

**SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV COLLEGE
FOR WOMEN (AUTONOMOUS)
CHENNAI - 600044
Re accredited with A+ Grade by NAAC**

MASTER OF PLANT BIOLOGY AND PLANT BIOTECHNOLOGY

(Shift – II- SFS)

Under the faculty of Science

(M.Sc. PBPBT)



CHOICE BASED CREDIT SYSTEM (CBCS)

OUTCOME BASED EDUCATION (OBE)

(Effective from the Academic Year 2020-21)

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RULES AND REGULATIONS

PG DEPARTMENT OF PLANT BIOLOGY & PLANT BIOTECHNOLOGY

Revised Syllabus of 2020 - 2021

(M. Sc. PBPBT)

OBJECTIVES OF THE COURSE:

- To provide an insight into the lower level organisms and whole Plant Kingdom by studying, exploring, understanding the importance of these organisms.
- To explore and create new methods by practical experience, scientific approach and research to grow and conserve the lower/higher level organisms and plants to create pollution free green Earth.
- To encourage the students for competitive examinations and decision making by enhancing their knowledge.
- To enable the students to pursue Master of Philosophy and Doctoral Research degree to work in colleges and Universities.

PG REGULATIONS

1. ELIGIBILITY FOR ADMISSION:

All candidates must have cleared their graduation in Plant Biology and Plant Biotechnology/Botany from a recognized educational institution in India.

2. ELIGIBILITY FOR THE AWARD OF DEGREE:

A candidate shall be eligible for the award of the Degree only if she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than two academic years, passed the examinations all the four-Semesters prescribed earning a minimum of 91 Credits (in Parts-I & II)

3. DURATION:

- a. Each academic year shall be divided into two semesters. The first academic year shall comprise the first and second semesters and the second academic year the third and fourth semesters.
- b. The odd semesters shall consist of the period from June to November of each year and the even semesters from December to April of each year. There shall be not less than 90 working days for each semester.

4. COURSE OF STUDY:

The main Subject of Study for Master Degree Courses shall consist of the following

PART – I CORE SUBJECTS, PROJECT/ELECTIVES

PART – II SOFT SKILLS & INTERNSHIP

1. Skill based subjects (Four) -
 - a) Teaching Skills
 - b) Research Skills
 - c) Soft Skill – SWAYAM COURSE (MOOC)
 - d) Soft Skill – SWAYAM COURSE (MOOC)

Recommended Credits Distribution: (Total should not be less than 91 Credits)

Course Type	No. of Papers	Credits / Paper	Credits
Core (Theory)	15	4	60
Core (Practical)			
Core (Project)			
Elective	5	3	15
Internship		2	2
Skill based courses	2	3	6
SWAYAM Courses	2	4	8
Total			91

5. ATTENDANCE

CATEGORY-A: ATTENDANCE REQUIREMENT

All candidates must put in 75% and above of attendance for Arts, Science, Commerce courses both UG/PG including MBA/MCA Degree courses for appearing the University Examination. (Theory/Practical)

CATEGORY –B: CONDONATION OF SHORTAGE OF ATTENDANCE

If a candidate fails to put in the minimum attendance (Percentage stipulated), the Principals shall condone the shortage of attendance up to a maximum limit of 10% (i.e. between 65% and above and less than 75%) for all UG/PG courses. (i.e. Arts Science, Commerce, MBA and MCA) after collecting the prescribed fee of RS.250/-each for Theory/Practical examination separately, (Theory Rs.250/- Per semester/Per Candidate: Practical Rs.250/- Per semester/ Per Candidate) towards the condonation of shortage of attendance.

CATEGORY-C: NOT ELIGIBLE FOR CONDONATION OF SHORTAGE OF ATTENDANCE

Candidates who have secured less than 65% but more than 50% of attendance are NOT ELIGIBLE for condonation of shortage of attendance and such candidates will not be permitted to appear for the regular examination, but will be allowed to proceed to the next year/next semester of the course and they may be permitted to take next University examination by paying the prescribed condonation fee of Rs.250/- each for Theory/Practical separately. Names of such candidates should be forwarded along with their attendance details in the prescribed format mentioning the category(3copies). Degree Wise/Year wise/Branch wise/semester wise/together with the fees collected from them. So as to enable them to get permission from the University and to attend the Theory/Practical examination subsequently without any difficulty.

CATEGORY-D: DETAINED STUDENTS FOR WANT OF ATTENDANCE

Candidate who have put in less than 50% of attendance have to repeat the course (by re-joining) for which they lack attendance without proceeding for II/III year as the case may be. Until they re-join the course and earn the required attendance for that particular semester/year, no candidates shall be permitted to proceed to the next year/next semester of the course under any circumstances. They have to obtain prior permission from the University to re-join the course.

Provided in case of candidates who are admitted form the academic year 2003 -2004 earning less than 50% of attendance in any one of the semesters due to any extraordinary circumstances such as medical ground, such candidates shall produce Medical Certificate issued by the authorized, Medical Attendant (AMA), duly certified by the Principal of the college shall be permitted to proceed to the next semester and to complete the course of study. Such candidates shall have to repeat the semester, which they have missed by re-joining after completion of final semester of the course, by paying the fee for the break of study ad prescribed by the University from time to time.

CATEGORY-E: CONDONATION OF SHORTAGE OF ATTENDANCE FOR MARRIED WOMEN STUDENTS

In respect of married women students undergoing UG/PG course, the minimum attendance for condonation (Theory/Practical) shall be relaxed and prescribed as 55% instead of 65% if they conceive during their academic career. Medical certificate from the Doctor attached to the Government Hospital (D.G.O) and the prescribed fee of Rs.250/- therefor together with the attendance details shall be forwarded to this office to consider the condonation of attendance mentioning the category.

0% Attendance

The candidates who have earned 0% of attendance, have to repeat the course (by re-joining) without proceeding to succeeding semester and they have to obtain prior permission from the University to re-join the course immediately for which applications issued for the academic year.

6. BREAK IN STUDY

After enrolling into any of the courses offered by the college a student is allowed to be absent continuously for period of FIVE years (Max. Condonable period- from the day of enrolment) after which she forfeits her admission.

A student who wants to continue her study within the condonable break period can rejoin in the same semester in the EXISTING VACANCY after getting the permission from the Principal and subsequently from University of Madras. Such students should also get a letter from the respective Head of the Department stating that she is not repeating any paper which she has already completed in other semesters.

7. TRANSFER OF STUDENTS AND CREDITS:

Transfer from other Autonomous or Non-Autonomous college or from other University is allowed for the same program with same nomenclature provided there is a vacancy in the respective program of study and the student has passed all the

examinations under the previous system. **Students with standing arrears are NOT eligible for transfer.**

The marks obtained in the previous system will be converted and grades will be assigned as per the University norms.

Such students **are eligible** for classification.

Such student is NOT eligible for ranking, prizing and medals on qualifying the PG degree.

8. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS

- 1) Candidate shall register their names for the First Semester Examination after the admission in the M.Sc. PBPBT Course.
- 2) Candidates shall be permitted to proceed from the first semester up to the final Semester irrespective of their failure in any of the Semester Examinations subject to the condition that the candidate should register for all arrear subjects of earlier semesters along with current (subject) semester subjects.
- 3) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed by the University/College.

9. PASSING REQUIREMENTS

1. There shall be no passing minimum for Internal. But 0 also should not be awarded. In case a student absents herself for all the CIA exams and ends in getting 0 in internal in a particular subject, she will be awarded 1 or 2 marks for attendance.
2. For all subjects (Theory/Practical/Project) the passing requirement is as follows:
 - i) candidate should secure not less than 50% of marks in End Semester

Examination (ESE) and not less than 50% in aggregate of the total internal and external marks.

3. A candidate who passes in all subjects earning 91 credits within the maximum period of four years reckoned from the date of admission to the course shall be declared to have qualified for the degree.
4. A student who fails in either Project work or Viva-voce shall be permitted to redo the project work for evaluation and re-appear for the Viva-voce on a subsequent occasion, if so recommended by the examiners.
5. Grading shall be based on overall marks obtained (Internal + External)

10. MEDIUM OF INSTRUCTION AND EXAMINATIONS

The medium of instruction and examinations for the papers of Part I & II shall be the language concerned. For part I subjects other than modern languages, the medium of instruction shall be either Tamil or English and the medium of examinations is in English/Tamil irrespective of the medium of instruction. For modern languages, the medium of instruction and examination will be in the languages concerned.

11. SUBMISSION OF RECORD NOTE BOOKS FOR PRACTICAL EXAMINATIONS

Candidates appearing for practical examinations should submit bonafide Record Note Books prescribed for practical examinations, otherwise the candidates will not be permitted to appear for the practical examinations.

12. CLASSIFICATION OF SUCCESSFUL CANDIDATES

1. A Candidate who qualifies for the Degree and secures CGPA between 9.0 – 10.0 shall be declared to have passed the examination in FIRST CLASS -

EXEMPLARY provided she has passed the examination in every subject she has registered as well as in the project work in the first appearance.

2. A Candidate who qualifies for the Degree and secures CGPA between 7.5 – 8.9 shall be declared to have passed the examination in FIRST CLASS WITH DISTINCTION provided she has passed the examination in every subject he/she has registered as well as in the project work in the first appearance.
3. A candidate who qualifies for the degree as per the regulations for passing requirements and secures CGPA between 6.0 – 7.4 shall be declared to have passed the examination in FIRST CLASS
4. A candidate who qualifies for the degree as per the regulations for passing requirements and secures CGPA between 5.0 –5.9 shall be declared to have passed the examination in SECOND CLASS
5. Only those candidates who have passed all the papers including practical and project work in the first appearance shall be considered for the purpose of RANKING.

13. RANKING

1. Candidates who pass all the examinations prescribed for the course in the first appearance itself alone are eligible for Ranking / Distinction.
2. Provided in the case of candidates who pass all the examinations prescribed for the course with a break in the First Appearance due to lack of attendance are only eligible for classification.

14. GRADING SYSTEM

The term grading system indicates a SEVEN (7) point scale of evaluation of the performance of students in terms of marks obtained in the Internal and External Examination, Grade points and letter grade.

Minimum Credits to be earned:

For TWO year PG Programme: Best 91 Credits (Part I: Major/Elective, Part –II: Soft skills)

Conversion of Marks to Grade Points and Letter Grade

(Performance in a Course / Paper)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
40-49	4.0-4.9	U	Re-appear
ABSENT	0.0	AAA	ABSENT

15. CLASSIFICATION & CALCULATION OF GPA AND CGPA

For a Semester:

GRADE POINT AVERAGE [GPA]

Sum of the multiplication of grade points by the credits of the courses

$$\text{GPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses in a semester}}$$

For the entire programme:

CUMULATIVE GRADE POINT AVERAGE [CGPA]

Sum of the multiplication of grade points by the credits of the courses

$$\text{CGPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses of the entire programme}}$$

CGPA	GRADE	CLASSIFICATION OF FINAL RESULT
9.5-10.0	O+	First Class - Exemplary *
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction *
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
0.0 and above but below 5.0	U	Re-appear

* The candidates who have passed in the first appearance and within the prescribed semester of the PG Programme (Major, Elective/Project and Non-Major Elective courses alone) / M.Phil. are eligible.

16. ESE REVALUATION

A student is eligible to appeal for revaluation of the paper only **if she secures a minimum of 10 in the internal tests (CAT) of that paper** if the internal maximum marks is 25 and **a minimum of 6 in the internal tests (CAT) of that paper** if the internal marks is 15. This has to be done within 10 days from the publication of results. She also has to pay the prescribed fee. The revaluation will be done by an external examiner appointed by the Principal.

17. ARREAR / REPEAT EXAMINATIONS

1. A candidate having arrear paper(s) shall have the option to appear along with the regular semester papers.

2. Candidates who fail in any of the papers in Part I & II of PG degree examinations shall complete the paper concerned within **four** years from the date of admission to the said course.

18. SUPPLEMENTARY / INSTANT EXAMINATION

1. Final year students (PG – II year 4th semester) are **only** eligible to apply for Supplementary / Instant Examination.
2. Students who have only one paper as arrear in the final semester are allowed to take up supplementary / instant examination.
3. Supplementary / Instant Examination will not be conducted for practical papers and projects.

19. CONCESSIONS FOR DIFFERENTLY-ABLED STUDENTS

1. Students who are mentally disabled, learning disability and mental retardation, who are slow learners, who are mentally impaired having learning disorder and seizure disorder and students who are spastic and cerebral palsy the following concessions shall be granted obtaining prior permission from the University
 - a. One-third of the time of paper may be given as extra time in the examination.
 - b. Leniency in overlooking spelling mistakes
2. Students who are visually challenged
 - a. Exempted from paying examination fees.
 - b. A scribe shall be arranged by the college and the scribe be paid as per the college decision.

20. MALPRACTICE

The College views malpractice of any kind very seriously. The college has a Malpractice committee consisting of four senior staff members. Students found to be directly or indirectly involved in malpractice of any kind during examinations will be subject to penalty of very high proportions.

21. MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMME TO QUALIFY FOR A DEGREE:

1. A student who for whatever reasons is not able to complete the programme within the normal period (N) or minimum duration prescribed for the programme, may be allowed **TWO** year period beyond the normal period to clear the backlog to be qualified for the degree. (Time span is $N + 2$ years for completion of the programme)
2. In exceptional cases like major accidents and child birth, an extension of **ONE** year be considered beyond maximum span of time that is **$N+2+1$** . Students qualifying during the extension period are **NOT** eligible for ranking.

23. REGULATORY BODIES

Under autonomy, the college is free to frame its curriculum and conduct examinations. These functions are monitored by the **Board of Studies, Board of Examiners and the Academic Council.**

Board of Studies

Separate Board of studies are constituted for each programme offered by a department. Each Board of Studies will meet at least once a year to design courses, modify syllabi / examination pattern and recommend the same to the Academic Council.

The Board of Studies is composed of:

- ◆ Head of the Department (Chair Person)
- ◆ A nominee of the University of Madras
- ◆ Two subject experts from other teaching institutions
- ◆ One representative from the Industry / Corporate sector / allied area relating to placement
- ◆ One meritorious alumnus
- ◆ The faculty of the department

The tenure of the external experts is for TWO years.

Board of Examiners

A list of board of examiners is obtained by circulating the details of courses offered by the college to other colleges and through the list provided by the departments.

Single valuation is done for UG courses and double valuation, one Internal and one External, for PG courses.

Academic Council

The Academic Council is composed of:

- ◆ The Principal (Chairman)
- ◆ All heads of the department in the college
- ◆ Four senior teachers of the college representing different categories of teaching
- ◆ Four representatives from the Industry / Corporate sector / allied area relating to placement / Commerce / Law / Education / Medicine / Engineering nominated by the Governing Body
- ◆ Three nominees of the University of Madras
- ◆ A faculty member nominated by the principal (Member Secretary)

The term of the nominated members shall be TWO years.

24. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Post graduates of various disciplines would be fully equipped:

- PEO 1: To hone their critical intelligence, professional behaviour and strive towards creative endeavour.
- PEO 2: To augment research and entrepreneurial skills supplemented with rich skills of communication, teamwork and leadership to excel in their profession.
- PEO 3: To imbibe a deep sense of rationality and in depth knowledge of the various contemporary issues that would elevate their comprehension in the global context.
- PEO 4: To pursue research and development in Life science.
- PEO 5: Secure jobs in the field of Education and in Institutes and Industries that require scientific thinking and critical problem solving skills.

25. PROGRAMME OUTCOMES (POs)

The Postgraduate students of all disciplines will be able to:

- **PO 1:** Identify and analyze the complex problems reaching substantiated conclusions using domain knowledge.
- **PO 2:** Apply investigative research, specialize in problem identification, formulate research design, utilize analytical tools, draw valid inferences and provide suggestions leading to nation building initiatives.
- **PO 3:** Strengthen professional ethics and career planning with systematic building of intrapersonal and interpersonal skills to participate in the intellectual diasporas.
- **PO 4:** Establish oneself as a self-reliant, empowered individual to have an inclusive, healthy and compassionate understanding towards life and society.
- **PO 5:** Equipped with technical/managerial expertise to innovate and critically analyze various attributes which constitute pivotal issues in a multidisciplinary scenario.
- **PO 6:** Emerge as innovators and pioneers to create new avenues of employment catering to the global trends as well as demands.

26. PROGRAMME SPECIFIC OUTCOMES (PSOs)

- **PSO 1:** To Gain an advanced knowledge on concepts in classical and modern Plant Biology and Plant Biotechnology/Botany.
- **PSO 2:** To learn and provide an insight into the whole Plant Kingdom by studying some of the organism's morphology, Biochemistry, Physiology, Genetics, Molecular biology and Genetic Engineering, Plant Tissue culture and biotechnology through theory, practical classes, study trips, seminars and workshops.
- **PSO 3:** To experience and analyze the importance of these organisms experimentally by using various technological aspects to customize products for the benefit of human kind.
- **PSO 4:** To develop and utilize contextual and experimental knowledge for scientific thinking and innovation through research and development.
- **PSO 5:** To Exhibit competencies to take up careers in Plant Biology and Biotechnological / Botany and allied fields.

27. QUESTION PAPER PATTERN:

QUESTION PAPER PATTERN FOR OBE (2020-21 onwards)

Theory

UG/PG –Question paper Pattern- conventional on- paper mode

Bloom's Category Level	Sections	Marks	Word limit	Total	Meaning of K's
K1, K2	Multiple Choice Questions 15 questions * 2	30	Correct choice	75	K 1 & K2 - Understanding Level K 3 - Apply Level K 4 - Analyze Level K 5 – Evaluate Level K 6 – Create Level
K3, K4	Section B 5 Questions out of 7 questions *5 Marks	25	Short answers {approx. 500 Words)		
K4, K5,k6	Section C 1 out of 3 Questions *10 Marks + Compulsory Question 10 Marks	20	Elaborate answers (approx. 1000 Words)		

*** 75 marks to be converted as 60 marks.**

**PG QUESTION PAPER PATTERN FOR
OBE ONLINE ASSESSEMENT (2020 - 2021)**

Bloom's Category Level	Sections	Marks	Description of answer	Total	Meaning of K's		
INTERNAL SETTING							
K1,K2,K3	Section A Multiple Choice Questions 25 Questions *1 Marks (No Choice)	25X1=25	Choose the right option.	50	K 1 & K2 - Understanding Level K 3 - Apply Level K 4 - Analyze Level K 5 – Evaluate Level K 6 – Create Level		
EXTERNAL SETTING							
K2,k3,K4, K5,K6	Section B 5 out of 7 Questions *5 Marks	25	Short answers/500 Words				

*** 50 marks to be converted as 60 marks.**

BLOOM'S CATEGORY LEVEL (ANNEXURE chart)

S.no	K component scale	Verbs for question
I.	K 1& K2 Verbs	Verbs to be used for questioning are “choose, find, identify, indicate, match, name, state, what, when, where, which, who, cite, label, reproduce. define, list, quote, revise, explain, show, sketch, illustrate, interpret, describe, substitute, convert, give example, rephrase
2.	K2 &k3	The questions may contain the verbs such as explain, show, sketch, illustrate, interpret, describe, substitute, convert, examFle, rephrase, apply, relate, solve, classify, predict, compute, prepare
3.	K4	The questions may contain verbs - Apply, relate, solve, classify, predict, compute, prepare.
4.	K5	The questions may contain any of the following verbs : Ascertain, diagnose, distinguish, infer, associate, examine, differentiate, reduce, discriminate, dissect, determine, justify, organize, recommend, solve.
5	K6	The questions may contain any of the following verbs: Appraise, conclude, critique, judge, assess, contrast, deduce, weigh. Compare, criticize, evaluate.

Question paper pattern for Continuous Assessment Test (CAT)

(The online assessment pattern)

P.G PROGRAMME

SHRIMATHI DEVKUNVAR NANALAL BHATT VAISHNAV

COLLEGE FOR WOMEN

M.SC. DEGREE EXAMINATION,

PG DEPARTMENT OF PLANT BIOLOGY AND PLANT BIOTECHNOLOGY

2020-21 YEAR,

I/II/III/IV SEMESTER

CAT – I/II/III

Sub Title:

Max. Marks: 50

Sub Code:

Date:

Time: 2hrs.

Question paper Pattern-Two Components: (Max marks=50) - 3hrs

I. Multiple Choice Questions (MCQ) - 20 marks (10x2=20)

II. Google Class Room (GCR) - 30 marks (Structured)

A. Section A: 5 out of 6 – each carries 2 marks (5x2=10)

B. Section B: 4 out of 5 – each carries 5 marks (4x5=20)

- The answers for the questions for QP uploaded in GCR will be as uploads (images of hand written answer sheets converted to pdf) in Google Class Room.
- The duration for each GCR session (answering and uploading) would be 3 hours (maximum).
- The structured component (30 marks) SHOULD be conducted in GCR as per the CAT schedule. MCQ (10X2=20) CAN be conducted out of schedule also, but should be completed during the CAT examination scheduled.

Note: The GCR question paper and MCQ assessment links to be shared with the COE office for approval and validity on or before the respective allotted dates.

COURSE PROGRAMME PROFILE

M.SC. PLANT BIOLOGY AND PLANT BIOTECHNOLOGY

TOTAL CREDITS: 91

TOTAL TEACHING HRS: 450

PART	COURSE	TITLE OF THE PAPER	CODE	L	T	H	C
I SEMESTER							
I	Core Theory I	Algae, Fungi, Microbiology	20PPBCT1001	4	2	6	4
I	Core Theory II	Bryophytes, Pteridophytes, Gymnosperms and Paleobotany	20PPBCT1002	4	2	6	4
I	Elective I	Plant Pathology	20PPBET1001	4	1	5	3
I	Elective II	Applications of Algae	20PPBET1002	4	1	5	3
I	Major Practical I	Algae, Fungi, Microbiology, Bryophytes, Pteridophytes, Gymnosperms and Paleobotany	20PPBCP1001	3	1	4	4
II	Skill based elective	Teaching Skills	18PSSTS1001	2		2	3
Total						28	21
II SEMESTER							
I	Core Theory III	Plant Anatomy, Embryology, Palynology	16PPBCT2003	4	2	6	4
I	Core Theory IV	Taxonomy of Angiosperms and Economic Botany	16PPBCT2A04	4	2	6	4
I	Core Theory V	Cell Biology	16PPBCT2A05	5	1	6	4
I	Elective III	Molecular biology and Genetic Engineering	16PPBCE2003	4	1	5	3
I	Major Practical II	Plant Anatomy, Embryology, Palynology, Taxonomy of Angiosperms, Economic Botany, and Cell Biology	13PPBCP2002	3	1	4	4

II	Soft Skills	SWAYAM (MOOC) NPTEL	18MOOC2002	2		2	4
		Total				29	23
III SEMESTER							
I	Core Theory VI	Genetics, Plant Breeding and Evolution	16PPBCT3006	4	2	6	4
I	Core Theory VII	Ecology and Phytogeography	13PPBCT3A07	4	2	6	4
I	Core Theory VII	Plant Tissue Culture	13PPBCT3A08	4	2	6	4
I	Elective IV	Bioinstrumentation and Bioinformatics	16PPBCE3A04	4	2	5	3
I	Major Practical III	Genetics, Plant Breeding and Evolution, Plant Tissue Culture, Ecology and Phytogeography	13PPBCP3003	3	2	4	4
II		Research Skills	18PSSRS3003	2		2	3
II		Internship	17PPBIP3001	-			2
		Total				29	24
IV SEMESTER							
I	Core Theory IX	Plant Biotechnology	16PPBCT4009	4	2	6	4
I	Core Theory X	Plant Physiology and Biochemistry	13PPBCT4010	2	2	6	4
I	Elective V	Pharmacognosy	14PPBCP4A05	4	1	5	3
I	Major Practical IV	Plant Biotechnology, Plant Physiology and Biochemistry	13PPBCP4004	2	2	4	4
I		PROJECT	13PPBPR4001	1	5	6	4
II	Extra Disciplinary	SWAYAM (MOOC)	18MOOC4004	2	2	4	4
		Total				31	23

L = Lecture Hrs; T = Tutorial Hrs; H = Hrs/week; C = Credits

RUBRICS FOR CONTINUOUS ASSESSMENT

Assignment	5 Marks
Seminar	5 Marks
Field visit	Yes
Participatory Learning	Yes
Group Discussion	Yes
Flipped/Blended Learning	Yes

Assessment Model (from 2020 – 21 onwards)
Post graduation programme
40% Internal 60% External

S.No	Assessment Component	Marks	Weighted %
A.	Theory		
1	INTERNAL ASSESSMENTS		
	Continuous Assessment Test(best two out of three)	2 x 50 = 100	15
2	Quiz/Group Discussion/Seminar/Assignment/Role Play/ Case Study/ Open Book/ snap Test/ Video Presentation/ Review (any three to be considered)	3 x 10 = 30	15
3	MCQ (one test to be conducted online during the semester)	20	10
4	EXTERNAL ASSESSMENT		
	End semester examinations	75	60
	Grand Total		100

B	Practical		
1	INTERNAL ASSESSMENTS		
	Continuous Assessment Test(best two out of three)	2 x 50 = 100	15
2	Record + Observation	10 +10 = 20	15
3	MCQ (one test to be conducted online during the semester)	20	10
4	EXTERNAL ASSESSMENT		
	End semester Examinations	60	60
	Grand Total		100

**DEPARTMENT OF M. SC. PBPBT
SDNB VAISHNAV COLLEGE FOR WOMEN**

(AUTONOMOUS)

CHENNAI-600044

PG DEPARTMENT OF PLANT BIOLOGY & PLANT IOTECHNOLOGY

COURSE FRAME WORK

SEMESTER I

S E M	COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS/ W	CR ED IT S	C A	SE	T
I	CORE I 20PPBCT1001	Core Theory I	Algae, Fungi, Microbiology	6	4	40	60	100
I	CORE II 20PPBCT1002	Core Theory II	Bryophytes, Pteridophytes, Gymnosperms and Paleobotany	6	4	40	60	100
I	ELECTIVE I 20PPBET1001	Elective I	Plant Pathology	5	3	40	60	100
I	ELECTIVE II 20PPBET1002	Elective II	Applications of Algae	5	3	40	60	100
I	PRACTICAL I 20PPBCP1001	Major Practical I	Algae, Fungi, Microbiology, Bryophytes, Pteridophytes, Gymnosperms and Paleobotany	4	4	40	60	100
I	Skill based elective 18PSSTS1001		TEACHING SKILLS	2	3	50	-	50
			TOTAL	28	21			

SEMESTER I
CORE THEORY I
ALGAE, FUNGI AND MICROBIOLOGY

TOTAL HOURS: 90

SUB CODE: 20PPBCT1001

CREDIT: 4

L-T-P: 5-1-1

COURSE OBJECTIVES:

1. To provide an insight into Algae, Fungi, Bacteria and Virus classification and morphology and Life cycle.
2. To know the importance of these organisms and develop scientific thinking through research and innovation for the benefit of mankind.
3. To acquire position/secure jobs in various fields of research and industries and will be able to provide training or employment for rural sector in cultivation of algae, fungi and mushroom.

COURSE OUTCOMES: on completion of the course the students will be able to

CO No.	CO Statement
CO1	To impart knowledge on classification of algae, Pigments, Flagella, Reserve food materials, Life cycle and contribution of Algologists.
CO2	To elucidate and enlighten general characteristics and Life cycle of selected algae.
CO3	To learn and understand classification of Fungi, the concept of heterothallism, sexuality, mushroom cultivation and importance of Fungi.
CO4	To explain and study the structure, reproduction and Life cycle of selected Fungi.
CO5	To classify, identify, isolate and purify the bacterial cultures for their economic importance and to learn the classification, morphology of plant viruses.

SYLLABUS ALGAE, FUNGI AND MICROBIOLOGY

Unit I 15 Hrs

Algae: Classification (F.E. Fritsch, 1945). Recent advancements in classification of algae. Contribution of Indian algologists. Pigments, Flagella, Reserve food materials, Reproduction and Life cycles in algae.

Unit II 25 Hrs

General characteristics of **Cyanophyceae, Chlorophyceae, Phaeophyceae, Bacillariophyceae, Rhodophyceae.**

Structure, reproduction, life cycle of following genera:

- Cyanophyceae** – *Lyngbya.*
- Chlorophyceae** – *Hydrodictyon, Cladophora, Chara.*
- Phaeophyceae** – *Dictyota, Padina.*
- Bacillariophyceae** – *Navicula.*
- Rhodophyceae** – *Polysiphonia, Gracilaria.*

Unit III 10 Hrs

Fungi: Classification (Ainsworth), Recent advancement in classification. Heterothallism – Sexuality, Parasexuality – Sex hormones, Mushroom cultivation, Economic importance of fungi.

UNIT IV 25 Hrs

Structure, reproduction & Life cycle of the following genera:

- Myxomycotina – *Plasmodiophora.*
- Mastigomycotina – *Saprolegnia.*
- Zygomycotina – *Rhizopus.*
- Ascomycotina – *Agaricus.*
- Basidiomycotina – *Puccinia.*
- Deuteromycotina – *Colletotrichum.*

Unit V 15 Hrs

Microbiology: Classification (Bergey's Manual, 1984) and identification of microorganism. **Microorganisms** - Bacteria: Morphology and fine structure of Bacteria – Culturing of Bacteria – Reproduction and Growth – Pure cultures and Cultural characteristics of Bacteria – Gram-Negative, Gram-Positive, Economic importance of bacteria. Virus- classification of plant virus, morphology and multiplication of plant viruses.

TEXT BOOKS:

- The Algae World. 2015. Editors: **Sahoo**, Dinabandhu, **Seckbach**, Joseph (Eds.) Springer Netherlands.
- Tortora, Case and Funke. 2000. Microbiology. Benjamin-Cummings Pub. Co.
- Alcamo. 2000. Fundamental of Microbiology, Jones and Barlett. Pub.
- Sambamurty, 2005. A Textbook of Algae, I. K International Publishing House.

BOOKS FOR REFERENCE:

- [Linda E. Graham](#), [James M. Graham](#), [Lee Warren Wilcox](#), 2009. Algae. Publisher Benjamin Cummings.
- [Robert A. Andersen](#) 2011. Algal Culturing Techniques, [Elsevier Science Publishing Co Inc.](#)
- Tortora, B.R. Funke, C.L. Case. 2004. Microbiology An Introduction. Pearson Education (Singapore) P. Ltd., Indian Branch, New Delhi.
- Carole Caranta, Miguel A. Aranda, Mark Tepfer and J.J. Lopez-Moya. 2011. Recent Advances in Plant Virology. Caister Academic Press.

E-LEARNING RESOURCES:

- www.algalweb.net/algweb2.html
- [Algae Research, Royal Botanic Garden Edinburgh](#)
- [ADIAC Diatom Image Database](#)
- [Algaevision](#) (UK Algal Image Database, Natural History Museum: images to accompany *The Algal Flora of the British Isles*: does not include diatoms)
- [British Phycological Society](#)

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	3	1
CO 2	3	3	3	2	3
CO 3	2	2	3	2	3
CO 4	3	2	3	3	3
CO 5	3	3	3	3	3
Average	2.8	2.6	2.8	2.6	2.6

KEY: PEDAGOGY (TEACHING METHODOLOGY): Lecture, Power point presentation/Seminar, Exercises and discussions (group and individual), Field Trips, Rapid fire question session, brain storming.

SEMESTER I
CORE THEORY II
BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND
PALEOBOTANY

TOTAL HOURS: 90

SUB CODE: 08PPBCT1002

CREDIT: 4

L-T-P: 4 – 1- 1

COURSE OBJECTIVES

1. To impart knowledge on structure of Bryophytes, Pteridophytes and Gymnosperms
2. To understand the mode of reproduction in Bryophytes, Pteridophytes and Gymnosperms
3. To gain knowledge on Fossilization and fossil forms

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	To explain the General characters and recent trends in Classification of Bryophytes, Pteridophytes and Gymnosperms
CO2	To discuss the Structural organization and evolution of Gametophytes and Sporophytes in lower forms like Bryophytes, Pteridophytes and Gymnosperms
CO3	To learn the Stellar evolution, Concepts of Evolution and Fossilization
CO4	To acquire knowledge on Morphology, reproduction, Life cycle and uses of some forms of Bryophytes, Pteridophytes and Gymnosperms
CO5	To create awareness about the contributions of Paleobotanists and some fossil forms.

SYLLABUS
BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND
PALEOBOTANY

Unit I **20 Hrs**

Bryophytes: General characters and recent trends in Classification by Crandall – Stoller and Stotler (2000), Structural organization and evolution of Gametophytes and Sporophytes, Economic importance of Bryophytes. Structure, Reproduction and Life cycle of the following genera: *Lunularia, Anthoceros, Funaria*.

Unit II **15 Hrs**

Pteridophytes: General characters and recent trends in Classification by Smith *et al.* (2006). Apospory, Apogamy, Heterospory and Stellar Evolution.

Unit III **20 Hrs**

Structure, Reproduction and Life cycle of the following genera: *Psilotum, Selaginella, Angiopteris, Adiantum, Pteris*.

Unit IV **20 Hrs**

Gymnosperms: General characteristics and Classification by K.R. Sporne (1965). Economic importance of Gymnosperms. Structure, Reproduction and life cycle of *Zamia, Araucaria, Cupressus, Ephedra*.

Unit V **15 Hrs**

Paleobotany: Gondwana Flora of India. Contributions of Birbal Sahni to Paleobotany. Study of fossils in understanding evolution. Study of fossil genera: *Sphenophyllum, Cordaites*.

Text books:

GEORGE, P. 2008. Introduction to Paleobotany, Neha Publishers & Distributors.

SAMBAMURTY, A.V. S. S. 2010. Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany

SHARMA, O. P. 2012. Diversity of Microbes and Cryptograms - Pteridophyta, Tata Mc – Graw Hill, New Delhi.

KUMAR, S. S. 2015. Textbook on Gymnosperms. Campus Books International.

BHATNAGAR, S. P. 2020. Gymnosperms, New Age International (P) Ltd., Publishers

Books for Reference:

SPORNE, K. R. 1974. The Morphology of Gymnosperms. B. I. Publications. New Delhi. C

SPORNE, K. R. 1976. The Morphology of Pteridophytes. B.I. Publications. New Delhi

STEWART. W. N. 1983. Paleobotany and the Evolution of Plants. Cambridge University Press, California.

HOPRA, R. N and P. K. KUMAR. 1988. Biology of Bryophytes. John Wiley. New York

POORTEN, A. V and B. GODDINET, 2009. Introduction to Bryophytes, Cambridge University Press.

E – Learning Resources

www.biologydiscussion.org

www.sciencedirect.com

ucmp.berkeley.edu

www.easybiologyclass.com

virtualpaleontologist.weebly.com

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	1	2	2	2
CO2	2	3	1	3	3
CO3	2	3	1	3	3
CO4	2	3	1	3	2
CO5	2	2	2	2	3
Average	2.2	2.4	1.4	2.6	2.6

Key: PEDAGOGY: Lecture, Power point presentation, Exercises and discussions (group and individual), Rapid fire question session.

SEMESTER I
CORE ELECTIVE PAPER I
PLANT PATHOLOGY

TOTAL HOURS: 75 Hrs

SUB CODE: 20PPBET1001

CREDITS: 3

L-T-P: 4-1-0

COURSE OBJECTIVES

1. To introduce basic principles, scope, significance and concepts of plant pathology
2. To impart knowledge of major plant diseases.
3. To understand molecular approach towards detection and diagnosis of plant disease and their management.
4. To study genetics of plant disease.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	Understand the scope and significance of plant pathology.
CO2	Explain the concept of diseases of crop plants, causal agents of plant diseases, disease cycle, and management of crop diseases.
CO3	Analyze the sign and symptoms of common plant diseases and device control measures in plant disease management.
CO4	Explain the process of host- parasite interaction.
CO5	Use various molecular methods to analyze the diseased plant samples in the laboratory for detection of plant pathogens.

SYLLABUS

PLANT PATHOLOGY

Unit I

15 Hrs

Scope and Significance of Plant pathology - Classification of plant diseases - Koch's postulates – A study of principles of plant infection – Inoculum potential – Infection and dissemination of pathogens.

Unit II

15 Hrs

Important diseases of crop plants in India - Bacterial blight of Rice, Wilt of cotton, Late blight of Potato, Red rot of sugar cane and TMV. Plant disease control - physical, chemical, integrated and biological.

Unit III

15 Hrs

Host-parasite interactions (Physiology of parasitism): Pathogenesis or Disease development, Plant-Parasite Relationship. Role of enzymes and toxins in disease development. Host Defense mechanisms: Structural and Biochemical defense.

Unit IV

15 Hrs

Genetics of plant disease: Disease Resistance – Genetics of virulence and resistance, Gene- for-gene concept, Techniques in plant breeding for disease resistance. Genetics of Host- parasite interaction – mutation, heterokaryosis, parasexual recombination.

Unit V

15 Hrs

Molecular Plant Pathology: Detection of pathogens in host tissues - ELISA and PCR- Incorporation of resistant gene by different methods (direct and indirect).

TEXT BOOKS:

Dube HC. 2018. Modern Plant Pathology. Agrobios (India

Singh.RS. 2017.Plant Diseases.Medtech Publisher.

Vidyasekharan.P. 2014. Principles of Plant Pathology. CBS Publishers & Distributors.

Ashok Aggarwal and Mehrotra RS. 2013. Fundamentals of Plant Pathology. McGraw- Hill Education (India) Private Limited .New Delhi.

George. N. Agrios. 2005. Plant Pathology. Academic Press San Diego, CA.

BOOKS FOR REFERENCES:

Kimatu J.N. 2018. Advances in Plant Pathology. Intech open limited.

Chaube. H.S.and Pundhir V.S. 2005. Crop Diseases and their Management. PHI Learning Pvt. Ltd.

[Sharma](#).P.D. 2004. Plant Pathology. Rasthogi publications.

Richard N Strange 2003 Introduction to Plant Pathology John Wiley & Sons Ltd.

Pandey B. P.2001. Plant Pathology. S. Chand Ltd.

E-LEARNING RESOURCES:

<http://www.apsnet.org/publications/commonnames/Pages/default.aspx>

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

<https://www.britannica.com/science/red-rot>

<http://agri.nv.gov/Plant-Industry/>

<http://plantpathologynews.com/index.htm>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	1	3	3	3
CO 2	1	1	3	3	3
CO 3	1	1	2	3	3
CO 4	1	1	2	2	2
CO 5	1	1	3	3	3
Average	1	1	2.6	2.8	2.8

KEY: PEDAGOGY (TEACHING METHODOLOGY):

Lecture, Power point presentation, Exercises (group and individual).

SEMESTER I
CORE ELECTIVE II
APPLICATIONS OF ALGAE

TOTAL HOURS: 75

SUB CODE: 16PPBCE1002

CREDITS: 3

L-T-P: 4-1-0

Course Objectives:

- 1 Learn the cultivation technique of macro and micro algae and to apply their knowledge for empowerment sector.
- 2 To identify the various forms for phycoremediation.
- 3 Provides an insight into applications of algae.

Course outcomes:

On successful completion of the course, the students will be able to:

CO No.	CO Statement
CO1	understand the historical perspective of use of algae for human needs for Nutraceuticals, biofertilizers and or aquaculture.
CO2	know the Chemical constituent of Single Cell Protein (SCP) viz., <i>Spirulina</i> and <i>Chlorella</i> and other forms for biodiesel production.
CO3	evaluate the significance and utilize them for industrial purposes for extraction and uses of agar-agar, carrageenan and alginic acid.
CO4	synthesis Liquid seaweed Fertilizers (LSF).
CO5	apply them in Nanotechnological field. Identify aquatic pollution and apply them for phycoremediation.

SYLLABUS

APPLICATIONS OF ALGAE

Unit I

15 Hrs

Historical perspective of use of algae for human needs; algae as Nutraceuticals; Chemical constituent of *Spirulina*, its vitamin and mineral content; chemical constituent of *Chlorella*. Biofertilizers; Structure and functions of heterocysts; Significance of using bluegreen algal fertilizers, Role of algae in Aquaculture.

Unit II

15 Hrs

Industrial uses of algae: Structure, source, extraction and uses of agar-agar, carrageenan and alginic acid. Liquid seaweed fertilizers – preparation, composition and uses.

Unit III

15 Hrs

Cultivation of macroalgae: Macro-algal cultivation in India: Rope cultivation, net cultivation and raft cultivation. Immobilization, genetic engineering and applications of Genetic Engineering in algae. National laboratories involved in marine algal cultivation.

Unit IV

15 Hrs

Mass cultivation of microalgae: Mass culture of *Spirulina* and *Haematococcus*. Composition of medium, techniques involved in their culture and harvest, Indian centers cultivating microalgae.

Unit V

15 Hrs

Importance of algae: in fisheries, parasitic algae, algae in medicine, Therapeutic uses of algae and Role of algae in Nanotechnology. Aquatic pollution – causes and consequences. Algae as pollution indicator and Phycoremediation.

Text Books:

1. Vashishta B.R and Sinha A.K.. 2008. *Algae*. . S.Chand and Co. Ltd., New Delhi
2. SAMBAMURTHY A.V.S.S. 2005. *A Text book of Algae*. I. K International Pvt. Ltd.
3. Lee R.E. 2008. *Phycology* (4th edition). Cambridge University press.
4. VASISHTA B.R., A.K. Sinha & V.P. Singh. 2010. *Algae*.S.Chand &Co Ltd.
5. SHARMA O.P. 2011. *Algae*. Tata McGraw Hill Co.

Books for Reference:

- 1 SOUTH, G.R., AND A. WHITTICK. 1987. *Introduction to Phycology*. Blackwell Scientific Publications. Oxford.
- 2 PARKER, S.P,(Ed.). 1982. *Synopsis and Classification of Living Organisms*. McGraw-Hill Book Company. New York.
- 3 LOBBAN, C.S., AND M.J. WYNNE (Eds.). 1981. *The Biology of Seaweeds*. Blackwell Scientific Publications. Oxford.
- 4 Chapman V.J and Chapman P.J, 1973. *The algae*. Mac Milan 2nd Edition, Newyork.
- 5 FRITSCH, F.E. 1945. *Structure and Reproduction of Algae*. Vol.II. CambridgeUniversity Press. Cambridge, updated.

E-learning resources:

www.agrifarming.in

www.agrifarming.in/tag/spirulina-algae-cultivation-in-india

www.zintro.com/area/algae-cultivation-in-india

www.indiamart.com/advancedbiofuelcenter/algae-fuel.html

<http://www.psaalgae.org>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	2	2
CO2	3	3	2	3	3
CO3	3	3	3	3	3
CO4	2	3	3	3	3
CO5	3	2	3	3	3
Average	2.8	2.8	2.8	2.8	2.8

KEY: PEDAGOGY :

Lecture, Power point presentation, Exercises (group and individual), Field and Industrial trips.

SEMESTER I

PRACTICAL I

(Covering Paper I & II)

TOTAL HOURS: 30

SUBCODE: 20PPBCP1001

CREDIT: 4

L-T-P: 1 – 1- 2

COURSE OBJECTIVES

Understand the diversity of Bacteria and Virus.

Create an interest in the identification of Algae and Fungi

Learn the systematic position and morphology of Bryophytes, Pteridohytes and Gymnosperms

Know the evolution of Bryophytes and Pteridophytes and Gymnosperms.

Realize the applied aspects of Paleobotany.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	Apply the knowledge in identifying Bacteria and Virus.
CO2	Understand the identification of Algae and Fungi
CO3	Learn the Life cycle of Bryophytes, Pteridohytes and Gymnosperms.
CO4	Know the evolutionary trends and affinities of living gymnosperms with respect to external and internal features
CO5	Understand the various fossil genera representing different fossil groups.

SYLLABUS **(Covering papers I and II)**

ALGAE:

1. Study of morphological & anatomical structures of genera mentioned in the theory.
2. Algal mixture – Identification.

Spotters

3. Ocular Micrometer.
4. Camera Lucida.
5. A study tour for Algal collection (Collection of not less than 5 specimens for submission)

FUNGI:

1. Study of Morphological & Reproductive structures of genera mentioned in the theory.
2. Protocol for Mushroom cultivation.

MICROBIOLOGY:

1. Preparation of media.
2. Isolation and Enumeration of microorganisms from the given soil, air and water samples.
3. Pure culture of bacteria and fungi.
4. Bacterial staining (Gram staining).

BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY:

Morphological, Anatomical and Reproductive study of genera mentioned in the theory.

Bryophytes - Lunularia, Anthoceros, Funaria.

Pteridophytes - Psilotum, Selaginella, Angiopteris, Adiantum, Pteris.

Gymnosperms – Zamia, Araucaria, Cupressus, Ephedra,

Paleobotany - Sphenophyllum, Cordaites

Text books:

Pelczar et al. 2011. Microbiology, 8th edition, Tata McGraw-Hill Co, New Delhi.

Vashistha, P.C., Sinha, A.K., Kumar, A. 2010. Pteridophyta, S. Chand. New Delhi, India.

Rajan, S. S. 2002. Practical Manual of Algae Paperback , Anmol Publication.

Khan, M. G., Gatew, S., Bekele, B. 2012. Practical Manual for Bryophytes and

Pteridophytes: Practical Manual Paperback – Illustrated, Lambert, Academic Publishing.

King, A. M. Q. 2011. Virus Taxonomy: Ninth Report of the International Committee on Taxonomy of Viruses, Elsevier Inc.

Books for Reference:

- Willey, Sherwood and Christopher. Laboratory exercises in Microbiology. McGrawHill, India. 9th edition.
- Van Griensven, L. J. L. D. 2000. Science and cultivation of edible Mushrooms, A. A. Balkema, Netherlands
- Acharya, B. S. 2017. Archegoniate. Kalyanii Publishers, New Delhi.
- Taylor, L. 2009. Paleobotany, Academic press.
- J. W. Byng. 2015. The Gymnosperms Handbook: A practical guide to extant families and genera of the world, Plant Gateway Ltd.

E – Learning Resources:

<https://www.itseyeris.com/book/paleobotany/>

https://www.geobotany.uaf.edu/teaching/plant_keys/bryophytes

[http://sfrc.ifas.ufl.edu/syllabi/fas4932_Algae_Biology_Ecology.](http://sfrc.ifas.ufl.edu/syllabi/fas4932_Algae_Biology_Ecology)

<https://www.ers-education.org/home/>

<https://www.easybiologyclass.com/killing-and-fixation-microtechnique-lecture-notes/>

Mapping of CO with PSO:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	2	3	3
CO4	2	2	3	3	3
CO5	2	2	3	3	2
Average	2.6	2.6	2.8	3	2.8

Key: PEDAGOGY (Teaching methodology to be adopted for the classroom instructional hours)

Lecture, Power point presentation, Exercises and discussions (group and individual), Rapid fire question session.

COURSE FRAME WORK**SEMESTER II**

S E M	COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS/ W	CR EDI TS	CA	SE	T
II	CORE III	Core Theory III	Plant Anatomy, Embryology, Palynology	6	4	40	60	100
II	CORE IV	Core Theory IV	Taxonomy of Angiosperms and Economic Botany	6	4	40	60	100
II	CORE V	Core Theory V	Cell Biology	6	4	40	60	100
II	ELECTIVE III	Elective III	Molecular biology and Genetic Engineering	5	3	40	60	100
II	PRACTICAL II	Major Practical II	Plant Anatomy, Embryology, Palynology, Taxonomy of Angiosperms, Economic Botany, and Cell Biology	4	4	40	60	100
II	Soft Skills 18MOOC2002		SWAYAM (MOOC)	2	4	50	-	50
			TOTAL	29	23			

SEMESTER II
CORE THEORY III

PLANT ANATOMY, EMBRYOLOGY AND PALYNOLOGY

TOTAL HOURS: 90 Hrs

SUB CODE: 16PPBCT2003

CREDIT: 4

L-T-P: 4-1-1

COURSE OBJECTIVE:

1. To understand various tissue systems in plants and its organization in plant organs.
2. To impart knowledge on the structure and process of pollination and fertilization in angiosperms.
3. To understand pollen architecture and aeropalynology.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	To identify plant materials, woods, etc., and perform the techniques in plant anatomy.
CO2	To explain the evolutionary concept of organization of shoot and root apex.
CO3	To discuss self-incompatibility in pollination and fertilization.
CO4	To relate between embryo, endosperm and seed.
CO5	To analyse and identify pollens in environment.

SYLLABUS

PLANT ANATOMY, EMBRYOLOGY AND PALYNOLOGY

UNIT I 20 Hrs

Organization & theories regarding shoot (Apical cell theory, Tunica corpus theory, Histogen theory), Root (Histogen, Korper-Kappe theory) and reproductive meristems (Tunica corpus, Mantle and Core). Meristems and Differentiation: Meristems and Matured tissues. Classification of meristems, Growth patterns and differentiation in meristems.

UNIT II 18 Hrs

Vascular cambium - Structure & Significance of storied & non-storied cambium. Factors affecting cambial activity.

Xylem: Differentiation, xylary elements – maceration technique-tracheids, vessels, fibre and parenchyma. Patterns of secondary wall. Tyloses; reaction wood, heart wood and sap wood, Growth rings.

Phloem: Primary and secondary elements – ontogeny – differentiation. Structural variation, characteristics of phloem components.

UNIT III 17 Hrs

Nodal anatomy: Leaf traces and leaf gaps. Branch traces and branch gaps, closing of leaf gaps. Stele system – Types of stele. Floral anatomy – Structure, arrangement of floral parts, vascular system, petal, sepal, stamen, pollen, carpel and ovule. Organogenesis and histogenesis.

UNIT IV 20 Hrs

Embryology: Microsporogenesis and Megasporogenesis – Structure, Process of fertilization in Angiosperms, Embryo sac – Structure and types, Types of endosperm and Polyembryony.

Self-incompatibility, Genetic basis of self-incompatibility, Barriers to fertilization, Significance of self - incompatibility, Methods to overcome incompatibility.

UNIT V 15 Hrs

Palynology: Pollen architecture, Pollen transfer, Pollen – pistil interaction. Methods of pollination. Aeropalynology – pollen allergy, palynological calendars, pollen analysis of honey.

TEXT BOOKS:

Bhojwani, S.S. and Bhatnagar, S.P. 2011. The Embryology of Angiosperms, Vikas Publishing House. Delhi.

Evert, R.F. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

Shivanna, K.R. 2003. Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.

Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA.

Johri, B.M. 1984. Embryology of Angiosperms, Springer-Verlag, Netherlands.

BOOKS FOR REFERENCE:

Raghavan, V. 2000. Developmental Biology of Flowering plants, Springer, Netherlands

Pandey, A.K. 1997. Introduction to Embryology of Angiosperms. CBS Publishers & Distributors, New Delhi

Maheswari.P 1991: An Introduction to Embryology of Angiosperms.Tata- McGraw hill Publishing Co .Ltd.

Esau,K. 1985. Anatomy of seed plants-John Willey.

Fahn 1979. Plant Anatomy Academic press

E- LEARNING RESOURCES:

<https://cms.botany.org/media/collection/id.24.html>

https://www.researchgate.net/publication/330727536_Plant_Embryology_and_Experimental_Biology

<https://www.nature.com/subjects/plant-embryogenesis>

<https://www.floridamuseum.ufl.edu/paleobotany/palynology/>

<https://www.tandfonline.com/toc/tpal20/current>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	1	1	2	3	3
CO 2	1	1	1	2	3
CO 3	1	1	2	2	2
CO 4	1	2	2	3	3
CO 5	1	1	3	3	3
Average	1	1.2	2	2.6	2.8

KEY: PEDAGOGY (TEACHING METHODOLOGY):

Lecture, Power point presentation, Permanent slides, Exercises (group and individual).

SEMESTER II
CORE THEORY IV

TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

TOTAL HOURS: 90

SUB CODE: 16PPBCT2A04

CREDIT: 4

L-T-P: 4 – 1 - 1

COURSE OBJECTIVES

1. To impart knowledge on Flowering plants and methods to identify them.
2. To understand the different basis of classification of flowering plants and naming the plants.
3. To gain knowledge on usage of cereals, pulses, cropping plants, legumes, wood, medicinal plants, nuts and spices.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	Acquire knowledge on different systems of classification
CO2	Understand the modern trends in taxonomy and apply in solving taxonomic problems.
CO3	Obtain knowledge of Binomial nomenclature and key preparation
CO4	To impart knowledge on Morphology and floral parts of some angiosperm families
CO5	To discuss the economic uses of pulses, legumes, spices and NTFP.

SYLLABUS

TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

Unit I **20 Hrs**

Systems of classification – Hutchinson and APG - Merits and demerits. Modern trends in taxonomy – Numerical taxonomy, Chemotaxonomy and Molecular taxonomy, Botanical Survey of India – its organization and role, Techniques in herbarium preparation, Binomial Nomenclature, Taxonomic hierarchy, ICBN and Key preparation.

Unit II **18 Hrs**

Study of the following families and Economic uses; Menispermaceae, Portulacaceae, Tiliaceae, Sapindaceae, Combretaceae, Rosaceae and Cucurbitaceae

Unit III **18 Hrs**

Study of the following families and Economic uses; Turneraceae, Molluginaceae, Oleaceae, Boraginaceae, Bignoniaceae, Euphorbiaceae and Verbenaceae.

Unit IV **17 Hrs**

Study of the following families and Economic uses; Casuarinaceae, Commelinaceae, Cannaceae, Typhaceae, Amaryllidaceae and Cyperaceae.

Unit V **17 Hrs**

Economic Botany – Detailed study of occurrence, mode of cultivation and economic uses of the following crop plants. Cereals - Rice; Pulses - Black gram; Sugar yielding plants - Sugarcane; Plantation crops - Coconut; Spices and condiments - Pepper; Tuber crops - Tapioca; Narcotics - Cannabis, Timber yielding plants - Teak Wood; Fibre yielding – Cotton.

Text books:

GROOMBRIDGE, B, (Ed.). 1992. Global Biodiversity: Status of The Earth's Living Resources, Chapman and Hall. London.

NAIK, V. N. 2000. Taxonomy of Angiosperms. Tata McGraw – Hill Publishing Company Limited New Delhi.

MABBERLEY, D.J. 2005. *The Plant-Book, A portable dictionary of the vascular plants*. Cambridge University Press, United Kingdom

SINGH, G. 2005. Plant Systematics – Theory and Practice. Oxford & IBH, New Delhi.

KOCHLAR, S. K. 2016. Economic Botany, Cambridge University Press.

Books for References:

GREUTER, W, (Ed.). 2000. International Code of Botanical Nomenclature. (St. Louis Code), Koeltz Vesentific Books, Germany.

STUESSY, T. F. 2002. Plant Taxonomy. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.

SIMPSON, M. G. 2006. Plant Systematics. Elsevier Academic Press, California, USA.

SIMPSON, B and M. OGORZALY, 2014. Plants in our World: Economic Botany, New Delhi.

NAIK, V. N. 1984. Taxonomy of Angiosperms, Tata McGraw-Hill Education,

E – Learning Resources:

[www.the plant list.org](http://www.theplantlist.org)

[www.biology discussion.org](http://www.biologydiscussion.org)

www.inaturalist.org

www.wbnsou.ac.in

www7.bbk.ac.uk

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	1	1	1	3
CO2	1	2	2	2	3
CO3	2	2	2	2	3
CO4	2	2	2	2	2
CO5	3	3	3	3	3
Average	2	2	2	2	2.8

Key: PEDAGOGY:

Lecture, Power point presentation, Drawing practice, Field visits, Plant Collection.

SEMESTER II
CORE THEORY V
CELL BIOLOGY

TOTAL HOURS: 90
CREDIT: 4

SUB CODE: 16PPBCT2A05
L-T-P: 4-1-1

Course Objectives:

1. To enable the students understand the elementary structure and functions of eukaryotic cell organelles.
2. This course enable students to acquire knowledge, conceptual understanding and develop skills of scientific investigations and evaluate scientific evidence to draw conclusions.
3. Students will understand the structure and purposes of basic components of cell, membranes, pumps, organelles, cell divisions, cell cycle, structure, types, identification - banding technique, chromosome aberrations, gene structure, and transposons.

Course Outcome:

On successful completion of the course the students will be able to

CO No.	CO Statement
CO1	understand the structure and purposes of plasma membrane, membrane pumps and electrical properties of membranes.
CO2	Discuss the Structure and function of intracellular organelles.
CO3	distinguish about the ultrastructure and function of Mitochondrial and chloroplast DNA, isolation and quantification techniques of nucleic acid.
CO4	evaluate and identify different stages of mitotic cell division, meiotic cell division and cell cycle.
CO5	analyze the morphology and fine structure of chromosomes, types banding techniques, chromosome aberrations, gene structure and transposons.

SYLLABUS

CELL BIOLOGY

- Unit I** **20 Hrs**
Plasma membrane- structure and function, structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channel, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
- Unit II** **20 Hrs**
Structural organization and function of intracellular organelles- Cell Wall, Endoplasmic reticulum, Dictyosomes, Lysosomes, Glyoxysomes, Peroxisomes, Vacuoles and Ribosomes. Structure and function of Cytoskeleton.
- Unit III** **15 Hrs**
Mitochondria, Nucleus and Chloroplast – Ultrastructure, and function of Mitochondrial and chloroplast DNA, Isolation and quantification of Nucleic Acid.
- Unit IV** **15 Hrs**
Cell division and Cell cycle: Mitosis and Meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.
- Unit V** **20 Hrs**
Chromosomes- morphology, fine structure, telomere, heterochromatin and euchromatin. Types: lamp brush, polytene and isochromosome, Chromosome identification -banding technique. chromosome aberrations, gene structure, transposons.

Text books:

- 1 Verma, P.S. & V.K. Agarwal, 2002, Cytology. S. Chand & Co. Ltd., New Delhi-55
- 2 Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr. 2008. Cell Biology and Genetics. Cengage Learning.
- 3 Verma, P.S. and Agarwal V.K. 2007. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S.Chand and Co. New Delhi.
- 4 Karp G. 2010. Cell Biology. John Wiley & Sons.
- 5 Plopper G. 2012. Principles of Cell Biology. Jones and Bartlett Learning, Burlington.

Reference Books:

1. Gilmartin and Bowler, 2002. Molecular Plant Biology: A practical approach (Vol. I and II), Oxford University press, UK.
2. De Robertis and De Robertis. 2005. Cell and Molecular biology. I Ed. Lippincott Williams and Wilkins. UK.
3. Joseph K. John. 2006, Biomembranes and Biosignalling. Campus Books International, New Delhi.
4. Harris, N. and Oparka, K.J. 1994. Plant Cell Biology: A Practical Approach. IRL Press, at Oxford, U.K.
5. Freifelder, D. 1987. Essentials of Molecular Biology, Jones & Bartlett, Boston.

E-Learning resources:

www.link.springer.com

www.biologydiscussion.org

www.promega.in

<http://www.freebookcentre.net/Biology/Cell-Biology-Books.html>

<https://www.freebookcentre.net/biology-books-download/Fundamentals-of-cytology.html>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	3	1	2	1
CO2	3	3	2	1	2
CO3	3	3	2	2	2
CO4	3	3	2	2	3
CO5	3	3	3	3	3
Average	2.8	3	2	2	2.2

KEY: PEDAGOGY:

Lecture, Power point presentation, Exercises (group and individual)

SEMESTER II
CORE ELECTIVE III

MOLECULAR BIOLOGY AND GENETIC ENGINEERING

TOTAL HOURS: 75

SUB CODE: 16PPBCE2003

CREDIT: 3

L-T-P: 4-1-0

COURSE OBJECTIVES:

- To provide strong fundamentals of Molecular biotechnology and its industrial applications.
- To impart knowledge and elucidate the structure and functions of nucleic acids and its various concepts and mechanisms involved through scientific thinking.
- To induce professionalism in high end areas of biotechnology for activating productive research in Cloning strategies, Recombinant DNA technology, IPR and Biosafety, thus helping in acquiring jobs in Life sciences field.

COURSE OUTCOMES: on completion of the course the students will be able to

CO No.	CO Statement
CO1	Learn and understand the scope of molecular biology by knowing the structure, types and functions of Nucleic Acids.
CO2	Discuss the Gene concept, structure and its function.
CO3	Acquire knowledge on the concept of a vector and its types.
CO4	Understand the Cloning strategies, IPR, Patents and Biosafety of GMO and GMPs.
CO5	Develop in-depth knowledge about Blotting techniques, Principles and applications of PCR, its types, Sequencing methods.

SYLLABUS

MOLECULAR BIOLOGY AND GENETIC ENGINEERING

Unit I **15 Hrs**

Scope of molecular biology – Nucleic Acids – Base pairing and variations in base composition – Types of DNA, Chargaff's rule – DNA size – fragility – hydrophobic interactions – denaturation, Circular and superhelical DNA – Topoisomerase – special base sequence – Repeated sequence – Single stranded DNA – DNA methylation, structure of RNA.

Unit II **15 Hrs**

Gene concept – fine structure – split gene – exons and introns. Gene function DNA replication – DNA Polymerase, Ligase, Helicase – Termination of DNA replication – Mismatch repair – Transcription in Prokaryotes – RNA polymerase – classes of RNA molecules – Transcription in Eukaryotes – splicing mechanisms – Reverse transcriptions. Translation, overlapping genes.

Unit III **15 Hrs**

Types of vectors – Plasmid, PBR322 and its derivatives – gene markers, phage and cosmid vectors, artificial chromosome vectors: BAC & YAC, shuttle vectors and expression vectors.

Unit IV **15 Hrs**

Cloning strategies: Recombinant DNA technology, Restriction enzymes for cloning, restriction mapping, and construction of chimeric DNA. Construction of genomic and cDNA libraries. Recombinant DNA technology. Intellectual Property Rights (IPR) and patents, Biosafety of GMO and GMPs.

Unit V **15 Hrs**

Southern, Northern and Western Blotting, Dot and Slot blots; Antisense RNA technology, DNA finger printing and DNA foot printing, RAPD, RFLP, Basic PCR principles and applications, RT PCR, anchored PCR, Real Time PCR, Q-PCR, Multiplex PCR, Sequencing methods, Chromosome walking and jumping.

TEXT BOOKS:

Ramawat K.G. and Shaily Goyal. 2009. Comprehensive Biotechnology. Fourth edition. S.CHAND & COMPANT LTD.

Date, J.W. and M.V. Schantz, 2002. From genes and genomes. John Wiley and Sons Ltd.

Watson, J.D., M. Jilman, J. Witkowski and M. Zoller., 2001. Recombinant DNA, Scientific American Books, USA.

Verma, P S 2010. Genetic engineering. S Chand & Company.

REFERENCES:

Primrose, S., R. Twyman and B. Old. 2001. Principles of gene manipulation, Blackwell Science Ltd., USA

Brown, T.A. 2001. Gene Cloning and DNA Analysis, 4th edition, Black Well Science.

Cibelli, J.R.P., Lanza, K.H.S., Campbell and M.D. West. 2002. Principles of Cloning, Academic Press.

Neelam Pathak and Smita Rastogi, 2009. Genetic Engineering, Oxford University Press

E-LEARNING RESOURCES:

[www.your genome.com](http://www.yourgenome.com)

www.britanica.com

www.biotechnologynotes.com

www.scienceabc.com

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	3	2	3	3
CO 2	1	3	2	2	1
CO 3	1	3	2	2	1
CO 4	1	3	2	2	3
CO 5	1	3	3	3	3
Average	1.2	3	2.2	2.4	2.2

KEY: PEDAGOGY (Teaching methodology):

Lecture, Seminar, Assignments, Power point presentation, Exercises (group and individual).

SEMESTER II
PRACTICALS II
(Covering Paper III, IV and V)

TOTAL HOURS: 30 Hrs

SUB CODE: 16PPBCP2002

CREDIT: 4

L-T-P: 1-1-2

COURSE OBJECTIVES

1. To develop the practical skills required in plant anatomy to make anatomical diagnoses of plant parts and to write anatomical descriptions.
2. To develop practical skills to analyze pollen grains.
3. Understand the systems of classification of angiosperms, nomenclature and interdisciplinary approaches.
4. Understand the techniques in cell division during mitosis and meiosis.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	To understand and acquire knowledge of the internal structure of stem, leaf and root (monocot and dicot), anomalous secondary thickening (dicot and monocot), anther, nodes and isolation of embryo.
CO2	Able to differentiate the stages of mitosis and meiosis.
CO3	Analyze and identify pollens in the environment.
CO4	Recognize members of the angiosperm families by identifying their diagnostic features and economic importance
CO5	Acquire lab based training in writing short species descriptions , illustration and key preparations for identification of species

SYLLABUS

PLANT ANATOMY

Techniques in making temporary microscopic preparations - free hand sections, peeling, vein clearing, maceration.

Permanent slides using microtome (submission of 5 slides)

Anomalous secondary growth *Boerhaavia*, *Dracaena*, *Nyctanthus*

Wood sections – T.S, T.L.S, R.L.S.

EMBRYOLOGY

Anther section, Preparation of dissected whole mount of embryo.

PALYNOLOGY

Pollen analysis of honey. Study of pollen (acetolysis or non acetolysis).

TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

Identification and Description of the given specimen at species and genus level using Gamble's Flora.

Description of species for the families mentioned in the theory.

Key preparation using plants mentioned in theory.

Field visits.

Submission of 25 herbarium sheets representing the families studied.

CELL BIOLOGY

Study of dividing cells – squash and smears techniques (Mitosis and Meiosis).

TEXT BOOKS:

Bhattacharya, K. 2014. A Textbook of Palynology (basic and Applied). New Central Book Agency (P) Limited.

Debarati Das.2017. Essential practical handbook of cell biology & genetics, biometry & microbiology. A laboratory manual. Academic Publishers.

Pandey, B.P. 2001.Plant anatomy. S. Chand (G/L) & Company Ltd.

Rajan,S.S. 2003. Practical Manual of Plant Anatomy and Embryology. Anmol Publications Pvt. Limited.

Singh, G. (2012). *Plant Systematics:Theory and Practice*. Oxford & IBH Pvt. Ltd., New Delhi.3rd edition.

T. K. Bose (2009). Trees of the World, Regional Plant Resource Centre, Bhubaneswar, Odisha, India

BOOKS FOR REFERENCE:

Bhojwani, S.S. and Bhatnagar, S.P. 2011. The Embryology of Angiosperms, Vikas Publishing House. Delhi.

Evert, R.F. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

Shivanna, K.R. 2003. Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.

Mohanty, C. R. 2017. Text Book of Plant Systematics, Kalynai Publisher, New Delhi.

Subrahmainayam , M. S. 2011. Modern Plant Taxonomy, Vikash Publishing House, New Delhi

Pandey, B. P. 2017. Taxonomy of Angiosperm. S. Chand Publication.

E- LEARNING RESOURCES:

[http://www.biologyreference.com/A-Ar/Anatomy-of-](http://www.biologyreference.com/A-Ar/Anatomy-of-Plants.html)

[Plants.htmlhttps://www.enchantedlearning.com/subjects/plants/plant/](http://www.enchantedlearning.com/subjects/plants/plant/)

<https://www.biologydiscussion.com/angiosperm/angiosperms-fertilization-embryology-and-seed-with-diagrams/>

<http://www.izsum.it/Melissopalynology/palino.htm?1>

<https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/taxonomy>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	2	2	3	3
CO 2	1	1	2	2	2
CO 3	1	2	2	3	3
CO 4	2	2	2	3	3
CO 5	2	2	2	3	3
Average	1.6	1.8	2	2.8	2.8

KEY: PEDAGOGY (TEACHING METHODOLOGY):

Lecture, Demonstrations, Power point presentation, Permanent slides, Exercises (group and individual)

COURSE FRAME WORK

SEMESTER III

SEM	COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS/W	CR EDITS	CA	SE	T
III	CORE VI	Core Theory VI	Genetics, Plant Breeding and Evolution	6	4	40	60	100
III	CORE VII	Core Theory VII	Ecology and Phytogeography	6	4	40	60	100
III	CORE VIII	Core Theory VIII	Plant Tissue Culture	6	4	40	60	100
III	ELECTIVE IV	Elective IV	Bioinstrumentation and Bioinformatics	5	3	40	60	100
III	PRACTICAL III	Major Practical III	Genetics, Plant Breeding and Evolution, Plant Tissue Culture, Ecology and Phytogeography	4	4	40	60	100
III	Skill based elective		Research Skills	2	3	50		50
III	INTERNSHIP		INTERNSHIP		2	40	60	100
			TOTAL	29	24			

SEMESTER III
CORE THEORY VI

GENETICS, PLANT BREEDING AND EVOLUTION

TOTAL HOURS: 90
CREDITS: 4

SUB CODE: 16PPBCT3006
L-T-P: 4-1-1

COURSE OBJECTIVES

1. Understands about various concepts of genetics and its importance in human health
2. Acquires deep understanding of Mendelian and non Mendelian genetics and its applications; learns about applied genetics and gene mapping methods.
3. Description of expression of genome revealing multiple levels of regulation and strategies to manipulate the same in the benefit of the mankind.
4. Students shall have the ability to apply fundamental knowledge of various principles of crop production including plant breeding and the scientific methods to solve problems in agriculture.
5. Discuss the interrelationships between molecular biology, developmental biology, and evolutionary theories.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	Understanding of Mendel's principle, its extension and chromosomal basis, and determination of gene action from genotype to phenotype.
CO2	Capability to perform gene mapping using 3- point test cross in Drosophila, gene mapping in humans by linkage analysis in pedigrees
CO3	Understand gene mutation, types of gene mutations, and methods for detection of induced mutations.
CO4	Apply principles involved in Plant Breeding in crop improvement and use plant breeding techniques for production of new superior crop varieties.
CO5	Understand and describe fundamental processes of evolutionary changes, including natural selection, variation, recombination, adaptation and mutation.

SYLLABUS

GENETICS, PLANT BREEDING AND EVOLUTION

Unit I

20 Hrs

Mendelian and Non Mendelian inheritance – Chiasma frequency –gene mapping, tetrad analysis. Sex determination in plants, sex linkage – dominant and recessive sex linked genes – holandric genes. Sex linked diseases – haemophilia and colour blindness, Pedigree chart.

Unit II

18 Hrs

Prokaryotic and Eukaryotic gene organizations- Regulation of gene action in Prokaryotes with reference to Lac Operon, Tryptophan Operon. Regulation of gene action in Eukaryotes with reference to Britten and Davidson model of gene regulation.

Unit III

17 Hrs

Mutation: Classification, detection, characterization, Mutagens – chemical and physical agents– Clastogens, Carcinogens.chromosomal aberrations.

Unit IV

20 Hrs

Plant Breeding: Principles involved in Plant Breeding and its importance in green revolution with reference to wheat, rice, sugarcane, maize and cotton. Methods of crop improvement: Selection (pure line, mass and clonal), hybridization, introduction and acclimatization- heterosis – causes and effects. Polyploidy in Plant Breeding – Breeding for disease restance, improved seed production and seed testing techniques.

Unit V:

15 Hrs

Evolution : Evolution – origin of life- theories of evolution - Darwin, Lamark and De Vries, Modern synthetic theory, variation- adaptation and selection.

TEXT BOOKS:

- Benjamin Lewin. 2010. Genes IX. Oxford University Press, USA.
- Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr. 2008. Cell Biology and Genetics. Cengage Learning.
- Verma, P. S. and Agrawal, V. K. 2006. Genetics. S. Chand & Company Ltd., New Delhi
- Hartl, D. L. and Jones, E.W 2005. Genetics: Analysis of genes and genomes,
- Gardner, E.J. Simmons, M. J, Snustad, D.P.2001. Principles of Genetics, 8th edition, John Wiley and Sons, Inc., New Jersey, USA.

BOOKS FOR REFERENCE:

- Verma, P. S. and Agarwal, V. K. 2008. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand and Company Limited, New Delhi.
- Shukla, R. S. and P. S. Chandel. 2007. Cytogenetics, Evolution, Biostatistics and Plant Breeding.S. Chand & Company Ltd., New Delhi.
- Strickberger M.W 2003. Genetics, 3rd edition. Prentice- Hall of India Pvt Ltd.,
- Sinha and Sunitha Sinha 1985, Cytogenetics, Plant Breeding and Evolution, Vani Educational Books.
- Gopalakrishnan T.S., Sambasivaiah. 2000. Principles of Organic evolution. Himalaya Publishing house.

E-LEARNING RESOURCES:

- <https://www2.le.ac.uk/projects/vgec/highereducation/topics/population->
- <https://www.britannica.com/science/genetics>
- www.biologyonline.com
- <https://www.plantbreeding.org/content/online-resources-for-plant-breeding-education>
- <https://www.nature.com/>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	1	2	3	3
CO 2	1	3	2	3	2
CO 3	1	2	3	3	2
CO 4	1	2	1	3	3
CO 5	1	1	1	2	3
Average	1.4	1.8	1.8	2.8	2.6

KEY: PEDAGOGY (TEACHING METHODOLOGY): Lectures, PPT presentations, Seminars and Discussions.

SEMESTER III
CORE THEORY VII
ECOLOGY AND PHYTOGEOGRAPHY

TOTAL HOURS: 90

SUB CODE: 13PPBCT3A07

CREDIT: 4

L-T-P: 4 – 1 - 1

COURSE OBJECTIVES

1. To impart knowledge on Community Ecology.
2. To understand the different Ecosystem their interrelationship and Energy levels
3. To gain knowledge on Global warming, pollution and its effects and steps to reduce it.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	Understand the basic concepts of ecology and various ecosystem
CO2	Obtain knowledge and Organize the ecosystem and mechanism of biogeochemical cycle and energy levels.
CO3	To discuss the causes, effect and protective measures against Green house effects and global warming.
CO4	To acquire indepth knowledge about Community Ecology and sampling of plant community by quadrat method.
CO5	To know the Phytogeographical regions of world and Floristic regions of India

SYLLABUS

ECOLOGY AND PHYTOGEOGRAPHY

UNIT I 18 Hrs

Ecosystem Ecology: Concept of Ecology and Ecosystem; Kinds of ecosystem – Natural and Artificial; components of ecosystem – Biotic and Abiotic; Types of ecosystem – Pond, Lake, Ocean, Grassland, Forest and Desert Ecosystem.

UNIT II 15 Hrs

Energy Flow: Energy flow in an ecosystem- food chain, food web, trophic level (pyramids), Types of energy flow models; Study of Nutrient cycles (Biogeochemical Cycles) – Atmospheric cycle (Hydrological and carbon cycle) and Edaphic Nutrient cycle (Nitrogen and Phosphorus cycle).

UNIT III 13 Hrs

Global Warming: Green House Effects – Causes and consequences – Carbon dioxide and carbon monoxide as pollutants – Depletion of Ozone Layer – Threats to ozone protector – Global efforts to save ozone layer; Biological Monitoring Programmes.

UNIT IV 22 Hrs

Community Ecology: Definition; Components of a Community - Composition, structure, origin and development of a community – Characters used in community structure – Methods of study of communities – Units of vegetation – Classification of community - Clementsian units of vegetation - Main concepts of communities. Basics of population ecology.

UNIT V 22 Hrs

Phytogeography – Definition - Distribution patterns - age and area hypothesis; Continental Drift – Major plant communities of world – Phytogeographic regions of world (Vegetation Belts) – Soils of India – Climatic regions of India – Floristic / Botanical regions of India – Vegetation of India.

Text books:

ODUM, E.P. 1978. Fundamentals of Ecology. Third Edition. Saunder's International Students Edition. Philadelphia, U.S.A.

KORMONDY, E. 1989. Basic Concepts of Ecology. Third Edition. Prentice - Hall of India, New Delhi.

SHARMA, P. D. 2003. Ecology and Environment. Rastogi Publication, Meerut. India.

DE SANTO, R. S. 2012. **Concepts of Applied Ecology, Springer.**

SHARMA, P. D. 2019. Plant Ecology and Phytogeography, Rastogi Publications.

Books for References:

DETLEF, E., E. BECK, and K. M. HOHENSTEIN, 2002. Plant Ecology, Springer - Verlag, Berlin Heidelberg, New York.

HUSAI, M. 2015. Environment and Ecology – Biodiversity, Climate Change and Disaster Management, Access Publishing.

KORMONDY EDWARD, 2017. Concepts of Ecology, Pearson Education,

M. C. MOLLES Jr & A. A. SHEER, 2018. Ecology: Concepts and Applications,
McGraw-Hill Education

BEGON, M and C. R. TOWNSEND, 2005. Ecology: From Individuals to Ecosystems, Wiley-Blackwell

E – Learning Resources:

onlinelibrary.wiley.com

www.ecology.co.uk

www.theplantlist.org

www.biologydiscussion.org

www.inaturalist.org

Mapping of CO with PSO:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	2	2	1
CO2	3	3	3	2	2
CO3	2	3	2	2	2
CO4	2	3	3	3	3
CO5	3	3	2	2	2
Average	2.6	2.8	2.4	2.6	2

Key: PEDAGOGY (Teaching methodology to be adopted for the classroom instructional hours)

Lecture, Power point presentation, Quadrat studies, Field visits, Discussions.

SEMESTER III
CORE PAPER VIII
PLANT TISSUE CULTURE

TOTAL HOURS: 90

SUB CODE: 13PPBCT3A08

CREDIT: 4

L-T-P: 5-1-1

COURSE OBJECTIVES:

4. To provide an insight into the history of plant tissue culture and importance of sterilization and laboratory designing.
5. To learn, identify and select different explants and media for plant tissue culturing practically researching and scientific thinking.
6. To acquire knowledge and creative thinking and analyze various crop improvement technique, thus by helping the agriculture/horticulture sectors and acquiring job.

COURSE OUTCOMES: on completion of the course the students will be able to

CO No.	CO Statement
CO1	To impart knowledge on the history of plant tissue culture, learn and discuss various sterilization procedures and design R&D Lab for plant tissue culture.
CO2	To enlist, elucidate and evaluate the media content for plant tissue culture.
CO3	To learn, understand and demonstrate various explants for plant tissue culture.
CO4	To explain and study the suspension and protoplast culture techniques and immobilization of cells and use of bioreactors in industries.
CO5	To discuss, compare and evaluate crop improvement in tissue culture.

SYLLABUS

PLANT TISSUE CULTURE

Unit I **20 Hrs**

Tissue culture: Milestones in tissue culture of plants. Concept of totipotency. Sterilization Procedures – Fumigation, wet and dry sterilization, ultraviolet sterilization, ultrafiltration and surface sterilization. Design of laboratory, R & D and commercial tissue culture facility.

UNIT – II **15 Hrs**

Tissue culture Media: Media for *in vitro* culture; Types of media – Solid, liquid and commercial prepacked media; Media composition – Macronutrients, Micronutrients and plant growth regulators (PGRs); Preparation of media; Selection of suitable media.

UNIT -- III. **20 Hrs**

Explants for Tissue Culture: Shoot tip, axillary buds, leaf discs, cotyledons, inflorescence and floral organs. Callus culture - initiation and maintenance of callus. Micropropagation - direct and indirect morphogenesis, somatic embryogenesis and synthetic seed production.

UNIT – IV **20 Hrs**

Suspension Culture - Culture systems, Isolation of single and aggregate of cells and regeneration of plants; Immobilization of cells and use of bioreactors.

Protoplast Culture - Isolation of protoplast, culture of protoplast, regeneration and sub-protoplast; Somatic cell hybridization, selecting desired hybrids and their regeneration into plants.

UNIT – V **15 Hrs**

Crop improvement in tissue culture: Meristem culture – production, virus free plants, production of clones, cell culture and production of secondary metabolites, protoplast as a tool in biotechnology, breaking self-incompatibility by embryo culture.

TEXT BOOKS:

Dixon, R.A and Gonzales, A. 2004. Plant cell culture – a practical approach. Oxford University Press

Gamborg, O.L. and Phillips, G.C. 2013. Plant Cell, Tissue and organ Culture: Fundamental methods. Springer Berlin Heidelberg

Purohit, S.D. 2012. Introduction to plant cell tissue and organ culture. PHI Learning.

Razdan, M. K. 2011. Plant Tissue Culture. Elsevier Science.

Timir, B.J and Ghosh, B. 2005. Plant Tissue Culture: Basic and Applied. Universities Press Pvt Ltd

BOOKS FOR REFERENCE:

Mather,J.P and Penelope E. R. 2013. Introduction to Cell and Tissue Culture Theory and Technique. Springer US.

Reinert, J., and Bajaj, Y.S. 2013. Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Springer Berlin Heidelberg.

Kalyan Kumar De. 2004. An Introduction to Plant Tissue Culture. New Central Book Agency (P) Limited.

Chawla , H. S. 2003.Plant Biotechnology A Practical Approach. Science Publishers.

Reinhard, E, Zenk, M.H and Barz, W. 2012. Plant Tissue Culture and its Bio-technological Application. Springer Berlin Heidelberg.

E-LEARNING RESOURCES:

<https://youtu.be/H1LK59Lh-Cg>

<https://youtu.be/js0o6lMsXcA>

<https://www.slideshare.net/THANKLORD/abt-1>

<https://www.slideshare.net/aachaljain2/immobilization-of-plant-cells>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	2	3	3
CO 2	3	2	2	3	3
CO 3	2	3	3	2	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Average	2.8	2.6	2.6	2.8	3

KEY: PEDAGOGY (TEACHING METHODOLOGY): Lecture, Power point presentation/Seminar, Exercises and discussions (group and individual), Field Trips, Rapid fire question session, brain storming.

SEMESTER III
CORE ELECTIVE IV
BIOINSTRUMENTATION & BIOINFORMATICS

TOTAL HOURS: 75
CREDIT: 3

SUB CODE: 16PPBCE3A04
L-T-P: 4-1-0

Course Objectives:

1. This course enable students to acquire knowledge, conceptual understanding and develop skills of scientific investigations and evaluate scientific evidence to draw conclusions.
2. To understand the principle, operation and maintenance of various tools/equipments in the laboratory.
3. To develop the knowledge about the information and applications of databases.

Course Outcome:

On successful completion of the course the students will be able to

CO No.	CO Statement
CO1	analyze the separation of biomolecules using chromatographic, electrophoretic and centrifugal techniques.
CO2	describe the principle, operation and use of various instruments to determine the concentration of molecules in biological samples.
CO3	to utilize the application of instruments used for the microscopic, physical and analytical studies of biological samples.
CO4	compare different kinds of biological databases and their formats.
CO5	understand the various techniques used for phylogenetic tree construction and drug designing.

SYLLABUS

BIOINSTRUMENTATION & BIOINFORMATICS

Unit I **15 Hrs**

Separation techniques: centrifugation, ultrafiltration, dialysis and Electrophoresis – Native and SDS PAGE, Chromatographic techniques -Paper chromatography, Thin Layer Chromatography (TLC), High Performance Thin Layer Chromatography (HPTLC), High Performance Liquid Chromatography (HPLC), Column chromatography and Gas Chromatography.

Unit II **15 Hrs**

Spectroscopic techniques: Colorimetry, UV-Visible Absorption Spectrophotometry, Infra Red Spectrophotometry, Mass Spectrophotometry, NMR Spectrophotometry and Fluorescent Spectroscopy.

Unit III **15 Hrs**

Microscopy: Light Microscopy, Dark-field, Phase contrast, Polarized light, Interference contrast (Nomarski) and Fluorescence Microscopy. Scanning and Transmission Electron Microscopy, Confocal Laser Scanning Microscopy, Photography – Micro and Macro photography.

Unit IV **15 Hrs**

Scope of Bioinformatics: Sequence analysis – Homology & Analogy – National center for biotechnology & information (NCBI). Biological data bases – primary data base – Protein sequence data base – MIPS – SWISS PROT; Secondary data base – Prosites – Finger print data base; Genomics and Proteomics.

Unit V **15 Hrs**

Phylogenetic analysis: Phylogenetic trees; Method of Phylogenetic Analysis - Phenetic and cladistics method of analysis – Introduction and approaches to Drug Discovery, Pharmacogenomics and Pharmacogenetics and its applications, Process of Drug discovery: Target identification – Target Validation – Lead identification – Lead optimization – Preclinical pharmacology and Toxicology.

Text Books

1. Asokan, P. 2001. Basics of Analytical Biochemistry. Chinnaa Publications.
2. Bajpai, P. K. 2006. Biological Instrumentation and Methodology. S. Chand & Company, New Delhi.
3. Veerakumari, L. 2009. Bioinstrumentation. MJP Publications.
4. Keith Wilson & John Walker 2010. Principles and Techniques of Biochemistry and Molecular Biology, 7th ed. Cambridge University Press.
5. Goutam Bhowmik & Sujoy Bose. 2011. Analytical Techniques in Biotechnology. Tata McGraw Hill Education Private Limited, New Delhi.

Reference Books:

1. Sawhney, S. K. & Randhir Singh. 2000. Introductory Practical Biochemistry. Narosa Publishing House.
2. Dunn S.R., M.J., Pennington. 2002. Proteomics from Protein sequence to function. 3rd edn. Viva Books Pvt., Ltd. New Delhi.
3. Liebler, C.D. 2002. Introduction to Proteomics: Tools for the New Biology. 1st Edn. Humana Press Inc, New Jersey.
4. Rodney Boyer. 2002. Modern Experimental Biochemistry. Pearson Education
5. Mehrotra, P, Kumund Sarin, Swapna. K. & Srivastava. 2005. The New hand Book of Bioinformatics, 1st edn. Vikas Publishing House Pvt. Ltd, Noida, Uttar pradesh.

E-Learning References

www.microscope-microscope.org/

www.chromatography.online.org/

<https://nptel.ac.in/courses/102103044/pdf/mod5.pdf>

<http://www.freebookcentre.net/Chemistry/Spectroscopy-Books-Download.html>

<https://chemistry.com.pk/books/chromatographic-methods/>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	3	3	3
CO2	3	3	3	3	2
CO3	3	3	3	3	3
CO4	3	3	1	3	1
CO5	3	3	3	3	3
Average	3	3	2.6	3	2.4

KEY: PEDAGOGY:

Power point presentation, Lecture, seminar, quiz and discussion (group and individual)

SEMESTER III

PRACTICAL III

(Covering Paper VI, VII & VIII)

TOTAL HOURS: 30

SUB CODE: 13 PPBCP3003

CREDIT: 4

L-T-P: 1 – 1- 2

COURSE OBJECTIVE

1. Acquires deep understanding of Mendelian and non Mendelian genetics and its applications; learn about applied genetics and gene mapping methods
2. Acquire knowledge about layout of plant tissue culture lab, techniques of sterilization and inoculation in tissue culture
3. Learning conventional breeding methods for self and cross pollinated crops and understanding their limitations.
4. Evaluate the quantitative characters of a plant community using quadrats and Belt transects.
5. Understand the phyto geography of world and India, biogeochemical cycles.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	Able to solve genetic problems in Mendelian and non-Mendelian inheritance.
CO2	Apply principles involved in Plant Breeding in crop improvement and use plant breeding techniques for production of new superior crop varieties.
CO3	Demonstrate the knowledge about the techniques of Plant Tissue Culture, organisation of tissue culture lab.
CO4	Understand and describe fundamental processes of evolutionary changes, including natural selection, variation, recombination, adaptation and mutation.
CO5	Apply different methods to find qualitative and quantitative characters of a plant community and to understand population Ecology

SYLLABUS

(Covering paper VI, VII and VIII)

Genetic Problems:

1. Mendels crosses
2. Gene interaction
3. Pedigree analysis
4. Chromosome mapping
5. Tetrad analysis

Plant Breeding:

1. Vegetative Propagation Techniques - Cutting, Grafting, Air Layering
2. Hybridization Techniques.

Evolution:

Theories of Evolution

Plant Tissue Culture:

1. Laboratory Techniques – Cleaning and sterilization of Glassware , Surface Sterilization and Inoculation (Laminar Air flow Chamber)
2. Preparation of MS and White's media.
3. Culture types
 1. Callus culture (leaf and stem)
 2. Axillary bud or shoot tip culture
 3. Anther culture
 4. Cotyledon culture
 5. Embryo culture

Ecology and Phytogeography

1. Types of Ecosystem – Pond, Lake, Ocean, Forest, Desert and Grassland,
2. Types of Energy Flow Models – single, Y channel, Hydrological cycle, Carbon cycle, Nitrogen cycle and Phosphorus cycle.

3. Green House Effect - Carbonmonoxide, Carbondioxide,. Ozone layer.
4. Determination of the qantitative characters of a plant community by Random Quadrat Method, Belt Transect Method and Line Transect Method and calculate the Abundance, Density and Frequency.
5. Mapping - Soil types in India (Alluvial soil, Black soil, Red soil, Skeletal mountain soil, Desert soil and laterite soil).
6. Mapping – Floristic/ Botanical regions of India (Western Himalayas, Eastern Himalayas, Gangetic plains, West Indian Desert/ Indus plain, Assam, Central India, Malabar, The Deccan, Andamans).

TEXT BOOKS:

Richard Kowles. 2013. Solving problems in genetics. Springer New York.

Chahal, G. S Gosal, S. S. 2002.Principles and Procedures of Plant Breeding. Biotechnological and Conventional Approaches CRC Press.

Timir Baran Jha · 2005. Plant Tissue Culture: Basic and Applied. Universities Press Pvt Ltd

Rastogi, V.B. 2018. Organic Evolution Paperback. MedTech.

Henderson, P. A.2003. Practical Methods in Ecology, Wiley-Blackwell.

Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India. 3.

REFERENCE BOOKS:

Banerjee, P.K.2011.Problems on Genetics Molecular Genetics and Evolutionary Genetics. New Central Book Agency.

Gupta, S. K. 2005. Practical Plant Breeding. Agrobios.

Gopalakrishnan T.S., Sambasivaiah. 2000. Principles of Organic evolution. Himalaya Publishing house.

Dixon,R.A and and Gonzales, A.2004. Plant cell culture – a practical approach. Oxford University Press.

Odum, E.2017. Fundamentals of Ecology Paperback – Cengage.

Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.

E – Learning Resources:

<https://www.plantbreeding.org/content/online-resources-for-plant-breeding-education>

<https://cmpcollege.ac.in/e-learning/>

<https://www.hzu.edu.in/bed/>

<https://www.researchgate.net/publication/322493473>

<https://www.oxfordbibliographies.com/view/document/obo->

Mapping of CO with PSO:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	2	2	2	3
CO2	2	2	3	2	3
CO3	2	2	2	2	3
CO4	2	2	2	2	2
CO5	2	3	1	2	2
Average	2.2	2.2	2	2	2.6

Key: PEDAGOGY (Teaching methodology to be adopted for the classroom instructional hours)

Demonstration, Experiments, Field work, Garden visit and discussions (group and individual), Rapid fire question session.

COURSE FRAME WORK

SEMESTER IV

SE M	COURSE CODE	COURSE TITLE	TITLE OF THE PAPER	HRS/ W	CR EDI TS	CA	SE	T
IV	CORE IX	Core Theory IX	Plant Biotechnology	6	4	40	60	100
IV	CORE X	Core Theory X	Plant Physiology and Biochemistry	6	4	40	60	100
IV	ELECTIVE V	Elective V	Pharmacognosy	5	3	40	60	100
IV	PRACTICAL IV	Major Practical IV	Plant Biotechnology, Plant Physiology and Biochemistry	4	4	40	60	100
IV	PROJECT		PROJECT	6	4	40	60	100
IV	Extra Disciplinary		SWAYAM (MOOC)	4	4	50		50
			TOTAL	31	23			

SEMESTER IV
CORE THEORY IX
PLANT BIOTECHNOLOGY

TOTAL HOURS: 90

SUB CODE: 16PPBCT4009

CREDIT: 4

L-T-P: 4 – 1 - 1

COURSE OBJECTIVES

1. To impart knowledge on Fermentation Technology and Fermentors.
2. To understand the different methods of Microbial production and Metabolic products.
3. To gain knowledge on Enzyme Technology.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	To discuss the procedure of sterilization and working principles of different Fermentors.
CO2	Understand the Microbial metabolic products and their production process.
CO3	To acquire knowledge about Enzyme technology, methods of immobilization and Biosensors.
CO4	To learn the process of microbial production of organic solvents and acids, aminoacids and antibiotics.
CO5	To obtain knowledge on Microbial production of fermented food and alcoholic beverages

SYLLABUS

PLANT BIOTECHNOLOGY

Unit I **13 Hrs**

Fermentation Technology: Sterilization procedure, components of media (Natural and Synthetic); Media (Substrates) for Industrial Fermentation. Bioreactors/Fermenter, Types of Bioreactors – Continuous stirred tank bioreactors, Bubble column bioreactors, Airlift bioreactors, Fluidized bed bioreactors, Packed bed bioreactors and Photobioreactors.

Unit II **17 Hrs**

Microbial Metabolic Products: Primary metabolites – Vitamins, Secondary metabolites –, Alkaloids, Gibberellins, Pigments and Steroids. High molecular weight compounds – Diabetes mellitus – Insulin – Techniques for recombinant insulin production, Interferons – Mechanisms of action, production of recombinant interferons, therapeutic applications of interferons.

Unit III **12 Hrs**

Enzyme Technology: Sources of Enzymes, Commercial production of enzymes – production process, isolation and purification of enzymes. Immobilisation of enzymes – Methods of immobilization, Microencapsulation, biosensors and types of biosensors. Industrial enzymes and therapeutic uses of enzymes.

Unit IV **17Hrs**

Microbial production: Organic solvents: Ethanol and Acetone; Antibiotics: Penicillin and Streptomycin; Amino acids: Lysine and Glutamic acid; Organic acids: Citric acid and Lactic acid.

Unit V **16 Hrs**

Microbial Production of Food: Fermented Foods, Advantages – Production process of Cheese, Bread and Yoghurt. Alcoholic beverages – Production process of Beer and Wine.

Text books:

PUROHIT, S. S., and S. K. MATHUR. 1993. Fundamentals of Biotechnology, Agrobotanical Publishers. India.

SATYANARAYANA, U. 12th Edition. 2018. Biotechnology, 2018.

[KRISHNA, G. K. A. and E. S. Devika.](#) 2016. **Plant Biotechnology, New Vishal Publications.**

ARUMUGAM, N and V. KUMARESAN. 2019. **Plant Biotechnology and Genetic**

Engineering, Saras Publications.

SINGH, P. 2013. Principles of Plant Biotechnology, Kalyani Publishers.

Books for Reference:

TORTORA, G. J., B. R. FUNKE and C. L. CASE, 8th Edition 2005. Microbiology. An introduction, Pearson Education Pvt., Ltd.

ALCAMO, 2000. Fundamental of Microbiology, Jones and Barlett Publishers.

THIEMAN, W. J. and M. A. PALLADINO. 2012. Introduction to Biotechnology, Pearson Benjamin Publishers

SLATER, A., N. SCOTT and M. FOWLER. 2008. **Plant Biotechnology: The genetic**

manipulation of Plants, OUP publishers.

FRAZIER, W. C. and D. C. WESTHOFF. 2006. Food microbiology. 4th edition. Tata Mc Graw-Hill publications. New Delhi.

E – Learning Resources:

<https://www.edx.org/learn/biotechnology>

https://cms.botany.org/home/resources/online_resources.html

https://www.biotech.iastate.edu/publications/ed_resources/Web_sites.html

<http://www.plantcell.org/content/teaching-tools-plant-biology>

<https://libguides.humboldt.edu/openedu/biol>

Mapping of CO with PSO:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	2	3	2	1	2
CO2	3	3	3	2	3
CO3	3	3	3	3	2
CO4	3	3	3	2	3
CO5	3	3	3	2	2
Average	2.8	3	2.8	2	2.4

Key: PEDAGOGY:

Lecture, Power point presentation, Exercises and discussions (group and individual), Rapid fire question session.

SEMESTER IV
CORE THEORY X
PLANT PHYSIOLOGY AND BIOCHEMISTRY

TOTAL HOURS: 90

SUB CODE: 13PPBCT4010

CREDITS: 4

L-T-P: 4-1-1

Course Objectives:

1. To study the role of growth hormones to maintain the life of plants.
2. To obtain knowledge on various metabolic processes in plants and the role of enzymes in regulation of cellular activity.
3. To understand the primary and secondary metabolites of plants.

Course Outcome:

On successful completion of the course the students will be able to

CO No.	CO Statement
CO1	Understand bioassay, biosynthesis and physiological actions of plant hormones.
CO2	Analyze and appraise the role of carbohydrates, proteins, lipids and secondary metabolites.
CO3	Understand nomenclature, properties of enzymes and kinetics.
CO4	Evaluate and appraise the role of photosynthesis and photoperiodism.
CO5	analyze different pathways involved in respiration

SYLLABUS

PLANT PHYSIOLOGY AND BIOCHEMISTRY

Unit I **15 Hrs**

Plant Growth and Developments: Plant hormones (natural and synthetic, Plant growth regulators – Bioassay, biosynthesis and physiological actions of auxins, gibberellins, cytokinins, ethylene, ABA and Brassins.

Unit II **10 Hrs**

Primary metabolites: carbohydrates, protein and lipids. Secondary metabolites – Structure, Types, Sources, Biosynthesis and function of alkaloids, terpenoids and flavonoids.

Unit III **15 Hrs**

Enzymes – Nomenclature (recent) – Chemical nature –properties – Enzyme kinetics - Michaelis-Menten constant – Regulation of enzyme activity.

Unit IV **25 Hrs**

Photosynthesis: Plant pigment system: Absorption and action spectrum – Phosphorescence and fluorescence. Light reaction - pathways of carbon fixation C₃, C₄ subtypes and CAM.

Photoperiodism: Critical day light – Photoperiodic induction – long and short day plants, Importance of photoperiod – Florigen – Phytochrome – P_R and P_{FR} forms.

Unit V **25 Hrs**

Respiration: Aerobic respiration - Glycolysis and Krebs' cycle, chemiosmotic ATP synthesis. Anaerobic respiration – Pentose phosphate pathway; Oxidation of Lipids – α – oxidation, β – oxidation, ω – oxidation and conversion of fats into carbohydrates (Glyoxylate cycle).

Nitrogen metabolism: Symbiotic and non – symbiotic N₂ fixation.

TEXT BOOKS:

1. Hames and Hooper. 2001. Instant notes – Biochemistry. Taylor & Francis Group, Newyork.
2. Jain, J.L. 2004. Biochemistry, S. Chand and Company, New Delhi.
3. Verma, V. 2007. Plant Physiology. 1st edition, Ane Books India, New Delhi
4. Jain.V.K. 2012, 2013, 2014. Fundamentals of Plant Physiology. S.Chand & Company, New Delhi.
5. Mukherji S. & Ghosh, A. K. 1996. Plant Physiology. I edn. New Central Book agency. India.

REFERENCE BOOKS:

1. Michael, M. Cox, 2005. Principles of Biochemistry, Freeman Company, New York.
2. Trivedi,P.C., Trivedi, Noggle, G.J. and Fritz, G.J. 2005. Introductory to Plant physiology. Second edition, Prentice Hall of India, New Delhi.
3. Lehninger, 2005. Biochemistry Fourth edition, Freeman Company, New York.
4. Nelson D.L. and P.C. and Gusmao K.S. 2006. Advances in Plant Physiology. I.K.International Pvt., Ltd., India.
5. Stryer L. 2012. Biochemistry, Freeman Company, Newyork.

E-Learning resources::

<https://www.nios.ac.in/media/documents/SrSec314NewE/Lesson-11.pdf>

<https://www.pdfdrive.com/plant-physiology-books.html>

<https://www.pdfdrive.com/plant-biochemistry-e165189725.html>

<https://www.scribd.com/book/282469316/Photoperiodism-in-Plants>

<https://openoregon.pressbooks.pub/mhccmajorsbio/chapter/8-3-the-two-parts-of-photosynthesis-light-dependent-reactions/>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	3	3	2	3	2
CO2	3	3	3	3	3
CO3	3	2	2	3	3
CO4	3	3	2	3	2
CO5	3	3	2	1	2
Average	3	2.8	2.2	2.6	2.4

KEY: PEDAGOGY:

Power point presentation, Lecture, seminar, quiz and discussion.

SEMESTER IV
CORE ELECTIVE V
PHARMACOGNOSY

TOTALHOURS: 75

SUB CODE: 16PPBCE4A05

CREDIT: 3

L-T-P: 4-1-0

COURSE OBJECTIVES

1. To create interest in research programmes in the subjects of phytochemistry and pharmacognosy.
2. Introduction to raw materials of natural origin including biosynthesis, chemical nature and evaluation of crude drugs.
3. Understanding the role of natural products in research and development of drugs.

COURSE OUTCOMES: on completion of the course the students will be able to...

CO No.	CO Statement
CO1	Acquire adequate knowledge and scientific information regarding basic principles of Pharmacognosy including herbal medicines.
CO2	Able to perform preclinical and clinical evaluation of drugs of various categories.
CO3	Able to do product detailing, marketing, distribution and selling of pharmaceutical products.
CO4	Associate medicinal compounds with their natural sources.
CO5	Able to perform experimental procedures as per laboratory standards in the area of Pharmacognosy.

SYLLABUS

PHARMACOGNOSY

Unit I

15 Hrs

Introduction, historical background, present status and future of pharmacognosy and its relationship with other fields of study. Traditional system of medicines - Homeopathy, Siddha, Ayurvedha and Unani.

Unit II

15 Hrs

Study of Crude Drugs – Crude drugs as pharmaceutical aids; its thereupatic uses; adulteration; Drug evaluation – organoleptic, microscopic, physical, chemical and biological evaluation; Storage of crude drugs; Marketing of drugs – dry, garbling and packing.

Unit III

15 Hrs

Chemical nature of natural Drugs - Classification, isolation and function of Alkaloids, Terpenoids, Glycosides, Volatile oils, Lipids, tannins, Resins and Carbohydrates.

Unit IV

15 Hrs

Grouping of Natural Drugs - Occurrence, distribution, organoleptic characters, chemical constituents and therapeutic uses.

1. Laxative – *Isphaghula*
2. Cardiotonics – *Digitalis*
3. Carmanatives – *Myristica fragrans*
4. Drugs acting on Nervous System – *Withania somnifera*
5. Antihypertensive – *Rauwolfia serpentina*
6. Anticancer – *Taxus baccata*

Unit V

15 Hrs

Grouping of Natural Drugs - Occurrence, distribution, organoleptic characters, chemical constituents and therapeutic uses.

7. Antitissive – *Ocimum sanctum*
8. Antidiabetic – *Gymnema sylvestre*
9. Antimalarial – *Cinchona officinalis*
10. Antiseptic and Disinfectant – *Curcuma longa*
11. Diuretic – *Tribulus terrestris*.
12. Antiviral – *Adhatoda vasica*

TEXT BOOKS:

Wallis, T.E. 2018. Text Book of Pharmacognosy CBS Pub. Delhi.

Gokhale ,S. B, Kokate, C, K ,Purohit, A ,P.2017. Nirali Prakashan

Kokate, C.K. and Gokhale ,S. B .2008.Practical Pharmacognosy . Nirali Prakashan.

Kirthikar,K.R, Basu, B.D.2006. Indian Medicinal Plants. M/s Bishen Singh Mahendra Pal Singh

Varro E.Tyler, Lynn. R.Brady, James E.Robbers.2000. Pharmacognosy McGaw Hill.

BOOKS FOR REFERENCE:

Jain, S.K.2017.Dictionary of Indian Folk medicine and Ethnobotony . Scientific Publishers.

Harbone,J.B..2013. Phytochemical methods . Springer Netherlands

William, C. E, Evans,D, Trease,G.E. 2009. Pharmacognosy. Elsevier Publications

Roma Mitra.1985. Bibiliography on pharmacognosy of medicinal plants. National Botanical Research Institute

Nalkarni , K.M. 1996.Indian Materia Medica. Popular Prakashan Pvt Ltd

E-LEARNING RESOURCES:

<https://www.intechopen.com/books/secondary-metabolites-sources-and-applications/introductory-chapter-secondary-metabolites>

<https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/medicinal-plant>

<https://www.dabur.com/article.aspx?PageId=53&MenuId=328&WebsiteId=1>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	1	1	2	3
CO 2	1	1	3	3	3
CO 3	1	1	2	3	3
CO 4	1	1	2	3	3
CO 5	2	2	3	3	3
Average	1.2	1.2	2.2	2.8	3

KEY: PEDAGOGY (TEACHING METHODOLOGY)

Lecture, Power point presentation, Exercises (group and individual).

SEMESTER IV
CORE PRACTICAL IV
(Covering Paper IX and X)

PLANT PHYSIOLOGY, BIOCHEMISTRY & PLANT BIOTECHNOLOGY

TOTAL HOURS: 90

SUB CODE: 13PPBCP4004

CREDIT: 4

L-T-P: 1-1-2

COURSE OBJECTIVES:

1. To equip the students with the basic skills related to theoretical knowledge and apply them in laboratory as well as field conditions and industries.
2. To demonstrate and make the students to use the laboratory instrument/equipment's practically.
3. To help the students focus in initiating scientific thinking, research and decision making approach.

COURSE OUTCOMES: on completion of the course the students will be able to

CO No.	CO Statement
CO1	To impart practical knowledge on the theoretical subjects handled.
CO2	To learn and understand the working principles of the laboratory tools and techniques, and utilize them practically.
CO3	To evaluate, interpret and analyze the acquired data.
CO4	To help the student with innovative thoughts and scientific thinking and research.
CO5	To help and facilitate students for taking up jobs in Botany, biotechnology, research and multidisciplinary fields.

SYLLABUS

PLANT PHYSIOLOGY AND BIOCHEMISTRY

1. Preparation of Percentage solution
2. Quantitative estimation of protein (Bradford's method)
3. Quantitative estimation of carbohydrates (Duboi's Method)
4. Extraction and estimation of total lipids.
5. Estimation of total amino acid.
6. Separation of photosynthetic pigments by paper chromatography
7. Separation of amino acids using TLC
8. Separation of alkaloids by paper chromatography or TLC
9. Determination of α -amylase activity
10. Estimation of peroxidase activity
11. Estimation of catalase activity
12. Identification of C₃ and C₄ plants.
13. Determination of C₄ photosynthetic subtypes using anatomical criteria
14. Comparative rate of respiration by titration method
15. Effect of plant growth regulators on seed germination.

PLANT BIOTECHNOLOGY

1. Citric acid Production by *Aspergillus niger* and its estimation.
2. Production of wine from grapes.
3. Methylene blue production, Test for Milk.
4. Production of Cheese.
5. Plate assay of amylase.
6. Plate assay of protease.

TEXT BOOKS:

PUROHIT, S. S., and S. K. MATHUR. 1993. Fundamentals of Biotechnology, Agrobotanical Publishers. India.

SATYANARAYANA, U. 12th Edition. 2018. Biotechnology, 2018.

[KRISHNA, G. K. A. and E. S. Devika](#). 2016. Plant Biotechnology, New Vishal Publications.

[ARUMUGAM, N and V. KUMARESAN](#). 2019. Plant Biotechnology and Genetic Engineering, Saras Publications.

REFERENCE BOOKS:

TORTORA, G. J., B. R. FUNKE and C. L. CASE, 8th Edition 2005. Microbiology. An introduction, Pearson Education Pvt., Ltd.

ALCAMO, 2000. Fundamental of Microbiology, Jones and Barlett Publishers.

[THIEMAN, W. J. and M. A. PALLADINO](#). 2012. Introduction to Biotechnology, Pearson Benjamin Publishers [SLATER, A., N. SCOTT and M. FOWLER](#). 2008. Plant Biotechnology: The genetic manipulation of Plants, OUP publishers.

FRAZIER, W. C. and D. C. WESTHOFF. 2006. Food microbiology. 4th edition. Tata Mc Graw-Hill publications. New Delhi.

E-Learning resources:

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<https://www.pdfdrive.com/plant-physiology-books.html>

<https://www.pdfdrive.com/plant-biochemistry-e165189725.html>

<https://www.scribd.com/book/282469316/Photoperiodism-in-Plants>

<https://openoregon.pressbooks.pub/mhccmajorsbio/chapter/8-3-the-two-parts-of-photosynthesis-light-dependent-reactions/>

<https://www.edx.org/learn/biotechnology>

https://cms.botany.org/home/resources/online_resources.html

https://www.biotech.iastate.edu/publications/ed_resources/Web_sites.html

<http://www.plantcell.org/content/teaching-tools-plant-biology>

<https://libguides.humboldt.edu/openedu/biol>

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	2	2	3	2	2
CO 4	2	2	3	3	2
CO 5	2	2	3	3	3
Average	2.4	2.4	3	2.8	2.6

KEY: PEDAGOGY (TEACHING METHODOLOGY): Lecture, Power point presentation/Seminar, Exercises and discussions (group and individual), Field Trips, Rapid fire question session, brain storming.

SEMESTER IV

PROJECT

TOTAL HOURS: 90

SUB CODE: 13PPBPR4001

CREDIT: 4

L-T-P: 1-2-3

COURSE OBJECTIVES:

1. The project is designed to cater to the needs of all categories/multidisciplinary approach of subjects related to botany/biotechnology, life sciences etc.
2. To infuse the students fresh mind and help them with creative ideas and innovative thoughts which will help them in novel thinking, researching, analyzing and decision making skills.
3. The project will be a buffet tablet which will help each and every student with something in their exponential career.

COURSE OUTCOMES: on completion of the course the students will be able to

CO No.	CO Statement
CO1	To know, understand and able to do the literature survey for the selected topic.
CO2	Acquire skills in practical work, experiments, laboratory techniques and field based studies with multidisciplinary work and tasks.
CO3	Handle instruments for analysis and discuss their experimental results
CO4	To discuss, compare, evaluate and interpret the results and to prepare reports/presentation and defend their work.
CO5	To facilitate students for taking up and shaping a successful careers in Botany/biotechnology/multidisciplinary fields.

Mapping of CO with PSO:

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	2	2
CO 2	3	3	3	3	2
CO 3	3	2	3	3	3
CO 4	2	3	1	3	2
CO 5	2	3	2	3	3
Average	2.6	2.8	2.4	2.8	2.4

KEY: PEDAGOGY (TEACHING METHODOLOGY): Lecture, Power point presentation/seminar, exercises, discussions (group and individual), field trips, rapid fire question session, brain storming, literature survey, practical's and data interpretation, report writing.

**PG QUESTION PAPER PATTERN FOR
OBE ONLINE ASSESSEMENT (2020 - 2021)**

Bloom's Category Level	Sections	Marks	Description of answer	Total	Meaning of K's		
INTERNAL SETTING							
K1,K2,K3	Section A Multiple Choice Questions 25 Questions *1 Marks (No Choice)	25X1=25	Choose the right option.	50	K 1 & K2 - Understanding Level K 3 - Apply Level K 4 - Analyze Level K 5 – Evaluate Level K 6 – Create Level		
EXTERNAL SETTING							
K2,k3,K4, K5,K6	Section B 5 out of 7 Questions *5 Marks	25	Short answers/500 Words				

*** 50 marks to be converted as 60 marks.**

**Shrimathi Devkunvar Nanalal Bhatt Vaishnav College for Women
(Autonomous)**

Re-accredited with “A+” Grade by NAAC

Amendments in the regulations from 2020 – 2021 onwards

PG

Changes in Part-II

Semester – I

Title	Internal Marks	External Marks	Credits
Skill based elective-Teaching Skills	50	-	3

Semester – II

Title	Internal Marks	External Marks	Credits
Soft Skills – SWAYAM (MOOC)	50	-	4

Semester – III

Title	Internal Marks	External Marks	Credits
Skill based elective -Research Skills	50	-	3

Semester – IV

Title	Internal Marks	External Marks	Credits
Extra Disciplinary– SWAYAM (MOOC)	50	-	4