Cambridge University Press.
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14. Sobti RC and Suparna S. Panchauri. 2009. Essentials of Biotechnology, Ane Books Pvt. Ltd.
15. Timir Baran Jha and Biswajith Ghosh 2007, Plant Tissue Culture, University Press.
16. Veer Bala Rastogi 2008. Fundamentals of Molecular Biology, Ane Books Pvt. Ltd.

B.Sc. BOTANY PROGRAMME

Semester V **Open Course-** BO5D01U

BIOINFORMATICS

(72 Hours) Theory Credit 4

Course objectives

1. Make the student aware of the nature of the very large amount of detailed information about ourselves and other species that has become available.
2. Make the student aware of the role of computers and computer science in the investigations and applications of these data.
3. Impart useful knowledge of the techniques by which, through the World Wide Web, we gain access to the data and the methods for their analysis.
4. Make the student confident in the use of computers to handle biological databases, information retrieval and to make him/her able to extend these skills by self-directed 'field work' on the Web.
5. Make him/her aware of the range of applications of bioinformatics to molecular biology, clinical medicine, pharmacology, biotechnology, agriculture, forensic science, anthropology and other disciplines
6. To create a sense of optimism that the data and methods of bioinformatics will create profound advances in our understanding of life, and improvements in the health of humans and other living things.

Module 1 **2 hours**

Defining bioinformatics

Scope and relevance of bioinformatics

Module 2 **6 hours**

Characteristics of living organisms

Overview of biological classification and nomenclature

Cell as the basic unit of life : Prokaryotic and eukaryotic cells, examples; Basic structure of prokaryotic and eukaryotic cells; Chemical composition and structure of biomolecules – Carbohydrates, Nucleic acids, Proteins

Module 3 **6 hours**

Biological information; DNA as the store house of genetic information ; Concept of gene, split genes ; Mechanism of DNA replication- the centraldogma, transcription, translation

Module 4 **4 hours**

DNA sequencing**: Sanger's** method; Protein sequencing**:** Edman degradation method

Module 5 **6 hours**

Introduction to genetic engineering - Gene cloning: Cloning vectors, restriction endonucleases, ligases . Techniques to transfer the recombinant DNA into cells: Transformation, transduction, electroporation, microinjection, DNA gun.

DNA libraries: Genomic DNA library, cDNA library

Module 6 **4 hours**

Genomics: Definition; Sequencing genes to sequencing genomes, Sequence assembly;

Major findings of the following genome projects- Human, *Arabidopsis thaliana, Drosophila melanogaster, Caenorhabditis elegans*

Module 7 **8 hours**

Biological Data bases: Bibliographic databases - Finding Scientific Articles, PubMed:

Genome sequence databases-Entrez Genome, TIGR database; Nucleic acid sequence databases; GenBank; Protein sequence databases – GenBank, SWISS-PROT; Protein structure database- Protein Data Bank; Searching Biological databases- Saving search results, FAST format, ASN.1 format, Batch Entrez, PDB flat file format, mmCIF format

Module 8 **10 hours**

Sequence comparison- Pair wise sequence alignment- Global alignment: Use of ALIGN; Local alignment: Use of BLAST, FASTA; Multiple sequence alignment: Use of ClustalW; Phylogenetic analysis – Use of PHYLIP; Data mining- Use of PERL in bioinformatics

Module 9 **6 hours**

Structure visualization- Molecular structure viewers, RasMol, SWISS-PDBViewer;

Predicting protein structure and function from sequence ; Protein modeling, docking and drug discovery

On Hand Training **18 hours**

Familiarize with the various databases given in the syllabus

Practice retrieving data from the various databases

Learn how to store the retrieved data

Practice the use of BLAST

Familiarize with the use of RasMol

References

1. Bioinformatics: *A Machine Learning Approach*. P Baldi and S Brunak. MIT Press, 2000
2. Bioinformatics : *A Practical Guide to the Analysis of Genes and Proteins*, 2001
3. Cynthia Gibas and Per Jambeck. O'Reilly, 2003*Developing Bioinformatics Computer Skills.*
4. TA Brown. Wiley *Genomes*. -Liss. 2001
5. *Genomics: The Science and Technology Behind the Human Genome Project* 2003
6. S. Parthasarathy *Pearl programming in bioinformatics*, , Ane Books Pvt.Ltd., New Delhi, 2009
7. *Genomic Pearl*, Rex A Dwyer, Cambridge, 2005
8. Desmond ST Nicholl , 2009.*Introduction to genetic engineering*, , Cambridge
9. Jin XIong, 2009 *Essential Bioinformatics*, Cambridge.

B.Sc. BOTANY PROGRAMME

SEMESTER I COMPLEMENTARY COURSE I BO1C01 U

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

General account of Gymnosperms

Type: *Cycas* 4 hrs

Module-3 Plant Pathology **4** Hrs

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

2. Study of the following diseases with name of disease, causative organisam, 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
3. Bhatia K. N (1975) A treatise on Algae. New Delhi. S. Chand and co. Publishing, New Delhi, Vikas publishing House Pvt.Ltd.
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8. Fritsch F. B (1945), Structure and Reproduction of Algae Vol. I & II. Cambridge University Press.
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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

B.Sc. BOTANY PROGRAMME

SEMESTER –II COMPLEMENTARY COURSE –II BO2C02 U

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) Determination of transpiration under different environmental conditions using Ganong's / Farmer's Potometer
4) Demonstration of osmosis using plant membrane

Demonstration Experiments:

1. Effect of carbon dioxide concentration on the rate of photosynthesis by *Hydrilla* plants
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)

References

1. Devlin and Witham - Plant Physiology, C B S Publishers
2. Jain V. K., 2008. Fundamentals of Plant Physiology, S. Chand and Co.
3. Kochhar P. L. & Krishnamoorthy H. N. Plant Physiology, Atmaram and Sons, Delhi, Lucknow.
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B.Sc. BOTANY PROGRAMME

SEMESTER –III COMPLEMENTARY COURSE –III BO3C03 U

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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6. Sharma, O.P. 1993. *Plant Taxonomy*. Tata McGraw – Hill Publishing Co Ltd., New Delhi.

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B.Sc. BOTANY PROGRAMME

SEMESTER –IV COMPLEMENTARY COURSE –IV BO4C04 U

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.

6 Hrs **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.

1. Christopher, E.P. 1958. *Introductory Horticulture*. McGraw – Hill, New York.
2. Esau, K. 1965. Plant Anatomy. Wiley, New York.
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5. Kumar, N. 1994. *Introduction to Horticulture*. Rajalakshmi Publications, Nagercoil.
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B. Sc Botany (Vocational) Degree - Semester wise course title
Vocational Subject – ENVIRONMENTAL MONITORING AND MANAGEMENT

Semester I	Course I ENVIRONMENTAL BIOLOGY PART –I *(Theory 36 hours)*
	Course II ENVIRONMENTAL BIOLOGY PART-II *(Theory 36 hours; Practical 36 hours)*
Semester II	Course III ENVIRONMENTAL MICROBIOLOGY *(Theory 36 hours)*
	Course IV ENVIRONMENTAL HYGEINE AND HUMAN HEALTH *(Theory 36 hours; Practical 36 hours)*
Semester III	Course V ENVIRONMENTAL MONITORING –PART I *(Theory 54 hours; Practical 36 hours)*
	Course VI ENVIRONMENTAL CONSERVATION AND MANAGEMENT PART- I *(Theory 54 hours; Practical 36 hours)*
Semester IV	Course VII ENVIRONMENTAL MONITORING - PART II *(Theory 54 hours, Practical 36 hours)*
	Course VIII ENVIRONMENTAL CONSERVATION AND MANAGEMENT – PART II *(Theory 54 hours, Practical 36 hours)*

B. Sc Botany (Vocational) Degree
ENVIRONMENTAL MONITORING AND MANAGEMENT
Semester 1 Course I Code BO (V)1BE 14U

ENVIRONMENTAL BIOLOGY PART -I
(Theory 36 hours) ***(credit 2)***

Objectives

To enable students to

- Create an awareness on aspects of the ecosystem and interactions within the system
- Have an idea on diverse group of plants, their survival and their interactions in different environments
- Understand the flow of energy & route of elements through the ecosystem

Module 1: (6 hrs)

Ecology: Definition, History and scope, Ecosystem concept –structure, composition and dynamics.

Module 2: (12 hrs)

Ecosystems: Inland water ecosystems, marine and coastal environments, terrestrial ecosystems. Plant and animal interactions.

Module 3: (14 hrs)

Energy in the ecosystem: Bioenergetics, flow of energy, models, concept and measurement of productivity. Biogeochemical cycles of C, N, O, S, P, halogens and metals.

Module 4: (4 hrs)

Biodiversity - definition, species, genetic and ecosystem diversity, Endemic species, endangered species (flora and fauna)

B. Sc Botany (Vocational) Degree

ENVIRONMENTAL MONITORING AND MANAGEMENT

Semester 1 Course 2 Code BO(V)1BE 15U

ENVIRONMENTAL BIOLOGY PART-II

(Theory 36 hours; Practical 36 hours) ***(Theory credit 2 ; Practical credit 1)***

Objectives

To enable students to

- Assess the inter-relationship between organisms at population & community level
- Create an awareness on importance of biological resources
- Study types and process of succession

Module 1: (4 hrs)

Population Ecology: Characteristics- Density, mortality, natality, age distribution and stabilizing factors

Module 2: (12 hrs)

Community Ecology- Structure, Analysis quadrate and transect method, ecotone and edge effects, ecological niche, ecological equivalents, ecotypes, ecological indicators, homeostasis in the ecosystem.

Module 3: (10hrs)

Ecological succession; Kinds, process, concept of climax, theories and significance. Attributes of succession and patterns in different places- hydrosere and xerosere.

Module 4: (10 hrs)

Biological resources: Plant and animal resources, mangrove and wet land resources, agricultural resources, forest products and biomass, microbial resources and their ecological significance.

Practicals (36 hours)

1. Vegetation analysis-Association, diversity, frequency, density, productivity (primary) indirect estimation of standing crop.
2. Aquatic ecosystems- Survey, mapping, preservation, identification and abundance estimation of macrophytes, biomass and primary productivity; estimation of chlorophyll, temperature, dissolved oxygen and pH.
3. Visits to mangrove and inland water ecosystems.
4. Demonstration of ecosystems and succession patterns: Familiarization of forest products, plants and animal resources.

B.Sc Botany (Vocational) Degree
ENVIRONMENTAL MONITORING AND MANAGEMENT

Semester II Course 3 Code BO(V)2BE16U

ENVIRONMENTAL MICROBIOLOGY

(Theory 36 hours) ***(Theory credit 2)***

Objectives

To enable students to

- Understand the world of microbes & evaluate their role in the environmental segments
- Evaluate the application of microbiology in different fields
- Study the aspects of food spoilage and importance of preservation of food

Module 1: (7 hrs)

History of microbiology: Types of micro organisms- structure, biology and classification of bacteria, fungi, virus and algae.

Module 2: (14 hrs)

Distribution and composition of microorganisms in soil, water and air, effects of physical and chemical factors on their growth and activity. Role of microbes in the environment, microbes in biogeochemical cycles, microbial transformation of metals, biological nitrogen fixation and microbial antibiotics.

Module 3: (7 hrs)

Food microbiology: General properties of food spoilage, chemical changes caused by microorganisms, microbial toxins, fermentation products, preservation of food.

Module 4: (8 hrs)

Diseases connected with food, food poisoning, food allergy, Microorganisms and water pollution: Significance of bio- indicators- faecal bacteria and pathogenic microorganisms, microbial interaction with other organisms, competition, parasitism and mutualism.

B.Sc Botany (Vocational) Degree
ENVIRONMENTAL MONITORING AND MANAGEMENT

Semester II Course 4 Code BO (V)2BE17U

ENVIRONMENTAL HYGEINE AND HUMAN HEALTH

(Theory 36 hours; Practical 36 hours) **(Theory credit 2 ; Practical credit 1)**

Objectives

To enable students to

- Understand the environmental factors that relate to human health & diseases
- Study the importance of sanitation & hygiene in preserving the environment & maintaining good health
- Make an awareness on industrial hazards

Module 1: (7 hrs)

Environmental factors in Health: Health and Diseases – sexually transmitted diseases-AIDS. Role of sex education . Physical, chemical and biological factors that affect health, home environment, meaning of poison, toxin and hazardous wastes.

Module 2: (10 hrs)

Industrial hazards- Physical, chemical, noise, radiation; dust of silica, cement, paper, cotton, jute, pesticides, particulate matter. Biological –psychological & physiological, fatigue; effects of water pollutants and air pollutants on human health.

Module 3: (12 hrs)

Mode of action of toxicants: Physical toxicity, particulates, gaseous, solvent and vapour. Chemical toxicity, halogens, hydrocarbons, pesticides and heavy metals. Physiological toxicity, irritants, anaesthetics, narcotics, asphyxiants and systemic poisons. Dose effect and dose response relationship, dose effect and dose response curves,

Module 4: (7 hrs)

Common water- borne diseases and their control, sanitation, basic needs, relationships of sanitation to health. Toxic effect due to combination of chemicals. Effect of wrongful disposal of wastes.

Practical (36 hours)

1. Microbial techniques- sterilization – flame sterilization, hot-air oven, boiling water bath, autoclaving, chemical sterilization, plating, isolation, streaking and identification.
2. Mounting and staining: (a) gram stain, (b) acid fast: aerobic and anaerobic microbes, identification: milk, food and soil microbes. Identification of pathogenic microbes in water.
3. Toxicity studies – Application of LC_{50} in fishes, spot test for plant.
4. Pollution indicators: Phytoplankton and zooplankton counts, biotic index, palmer–s algal pollution index.
5. Field visits (regions of environmental problems)

B.Sc Botany (Vocational) Degree

ENVIRONMENTAL MONITORING AND MANAGEMENT

Semester III Course 5 Code BO (V)3BE18U

ENVIRONMENTAL MONITORING PART I

(Theory 54 hours; Practical 36 hours) (Theory credit 2 ; Practical credit 1)

Objectives

To enable students to

- Study about pollutants that adversely affect air environment
- Familiarize techniques involved in monitoring & controlling of air pollutants
- To study the causes & effects of soil pollution
- To highlight the adverse effects of quarrying, deforestation & unscientific farming practices
- To create an awareness on different land use practices, involved in preserving our soil resource
- Study the methods involved in analysis of the soil pollutants

Module 1: (15 hrs)

Air pollution: Structure and constituents; sources , nature and types of pollutants, particulate matter, aerosols, fly ash, sulphur, halogen, carbon and nitrogen compounds, primary and secondary air pollutants, Photochemical smog, Ozone depletion, Acid rain, Green house effect, Inversions, Biopollutants: effect of air pollution on health, plants, climate and materials. Radioactive pollutants: origin of radionuclides-natural and artificial- their path and effects on the ecosystem. Principles of sampling and analysis of air pollutants.

Module 2: (14 hrs)

Air pollution monitoring and control: pollution control by particulate removal, setting chamber, air scrubbers, water spraying, filters and electro static preceptors. Removal of gaseous pollutants and treatment of air pollutants - in chemical industries, refineries, thermal power plants, cement industries, automobile exhausts. Air quality standards and principles of air monitoring devices

Module 3: (5 hrs)

Environmental chemistry of soil: Nature of soil, water and air-mineral water- organic matter- acid- base and ion exchange reactions mineral matter, organic matter, macro and micro nutrients,

Module 4: (6 hrs)

Soil pollution: Sources, nature and types of pollutants- fertilizer residues, solid wastes, radio active substances, hospital wastes, pesticide pollution, field run off and sewage effluents.

Module 5: (14 hrs)

Adverse effects of soil pollution: Various aspects of soil erosion, soil degradation, water logging, sand and clay mining, desertification, quarrying, land conversion for agriculture, deforestation and farming, urban housing, road development and over grazing. Soil plant interactions, adverse effects of land use practices in Kerala. Soil pollution monitoring and control: Methods and principles of analysis for the soil pollutants.

Practical 36 hours

1. Sampling techniques of soil.
2. Physical parameters: Soil type, soil profile and texture.
3. Preparation of soil extract.
4. Determination of pH, acidity, total organic content, potassium and calcium.
5. Total coliforms and feacal coliforms in the soil samples.
6. Total kjeldhal nitrogen (demonstration), lime and gypsum status of soil.
7. Field visits(regions of environmental problems)

B.Sc Botany (Vocational) Degree
ENVIRONMENTAL MONITORING AND MANAGEMENT

Semester III Course 6 Code BO (V)3BE19U

ENVIRONMENTAL CONSERVATION AND MANAGEMENT PART- I

(Theory 54 hours; Practical 36 hours) (Theory credit 2 ; Practical credit 1)

Objectives

To enable students to

- Familiarize different aspects of habitat management
- Highlight strategies and planning involved in land use management for sustainable development
- Create an awareness on importance of solid waste & water resource management
- Study various aspects of ecotourism
- Evaluate the importance of environmental education in preserving our resources

Module 1: (15 hrs)

Habitat management: Conservation of forests, wild life, air water and soil environments. Biodiversity biosphere reserves, sanctuaries, national parks, sacred groves, cause of extinction of species, red data book, coastal regulatory zone act, management of mangrove vegetation. Ecological modeling - significance.

Module 2: (6 hrs)

Water resources Management: Socio-economic factors involved in managing water resources. Conventional and non-conventional sources of water supply management.

Module 3: (10 hrs)

Land use management for sustainable development: Strategies and planning for soil pollution control, Changes in agricultural practices, Solid waste management, vermicomposting, bacterial composting, Precautions in the use of radioactive substances. Occupational health hazards with relation to solid waste disposal.

Module 4: (15 hrs)

Ecotourism: From an environmental management perceptive rather than tourism as an industry. Identification of nature based ecotourism opportunities in Kerala- dam sites, HEP, water falls, mangroves, bird sanctuaries, pilgrim tourism, forest area, parks, sacred groves, beaches, wildlife sanctuaries, national parks. Strategies to maintain these areas in an ecological sustainable way. Coastal management activities in India and Kerala.

Module 5: (8hrs)

Environmental Education: Education to inculcate environmental consciousness among learners. Non-formal and formal education (business, union, community and other organizations): methodologies (posters, banners, audio-visual aids, street plays, padayatras, corner meetings).

B.Sc Botany (Vocational) Degree
ENVIRONMENTAL MONITORING AND MANAGEMENT

Semester IV Course 7 Code BO(V)4BE20U

ENVIRONMENTAL MONITORING - PART II

(Theory 54 hours, Practical 36 hours) (Theory credit 2 ; Practical credit 1)

Objectives

To enable students to

- Create an awareness on importance of water as a resource
- Know about pollutants that adversely affect aquatic environment
- Familiarize techniques involved to analysis of water pollutants
- Study the causes & effects of water pollutantion
- Highlight the adverse effects various industries that contribute to aquatic pollution
- Study methods involved in water pollution monitoring and control

- Perform analysis to assess soil & water quality

Module 1: (15 hrs)

Hydrosphere: Nature and composition of natural waters, Trace level substances in water, Redox equilibria in natural waters. Physical and chemical properties of water in relation to living organisms, Biological importance of water, Hydrological cycle, ground water, types of water, origin, movement, storage and factors affecting ground water. Ground water replenishment, potable water qualities. Quality and productivity of fresh water, estuarine and marine water.

Module 2: (8 hrs)

Water analysis: Sampling techniques- sample preservation and their importance. Physical and chemical tests of water related to water pollution.

Module 3: (10 hrs)

Water pollution: Sources, types and nature of pollutants. Nature and effects of water pollutants- acids, alkalis, thermal , radio active, heavy metals, pesticides, waxes, soaps, fertilizers, farm wastes, sewage and industrial effluents ,synthetic detergents. Effects of water pollutants on human beings, plants and animals. Quality of water eutrophication, bloom formation, COD, BOD, turbidity, salinity and colour.

Module 4: (14 hrs)

Water pollution monitoring and control: Water and waste water treatment. Preliminary, primary, secondary and tertiary treatments. Treatment of industrial waste water chemical, fertilizer, paper pulp, tannery, sugar distillery and oil refineries, Recycling of industrial and domestic waste waters. Water quality criteria and standards (Indian and International). Principles and methods of water analysis. Water quality monitoring devices-principles.

Module 5: (7 hrs)

Biomonitoring: Bioassesment-Bioassays, 5 Rs of biomonitoring eutrophicaction monitoring. Biotic index. Bioindicators- Uses of biomonitoring.

Practical 36 hours

1. Sampling techniques of water and preservation of water samples.
2. Analysis of physical parameters- temperature, colour, pH, turbidity, conductivity, total solids, total dissolved solids and total suspended solids.
3. Analysis of chemical parameters: Acidity, alkalinity, carbon dioxide, hardness, dissolved oxygen, COD, BOD (demonstration).
4. Analysis of biological parameters: Identification counting of zooplanktons and phytoplanktons, estimation of productivity using algae.
5. Field visits for water sampling.

B.Sc Botany (Vocational) Degree

ENVIRONMENTAL MONITORING AND MANAGEMENT

Semester IV Course 8 Code BO(V)4BE21U

ENVIRONMENTAL CONSERVATION AND MANAGEMENT PART II

(**Theory 54 hours, Practical 36 hours) (Theory credit 2 ; Practical credit 1)**

Objectives

To enable students to

- Create an awareness on the present laws associated with prevention & control of pollution
- Study the principles and tools evolved for development on sustainable basis
- Know about role of various international & national organizations that help in preserving our environment & resources
- Get an idea on aspects of disaster management and its effect on development
- Attain the acquired ability to impart knowledge to local public as a means to preserve environment and resources at grass root level

Module1: (15 hrs)

Environmental Planning and Protection laws: General structure of environmental laws in India. Constitutional responsibilities and powers with respect to environmental planning and protection. Land-use planning systems and legislation to promote development. An awareness regarding the present laws on the following topics: Pollution control (air, water and noise), waste disposal (solid and hazardous). Regulation of hazardous substances (pesticides, environmental contaminants, radio active substances, lead, asbestos), regulation of human- ingested products (food additives, therapeutic substances).

Module 2: (20 hrs)

Principles and tools in sustainable development: Careful identification of the causes and consequences (short term and long term) of a broad range of problems in developing and industrial countries. Environmental impact assessment, environmental auditing, remote sensing, geographic information systems, biofarming, environmental planning for sustainable development. Role of UNEP, UNDP, International Bureau for Plant Genetic Resources (NBPGR), non conventional energy use, conservation of gene reserve, global environmental management.

Module 3: (7 hrs)

Environmental Policy: Role of social movements, formal organizations, institutions (Parliament and Cabinet), mass media, the educational systems and scientists.

Module 4: (12 hrs)

Disaster management and Development: Characterization of natural disasters - Earthquake, draught, flood and landslide. Link between disasters and development.

Practicals **(**36 hours)

A dissertation work based on any one of the environmental science/ management aspect instead of routine practical. Hours allotted for practical for paper VI & paper VIII will be converted to dissertation work

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B. Sc Botany (Vocational) Degree - Semester wise course title
Vocational Subject FOOD MICROBIOLOGY

Semester I	Course I MICROBIAL WORLD PART I *(Theory 36 hours)*
	Course II MICROBIAL WORLD - PART II *(Theory 36 hours; Practical 36 hours)*
Semester II	Course III APPLIED MICROBIOLOGY- PART I (Theory 36 hours)
	Course IV APPLIED MICROBIOLOGY PART II (Theory 36 hours; Practical 36 hours)
Semester III	Course V PRINCIPLES OF FOOD MICROBIOLOGY (Theory 54 hours; Practical 36 hours)
	Course VI CONTAMINATION, SPOILAGE AND PRESERVATION OF FOOD -PART I (Theory 54 hours; Practical 36 hours)
Semester IV	Course VII CONTAMINATION, SPOILAGE AND PRESERVATION OF FOOD-PART II (Theory 54 hours, Practical 36 hours)
	Course VIII FOOD FERMENTATIONS, FOOD INFECTION AND FOOD BORNE DISEASES (Theory 54 hours, Practical 36 hours)

B. Sc Botany (Vocational) Degre

FOOD MICROBIOLOGY

Semester I Course 1 Code BO(V)1BF14U

MICROBIAL WORLD – PART I

(Theory 36 hours) (Theory credit 2)

Module-1 (6 hrs)

History and scope of microbiology. Contributions of early Microbiologists.

Microscopy- Bright field microscopy, Dark field microscopy , Fluorescence microscopy, Phase contrast and Electron microscopy-TEM and SEM

Module II (10 hrs)

a) Prokaryotic cell structure and function, size, shape and arrangement , cell organisation , membrane system, nucleoid, wall structure –peptidoglycan, gram positive and gram negative cell walls, components external to cell wall-capsule, slime layers, RS layers, pili and fimbriae, flagella, endospore.

b) Eukaryotic cell-structure and function, nucleus, cell inclusions-living and non living, external cell coverings, cilia and flagella.

Module-III (10 hrs)

Virus Architecture

a) Structure of viruses, virion size, nucleic acids, capsids, Principles of virus taxonomy.
b) Bacteriophages –discovery, classification and nomenclature. Replication of bacterial viruses -adsorption, penetration, transcription, assembly and release. Mechanism of lysogeny.
c) Animal viruses- structure, classification, reproduction/multiplication. Persistent, latent and slow virus infections. Viruses and cancer, HIV, oncogenic DNA viruses, viroids and prions.
d) Plant viruses-virion, morphology, reproduction, transmission,TMV.

Module-IV (10 hrs)

Microorganisms-General characters of Fungi, Yeast, Algae, Protozoa, Actinomycetes, Cyanobacteria, Archaebacteria.

B. Sc Botany (Vocational) Degree
FOOD MICROBIOLOGY
Semester I Course 2 Code BO(V)1BF15U
MICROBIAL WORLD - PART II
(Theory 36 hours; practical 36 hours) (Theory credit 2 ; Practical credit 1)

Module I (6 hrs)

Bacterial classification (Bergey–s manual)

Gram negative bacteria- Aerobic and anaerobic forms, Mycoplasma

Gram positive bacteria- Endospore forming and Non-spore forming

Module II (8 hrs)

Reproduction and Growth of bacteria- growth curve, generation time, continuous culture, restriction of growth and synchronous culture- Quantitative measurement of growth.

Module III (12 hrs)

Bacterial physiology- Nutritional requirements of microorganisms-Nutritional types of Bacteria. Physical conditions required for growth

Bacterial metabolism- Respiration, Fermentation, Photosynthesis.

Module IV (10 hrs)

Bacterial Genetics- Mutation, Recombination-Transformation, Conjugation and Transduction, Plasmid, Recombinant DNA Technology.

Practicals **(**36 hrs)

1. Laboratory techniques in Microbiology;

   a) Use of microscope- Bright field, dark field and phase contrast microscopy.

   b) Use of equipment and glass wares- Inoculating loop, needle, Petri dishes, flasks, culture tubes, Pasteur pipettes, hot air oven, autoclave, incubator, water bath, colony counter, filters, UV lamp, pH meter, centrifuge, colorimeter, laminar air flow system.

c) Micrometry- Calibration of ocular micrometer- measurement of fungal spores, yeast cells and bacteria.

2. Study of bacteria

a) Preparation and fixation of bacteria for staining

b) Simple staining- methylene blue, crystal violet, carbol fuchsin.

c) Differential staining- Gram staining, acid fast staining, spore staining, cell wall staining, capsular staining, flagella staining,

B. Sc Botany (Vocational) Degree
FOOD MICROBIOLOGY

Semester II Course 3 Code BO (V) 2BF16U

APPLIED MICROBIOLOGY- PART I

(Theory 36 hours) **(Theory credit2)**

Module I (10 hrs)

Sterilization techniques- Principles of sterilization, Control of microorganism by Physical agents- dry heat, moist heat and filtration. Chemical agents- phenolic compounds, alcohol, halogens, aldehyde and gaseous agent.

Module II (8 hrs)

Preparation and staining- Fixation, wet mount and hanging drop techniques, stained smear, stains- Simple and Differential staining- gram staining, Special staining techniques- spore staining, capsular staining and acid fast staining.

Module III (6 hrs)

Preparation and sterilization of media-Crude and synthetic media, selective and differential media- nutrient broth, nutrient agar, PDA, Czapex-dox agar.

Isolation of microbes-serial dilution, pour plate, spread plate, and streak plate technique.

Module IV (12 hrs)

Antimicrobial chemotherapy; - chemotherapeutic agents- Antibiotics-mode of action, Antifungal agents, Antiviral agents. Determination of antimicrobial activity-Tube dilution technique, Disk diffusion technique.

B. Sc Botany (Vocational) Degree

FOOD MICROBIOLOGY

Semester II Course 4 Code BO(V)2BF17U

APPLIED MICROBIOLOGY PART II

(Theory 36 hours; practical 36 hours) (Theory credit 2 ; Practical credit 1)

Module I (10 hrs)

Environmental microbiology:- role of microbes in bio-geochemical cycling- Carbon, Sulphur and Nitrogen cycles- Biological nitrogen fixation, bio fertilizers, bio compost, bio deterioration(in brief). Role of microbes in organic decomposition

Module II (6 hrs)

Microbiology of water- Microorganisms and water pollution- significance of bio indicators- faecal bacteria and pathogenic microorganisms. Detection of coliforms by MPN. Waste water treatment.

Module III (12 hrs)

Clinical microbiology

Fundamentals of Immunology- Immunity- Innate and Acquired immunity. Immune response, Antigens- factors influencing immunogenicity-epitopes-haptens. Immunoglobulin-basic and fine structure-classes. Hypersensitive reaction-Classification-type I, type II, type III and type IV.
Toxins, toxoids, vaccines, interferon.

Module IV (8 hrs)

Microbial diseases

a) Bacterial diseases- diphtheria, tuberculosis, whooping cough, leprosy, syphilis, tetanus and cholera.

b) Viral diseases- chicken pox and shingles, measles, mumps, rabies, serum hepatitis, poliomyelitis

Practicals (36 hrs)

1. To see if bacteria are motile- Hanging drop technique.
2. Preparation of culture media

   a) Cleaning glass wares, drying, plugging tubes, flaks, pipettes, etc.

   wrapping Petri dishes, making a Pasteur pipette.

   b) Sterilization – media, glass wares

   i Moist heating-autoclaving, tyndallisation, boiling in water, steaming.

   ii Dry heating- Heating in hot air oven and flaming.

   iii Sterilization of heat labile substances-Chemical means, filtration, gaseous sterilization.

   c) Preparation of media- Nutrient agar, Nutrient broth, PDA, Czapex Dox

   agar, Preparation of agar slant, agar plate, broth tube and flasks.

B. Sc Botany (Vocational) Degree

FOOD MICROBIOLOGY

Semester III Course 5 Code BO(V)3BF18U

PRINCIPLES OF FOOD MICROBIOLOGY

(Theory 54 hours; Practicals 36 hours) **(Theory credit 2 ; Practical credit 1)**

Module-I (10 hrs)

Fungi, yeast and bacteria associated with food-general characteristics and industrial importance.

Module-II (8 hrs)

a) Food as a substrate for microorganisms- pH, moisture, concept of water activity, oxidation-reduction potential, nutrient content, inhibitors and biological structure.

b) General principles of food preservation, asepsis, removal, anaerobic conditions- methods and principles.

Module-III (18 hrs)

Preservation of food

a) Preservation using high temperature, heat resistance, heat penetration, thermal processes, canning.

b) Preservation using low temperature- chilling, freezing.

c) Preservation by drying.

d) Preservatives, additives, added inorganic, organic and developed preservatives.

c) Preservation by radiation- UV rays, ionizing radiations.

Module-IV (18 hrs)

Microorganism as food

a) Fat, vitamins, enzymes, proteins and other substances.

b) Mushrooms- major field and cultivated mushrooms.

Practicals (36 hrs)

1 Isolation of fungi causing storage rot of fruits and vegetables.

2 Identification of important fungi associated with post harvest rot of vegetables like onion, beans, tomato, capsicum, bitter gourd, tapioca, cow pea, ladies finger, brinjal etc.

3 Isolation of fungi:

a) From infected cereals and pulses

b) From other foodstuffs including pickle, jam, dried fruits etc.

c) Isolation of fungi from mixed c

Bacteriological examination of water by multiple tube fermentation tests or multiple tube test,

1. Presumptive test
2. Confirmed test
3. Completed coliform test

B. Sc Botany (Vocational) Degree

FOOD MICROBIOLOGY

Semester III Course 6 Code BO(V)3BF19U

CONTAMINATION, SPOILAGE AND PRESERVATION OF FOOD - PART I

(Theory 54 hours; Practicals 36 hours) **(Theory credit 2 ; Practical credit 1)**

Module-I (12 hrs)

Contamination of food from natural sources. Pre-harvest and post harvest contamination of vegetables and fruits from animals, from sewage, soil, water, and air. Contamination during processing and transport.

Module-II (12 hrs)

General principles underlying spoilage, fitness of food, cause of spoilage, number, growth and kinds of spoilage.

Chemical changes due to microbial spoilage, Nitrogenous organic compound and non-nitrogenous organic compounds.

Module-III (20 hrs)

a) Cereals, cereal products and pulses-contamination, preservation and spoilage of grains, flours, bread, cake etc.

b) Sugar and sugar products-Contamination, preservation and spoilage of cane sugar, jaggery, molasses and syrups, honey, candy.

Module-IV (10 hrs)

Vegetables and fruits- contamination and preservation and spoilage of raw vegetables and fruits, fruit juices and fermented product.

Practicals (36 hrs)

1. Isolation of bacteria
    a) Pour plate method
    b) Dilution method
    c) Streak plate method
2. Culturing of fungi for morphological studies
    a) Agar plate method
    b) Slide culture method
    c) Glass slide technique for observing fungi spore germination.

B. Sc Botany (Vocational) Degree

FOOD MICROBIOLOGY

Semester IV Course 7 Code BO(V)4BF20U

CONTAMINATION, SPOILAGE AND PRESERVATION OF

FOOD-PART II

(Theory 54 hours; Practicals 36 hours) **(Theory credit 2 ; Practical credit 1)**

Module-I (18 hrs)

a) Fish and other sea foods- Contamination, preservation- heat, cold, drying. Spoilage- factors influencing spoilage- causative organisms, spoilage of special kind of fish and seafood.

b) Meat and meat products-Contamination, preservation, heat, cold, drying, preservatives. Spoilage- general principles, types of spoilage.

Module-II (12 hrs)

Eggs- contamination, preservation, removal, heat, cold, drying, preservatives. Spoilage- defects and changes, bacterial rots, fungal rots.

Poultry-Contamination, preservation, removal, heat, cold, drying, preservatives, spoilage.

Module-III (12 hrs)

Milk and milk products- Contamination, preservation, asepsis, removal, heat, cold, drying, preservatives, spoilage: milk and cream, condensed and dry milk, frozen desserts, butter, cheese.

Module-IV (12 hrs)

a) Miscellaneous foods- Contamination, fatty foods, salad dressings, essential oils, bottled beverages, spices and condiments.

b) Heated canned foods- cause of spoilage, grouping on pH, types of spoilage, canned meat and fish.

Practicals (36 hrs)

1. Quantitative estimation of microorganism
   a) Viable count
      i Spread plate technique
      ii Serial dilution technique
      iii Drop technique
   b) Total count- Haemocytometer method.
1. Bacteriological analysis of milk by MBRT.

B. Sc Botany (Vocational) Degree
FOOD MICROBIOLOGY

Semester IV Course 8 Code BO(V)4BF21U

FOOD FERMENTATIONS, FOOD INFECTION AND

FOOD BORNE DISEASES

(Theory 54 hours; Practicals 36 hours) **(Theory credit 2 ; Practical credit 1)**

Module-I (20 hrs)

a) Production of cultures for food fermentation, Culture-maintenance and preparation, bacterial, fungal and yeast cultures

b) Fermentation of foods- bread, malt beverages, wine, distilled liquors, vinegar, sauerkraut. Oriental fermented food- tempeh, soya sauce, idlly, appam, chemical leavening, processing of tea, coffee, cocoa, vanilla.

Module-II (12 hrs)

Food infection and food intoxication

Chemicals, poisonous plants, animals and fungi: Aflatoxicosis*, Staphylococcus* poisoning, *Clostridium prefringens* food poisoning, Botulisum, Salmonellosis.

Module-III (12 hrs)

Food and Water borne diseases

Viral- gastroenteritis, infectious hepatitis, poliomyelitis.

Bacterial- cholera, typhoid fever, gasteroentritis (Campylobacter jejuni)

Protozoas- Amoebiasis

Special reference of field investigation, laboratory testing and preventive measures

Module-IV (10 hrs)

Food sanitation, Food vending, Employee's health, Sewage and waste treatment and disposal.

Practicals (36 hrs)

1. Demonstration of enzyme action using a yeast fermentation system
2. Demonstration of the effect of temperature on yeast fermentation.
3. Determination of the effect of the enzyme concentration on yeast fermentation.
4. Effect of environment on microbial growth:

a) effect of temperature

b) effect of osmotic pressure

c) effect of oxygen

d) ionic effect.

4. Biochemical activates of microorganisms.

1. IMViC test – Indole test

Methyl red and Voges – Proskauer test

Citrate Utilization test

2. Catalase test

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B.Sc Botany (Vocational) Degree

HORTICULTURE AND NURSERY MANAGEMENT

Semester I	Course 1 - Fundamentals of horticulture *(Theory 36 hours)*
	Course 2 - Plant Propagation *(Theory 36 hours; Practical 36 hours)*
Semester II	Course 3 - Ornamental horticulture and Landscaping *(Theory 36 hours)*
	Course 4 - Plant Protection and Nursery management *(Theory 36 hours; Practical 36 hours)*
Semester III	Course 5 -Floriculture *(Theory 54 hours; Practical 36 hours)*
	Course 6 -Olericulture *(Theory 54 hours; Practical 36 hours)*
Semester IV	Course 7 - Pomology, Food Technology and Post harvest management of horticultural crops *(Theory 54 hours, Practical 36 hours)*
	Course 8 -Cultivation of medicinal and Aromatic plants, Spices, and Plantation Corps *(Theory 54 hours, Practical 36 hours)*
Semester 5 & 6	Project

B.Sc Botany (Vocational) Degree

HORTICULTURE AND NURSERY MANAGEMENT

Semester 1 Course 1 BO (V) 1B H14U

FUNDAMENTALS OF HORTICULTURE

(Theory: 36 hrs) **(Theory credit 2)**

MODULE 1 (15Hrs.)

1. Introduction, definition, history, development and division of horticulture.

2. **Soil** - Formation of soil, weathering (physical, chemical and biological pedogenesis). Components of soil - soil air, soil water, field capacity, permanent wilting percentage, pH, mineral matter, organic matter (types and its importance). Classification of soil - basis of classification - soil profile- soil types - red soil, black soil, alluvial soil, laterite soil, coastal soil, sandy soil, serpentine soil, sodic soil, problematic soil, acidic and alkaline - properties and reclamation. Soil preparation- soil treatment, selection of site for crops, role of micro organisms and humus.

MODULE 2 (21 Hrs.)

1. Water management and manuring: principles and methods of irrigation - dry and wet land water management - sprinkler, drip, and pitcher irrigation system - micro irrigation for mist chambers.Manures- organic manure - compost making - green manuring - objectives and examples of few manure crops suitable for Kerala.

2. Garden Tools and Implements.

3. Plant growth regulators in horticulture- natural and synthetic regulators, preparation and methods of application.

4. Plant propagating structures ﷿green house, glass house, hot bed, cold frame, lath house, net house, and mist chamber.

B. Sc Botany (Vocational) Degree

HORTICULTURE AND NURSERY MANAGEMENT

Semester I Course 2 BO (V) 1 BH 15U

PLANT PROPAGATION

(Theory: 36 hrs; practicals 36 hrs) **(Theory credit 2 ; Practical credit 1)**

Module 1 36 hrs

I - Methods of plant propagation: definition and basic concepts, types.

1. Propagation by seeds: characteristics of good seeds, types of pure seeds, seed treatment, seed dormancy, care of seedlings.
2. Vegetative Propagation: Natural ﷿ Suckers, offsets, rhizome, stolon﷿etc.
3. Artificial : Propagation by cuttings: stem, root and leaf cuttings, factors affecting rooting of cuttings
4. Layering-advantages and disadvantages, types of layering ground layering, air layering, different types.
5. Propagation by grafting:-advantages and disadvantages, stock-scion relationships, incompatibility
6. Grafting and budding methods:-approach, whip, cleft and epicotyls grafting, shield (T&I) and patch budding, green budding.
7. Micro propagation of horticulture plants-definition, principles, methods, advantages and disadvantages.

Practical 1 (36 hrs)

1. Collection and identification of different types of soil from the locality.
2. Estimation of soil p^H using p^H meter/paper.
3. Determination of water content of different types of soils.
4. Determination of field capacity of the soil.
5. Determination of permanent wilting percentage(PWP) or wilting coefficient of a soil
6. Preparation of vermicompost.
7. Identification and uses of various garden tools and implements .Work experience based on these tools.
8. Preparation of potting mixtures of known combinations .Determine the water holding capacity and its effect on plant growth (small project work).
9. Practice different types of grafting(approach, whip or tongue, saddle, cleft and crown grafting)in Hibiscus, Sapota, Camboge, Jack fruit tree and mango
10. Practice different type of budding - shield (T&I) and patch in rose, Hibiscus, bougainvillea and rubber etc.

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HORTICULTURE AND NURSERY MANAGEMENT

Semester II **Course 3** BO (V) 2 BH16U **ORNAMENTAL HORTICULTURE AND LANDSCAPING**

(Theory: 36 hours) **(Theory credit 2)**

***Module* 1** (28 Hrs.)

ORNAMENTAL HORTICULTURE

Unit I -Ornamental gardening: history of gardening, gardening trends in India, types of gardens-characteristics and components of English, Mughal, Japanese, Persian, French and Italian gardens-designing a garden: budgeting and layout garden components (brief account only). Gardening: layout of the garden: for small, medium, and large gardens. Different types: indoor garden, water garden, green house, rockery; garden components - lawns, shrubs and shrubberies, flower beds, carpet beds, borders, hedges, roads, walks and paths in the garden.- Garden ornaments. Hydroponics, Bonsai; routine duties in a garden.

(8Hrs.)

Unit II - Cultivation of plants in pots ;different type of pots and containers-Earthen and plastic pots, par affined paper or styloform cups, polythene bags, basket container-plants suitable for pot culture, soil mixtures, their constituents of different type of pot plants-Annuals, Bulbs and tubers, Roses, Crotons, Palms, Ferns, Begionas, Anthurium, Succulents , cacti, and fruit plants. Orchard planning, lay out, preparation of nursery beds.

(4Hrs.)

Unit III -Pruning :-Principle, purpose and methods-right season for pruning-precautions in pruning operations-top dressing, staking, disbudding, defruiting, shaping and topiary-pruning fruit trees, root pruning-ringing or girdling-wintering.

(4Hrs.)

Unit IV - Brief study including taxonomy and methods of cultivation of the following groups of ornamental plants with suitable examples.

1. Shrubs; flowering shrubs, ornamental foliage shrubs
2. Climbers and creepers
3. Annuals, Biennials and herbaceous perennials
4. Bulbs, tubers and cons
5. Ferns and selaginellas
6. Succulents and cacti
7. Ornamental grasses/bamboos
8. Palm, cycads and conifers. (8Hrs.)

Unit V - Indoor gardening: Designing-selection of garden ornaments. Identification and selection of indoor plants-care and maintenance of indoor plants-care of water garden-fountain and suitable. Adornments. Conservatory: green house and fern house (fernery)-components-care and management. (4Hrs.)

Module 2 (8 Hrs)

LANDSCAPING

UNIT I- Landscape gardening and Arboriculture: Landscaping for institution. Public buildings and industrial areas. Importance and value of trees selection, planting, maintenance and care of trees-role of trees in land scaping.

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B. Sc Botany (Vocational) Degree

HORTICULTURE AND NURSERY MANAGEMENT

Semester II Course 4 BO (V) 2B H17U
PLANT PROTECTION AND NURSERY MANAGEMENT
(Theory 36 Hrs; Practical 36 Hrs) (Theory credit 2 ; Practical credit 1)

Module 1 (18 hrs)

PLANT PROTECTION

Unit - I Weeds and their control. (4Hrs.)

Unit – II Pests: insect and non-insect pests. Pest control: physical, chemical and biological Control. (4Hrs.)

Unit – III Diseases: common diseases of horticultural crops-symptoms, casual organisms, mode of spreading and control measures. (4Hrs.)

Unit - IV Commonly used agricultural chemicals: Insecticides: eg. BHC. Carbary (sevin), Carbofuran (Furadon) Malathion, Phorate (thimet), Quanalphos (Ekalux) Fungicides: Captan,Bavistin, antibiotics, Dithane M45, organo-mercurial compounds, sulphur dust, Zineb (Dithane Z- 78, Hexathane) Rodenticides-Anticoagulants (Ratafin), zinc phosphide (Retox) Herbicides:-2,4D Sodium salt, 2,4D amine salt (Weeder96) etc. (6Hrs.)

Module 2 (18Hrs.)

NURSERY MANAGEMENT

Unit I-Importance of nursery, types of nurseries-small scale and large scale, planning, budgeting and lay out-irrigation and plant protection devices in nurseries. (6Hrs.)

Unit II-Maintenance and management of nurseries: personals involved, technicians and casual laborers-customer relations-assessment of customer needs-export potential of horticultural products-loans and subsidies from banks and other agencies. (7Hrs.)

Unit III- Planting and transplanting: seasons for planting and transplanting, transplanting failures- Transplanting trees and shrubs, annuals, corms, bulbs and tubers. (5Hrs.)

PRACTICAL 2 (36Hrs.)

A Prepare soil mixtures for different type of pot plants, viz, roses, begonias, Palms, Ferns, Anthurium and cacti etc.

B .Prepare layout for small, medium and large gardens.

C Practice different pruning operation (top dressing, shaping and topiary) in the following plants- Casuarinas, Bougainvillae, Phyllanthus, Muraya D Visit a garden and identify the components, plants, and prepare a report.

B.Sc Botany (Vocational) Degree

HORTICULTURE AND NURSERY MANAGEMENT

Semester 3 Course 5 BO (V) 3B H18U

FLORICULTURE

(Theory: 54 hours, practical 36 hours) **(Theory credit 2 ; Practical credit 1)**

Module 1 36 hours

UNIT I 10 hrs

Floriculture:-importance, scope and significance, components of floriculture: ornamental gardening , commercial floriculture, landscape gardening, arboriculture

Commercial floriculture: importance, scope and significance-perfume industry, flower pigments-flower trading-cut flowers post harvest treatment and packaging of cut flowers.

UNIT II 12 hrs

Detailed study of the cultivation(species and varieties, propagation, planting and after care, pruning, nutrition, plant protection, harvesting and marketing of flowers) cultivation of the following flowering plants

Rose, Orchids, Anthurium, Jasmine, Chrysanthemum, Gladiolus

Study of minor commercial flowers (taxonomy, uses, harvesting and marketing) Marigold, Crossandra, Gomphrena, Gerbera, Aster, Celosia, Tube rose, Heliconia, Dahlia, Amaryllis etc.

UNIT III 8 hrs

Landscape gardening and Arboriculture: Landscaping for institution. Public buildings and Industrial areas. Importance and value of trees selection, planting, maintenance and care of trees-role of trees in land scaping.

UNIT IV 6 hrs

Bonsai-:basic styles-Identification of plants suitable for Bonsai-Bonsai containers-Operation required: pruning, nipping and wirirng.

Module 2 18 hours

UNIT I 14 hrs

Flower arrangement: Principles, different styles: Fresh, dryand artificial: practical hints for flower arrangement-flower carpet-preparation of bouquets, wreaths and garlands Techniques to prolong the vase life of flowers-practical application of flower arrangement-vegetable carving and decorations

UNIT II 4 hrs

Floriculture promotion and extension: Role of agri-horticultural societies, Krishi bhavans, flower shows and exhibition.

PRACTICALS **36 hours**

1. Make the layout of small, medium and big garden-identify plants suited to the different components of the garden
2. Identification of the common garden plants-their botanical name and family
3. Post harvest treatment and packaging of cut flowers
4. Different styles of flower arrangement, bouquet, wreath and garland
5. Identification and collection of locally available plant materials for dry/artificial flower arrangement
6. Make bonsai of any one of the plants in your locality
7. Each student should familiarize with cultivation of ornamental plants in the syllabus
8. Visit and prepare a report on flower shows organized by agri-horticulture societies/any other agencies

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B.Sc Botany (Vocational) Degree
HORTICULTURE AND NURSERY MANAGEMENT
Semester 3 Course 6 BO (V) 3B H19U
OLERICULTURE
(Theory: 54 hours, practical: 36 hours) (Theory credit 2 ; Practical credit 1)

Module 1 27 hours

UNIT I

Vegetables: Introduction, classification-botanical, cultural, thermo classification, food value of common vegetables grown in Kerala, role of vegetable growing in Indian economy

UNIT II

Types of vegetable farming-kitchen, garden, terrace garden, market garden, truck garden, vegetable garden for processing, vegetable forcing, garden for seed production, organic farming and its significance

UNIT III

Cultivation-planting season, preparation of soil, seed selection, seeding, transplanting-thinning, mulching. Irrigation, manuaring, plant protection methods-special care (if any). harvesting and post harvesting operations of the following corps:

Warm season vegetables: brinjal, chilli, cucumber, bitter guard, pumpkin, snake guard, yam, tapioca, colocasia, ginger, lady's finger, cow pea, cephalandra, ash guard, amaranth, coleus, musa

Module 2 27 hours

Cool season vegetables: cabbage, carrot, beet, onion, peas and beans

UNIT I

Pre and post harvest changes in vegetables: role of growth regulators and stimulants in vegetable production: changes during cooking and processing-spoilage of vegetables-factors influencing spoilage-microbial spoilage-problems and prospects of vegetable cultivation in Kerala

UNIT II

Mushroom as a vegetable: cultivation of edible mushrooms; button, paddy straw and oyster mushroom. Spawn production, utilization of paddy straw and other agro wastes in cultivation, farm design, pest and disease control

Practicals

1. Familiarization of different vegetable crops-through field visits and slide show, familiarization of seeds of vegetable corps, preparation of nursery bud , sawing and after care
2. Cultivate any five vegetable corps either in the pot or in the field. Equal representation should be given to plants like climbers, trailers, root tubers, under ground stem crops etc. calculation of fertilizer requirement, application by different methods
3. Sterilization o paddy straw, inoculation, cultivation and harvesting of oyster/pleurotus sp. Using poly bag method
4. Field study: visit a market garden/truck garden to study the various cultivation practice

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HORTICULTURE AND NURSERY MANAGEMENT

Semester4 Course 7 BO (V) 4B H20U

POMOLOGY, FOOD TECHNOLOGY AND POST HARVEST MANAGEMENT

(Theory: 54 hours; practical: 36 hours) **(Theory credit 2 ; Practical credit 1)**

Module 1 36 hours

POMOLOGY

UNIT I

Importance of fruits: classification-fruit cultivation in India-role of fruits in Indian economy 6hrs

UNIT II

Cultivation of fruit trees/plants with special reference to Musa, Pineapple, Papaya, Mango, Sapota, Guava

Selection of suitable sites-seasons for planting-preparation of land selection of fruit plants and their varieties-planning, aftercare and pruning-disease and pest control 10hrs

UNIT III

Reasons for failure to fruit development; internal and external factors; causes and remedies; role of plant growth regulators in fruit yielding plants 10hrs

UNIT IV

Harvesting, marketing and storage of fruits: Basic principles in harvesting and marketing; storage of fruits; physiological changes during storage , factors influencing storage and methods of storage 10hrs

Module 2 **18 hrs**

FOOD TECHNOLOGY AND POST HARVEST MANAGEMENT OF HORTICULTURAL CROPS

UNIT I

Importance of post harvest management of fruits, vegetables and other horticultural produce. Post harvest losses of fruits, vegetables, physiology of maturity, ripening and senescence

Post harvest management techniques for fruits and vegetables, storage of fruits and vegetables, ambient low temperature and controlled atmosphere storage systems

Packaging of fresh and processed products

General principles and methods of preservation. Principles of preservation by dehydration, thermal processing, chemical preservatives, fermentation, ionizing, radiation

Government policies, regulations and specifications for fresh and processed products, export promotion agencies and their role on export of fresh and processed products.

Postharvest technology of major spices, postharvest management of cut flowers.

14hrs

UNIT II

General guidelines for establishment of a home scale processing unit, Preparation of jams, jellies, squashes, pickles, salads, syrups and beverages.

4hrs

PRACTICALS **36 hours**

1. Identification of plant diseases of fruit trees
2. Preparation of Bordeaux mixture
3. Cultivate any one of the crops listed in syllabus
4. Identification and conservation of wild local varieties of Mangoes, Jack fruits, Musa etc
5. Preparation of any one of the fruit products mentioned in the syllabus

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B.Sc Botany (Vocational) Degree

HORTICULTURE AND NURSERY MANAGEMENT

Semester 4 Course 8 BO (V) 4B H21U

CULTIVATION OF MEDICINAL AND AROMATIC PLANTS,

SPICES AND PLANTATION CROPS

(Theory: 54 hours; Practical: 36 hours) **(Theory credit 2 ; Practical credit 1)**

Module 1 24 hours

Definition, significance of medicinal and aromatic plans in Indian systems of medicine. Taxonomy and uses of important medicinal and aromatic plants available in Kerala

Cultivation of Sida, Adathoda, Ocimum, Rauvolfa, Vinca, Mentha, Calamus,Pumbago,Kaempiferia, Lemon grass, Vetiver,Turmeric

Module 2 15 hours

Spices; significance,role of spices in Indian economy, cultivation and processing of pepper, cardamom, clove, nutmeg, curcuma, cinnamon and campoge.

Module 2 15 hours

Plantation crops-scope and importance of plantation crops, Types of plantation crops. Cultivation of rubber,cocoa,cashew,coconut and tea.

PRACTICALS 36 hours

1. Collection and identification of important medicinal and aromatic plants
2. Extraction of the active principles of local medicinal, aromatic and spices(Any five types)

FIELD WORK

Visit any spice/plantation crop estate to familiarize with the cultivation and processing practices. Besides, a project work based on horticultural aspects is an essential requirement

REFERENCES

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MAHATMA GANDHI UNIVERSITY B.Sc Botany (Vocational) Degree Vocational Subject Plant Biotechnology	
Semester I	Course I General Microbiolog *(36 hours)*
	Course II Applied Microbiology *(36 hours; Practical 36)*
Semester I I	Course III Biotechniques and Instrumentation *(36 hours)*
	Course IV Fundamentals of Enzymology and Radiobiology *(36 hours; Practical 36 hours)*
Semester III	Course V Basics of molecular cloning techniques *(54 hours; Practical 36 hours)*
	Course VI Plant Tissue Culture *(54 hours; Practical 36 hours)*
Semester IV	Course VII Genetic Engineering *(54 hours; Practical 36 hours)*
	Course VIII Biotechnology for crop improvement *(54 hours; Practical 36 hours)*

B.Sc Botany (Vocational) Degree

PLANT BIOTECHNOLOGY

Semester I Course 1. BO(V)1BP 14U

GENERAL MICROBIOLOGY

(Theory 36 hours) **(Theory credit 2 ; Practical credit 1)**

OBJECTIVES OF THE COURSE

1. To familiarize the world of microbes to the students
2. To have a thorough understanding of the techniques involved in microbiology

MODULE 1 (8 hours)

Introduction and History of Microbiology

Definition of microbiology and introduction to applied branches of microbiology – air, soil, water, milk, industrial, medical.

Groups of micro organisms : Algae, Fungi, Bacteria, Protozoa, Viruses – General Outline.

Microscopy – Antony Van Leeuwenhock, Robert Hook. Theory of Spontaneous Generation, Germ Theory of disease. Important contributions of Louis Pasteur, Robert Koch, Joseph Lister, Alexander Flemming, Edward Jenner, Tyndall.

Major microbiological institutes of India.

Scope and Applications of microbiology

Differences between Prokaryotic and Eukaryotic cells.

Bacterial taxonomy – General principles of classification, Numerical taxonomy, New approaches in bacterial taxonomy.

MODULE 2 (12 hours) Bacterial cells : Morphology , size, shape, arrangements of bacteria.

Ultrastructure: structures and functions of capsule, flagella, pili, cellwall, plasma membrane, cytoplasm, ribosomes, mesosomes, reserve food materials, nuclear materials – nucleoids, plasmids and their characteristics.

Reproduction: Binary fission, Budding, Fragmentation., bacterial endospores

Recombination in bacteria: Conjugation, Transformation, Transduction.

MODULE 3 (6 hours)

Viruses: General characteristics, chemical composition and properties of viruses; Multiplication and Transmission of Plant viruses and Bacteriophages, Architecture of TMV and HIV

MODULE 4 (10 hours)

Pure culture techniques: Isolation and culture of bacteria – serial dilution, Pour plate, Streak plate, Spread plate and Stab cultures.

Nutritional requirements of bacteria: Classification on the basis of Carbon and energy sources, nutritional types –Autotrophs, heterotrophs, Phototrophs, Chemotrophs, Lithotrophs, Organotrophs.

Microbial growth: Definition of growth, phases and growth curve. Effect of environmental factors on growth – pH, temperature, oxygen, osmotic pressure, light, moisture.

Bacteriological media: Natural, synthetic, semisynthetic, living, enriched, enrichment, differential, selective.

Methods of preservation of cultures.

REFERENCES

1. A.J. Salle (1974)Fundamental Principles of Bacteriology (TMH Edition) Tata McGraw – Hill Publishing Co. Ltd , New Delhi – 110008.
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4. Michael J. Pelczar, Jr, E.C.S. Chan, Noel R. Krieg (1993) Microbiology (Fifth Edition), Tata Mcgraw – Hill Publishing Company Ltd, NewDelhi.
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B. Sc Botany (Vocational) Degree
PLANT BIOTECHNOLOGY
Semester I Course 2 BO(V)1BP15U
APPLIED MICROBIOLOGY
(Theory 36 hours; practical 36 hours) **(Theory credit 2 ; Practical credit 1)**

OBJECTIVES OF THE COURSE

1. To learn techniques utilized by biotechnical companies
2. To Describe the common methods and applications of biotechnology with regard to micro organisms

MODULE 1 (4 hours)

Stains and staining techniques : Definition of dye or stain, Classification of stains – acidic, basic and neutral stains.

Theories, procedures and mechanisms of simple staining, negative staining, capsule staining, endospore staining, differential staining – grams staining.

MODULE 2 (4 hours)

Instruments used in microbiology labs: Principle, Working and application of Micropipettes, Inoculation loops, Laminar Air Flow, Hot air oven, Autoclave, Colony counter, Haemocytometer, Micromanipulator, Lyophilizer, Incubator.

MODULE 3 (4 hours)

Concept of sterilizaton : Definition of sterilization, antiseptics, disinfectants, anti microbial agents.

Dry and moist heat, Pasteurisation, Tyndalization, Radiation, Ultrasonication, Filtration. Chemical methods of sterilization . Fumigation.

MODULE 4 (8 hours)

Plant Microbe interaction: Gene – gene hypothesis, R genes, avr genes, Hypersensitive Response, Pathogen related proteins. Disease responsive genes- β- 1, 3 glucanase, phytoalexins.

MODULE 5 (6 hours)

Application of microbes in Agriculture: Use of microbes in nitrogen fixation, as biopesticides, as biofertilizers, agroprocessing. Role of microorganisms in environmental remediation.

MODULE 6 (10 hours)

Industrial Microbiology: Fermentation – Definition, Stages of Fermentation, Media design, SSF, SmF- Advantages and Disadvantages. Continuous and Batch Fermentation.

Production of Antibiotics- Penicillin, Streptomycin

Production of Organic Acids- Citric Acid, Vinegar

Production of Alcohol – Ethanol, Wine, Beer

Production of Enzymes- Cellulase, Protease

Diary Products – Butter, Cheese

Bread making

Practicals

1. Isolation of Microorganisms from Drinking water/ Soil – Serial Dilution Technique
2. Viable count – Enumeration of bacteria – Pour Plate Technique
3. Streak Plate Technique for purification of bacteria
4. Preparation of agar slants and broths
5. Grams– staining
6. Alcoholic fermentation by Yeast
7. Enumeration of spores – Haemocytometer
8. Hanging drop experiment – Demonstration
9. Test for catalase
10. Test for amylase
11. Isolation of Rhizobium from root nodules of leguminous plants
12. Demonstration – Principle, working and application of Laminar air flow, Autoclave Colony counter, Hot air oven, Incubator

EFERENCES

1. A.N. Glazes (1995) Microbial Biotechnology, New York: WH
2. N.Mukherjee, T Ghosh (1995). Agricultural Microbiology,(First Edition). Kalyani Publishers.
3. Powar & Daginawala (1997)General Microbiology (Vol II). Himalaya Publishing House
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5. S.R.Maloy (1994). Microbial Genetics. Jones and Bartlett Publishers.
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B.Sc Botany (Vocational) Degree

PLANT BIOTECHNOLOGY

Semester II **Course 3** **BO(V)2BP16U**

BIOTECHNIQUES AND INSTRUMENTATION

(Theory 36 hours) **(Theory credit 2)**

OBJECTIVES OF THE COURSE

1. To create an awareness among the students about the various techniques involved in the study of Biotechnology.
2. To expertise the students in using the equipments used in Modern Laboratories.

MODULE I (4 hours)

Common Laboratory Practices - cleaning of Labwares, Handling of Hazardous chemicals and solvents. Water distillation

MODULE II (8 hours)

Microscopy: Compound Microscope – parts of compound microscope, bright field microscopy, dark field microscopy. Phase contrast microscopy, fluorescent microscopy, Electron microscopy- TEM, SEM, Tissue preparation in light and electron Microscopy

Micrometry, Camera Lucida

MODULE III (6 hours)

Chromatography : Principles and applications, mobile and stationary phases, Rf value, Paper chromatography, TLC, Ion- Exchange chromatography, Affinity chromatography, Gel filteration chromatography, HPLC, GLC.

MODULE IV (6 hours)

Electrophoresis: Principles and Applications. Separation of macromolecules by Agarose gel Electrophoresis, Poly Acrylamide Gel Electrophoresis, SDS - PAGE, Pulse Field gel Electrophoresis, Iso Electric focussing, Two dimensional gel Electrophoresis.

MODULE V (6 hours)

Centrifugation : Principles and Applications, Types of centrifuges, parts of centrifuges. Velocity gradient centrifugation, Isopycnic centrifugation, Differential centrifugation.

MODULE VI (6 hours)

Colorimetry and Photometry- Beer- Lamberts Law; colorimeter and spectrophotometer. Electromagnetic Spectum. UV spectroscopy, NMR, ESR, Xray Crystallography, Mass Spectroscopy.

REFERENCES

1. Debajyoti Das. Bio physics and Biophysical Chemistry (Third Edition),Academic Press,Calcutta.
2. Sharma, B.K. (2002). Spectroscopy, Goel Publishing House, Meerut
3. T.C. Ford and Graham J.M. (1991) An Introduction to Centrifugation, Bios
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B.Sc Botany (Vocational) Degree

PLANT BIOTECHNOLOGY

Semester II Course 4 BO(V)2BP17U

FUNDAMENTALS OF ENZYMOLOGY AND RADIOBIOLOGY

(Theory 36 hours; Practicals 36 hours) **(Theory credit 2 ; Practical credit 1)**

OBJECTIVES OF THE COURSE

1. To recognize the foundations of modern biotechnology.
2. To gain an appreciation for the basic sciences that apply to biotechnology.

MODULE I (6 hours)

Molarity, Molality and Normality: Definitions and simple problems. Buffers: definition, preparations. pH Meter : Glass electrode and calomel electrode, Measurement of pH.

MODULE II (6 hours)

Basic enzymology: Nomenclature and classification, Mechanism of action, Regulation, Enzyme inhibition, Isoenzymes.

MODULE III (6 hours)

Enzyme assay and kinetics : Spectrometric method, Radio isotop method, Immunochemical method, factors affecting velocity of enzyme catalysed reaction, Michaelis - Menton equation, Line Weaver and Burke plot , Km value .

MODULE IV

Radioisotopes and their applications in biology; half life period, tracer techniques. Measurement of Radioactivity - GM counter, Solid Scintillation counter, Liquid scintillation counter, Autoradiography. Applications of C14, P32, S35 isotopes in Biology.

Handling of radio is isotopes - Radiation dosimetry

(10 hours)

MODULE V

Methods of isolation, purification and quantification of nucleic acids from plants, plasmid DNA from bacteria, bacteriophage DNA.

(8 hours)

Practicals

1. Colorimetric quantification of Proteins by Lowry's method
2. Colorimetric quantification of DNA by diphenyl amine method

3. Paper chromatography to separate amino acids
4. TLC - for separation of Plant pigments
5. Isolation and purification of nucleic acids from green peas.

REFERENCES

1. P.M. Philoposes (2004)Expenimental Biotechnology (First Edition)Dominant Publishers & distributors, New Delhi
2. H. K. Das (2005). Text Book of Biotechnology, Wiley Dream tech, India Pvt Ltd.
3. Keith Wilson & John Walker (1997)Practical Biochemistry, Principles & Technighes (Fourth Edition)Cambridge University Press.
4. Debajyoti Das. Bio physics and Biophysical Chemistry (Third Edition)Calcutta, Academic Press.

B.Sc Botany (Vocational) Degree

PLANT BIOTECHNOLOGY

Semester III Course 5 BO(V)3BP18U

BASICS OF MOLECULAR CLONING TECHNIQUES

(Theory 54 hours; Practicals 36 hours) **(Theory credit 2 ; Practical credit 1)**

OBJECTIVES OF THE COURSE

After the course the student should

1. have acquired the theoretical and practical skills necessary to construct and use recombinant DNA molecules and vectors.
2. know the most common vectors used for cloning.

MODULE I (4 hours)

Recent advances in Genetic Engineering, Old Vs New Biotechnology, scope and importance of recombinant DNA Technology.

MODULE II (7 hours)

Enzymes used in genetic Engineering : Restriction Endonucleases,

Ligases, DNA polymerases, Reverse Transcriptase, Polynucleotide Kinase, Terminal Transperase, Alkaline Phosphatase.

MODULE III (14 hours)

Cloning vectors: Vectors from plasmids- Essential features common plasmid vectors - PBR322, PUC18, Vectors from Bacteriophages - construction of l based vectors, M_{13}, cosmids, Phagemids.

Eukaryotic vectors YAC, BAC, Shuttle Vectors.

Expression vectors - construction and applications, Expression casettes

MODULE IV (6 hours)

Molecular probes - Preparation of probes, methods of labelling- radioactive and non radioactive labelling, Applications.

MODULE V (5 hours)

Polymerase Chain Reaction - Methods, types and applications

MODULE VI (8 hours)

Nucleic acid hybridisation : Principles and applications; Southern Blotting, Northern Blotting, Western Blotting, Dot - Blotting, colony hybridisation, Plaque hybridisation, ELISA, RIA, *In-situ* hybridisation.

MODULE VII (10 hours)

Sequencing of DNA : Maxam and Gilbert chemical degradation method, Sanger and Coulson Enzymatic method, Direct DNA sequencing using PCR Automated DNA sequencing methods.

Protein sequencing : Pre - requisites, Edman degradation method, Sangers method, Dansyl chloride method, Enzymatic method.

Practicals ***36 hours***

1. Restriction digestion of plasmid DNA
2. Agarose gel electrophoresis - fractionation and staining of DNA
3. Preparation of competant cells for transformation
4. Transformation of competent cells

REFERENCES

1. B.D. Singh (1998.) Biotechnology (First Edition) , Kalyani Publishers.
2. J.Sambrook, E.F. Fritsch and Maniatis(1989)Molecular Cloning: A Laboratory Manual, Cold Spring Harbour Laboratory Press.
3. M.S. Clark (1997. Plant Molecular Biology,A Laboratory Manual, Springer Verlag.
4. S.S. Pubohit (2005) Biotechnology Fundamentals & Applications (Fourth Edition), Agrobious (India)
5. T.A. Brown (1996). Gene Cloning An introduction (Third Edition), Chapman and Hill.

B.Sc Botany (Vocational) Degree
PLANT BIOTECHNOLOGY
Semester III Course 6 BO(V)3BP19U
PLANT TISSUE CULTURE
(Theory 54 hours; Practicals 36 hours) (Theory credit 2 ; Practical credit 1)

OBJECTIVES OF THE COURSE

1. This course gives basic and applied knowledge in plant tissue culture.
2. To learn the techniques involved in plant tissue culture.
3. To equip the student to meet the occupational demands.

MODULE I (5hours)

Introduction and history of plant tissue culture.

Contributions of Haberlandt, Hanning, R. J. Gautheret and P. Nobecourt, White, Miller, F. Skoog and T. Murashige.

MODULE II (13 hours)

1. General facilities for plant tissue culture: (5hours)
Equipments, laboratory organization and green house.

Methods of sterilization

Dry heat

Wet heat

Filter sterilization

Sterilization by chemicals and antibiotics

2. Plant tissue culture medium (8 hours)

General components

Plant growth regulators

Cytokinins

Auxins,

Gibberellins, Abscissic acid,

Ethylene

Method of preparation of stock solutions

MS medium

Sterilization of plant material, medium and glass wares.

MODULE III (8 hours)

Micropropagation, different stages of micropropagtion.

Isolation and inoculation of different types of explants: shoot tips and nodal segments, leaves, anther, ovule and seeds.

Isolation, inoculation and incubation

Method and importance of subculture.

Hardening of tissue cultured plantlets – necessity.

MODULE IV (4 hours)

Methods of *in vitro* propagation; direct and indirect.

Axillary budding, adventitious budding and somatic embryogenesis.

MODULE V (8 hours)

Callus and suspension culture.

Organogenesis and factors affecting organogenesis.

Cytodifferentiation and factors affecting cytodifferentiation.

Induction of somatic embryos – direct and indirect.

Factors affecting somatic embryogenesis.

Importance of somatic embryogenesis

Synthetic (artificial) seeds.

Method of preparation and importance of artificial seeds.

MODULE VI (7 hours)

Somaclonal variation, causes and applicationsof somaclonal variations.

Genetic basis of somaclonal variation.

Cell line selection of *in vitro* mutants for biotic and abiotic stresses.

Stress tolerant plants through tissue culture

Stages employed for selection of mutants which are resistant to a particular stress

Salt and osmotic tolerance

Heavy metal tolerance

Drought tolerance

Tolerance against diseases and flooding

MODULE VII (5 hours)

Anther and pollen culture

Advantages of pollen culture over anther culture

Androgenesis – direct and indirect

Ovary cultue.

Production of haploids, dihaploids and it significance in plant breeding.

MODULE VIII (4 hours)

Applications of plant tissue culture.

Main Institutes conducting Tissue culture Research in India.

Plant quarantine and international exchange of germplasm.

PRACTICALS

1. Preparation of stock solutions of MS medium
2. Preparation of MS medium
3. Complete procedure involving identification, isolation, sterilization and inoculation of different explants.

REFERENCES

1.Kalyan Kumar De(2007). Plant Tissue Culture. New Central Book Agency.

2. M.K.Razdan (2003). Introduction to Plant Tissue Culture. Oxford and IBH Publishers, New Delhi.
3. R.P.Singh. (1992) Introductory Biotechnology.
4. S.S Purohit (2000). Biotechnology: Fundamentals and applications, Third addition, Student edition. Jodhpur.
5. S.S.Purohit (2005). Plant Tissue Culture . Student edition. Jodhpur.

B.Sc Botany (Vocational) Degree
PLANT BIOTECHNOLOGY
Semester IV Course 7 BO(V)4EP20U
GENETIC ENGINEERING
(Theory 54 hours; Practicals 36 hours) **(Theory credit 2 ; Practical credit 1)**

OBJECTIVES OF THE COURSE

1. To explain major concepts in Recombinant DNA Technology.
2. Evaluate the advantages and risks in the use of genetic engineering in different fields of biotechnology.

MODULE I

Gene cloning strategies - methods of isolation of foreign gene, Transformation and transfection, screening of transformants- Marker genes and Reporter genes, Direct and Indirect selection of transformants.

(10 hours)

MODULE II

Genetic Transformation of plants : Direct and Indirect gene transfer - vectors based on Ti plasmid, Ri plasmid of Agrobacterium, Agroinfection. Plant viral vectors-Caulimo virus vectors, Gemini virus vectors

(10 hours)

MODULE III

Gene Libraries - Genomic libraries Vs cDNA libraries - construction, screening and applications.

Mapping of DNA : Restriction mapping, Chromosme walking, Chromosome jumping, DNA foot printing Transposon tagging.

(8 hours)

MODULE IV

DNA Based Molecular markers - concept of using DNA sequence level variations as genetic markers. Tools to detect and exploit DNA sequence variations. Minisatellities, Microsatellite, RFLP, AFLP and RAPD their applications in plant Breeding.

DNA fingerprinting : Scheme and applications. (14 hours)

MODULE V

DNA chip Technology and Micro arrays- Types of DNA chips and their production. Applications of micro arrays on DNA chips

(5 hours)

MODULE VI

Human genome Project -Overview.

Nanotechnology - Basic Principles, Structural DNA Nanotechnology, Applications of Nanotechnology.

Ethical, Legal, Social, Environmental and Practical problems of Recombinant DNA Technology.
(7 hours)

PRACTICALS

1. Isolation and purification of Plasmid DNA
2. Restriction Mapping
3. Southern Blotting Analysis
4. Methods of Direct Gene transfer – Microinjection, Biolistic Transfer, Liposome mediated gene transfer, Electroporation, Chemical mediated gene transfer
5. Agrobacterium mediated gene transfer- Agroinfection
6. Genetically engineered plants

REFERENCES

1. S.N. Jogdand (1997). Gene Biotechnology (First Edition)
   Himalaya Publishing House
2. Sandhya Mitra (1996). Genetic Engineering, Macmillan India Ltd.
   R.W. Old and S.B. Primrose (1994)
3. Principles of Gene Manipulation -An Introduction to Genetic Engineering (Fifth Edition)
   Black well Scientific Publishers.
4. P. K. Gupta (2004). Biotechnology & Genomics (First Edition)
   Rastogi Publishers, Shnagi Road, Meerut.
5. H. K. Das (2005). Text Book of Biotechnology, Wiley Dream tech, India Pvt Ltd.
6. R. C. Dubey (2002). Text book of Biotechnology. S. Chand and Company Ltd., New Delhi.

B.Sc Botany (Vocational) Degree
PLANT BIOTECHNOLOGY
Semester IV Course 8 BO(V)4EP21U
BIOTECHNOLOGY FOR CROP IMPROVEMENT
(Theory 54 hours; Practicals 36 hours) **(Theory credit 2 ; Practical credit 1)**

OBJECTIVES OF THE COURSE

1. To familiarize the students with the recent advances in plant biotechnology
2. To create an awareness in the students with the role of tissue culture technique in crop improvement.

MODULE I

Micropropagation of Banana and Anthurium with emphasis on

Limitations of conventional propagation

Methods of sterilization

Inoculation and incubation

Medium for culture initiation, multiplication and rooting.

Hardening and field transfer.

(2 hours)

MODULE II

Shoot tip and meristem culture - Importance

Virus elimination for the production of virus free plants through meristem culture.

hours)

MODULE III

Zygotic embryo culture.

Types of embryo culture (Pierik, 1989) • Immature and mature.

Nutritional requirements

Precocious germination

In vitro pollination and fertilization.

Embryo rescue • technique and applications.

(6 hours)

MODULE IV

Endosperm culture • Callusing and organogenesis from endosperm.

Triploid production

Importance of triploids in ornamental and horticultural crops.

(3 hours)

MODULE V

Protoplast isolation and culture.

Enzymes used

Droplet culture

Co-culture

Feeder layer technique

Hanging droplet culture

Bead culture

Callus proliferation from protoplast and regeneration of plantlets.

Somatic hybridization, cybrids and their applications.

Steps involved in somatic hybridization

Spontaneous and induced fusion •

mechanical fusion, chemofusion, electrofusion.

Hybrid identification and selection • methods

Hybrid isolation • methods.

Single cell culture and its importance.

Paper raft nurse technique

The petridish plating technique

The microchamber technique

Growth of single cell induced by nurse callus

The microdroplet technique.

-(12 hours)

MODULE VI

Germplasm conservation and cryopreservation

Importance of wild species Germplasm

In-situ and ex-situ conservation an

In vitro techniques in Germplasm conservation

1. Slow growth method
2. Cryopreservation

-Preparation of Germplasm for cryopreservation

-Pre-treatments

-Cryoprotectants

-Freezing and cryo-storage

-Post-cryopreservation recovery**.**

-(4 hours)

MODULE VII

Production of secondary metabolites.

Bioreactors **&#65533;** design

Types- batch, continuous, multistage bioreactors.

Cell immobilization and immobilized cell bioreactors.

Process scale up, biotransformation, elicitors and down stream processing.

Hairy root culture

(6 hours)

MODULE VIII

Genetically modified crops.

Application of transgenic plants in agriculture **&#65533;** herbicide resistance, drought resistance, modification of seed protein quality **&#65533;** golden rice. Antisense RNA technology **&#65533;** gene silencing, Flavour savour tomato.

(10 hours)

MODULE IX

Plants are bioreactors **&#65533;** molecular farming, production of edible vaccines antibodies, biodegradable plastics.

Ecological impact of transgenic plants

Intellectual Property Right: protection of IPR- patenting

(7 hours)

Practicals

1. Set up an experiment for paper raft nurse technique
2. Method of inoculation of Banana and Anthurium
3. *In vitro* plantlet regeneration of any two medicinal plants.
4. Production of synthetic seeds

REFERENCES

1. Sen and Giles (1983). Plant cell culture for crop improvement.
2. S.S. Bhojwani and N.K.Razdan. (1983). Plant tissue culture-Theory and practice, Amsterdam: Elsevier.
3. J. Reinert and Y.P.S Bajaj. (eds.) (1977).Applied and fundamental aspects of plant cell, tissue and organ culture, Berlin: Springer Verlag.
4. T.A. Thorpe (eds.) (1982). Plant Tissue culture- Methods and application, New York: Academic Press.
5. L.R. Walter and F. Canstable (eds.) (1982) Plant tissue culture methods, Canada: National Research Council.
6. Biotechnology for all **&#65533;** Yojana, April 1996, pp. 33-35

7. Programme Advisory Note: Plant Biotechnology Including tissue culture and cell culture. United National Development Programme, New York, 1989

MAHATMA GANDHI UNIVERSITY
B.Sc. BOTANY AND BIOTECHNOLOGY (DOULE CORE) PROGRAMME
Common Course for Botany and Biotechnology (Double Main)

Semester : I Common Course 1 Code :BO&BT1A01U

OPERATING SYSTEMS AND OFFICE AUTOMATION
(Theory : 36Hours, Practicals: 36 Hours)

Course Objectives
Students should be able:

1. To understand the basic operation systems of the Computer and Office Automation.
2. To access informations in advanced biological sciences using internet
3. To develop essential computer skills to solve biological problems
4. To apply algorithmic principles to solve biological problems.

Theory (36 Hours)

1.Introduction to computers

- Input and output devices
- Storage devices: Hard Disk, Diskette, Digital tape, CD ROM, DVD (capacity and access time)
- Main Circuit board of a PC : chips, Ports Expansion slots.
- Memory : Register, buffer, RAM, ROM, PROM, EPROM, EEPROM
- Types of processing: Batch, Real time, online, offline 3 hrs

2. History Evaluation, Generation of computers I, II, III, IV, V

- Classification of computers (Main Frames, mini computers, microcomputers, special purpose) Comparison with respect to memory, power, cost, size
- Modern computers : The mini computers, Main Frame computers,

  parallel processing computer and the super computer. 2 hrs

3. Introduction to Operating Systems:

- Operating system concept
- Windows 98/XP
- Windows server NT / 2007
- Unix/ Linux and servers 5 hrs

4.Data processing and presentation

- Introduction
- MS Office (Word, Excel, Power Point) 7 hrs

5.Computer viruses:

- An overview of computer viruses.
- What is a virus? Virus symptoms, How do they get transmitted? What are the dangers? General Precautions. 1 hr.

6. Computer Networking

- Introduction to networking: Various terminologies, Associated hardware device, gadgets (Router, Switch etc) tools, services and resource. Network topologies and protocols: LAN, WAN and MAN
- World Wide Web www, Network security: Fire walls 4 hrs.

7. Internet searches:

- Search Engines: Google, Yahoo etc.
- Concept of text based searching
- Searching Medline, bibliographic databases. 3 hrs

8. Algorithms, Flow charts and Programming concepts:

- Algorithms : Concepts and Definition.
- Converting Algorithms to Flow charts.

- Coding: Flow charts to programmes
- Comparing algorithms, flow charts and programs 6 hrs.

9. Data Bases

- Introduction and need of databases
- Types of Databases
- Basic concepts in Data Abstraction , Data models, Instances and schemes, ER Model, Network data model (Basic concepts), Hierarchial data Model (Basic concept) , multimedia data bases (Basic concepts and Applications)
- Indexing and Hashing: B+ Tree indexed files, B tree indexed files.
- Static Hash function
- Dynamic Hash function
- Text databases, Overview of biological databases. 5 hrs

Practicals (36 hours)

Computer ◆ Getting familiar with hardware, booting and operating

Operating Systems ◆ DOS, Windows 98/XP, UNIX etc.

File handling : copy, rename, delete, type etc.

Directory : Structure, make, rename, move directory

Scanning of viruses and using anti virus programme.

Word processing (Microsoft word) Creating, saving and operating a document, editing, inserting, deleting, formatting, moving, copying text, Find and replace, spell checker, Grammar checker.

Document Enhancement (Borders, Shading, Header, Footer) Printing Document (Page Layout, Margins)

Introduction to the use of wizards and templates, working with graphics (Word Art), Working with table, charts, inserting files (Pictures, Databases , Spreadsheets)

Use of internet ◆ Downloading and installing software / programme on Windows 98/ XP, (Acrobat Rader, Post Script viewer etc)

Searching , Surfing on the www

Spread sheet application (Microsoft Excel)

Worksheet Basics: Entering information in a worksheet, saving and opening a worksheet, editing, copying, moving data, inserting, deleting, moving column and rows, clearing and formatting cells, printing worksheet

Database application (Microsoft Access)

Fields, Records, Files, Organisation of files, Access mode, updating record, Querying, reports, forms and subform.

Usage of multimedia ◆Creation of computer presentation with graphics (Microsoft Power Point) Creation of slides, photoshop, Rapid presentation design using wizard.

References

1. Introduction to computers, Data processing and networking
2. Computer fundamentals ◆ PK Singha
3. Introduction to Bioinformatics ◆ Artwood

MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY & BIOTECHNOLOGY (DOUBLE CORE) PROGRAMME

Core Course for Biotechnology

Semester I BT Course 1 Code :BO&BT1B$_{BT}$01U

MOLECULAR BIOLOGY AND METHODS IN MOLECULAR BIOLOGY

[Theory 54 hours , Practicals 18 hours, Total 72 hours]

Course Objective:

Students should be able :

1. To familiarize with the genetic make up and control of cells at molecular level

2. To familiarize with the modern tools and techniques associated with molecular biology research

Module 1

1. Introduction to heredity and the genetic material, characteristics of genetic material, the molecular basis of heredity, Early studies of DNA [works of F.Miescher, Albert Kossel, Phoebus Levene, Erwin Chargaff] DNA as the source of genetic information, The discovery of transforming principle[Griffith's experiment], Identification of the transforming principle[Avery, MacLeod and McCarty's experiment]; [Hershey and Chase experiment], Watson and Crick's discovery of the structure of DNA, discovery of RNA as the genetic material in some organisms [Heinz Fraenkal-Conrat's experiment]. 4 hours

2. The structure of DNA, Primary structure; structure of ribose and deoxyribose sugars, Structure of N bases, structure of nucleosides and nucleotides, phosphodiester bond and structure of a polynucleotides, Secondary Structure; structure of DNA double helix, different secondary structures [A,B and Z] , circular DNA 4 hours

3. Suspected forms of DNA replication, conservative, dispersive and semi

conservative, Meselson and Stahl's experiment 4 hours

4 Requirements for replication; template, raw materials, enzymes and other proteins,direction of replication, mechanism of replication, Bacterial DNA replications, bacterial DNA polymerase, eukaryotic DNA replication, DNA polymerase, location of replication within the nucleus, DNA synthesis at the ends of chromosomes, telomerases 5 hours

5. Modes of replication, theta replication, rolling circle replication, linear eukaryotic replication. Recombination; Holliday model, enzymes required for recombination

3 hour

6. Transcription, the structure of RNA, types of RNA, mRNA, tRNA, rRNA, snRNA, snoRNA, miRNA, requirements for transcription, the subscribed and unsubscribed strands of DNA, experiments by Julius Marmu, transcription factors

4 hours

7. Promoters; bacterial and eukaryotic, RNA polymerase; bacterial and eukaryotic, the process of bacterial transcription, the process of eukaryotic transcription, RNA processing; split genes, exons, introns (group I , II and nuclear types),
4 hours

8. Messenger RNA, early studies of mRNA, Brenner, Jacob and Meselson's

experiment, Pre-mRNA processing in eukaryotes, addition of 5' cap and 3'

polyA tail, RNA splicing, spliceosome, the process of splicing in different groups of introns, nuclear location of splicing, mRNA editing, guide RNAs (gRNAs).Structure of tRNA, modified bases in tRNA, clover leaf model of tRNA, tRNA genes structure and processing, rRNA; rRNA gene structure and processing, small interfering RNAs,experiment of Fire and Mellow, RNA interference (RNAi)

5 hours

9. Translation, the genetic code, breaking the genetic code, experiments of Nirenberg and Matthaei and Nirenberg and Leder, Contributions of HG Khorana in connection with the breaking of the genetic code, characteristics of the code,
The process of translation, polyribosomes, RNA-RNA interaction in translation, mRNA survilience; non-sense mediated mRNA decay, non-stop mRNA decay, stalled ribosome, translation inhibitors 4 hours

10. Gene regulation, principles of gene regulation, levels of gene control, gene regulation in bacterial cells; operon concept, negative and positive control, inducible and repressible operons, *lac* operon of E.coli, *trp* operon of *E.coli* , attenuation and anti-termination

Gene regulations in eukaryotes; chromatin structure, DNase I hypersensitivity, histone acetylaltion, DNA methylation, Alternative splicing of mRNA, RNA silencing 4 hours

11 Mutations, definition, importance of mutation, Types of mutations, gene mutations, types of gene mutations, causes of mutations, DNA repair, mismatch repair, direct repair, base-excision repair, nucleotide excision repair, photoreactivation, SOS response 4 hours

12. Cancer genetics, the nature of cancer, cancer as a genetic disease, role of environmental factors in cancer, genetic changes that contribute to cancer, oncogenes and tumor suppressor genes, changes in chromosome number and structure, genomic instability, DNA repair genes, changes in patterns of DNA methylation, genes that promote vascularisation and the spread of tumors,

4 hours

Module 2

1. DNA sequencing; Sanger's dideoxy method, working of automated DNA sequencer

Gene synthesis; work of Khorana, working of automated nucleic acid synthesizer

Polymerase chain reaction; An Overview ,Components and Conditions for PCR Optimization, Primer Design, Isolation of Nucleic Acids for PCR Amplification , Site-Directed Mutagenesis by PCR, Restriction Enzyme Analysis of PCR Products, Cloning of PCR Products , Symmetric PCR ,Asymmetric PCR ,Inverse PCR ,Anchored PCR, RT-PCR, RT-PCR Applications Research Applications of PCR, Non-isotopic Probe Synthesis and Detection by Chemiluminescence

RAPD, RFLP, AFLP, DNA finger printing, DNA foot printing

5 hours

Practicals:- **18 hours**

Isolation of chromosomal and plasmid DNA from bacterium

Restriction digestion of DNA and assigning restriction sites

Isolation of plant genomic DNA

Designing a primer for a well characterized *E.coli* gene

PCR amplification of the gene from *E.coli* DNA using the designed primer

RAPD analysis of three closely related bacterial strains

Note: Practical training of 36 hours duration should be given to students in the field of modern techniques in Molecular Biology

References:-

1. Molecular biology of the gene, JD Watson, 2007, Addison-Wesley
2. Molecular Biology, RF Weaver, 2007, McGraw Hill
3. Biochemistry and molecular biology, TA Swanson, 2006, Lippin Cott Williams & Wilkins
4. laboratory investigation in cell and molecular biology, A Bergman, 2001, John Wiley and sons
5. Molecular Biology of cancer: mechanisms, target and therapeutics, L pecorino, 2005, Oxford University press

Semester II **BO Course 2** **BO &BT2B$_{BO}$**02U

BIOSTATISTICS

[Theory 54 hours , Practicals 18 hours, Total 72 hours]

Module I

Introduction

1 Introduction to statistics - application of statistics in biosciences with examples. Statistical data – various types of data: Primary data, secondary data, quantitative and qualitative data, collection and classification of data, frequency distribution. Diagrammatic representation of data – significance and utility, types of diagrams- bar diagrams, pie diagram, histograms, frequency polygon, frequency curve. (6Hrs)

2 Population and sampling techniques- significance and utility, random sampling, stratified sampling, systematic sampling, multistage sampling. (4Hrs)

Module II

Descriptive statistics

1 Measures of central tendency- introduction, definition, Advantages and limitations. Mean, median and mode - computation in grouped and ungrouped data. Comparison.

2 Measures of dispersion- introduction, definition and objectives. Range, Mean deviation, standard deviation, standard error - computation in grouped and ungrouped data; comparison

3 Skewness and Kurtosis- definition, types, graphical representation with examples. (8Hrs)

Module III

Probability

1 Probability- introduction, classical definition, theorems of probability- addition theorem and multiplication theorem, conditional probability. Applications.

2 Standard probability distributions- introduction and applications. Binomial distribution- definition, assumption with respect to a biological example. Poisson distribution- definition, forms of poisson distribution, assumption with respect to a biological example. Normal distribution- definition, properties, standard normal curve, assumption with respect to a biological example. (9Hrs)

Module IV

Inferential statistics

1 Testing of hypothesis- Hypothesis -definition, hypothesis testing, procedure of hypothesis testing, errors in hypothesis testing– type I and type II errors, two tailed and one tailed test of hypothesis. Chi square test and estimation of linkages, student t- test and F test.

2 Experimental designs – introduction, principles, replication and randomisation. Completely randomised design, Randomised block design, Latin square design, factorial design.

3 Interpolation and extrapolation- introduction, definitions, significance and utility, assumptions, graphic methods.

4 Computer analysis of data – application of computer in statistical data processing, statistical programmes, preparation of charts and graphs, formula application with respect to M Stat. (12Hrs)

Module V

Analysis of variants

1. ANOVA- introduction, Assumptions, technique of analyzing variance, one way and two way ANOVA followed by t- test.
2. Multivariate analysis of variants and its application in biological sciences

(8Hrs)

Module VI

Correlation and regression

1. Correlation- introduction, definition and utility. Types of correlation, positive and negative correlation, scatter diagram and correlation graph, coefficient of correlation. Calculation.
2. Regression- introduction, utility, regression coefficient, comparison of correlation and regression,

(7Hrs)

Module VII

Practical

1. Classify a given data using frequency distribution and represent it graphically.
2. Analyse a data for mean, median and mode.
3. Analyse a data for mean deviation, standard deviation and standard error
4. Application of addition and multiplication theorem of probability.
5. Test the significance of the given data using chi-square test, t test and f test.
6. Analyse a set of data for correlation and regression
7. Analyse a given data in CRD, RBD and LSD.
8. Analyse the given data using M stat.
9. Prepare graphs with the help of MS excel or M stat. (18 hrs)

References

1. Bernard Rosner, 2005. Fundamentals of Biostatistics. Duxbury Press.
2. Marcello Pagano, Kimberlee Gauvreau. 2000. Principles of Biostatistics. Duxbury Press
3. Panse, V.G. and Sukathme, P.V. 1995. Statistical methods for agricultural workers. ICAR, New Delhi.
4. Pranab Kumar Banerjee, 2004. Introduction to Biostatistics. S. Chand and company Limited.
5. Roland Ennos, 2006. Statistical and Data Handling Skills in Biology, 2nd Edition. Pearson Education

MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY AND BIOTECHNOLOGY (DOULE CORE)PROGRAMME

Core Course for Biotechnology

Semester : II **BT Course 2** **Code :BO&BT2B$_{BT}$02U**

BIOPHYSICS AND INSTRUMENTATION

(Theory : 54hours; Practical: 18 hours)

(Theory : 54 hours)

Course Objectives

Students should be able:

1. To understand rules, principles and models of atomic structure.
2. To develop skills in separating different biomolecules.
3. To apply various spectroscopic methods to characterize biomolecules.

Module 1:Atomic structure

Historical account,significance 2nd and 3rd postulate of Bohr's model,derivatives of radius and energy value.Quantization of energy levels.Using Rydburg's constant,atomic spectra in signature of the element.Bohr-sommerfeld model.Vector atom model,quantum numbers.Selection rules.paulis exclusion principles.Emission spectra with respect to NA atom to understand selection rules **(5 h)**

Module 2:Spectroscopy

Definition-Electromagnetic wave,electromagnetic spectrum,application of each region of EM spectrum for spectroscopy. Introduction to molecular energy levels,excitation, absorption, emission. Rotational spectra.Energy levels of rigid diatomic molecules .Vibrational and rotational spectra.Energy levels of diatomic vibrating molecules,rotational vibrational spectroscopy, IR spectroscopy, principle,constructing and working of IR spectrometer.Application of IR spectroscopy to biomolecules.Electro spectroscopy:UV-Visible spectroscopy: Principle, construction and working of colorimeter ,spectrophotometer and fluorometer, Application to biomolecules (proteins, DNA, Hb, chlorophyll), Raman Spectra **(12 h)**

Module 3:Radioactivity

Nucleus-properties.Nuclear forces. Nuclear models(liquid drop and shell model),radioactive nucleus. Revision of nuclear radiation and their properties-alpha,beta and gamma.Half-life-physical and biological. Handling and standardization of alpha, and beta emiting isotopes.Radioimmunoassay, Radiopharmaceuticals and its uptake-dosimetry and detection Principle-construction and working of pen and batch dosimeter. GM counter, Scintillation counter(solid and liquid) **(10 h)**

Module 4:Thermodynamics as applied to biological system

Enthalpy ,entropy,free enrgy,Gibb's free energy(G),Helmholtz free energy(A).Chemical potential,half cell potential.Redox potential ,structure and biowenergetics of mitochondria and chloroplast **(5 h)**

Module 5:Cell membrane

Organization of plasma membrane,Mass transport,diffusion ,basics,passive and active transport,membrane potential.Nernst equation.Passive electrical properties of cell(capaciatance and resistance).Active electrical properties.Electrical model(equivalent) of cell membrane.Depolarization,hyperpolarization of membrane (neuronal).Generation of active potential.Types of biopotentials .Biopotential measurement instruments. **(8 h)**

Module 6: Thermoregulation

Thermometric properties and types of thermometers(clinical, thermocouple, bimetallic, platinum resistance, thermistor-thermometers).Body temperature and its regulation

(2 h)

Module 7: Bioinstruments

Concepts-analytical techniques, analytical method, procedure and protocol, principle construction, working and application for analysis of biomolecules of following instruments: pH meter, centrifuge (RCF, sedimentation concept),different types of centrifuges, Mass spectroscopy (Bainbridge mass spectrometer),Atomic absorption spectrometer(AAS),Nuclear magnetic resonance spectrometer(NMR), XRD. **(6 h)**

Module 8: **Electron microscope**

Concept of vacuum working electron gun, construction and working of SEM, TEM, STEM, sample preparation. **(8 h)**

(Practical: 18 hours)

1. Spectral properties (Colorimetric or UV/Visible Spectral analysis of colouring pigments- Beta cyanin, Anthocyanin, Xanthine, Lycopene, Curcumin, capsicin)
2. Separation Techniques: Chromatography (PC, TLC and Column), GC & HPLC , HPTLC (Demonstration only)
3. Electrophoretic separation of protein.

References

1. Perspective of Modern Physics-Arthur Beisen(Mc Graw Hill)
2. Nuclear Physics:an introduction:SB Patel(New Age International)
3. Introduction to Atomic Spectra: HE White(Mc Graw Hill)
4. Text Book of optics and atomic physics:PP Khandelwal(Himalaya publications)
5. Molecular Cell Biology:Lodish,Berk,Matsudora,Kaiser,Kriegen(WH Freeman and Co.)
6. Biophysics:Cotrell(Eastern Economy Edition).
7. Clinical Biophysics:Principles and Techniques:P Narayanan (BhalaniPubl.,Mumbai).
8. Biophysics:Pattabhi and Gautham

MAHATMA GANDHI UNIVERSITY
B.Sc BOTANY & BIOTECHNOLOGY (DOUBLE CORE) PROGRAMME

Core Course of Biotechnology

Semester : II **BT Course 3** **Code :BO&BT2B$_{BT}$03U**

RECOMBINANT DNA TECHNOLOGY

[Theory 54 hours , Practical: 18 hours, Total 72 hours]

Course Objectives:-

Students should be able:

1. To understand advances in field of genetic engineering and their applications.
2. To familiarize with the various tools and techniques in genetic engineering

Module1 **10 hours**

- Introduction to gene cloning
- DNA isolation; DNA isolation solutions, isolation buffer pH, concentration and ionic strength, DNase inhibitors, detergents used for isolation, methods for breaking the cells
- Removal of proteins from cell homogenate; using organic solvents, Kirby method and Marmur method, using CTAB
- Removal of RNA; using RNase A, RNase T1
- Concentrating the isolated DNA; precipitating with alcohols, salts added along with alcohol
- Determination of the concentration and purity of DNA; using UV spectrophotometry
- Storage of DNA samples
- Commercially available kits for genomic and plasmid DNA isolation
- Preparation of genomic DNA from animal cells, plant cells and bacterial cells; protocol for small scale and large scale preparations
- Isolation of plasmid DNA; protocol for small scale and large scale preparations
- Isolation and purification of RNA; purification of total RNA, RNase inhibitors, preparation of cell material, preparation of glass wares, guanidinium hot phenol method, high salt lithium chloride method, isolation of poly A RNA

Module 2 **15 hours**

- Agarose Gel electrophoresis of DNA and RNA; principles of electrophoresis, buffers used for electrophoresis of nucleic acids, gel concentration, sample concentration, sample loading solutions, gel staining, determination of molecular weight using molecular weight markers, special precautions and treatments required for electrophoresis of RNA, elution of DNA from agarose gels; electroelution, using low-melting point agarose,
- Nucleic acid transfer and hybridization; Southern blot transfer, dot-blot transfer, plaque and colony transfer, Southern blot hybridization, Northern blot transfer and hybridization, in situ hybridization
- Preparation of probes for hybridization, radioactive labeling, digoxigenin labeling, nick translation, preparation of primer using PCR, RNA probes

Module 3 **15 hours**

- Principle of DNA cloning
- Cloning vectors; essential features of a cloning vector, plasmid derived vectors , bacteriophage derived vectors, hybrid vectors, high capacity cloning vectors;BACs, PACs and YACs , Agrobacterium based vectors, shuttle vectors, expression vectors
- Enzymes used in recombinant DNA technology; type II restriction endonucleases, ligases, S1 nuclease, alkaline phosphatase, terminal transferase, DNA polymerase I, reverse transcriptase, exonuclease III, bacteriophages λ exonuclease,
- Finding gene of interest; shot gun cloning followed by screening, construction and use of genomic DNA library and cDNA library, screening DNA libraries, chromosome walking, *in silico* gene discovery, cloning of the gene of interest, altering the gene of interest through site directed mutagenesis,
- Preparation of recombinant DNA molecule, blunt ends and sticky ends, using tailing method, using polylinkers
- Methods to transfer the recombinant DNA molecule into the cloning host; transformation, transfection, transduction, electroporation, microinjection, microprojectiles and DNA gun, *Agrobacterium* mediated transfer
- Methods to select the recombinants; antibiotic markers, insertional inactivation, replica plating, blue-white selection, use of reporter genes; GUS, luciferase and GFP genes

Module 4 **14 hours**

- Transgenesis; introduction to transgenic organisms and their applications.
- Mechanism of gene transfer into eukaryotic cells, transfection methods; using polyethelene glycol, chemical transfection using lithium acetate, calcium phosphate, and DEAE-dextran, lipofection, electroporation, microinjection, DNA gun, fate of DNA transferred to eukaryotic cells, random integration transgenesis – gain of function effects and loss of function effects, gene targeting,
- Examples of transgenic crop plants and animals
- Antisense and RNAi technology
- Production of knock out models and their use
- Applications of recombinant DNA tecnology
- Ethical, Social and legal issues associated with recombinant DNA technology

Module 5 : Practical **18 hours**

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

References:-

1. Recombinant DNA , JD Watson, 1992, Scientific American Books
2. Recombinant DNA: genes and genomes – a short course, JD Watson et al., 2006, WH Freeman & Co.
3. Recombinant DNA technology and applications, Alex Prokop et al., 1997, McGraw Hill
4. Principles of Gene Manipulation: An Introduction to Genetic Engineering, by R.W. Old and S.B. Primrose, 2000, Blackwell Scientific
5. Molecular Cloning: a Laboratory Manual.. Sambrook J, Russel DW & Maniatis T. 2001, Cold Spring Harbour Laboratory Press

MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY & BIOTECHNOLOGY (DOUBLE CORE) PROGRAMME

Core Course of Biotechnology

Semester – III **BT** Course 4 **Code :BO&BT3B$_{BT}$04U**

MICROBIOLOGY AND MICROBIAL BIOTECHNOLOGY

[Theory 54 hours , Practical: 36 hours, Total 90 hours]

Course Objectives:

The student should be able:

- To identify different types of microbes and their crucial roles in various bioprocesses
- To apply various microbial processes/systems/activities, which have been used for the development of industrially important products/processes.

Module I : Microbiology

Unit 1 **3 hours**

Definition

Brief classification of microbes:- bacteria, archaea, protozoa, algae, fungi, viruses

History of microbiology, Golden age of microbiology, Germ theory, Koch's postulates

Economic importance of microbes

Unit 2 **8 hours**

Observing microorganisms

Microscopy : compound light microscope, darkfield microscope, phase contrast microscope, fluorescent microscope, confocal microscope, scanning electron microscope, transmission electron microscope, scanning acoustic microscop

Preparing smears for microscopy

Staining, differential staining, Gram staining, acid fast staining, special stains, negative staining for capsules, endospore staining, flagella staining

Morphology of bacteria

Size range of bacterial cells, shape and arrangement of bacterial cells

Methods to classify bacteria: biochemical methods, serological testing, phage typing, fatty acid profiling using FAME, ribotyping and rRNA sequencing

Bergey's manuel, examples and characteristics (brief account) of gram negative bacteria, gram positive bacteria, bacteria with unusual properties, gram positive filamentous bacteria with complex morphology

Structure of bacterial cell

Structures external to cell wall:

Glycocalyx

Cell wall: composition, structure, function, cell wall and Gram staining mechanism

Flagella: structure of flagella, different types of arrangements of flagella

Fimbriae and pili

Structures internal to cell wall

Plasma membrane, composition, structure and function

Spheroplast, cytoplasm, ribosome, nucleoid, plasmid, inclusions, endospores

Unit 3 **12 hours**

Culturing Bacteria

Nutritional requirements, nutritional types of bacteria: phototrophs, chemotrophs, autotrophs, heterotrophs, obligate parasites

Bacteriological Media: selective media, differential media, media for characterization of bacteria

Solid and semi solid media, broth

Physical conditions required for growth: temperature, pH, oxygen, cultivation of aerobic and anaerobic bacteria, candle jar, anaerobic jar, CO_2 generating packet, CO_2 incubator

Batch culture, continuous culture, enrichment culture, pure culture, methods to obtain pure culture: streak plate method, serial dilution method, use of special media

Preserving bacterial culture: Glycerol stock, deep freezing, lyophilisation

Growth of bacterial cultures: binary fission, budding (eg. Pseudomonas acidophila), fragmentation (eg. Nocardia)

Bacterial growth kinetics, Growth curve, different phases

Measurement of bacterial growth: direct microscopic count, serial dilution, pour plate, spread plate and plate count, membrane filter count, turbidometric method, dry weight method, most probable number method,

Quorum sensing

Unit 4 **8 hours**

Control of microbial growth

Sterilization, methods of sterilization

Heat treatment: thermal death point, thermal death time, moist heat and dry heat, autoclave, design, operation, pasteurization, flaming, hot air oven, low temperature treatment

Filtration: membrane filters

Chemical methods: phenols, bisphenols, biguanides, halogens, alcohols, compounds of heavy metals, soaps and detergents, acid anionic sanitizers, quaternary ammonium compounds, chemical preservatives; SO2, sodium benzoate, sorbic acid, calcium propionate, sodium nitrate

Antimicrobial drugs: drugs inhibiting cell wall synthesis, drugs inhibiting protein synthesis, drugs causing injury to plasma membrane, drugs inhibiting nucleic acid synthesis, drugs inhibiting the synthesis of essential metabolites, penicillins, penicillinase resistant penicillin, penicillin and β-lactamase inhibitors, cephalosporins, bacitracin, vanomycin, tetracyclines, sulfonamides.

Antifungal Drugs: agents affecting fungal sterols, agents affecting fungal cell walls, agents inhibiting nucleic acid synthesis

Antiviral Drugs: nucleoside and nucleotide analogues, enzyme inhibitors, reverse transcriptase inhibitor, protease inhibitors, interferons

Determination of the efficiency of a drug: disk diffusion assay, broth dilution test and determination of minimal inhibitory concentration

Unit 5 **3 hours**

Genetic recombination in bacteria: transformation, conjugation and transduction

Unit 6 **5 hours**

Viruses

Characteristics of viruses, size range, host range

Classification of viruses

Structure of viruses: general morphology, nucleic acids, capsid and envelope

Culturing bacteriophages in the laboratory, culturing animal viruses: in living animals, in embryonated eggs, in cell cultures

Viral multiplication: Multiplication of bacteriophages; lytic cycle, lysogenic cycle, multiplication of animal viruses, differences in the multiplication strategies of DNA and RNA viruses

Viruses and cancer, DNA and RNA oncogenic viruses

Module II

Microbial Biotechnolgy

Unit 1 **3 hours**

Introduction, scope and historical developments, importance of microbes in industry; microbial biomass, microbial enzymes, microbial metabolites and microbial recombinant products.

Isolation, screening and genetic improvement of industrially important organisms.

Unit 2 **5 hours**

Fermentation, Definition, chronological development of fermentation industry

Submerged fermentation and solid state fermentation

Media for industrial fermentation, major components, water, carbon sources, nitrogen sources, minerals, chelators, oxygen requirement, rheology, foaming and antifoaming agents.

Medium optimization: one factor at a time approach, factorial approach, fractional factorial approach: statistical design of experiments, Plackett-Burman design and response surface method.

Fermenter, functions of a fermenter, Design of a biofermenter, body constructon, types of fermenters: Waldhof type, tower type, air lift type, packed tower type , sterilization of the fermenter, aeration, porous sparger, orifice spurger, nozzle sparger, probes

Recovery of fermentation products, foam separation, precipitation, filtration, centrifugation

Unit 3 **4 hours**

Primary metabolism products, production of industrial ethanol as a case study; Secondary metabolites, bacterial antibiotics production;

Recombinant DNA technologies for microbial processes; Strategies for development of industrial microbial strains with scale up production capacities; metabolic pathway engineering of microbes for production of novel product for industry.

Unit 4 **3 hours**

Microbial enzymes, role in various industrial processes, Bio-transformations, Bioaugmentation with production of vitamin C as a case study, Microencapsulation technologies for immobilization of microbial enzymes.

Industrial biotechnology for pollution control, treatment of industrial and other wastes, biomass production involving single cell protein; Bioremediation of soil; Production of eco-friendly agricultural chemicals, biopesticides, bio-herbicides, bio-fertilizers, bio-fuels, etc.

Practical **36 hours**

1. Isolation of bacteria through serial dilution and plating technique
2. Gram staining technique
3. Acid fast staining technique
4. Endospore staining technique
5. Flagella staining technique
6. MPN analysis of water samples
7. Identification of bacteria using biochemical tests
8. Preparation of the growth curve of a bacterium using turbidometric method
9. Disk diffusion assay and determination of antimicrobial activity of medicinal plant extracts
10. Production of wine and recovery of alcohol
11. Production of one enzyme through solid state fermentation
12. Production of an enzyme through submerged fermentation

References:-

1. Kun LY. 2006. *Microbial Biotechnology*. World Scientific.
2. Tortora et al. 2008. Microbiology an introduction, Pearson Education
3. Michael J Pelczar et al. 2000. TATA McGraw Hill
4. PF Stanbury et al. 2008. Elsevier

MAHATMA GANDHI UNIVERSITY

B.Sc. BOTANY & BIOTECHNOLOGY (DOUBLE CORE) PROGRAMME

Core Course in Biotechnology

Semester – III **BT** Course 5 Code :BO&BT3B_{BT}05U

PLANT BIOTECHNOLOGY

(Theory : 54 hours; Practical : 36 hours; Total 90 hours)

Course Objectives

The student should be able:

1. To familiarize with the tools and techniques of plant biotechnology
2. Aware of the life forms and activities that can be exploited for human advancement.
3. To impart an introductory knowledge about the potential of plant transgenics
4. To discuss about various aspects of biosafety regulations, IPR and bioethic concerns arising from the commercialization of biotech products

Module 1 **20hours**

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, inoculation and incubation, sub culturing, Establishment of axenic explants, callus initiation and multiplication, production of suspension culture, cell
4. Micropropagation-advantages and disadvantages, different methods – axillary bud proliferation, direct and indirect organogenesis and somatic embryogenesis, different phases of micropropagation – hardening, transplantation and field evaluation.
5. Applications of tissue culture : Micropropagation of elite plants, Synthetic seed production, Meristem culture for virus free plants, Somaclonal variation and *in vitro* mutagenesis, Embryo rescue – embryo culture, Protoplast isolation culture and regeneration, Somatic cell hybridization, I*n vitro* secondary metabolite production –– cell immobilization, bio reactors, hairy root culture, *In vitro* production of haploids – anther and pollen culture, Cryopreservation, *in vitro* fertilization

Module 2 **20 hours**

1. Methods of plant transformation; Gene cloning, genetic engineering: vectors and methods of transformation – electroporation, particle bombardment, *Agrobacterium* mediated, different types of Agrobacterium based vectors
2. Vectors for plant transformation; Target traits and transgenic crops; Genetic and molecular analyses of transgenics; Role of molecular markers in characterization of transgenic crops, fingerprinting of cultivars ,
3. Achievements, problems and future thrusts in horticultural biotechnology.
4. Biotechnology and floriculture, molecular approaches to control ethylene response, improving shelf life, improving resistance for environmental stress, approaches to improve flower development, pigment production. achievements of bio-technology in flower crops
5. Extraction of biocolours , uses in food and textile industries.
6. Examples of transgenic plants produced successfully, Bt crops, golden rice, Flavr Savr Tomato, virus and herbicide resistant crops, edible vaccines.
7. Biosafety issues, regulatory procedures for commercial approval.

Module 3 **14 hours**

Unit 1

Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, The Cartagena protocol on biosafety, WTO and other international agreements related to biosafety, Cross border movement of germplasm; Risk management issues - containment.

UNIT 2

General principles for the laboratory and environmental biosafety; Health aspects; toxicology, allergenicity, antibiotic resistance, Sources of gene escape, tolerance of target organisms, creation of superweeds/superviruses, etc.

UNIT III

Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies ,Radiation safety and nonradio isotopic procedures; Benefits of transgenics to human health, society and the environment.

UNIT IV

Intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications, etc; Protection of plant variety and farmers right act; Indian patent act and amendments, patent filing; Convention on biological diversity; Implications of intellectual property rights on the commercialization of biotechnology products.

Module 4: PRACTICALS **36hours**

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 budcontaining uninucleate pollen for anther culture using cytological techniques
5. Establishment of the axenic culture of any one crop plant
6. Micropropagation of on orchid variety
7. Establishment of the suspension culture of one medicinal plant
8. Production of somatic embryos from one plant
9. Transformation of leaf discs using Agrobacterium and selection of transmormed leaf discs
10. Induction of hairy root culture in any one plant
11. Visit a well equipped biotechnology lab and submit a report along with the practical record.

References

a. Keshavachandran R & Peter KV. 2008. Plant Biotechnology: Methods in Tissue Culture and Gene Transfer. Orient & Longman (Universal Press)

b. Debnath M. 2005. Tools and Techniques of Biotechnology. Pointer Publ.

c. Brown TA. 2001. Gene Cloning and DNA Analysis and Introduction. Blackwell Publ.

d. Chadha KL, Ravindran PN & Sahijram L. (Eds.). 2000. Biotechnology of Horticulture and Plantation Crops. Malhotra Publ. House.

c. Singh BD. 2007. Biotechnology: Expanding Horizon. Kalyani.

MAHATMA GANDHI UNIVERSITY
B. Sc. BOTANY & BIOTECHNOLOGY (DOUBLE CORE) PROGRAMME

Core Course in Botany (Revised)

Semester IV BO Course 4 Code:BO&BT4B$_{BO}$04U

PHYCOLOGY

(Theory – 54 hours; Practicals – 36 hours)

Course Objectives
The student should be able:

1. To understand the biodiversity of algae.
2. To understand the identifying characters of the different types and classify them.
3. To understand the habit, habitat, structure, life history and economic importance of the various types.
4. To trace the phylogeny, affinities and evolution of various groups of algae.
5. To describe and demonstrate the process of isolation, culture and maintainence of algae.

Module – I

Introduction: General characters of algae, classification (Fritsch F.E., 1935,1945)

3 hrs.

Module – II

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. Pheophyceae : Sargassum
f. Rhodophyceae: Polysiphonia **24 hrs.**

Module – III

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. Alga as sources of food and medicine
e. Diatoms and nanotechnology
f. Algae as sources of biofuel
g. Toxic algae – algal blooms, red tides and fish poisoning
h. Algae as primary producers – oxygen liberators
i. Cynaobacteria as a source of restriction endonuclease
j. Role of algae in aquaculture

9 hrs.

Module – IV

Algal culture- General introduction and importance – collection, isolation, culturing – pure culture, culture maintenance. Culture requirements: medi physical and chemical; types of cultures – monoculture, synchronous, mass culture. Mass cultivation systems – principles and procedures; photobioreactor closed loop system, open pond system; set up and back up cultures, growth dynamics: harvesting of microalgae and macroalgae; filtration, centrifugatio flotation and flocculation; processing. Methods in preservation and staining

18 hrs.

actical

odule – V

i. Make micropreparation of vegetative and reproductive structures of the types
ii. Identification of algal specimens up to generic level
iii. Preparation of labeled sketches of the specimens
iv. Algal collection and submission of a field report
v. Demonstration of aseptic culture techniques, preparation of media and pure culture
vi. Algal harvesting techniques employed in algal culture **36 hrs.**

FERENCE BOOKS

1. V.J. Chapman 1962. The Algae. Mc Millan & Co. London

2. F.E. Fritsch 1945. Structure and reproduction of algae. Vol. 1. Cambridge University Press.

3. J.E. Bardach, J.H. Ryther and W.O. McLarney. 1972 Aquaculture: The Farming and Husbandry of Freshwater snd Marine Organisms. Wiley - Interscience Press.

4. M. Borowitzka and L. Borowitzka (eds.) 1988. Micro – Algal Biotechnology. Cambridge University Press.

5. Anderson, R.A. 2005. Algal Culturing Techniques. Elsevier Academic Press, Burlington, MA.

6. Amos Richard (ed.) Handbook of Microalgal culture : Biotechnology and Applied Phycology.

http://www.phycology.net/

http://www.algaebase.org/

http://www.seaweed.ie/

http://www.brphycsoc.org/ (The british phycological society)

http://www.intphycsoc.org/ (The International Phycological society)

http://www.isaseaweed.org/ (The international seaweed association)

http://botany.si.edu/projects/algae/ (Smithsonian national museum of Natural History)

http.//www.oilgae.com

http.//www.bigelow.org/course

MAHATMA GANDHI UNIVERSITY
B.Sc. BOTANY & BIOTECHNOLOGY (DOUBLE CORE) PROGRAMME
Core Course in Biotechnology
Semester – IV **BT** Course 6 **Code :BO&BT4B$_{BT}$06U**

ANIMAL BIOTECHNOLOGY AND NANO-BIOTECHNOLOGY
[Theory 54 hours , Practical: 36 hours, Total 90 hours]

Course Objectives

The student should be able

1. To acquire basic knowledge of current developments in different areas of animal biotechnology.
2. To understand and develop skills involved in the production of nanoparticles and their application in life sciences

Module 1 : ANIMAL BIOTECHNOLOGY

Unit 1 10 hours

- Structure of animal cell
- History of animal cell culture
- Cell culture media and reagents, different type of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application.
- Infrastructure requirements, conditions required for culturing animal cells,
- Behavior of cells in culture conditions, division, their growth pattern, estimation of cell number.
- Culture of mammalian cells, tissues and organs, primary, culture, secondary culture, continuous cell lines, suspension cultures
- Development of cell lines, characterization and maintenance of cell lines, stem cells, cryopreservation
- common cell culture contaminants.

- Commercial scale production of animal cells
- Application of animal cell culture for *in vitro* testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

Unit 2 5 hours

- Introduction to immune system, cellular and humeral immune response,
- Vaccines, history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, hybridoma technology.
- Antigen-antibody based diagnostic assays including radioimmunoassays and enzyme immunoassays, immunoblotting, commercial scale production of diagnostic antigens and antisera.

Unit 3 5 hours

- Structure of sperms and ovum, cryopreservation of sperms and ova of livestock, artificial insemination, super ovulation, *in vitro* fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-splitting, embryo sexing, *in utero* testing of foetus for genetic defects

Unit 4 4 hours

- Animal cloning basic concept, cloning from embryonic cells and adult cells, cloning of different animals, cloning for conservation of endangered species
- Ethical, social and moral issues related to cloning

Unit 5 5 hours

- Transgenic manipulation of animal embryos, animal viral vectors, different applications of transgenic animal technology
- Transgenic animal production and application in expression of therapeutic proteins, biopharming
- Gene knock out technology and animal models for human genetic disorders

Unit 6 5 hours

- Gene therapy, somatic cell therapy, germline therapy, gene augmentation therapy, gene replacement therapy
- Candidate diseases for gene therapy
- Methods of gene transfer, vectors used
- Initial trials and observations
- Current status of gene therapy

Module II: NANO-BIOTECHNOLOGY

Unit 1 5 hours

- Introduction to Biomacromolecules: The modern concepts to describe the conformation and dynamics of biological macromolecules: scattering techniques, micromanipulation techniques, drug delivery applications.

Unit 2 5 hours

- Cellular engineering: signal transduction in biological systems, feedback, control signaling pathways, cell-cell interactions etc. Effects of physical, chemical and electrical stimuli on cell function and gene regulation.

Unit 3 6 hours

- Chemical, physical and biological properties of biomaterials and bioresponse
- Biosynthesis, and properties of natural materials (proteins, DNA, and polysaccharides), structure-property relationships in polymeric materials (synthetic polymers and structural proteins);
- Aerosol, properties, application and dynamics
- Statistical Mechanics in Biological Systems

Unit 4 4hours

- Characteristics of nanoparticles

- Preparation and characterization of nanoparticles, biosynthesis of nanoparticles, Nanoparticular carrier systems, Micro- and Nano-fluidics, Drug and gene delivery system, Microfabrication, Biosensors, Chip technologies, Nano- imaging, Metabolic engineering and Gene therapy.

Practicals **36 hours**

- Packing and sterilization of glass and plastic wares for cell culture
- Preparation of reagents and media for cell culture.
- Primary culture of chicken embryo fibroblast.
- Secondary culture of chicken embryo fibroblast.
- Cultivation of continuous cell lines.
- Quantification of cells by trypan blue exclusion dye.
- Isolation of lymphocytes and cultivation of lymphocytes
- Study of effect of toxic chemicals on cultured mammalian cells
- Isolation of microbes capable of biosynthesis of nanoparticles

Suggested Readings

1. Gordon I. 2005. Reproductive Techniques in Farm Animals. CABI.
2. Levine MM, Kaper JB, Rappuoli R, Liu MA, Good MF. 2004. New Generation Vaccines. 3rd Ed. Informa Healthcare.
3. Lincoln PJ & Thomson J. 1998. *Forensic DNA Profiling Protocols*. Humana Press.
4. Portner R. 2007. *Animal Cell Biotechnology*. Humana Press.
5. Nalwa HS. 2005. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology. American Scientific Publ.
6. Niemeyer CM & Mirkin CA. 2005. *Nanobiotechnology*. Wiley

MAHATMA GANDHI UNIVERSITY

B.Sc BOTANY & BIOTECHNOLOGY (DOUBLE CORE) PROGRAMME

Core Course in Biotechnology

Semester – IV BT Course 7 Code :BO&BT4B$_{BT}$07U

BIOINFORMATICS

[Theory: 54 hours, Practical: 36hours, Total 90 hours]

Course Objectives:-

The student should be able:

1. To acquire detailed information about ourselves and other species
2. To understand the role of computer science in biological investigations.
3. To access data and techniques through the World Wide Web and utilize them for analysis.
4. To use computers with confidence and handle biological databases, information retrieval and make him/her able to extend these skills by self-directed 'field work' on the Web.
5. To apply principles of bioinformatics in molecular biology, clinical medicine, pharmacology, biotechnology, agriculture, forensic science, anthropology and other disciplines
6. To develop a sense of optimism that the data and methods of bioinformatics will create profound advances in our understanding of life, and improvements in the health of humans and other living things.

Module 1: An Introduction to bioinformatics
5 hours

Scope and relevance of bioinformatics

Genomics: Definition

Sequencing genes to sequencing genomes

Sequence assembly

Major findings of the following genome projects

- Human
- *Arabidopsis thaliana*
- *Drosophila melanogaster*
- *Caenorhabditis elegans*

Module 2: Biological Data bases **20 hours**

Detailed study of the following Biological Data bases:

- Bibliographic databases
  - Finding Scientific Articles
    - PubMed
- Genome sequence databases
  - Entrez Genome
  - TIGR database
- Nucleic acid sequence databases
  - GenBank
- Protein sequence databases
  - GenBank
  - SWISS-PROT
- Protein structure database
  - Protein Data Bank

Searching Biological databases

Saving search results

- FASTA format
- ASN.1 format
- Batch Entrez
- PDB flat file format
- mmCIF format

DNA micro array data bases

- Gene expression Omnibus, NCBI
- Stanford microarray database

2D gel electrophoresis data bases

- ExPASy SWISS-2DPAGE
- Danish Centre for Human Genome Research database

Module 3: Alignment **15 hours**

Sequence comparison

- Pair wise sequence alignment
  - Global alignment: Use of ALIGN
  - Local alignment: Use of BLAST, FASTA
- Multiple sequence alignment
  - Use of ClustalW
- Phylogenetic analysis
  - Use of PHYLIP

Data mining

Use of PERL in bioinformatics

Module 4: Molecular Visualization Tools **14 hours**

Structure visualization

- Molecular structure viewers
- RasMol
- SWISS-PDBViewer

Predicting protein structure and function from sequence

Protein modeling, Docking and drug discovery

Module 5: Practical **36 hours**

Familiarize with the various databases given in the syllabus

Practice retrieving data from the various databases

Learn how to store the retrieved data

Practice the use of BLAST

Familiarize with the use of RasMol

References

1. Bioinformatics : A Machine Learning Approach. P Baldi and S Brunak. MIT Press
2. Bioinformatics : A Practical Guide to the Analysis of Genes and Proteins
3. Developing Bioinformatics Computer Skills. Cynthia Gibas and Per Jambeck. O'Reilly Genomes . TA Brown. Wiley-Liss.
4. Genomics: The Science and Technology Behind the Human Genome Project. CR Cantor and CL Smith. John Wiley and Sons.

MAHATMA GANDHI UNIVERSITY
B. Sc. BOTANY & BIOTECHNOLOGY (DOUBLE CORE) PROGRAMME

Core Course in Biotechnology
Semester V BT **Course 8** Code: BO&BT5B$_{BT}$08U

CELL BIOLOGY, DEVELOPMENTAL BIOLOGY & EVOLUTION

(Theory: 54hrs; Practical: 36hrs)

Course Objectives

Students should be able:

1. To understand the ultra structure and functioning of the cell at submicroscopic and molecular level.
2. provide an idea of origin, concept of continuity and complexity of life activities.
3. To appreciate developmental biology as one of the most exciting areas of
4. contemporary biology.
5. To understand the concept of unification of genomic, developmental, organismal,
6. population and natural selection approaches to evolutionary change.
7. To understand the process of evolution which acts through inherited changes in the development of organism.
8. To relate embryonic development with life history evolution, adaptation and responses to and integration with environmental factors.

Section A: Cell Biology

Module – I

Historical account of cell biology: Cell theory and protoplasm theory, Cell: Physio-chemical nature of plasma membrane and cytoplasm, prokaryotic a eukaryotic cell. structural organization and function of intracellular organelles – cell wall, nucleus, mitochondria, ribosome, dictyosomes, microbodie golgibodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure and function of cytoskeleton and its role in motilit **9 hrs.**

Module – II

Chromosomes: morphology- fine structure, Dupraw model, Nucleosome model; chemical organization of nucleosome-nucleoproteins, karyotype and idiogram. Special types of chromosomes- salivary gland, lampbrush and B chromosome.

Organization of genes and chromosomes: operon, interrupted genes, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.

Numerical aberrations of chromosomes-Aneuploidy and euploidy. Structural aberrations of chromosomes- deletion, duplication, inversion and translocation and their meiotic behaviour.

Mutations: spontaneous and induced. Mutagens-physical and chemical mutagens. Chromosomal and point mutations. Molecular mechanism of mutation: transition, transversion and substitution.

11hrs

Module -III

Cell division and cell cycle: mitosis and meiosis, cell cycle regulation, steps and control of cell cycle. Stem cells- definition, sources and applications. ; Interaction of cells with their environment, cell signalling.

8hrs

Section B: Developmental Biology

Module – IV

Introduction to developmental biology: basic concepts of development, potency, commitment, specification, induction, competence, determination a differentiation; genomic equivalence and cytoplasmic determinants: imprinting mutants and transgenics in analysis of development

4 hrs.

Module – V

Gametogenesis, fertilization and early development: Animal development: oogenesis, fertilization, embryonic cleavage divisions: blastulation, gastrulation a morphogenesis; Development of model organisms – Drosophila and Caenorhabditis; maternal and zygotic gene activity in development.
Plant development: microsporogenesis and megasporogenesis; Embryogenesis (brief account only), establishment of symmetry in plants, seed formation a development of seedling, shoot and root meristem, leaf development, development of model organism – Neurospora a Arabidopsis.

13 hrs.

Section C: Evolution

Module – VI

Introduction- progressive, retrogressive, parallel and convergent evolution.

Emergence of evolutionary thoughts: Lamarck; Darwin; Weisman–s and De vries– (concepts of variation, adaptation, struggle, fitness and natu selection: Spontaneity of mutations; the evolutionary synthesis.) Origin of cells and unicellular evolution: origin of basic biological molecules, abiotic synthes of organic monomers and polymers; Oparin – Haldane theory; experiment of Miller (1953); evolution of prokaryotes and eukaryotes. Neo Darwinis Reproductive isolation, mutation, genetic drift, speciation. Variation and evolution, hybridization and evolution, polyploidy and evolution. Mutation a evolution. Molecular evolution: concepts of neutral evolution, molecular divergence and molecular clocks; molecular tools in phylogeny: classification a identification; protein and nucleotide sequence analysis; origin of new genes and proteins; gene duplication and divergence.

6hrs.

Module – VII

Paleontological evidences: Geological time scale; eras, periods and epoch; major events in the evolutionary time scale; origin of organisms: major groups plants and animals; stages in primate evolution.

3hrs.

Practical
Module – VIII

i. Mitosis – smear preparation with onion root tip and calculation of mitotic index
ii. Meiosis – study of meiosis: *Rhoeo* flower buds and grass hopper testis
iii. Squash preparation of cheek epithelium- Identification of Barr body.
iv. Study of different developmental stages of chick embryos
v. Study of different stages of microsporogenesis and megasporogenesis
vi. Extraction of *Amaranthus/Tridax* embryo
vii. Cytochemical localization of esterases in stigma
viii. Pollen counting and viability test of *Impatiens*
ix. Identification of CS of anthers and LS of ovules
x. PTC testing
xi. Identification of salivary gland chromosome.

36 hrs.

REFERENCE BOOKS

1. Lodish et al.2004. Molecular Cell Biology – (Scientific American Book)
2. Eduard Gasque – –Manual of Laboratory Expts in Cell Biol .–(W. C. –Wilson Pub)
3. Alberts et al. .2002. The Biology of the Cell
4. Cooper & Hausman .2004. The Cell – A Molecular Approach
5. Maheaswari, P. 1950. An introduction to embryology of Angiosperms. Mc Graw Hill.
6. Balinsky, B.I., 1965. An Introduction to embryology, W.B. Saunders company

7. Bodemer, L.W., 1968. Modern Embryology, Winston Inc. USA

8. Dodd, H.I., and Dodd, J.M. , 1978. The biology of metamorphosis , In Physiology of amphibia, Vol. 3, Academic press, N.Y

9. Gilbert, S.F., 1997. Developmental Biology, 5th Edn, Sinauer, Associates, Massachusettes.

10. George, M. Malacinski (ed) 1988, Developmental genetics of higher organisms, Macmillan Publishing Co.,

11. Tamarin, R., 1991, Principles of Genetics, 3rd edition.

12. Vasudeva Rao, 1994. Developmental Biology: A modern synthesis, Oxford & IBH, New Delhi

13. De Robertis, E.D.P. and Robertis, E.M.F. 1991. Cell and molecular biology. Lea and Febiger

14. Dobzhansky, B. 1961. Genetics and the origin of species. Coloumbia University Press. NY.

MAHATMA GANDHI UNIVERSITY
B. Sc. BOTANY & BIOTECHNOLOGY (DOUBLE CORE) PROGRAMME
Open Course in Biotechnology

Semester- V Open **Course 1** Code: BO&BT5D$_{BT}$01U (Open course)

ENVIRONMENTAL BIOTECHNOLOGY

(Theory-90 Hours)

Course objectives

Students should be able:

1. To understand the basic principles of environmental monitoring and management
2. To realize different sources of pollution and eco-friendly approaches to minimize it
3. To apply eco-technology for waste management and sustainable development
4. To understand various *in situ* and *ex situ* conservation strategies
5. To apply basic principles of geo informatics and remote sensing for conservation of environmental resources.

Module – I

Environmental pollution: concepts, types, source and effects; solid and liquid waste management, soild waste, sources and types; methods of treatment physical, chemical, biological – aerobic:composting and vermicomposting, anaerobic: anaerobic digesters: liquid waste sources and types; methods treatment – physical, chemical, biological - aerobic, anaerobic; phytoremediation, aquatic macrophyte system, activated sludge process, artificial wetlanc nutrient film technique **18 hrs.**

Module – II

Air pollution, concepts, sources and effects; green house effect, global warming, climatic changes, ozone depletion and acid rain: Montreal protocol and Kyo protocol: air pollution control measures – bioscrubbers, biocatalysts, biofilters, membrane bioreactor, biodesulfuration of coal, gre belts **14 hrs.**

Module – III

Technology for sustainable agriculture, agrobiotechnology – plant gentric engineering, recombinant DNA technology, plant tissue culture and floricultur mushroom cultivation. Biological pest management strategies, biopesticides, biofertilizers. Technology for sustainable industries, bioremediation xenobiotics, oil spills, plastics. Sustainable alternate energy resources, renewable and non-renewable energy resources, conventional and non-conventior energy resources waste to energy concept. Biogas production, microbial hydrogen production, bioethanol production.
18 hrs.

Module – IV

Conservation biology – *in situ* conservation- bioreserves, national ,parks, sanctuaries, tiger reserves: *ex situ* conservation - botanical garder cryopreservation, germplasm, seed bank. Environmental modeling, biomodelling concepts and application, biological indicators: global environment monitoring system. Application of geo-informatics in conservation and environmental modeling
15 hrs.

actical
odule – V

i. Water quality analysis 0- pH, DO, BOD, COD, TDS, dissolved CO_2 , chlorinity, sulphate, calcium and magnesium.
ii. Soil chemical analysis – soil sampling, techniques, water soluble minerals, soil pH, moisture and bulk density
iii. Field visit of natural ecosystems – quadrate study, species structure, density, frequency and abundance, identification of trophic levels
iv. Practical training in vermicomposting, mushroom cultivation, azolla cultivation **25hrs.**

FERENCES

1. Odum E.P. Concepts in ecology.
2. Miller T. 2009. Environmental biology.
3. Scrag A. 2007. Environmental biotechnology
4. Sharma B.K. Environmental pollution
5. Sharma P.D. Environmental biology
6. Southwood, E. Ecological methods.

B. Sc Zoology (Vocational) Degree

COMPLEMENTARY COURSE BOTANY

Semester I

Paper I Plant Diversity and Plant Pathology- Theory 3hs/week Practical 2hrs/week

Semester II

Paper II Angiosperm Taxonomy and Economic Botany - Theory 3hs/week Practical 2hrs/week

Semester III

Paper III Plant Physiology - Theory 3hs/week Practical 2hrs/week

Semester IV

Paper IV Angiosperm Anatomy and Applied Botany - Theory 3hs/week Practical 2hrs/week

B. Sc Zoology (Vocational) Degree

COMPLEMENTARY COURSE BOTANY

Semester I Course 1 Code BO (V) 1C01U

PLANT DIVERSITY AND PLANT PATHOLOGY

(Theory 54hrs; Practical 36hrs)

Module I **48 hours**

Plant Diversity

Unit I 3hrs

Introduction to origin of plants-diversity in the existing forms of plants, evolutionary trends among the plants, general classification of plants-Eichler's System

Unit II 5hrs

Viruses: General account- discovery, different types, evolutionary significance. Structure and multiplication of T even phages. Tobacco mosaic virus- structure and multiplication. General importance of viruses- harmful and beneficial aspects.

Unit III 7hrs

Bacteria: Classification, structure, physiology, multiplication and bacterial genetic recombinations-conjugation, transformation and transduction. Importance- agriculture, medicine, industry and environmental management. Archaebacteria- methanogens- importance.

Unit IV 14hrs

Algae: General account-classification: study of the following types with special reference to systematic position, structure and reproduction: Nostoc, Chlamydomonas, Volvox, Oedogonium, Cladophora, Ectocarpus, Polysiphonia. Economic importance of algae.

Unit V 7hrs

Fungi: General classification- salient features of Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. Study of the following types with special reference to systematic position, structure and reproduction: Phytophthora, Peziza, Puccinia. Economic importance of fungi.

Unit VI 3hrs

Lichens: General features, classification: Structure and reproduction in Usnea. Importance of lichens.

Unit VII 3hrs

Bryophyta: General account and classification: structure and reproduction in Riccia

Unit VIII 3hrs

Pteridophyta: General account and classification with special reference to vascularization: Structure and reproduction in Selaginella

Unit IX 3hrs

Gymnosperms: General account and classification with special reference to seed habit: Structure and reproduction in Cycas.

Module II

Plant Pathology **6 hours**

Unit I 3hrs

Classification of plant diseases based on causes: Host-parasite interactions- toxins, enzymes, defense- Control of plant diseases- use of fungicides, pesticides, antibiotics. Biological agents for disease control, genetically modified plants and disease resistance-Bt cotton.

Unit II 3hrs

Study of the following plant diseases: Leaf mosaic of tapioca, Bacterial blight of paddy, Nut fall of areca nut.

Practicals **36 hours**

1. Students should be trained to identify micropreparations of cryptogam and gymnosperm materials mentioned in the syllabus.
2. Prepare bacterial smear and stain (Gram staining)
3. Identify the plant diseases mentioned in the syllabus

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COMPLEMENTARY COURSE BOTANY

Semester II Course 2 Code BO (V) 2C02U

ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY

(Theory 54hours ; Practical 36hours)

Module I **38hrs**

Angiosperm taxonomy

Unit I 4 hrs

Angiosperm Taxonomy: Importance of classification, cytotaxonomy, chemotaxonomy, numerical taxonomy

Unit II 4 hrs

Field study- importance, field notes, vasculum, herbarium techniques- plant press, drying sheets, disinfection and mounting, classification of herbaria

Unit III 2 hrs

Bentham and Hooker's classification and its merits and demerits

Unit IV 6 hrs

Morphology of angiosperms with special emphasis on reproductive structures-description of flower, types of inflorescences and fruits.

Unit V 24 hrs

Study of the following families with special reference to their economic importance: Annonaceae, Malvaceae, Rutaceae, Leguminosae, Umbelliferae, Rubiaceae, Compositae, Apocyanaceae, Lamiaceae, Euphorbiaceae, Palmae and Poaceae.

Module II **16 hrs**

Economic Botany

Unit I 4 hrs

History of domestication of plants. Classification of plants based on their uses-cereals, pulses, forages, fibre, sugar, fats and oil yielding, spices, beverages, fumigatories, masticatories, timber, gums, dyes, insecticides, vegetables, fruits, ornamentals, medicinal and latex yielding plants.

Unit II 4 hrs

Study of the following plants with special reference to economic products, morphology of useful part and uses: Cereals-paddy and wheat; Pulses- green gram, Bengal gram; Tuber- Tapioca, potato; Spices- pepper, cardamom; Beverages- tea, coffee; Oil- coconut, ground nut; Fiber- cotton, coir; Latex- para rubber, sapota; Ornamentals- Rosa, Orchids, Anthurium

Unit III 4 hrs

Characteristics and uses of the following medicinal plants: Sida, Rauvolfia, Adhatoda, Catheranthus, Neem, Ocimum, Eclipta, Boerhaavia, Phyllanthus

Practicals **36 hrs**

Module I 18 hrs

1. Students should be trained to identify different inflorescence types and fruits
2. Work out the vegetative and floral characteristics of the families mentioned in the syllabus

Module II 18 hrs

1. Identify the source plants of the commercial products mentioned in the syllabus
2. Make a list of ayurvedic preparations in which the medicinal plants mentioned in the syllabus are used

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COMPLEMENTARY COURSE BOTANY

Semester III **Course 3** **Code BO (V) 3C03U**

PLANT PHYSIOLOGY

(Theory 54hours ; Practical 36hours)

Unit I 8 hrs

Water relations of plants: Source of water for plants, physical phenomena involved in water absorption, active and passive absorption, transport of water; transpiration, stomatal mechanism, K-ABA theory, guttation, water stress

Unit II 6 hrs

Mineral nutrition: Major and minor elements-hydroponics, role of selected elements in plant metabolism-nitrogen, phosphorus, potassium, magnesium, zinc and boron; mineral absorption-active and passive-carrier concept.

Unit III 10 hrs

Photosynthesis: Major events in the history of photosynthesis, photosynthetic apparatus, pigments, light, absorption of light, energy transformation, chemiosmotic theory of ATP formation, assimilatory power, red drop, Emerson enhancement effect, two pigment systems, light and dark reactions, diversity in carbon fixation schemes-C3,C4 and CAM- factors affecting photosynthesis, law of limiting factors.

Unit IV 6 hrs

Translocation of organic solutes: Substances translocated, path of translocation, direction of translocation, source and sink concept, mechanism of translocation-Munch hypothesis.

Unit V 8 hrs

Respiration: Respiratory substrates, priority of use, energy yield, aerobic and anaerobic respiration, glycolysis, Krebs cycle, ETS and terminal oxidation, RQ, pentose phosphate pathway; fermentation; factors affecting respiration and their significance.

Unit VI 8 hrs

Nitrogen metabolism: Sources of nitrogen, biological nitrogen fixation, mechanism of nitrogen fixation in root nodule of legume, amono acids- structure and properties, synthesis- protein synthesis, protein structure and degradation.

Unit VII 8 hrs

Growth and movements: Seed-structure and physiology; dormancy- causes and significance- techniques of breaking seed dormancy, seed germination-physiology and processes. Growth regions, rate of growth, sigmoid curve, regulation of growth-hormones, auxins- natural and synthetic- GA, Cytokinin, ethylene, ABA- role and practical applications. Photoperiodism and vernalization. Senescence and abscission. Tropic and nastic movements- geotropism, phototropism, hydrotropism, seismonastic and nyctinastic movements

Practicals **36 hrs**

Core experiments 24 hrs

Students are expected to carry out the following experiments by themselves:

1. Separation of chloroplast pigments by paper chromatography/TLC

2. Demonstration of osmosis using a plant membrane
3. Effect of light on photosynthesis
4. Compare the stomatal indices of two plants

Experiments for demonstration 12 hrs

1. Relation between water absorption and transpiration
2. Evolution of oxygen during photosynthesis
3. Light screen experiment
4. Mohl's experiment
5. Detection of starch in leaf
6. Simple respiroscope

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COMPLEMENTARY COURSE BOTANY

Semester IV Course 4 Code BO (V) 4C04U

ANGIOSPERM ANATOMY AND APPLIED BOTANY

(Theory 54 hours ; Practical 36hours)

Module I **36 hrs**

Anatomy

Unit I 14 hrs

Structure of cell wall: Cell wall as the structural component of the cell, functions of the cell wall, formation of cell wall, chemistry of cell wall, growth of cell wall, intussusception, apposition, schizognous and lysigenous cavity development, plasmodesmata, primary pit field, pits, primary and secondary wall; non living cell inclusions-starch, aleurone grains, cystolith, raphides, druses.

Unit II 8 hrs

Tissues: Meristems- features and position, apical meristems, organization, theories; cambium-origin and role; permanent tissues- simple and complex; structure of xylem and phloem, vascular bundles; secretary tissues-glands, ducts, cavities, laticifers

Unit II 12 hrs

Primary structure and secondary growth: Stem, root and leaf of dicot and monocot; Formation of cambium and its activity in dicot stem, secondary tissues, heart wood, sap wood, growth rings, ring porous and diffuse porous wood, hard wood, soft wood, periderm, lenticels, bark; secondary growth in dicot root; anomalous secondary growth in Bignonia

Unit III 2 hrs

Ecological anatomy: anatomy of hydrophytes, xerophytes and epiphytes

Module II **18 hrs**

Applied Botany

Unit I 9 hrs

Plant breeding: Objectives and methods- plant introduction, quarantine, acclimatization; selection- mass, pureline and clonal selection; hybridization- intervarietal, interspecific, intergeneric hybridization, procedure of hybridization; heterosis; mutation breeding- objectives and procedure; polyploidy breeding; role of asexual reproduction in plant propagation-apomixis, apospory, apogamy, parthenogesis, polyembryony

Unit II 9 hrs

Horticultural practices: Vegetative propagation- budding, grafting, layering; plant tissue culture- principle, procedure and applications; culture media, callus, organogenesis, somatic embryogenesis, hardening, synthetic seeds

Practicals **36 hrs**

1. Study the anatomy of plant structures (both primary and secondary) using micro

   preparations- stem, root and leaf of dicot and monocot
2. Anatomy of Bignonia stem after secondary thickening
3. Emasculation using a suitable flower
4. Budding, grafting and layering in garden plants

Students are expected to submit a laboratory record of their practical works duly certified by the Head of the Department of Botany or Teacher in Charge. Permission will not be granted to appear for the practical examination without the laboratory record.

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