Holy Cross College (Autonomous), Nagercoil

Kanyakumari District, Tamil Nadu.
Accredited with A^{++} by NAAC - V Cycle (CGPA 3.53)

Affiliated to
Manonmaniam Sundaranar University, Tirunelveli

Semester I - VI

UG Guidelines & Syllabus

DEPARTMENT OF BOTANY

2023-2026
(With effect from the academic year 2025-2026)

Issued from
THE DEANS' OFFICE

Vision

To impart knowledge with professional zeal and devotion for plant science

Mission

Providing student – centered and profession- oriented higher education that bestows academic environment to create intellectuals with scientific temperament, in the context of global issues and environmental challenges.

Graduate Attributes

Graduates of our College develop the following attributes during the course of their studies.

- **Creative thinking:**

Equipping students with hands-on-training through skill-based courses and promote startup.

- **Personality development:**

Coping with increasing pace and change of modern life through value education, awareness on human rights, gender issues and giving counselling for the needful.

- **Environmental consciousness and social understanding:**

Reflecting upon green initiatives and understanding the responsibility to contribute to the society; promoting social and cultural diversity through student training and service-learning programmes.

- **Communicative competence:**

Offering effective communication skills in both professional and social contexts through bridge courses and activities of clubs and committees.

- **Aesthetic skills:**

Engaging mind, body and emotions for transformation through fine arts, meditation and exercise; enriching skills through certificate courses offered by Holy Cross Academy.

- **Research and knowledge enrichment:**

Getting in-depth knowledge in the specific area of study through relevant core papers; ability to create new understanding through the process of critical analysis and problem solving.

- **Professional ethics:**

Valuing honesty, fairness, respect, compassion and professional ethics among students. The students of social work adhere to the *National Association of Social Workers Code of Ethics*

- **Student engagement in the learning process:**

Obtaining extensive and varied opportunities to utilize and build upon the theoretical and empirical knowledge gained through workshops, seminars, conferences, industrial visits and summer internship programmes.

- **Employability:**

Enhancing students in their professional life through Entrepreneur development, Placement & Career guidance Cell.

- **Women empowerment and leadership:**

Developing the capacity of self-management, team work, leadership and decision making through gender sensitization programmes.

Programme Educational Objectives (PEOs)

PEOs	Upon completion of B.A/B.Sc. Degree Programme, the graduates will be able to:	Mapping with Mission
PEO1	apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.	**M1& M2**
PEO2	use practical knowledge for developing professional empowerment and entrepreneurship and societal services.	**M2, M3, M4 & M5**
PEO3	pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.	**M3, M4, M5 & M6**

Programme Outcomes (POs)

Pos	Upon completion of B.Sc. Degree Programme, the graduates will be able to:	Mapping with PEOs
PO1	obtain comprehensive knowledge and skills to pursue higher studies in the relevant field of science.	**PEO1**
PO2	create innovative ideas to enhance entrepreneurial skills for economic independence.	**PEO2**
PO3	reflect upon green initiatives and take responsible steps to build a sustainable environment.	**PEO2**
PO4	enhance leadership qualities, team spirit and communication skills to face challenging competitive examinations for a better developmental career.	**PEO1 &PEO3**
PO5	communicate effectively and collaborate successfully with peers to become competent professionals.	**PEO2&PEO3**
PO6	absorb ethical, moral and social values in personal and social life leading to highly cultured and civilized personality	**PEO2 & PEO3**
PO7	participate in learning activities throughout life, through self-paced and self-directed learning to improve knowledge and skills.	**PEO1&PEO3**

Programme Specific Outcomes (PSOs)

PSOs	On successful completion of the B.Sc. Botany programme, the students are expected to:	Mapping with POs
PSO1	implement the concept of science and technology to foster the traditional and modern techniques for solving the complex problems in Plant Biology.	**PO4**
PSO2	ensure the use of contemporary tools and techniques in understanding the scope and significance of Botany	**PO1& PO3**
PSO3	develop the scientific problem solving skills during experimentation, research projects, analysis and interpretation of data	**PO4 & PO7**
PSO4	design scientific experiments independently and to generate useful information to address various issues in Botany.	**PO6 & PO7**
PSO5	enhanced capacity to think critically; ability to design and execute experiments independently and/or team under multidisciplinary settings	**PO2 & PO5**
PSO6	design and standardize protocols for public health and safety, and cultural, societal, and environmental considerations	**PO6 & PO3**
PSO7	apply appropriate techniques, resources, and modern ICT tools for understanding plant resources.	**PO2 & PO7**
PSO8	demonstrate the contextual knowledge in sustainable exploitation of medicinal, economically important and endangered plants as per the National Biodiversity Act.	**PO6**
PSO9	follow the concept of professional ethics and bioethics norms for practicing the value of plant kingdom.	**PO6**
PSO10	communicate proficiently with various stakeholders and society, to comprehend and to write and present reports effectively	**PO4 & PO6**

Mapping of POs and PSOs

POs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10

PO 1	3	3	3	3	3	2	3	2	2	3
PO 2	3	3	3	3	3	2	3	2	3	3
PO 3	3	3	2	3	3	3	3	3	3	3
PO4	2	2	3	2	2	2	2	2	2	3
PO5	3	2	3	3	2	3	2	3	2	3
PO6	3	2	2	2	3	3	2	3	3	2
PO7	3	3	2	2	3	2	3	2	2	2
Total	20	18	18	18	19	18	18	17	17	19
Average	2.8	2.5	2.5	2.5	2.7	2.5	2.5	2.4	2.4	2.7

Eligibility Norms for Admission

Eligibility: 10 + 2 pattern

Those who seek admission to B.Sc. Botany Programme must have passed Higher Secondary Examination conducted by the Board of Higher secondary Examination, Tamil Nadu with Botany or Biology as one of the subjects or any other examinations recognized and approved by the Syndicate of Manonmaniam Sundaranar University, Tirunelveli.

Duration of the Programme: 3 years

Medium of Instruction: English

Passing Minimum

A minimum of 40% in the external examination and an aggregate of minimum 40% is required. There is no minimum pass mark for the continuous internal assessment.

Components of the B.Sc. Botany programme

Part III (Core Courses and Elective Courses)

Core Courses	Core-Theory	8 x 100	800
	Core Lab Course	8 x 100	800
	Discipline Specific Elective-Theory	4 x 100	400
	Core Research Project	1 x 100	100
	Total Marks		**2100**
Elective Courses	Theory	4 x 100	400
	Lab Course	4 x 100	400
	Total Marks		**800**
	Total Marks		**2900**

- **Core and Elective Lab Courses carry 100 marks each.**
- Practical examination will be conducted at the end of each semester for Core and Elective Courses.

Course Structure

Distribution of Hours and Credits

Curricular Courses

Course	**SI**	**S II**	**S III**	**S IV**	**S V**	**SVI**	**Total**	
							Hours	**Credits**
Part I –Language	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Part II-English	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Part-III								
Core Course Core Lab Course	5(5) 3(3)	5(5) 3(3)	5(5) 3(3)	5(5) 3(3)	5 (4) + 5 (4) + 3 (2) 2(2)	6 (5) + 6 (5) + 3 (2) 3 (2)	70	62

Core Research Project					5(4)			
Elective /Discipline Specific Elective Courses	4 (3) 2(2)	4(3) 2(2)	4 (3) 2(2)	4(3) 2(2)	4 (3) 4 (3)	5 (3) 5 (3)	42	32
Part IV								
Non-major Elective	2 (2)	2 (2)					4	4
Skill Enhancement Course		2 (2)	2(2) + 2 (2)	2 (2)			8	8
Foundation Course	2 (2)						2	2
Environmental Studies				2 (2)			2	2
Professional Competency Skill					2 (2)	2 (2)	4	4
Internship					(2)			2
Total	**30 (23)**	**30 (23)**	**30 (23)**	**30 (23)**	**30 (26)**	**30 (22)**	**180**	**140**

Co-curricular Courses

Course	**S I**	**S II**	**S III**	**S IV**	**S V**	**S VI**	**Total**
LST (Life Skill Training)	-	(1)	-	(1)			2
Skill Development Training (Certificate Course)	(1)						1
Field Project		(1)					1
Specific Value-added Course	(1)		(1)				2
Generic Value-added Course				(1)		(1)	2
MOOC	(2)						2
Student Training Activity: Clubs & Committees / NSS				(1)			1
Community Engagement Activity: RUN				(1)			1
Human Rights,Justice and Ethics					(1)		1
Gender Equity and Inclusivity						(1)	1
Total							**14**

Total number of Compulsory Credits = Academic credits + Non-academic credits: 140 + 14

Courses Offered

SEMESTER I

Course	**Course Code**	**Title of the Course**	**Credits**	**Hours/ Week**
Part I	TU231TL1 FU231FL1	Language: Tamil French	3	6
Part II	EU241EL1	English: A Stream	3	6
	EU241EL2	English: B Stream		
	EU241EL3	English: C Stream		

Part III	BU231CC1	Core Course I: Plant Diversity -I-Algae	5	5
	BU231CP1	Core Lab Course I: Plant Diversity -I-Algae -Practical I	3	3
	BU231EC1	Elective Course I: Allied Botany -I	3	4
	BU231EP1	Elective Lab Course I: Allied Botany Practical	2	2
Part IV	BU231NM1	Non Major Elective NME I: Nursery and Landscaping	2	2
	BU231FC1	Foundation Course	2	2
		Total	**23**	**30**

SEMESTER II

Course	Course Code	Title of the Course	Credits	Hours/ Week
Part I	TU232TL1 FU232FL1	Language: Tamil French	3	6
Part II	EU242EL1	English: A Stream	3	6
	EU242EL2	English: B Stream		
	EU242EL3	English: C Stream		
Part III	BU232CC1	Core Course II: Plant Diversity II- Fungi, Bacteria, Viruses, Plant Pathology and Lichens	5	5
	BU232CP1	Core Lab Course II: Plant Diversity II- Fungi, Bacteria, Viruses, Plant Pathology and Lichens – Practical -II	3	3
	BU232EC1	Elective Course II: Allied Botany -II	3	4
	BU232EP1	Elective Lab Course II: Allied Botany Practical	2	2
Part IV	BU232NM1	Non Major Elective NME II: Mushroom Cultivation	2	2
	BU232SE1	Skill Enhancement Course SEC I: Botanical Garden and Landscaping	2	2
		Total	**23**	**30**

SEMESTER III

Course	Course Code	Title of the Course	Credits	Hours / Week
Part I	TU233TL1 FU233FL1	Language: Tamil French	3	6
	EU243EL1	English: A Stream	3	6
	EU243EL2	English: B Stream		
	EU243EL3	English: C Stream		
Part III	BU233CC1	Core Course III: Plant Diversity – III – Bryophytes and Pteridophytes	5	5
	BU233CP1	Core Lab Course III: Plant Diversity – III – Bryophytes and Pteridophytes Practical	3	3
	BU233EC1	Elective Course III: Allied Botany -III	3	4
	BU233EP1	Elective Lab Course III: Allied Botany Practical	2	2

Part IV	BU233SE1	Skill Enhancement Course SEC II: Entrepreneurial Opportunities in Botany	2	2
	UG23CSE2	Skill Enhancement Course SEC-IV: Digital Fluency	2	2
		Total	**23**	**30**

SEMESTER IV

Course	Course Code	Title of the Course	Credits	Hours / Week
Part I	TU234TL1 FU234FL1	Language: Tamil French	3	6
Part II	EU244EL1	English: A Stream	3	6
	EU244EL2	English: B Stream		
	EU244EL3	English: C Stream		
Part III	BU234CC1	Core Course IV: Plant Diversity – IV – Gymnosperms, Paleobotany and Evolution	5	5
	BU234CP1	Core Lab Course IV: Plant Diversity –IV – Gymnosperms, Paleobotany and Evolution- Practical -IV	3	3
	BU234EC1	Elective Course IV: Allied Botany – IV	3	4
	BU234EP1	Elective Lab Course IV: Allied Botany Practical	2	2
	UG23CSE1	Skill Enhancement Course SEC-III: Fitness for Wellbeing	2	2
	UG234EV1	Environmental Studies (EVS)	2	2
		Total	**23**	**30**

SEMESTER V

Course	Course Code	Title of the Course	Credits	Hours/ Week
Part III	BU235CC1	Core Course V: Plant Morphology, Taxonomy and Economic Botany	4	5
	BU235CC2	Core Course VI: Cell Biology, Plant Anatomy and Embryology	4	5
	BU235CP1	Core Lab Course V: Plant Morphology, Taxonomy and Economic Botany	2	3
	BU235CP2	Core Lab Course VI: Cell Biology, Plant Anatomy and Embryology	2	2
	BU235RP1	Core Research Project	4	5
	BU235DE1	**Discipline Specific Elective I:** a) Bio-Analytical Technology	3	4
	BU235DE2	**Discipline Specific Elective I**: b) IKS: Herbal Therapeutics		
	BU235DE3	**Discipline Specific Elective I:** c) Fermentation Technology		
	BU235DE4	**Discipline Specific Elective II :** a) Phytobioresources	3	4
	BU235DE5	**Discipline Specific Elective II** : b) Seed Biology		

	BU235DE6	**Discipline Specific Elective II** : c) Pomology		
Part IV	UG235PS1	Professional Competency Skill I: Career Skills	2	2
	BU235IS1	Internship	2	-
		Total	**26**	**30**

SEMESTER VI

Course	Course Code	Title of the Course	Credits	Hours
Part III	BU236CC1	Core Course VII: Plant Physiology and Biochemistry	5	6
	BU236CC2	Core Course VIII: Genetics, Plant Ecology and Phytogeography	5	6
	BU236CP1	Core Lab Course VII: Plant Physiology and Biochemistry	2	3
	BU236CP2	Core Lab Course VIII: Genetics, Plant Ecology and Phytogeography	2	3
	BU236DE1	**Discipline Specific Elective III:** a) Horticulture and Plant Breeding	3	5
	BU236DE2	**Discipline Specific Elective III:** b) Sustainable Management of Bioresources		
	BU236DE3	**Discipline Specific Elective III:** c) Forensic Botany		
	BU236DE4	**Discipline Specific Elective IV:** a) Plant Biotechnology and Molecular Biology	3	5
	BU236DE5	**Discipline Specific Elective IV:** b) Forestry		
	BU236DE6	**Discipline Specific Elective IV:** c) Computational tools and Artificial Intelligences in Botany		
	BU236PS1	**Professional Competency Skill II:** Molecular and Analytical Approaches in Plant Biology and Systematics	2	2
		Total	**22**	**30**
TOTAL			**140**	**180**

Co-curricular Courses

Part	Semester	Course Code	Title of the Course	Credit
	I & II	UG232LC1	Life Skill Training I: Catechism	1
		UG232LM1	Life Skill Training I: Moral	
	I	UG231C01 –	Skill Development Training (SDT) - Certificate Course	1
	II	BU232FP1	Field Project	1
	I & III	BU231V01 -	Specific Value-added Course	1+1
	VI	UG236OC1 & UG236OC2	MOOC	2
	III & IV	UG234LC1	Life Skill Training II: Catechism	1
		UG234LM1	Life Skill Training II: Moral	
	IV & VI	GVAC2401 -	Generic Value-added Course	1 +1

Part V	I - IV	UG234ST1	Student Training Activity – Clubs & Committees / NSS	1
	IV	UG234CE1	Community Engagement Activity - RUN	1
	V	UG235HR1	Human Rights, Justice abd Ethics	1
	VI	UG236GE1	Gender Equity and Inclusivity	1
Total				**14**

Specific Value-added Courses

Semester	Course Code	Title of the Course	Credit
I	BU231V01	Art of Bonsai	1
I	BU231V02	Lemon grass - cultivation and oil extraction	1
I	BU231V03	Poisonous and Allergic plants	1
III	BU233V01	Miniature Garden in Limited Space	1
III	BU233V02	Cultivation of Algae	1
III	BU233V03	Fermentation Technology	1

Self-Learning Course

Semester	Course Code	Title of the Course	Credit
III / V	BU233SLI/BU235SL1	Natures Wealth	1
IV/ VI	BU234SLI /BU236SL1	Herbal Formulations	1

Examination Pattern

Each paper carries an internal component. There is a passing minimum for external component. A minimum of 40% in the external examination and an aggregate of 40% is required.

i. Part I – Tamil, Part II – English, Part III - (Core Course/ Elective Course)

Ratio of Internal and External= 25:75

Continuous Internal Assessment (CIA)

Internal Components and Distribution of Marks

Components	Marks
Internal test (2) - 40 marks	10
Quiz (2) - 20 marks	5
Assignment: (Model Making, Exhibition, Role Play, Seminar, Group Discussion, Problem Solving, Class Test, Open Book Test etc. (Minimum three items per course should be included in the syllabus & teaching plan) (30 marks)	10
Total	**25**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 4 x 1(No choice)	4	Part A 10 x 1 (No choice)	10
Part B 2 x 6 (Internal choice)	12	Part B 5 x 6 (Internal choice)	30
Part C 2 x 12 (Internal choice)	24	Part C 5 x 12 (Internal choice)	60
Total	**40**	**Total**	**100**

ii. Lab Course:

Ratio of Internal and External= 25:75

Total: 100 marks

Internal Components and Distribution of Marks

Internal Components	Marks
Performance of the Experiments	10
Regularity in attending practical and submission of records	5
Record	5

Model exam	5
Total	**25**

Question pattern

External Exam	**Marks**
Major Practical	
Minor Practical / Spotters /Record	75
Total	**75**

Core Research Project

Ratio of Internal and External = 25:75

Components	**Marks**
Internal	25
External	
Core Research Project Report	40
Viva voce	35
Total	**100**

Part - IV

i. Non-major Elective, Skill Enhancement Course I & II, Foundation Course and Professional Competency Skill

Ratio of Internal and External = 2**5: 75**

Internal Components and Distribution of Marks

Components	**Marks**
Internal test (2) – 25 marks	10
Quiz (2) – 20 marks	5
Assignment: (Model Making, Exhibition, Role Play, Album, Group Activity, etc. (Minimum three items per course)	10
Total	**25**

Question Pattern

Internal Test	**Marks**	**External Exam**	**Marks**
Part A 2 x 2 (No Choice)	4	Part A 5 x 2 (No Choice)	10
Part B 3 x 4 (Open choice **Three** out of **Five**)	12	Part B 5 x 4 (Open choice any **Five** out of **Eight**)	20
Part C 1 x 9 (Open choice O**ne** out of **Three**)	9	Part C 5 x 9 (Open choice any **Five** out of **Eight**)	45
Total	**25**	**Total**	**75**

ii. Skill Enhancement Course III & IV

Digital Fluency

Components	**Marks**
Internal	
Quiz (15 x 1)	15
Lab Assessment (5 x 2)	10
Total	**25**
External	
Practical (2 x 25)	50
Procedure	25
Total	**75**

Fitness and Wellbeing

Components	**Marks**

Internal	
Quiz (15 x 1)	15
Exercise (2 x 5)	10
Total	**25**
External	
Written Test: Part A: Open choice – 5 out of 8 questions (5 x 5) Part B: Open choice – 5 out of 8 questions (5 x 10)	25 50
Total	**75**

iii. Environmental Studies

Internal Components	**Marks**
Project Report	15
Viva voce	10
Total	**25**

External Exam	**Marks**
Part A 5 x 2 (No Choice)	10
Part B 5 x 4 (Open choice any **Five** out of **Eight**)	20
Part C 5 x 9 (Open choice any **Five** out of **Eight**)	45
Total	**75**

iv. Internship

Components	**Marks**
Industry Contribution	50
Report & Viva-voce	50
Total	**100**

v. Professional Competency Skill

Internal Components	**Marks**
Test – 20 marks	5
Individual Activity	10
Group Activity	10
Total	**25**
External Exam	**Marks**
Part A 5 x 2 (No Choice)	10
Part B 5 x 4 (Open choice any **Five** out of **Eight**)	20
Part C 5 x 9 (Open choice any **Five** out of **Eight**)	45
Total	**75**

Co-Curricular Courses:

i. Life Skill Training: Catechism & Moral
Human Rights, Justice and Ethics
Gender Equity and Inclusivity

Internal Components

Component	**Marks**
Project - Album on current issues	25
Group Activity	25
Total	**50**

External Components

Component	Marks
Written Test: Open choice – 5 out of 8 questions (5 x 10)	50
Total	**50**

ii. Skill Development Training - Certificate Course:

Components	Marks
Attendance & Participation	50
Skill Test	50
Total	**100**

iii. Field Project:

Components	Marks
Field Work	50
Field Project Report & Viva-voce	50
Total	**100**

iv. Specific Value-Added Courses & Generic Value-Added Courses:

Components	Marks
Internal	25
External	75
Total	**100**

v. Student Training Activity: Clubs and Committees

Compulsory for all I & II year students (1 credit).

Component	Marks
Attendance	25
Participation	75
Total	**100**

vi. Community Engagement Activity: Reaching the Unreached Neighbourhood (RUN)

Components	Marks
Attendance & Participation	50
Field Project	50
Total	**100**

vii. Self-Learning Course

Internal Test	Marks	External Exam	Marks
Part A 3 x 5(Open choice)	15	Part A 5 x 5 (Open choice)	25
Part B 1 x 10 (Open choice)	10	Part B 5 x 10 (Open choice)	50
Total	25	**Total**	**75**

Outcome Based Education (OBE)

(i) Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No.	Level	Parameter	Description
1	KI	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/ Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision

6	K6	Synthesis /Creating	The learner creates a new product or point of view

(ii) Weightage of K – Levels in Question Paper

Number of questions for each cognitive level:

Programme	Assessment	Lower Order Thinking									Higher order thinking			Total number of questions
		K1			K2			K3			K4, K5, K6			
	Part	A	B	C	A	B	C	A	B	C	A	B	C	
I UG	External	5	2	1	3	2	2	2	1	2	-	-	-	20
	Internal	2	1	-	1	1	1	1	-	1	-	-	-	8
II UG	External	5	1	1	4	1	1	-	3	1	1	-	2	20
	Internal	1	1	-	1	1	1	1	-	1	1	-	-	8
III UG	External	5	1	1	4	1	1	-	3	1	1	-	2	20
	Internal	1	-	-	1	-	1	1	1	1	1	1	-	8

The levels of assessment are flexible and it should assess the cognitive levels and outcome attainment.

Evaluation

i. The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade points.

ii. Evaluation of each course shall be done by Continuous Internal Assessment (CIA) by the course teacher as well as by an end semester examination and will be consolidated at the end of the semester.

iii. There shall be examinations at the end of each semester, for odd semesters in October/November; for even semesters in April/ May.

iv. A candidate who does not pass the examination in any course(s) shall be permitted to reappear in such failed course(s) in the subsequent examinations to be held in October/ November or April/May. However, candidates who have arrears in practical examination shall be permitted to reappear for their areas only along with regular practical examinations in the respective semester.

v. Viva-voce: Each project group shall be required to appear for Viva -voce examination in defence of the project.

vi. The results of all the examinations will be published in the college website.

Conferment of Bachelor's Degree

A candidate shall be eligible for the conferment of the Degree of Bachelor of Arts / Science / Commerce only if the minimum required credits for the programme thereof (140 + 18 credits) is earned.

Grading System

For the Semester Examination:

Calculation of Grade Point Average for End Semester Examination:

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

For the entire programme:

Cumulative Grade Point Average (CGPA) $\Sigma_n\Sigma_i C_{ni}G_{ni} / \Sigma_{ni}\Sigma_i C_{ni}$

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

where

C_i - Credits earned for course i in any semester

G_i - Grade point obtained for course i in any semester

n - semester in which such courses were credited

Final Result

Conversion of Marks to Grade Points and Letter Grade

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	C	Satisfactory
00-39	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

Overall Performance

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	
4.0 and above but below 5.0	C	Third Class
0.0 and above but below 4.0	U	Re-appear

*The candidates who have passed in the first appearance and within the prescribed semester are eligible for the same.

SEMESTER I

CORE COURSE I: PLANT DIVERSITY I ALGAE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231CC1	3	2	-	-	5	5	75	25	75	100

Pre-requisites:

Students should be familiar with the basics of different classes of algae.

Learning Objectives

1.To provide a comprehensive knowledge on the biology of algae and to understand the evolution higher of plants.

2. To understand the role of algae in ecosystems as primary producers of nutrition and also the importance of algae to animals and humans.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	relate to the structural organization, reproduction and significance of algae.	**K2 &K5**
2.	demonstrate knowledge in understanding the various life cycle patterns and the fundamental concepts in algal growth	**K3 &K1**
3.	explain the benefits of various algal technologies on the ecosystem.	**K1**
4.	compare and contrast the thallus organization and modes of reproduction in algae.	**K4 & K5**
5.	determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses.	**K5 & K6**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Unit	Contents	No. of Hours
I	General characters of algae, Classification (Fritsch-1935-1945), criteria for classification, algal distribution.	**15**
II	Thallus organization (unicellular-*Chlorella*, Diatoms, colonial-*Volvox*, filamentous-*Anabaena*, *Oedogonium*, siphonous-*Caulerpa*, parenchymatous- *Sargassum*, *Gracilaria*).	**15**
III	Reproduction-Vegetative, asexual, sexual reproduction and life histories (haplontic-, *Oedogonium* and *Chara*, diplontic-Diatoms and *Sargassum*, diplohaplontic-*Ulva* and diplobiontic-*Gracilaria*)	**15**
IV	Algal cultivation methods, Algal production systems; indoor cultivation methods and large-scale cultivation of algae, harvesting of algae.	**15**
V	Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite. Resource potential of algae: Application of algae as fuel, agriculture and pharmaceutical. Phyco remediation. Role of algae in CO_2 sequestration, Algae as indicator of water pollution, algal bioinoculants, Bioluminescence.	**15**
	Total	**75**

Self-Study	Algal Distribution, Algae as indicator of pollution**.**

Textbooks:

1. Edwardlee, R. 2018. Phycology. (Fifth Edition). Cambridge University Press, London.
2. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.

3. Singh, Pandey and Jain. 2020) A text book of Botany. (Fifth Edition) Rastogi Publication, Meerut.
4. Vashishta, P.C. 2014. Botany for Degree Students – Algae. S.Chand & Company Ltd, New Delhi.
5. Ian Morris. 1977. An introduction to the algae. Hutchinson & Co Publishers Ltd., London.

References Books:

1. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. University of Sulaimani, Iraq.
2. Mihir Kumar, D. 2010. Algal Biotechnology. Daya Publishing House, New Delhi.
3. Chapman V.J. and Chapman D.J. 2013. The Algae. Alpha Numera,Delhi.
4. Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University Press, London.
5. Round, FE. 1984. The Ecology of Algae. Cambridge University Press,London.
6. Lee, R.D. 2008. Phycology. (4th Edition). London: Cambridge University Press, New York.
7. Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India, New Delhi.

Web Resources:

1. https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382
2. https://www.crcpress.com/Algae-Anatomy-Biochemistry-and-Biotechnology-Second-Edition/Barsanti-Gualtieri/p/book/9781439867327
3. https://www.crcpress.com/Marine-Algae-Biodiversity-Taxonomy-Environmental-Assessment-and-Biotechnology/Pereira-Neto/p/book/9781466581678
4. https://www.kopykitab.com/Botany-For-Degree-Students-ALGAE-by-B-R-Vashishta
5. https://www.wileyindia.com/a-textbook-of-algae.html

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	3	3	3
CO2	3	3	1	2	2	1	2
CO3	3	3	3	1	2	1	2
CO4	3	3	1	2	1	2	2
CO5	3	3	2	1	2	2	2
Total	15	15	10	9	10	9	11
Average	3	3	2	1.8	2	1.9	2.2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	2	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	`1	2	3
CO3	2	2	3	2	2	2	1	2	1	2
CO4	3	3	3	3	3	2	2	2	2	3
CO5	3	3	2	3	3	2	2	3	2	3
Total	14	14	12	13	13	10	9	10	9	12
Average	2.8	2.8	2.4	2.6	2.6	2.0	1.8	2.0	1.8	2.4

S-Strong (3) M-Medium (2) L-Low (1)

SEMESTER I

CORE LAB COURSE I: PLANT DIVERSITY I: ALGAE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
BU231CP1	1	-	2	-	3	3	45	25	75	100

Pre-requisites: Students should be familiar with the basics of algae.

Learning Outcomes:

1. To develop skills to identify micro and macroalgae based on habitat, thallus structure and the internal organization.
2. To develop skills to prepare the microslides of algae.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recall and identify algae using key identification characters.	**K1**
2.	demonstrate practical skills in preparation of fresh mount and identification of algal forms from algal mixture.	**K3 &K2**
3.	describe the internal structure of algae prescribed in the syllabus	**K2**
4.	decipher the algal diversity in fresh/marine water and their economic significance.	**K4 &K6**
5.	evaluate the various techniques used to culture algae for commercial purposes	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

EXPERIMENTS	No. of Hours
. Micro-preparation of the types prescribed in the syllabus. a. *Caulerpa* - Thallus b. *Sargassum* – Stipe and Leaf c. *Gracilaria* - Thallus d. *Ulva* – Thallus e. *Chara* - Thallus 2. Identifying the micro slides relevant to the syllabus. a. *Chlorella* b. *Diatoms* c. *Volvox* with daughter colony, *Volvox* antheridia, *Volvox* archegonia d. *Anabaena* e. *Oedogonium* f. *Sargassum* male conceptacle, *Sargassum* female conceptacle g. *Gracilaria* Cystocarp 3. Identifying types of algal mixture. 4. Economic importance of Algae as: (i) Food (ii) Feed (iii) Biofertilizers (iv) Seaweed liquid fertilizer (v) Hydrogen production by algae (vi) SCP (vii) Agar Agar (viii) Alginate (ix) Diatomaceous earth. 5. Field visit to study fresh water/marine water algal habitats. 6. Visit to nearby industry actively engaged in algal technology.	**45**

Textbooks:

1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany-1 (Tenth Edition). Meerut: Rastogi Publications.
3. Round, FE. 1984. The Ecology of Algae. Cambridge University Press, London.
4. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. University of Sulaimani, Sulaymaniyah, Iraq.

5. Singh, Pandey and Jain. 2020. A text book of Botany. (Fifth Edition). Rastogi Publication, Meerut.

References Books:

1. Nancy Serediak and M. Huynh. 2011. Algae identification Lab Guide. Agriculture and Agri-Food, Canada.
2. Chapman, V.J and Chapaman, D.J. 1960. The Algae. ELBS & MacMillan, London.
3. Lee, R.D. 2008. Phycology. (Fourth Edition). Cambridge University Press, London.
4. Edwardlee, R. 2018. Phycology. (Fifth Edition). Cambridge University Press, London.

Web Resources:

1. https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492
2. https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id=8d5DAAAACAAJ&redir_esc=
3. https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-(PDF-21P).html
4. https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/
5. https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&redir_esc=y

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	1	2	1	2
CO2	3	3	2	1	3	2	2
CO3	3	2	3	2	2	2	1
CO4	3	3	3	2	3	1	3
CO5	3	3	3	2	2	2	2
Total	15	13	14	8	12	8	10
Average	3	2.6	2.8	1.6	2.4	1.6	2.0

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	3	3	3	3	3	2	2	2	3
CO2	2	2	3	3	3	2	3	2	1	3
CO3	3	2	3	3	3	3	3	2	2	3
CO4	3	3	3	3	3	2	2	1	2	3
CO5	2	2	3	3	3	3	2	1	2	3
Total	12	12	15	15	15	13	12	8	9	15
Average	2.4	2.4	3	3	3	2.6	2.4	1.6	1.8	3

S-Strong (3) M-Medium (2) L-Low(1)

SEMESTER I

ELECTIVE COURSE I: ALLIED BOTANY -I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231EC1	4	-	-	-	3	4	60	25	75	100

Pre-requisites: To study the basics of botany.

Learning Objectives

Course Outcomes

1.To study morphological and anatomical adaptations of plants of various habitats.

2. To demonstrate techniques and experiments in plant tissue culture, plant physiology and biochemistry**.**

On the successful completion of the course, student will be able to:		
1.	increase the awareness and appreciation of human friendly algae and their economic importance.	**K3**
2.	develop an understanding of microbes and fungi and appreciate their adaptive strategies	**K2**
3.	develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	**K2**
4.	compare the structure and function of cells and explain the development of cells.	**K4**
5.	understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	**K2**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Unit	Contents	No. of Hours
I	**Algae:** General characters of algae - Structure, reproduction and life cycle of the following genera - *Anabaena* and *Sargassum* and economic importance of algae.	**12**
II	**Fungi, Bacteria and Virus:** General characters of fungi, structure, reproduction and life cycle of the following genera - *Penicillium* and *Agaricus* and economic importance of fungi. Bacteria - general characters, structure and reproduction of *Escherichia coli* and economic importance of bacteria. Virus - general characters, structure of TMV, structure of bacteriophage	**12**
III	**Bryophytes, Pteridophytes and Gymnosperms:** General characters of Bryophytes, Structure and life cycle of *Funaria*. General characters of Pteridophytes, Structure and life cycle of *Lycopodium*. General characters of Gymnosperms, Structure and life cycle of *Cycas*.	**12**
IV	**Cell Biology:** Prokaryotic and Eukaryotic cell- structure /organization. Cell organelles - ultra structure and function of chloroplast, mitochondria and nucleus. Cell division - mitosis and meiosis	**12**
V	**Genetics and Plant Biotechnology:** Mendelism - Law of dominance, Law of segregation, Incomplete dominance. Law of independent assortment. Monohybrid and dihybrid cross - Test cross - Back cross. Plant tissue culture - In vitro culture methods. Plant tissue culture and its application in biotechnology.	**12**
	Total	**60**

Self Study	General Characters of Algae, Fungi, Bacteria

Textbooks:

1. Singh, V., Pande, P. C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
2. Bhatnagar, S.P. and Alok Moitra. 2020. Gymnosperms. New Age International (P) Ltd., Bengaluru.
3. Sharma, O.P. 2017. Bryophyta. MacMillan India Ltd, Delhi.
4. Lee, R.E. 2008. Phycology. (Fourth Edition). Cambridge University Press, New Delhi.
5. Rao, K. Krishnamurthy, K.V. and Rao, G.S. 1979. Ancillary Botany. S.Viswanathan Pvt. Ltd., Madras.

Reference Books:

1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes. Surjeet Publications, New Delhi.
2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd, New Delhi.
3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, New Delhi.
4. Coulter, M. Jhon 2014. Morphology of Gymnosperms. Surjeet Publications, New Delhi.
5. Vashishta, P.C. 2014. Botany for Degree Students Algae. Chand & Company Ltd., New Delhi.
6. Parihar, N.S.2013. An introduction to Embryophyta –Bryophytes. Surjeet Publications, New Delhi.
7. Pandey, B.P. 1986. Text Book of Botany. Vol I &II. S. Chand and Co, New Delhi.

Web Resources

1. https://www.kobo.com/us/en/ebook/the-algae-world
2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html
3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
5. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	1	2
CO2	3	2	3	2	2	2	1
CO3	3	2	3	3	2	2	2
CO4	3	3	2	2	2	2	2
CO5	3	2	3	2	2	1	2
Total	15	12	13	11	10	8	9
Average	3	2.4	2.6	2.2	2.0	1.6	1.8

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	2	2	2	2	2	2	3
CO2	3	2	2	3	3	1	1	2	3	2
CO3	2	3	3	2	2	2	1	2	2	2
CO4	3	2	2	3	3	2	2	1	2	3
CO5	3	3	2	3	2	1	2	2	1	3
Total	14	13	12	13	12	8	8	9	10	13
Average	2.8	2.6	2.4	2.6	2.4	1.6	1.6	1.8	2.0	2.6

S-Strong (3) **M-Medium(2)** **L-Low(1)**

SEMESTER I

ELECTIVE LAB COURSE I: ALLIED BOTANY PRACTICAL

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231EP1	-	-	2	-	2	2	30	25	75	100

Prerequisites: Practical pertaining to above subjects is important to get knowledge on various aspects of plants.

Learning Outcomes

1. To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of microorganisms, algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms.
2. To understand the laws of inheritance, genetic basis of loci and alleles.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	study the internal organization of algae and fungi.	**K1**
2.	develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	**K2**
3.	study the classical taxonomy with reference to different parameters.	**K4**
4.	understand the fundamental concepts of plant anatomy and embryology	**K2**
5.	study the effect of various physical factors on photosynthesis.	**K3**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze

	Contents	No. of Hours
	EXPERIMENTS **1.** Make suitable micro preparation of a. Anabaena b. *Sargassum* - Stipe, Leaf, c. Penicillium d. Agaricus e. Structure of Bacteria f. Structure of Bacteriophage g. *Funaria* – Stem, Archegonial cluster, Antheridial cluster, Sporophyte L.S h. *Lycopodium* – Stem, Cone i. *Cycas* – Leaflet, T.S Microsporophyll, T.S. of Megasporophyll, Ovule L.S 2. Micro photographs of the cell organelles ultra structure – Chloroplast, Mitochondria, Nucleus, Mitosis and Meiosis 3. Simple Genetic Problem 4. Biotechnology Spotters a. Hot Air Oven b. Laminar Air Flow Chamber c. Autoclave	**30**

Textbooks:

1. Sharma, O.P. 2017. Bryophyta. MacMillan India Ltd, New Delhi.
2. Sharma, O.P. 2012. Pteridophyta. Tata McGraw-Hills Ltd., New Delhi.
3. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.

4. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, England.
5. Noggle, G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.

Reference Books:

1. Strickberger, M.W. 2005. Genetics (Third Edition). Prentice Hall, New Delhi.
2. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide. Ottawa Agriculture and Agri food Canada Publisher, Canada.
3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing, New Delhi.
4. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & WileyPublications, London.
5. Steward, F.C. 2012. Plant Physiology. US Academic Press, United States.

Web Resources:

1. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883
2. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover
3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ
4. https://medlineplus.gov/genetocs/understanding/basics/cell/
5. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf
6. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
7. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	1	2
CO2	3	2	2	2	3	2	2
CO3	3	3	3	2	2	1	2
CO4	3	2	2	3	3	1	2
CO5	3	3	2	2	3	2	3
Total	15	13	11	11	13	7	11
Average	3	2.6	1.1	2.2	2.6	1.4	2.2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	2	2	1	2	1	1	2	2
CO2	2	3	2	1	1	1	1	2	1	2
CO3	3	3	1	1	2	2	2	1	2	1
CO4	3	2	2	2	1	2	2	2	2	2
CO5	3	3	3	2	2	1	2	2	1	2
Total	14	13	10	8	7	8	8	6	8	7
Average	2.8	2.6	2.0	1.6	1.4	1.6	1.6	1.2	1.6	1.4

S-Strong (3) M-Medium (2) L-Low (1)

SEMESTER I

NON-MAJOR ELECTIVE NME I: NURSERY AND LANDSCAPING

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231NM1	2	-	-	-	2	2	30	25	75	100

Pre-requisites:

Students should know about the fundamental concepts of nursery and landscaping.

Learning Objectives

1. To recognize the importance of growing plants and practice the knowledge gained by developing kitchen garden and ornamental garden.
2. To be able to design gardens, learn the methods of propagation and become entrepreneur in Horticulture.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recognize the basic principles and components of gardening.	K2
2.	explain about bio-aesthetic planning and conceptualize flower arrangement.	K1
3.	apply techniques for design various types of gardens according to the culture and art of bonsai.	K3
4.	compare and contrast different garden styles and landscaping patterns	K4
5.	establish and maintain special types of gardens for outdoor and indoor landscaping.	K2

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Unit	Contents	No. of Hours
I	Introduction, prospects and scope of nursery and landscaping.	**6**
II	Methods of Propagation – cutting, layering, grafting, budding, Floriculture – Rose, Chrysanthemum, Jasmine – cultivation.	**6**
III	Gardening – formal garden, informal garden, vegetable garden, landscaped layout designing – formation and maintenance of lawn.	**6**
IV	Nursery structures – Green house – Shade house, Mist chamber – Topiary, Bonsai culture.	**6**
V	Manures, composting – vermicomposting.	**6**
	Total	**30**

Self Study	Cultivation of Rose

Textbooks:

1. Amarnath V. 2006. Nursery and Landscaping. M/s IBD Publishers, New Delhi.
2. Butts, E. and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd., Canada.
3. Mukherjee, D. 2002. Gardening in India, Oxford IBH publishing Co., New Delhi.
4. Kumar, N. 1997. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil.
5. De, L. C. 2013. Nursery and Landscaping. Pointer Publishers, India.

Reference Books:

1. Agrawal, P. K. 1993. Hand Book of Seed Technology. Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
2. Janick Jules. 1979. Horticultural Science. (Third Edition), W.H. Freeman and Co., San Francisco, USA.
3. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers, India.
4. Sharma, V. K. 1999. Encyclopedia of Practical Horticulture. Deep and Deep Publ. Pvt. Ltd., New Delhi.
5. Ingels J. and Smith A. F. 2018. Landscaping: principles & practices. Cengage Learning, United States.

Web Resources:

1. https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And-Landscaping-by-V-Amarnath
2. https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788
3. https://www.amazon.in/Gardening/b?ie=UTF8&node=1637077031
4. https://in.pinterest.com/pin/496733033900458021/?lp=true
5. https://www.gardenvisit.com/ebooks

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	3	2	2	2
CO2	3	3	2	2	1	2	2
CO3	3	3	3	3	2	3	2
CO4	3	3	2	3	2	3	3
CO5	3	3	2	3	2	2	3
Total	15	14	10	14	9	12	12
Average	3	2.8	2	2.8	1.8	2.4	2.4

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	3	3	3	3	3	2	2	2	3
CO2	2	2	3	3	3	2	3	2	1	3
CO3	3	2	3	3	3	3	3	2	2	3
CO4	3	3	3	3	3	2	2	1	2	3
CO5	2	2	3	3	3	3	2	1	2	3
Total	12	12	15	15	15	13	12	8	9	15
Average	2.4	2.4	3	3	3	2.6	2.4	1.6	1.8	3

S-Strong (3) M-Medium (2) L-Low (1)

SEMESTER I

FOUNDATION COURSE: BASICS OF BOTANY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231FC1	2		-	-	2	2	30	25	75	100

Pre-requisites:

To recall the students about the basic aspects of botany.

Learning Objectives

1. To learn about the classification and Salient features of algae, fungi, bryophytes, Pteridophytes and gymnosperms, viruses and bacteria.

2. To learn about cell biology, Plant Morphology, Genetics, and plant physiology.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	increase the awareness and appreciation of human friendly algae and their economic importance	**K1**
2.	develop an understanding of microbes and fungi and appreciate their adaptive strategies	**K1**
3.	develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms	**K2**
4.	compare the structure and function of cells and explain the development of cells.	**K4**
5.	understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	**K2**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze

Unit	Contents	No. of Hours
I	**BIODIVERSITY** Systematics: Two Kingdom and Five Kingdom systems - Salient features of various Plant Groups: Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.	**6**
II	**CELL BIOLOGY** Cell as the basic unit of life - Prokaryotic and Eukaryotic Cell (Plant Cell) - Light Microscope and Electron Microscope Ultra Structure of Prokaryotic and Eukaryotic Cells - Cell Wall - Cell Membrane, Plastids, Ribosomes.	**6**
III	**PLANT MORPHOLOGY** Structure and Modification of Root, Stem and Leaf - Structure and Types of Inflorescences - Structure and Types of Flowers, Fruits and Seeds.	**6**
IV	**GENETICS** Concept of Heredity and Variation - Mendel's Laws of Inheritance.	**6**
V	**PLANT PHYSIOLOGY** Cell as a Physiological Unit : Water relations -Absorption and movement : Diffusion, Osmosis, Plasmolysis, Imbibition -Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition	**6**
	Total	**30**

Self Study	Prokaryotic and Eukaryotic Cell (PlantCell), Structure and Modification of Root, Stem and Leaf

Textbooks:

1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
5. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II, S.Chand and Co. New Delhi.
6. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany, S. Viswanathan Pvt. Ltd., Madras.

Reference Books:

1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes. Surjeet Publications, Delhi.
2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd., NEW Delhi.
3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.
4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
5. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. S. Chand & Company Ltd, Delhi.

Web Resources:

1. https://www.kobo.com/us/en/ebook/the-algae-world
2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html
3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
5. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	1	2	1	2
CO2	3	2	2	2	2	2	2
CO3	3	2	1	1	2	2	2
CO4	3	2	2	1	2	1	3
CO5	3	1	3	2	2	1	2
Total	15	9	9	7	12	7	11
Average	3	1.8	1.8	1.4	2.4	1.4	2.2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	3	1	2	2	2	1
CO2	3	2	3	2	3	2	2	`2	2	2
CO3	2	2	2	1	2	2	1	3	2	1
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	2	3	1	3	2
Total	14	13	13	12	13	9	11	11	9	8
Average	2.8	2.6	2.6	2.4	2.6	1.8	2.2	22	1.8	1.6

S-Strong (3) M-Medium (2) L-Low (1)

SEMESTER I

SPECIFIC VALUE-ADDED COURSE: ART OF BONSAI

Course Code	L	T	P	S	Credit	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231V01	2	-	-	-	1	2	30	25	75	100

Pre-requisites:

Students should be familiar with growing plants.

Learning Objectives

1. Practitioners learn to appreciate the value of patience and the rewards it can bring when applied consistently, a lesson that can be valuable in various aspects of life.
2. Bonsai involves shaping and styling trees in aesthetically pleasing ways, allowing practitioners to express their creativity and artistic vision.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	develop the ability to analyze various tree species and create balanced and aesthetically pleasing bonsai designs.	**K5**
2.	will acquire hands-on skills in techniques such as pruning, wiring, and repotting.	**K1 & K4**
3.	maintain the health and vitality of their bonsai trees.	**K2**
4.	appreciate the philosophy behind bonsai and how it reflects harmony with nature and the passage of time.	**K5**
5.	compose different styling techniques, including branch placement, trunk positioning, and foliage arrangement, enabling them to create captivating bonsai compositions.	**K3 & K6**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Unit	Contents	No. of Hours
I	Overview of Bonsai: History, philosophy, and cultural significance. Principles of Bonsai: Miniaturization, proportion, balance, and harmony. Basic Tools and Materials: Introduction to tools, soil, pots, wire, and other essentials.	**6**
II	Plant Selection: Types of trees suitable for bonsai, characteristics, and seasonal considerations. Pruning and Shaping: Techniques for shaping branches and foliage, understanding apical dominance. Wiring and Bending: Using wire to guide growth and create desired shapes, avoiding damage. Repotting and Root Pruning: Importance of repotting, timing, and proper techniques.	**6**
III	Classic Bonsai Styles: Informal upright, formal upright, slanting, cascade, semi-cascade, and more. Elements of Design: Emphasis, balance, contrast, rhythm, and unity in bonsai composition. Pot Selection: Matching pots to tree styles, understanding pot aesthetics and sizes.	**6**
IV	Watering and Fertilizing: Proper watering techniques and balanced nutrition for bonsai health. Pest and Disease Management: Identifying common issues and preventive measures. Seasonal Care: Adjusting care routines for different seasons, winter protection. Display and Presentation: Creating captivating displays for different occasions and settings.	**6**
V	Air Layering and Grafting: Advanced propagation techniques to create unique bonsai. Deadwood Techniques: Carving and preserving deadwood features for artistic effect. Creating Miniature Landscapes (Saikei): Combining multiple trees and elements to tell a story.Bonsai Exhibition and Judging: Preparing	**6**

	bonsai for exhibitions, understanding evaluation criteria.	
	Total	**30**

Text Books:

1. Kawasumi, M. (2012). The Secret Techniques of Bonsai: A Guide to Starting, Raising, and Shaping Bonsai. Kodansha International, Tokyo, Japan.
2. Lewis, C. (1997). Bonsai Survival Manual: Tree-by-Tree Guide to Buying, Maintaining, and Problem Solving. Cassell, UK.
3. Prescott, D. (2009). The Bonsai Handbook. Firefly Books, Canada.

References Books:

1. Chan, P. (2019). The Bonsai Bible: The Definitive Guide to Choosing and Growing Bonsai. Octopus Publishing Group, UK.
2. Tomlinson, H. (2004). The Complete Book of Bonsai: A Practical Guide to its Art and Cultivation. Dorling Kindersley, New York, USA.
3. Gustafson, H. L. (1994). The Bonsai Workshop. Timber Press, USA
4. Naka, J. Y. (1984). Bonsai Techniques I & II. Bonsai Institute of California, USA
5. Koreshoff, D. R. (2007). Bonsai: Its Art, Science, History, and Philosophy. Tuttle Publishing, Vermount, USA.

Web Resources:

1.https://www.bonsaicare.com/care-guide
2.https://www.absbonsai.org/history-of-bonsai/
3.https://www.bonsaiworld.com/bonsai-techniques/
4.https://www.bonsaienthusiastsblog.com/beginners-guide-to-getting-started-with-bonsai-trees/

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	1	2	1	2
CO 2	3	2	2	2	2	1	1
CO 3	3	3	2	1	2	2	2
CO 4	3	2	2	1	2	1	2
CO 5	3	2	2	2	2	2	2
Total	15	12	11	7	10	7	9
Average	3	2.4	2.2	1.4	2.0	1.4	1.8

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	2	2	2	1	1	1	2	2
CO 2	2	2	2	1	2	1	1	1	2	2
CO 3	3	3	1	1	2	2	2	1	1	1
CO 4	3	3	2	1	2	2	2	2	2	2
CO 5	2	3	2	2	2	1	2	2	2	2
Total	13	14	9	7	10	7	8	7	9	9
Average	2.6	2.8	1.8	1.4	2.0	1.4	1.6	1.4	1.8	1.8

S-Strong (3) M-Medium (2) L-Low (1)

SEMESTER I

SPECIFIC VALUE-ADDED COURSE: LEMON GRASS - CULTIVATION AND OIL EXTRACTION

Course Code	L	T	P	S	Credit	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231V02	2	-	-	-	1	2	30	25	75	100

Pre-requisites:

Basic understanding of agricultural cultivation and essential oil extraction techniques.

Learning Objectives:

1. Master the cultivation techniques of lemongrass, from planting to harvesting.
2. Acquire skills in the extraction and application of lemongrass oil.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	understand lemongrass cultivation techniques.	**K1**
2.	learn the harvesting and processing methods.	**K2**
3.	acquire knowledge of oil extraction from lemongrass.	**K3**
4.	explore the properties and applications of lemongrass oil.	**K4**
5.	implement sustainable practices in cultivation and extraction.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate

Unit	Contents	No. of Hours
I	Lemon grass: Origin, Botanical description, Economic Importance	**6**
II	Lemon grass varieties, Propagation, Seed Production, Nursery raising	**6**
III	Planting, Irrigation, Nutrition, Intercultural operations	**6**
IV	Plant Protection Measures: Insect pests, Diseases, Harvest and yield	**6**
V	Post Harvest Management: Drying, Distillation, Purification of oil, Storage and packing of oil	**6**
	Total	**30**

Textbooks:

1. Azhar Ali Farooqi, Sreeramu. B. S 2004. *Cultivation Of Medicinal and Aromatic Crops.* Universities Press (India) Pvt. Limited, New Delhi.
2. Anand Akhila 2009. *Essential Oil-Bearing Grasses: The Genus Cymbopogon.* CRC Press, UK.

References Books:

1.Weiss, E.A. *Essential Oil Crops.* 1997. CAB International, UK.

2.Ying Sun 2012. *Extraction Method of Lemongrass Essential Oil.* China Publishers (China Edition), China.

Web Resources:

1. https://agritech.tnau.ac.in/horticulture/extraction_methods_natural_essential_oil.pdf
2. https://iopscience.iop.org/article/10.1088/1757-899X/506/1/012053
3. https://www.academia.edu/39345350/extraction_of_essential_oil_from_cymbopogon_citratus_lemon_grass_and_a_comparative_study_of_separation_techniques

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	3	1	2
CO2	3	3	3	3	2	2	1
CO3	3	3	3	2	3	1	2
CO4	3	3	3	2	3	2	1
CO5	3	3	3	2	3	1	2
Total	15	15	15	11	14	7	8
Average	3	3	3	2.2	2.8	1.4	1.6

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	2	2	2	3	2	1	2	3
CO2	3	3	3	2	2	2	2	1	1	2
CO3	3	3	3	3	2	2	2	2	2	1
CO4	3	3	3	2	1	3	2	2	2	1
CO5	3	3	3	2	2	2	1	2	2	3
Total	15	15	14	11	9	12	9	8	9	10
Average	3	3	2.8	2.2	1.8	2.2	1.8	1.6	1.8	2.0

3 -Strong 2 - Medium 1 - Low

SEMESTER I

SPECIFIC VALUE -ADDED COURSE: POISONOUS AND ALLERGIC PLANTS

Course Code	L	T	P	S	Credit	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU231V03	2	-	-	-	1	2	30	25	75	100

Pre-requisites:

Basic understanding about toxic and allergic plants.

Learning Objectives:

1. Recognizing factors like climate, season, and rainfall affecting plant toxicity and understanding the poisonous compounds
2. Familiarity with specific toxic and allergic plants and ensures safety measures against accidental exposure or ingestion.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	comprehend the influence of environmental factors such as climate, season, and rainfall on plant toxicity.	**K2**
2.	identify various poisonous compounds found in plants, including alkaloids, polypeptides, and amines.	**K4**
3.	recognize the toxicity mechanisms of oxalates, resins, and phytotoxins (Toxalbumins) in plants.	**K2**
4.	distinguish between different poisonous plant species	**K4**
5.	demonstrate knowledge of appropriate responses and treatments for poisoning incidents.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate

Unit	Contents	No. of Hours
I	Introduction to poisonous plants. Factors Influencing- Climate, season, and rainfall	**6**
II	Toxic Compounds in Plants (Alkaloids, Polypeptides, and Amines) and their adverse effects	**6**
III	Toxic Compounds in Plants (Oxalates, Resins, Phytotoxins (Toxalbumins)) and their adverse effects	**6**
IV	Poisonous Plants – *Lantana* and *Nerium* -focusing on their toxic components, mechanisms of toxicity, and the clinical symptoms.	**6**
V	Poisonous Plants – *Parthenium* and *Strychnos nux-vomica* -focusing on their toxic components, mechanisms of toxicity, and the clinical symptoms.	**6**
	Total	**30**

Textbooks:

1. Lewis S. Nelson, Richard D. Shih, Michael J. Balick. 2017. *Handbook of Poisonous and Injurious Plants*. New York Botanical Garden, USA.
2. Spoerke, Susan C. Smolinske. 1990. *Toxicity of Houseplants.* CRC Press, UK.

References Books:

1. Ram Nath Chopra, R. L. Badhwar, Sudhamoy Ghosh. 1965. *Poisonous Plants of India.* Indian Council of Agricultural Research, New Delhi.
2. D. Jesse Wagstaff. 2008. *International Poisonous Plants Checklist - An Evidence-Based Reference*. CRC Press, UK.

Web Resources:

1. https://science.umd.edu/classroom/bsci124/lec30.html
2. https://anrcatalog.ucanr.edu/pdf/8560.pdf

3. https://www.coursehero.com/file/23960699/Lecture-21-POISONOUS-and-ALLERGY-PLANTSppt/

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	3	2	2
CO2	3	3	3	3	3	1	3
CO3	3	3	2	3	3	1	2
CO4	3	3	2	3	3	2	2
CO5	3	3	2	3	3	2	3
Total	**15**	**15**	**12**	**15**	**15**	**8**	**12**
Average	**3**	**3**	**2.4**	**3**	**3**	**1.6**	**2.4**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	2	1	1	3	1	2	2	3
CO2	3	3	2	2	1	3	1	2	2	3
CO3	3	3	1	1	2	3	2	2	2	3
CO4	3	3	2	1	2	3	2	1	1	3
CO5	3	3	2	2	2	3	1	1	2	3
Total	15	15	9	7	8	15	7	8	9	15
Average	3	3	1.8	1.4	1.6	3	1.4	1.6	1.8	3

3 -Strong 2 - Medium 1 - Low

SEMESTER II

CORE COURSE II: PLANT DIVERSITY II: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU232CC1	3	2	-	-	5	5	75	25	75	100

Pre-requisites:

Students should be familiar with the basics of fungi, bacteria, viruses and lichens.

Learning Objectives

1. To describe the common characteristics of fungi, bacteria and viruses and to identify the main groups of plant pathogens, plant diseases and their symptoms.

2. To understand lichen structure, function, identification, and ecology; Comprehend the events of symbiosis and lichenization and to demonstrate the use of lichens as bioindicator species.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recognize the general characteristics of microbes, fungi and lichens and disease symptoms.	**K1**
2.	develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural organization.	**K2 &K1**
3.	identify the common plant diseases, according to geographical locations and device control measures.	**K3 & K4**
4.	analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.	**K4**
5.	determine the economic importance of microbes, fungi and lichens.	**K2**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze

Unit	Contents	No. of Hours
I	**FUNGI** Classification of fungi - (Alexopoulos and Mims, 1979), criteria for classification, Characteristic features, thallus organization, mode of nutrition, structure, reproduction and life-history of classes, each with one suitable example: Zygomycotina (*Mucor*), Ascomycotina (*Saccharomyces*), Basidiomycotina (*Agaricus*) and Deuteromycotina (*Alternaria*). Importance of mycorrhizal association.	**15**
II	**ECONOMIC IMPORTANCE OF FUNGI:** Cultivation of mushroom – *Pleurotus* (food). Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi. Agriculture (Biofertilizers); Mycotoxins	**15**
III	**BACTERIA, VIRUS:** Classification (Bergey's, 1994), structure and reproduction of bacteria- vegetative (budding, fragmentation and binary fission), sexual (transduction, transformation and conjugation) and asexual (endospore, conidia and zoospore), Mycoplasma, Virology -Viruses general characters, structure and reproduction (lytic and lysogenic cycle).	**15**

IV	**PLANT PATHOLOGY:** General symptoms of plant diseases; Geographical distribution of diseases; Etiology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of the following plant diseases. General characters of Bacteria and Viruses. **Bacterial diseases** – Citrus canker and Bacterial wilt of Banana **Viral diseases** – Tobacco Mosaic and Vein clearing of Papaya **Fungal diseases** – Blast disease in rice and Tikka disease	**15**
V	**LICHEN:** Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, distribution, thallus organization, reproduction and ecological significance of lichens with special reference to Usnea. Economic importance of Lichens: food, fodder and nutrition, flavor, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicine (Ayurvedic, Siddha), pharmaceutical products, biodegradation agent, air pollution and biomonitoring, soil formation, nitrogen fixation, Harmful aspects, poison from lichens.	**15**
	Total	**75**

Self-study	**Harmful effects of fungi, General characters of virus**

Textbooks:

1. Pandey, B.P. 2019. College Botany. Fungi & Pathology. Vol. I. S. Chand Publishers, New Delhi.
2. Mehrotra, R.S and Aneja, K.R. 2023. An introduction to Mycology. New Age International (P) Ltd, Publishers, New Delhi.
3. Satyanarayana T and Johri B.N. 2021. Microbial diversity, Current Perspectives and Potential Applications. IK International, New Delhi.
4. Nair, L.N. 2007. Topics in Mycology and Pathology. New Central Book Agency, Kolkata.
5. Sharma, P.D. 2016. Plant Pathology. Rastogi Publication, Meerut.
6. Mahendra Rai. 2013. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.

References Books:

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 2007. Introductory Mycology. (Fourth Edition). John Wiley & Sons, Singapore.
2. Webster, J and Weber, R. 2007. Introduction to Fungi. (Third Edition). Cambridge University Press, London.
3. Sharma, O.P. 2017. Fungi and Allied microbes. The McGraw –Hill companies, New Delhi.
4. Burnett, J.H. 1976. The fundamentals of Mycology. ELBS Publication, London.
5. Bessey, E.A. 2015. Morphology and Taxonomy of Fungi. Vikas Publishing House Pvt. Ltd., New Delhi.
6. Dharani Dhar Awasthi. 2000. A Handbook of Lichens. Vedams eBooks (P) Ltd., New Delhi.
7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1985. Microbiology. Tata McGraw Hill Publishing House, New Delhi.
8. Pandey, P.B. 2014. College Botany- 1: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand Publishing, New Delhi.

Web Resources:

1. https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE
2. http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html

3. http://www.freebookcentre.net/Biology/Mycology-Books.html
4. https://www.kobo.com/us/en/ebook/introduction-to-fungi
5. http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html
6. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	1	2	1	2
CO 2	2	3	2	2	3	2	1
CO 3	3	3	3	1	2	1	2
CO 4	3	2	3	2	3	1	2
CO 5	3	3	2	1	2	2	2
Total	14	13	12	7	12	7	9
Average	2.8	2.6	2.4	1.4	2.4	1.4	1.8

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	2	1	1	2	1	2	1	2
CO 2	2	3	2	2	1	1	1	2	1	2
CO 3	2	2	1	1	1	1	2	1	2	2
CO 4	3	2	2	2	2	2	2	2	2	2
CO 5	3	2	2	2	2	2	1	2	1	1
Total	13	12	9	8	7	8	7	9	7	9
Average	2.6	2.4	1.8	1.6	1.4	1.6	1.4	1.8	1.4	1.8

S-Strong (3) M-Medium (2) L-Low(1)

SEMESTER II

CORE LAB COURSE II: PLANT DIVERSITY II: FUNGI, BACTERIA, VIRUSES, PATHOLOGY AND LICHENS - PRACTICAL-II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
BU232CP1	1	-	2	-	3	3	45	25	75	100

Pre-requisites: Students should be familiar with the basics of fungi, bacteria, viruses and lichens

Learning Outcomes

1. To enable students to identify microscopic and macroscopic fungi and to prepare microslides of fungi and lichens.
2. To know the presence of pathogen inside the plant tissues through microscopic sections.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	identify microbes, fungi and lichens using key identifying characters	**K1 & K4**
2.	develop practical skills for culturing and cultivation of fungi.	**K3**
3.	identify and select suitable control measures for the common plant diseases.	**K1**
4.	analyze the characteristics of microbes, fungi and plant pathogens	**K2 & K4**
5.	access the useful role of fungi in agriculture and pharmaceutical industry.	**K2**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 –** Analyze

EXPERIMENTS	No. of Hours
EXPERIMENTS 1. Microscopic observation of vegetative and reproductive structures of types prescribed in the syllabus through temporary preparations and permanent slides. 2. Identifying the micro slides relevant to the syllabus. 3. Herbarium specimens of bacterial diseases/photograph. 3. Protocol for mushroom cultivation. 4. Inoculation techniques for fungal culture (Demonstration only). 5. Study of economically important products obtained from fungi: Fungal biofertilizers, biopesticides, biofungicide (*Trichoderma*), edible mushroom/Yeast, organic acids (citric acid) enzymes (protease), antibiotics and vitamins. 6. Mycorrhiza: ecto-mycorrhiza and endo-mycorrhiza (Photographs) 7. Visit to fungal biotechnology laboratories. 8. Ultra structure of bacteria. 9. Structure of bacteriophage. 10. Micro-preparation of *Usnea* to study vegetative and reproductive structures. 11. Identifying the micro slides relevant to the syllabus. 12. Study of thallus and reproductive structures (apothecium) through permanent slides. 13. Economic importance of Lichens - Dye and perfume.	45

Textbooks:

1. Chmielewski, J.G and Krayesky, D. 2013. General Botany laboratory Manual. Author House, Bloomington, USA.
2. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi.
3. Webster, J and Weber, R. 2012. Introduction to Fungi. (Third Edition). Cambridge University Press, Cambridge.

4. Nair, L.N. 2007. Topics in Mycology and Pathology. New Central Book Agency, Kolkata.

Reference Books:

1. Alexopoulos, J and Mims, W. 2007. Introductory Mycology. Wiley Eastern Limited, New Delhi.
2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany -1.(Tenth Edition). Rastogi Publications, Meerut.
3. Singh, R and U.C. Singh 2020. Modern mushroom cultivation. (Third Edition) Agrobios, Jodhpur.
4. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer, New Delhi.
5. Satyanarayana T and Johri B.N. 2023. Microbial diversity, Current Perspectives and Potential Applications. IK International, New Delhi.

Web Resources:

1. https://www.amazon.in/Practical-Manual-Fungi-Fungicides/dp/B0025AEFP4
2.https://books.google.co.in/books/about/Practical_Mycology.html?id=5ycJAQAAMAAJ&redir
3. https://www.flipkart.com/colour-handbook-practical-plant-pathology/p/itmefsn6dyhfhs9b
4.https://books.google.co.in/books/about/Practical_Botany.html?id=T5narQEACAAJ&redir_esc=y
5. https://www.kobo.com/us/en/ebook/introduction-to-fungi

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	1	2	1	2
CO 2	3	2	2	2	2	1	1
CO 3	3	3	2	1	2	2	2
CO 4	3	2	2	1	2	1	2
CO 5	3	2	2	2	2	2	2
Total	15	12	11	7	10	7	9
Average	3	2.4	2.2	1.4	2.0	1.4	1.8

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	2	2	2	1	1	1	2	2
CO 2	2	2	2	1	2	1	1	1	2	2
CO 3	3	3	1	1	2	2	2	1	1	1
CO 4	3	3	2	1	2	2	2	2	2	2
CO 5	2	3	2	2	2	1	2	2	2	2
Total	13	14	9	7	10	7	8	7	9	9
Average	2.6	2.8	1.8	1.4	2.0	1.4	1.6	1.4	1.8	1.8

S-Strong (3) M-Medium (2) L-Low (1)

SEMESTER II

ELECTIVE COURSE II: ALLIED BOTANY - II

Course Code	L	T	P	S	Credits	Total Hours	Marks		
							CIA	External	Total
BU232EC1	**4**	**-**	**-**	**-**	**3**	**60**	**25**	**75**	**100**

Pre-requisites: To study the basics of botany.

Learning Objectives

1. To gain a solid grasp of plant systematics, acknowledging the pivotal role of plant anatomy in production systems, and comprehending the shift from vegetative to reproductive phases.
2. To acquire knowledge in the physiological processes governing plant metabolism, energy production, and utilization.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	understand the fundamental concepts of plant anatomy and embryology.	**K2**
2	analyze and recognize the different organs of plants and secondary growth.	**K4**
3	understand water relation of plants with respect to various physiological processes.	**K2**
4	know about the fundamental concepts of aerobic and anaerobic respiration.	**K1**
5	classify plant systematics and recognize the importance of herbarium and virtual herbarium	**K3**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze

Unit	Contents	No. of Hours
I	Morphology of Flowering Plants: Plant and its parts. Structure and function of root and stem. Leaf and its parts. Leaf types- simple and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose and Special types. Terminology with reference to flower description.	**12**
II	Taxonomy: Study of the range of characters and plants of economic importance in the following families: Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Cannaceae	**12**
III	Anatomy: Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot roots - anatomy of monocot and dicot stems - anatomy of dicot and monocot leaves.	**12**
IV	Embryology: Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination -double fertilization, structure of dicotyledonous and monocotyledonous seeds.	**12**
V	Plant Physiology: Absorption of water, photosynthesis - light reaction - Calvin cycle; respiration - Glycolysis - Krebs cycle - electron transport system. Growth hormones - auxins and cytokinin and their applications.	**12**
	Total	**60**

Self-study	**Economic importance of families prescribed in the syllabus**

Textbooks:

1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition). The McGraw Hill Companies, New Delhi.
2. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.

3. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
4. Salisbury, F. B.C.W. Ross.2001. Plant Physiology. Wass worth Pub. Co., Belmont, USA
5. Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb., Philippines.

References Books:

1. Lawrence. G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad.
2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Pandey, B.P. 2012. Plant Anatomy, S. Chand & Co., New Delhi.
4. Jain, VK. 2006. Fundamentals of Plant Physiology, S. Chand & Co., New Delhi.
5. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future, Vedams (P) Ltd. New Delhi.
6. Jain, V.K. 2006. Fundamentals of Plant Physiology, S. Chand and Company Ltd., New Delhi.
7. Verma, S.K. 2006. A Textbook of Plant Physiology, S. Chand & Co., New Delhi.

Web Resources:

1.https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y
2.https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y
3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp
4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG
5. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	1	2	2	1	2
CO 2	3	2	2	1	2	2	1
CO 3	3	3	2	2	2	2	1
CO 4	3	1	3	2	2	2	2
CO 5	3	2	2	2	2	2	2
Total	**15**	**10**	**10**	**9**	**10**	**9**	**8**
Average	**3**	**2**	**2**	**1.8**	**2**	**1.8**	**1.6**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	3	3	2	2	1	2	2	2	3
CO 2	3	2	3	3	2	2	2	2	2	3
CO 3	3	3	3	3	2	2	2	3	3	3
CO 4	3	3	3	2	2	2	2	2	3	2
CO 5	3	3	3	3	3	3	3	2	2	2
Total	**14**	**14**	**15**	**13**	**11**	**10**	**11**	**11**	**12**	**13**
Average	**2.8**	**2.8**	**3**	**2.6**	**2.2**	**2**	**2.2**	**2.2**	**2.4**	**2.6**

S-Strong (3) M-Medium (2) L-Low (1)

SEMESTER II

ELECTIVE LAB COURSE II: ALLIED BOTANY PRACTICALS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU232EP1	-	-	2	-	2	2	30	25	75	100

Prerequisites: Practical pertaining to above subjects is important to get knowledge onvarious aspects of plants.

Learning Outcomes

1. To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of microorganisms,algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms.
2. To understand the laws of inheritance, genetic basis of loci and alleles.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	study the internal organization of algae and fungi.	**K2**
2.	develop critical understanding on morphology, anatomy and reproduction of bryophytes, pteridophytes and gymnosperms.	**K4**
3.	study the classical taxonomy with reference to different parameters.	**K1**
4.	understand the fundamental concepts of plant anatomy and embryology	**K2**
5.	study the effect of various physical factors on photosynthesis.	**K2**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

Contents	No. of Hours
EXPERIMENTS 1. To describe in technical terms, plants belonging to all thefamilies prescribed in the syllabus and to identify the plants to their family. 2. To dissect a flower, construct floral diagram and write floralformula. 3. Demonstration experiments 1. Ganong's Light screen 2. Ganong's Respiroscope 4.To make suitable micro preparations of anatomy materialsprescribed in the syllabus. 5. Spotters – Angiosperm, Anatomy and Embryology.	**30**

Textbooks:

1. Sharma, O.P. 2017. Bryophyta. MacMillan India Ltd, New Delhi.
2. Sharma, O.P. 2012. Pteridophyta. Tata McGraw-Hills Ltd., New Delhi.
3. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd.,New Delhi.
4. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, England.
5. Noggle, G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.

Reference Books:

1. Strickberger, M.W. 2005. Genetics (Third Edition). Prentice Hall, New Delhi.
2. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide. Ottawa Agriculture and Agri food Canada Publisher,

Canada.
3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing, New Delhi.
4. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & Wiley Publications, London.
5. Steward, F.C. 2012. Plant Physiology. US Academic Press, United States.

Web Resources:

1. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883
2. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1 &dq=gymnosperms&printsec=frontcover
3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ
4. https://medlineplus.gov/genetocs/understanding/basics/cell/
5. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf
6. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
7. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	1	2
CO2	3	2	2	2	3	2	2
CO3	3	3	3	2	2	1	2
CO4	3	2	2	3	3	1	2
CO5	3	3	2	2	3	2	3
Total	15	13	11	11	13	7	11
Average	3	2.6	1.1	2.2	2.6	1.4	2.2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	2	2	1	2	1	1	2	2
CO 2	2	3	2	1	1	1	1	2	1	2
CO 3	3	3	1	1	2	2	2	1	2	1
CO 4	3	2	2	2	1	2	2	2	2	2
CO 5	3	3	3	2	2	1	2	2	1	2
Total	14	13	10	8	7	8	8	6	8	7
Average	2.8	2.6	2.0	1.6	1.4	1.6	1.6	1.2	1.6	1.4

S-Strong (3) M-Medium (2) L-Low (1)

SEMESTER II

NON-MAJOR ELECTIVE NME II: MUSHROOM CULTIVATION

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU232NM1	2	-	-	-	2	2	30	25	75	100

Pre-requisites:

Basic knowledge on structure and function of various groups of mushrooms.

Learning Objectives

1. To learn and develop skills in mushroom cultivation and harvest technology.
2. To understand and appreciate the role of mushrooms in nutrition, medicine and health.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recall various types and categories of mushroom.	**K1**
2.	explain about various types of food technologies associated with mushroom industry.	**K2**
3.	apply techniques studied for cultivation of various types of mushrooms.	**K3**
4.	analyze and decipher the environmental factors and economic value associated with mushroom cultivation	**K4**
5.	develop new methods and strategies to contribute to mushroom production.	**K3**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze

Unit	Contents	No. of Hours
I	Introduction: Morphology, Types of Mushrooms, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.	**6**
II	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.	**6**
III	Life cycle of *Pleurotus* spp and *Agaricus* spp.	**6**
IV	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.	**6**
V	Diseases and post harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.	**6**
	Total	**30**

Self-study	**Nutritive value of common edible mushrooms.**

Textbooks:

1. Gogoi, R, Rathaiah, Y and Borah, T. R. 2019. Mushroom cultivation technology. Scientific Publishers, India.
2. Suman, B. C, and Sharma, V. P. 2007. Mushroom cultivation in India. Daya Books, India.
3. Swaminathan, M. 2018. Food and Nutrition. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
4. Reethi Singh and Singh, U.C. 2005. Modern Mushroom Cultivation. International Book Distributors, Dehradun.
5. Prasad Prem Kumar and Sahu Verma. 2013. Mushroom: Edible and medicinal: Cultivation conservation, strain improvement with their marketing. Daya Publishing House, New Delhi.

Reference Books:

1. Beetz A. E and Greer L. 2004. Mushroom cultivation and marketing. ATTRA publication, United States.
2. Marimuthu, T. Krishnamoorthy, A. S. Sivaprakasam, K. and Jayarajan, R. 1991. Oyster Mushrooms. Tamil Nadu Agricultural University, Coimbatore:
3. Miles, P. G and Chang, S. T. 2004. Mushrooms: cultivation, nutritional value, medicinal effect, and environmental impact. CRC press, United States.
4. Nita Bahl. 2002. Handbook on Mushroom. (Fourth Edition). Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi.
5. Suman, B.C and Sharma, V.P. 2005. Mushroom Cultivation Processing and Uses M/s. IBD Publishers and Distributors, New Delhi.

Web Resources:

1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X
2. http://nrcmushroom.org/book-cultivation-merged.pdf
3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf
4. http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/
5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	2	1	2
CO 2	3	3	2	2	1	3	2
CO 3	2	3	2	3	1	2	2
CO 4	3	3	3	3	1	2	3
CO 5	3	3	2	3	2	3	2
Total	14	15	12	14	7	11	11
Average	2.8	3	2.4	2.8	1.4	2.2	2.2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	2	2	3	3	1	2	1	1
CO 2	3	3	2	2	3	3	2	2	1	3
CO 3	3	3	2	2	3	3	3	2	1	2
CO 4	3	3	3	3	3	3	2	1	1	3
CO 5	3	3	3	2	3	3	2	1	1	3
Total	15	14	12	11	15	15	10	8	5	12
Average	3	2.8	2.4	2.2	3	3	2	1.6	1	2.4

S-Strong (3) M-Medium (2) L-Low (1)

SEMESTER II

SKILL ENHANCEMENT COURSE SEC I: BOTANICAL GARDEN AND LANDSCAPING

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU232SE1	2	-	-	-	2	2	30	25	75	100

Pre-requisites: Students should know about the fundamental concepts of gardening and landscaping.

Learning Objectives

1. To know about the fundamental concepts of gardening and landscaping.
2. To inculcate entrepreneurial skills in students for creative landscaping design using CAD software.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	know about the fundamental concepts of gardening and landscaping	**K1**
2.	provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.	**K2**
3.	illustrate the significance of garden adornments and propagation structures.	**K3 & K6**
4.	create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.	**K4**
5.	inculcate entrepreneurial skills in students for creative landscaping design using cad software.	**K5 & K6**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Unit	Contents	No. of Hours
I	Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden, Vertical gardens, roof gardens, art of making bonsai. Greenhouse.	**6**
II	Bioaesthetic planning, definition, need, round country planning, urban planning and planting at avenues, railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds.	**6**
III	Landscape designs, Styles of garden, formal, informal and free style gardens, Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, damsites, IT parks, corporate.	**6**
IV	Establishment and maintenance - indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.	**6**
V	Computer Aided Designing (CAD) for outdoor and indoor landscaping Exposure to CAD (Computer Aided Designing).	**6**
	Total	**30**

Self-Study	Establishment and maintenance of gardens.

Text Books

1. Acquaah, J. 2019. Horticulture – principles and practices, (Fourth edition), PHI learning Pvt. Ltd., New Delhi.

2. Rao Manibhushan K. 2005. Textbook of horticulture. Mac Millan India Ltd., Kolkata.

3. Gangulee H. C. and Kar A. K. 2011. College Botany (Volume – II), New Central Book Agency, Kolkata

4. Sharma V. K. 2011. Encyclopedia of Practical Horticulture, (Volume - IV), Deep and Deep Publ. Pvt. Ltd., New Delhi
5. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers, Chennai.

References Books

1. Berry, F. and Kress, J. 1991. Heliconia: An Identification Guide. Smithsonian Books, Washington DC.
2. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd., Canada.
3. Russell, T. 2012. Nature Guide: Trees: The world in your hands (Nature Guides).
4. Acquaah, J. 2009. Horticulture – principles and practices, (Fourth Edition), PHI learning Pvt. Ltd., New Delhi.
5. Edment Senn Andrews. 1994. Fundamentals of Horticulture. Tata. McGraw Hill Publishing Co., Ltd., New Delhi.

Web Resources

1. https://www.amazon.in/Gardening-Landscape-Design-and-Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Garden
2. https://www.overdrive.com/subjects/gardening
3. https://www.scribd.com/book/530538456/Opportunities-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Careers
4. https://www.scribd.com/book/305542619/Botanic-Gardens
5. https://www.overdrive.com/subjects/gardening

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	2	1	2
CO 2	3	3	3	2	3	3	2
CO 3	3	3	3	1	2	2	1
CO 4	3	3	3	2	3	2	3
CO 5	3	3	3	2	2	3	3
Total	15	15	15	11	12	11	11
Average	3	3	3	2.2	2.4	2.2	2.2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	3	3	3	2	3	3
CO 2	3	3	2	3	3	3	3	`2	3	3
CO 3	2	3	3	3	3	3	3	2	3	3
CO 4	3	3	3	3	3	3	3	2	3	3
CO 5	3	3	3	3	3	3	3	2	3	3
Total	15	15	14	15	15	15	15	10	15	11
Average	3	3	2.8	3	3	3	3	2	3	2.2

S-Strong (3) M-Medium (2) L-Low (1)

SEMESTER I & II
LIFE SKILL TRAINING I: CATECHISM

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG232LC1	1	-	-	-	1	1	15	50	50	100

Objectives:

1. To develop human values through value education
2. To understand the significance of humane and values to lead a moral life
3. To make the students realize how values lead to success

Course Outcomes

On the successful completion of the course, student will be able to:		
1	understand the aim and significance of value education	K1,K2
2	develop individual skills and act confidently in the society	K3
3	learn how to live lovingly through family values	K3
4	enhance spiritual values through strong faith in God	K6
5	learn good behaviours through social values	K6

K1 - Remember **K2**-Understand; **K3**-Apply; **K6**- Create

Units	Contents	No. of Hours
I	**Value Education:** Human Values – Types of Values – Growth – Components – Need and Importance - Bible Reference: Matthew: 5:3-16	3
II	**Individual Values: Esther** Vanishing Humanity – Components of Humanity – Crisis – Balanced Emotion – Values of Life - Bible Reference: Esther 8:3-6	3
III	**Family Values: Ruth the Moabite** Respecting Parents – Loving Everyone – Confession – True Love Bible Reference: Ruth 2:10-13 **Spiritual Values: Hannah** Faith in God – Wisdom – Spiritual Discipline – Fear in God – Spiritually Good Deeds -Bible Reference: 1 Samuel 1:24-28	3
IV	**Social Values: Deborah** Good Behaviour – Devotion to Teachers – Save Nature – Positive Thoughts – The Role of Youth in Social Welfare - Bible Reference: Judges 4:4-9	3
V	**Cultural Values**: **Mary of Bethany** Traditional Culture – Changing Culture – Food – Dress – Habit – Relationship – Media – The Role of Youth - Bible Reference: Luke 10:38-42	3
	Total	15

Textbook

Humane and Values. Holy Cross College (Autonomous), Nagercoil
The Holy Bible

SEMESTER I & II

LIFE SKILL TRAINING I: MORAL

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG232LM1	1	-	-	-	1	1	15	50	50	100

Objectives:

1. To develop human values through value education
2. To understand the significance of humane and values to lead a moral life
3. To make the students realize how values lead to success

Course Outcomes

On the successful completion of the course, student will be able to:		
1	understand the aim and significance of value education	K1,K2
2	develop individual skills and act confidently in the society	K3
3	learn how to live lovingly through family values	K3
4	enhance spiritual values through strong faith in God	K6
5	learn good behaviours through social values	K6

K1 - Remember **K2**-Understand; **K3**-Apply; **K6**- Create

Units	Contents	No. of Hours
I	**Value Education:** Introduction – Limitations – Human Values – Types of Values – Aim of Value Education – Growth – Components – Need and Importance	3
II	**Individual Values:** Individual Assessment – Vanishing Humanity – Components of Humanity – Crisis – Balanced Emotion – Values of Life.	3
III	**Family Values:** Life Assessment – Respecting Parents – Loving Everyone – Confession – True Love.	3
IV	**Spiritual Values:** Faith in God – Wisdom – Spiritual Discipline – Fear in God – Spiritually Good Deeds.	3
V	**Social Values:** Good Behaviour – Devotion to Teachers – Save Nature – Positive Thoughts – Drug Free Path – The Role of Youth in Social Welfare. **Cultural Values**: Traditional Culture – Changing Culture – Food – Dress – Habit – Relationship – Media – The Role of Youth.	3
	Total	15

Textbook:

Humane and Values. Holy Cross College (Autonomous), Nagercoil

SEMESTER III

CORECOURSE III: PLANT DIVERSITY-III BRYOPHYTES AND PTERIDOPHYTES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU233CC1	3	2	-	-	5	5	75	25	75	100

Pre-requisite: Basics of Bryophytes and Pteridophytes.

Learning Objectives:

1. To enable the students to have an overview of non-vascular and vascular cryptogams.
2. To know the evolution, morphological diversity, structure, reproduction and economic importance of Bryophytes and Pteridophytes.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	decipher the stages of plant evolution and their transition to land habitat.	**K1& K2**
2.	recognize morphological variations of Bryophytes and Pteridophytes	**K2 & K4**
3.	explain and analyze the anatomy and reproduction of Bryophytes and Pteridophytes.	**K2 & K4**
4.	access and interact about the useful role of Bryophytes and Pteridophytes.	**K3**
5.	compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and Pteridophytes.	**K4**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze

Units	Contents	No. of Hours
I	**BRYOPHYTES:** General characters of bryophytes, Evolution of bryophytes, Classification (Watson, 1971, up to family level). Economic importance of Bryophytes – Ecological importance (Pollution indicators and monitoring), Medicinal uses, horticulture and industrial uses.	**15**
II	Structure, reproduction and life histories of the following classes each with a suitable example: Hepaticopsida (*Marchantia*); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Polytrichum*).	**15**
III	**PTERIDOPHYTES:** General Characters of Pteridophytes, Classification (Reimer, 1954), Origin and evolution of Pteridophytes. Stelar Evolution. Types of steles. Economic and Ecological importance of Pteridophytes.	**15**
IV	Morphology, anatomy and reproduction of the taxa belonging to each of the following classes: Psilotopsida (*Psilotum*), Lycopsida (*Selaginella*), heterospory and Seed habit.	**15**
V	Morphology, anatomy and reproduction of the taxa belonging to each of the following classes: Sphenopsida (*Equisetum*), Pteropsida (*Marsilea*). Apogamy and apospory and homospory	**15**
	Total	**75**

Self-Study	Economic importance of Bryophytes – Ecological importance (Pollution indicators and monitoring), Medicinal uses, horticulture, industrial uses. Economic and Ecological importance of Pteridophytes.

Textbooks:

1. Sharma, O.P.2017. *Bryophyta*, MacMillan India Ltd. New Delhi.
2. Vashishta, P.C. Sinha, A.K. Anil Kumar, 2006. *Botany for Degree Students: Pteridophyta* (*Vascular Cryptogams*). S. Chand & Company Limited, New Delhi Publishing.

Reference Books:

1. Sporne, K.L. 1976. *Morphology of Pteridophytes.* (4th edition), B.I. Publication. Chennai.

2. Parihar, N.S. 1996. *The Biology and Morphology of Pteridophytes.* Central Book Depot, Allahabad.
3. Schofield, W. B. 2001. *Introduction to Bryology.* Blackburn Press, USA.
4. Johri, R.M., Latha, S. and Sharma, S. 2004. *Textbook of Broyophytes.* Dominant Publishers and distributors, New Delhi.
5. Srivastava, H.N. 1990. *Fundamentals of Pteridophytes.* Pradeep Publications, Jalandhar.

Web Resources:

1. https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoorten-ebook/dp/B007NWFWQK
2. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
3. http://www.jnpg.org.in/WebDoc/EContent/science/General%20characters%20of%20Pteridophytes.pdf
4. http://www.bsienvis.nic.in/Database/Pteridophytes-in-India_23432.aspx
5. http://www.botany.ubc.ca/bryophyte/mossintro.html

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	2	2	2	2	1
CO2	2	2	2	3	2	1	2
CO3	2	2	1	2	1	2	3
CO4	2	2	2	2	2	2	1
CO5	3	3	2	2	2	1	2
Total	11	11	9	11	9	8	9
Average	2.2	2.2	1.8	2.2	1.8	1.6	1.8

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	3	2	2	2	2	2	2	1
CO2	2	2	3	2	2	1	1	2	2	2
CO3	3	2	3	2	2	2	2	2	2	2
CO4	3	2	3	3	3	2	2	3	2	3
CO5	3	2	3	3	2	2	2	2	1	2
Total	14	12	15	12	11	9	9	11	9	10
Average	2.8	2.4	3	2.4	2.2	1.8	1.8	2.2	1.8	2

3 -Strong 2 - Medium 1 - Low

SEMESTER III

CORE LAB COURSE I: PLANT DIVERSITY-III BRYOPHYTES AND PTERIDOPHYTES PRACTICAL III

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU233CP1	1	-	2	-	3	3	45	25	75	100

Pre-requisite: Students should be familiar with the basics of Bryophytes and Pteridophytes.

Learning Objectives:

1. To enable the students gain expertise in hand sectioning technique.
2. To study diversity of Bryophytes and Pteridophytes and the structure of fossil forms.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recognize the major groups of non-vascular and vascular cryptogams	**K1**
2.	describe the structure of bryophytes and pteridophytes forms prescribed in the syllabus	**K2**
3.	identify and illustrate the morphological and anatomical features of bryophytes and pteridophytes	**K3**
4.	develop comprehensive skills in sectioning and micro preparation	**K4**
5.	interpret the significance of reproductive structures in bryophytes and pteridophytes	**K4**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze

EXPERIMENTS	No. of Hours
Morphological and Anatomical Study of the following 1. Bryophytes a) *Marchantia* –Dorsal view, Ventral view, T.S. of Thallus Slides – *Marchantia* Antheridiophore, Archegoniophore, Sporophyte, Gemma cup V.S. b) *Anthoceros:* Slides – Thallus V.S., AntheridiaV.S., sporophyte c) *Polytrichum*- habit, Slides - Leaf T.S., Antheridia V.S., Sporophyte V.S. 2. Pteridophytes a) *Psilotum* Habit, T.S. of stem *Slide- Psilotum* T.S. of synangium b) *Selaginella* – Habit, T.S. of stem, rhizophore Slide- Selaginella L.S. of Cone c) *Equisetum* – habit, *Slide* –T.S. of stem, rhizome root., L.S. of cone. d)*Marsilea* – Habit, T.S. of Petiole, rhizome *Slide*- Sporocarp V.S. 3. Botanical excursion.	**45**
Total	**45**

Textbooks:

1. Ashok, M. Bendre and Kumar. 2010. *A text book of Practical Botany, Algae, Fungi, Lichens, Microbiology, Plant Pathology, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany*. Revised edition. Rastogi publication, Meerut, India.
2. Prem Puri. 2001. *Bryophytes– Morphology Growth and Differentiation*. Atma Ram & Sons. Lucknow, India.

Reference Books:

1. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. *Practical manual for*

Bryophytes and Pteridophytes. Lambert Academic Publishing, UK.
2. Puri, P. 1980. *Bryophytes*. Atma Ram and Sons, New Delhi.
3. Sporne, K.R. 1991. *The Morphology of Pteridophytes*. B.I. Publ. Pvt. Ltd. Chennai.
4. Vashista. P.C. 1971. *Botany for Degree Students: Pteridophyta*. S.Chand & Co. New Delhi.
5. Pandey, B. P. 2004. *College Botany*. (Volume I & II). S. Chand & Company, New Delhi.

Web Resources:

1. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4
2. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883
3. http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html
4. https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual
5. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/

MAPPING WITH PROGRAMME OUTCOMES:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	2	1	2
CO2	3	2	1	2	2	1	2
CO3	3	2	2	2	3	1	2
CO4	3	3	3	3	3	2	2
CO5	2	2	3	2	2	2	1
Total	14	11	11	11	12	7	9
Average	2.8	2.2	2.2	2.2	2.4	1.4	1.8

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PS10
CO1	2	1	2	3	2	1	2	2	2	3
CO2	3	2	2	2	3	3	2	3	2	2
CO3	2	2	3	3	2	1	2	3	3	3
CO4	3	3	3	3	3	2	2	3	3	3
CO5	3	3	2	2	3	1	2	3	2	2
Total	13	11	12	13	13	8	10	14	12	13
Average	2.6	2.2	2.4	2.6	2.6	1.6	2	2.8	2.4	2.6

3 -Strong 2 - Medium 1 - Low

SEMESTER III

ELECTIVE COURSE III: ALLIED BOTANY -III

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU233EC1	3	1	-	-	3	4	60	25	75	100

Pre-requisite: To study the basics of botany.

Learning Objectives:

1. **To study morphological and anatomical adaptations of plants of various habitats.**
2. **To demonstrate techniques and experiments in plant tissue culture, plant physiology and biochemistry.**

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	study the core concepts and fundamentals of plant biotechnology and genetic engineering.	**K1**
2.	develop an understanding of microbes and fungi and appreciate their adaptive strategies	**K2**
3.	interpret the significance of reproductive structures in bryophytes and pteridophytes and gymnosperms.	**K2**
4.	increase the awareness and appreciation of human friendly algae and their economic importance.	**K3**
5.	compare the structure and function of cells and explain the development of cells.	**K4**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze

Unit	Contents	No. of Hours
I	**Algae:** General characters of algae - Structure, reproduction and life cycle of the following genera - *Anabaena* and *Sargassum* and economic importance of algae.	**12**
II	**Fungi, Bacteria and Virus:** General characters of fungi, structure, reproduction and life cycle of the following genera - *Penicillium* and *Agaricus* and economic importance of fungi. Bacteria - general characters, structure and reproduction of *Escherichia coli* and economic importance of bacteria. Virus - general characters, structure of TMV, structure of bacteriophage	**12**
III	**Bryophytes, Pteridophytes and Gymnosperms:** General characters of Bryophytes, Structure and life cycle of *Funaria*. General characters of Pteridophytes, Structure and life cycle of *Lycopodium*. General characters of Gymnosperms, Structure and life cycle of *Cycas*.	**12**
IV	**Cell Biology:** Prokaryotic and Eukaryotic cell- structure /organization. Cell organelles - ultra structure and function of chloroplast, mitochondria and nucleus. Cell division - mitosis and meiosis	**12**
V	**Genetics and Plant Biotechnology:** Mendelism - Law of dominance, Law of segregation, Incomplete dominance. Law of independent assortment. Monohybrid and dihybrid cross - Test cross - Back cross. Plant tissue culture - In vitro culture methods. Plant tissue culture and its application in biotechnology.	**12**
	Total	**60**

Self – Study	General Characters of Algae, Fungi, Bacteria

Textbooks:

1. Bhatnagar, S.P. and Alok Moitra. 2020. *Gymnosperms.* New Age International (P) Ltd., Bengaluru.

2. Sharma, O.P. 2017. *Bryophyta*. MacMillan India Ltd, Delhi.
3. Lee, R.E. 2008. *Phycology*. (4th Edition). Cambridge University Press, New Delhi.
4. Rao, K. Krishnamurthy, K.V. and Rao, G.S. 1979. *Ancillary Botany*. S. Viswanathan Pvt. Ltd., Madras.

Reference Books:

1. Parihar, N.S. 2012. *An introduction to Embryophyta –Pteridophytes*. Surjeet Publications, New Delhi.
2. Alexopoulos, C.J. 2013. *Introduction to Mycology*. Willey Eastern Pvt. Ltd, New Delhi.
3. Vashishta, P.C. 2014. *Botany for Degree Students Gymnosperms*. Chand & Company Ltd, New Delhi.
4. Vashishta, P.C. 2014. *Botany for Degree Students: Algae*. Chand & Company Ltd., New Delhi.
5. Parihar, N.S.2013. *An introduction to Embryophyta –Bryophytes*. Surjeet Publications, New Delhi.

Web Resources:

1. https://www.kobo.com/us/en/ebook/the-algae-world
2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html
3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
5. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	1	2
CO2	3	2	3	2	2	2	1
CO3	3	2	3	3	2	2	2
CO4	3	3	2	2	2	2	2
CO5	3	2	3	2	2	1	2
Total	15	12	13	11	10	8	9
Average	3	2.4	2.6	2.2	2.0	1.6	1.8

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	2	2	2	2	2	2	3
CO2	3	2	2	3	3	1	1	2	3	2
CO3	2	3	3	2	2	2	1	2	2	2
CO4	3	2	2	3	3	2	2	1	2	3
CO5	3	3	2	3	2	1	2	2	1	3
Total	14	13	12	13	12	8	8	9	10	13
Average	2.8	2.6	2.4	2.6	2.4	1.6	1.6	1.8	2.0	2.6

3 -Strong 2 - Medium 1 - Low

SEMESTER III

ELECTIVE LAB COURSE III: ALLIED BOTANY PRACTICAL

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU233EP1	**-**	**-**	**2**	**-**	**2**	**2**	**30**	**25**	**75**	**100**

Pre-requisite: Knowledge on various aspects of plants.

Learning Outcomes:

1. To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of microorganisms, algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms.
2. To understand the laws of inheritance, genetic basis of loci and alleles.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	to study the internal organization of algae and fungi.	**K1**
2.	develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	**K2**
3.	understand the fundamental concepts of plant anatomy and embryology	**K2**
4.	to analyze the classical taxonomy with reference to different parameters.	**K3**
5.	to compare the effect of various physical factors on photosynthesis.	**K4**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze

S.No.	Contents	No. of Hours
1	1. Make suitable micro preparation of a. Anabaena b. *Sargassum* - Stipe, Leaf, c. Penicillium d. Agaricus e. Structure of Bacteria f. Structure of Bacteriophage g. *Funaria* – Stem, Archegonial cluster, Antheridial cluster, Sporophyte L.S h. *Lycopodium* – Stem, Cone i. *Cycas* – Leaflet, T.S Microsporophyll, T.S. of Megasporophyll, Ovule L.S 2. Micro photographs of the cell organelles ultra structure – Chloroplast, Mitochondria, Nucleus, Mitosis and Meiosis 3. Simple Genetic Problem 4. Biotechnology Spotters a. Hot Air Oven b. Laminar Air Flow Chamber c. Autoclave	**30**
	Total	**30**

Textbooks:

1. Subramaniam, N.S. 1996. *Laboratory Manual of Plant Taxonomy*. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Noggle, G.R and G.J. Fritz. 2002. *Introductory Plant Physiology*. Prentice Hall of India, New Delhi.

Reference Books:

1. Strickberger, M.W. 2005. *Genetics* (3rd Edition). Prentice Hall, New Delhi.
2. Nancy Serediak and M. Huynh. 2011. *Algae Identification Lab Guide*. Accompanying manual to algae identification field guide. Ottawa Agriculture and Agri food Canada Publisher, Canada.
3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. *Practical Manual for Bryophytes and Pteridophytes*. Lambert Academic Publishing, New Delhi.
4. Aler Gingauz. 2001. *Medicinal Chemistry*. Oxford University Press & Wiley Publications, London.
5. Steward, F.C. 2012. *Plant Physiology*. US Academic Press, United States.

Web Resources:

1. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/ dp/ 8126106883
2. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover
3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ
4. https://medlineplus.gov/genetocs/understanding/basics/cell/
5. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	1	2
CO2	3	2	2	2	3	2	2
CO3	3	3	3	2	2	1	2
CO4	3	2	2	3	3	1	2
CO5	3	3	2	2	3	2	3
Total	15	13	11	11	13	7	11
Average	3	2.6	1.1	2.2	2.6	1.4	2.2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	2	2	1	2	1	1	2	2
CO2	2	3	2	1	1	1	1	2	1	2
CO3	3	3	1	1	2	2	2	1	2	1
CO4	3	2	2	2	1	2	2	2	2	2
CO5	3	3	3	2	2	1	2	2	1	2
Total	14	13	10	8	7	8	8	6	8	7
Average	2.8	2.6	2.0	1.6	1.4	1.6	1.6	1.2	1.6	1.4

3 -Strong 2 - Medium 1 - Low

SEMESTER III

SKILL ENHANCEMENT COURSE SEC II: ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

Course Code	L	T	P	S	Credit	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU233SE1	2	-	-	-	2	2	30	25	75	100

Pre-requisite: Familiarity with various entrepreneurial fields of Botany.

Learning Objectives:

1. To foster student's comprehension of entrepreneurial opportunities within Botany, including ventures utilizing medicinal plants, biotechniques, and marketing bioproducts.
2. To cultivate a mindset among students to initiate their own ventures as a means of income generation and professional empowerment.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	explain the concept of entrepreneurial opportunities in Botany.	**K1**
2.	relate to how various fields of botany could be understood with an entrepreneurial approach.	**K2**
3.	make use of the knowledge gained to start new venture with the help of government agencies	**K3**
4.	decipher effective ways of making vale added products from coconut, banana, and jack fruit	**K4**
5.	develop strategies to cultivate algae and ornamental plants	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate;

Unit	Contents	No. of Hours
I	Introduction to entrepreneurship, Scope and identification of new ventures using plant resources, General concept about the Govt. formalities, rules & regulation, Role of funding agencies – NABARD, Rural Banking and DIC	**6**
II	Value Addition of Coconut: Cultivation and value addition in Coconut; Coconut honey, White meat, Dessicated coconut, Coconut flour, Coconut milk, Coconut chips. Value added products from Coconut Shell	**6**
III	Value Addition of Banana: Cultivation and value addition in Banana; Banana flour, Banana puree, Banana RTS Juice, Banana Wine, Banana biscuits, and Banana fibre	**6**
IV	Value Addition of Jackfruit: Cultivation and value addition of Jack fruit; Dried jack, Jack rind pickle, Jack fruit halwa, Jack fruit toffee, and Jack chips	**6**
V	*Spirulina* and *Azolla* cultivation. Elite and ornamental Plants in vitro propagation, Selection of superior biotypes of orchids, and Syngonium.	**6**
	Total	**30**

Self – Study	Production of Biofertilizers, Vermicomposting

Textbooks:

1. Gurinder Shahi. 2004. *Bio-Business in Asia: How countries Can Capitalize on the Life Science Revolution.* Pearson Prentice Hall, New Delhi, India.
2. Vijay Sethi, Shruthi Sethi, Bidyut C. Deka, Meena, Y.R. 2006. *Processing of Fruits and Vegetables for Value Addition*. Indus Publishing Company, Delhi.

References Books:

1. NIIR Board of Consultants & Engineers. 2006.*The Complete Book on Coconut & Coconut Products*. National Institute of Industrial Research, Delhi.

2. Richard Oliver. 2000. *The Coming Biotech Age: The Business of Biomaterials. McGraw* Hill Publications, New York, USA.
3. Priya Lokare. 2021. *Spirulina Farming.* Amazon Digital Services LLC - KDP Print US
4. Kumar, N. 1997. *Introduction to Horticulture.* Rajalakshmi Publications, Nagercoil.
5. Karthikeyan, S. and Arthur Ruf. 2009. *Bio business.* MJP Publications. Chennai, India.

Web Resources:

1. https://www.brainkart.com/article/Entrepreneurial-Botany_38321/
2. .http://www.brainkart.com/article/Economically-Useful-Plants-andEntrepreneurial-Botany_38301
3. http://parrotisland.mainsecureserver.com/catalog/images/Coconut%20Chips1.jpeg
4. http://www.boreas-online.com/catalog/pics/Defatted_Desiccated_Coconut.jpg
5. https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	3	1	1	2	2	1
CO2	2	3	1	2	2	1	1
CO3	3	3	2	1	1	1	1
CO4	2	3	2	1	1	2	1
CO5	2	3	1	2	2	2	2
Total	11	15	7	7	8	8	6
Average	2.2	3	1.4	1.4	1.6	1.6	1.2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	1	1	2	2	2	3	2	2	1	1
CO2	2	2	3	3	3	3	2	2	2	1
CO3	3	3	3	3	3	3	2	2	2	1
CO4	3	2	1	3	2	3	2	2	1	2
CO5	1	2	1	1	2	2	1	2	3	2
Total	10	10	10	12	12	14	9	10	9	7
Average	2	2	2	2.4	2.4	2.8	1.8	2	1.8	1.4

3 -Strong 2 - Medium 1 - Low

SEMESTER III / IV
SKILL ENHANCEMENT COURSE SEC IV: DIGITAL FLUENCY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG23CSE2	2	-	-	-	2	2	30	50	50	100

Pre-requisite: Basic computer knowledge

Learning Objectives:

1. To provide a comprehensive suite of productivity tools that enhance efficiency
2. To build essential soft skills that are needed for professional success.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	work with text, themes and styles	**K1**
2.	produce a mail merge	**K2**
3.	secure information in an Excel workbook	**K2**
4.	perform documentation and presentation skills	**K2, K3**
5.	add special effects to slide transitions	**K3**

K1 - Remember; **K2** - Understand; **K3** – Apply

Units	Contents	No. of Hours
I	**Microsoft Word 2010:** Starting Word 2010 - Understanding the Word Program Screen - Giving Commands in Word - Using Command Shortcuts – Document: Creating - Opening - Previewing - Printing and Saving. Getting Started with Documents: Entering and Deleting Text - Navigating through a Document - Viewing a Document. Working with and Editing Text: Spell Check and Grammar Check-Finding and Replacing Text - Inserting Symbols and Special Characters – Copying, Moving, and Pasting Text.	**6**
II	**Formatting Characters and Paragraphs**: Changing Font Type, Font Size, Font Color, Font Styles and Effects, Text Case, Creating Lists, Paragraph Alignment, Paragraph Borders and Shadings, Spacing between Paragraphs and Lines. Formatting the Page: Adjusting Margins, Page Orientation and Size, Columns and Ordering, Headers and Footers, Page Numbering. Working with Shapes, Pictures and SmartArt: Inserting Clip Art, Pictures and Graphics File, Resize Graphics, Removing Picture's Background, Text Boxes, Smart Art, Applying Special Effects. Working with Tables: Create Table, Add and delete Row or Column, Apply Table Style - Working with Mailings.	**6**
III	**Microsoft Excel 2010:** Creating Workbooks and Entering Data: Creating and Saving a New Workbook - Navigating the Excel Interface, Worksheets, and Workbooks - Entering Data in Worksheets - Inserting, Deleting, and Rearranging Worksheets. Formatting Worksheets: Inserting and Deleting Rows, Columns and Cells - Formatting Cells and Ranges - Printing your Excel Worksheets and Workbooks. Crunching Numbers with Formulas and Functions: Difference between Formulae and Functions - Applying Functions. Creating Powerful and Persuasive Charts: Creating, Laying Out, and Formatting a Chart.	**6**
IV	**Microsoft PowerPoint 2010:** Creating a Presentation - Changing the Slide Size and Orientation - Navigating the PowerPoint Window - Add content to a Slide - Adding, Deleting, and Rearranging Slides - Using views to work on Presentation. Creating Clear and Compelling Slides: Planning the Slides in Presentation - Choosing Slide	**6**

	Layouts to Suit the Contents - Adding Tables, SmartArt, Charts, Pictures, Movies, Sounds, Transitions and Animations - Slideshow.	
V	**Digital Platforms:** Graphic Design Platform: Canva - Logo Making, Invitation Designing. E-learning Platform: Virtual Meet – Technical Requirements, Scheduling Meetings, Sharing Presentations, Recording the Meetings. Online Forms: Creating Questionnaire, Publishing Questionnaire, Analyzing the Responses, Downloading the Response to Spreadsheet.	**6**
	Total	**30**

Self-study	Parts of a computer and their functions

Textbook:

Anto Hepzie Bai J. & Divya Merry Malar J.,2024, Digital Fluency, Nanjil Publications, Nagercoil.

Reference Books:

1. Steve Schwartz, 2017, *Microsoft Office 2010 for Windows*, Peachpit Press.
2. Ramesh Bangia, 2015, Learning Microsoft Office 2010, Khanna Book Publishing Company.
3. Bittu Kumar, 2018, *Mastering MS Office*, V & S Publishers.
4. James Bernstein, 2020, *Google Meet Made Easy*, e-book, Amazon.
5. Zeldman, Jeffrey, 2005, *Web Standards Design Guide*, Charles River Media.

Web Resources:

1. https://www.youtube.com/watch?v=oocieLn6umo
2. https://www.youtube.com/watch?v=pPSwbK4_GdY
3. https://www.youtube.com/watch?v=DKAiSDhU4To
4. https://www.youtube.com/watch?v=sbeyPahs-ng
5. https://www.youtube.com/watch?v=fACEzzmXelY

SEMESTER III

SPECIFIC VALUE -ADDED COURSE: MINIATURE GARDEN IN LIMITED SPACE

Course Code	L	T	P	S	Credit	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU233V01	2	-	-	-	1	2	30	25	75	100

Pre-requisites:

Students should have basic understanding of gardening concepts and interest in plant care.

Learning Objectives:

1. Develop hands-on skills in gardening techniques, including propagation and terrarium and Kokedama creation.
2. Acquire knowledge of gardening styles, plant selection for indoor spaces, and sustainable gardening practices.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	grasp the concept of vertical gardening and its benefits.	**K1**
2.	understand how indoor plants can break office monotony and improve the overall workspace environment.	**K2**
3.	acquire skills in laying soil, manuring, and watering for optimal plant growth.	**K3**
4.	differentiate between formal and informal garden styles.	**K4**
5.	design and assemble their own terrariums, Miniature Fairy Garden, Kokedama.	**K6**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Unit	Contents	No. of Hours
I	Scope and objectives of gardening and style of gardens: Formal, Informal, gardening tools, potting soil, types of propagation	**6**
II	Principles and making of Terrarium, Kokedama and Miniature fairy garden. Concept of Vertical gardens.	**6**
III	Plants suitable for office space, aesthetic value, breaking office monotony, air purifier.	**6**
IV	Importance of layout and principles in kitchen and balcony garden, composting and micro greens	**6**
V	Gardening management operations: - soil laying, manuring, watering, management of pests and diseases.	**6**
	Total	**30**

Textbooks:

1. Donni Webber 2016. *Magical Miniature Gardens and Homes.* Page Street Publishing
1. Company, Salem, USA.
2. Singh Dueep Jyot 2019. *Gardening in a Limited Space for Newbies: the Magic of the Small*
3. *Garden.* Mendon Cottage Books, UT, USA.

References Books:

1. Dueep Jyot Singh and John Davidson 2013. *The Beginner's Guide to Indoor and Miniature Gardens*. JD- BiZ Corp. Publishing, Texas, USA.
2. Nick Creighton 2022 *The Portable Garden: Micro Gardening for Renters and Small Space Dwellers – Transform Your Balcony, Patio, or Window Space into a Lush Retreat*. Nick Creighton Publisher, USA
3. Arora J S 2006. *Introductory Ornamental Horticulture,* Kalyani Publication, New Delhi.
4. Bose, TK. Maiti RG, Dhua RS & Das P. 1999. *Floriculture and Landscaping*. Naya Prakash Publishers, New Delhi.

5. Prasad S and Kumar U. 2003. *Commercial Floriculture.* Agrobios, New Delhi.

Web Resources:

1. https://rootbridges.com/blogs/root-bridges-blog/miniature-gardening-tips-benefits#:~:text=Plants%20like%20Spider%20plant%2C%20Peperomia,are%20used%20in%20miniature%20gardens.&text=A%20large%20open%20surface%20concrete,soil%20and%20a%20drainage%20system.
2. https://www.clicbrics.com/blog/miniature-garden-ideas
3. https://terrariumcreations.elementor.cloud/bring-nature-into-your-home-with-a-vertical-garden-terrarium/

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	3	3	1	2	1	3
CO2	2	3	3	1	3	1	3
CO3	3	3	3	1	2	1	2
CO4	3	2	3	3	2	2	2
CO5	3	3	3	2	1	2	3
Total	13	14	15	8	10	7	13
Average	2.6	2.8	3	1.6	2	1.4	2.6

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	1	2	2	3	2	1	2	3
CO2	3	3	3	2	2	3	1	3	3	3
CO3	3	3	3	2	3	3	1	1	2	3
CO4	1	1	1	2	1	2	2	1	2	2
CO5	3	3	3	3	3	3	2	3	2	3
Total	13	13	11	11	11	14	8	9	11	14
Average	2.6	2.6	2.2	2.2	2.2	2.8	1.6	1.8	2.2	2.8

3 -Strong 2 - Medium 1 - Low

SEMESTER III

SPECIFIC VALUE -ADDED COURSE: CULTIVATION OF ALGAE

Course Code	L	T	P	S	Credit	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU233V02	2	-	-	-	1	2	30	25	75	100

Pre-requisites:

Basic knowledge of biology and laboratory techniques.

Learning Objectives:

1. To understand algae cultivation techniques, media composition, and seaweed cultivation practices.
2. To explore SLF production in agriculture and assess the environmental impact of algal cultivation.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	obtain an in-depth knowledge on culture and mass cultivation of algae and its different methods.	**K1**
2.	explore and recommend commercial potential of algal products.	**K2**
3.	understand the apply facet of algology and acquire a complete knowledge about the cultivation methods in algae	**K3**
4.	describe the preparation of seaweed liquid fertilizers and their applications in agriculture and horticulture.	**K4**
5.	acquire the information about algal applications in different industries and agriculture fields in the current scenario.	**K5 & K6**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Unit	Contents	No. of Hours
I	Introduction to *Spirulina*, Nutritional values and Commercial significance. Cultivation techniques: Culture media, growth conditions and harvesting techniques	**6**
II	Introduction to Single Cell Protein (SCP), Nutritional values and Commercial significance. Cultivation techniques: Various substrates, fermentation process optimization of growth condition and harvesting techniques	**6**
III	Introduction to Macroalgae – *Gracilaria*, ecological importance, and commercial uses. Cultivation techniques: Site selection, farming systems, optimal growth condition and harvesting techniques	**6**
IV	Introduction to Seaweed Liquid Fertilizer (SLF), commercial usage. Extraction Process: Seaweed harvesting, washing, grinding and extraction	**6**
V	Role of seaweeds in aquaculture: Environment Impact Assessment of algal cultivation.	**6**
	Total	**30**

Textbooks:

1. Kumar H.D. and Singh, H.N. 1976. *A Text Book of Algae.* Affiliated East West Press Pvt. Ltd., New Delhi.
2. Kumar, H.D. 1990. *Introductory Phycology.* Affiliated East West Press (P) Ltd., New Delhi.

References Books:

1. Bilgrami, K.S., and L.C. Saha. 1996. A Text Book of Algae. CBS Publishers & Distributors (P) Ltd., New Delhi.
2. Chapman, V.J. and Chapman, D.J., 1973. The Algae. (2nd Ed.). ELBS & MacMillan, UK.
3. Fritsch F.E. 1935. The Structure and Reproduction of Algae. Cambridge University Press, Cambridge, U.K.
4. Pandey, B.P. 1993. A Text book of Botany-Algae. S. Chand & Co., (P) Ltd., New Delhi.
5. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West. Press Pvt. Ltd, Delhi. edition.

Web Resources:

1. https://www.aiche.org/academy/videos/conference-presentations/study-culture-strategies-microalgae-continuous-photobioreactor-system-biofuel-production
2. https://link.springer.com/article/10.1007/s10811-013-9983-
3. https://www.nrel.gov/docs/legosti/old/2360.pdf
4. https://plantlet.org/algal-culture-types-culture-media/
5. https://www.fao.org/4/w3732e/w3732e06.htm

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	3	1	2
CO2	3	3	3	3	3	2	3
CO3	3	3	3	2	3	2	2
CO4	3	3	3	2	2	2	3
CO5	3	2	3	2	3	3	3
Total	15	14	15	11	14	10	13
Average	3	2.8	3	2.2	2.8	2.0	2.6

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	2	2	3	1	2	2	1
CO2	3	3	2	3	2	3	2	1	2	2
CO3	3	3	3	3	2	3	1	1	2	1
CO4	3	3	3	2	1	3	2	2	2	3
CO5	3	3	2	2	3	3	2	2	1	2
Total	15	15	13	12	10	15	8	8	9	9
Average	3	3	2.6	2.4	2	3	1.6	1.6	1.8	1.8

3 -Strong 2 - Medium 1 - Low

SEMESTER III

SPECIFIC VALUE -ADDED COURSE: FERMENTATION TECHNOLOGY

Course Code	L	T	P	S	Credit	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU233V03	2	-	-	-	1	2	30	25	75	100

Pre-requisites:

Should have knowledge on various fermentation technologies.

Learning Objectives

1. To understand the significance, safety, and quality control in large-scale production of fermentative products, including design and operation of industrial practices.
2. To gain insights into various fermentation technologies and bioproduct recovery.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	enumerate the significance of industrially useful microbes.	**K1**
2.	explain the design and operation of industrial practices in mass production of fermented products.	**K2**
3.	explain the process of maintenance and preservation of microorganisms.	**K3**
4.	analyze the various aspects of the fermentation technology and apply for fermentative production.	**K4**
5.	validate the experimental techniques for microbial production of enzymes, anti-biotics and acids	**K5 & K6**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Unit	Contents	No. of Hours
I	Scope and opportunities of fermentation technology. Principles of fermentation. Fermentative production of vinegar.	**6**
II	Fermentative production of alcohol: Wine: crushing, fermentation, aging, and bottling.	**6**
III	Fermentative production of acids - Citric acid: fermentation medium, fermentation, extraction, and purification.	**6**
IV	Fermentative production of antibiotics – Streptomycin: fermentation, extraction, purification, and formulation.	**6**
V	Microbial production of enzymes – Amylase: microbial cultivation, enzyme extraction, purification, and formulation.	**6**
	Total	**30**

Textbooks:

1.Reed G. 2004. *Prescott & Dunn's Industrial Microbiology.* (4th Edition), AVI Pub. Co., USA.
2.Casida L.E. 2015. *Industrial Microbiology.* (3rd Edition), New Age International (P) Limited Publishers, New Delhi, India.

References Books:

1.Waites M.J., Morgan N.L., Rockey J.S. and Higton G. 2001. *Industrial Microbiology: An*

2.Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. *Microbiology.* (5th Ed.),. Tata McGraw-Hill Publishing Company Limited, New Delhi.
3.Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. *Principles of Fermentation Technology*. Butterworth-Heinemann Press. UK.
4.Peppler, H. J. D. Perlman. 2014. *Microbial Technology: Fermentation Technology*. Academic Press, UK. *Introduction.* (1st Edition), Blackwell Science, London, UK.

5.Black J.G. 2008. *Microbiology: Principles and Explorations.* (7th Ed). Prentice Hall, New Delhi.

Web Resources:

1. https://ebooks.foodtechlearning.xyz/2020/12/principal-of-fermentation-technology-by.html
2. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01LMDYFNQ
3. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01E3IC73W
4. https://uomustansiriyah.edu.iq/media/lectures/6/6_2017_09_25!11_14_34_PM.pdf
5. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000284/M025601/ET/1513594624Paper15EMB_Module21__etext.pdf

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	3	3	2	3
CO2	3	3	3	3	3	2	2
CO3	3	3	3	2	2	1	2
CO4	3	3	3	3	3	1	2
CO5	3	3	3	3	3	1	3
Total	15	15	15	14	14	7	12
Average	3	3	3	2.8	2.8	1.4	2.4

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	3	2	2	2	2	3
CO2	3	3	3	3	3	1	1	2	1	2
CO3	3	3	3	3	3	2	2	2	1	3
CO4	3	3	3	3	3	1	1	2	2	2
CO5	3	3	3	3	3	2	1	1	2	2
Total	15	15	15	15	15	8	7	9	8	12
Average	3	3	3	3	3	1.6	1.4	1.8	1.6	2.4

3 -Strong 2 - Medium 1 - Low

SEMESTER III / V
SELF-LEARNING COURSE: NATURE'S WEALTH

Course Code	L	T	P	S	Credit	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU233SL1/ BU235SL1	-	-	-	-	1	-	-	25	75	100

Pre-requisites:
Basic understanding of plant biology and agricultural practices.

Learning Objectives:
1. Gaining comprehensive knowledge of various plant species, their origins, cultivation techniques, economic significance, and practical applications in agriculture and industry.
2. Develop proficiency in identifying, describing, and understanding the uses of cereals, legumes, vegetables, fruits, spices, condiments, beverages plants, fibers, timber, oil-yielding plants, and medicinal plants.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	learn the origin and history of various crop plants.	**K1**
2.	understand the cultivation of various economically important crops.	**K2**
3.	acquire knowledge on the binomial nomenclature and morphology of economic crops.	**K3**
4.	acquire the skill for preparation plant-based products.	**K4**
5.	produce beverages and narcotics from specific plants.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate

Unit	Contents
I	**Cereals and Legumes:** Origin and History, Botanical description, Cultivation, Harvesting and uses of Cereals and Legumes: Wheat, Rice, Maize, Black gram, and Red gram.
II	**Vegetables and Fruits:** Origin and History, Botanical description and economic importance of Vegetables and Fruits: Banana, Mango, Brinjal, Tomato and Potato.
III	**Spices and Condiments:** Origin and History, Botanical description, Cultivation and uses of Spices and Condiments: Pepper, Cardamom, Clove, Chilly, and Turmeric.
IV	**Beverages Plants, Fibres and Timber:** Origin and History, Botanical description, Cultivation, Processing and uses of Beverages plants: Tea, Coffee and Cocoa. Fibers and Timber: Cotton and Teak.
V	**Oil Yielding Plants:** Origin and History, Botanical description, Harvesting, Extraction and uses of Fatty oils and Vegetable Fats: Sun flower, Soya bean, Coconut and Gingelly.

Textbooks:
1. Kochhar, S.L. (2012). *Economic Botany in Tropics.* MacMillan & Co. New Delhi, India.
2. Panday, BP. (2000). *Economic Botany.* S. Chand Publishing Company, New Delhi.

Reference Books:
1. Wickens, GE. 2001. *Economic Botany: Principles & Practices.* Kluwer Academic Publishers, The Netherlands.
2. Chrispeels, MJ. And Sadava, DE. 2003. *Plants, Genes and Agriculture.* Jones & Bartlett Publish, USA.
3. Singh, N.P 2007. *Fruit and Vegetable Preservation*. Oxford Book Company, New Delhi.
4. Ahlluwalia, Vikas 2007. *Food Processing.* Paragon International Publishers, New Delhi.
5. Baruah, B 2017. *Economic Botany.* Kalyani Publishers, New Delhi.

Web Resources:
1. https://www.scribd.com/document/363486959/Economic-Botany
2. https://content.kopykitab.com/ebooks/2014/06/3256/sample/sample_3256.pdf

3. http://bgsscienceacademy.ac.in/EducationalNotes/StudyMaterial/BOTANY/Botany%20Paper%205%20Notes%20TAXONOMY%20AND%20ECONOMIC%20BOTANY.pdf
4. https://ouat.ac.in/wp-content/uploads/2024/03/Food-Science.pdf
5. https://www.jvwu.ac.in/documents/75-final%20%20Principles%20of%20Food%20Science%20and%20Nutrition.pdf

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	1	3	3	3
CO2	3	2	3	2	3	3	2
CO3	3	2	2	2	3	1	2
CO4	2	3	2	2	3	2	2
CO5	2	3	2	3	3	3	2
Total	13	12	12	10	15	12	11
Average	2.6	2.4	2.4	2.0	3	2.4	2.2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	2	2	2	2	2	2	2	3
CO2	3	3	2	2	2	3	2	2	2	3
CO3	2	2	1	1	1	2	2	1	2	3
CO4	3	2	2	3	3	2	2	2	3	2
CO5	3	3	2	3	3	2	2	2	3	2
Total	14	12	9	11	11	11	10	9	12	13
Average	2.8	2.4	1.8	2.2	2.2	2.2	2.0	1.8	2.4	2.6

3 -Strong 2 - Medium 1 - Low

SEMESTER IV

CORE COURSE IV: PLANT DIVERSITY IV – GYMNOSPERMS, PALEOBOTANY AND EVOLUTION

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU234CC1	3	2	-	-	5	5	75	25	75	100

Pre-requisite:

Fundamentals of Gymnosperms, fossil records and evolution.

Learning Objectives:

1. To enable the students to understand internal and the reproductive structures of Gymnosperms and the importance of evolution.
2. To acquaint students with evidences of the past history of plant groups and significance of the fossilization.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	relate the general characteristics of Gymnosperms	**K1**
2.	explain about the morphology and anatomy of Gymnosperms.	**K2**
3.	understand the various fossilization methods and their significance in paleo botany.	**K2**
4.	compare and contrast the reproductive structures of Gymnosperms & fossil forms	**K4**
5.	analyze the anatomy and reproduction of Gymnosperms along with their ecological and economical importance.	**K4**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze

Unit	Contents	No. of Hours
I	Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics, Economic importance of Gymnosperms with special reference to oil, resin, timber, etc.	**15**
II	Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (*Cycas*), Coniferales (*Pinus*).	**15**
III	Morphology, anatomy and reproduction of the taxa belonging to the following order: Gnetales (*Gnetum*). Introduction to fossils, Contribution of Birbal Sahni, Fossilization processes such as compression, casts, molds, petrification, impressions and coal balls. Geological time scale.	**15**
IV	Study of the following fossils: Rhynia,Lyginopteris and Lepidodendron.	**15**
V	Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De Veries, modern synthetic theory. Concept of species - Allopatric and sympatric.	**15**
	Total	**75**

Self-Study	Economic importance of Gymnosperms with special reference to oil, resin, timber

Textbooks:

1. Bhatnagar, S.P., Alok Moitra 2022. *Gymnosperms*. New Age International Publishers, New Delhi.
2. Vashista, P.C., Sinha, A.K., Anil Kumar. 2006. *Botany for Degree Student: Gymnosperms.* S. Chand & Co., New Delhi.

References Books:

1. Sporne, K.R.2020. *The Morphology of Gymnosperms*. B.I. Publications, New Delhi.
2. Stewart, W.N and Rathwell, G.W. 1993. *Paleobotany and the Evolution of Plants*. Cambridge , University Press, U.K.
3. Anil Kumar. 2006. *Gymnosperms.* S. Chand & Company Pvt. Ltd. New Delhi.
4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. 2005. *Biology*. Tata McGraw Hill, Delhi.
5. Gangulee, H.C and Kar A.K. 2013. *College Botany*. (5th Edition). S. Chand & Company, New Delhi.

Web Resources:

1.https://books.google.co.in/books?hl=en&lr=&id=Pn7CAAAQBAJ&oi=fnd&pg=PA1&dq=Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false
2.https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y
3.https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC
4.https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf.
5.https://www.palaeontologyonline.com/

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	1	2	1
CO2	3	3	2	2	3	2	3
CO3	3	3	2	2	1	2	1
CO4	3	3	3	3	3	3	3
CO5	3	3	1	3	2	3	2
Total	15	15	10	12	10	12	10
Average	3	3	2	2.5	2	2.5	2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	2	2	1	1	2	2	2	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	3	3	2	2	1	2	1	3	1	3
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	2	1	3	1	3
Total	15	15	11	12	10	10	9	14	9	14
Average	3	3	2.2	2.4	2	2	1.8	2.8	1.8	2.8

3 -Strong 2 - Medium 1 - Low

SEMESTER IV

CORE LAB COURSE IV: PLANT DIVERSITY IV – GYMNOSPERMS, PALEOBOTANY & EVOLUTION- PRACTICAL -IV

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
BU234CP1	1	-	2	-	3	3	45	25	75	100

Pre-requisites:

Familiarity with the fundamentals of Gymnosperms & Paleobotany.

Learning Objectives:

1. To enable students observe and record the anatomical features of selected species of Gymnosperms.
2. To understand the anatomy of the fossil plants through microscopy.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	describe the structure of fossil forms prescribed in the syllabus.	**K1**
2.	develop comprehensive skills in sectioning and micro preparation.	**K2**
3.	identify and illustrate the anatomical features of selected species of gymnosperms.	**K3**
4.	interpret the significance of reproductive structures in gymnosperms.	**K4**
5.	analyze, observe and record the morphological features of selected species of gymnosperms.	**K4**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze

Contents	No. of Hours
1.Study of morphology, anatomy and structure of the vegetative and reproductive organs of *Cycas, Pinus* and *Gnetum.* 1. *Pinus* *Pinus* – Habit T.S of Needle T.S of Stem **Slides:** L.S of Male cone, L.S of Female cone Entire Male and Female cone 2. *Cycas* T.S. of Normal root T.S. of Coralloid root T.S. of Rachis T.S. of Leaflet **Slides:** T.S. of Microsporophyll, L.S of Megasporophyll , L.S. of Ovule Entire Male and Female cone 3. *Gnetum* *Gnetum* - Habit T.S of Stem T.S of Leaf **Slides:** L.S. of Ovule Entire Male cone & Female cone 4. Identifying the micro slides relevant to the syllabus. 5. Field visit to study the habitat (Hill station). 6. Study the following fossil members: *Rhynia, Lyginopteris* and *Lepidodendron.*	45

through permanent slides. 7. Photograph of evolution scientists.	
Total	**45**

Textbooks:

1.Sharma, O.P and, Dixit. S. 2002.*Gymnosperms.* Pragati Prakashan, New Delhi.
2.Gangulee, H.C and Kar A.K. 2013. *College Botany.* (5th Edition). S. Chand& Company, New Delhi.

References Books:

1.Smith, G.M. 1955. *Cryptogamic Botany.* (Vol.II). Tata McGraw Hill. New Delhi.
2.James. W. Byng. 2015. *The Gymnosperms Practical Hand Book.* Plant Gateway, Tol Bot Street, Herford, SG137BX, United Kingdom.
3.Sharma, O.P. 2012. *Textbook of Pteridophyta,* TATA MacMillan India Ltd., New Delhi.
4.Kirkaldy, J.E. 1963. *The Study of Fossils.* Hutchinson Educational, London.
5.Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. 2005. *Biology.* Tata McGraw Hill, Delhi.

Web Resources:

1. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv =1&dq=gy**mnosperms &printsec=frontcover**
2. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721
3. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAAIAAJ
4. https://trove.nla.gov.au/work/11471742?q&versionId=46695996
5. http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html**.**

MAPPING WITH PROGRAMME OUTCOMES:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	3	2	1	2
CO2	3	3	2	2	3	3	2
CO3	2	2	3	3	1	2	1
CO4	3	3	3	3	3	2	2
CO5	3	3	2	2	3	3	2
Total	14	14	12	13	12	11	9
Average	2.8	2.8	2.4	2.6	2.4	2.2	1.8

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PS10
CO1	2	1	2	3	2	1	2	2	2	3
CO2	3	2	2	2	3	3	2	3	2	2
CO3	2	2	3	3	1	2	1	3	3	3
CO4	3	3	3	3	3	2	2	3	3	3
CO5	3	3	2	2	3	3	2	3	2	2
Total	13	11	12	13	12	11	9	14	12	13
Average	2.6	2.5	2.4	2.6	2.4	2.2	1.8	2.8	2.4	2.6

3 -Strong 2 - Medium 1 - Low

SEMESTER IV

ELECTIVE COURSE IV: ALLIED BOTANY IV

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
BU234EC1	3	-	1	-	3	4	60	25	75	100

Pre-requisites: Basics of botany.

Learning Objectives:

1. To gain a solid grasp of plant systematics, acknowledging the pivotal role of plant anatomy in production systems, and comprehending the shift from vegetative to reproductive phases.
2. To acquire knowledge in the physiological processes governing plant metabolism, energy production, and utilization.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	know about the fundamental concepts of aerobic and anaerobic respiration.	**K1**
2.	understand the fundamental concepts of plant anatomy and embryology.	**K2**
3.	understand water relation of plants with respect to various physiological processes.	**K2**
4.	classify plant systematics and recognize the importance of herbarium and virtual herbarium.	**K3**
5.	analyze and recognize the different organs of plants and secondary growth.	**K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze

Unit	Contents	No. of Hours
I	**Morphology of Flowering Plants:** Plant and its parts. Structure and function of root and stem. Leaf and its parts. Leaf types- simple and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose and Special types. Terminology with reference to flower description.	**12**
II	**Taxonomy:** Study of the range of characters and plants of economic importance in the following families: Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Cannaceae	**12**
III	**Anatomy:** Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot roots - anatomy of monocot and dicot stems - anatomy of dicot and monocot leaves.	**12**
IV	**Embryology:** Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination -double fertilization, structure of dicotyledonous and monocotyledonous seeds.	**12**
V	**Plant Physiology:** Absorption of water, photosynthesis - light reaction - Calvin cycle; respiration - Glycolysis - Krebs cycle - electron transport system. Growth hormones - auxins and cytokinin and their applications.	**12**
	Total	**60**

Self-Study	Economic importance of families prescribed in the syllabus

Textbooks:

1. Sharma, O.P. 2017. *Plant Taxonomy.* (2nd Edition). The McGraw Hill Companies, New Delhi.
2. Maheshwari, P. 2012. *Recent Advances in Embryology of Angiosperms.* Intl. Soc. Plant Morphologists, New Delhi.

3.Salisbury, F. B.C.W. Ross.2001. *Plant Physiology*. Wass worth Pub. Co., Belmont, USA

References Books:

1.Lawrence. G.H.M. 1985. *An Introduction to Plant Taxonomy*, Central Book Depot, Allahabad.
2.Bhojwani, S.S and Bhatnagar, S.P. 2016. *The Embryology of Angiosperms* (6th revised and enlarged edition). Vikas Publishing House, New Delhi.
3.Pandey, B.P. 2012. *Plant Anatomy.* S. Chand & Co., New Delhi.
1. Jain, VK. 2006. *Fundamentals of Plant Physiology.* S. Chand & Co., New Delhi.
2. Rajni Gupta. 2012. *Plant Taxonomy: Past, Present and Future.* Vedams (P) Ltd. New Delhi.

Web Resources:

1. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y
2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y
3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp
4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/ dp/ B00UN5KPQG
5. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	1	2	2	1	2
CO 2	3	2	2	1	2	2	1
CO 3	3	3	2	2	2	2	1
CO 4	3	1	3	2	2	2	2
CO 5	3	2	2	2	2	2	2
Total	15	10	10	9	10	9	8
Average	3	2	2	1.8	2	1.8	1.6

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	3	3	2	2	1	2	2	2	3
CO 2	3	2	3	3	2	2	2	2	2	3
CO 3	3	3	3	3	2	2	2	3	3	3
CO 4	3	3	3	2	2	2	2	2	3	2
CO 5	3	3	3	3	3	3	3	2	2	2
Total	14	14	15	13	11	10	11	11	12	13
Average	2.8	2.8	3	2.6	2.2	2	2.2	2.2	2.4	2.6

3 -Strong 2 - Medium 1 - Low

SEMESTER IV

ELECTIVE LAB COURSE IV: ALLIED BOTANY PRACTICAL

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU234EP1	-	-	2	-	2	2	30	25	75	100

Prerequisite: Knowledge onvarious aspects of plants.

Learning Outcomes:

1.To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of microorganisms,algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms.

2.To understand the laws of inheritance, genetic basis of loci and alleles.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	study the classical taxonomy with reference to different parameters.	**K1**
2.	understand the effect of various physical factors on photosynthesis.	**K2**
3.	use the fundamental concepts of plant anatomy and embryology	**K3**
4.	analyze the internal organization of algae and fungi.	**K4**
5.	develop critical understanding on morphology, anatomy and reproduction of bryophytes, pteridophytes and gymnosperms.	**K4**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze

Contents	No. of Hours
1. Describe in technical terms, plants belonging to all the families prescribed in the syllabus and to identify the plants to their family. 2. Dissect a flower, construct floral diagram and write floralformula. 3. Demonstration experiments i. Ganong's Light screen ii. Ganong's Respiroscope 4. Make suitable micro preparations of anatomy materialsprescribed in the syllabus. 5. Spotters – Angiosperm, Anatomy and Embryology.	**30**
Total	**30**

Textbooks:

1. Sharma, O.P. 2017. *Bryophyta.* MacMillan India Ltd, New Delhi.
2. Sharma, O.P. 2012. *Pteridophyta.* Tata McGraw-Hills Ltd., New Delhi.
3. Subramaniam, N.S. 1996. *Laboratory Manual of Plant Taxonomy*. Vikas Publishing House Pvt. Ltd., New Delhi.
4. Benjamin, A. Pierce. 2012. *Genetics- A conceptual Approach.* W.H. Freeman and Company, England.
5. Noggle, G.R and G.J. Fritz. 2002. *Introductory Plant Physiology.* Prentice Hall of India, New Delhi.

Reference Books:

1. Strickberger, M.W. 2005. *Genetics* (3rd Edition). Prentice Hall, New Delhi.
2. Nancy Serediak and M. Huynh. 2011. *Algae Identification Lab Guide. Accompanying manual to algae identification field guide.* Ottawa Agriculture and Agri food Canada Publisher, Canada.
3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. *Practical Manual for Bryophytes and Pteridophytes.* Lambert Academic Publishing, New Delhi.

4. Aler Gingauz. 2001. *Medicinal Chemistry.* Oxford University Press & Wiley Publications, London.
5. Steward, F.C. 2012. *Plant Physiology.* US Academic Press, United States.

Web Resources:

1. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883
2. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover
3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ
4. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
5. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	1	2
CO2	3	2	2	2	3	2	2
CO3	3	3	3	2	2	1	2
CO4	3	2	2	3	3	1	2
CO5	3	3	2	2	3	2	3
Total	15	13	11	11	13	7	11
Average	3	2.6	1.1	2.2	2.6	1.4	2.2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	2	2	1	2	1	1	2	2
CO 2	2	3	2	1	1	1	1	2	1	2
CO 3	3	3	1	1	2	2	2	1	2	1
CO 4	3	2	2	2	1	2	2	2	2	2
CO 5	3	3	3	2	2	1	2	2	1	2
Total	14	13	10	8	7	8	8	6	8	7
Average	2.8	2.6	2.0	1.6	1.4	1.6	1.6	1.2	1.6	1.4

3 -Strong 2 - Medium 1 - Low

SEMESTER III / IV

SKILL ENHANCEMENT COURSE SEC-III: FITNESS FOR WELLBEING

Course Code	L	T	P	S	Credits	Total Hours	Marks		
							CIA	External	Total
UG23CSE1	1	-	1	-	2	30	25	75	100

Pre-requisites: Basic understanding of health and wellness concepts

Learning Objectives

1. To understand the interconnectedness of physical, mental, and social aspects of well-being, and recognize the importance of physical fitness in achieving holistic health.
2. To develop proficiency in mindfulness techniques, yoga practices, nutritional awareness, and personal hygiene practices to promote overall wellness and healthy lifestyle.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	know physical, mental, and social aspects of health	K1
2	understand holistic health and the role of physical fitness.	K2
3	apply mindfulness and yoga for stress management and mental clarity.	K3
4	implement proper personal hygiene practices for cleanliness and disease prevention.	K3
5	luate and implement right nutritional choices.	K5

K1-Remember; **K2**-Understand; **K3**-Apply; **K5**-Evaluate

Unit	Contents	No. of Hours
I	**Understanding Health and Physical Fitness** Health – definition- holistic concept of well-being encompassing physical, mental, and social aspects. Physical fitness and its components- muscular strength- flexibility, and body composition. Benefits of Physical Activity- its impact on health and well-being.	6
II	**Techniques of Mindfulness** Mind – Mental frequency, analysis of thought, eradication of worries Breathing Exercises – types and its importance Mindfulness –pain management - techniques for practicing mindfulness - mindfulness and daily physical activities.	6
III	**Foundations of Fitness** Stretching techniques to improve flexibility. Yoga-Definition, yoga poses (asanas) for beginners, Sun Salutations (Surya Namaskar), Yoga Nidra – benefits of yoga nidra.	6
IV	**Nutrition and Wellness** Role of nutrition in fitness - macronutrients, micronutrients - mindful eating practices, balanced diet - consequences of overeating. Components of healthy food. Food ethics.	6
V	**Personal Hygiene Practices** Handwashing- techniques, timing, and importance, oral hygiene- brushing, flossing, and dental care, bathing and showering- proper techniques and frequency, hair care- washing, grooming, and maintaining cleanliness, maintaining personal hygiene, dangers of excessive cosmetic use.	6
	Total	30

Self-study	Balance diet and basic excercises

Textbook:

Bojaxa A. Rosy and Virgin Nithya Veena. V. 2024. *Fitness for Wellbeing*.

Reference Books:

1. Arul Raja Selvan S. R, 2022. *Yogasanam and Health Science*. Self publisher.
2. Vision for Wisdom. 2016. *Value Education*. The World Community Service Centre Vethathiri Publications.
3. WCSC – Vision for Wisdom. 2016. *Paper 1: Yoga and Empowerment*. Vazhga Valamudan Offset Printers Pvt Ltd 29, Nachiappa St, Erode.
4. Lachlan Sleigh. 2023. *Stronger Together the Family's Guide to Fitness and Wellbeing*. Self Publisher.
5. William P. Morgan, Stephen E. Goldston. 2013. *Exercise And Mental Health*. Taylor & Francis.

Web Resources:

1. https://www.google.co.in/books/edition/Psychology_of_Health_and_Fitness/1lYOAwAABAJ?hl=en&gbpv=1&dq=fitness+for+wellbeing&printsec=frontcover
2. https://www.google.co.in/books/edition/The_Little_Book_of_Active_Wellbeing/aA6SzgEACAAJ?hl=en
3. https://www.google.co.in/books/edition/Physical_Activity_and_Mental_Health/yu96DwAAQBAJ?hl=en&gbpv=1&dq=fitness+for+wellbeing&printsec=frontcover
4. https://www.google.co.in/books/edition/The_Complete_Manual_of_Fitness_and_Well/pLPAXPLIMv0C?hl=en&gbpv=1&bsq=fitness+for+wellbeing&dq=fitness+for+wellbeing&printsec=frontcover
5. https://www.google.co.in/books/edition/The_Wellness_Code/4QGZtwAACAAJ?hl=en

SEMESTER IV
ENVIRONMENTAL STUDIES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG234EV1	2	-	-	-	2	2	30	25	75	100

Pre-requisite: Interest to learn about nature and surrounding.

Learning Objectives

1.To know the different types of pollutions, causes and effects

2.To understand the importance of ecosystem, resources and waste management

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	know the different kinds of resources, pollution and ecosystems	**K1**
2.	understand the biodiversity and its constituents	**K2**
3.	use the methods to control pollution and, to conserve the resources and ecosystem	**K3**
4.	analyse the factors behind pollution, global warming and health effects for sustainable development	**K4**
5.	evaluate various water, disaster and waste management systems	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Nature of Environmental Studies** Multidisciplinary nature of environmental studies- scope of environmental studies - environmental ethics-importance- types- natural resources - renewable and non-renewable resources – forest, land, water and energy resources.	6
II	**Biodiversity and its Conservation** Definition: genetic, species of biodiversity - biodiversity hot-spots in India - endangered and endemic species of India – Red Data Book - In-situ and Ex-situ conservation of biodiversity. Ecosystem- types - structure and function - food chain - food web- ecological pyramids- forest and pond ecosystems.	6
III	**Environmental Pollution** Pollution - causes, types and control measures of air, water, soil and noise pollution. Role of an individual in prevention of pollution. Solid waste management: Causes, effects and control measures of urban and industrial wastes. Disaster management– cyclone, flood, drought and earthquake.	6
IV	**Environmental Management and Sustainable Development** From unsustainable to sustainable development -Environmental Law and Policy – Objectives; The Water and Air Acts-The Environment Protection Act - Environmental Auditing-Environmental Impact Assessment-Life Cycle Assessment- Human Health Risk Assessment, Water conservation, rain water harvesting, watershed management.	6
V	**Social Issues and the Environment** Population explosion-impact of population growth on environment and social environment. Women and Child Welfare, Role of information technology in environment and human health. Consumerism and waste products. Climate change - global warming, acid rain and ozone layer depletion. **Field work:** Address environmental concerns in the campus (or) Document environmental assets- river / forest / grassland / hill / mountain in the locality (or)	6

	Study a local polluted site-urban / rural / industrial / agricultural area.	
	Total	**30**

Self-study	Pollutants, Ecosystems and Resources

Textbook

Punitha A And Gladis Latha R, 2024. Fundamentals Of Environmental Science.

Reference Books

1. Agarwal, K.C., 2001. *Environmental Biology*, Nidi Publishers. Ltd. Bikaner.
2. Brunner R.C., 1989, *Hazardous Waste Incineration*, Mcgraw Hill Ltd.
3. Gorhani, E & Hepworth, M.T. 2001. *Environmental Encyclopedia*, Jaico Publ. House, Mumbai.
4. De A.K.,2018. *Environmental Chemistry*, Wiley Eastern Ltd.
5. Gleick, H.P. 1993. *Water In Crisis*, Pacific Institute For Studies Oxford Univ. Press.

Web Resources

1.https://www.sciencenews.org/topic/environment
2.https://news.mongabay.com/2024/05/
3. https://www.sciencedaily.com/news/earth_climate/environmental_issues/
4.https://wildlife.org/rising-oryx-numbers-may-distress-new-mexico-ecosystem/
5. https://phys.org/news/2024-02-global-wild-megafauna-ecosystem-properties.html

SEMESTER III & IV
LIFE SKILL TRAINING II: CATECHISM

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG234LC1	1	-	-	-	1	1	15	50	50	100

Learning Objectives:

1. To develop human values through value education
2. To understand the importance of personal development to lead a moral life

Course Outcomes

Upon completion of this course the students will be able to		
1	know and understand the aim and importance of value education	K1,K2
2	get rid of inferiority complex and act confidently in the society	K3
3	live lovingly by facing loneliness and make decisions on their own	K3
4	develop human dignity and able to stand bravely in adversity	K6
5	learn unity in diversity and grow in a life of grace	K6

K1 - Remember **K2**-Understand; **K3**-Apply; **K6**- Create

Units	Contents	No. of Hours
I	**Face Loneliness:** Loneliness – Causes for Loneliness – Loneliness in Jesus Christ Life – Ways to Overcome Loneliness – Need and Importance Bible Reference: Matthew: 6:5-6	3
II	**Inferiority Complex:** Inferiority Complex - Types – Ways to Get Rid of Inferiority Complex – Words of Eric Menthol – Balanced Emotion – Jesus and his Disciples. Bible Reference: Luke 8:43-48	3
III	**Decision Making:** Importance of Decision Making – Different Steps – Search – Think – Pray – Decide- Jesus and his Decisions Bible Reference: Mathew 7:7-8 **Independent:** Freedom from Control – Different Types of Freedom - Jesus the Liberator Bible Reference: Mark 10:46-52	3
IV	**Human Dignity:** Basic Needs – Factors that Degrade Human Dignity – How to Develop Human Dignity. Bible Reference: Luke 6:20-26 **Stand Bravely in Adversity:** Views of Abraham Maslow – Jesus and his Adversity. Bible Reference: Luke 22:43	3
V	**Unity in Diversity:** Need for Unity – The Second Vatican Council on the Mission of Christian Unity. Bible Reference: I Corinthians 1:10 **To Grow in a Life of Grace:** Graceful Life – View of Holy Bible – Moses – Amos – Paul – Graceful Life of Jesus Bible Reference: Amos 5:4	3
TOTAL		**15**

Textbooks

Valvukku Valikattuvom, Christian Life Committee, Kottar Diocese
The Holy Bible

SEMESTER III & IV
LIFE SKILL TRAINING II: MORAL

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG234LM1	1	-	-	-	1	1	15	50	50	100

Objectives:

1. To cultivate human values through value education
2. To comprehend the importance of humane and morals to lead ethical and moral life.

Course Outcome

Upon completion of this course the students will be able to		
1	know the significance of life	K1
2	understand the importance of self-care	K2
3	realise the duty of youngsters in the society and live up to it	K3
4	analyse how to achieve success in profession	K4
5	develop mystical values by inculcating good thoughts	K5

K1 - Remember; K2 - Understand; K3 – Apply; K4 - Analyse; K5 – Evaluate

Unit	Contents	No. of Hours
I	**Edu Care:** Introduction- -Personal Care-Temple of Mind-Emotional stability- Inner views- Internal and external Beauty- Life is a Celebration	**3**
II	**Self-care:** Self- discipline- Selfishness in doing good things- Adolescence stage- What am I? - Self-esteem- Self-Confidence- Respect for womanhood	**3**
III	**Profession based Values:** Time Management-Continuous effort- What next? –Present moment is yours, Hard work and Smart Work-Broad view- destruct your failures	**3**
IV	**Mystical Values:** Thoughts- Positive and negative thoughts- Origin of negative thoughts-Moralisation of needs- Elimination of obstacles	**3**
V	**Society and you:** Knowing Humanity-Thankfulness- love and happiness-Honesty- Heroism -Youth is gift of God-Youngsters in politics and social media utilization.	**3**
TOTAL		**15**

Text Book

"Munaetrathin Mugavari", G. Chandran, Vaigarai Publisher.

SEMESTER IV/ VI

SELF - LEARNING COURSE: HERBAL FORMULATIONS

Course Code	L	T	P	S	Credit	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU234SL1/ BU236SL1	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**25**	**75**	**100**

Pre-requisite: Basic understanding of herbal formulations effectively.

Learning Objectives:

1. Understand the principles of herbal medicine, including plant identification, cultivation, extraction methods, and formulation techniques.
2. Evaluate the therapeutic properties and potential health benefits of various herbs and herbal combinations for specific health conditions.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	**obtain the knowledge of herbal preparation using various types of medicinal plants.**	**K1**
2.	learn the herbal decoction and herbal powder preparation	**K2**
3.	study and investigate the disease curing ability of medicinal plants in various ailments.	**K3**
4.	evaluate the herbal based formulations and products in pharmaceutical industries.	**K4**
5.	create new formulations using therapeutically valuable plant materials for the healthy life of society.	**K5, K6**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6-** Create

Unit	Contents
I	Herbal decoction preparation: *Andrographis paniculata*, *Tinospora cordifolia*, *Alpinia officinarum*, *Hygrophila auriculata* and *Adhathoda vasica*.
II	Herbal powder preparation: *Withania somnifera*, *Cyanodon dactylon,* Anti diabetic Sooranam, Kaphasura kudineer.
III	Herbal massage oil preparation: Pindathylam, Herbal bath conditioner preparation: Nalankumavu, Panchakarbam. Preparation of Herbal Face pack.
IV	Herbal hair oil preparation: Neelibirikathi. Herbal cream preparation: Mathanthylam. Herbal health drinks preparation: Mathulaimanabaku (Punica granatum and Hibiscus Rose Milk).
V	Herbal Consumable preparation: Herbal tea, herbal soup, herbal sweet and Flowers Salad. Preparation of Herbal Mosquito Repellent.

Textbooks:

1. Gokhale, S.B., Kokate, C.K. and Purohit, A.P. 2003. *Pharmacognosy.* Nirali Prakashan, Pune.
2. Joshi, S.G. 2001. *Medicinal Plants.* Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Reference Books:

1. Bhattacharjee, S.K. 2004. *Hand Book of Medicinal Plants.* Pointer Publishers, Jaipur.
2. Harbourne, J. B. 1998. *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis* (3rd Ed.). Chapman and Hill Co., New York.
3. Agnes Arber. 1999. *Herbal Plants and Drugs.* Mangal Deep Publications, New Delhi.
4. Rath, A. K. and Mishra, S. R. 2017. *Ethnobotany.* Kalyani Publishers, New Delhi.
5. Jain, S.K. 1995. *Manual of Ethnobotany.* Scientific Publishers, Jodhpur.

Web Resources:

1. http://www.who.int/topics/traditional_medicine/en/
2. https://www.who.int/health-topics/traditional-complementary-and-integrative-medicine#tab=tab_1
3. https://guides.lib.purdue.edu/c.php?g=352748&p=6133178
4. https://bsi.gov.in/page/en/medicinal-plant-database
5. https://nmpb.nic.in/

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**3**	**1**	**3**	**2**	**3**
CO2	3	2	3	1	3	2	3
CO3	2	3	3	2	2	3	2
CO4	3	3	3	2	2	3	2
CO5	3	3	3	2	2	2	3
Total	**14**	**13**	**15**	**8**	**12**	**12**	**13**
Average	**2.8**	**2.6**	**3**	**1.6**	**2.4**	**2.4**	**2.6**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	2	2	2	3	2	2
CO 2	3	3	2	2	2	2	2	3	2	2
CO 3	3	3	3	3	3	2	1	3	3	2
CO 4	3	3	3	3	3	3	1	3	3	3
CO 5	3	3	3	3	3	3	1	3	3	3
Total	**15**	**15**	**14**	**14**	**13**	**12**	**7**	**15**	**13**	**12**
Average	**3**	**3**	**2.8**	**2.8**	**2.6**	**2.6**	**1.4**	**3**	**2.6**	**2.4**

3 -Strong 2 - Medium 1 - Low

SEMESTER V

CORE COURSE V: PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU235CC1	4	1	-	-	4	5	75	25	75	100

Pre-requisite: Prior knowledge on plant structure, classification principles, and the economic significance of plants

Learning Objectives:

1. To impart knowledge on the vegetative and floral morphology of flowering plants and familiarize students with plant classification systems.
2. To enable students to identify key floral characteristics of selected plant families and understand their economic significance.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the morphological features of vegetative and floral structures in flowering plants, including modifications of roots, stems, leaves, inflorescences, and fruits.	**K1**
2.	explain the principles of different angiosperm classification systems, botanical nomenclature, and herbarium techniques for plant identification and preservation.	**K2**
3.	identify and differentiate selected plant families based on the different system of classification and recognize their key morphological characteristics.	**K3**
4.	analyze the distinguishing floral features of selected plant families and their taxonomic significance in classification.	**K4**
5.	assess the economic importance of plants from the prescribed families concerning their role in food, medicine, timber, dyes, and other commercial uses.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	Introduction to systematic: Botanical nomenclature: Principles and rules of International Code of Nomenclature (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations. Morphology of root, stem and leaves. Inflorescences—racemose, cymose, and special types. Fruit – types, floral diagram and floral formula.	**15**
II	Systems of Angiosperm classification – Detailed study on Sexual system-Carolus Linnaeus, Natural System – Bentham and Hooker, Phylogenetic System - APG Classification (2016). Herbarium technique–collection, pressing, drying, mounting, preservation of plant specimens and functions. Virtual herbarium. Taxonomic literature: Floras, monographs, revisions, journals and *Hortus malabarica.*	**15**
III	Study of the following families based on the natural system and their economic importance: Annonaceae, Nymphaeaceae, Rutaceae, Caesalpinaceae, Anacardiaceae, Cucurbitaceae, Apocynaceaeand Asclepiadaceae.	**15**
IV	Study of the following families based on the natural system and their economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Amaranthaceae, Liliaceae, Arecaceae and Poaceae.	**15**

V	Study of the following groups of plants with special reference to their botanical name, family, morphology of useful part, economic products and uses: Cereals - Paddy, Wheat; Pulses - Green gram, Bengal gram; Tuber crops -Tapioca, Potato; Spices - Pepper, Cardamom; Beverages - Tea, Coffee; Oil yielding plants - Coconut, Groundnut; Fibre yielding plants - Cotton, Coir; Timber yielding plants - Teak, Rose wood; Latex yielding plants - Para rubber, Sapota; Ornamental plants - Rose, Orchids.	**15**
	Total	**75**
Self-study	Virtual herbarium, floras, monographs, revisions.	

Textbooks:

1. Takhtajan, A.L.1997.*Diversity and Classification of Flowering Plants*. Columbia University Press, New York.
2. Sharma O.P. 2013. *Plant Taxonomy*, McGraw Hill Education Pvt.Ltd., New Delhi.

Reference Books:

1. Pullaiah, T. 2007. *Taxonomy of Angiosperms.* (3rded.), Regency Publication, New Delhi.
2. Mondal, A.K. 2005. *Advanced Plant Taxonomy*. New Central Book Agency (P) Ltd, New Delhi.
3. Roslin, A.S. 2005. *A Text Book on Taxonomy of Flowering Plants*. Assisi Offset Press, Nagercoil.
4. Vashista, P.C. 2015. *Taxonomy of Angiosperms*. Vikas Publications, New Delhi.
5. Singh and Jain 2007. *Taxonomy of Angiosperms*. Rastogi Publications, New Delhi.

Web Resources:

1. https://books.google.co.in/books/about/Plant_Taxonomy_2E.html?id=_px_WA wHiZIC&redirhttps://books.google.co.in/books/about/Plant_Taxonomy_and_Bi osystematics.html?id=VfQnuwh3bw8C&redir_esc=y_esc=y

2.https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi 0lwSXFnUC&redir_esc=y

3.https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9 gC&redir_esc=y

4.https://books.google.co.in/books/about/Economic_Botany.html?id=2ahsDQAA QBAJ&redir_esc=y

5.https://books.google.co.in/books/about/Textbook_Of_Economic_Botany.html?id =XmZFJO_JHv8C&redir_esc=y

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	2	3	3	1
CO2	3	1	3	2	3	3	1
CO3	3	1	2	2	3	3	1
CO4	3	1	3	2	3	3	1
CO5	3	2	3	2	3	3	1
TOTAL	**15**	**7**	**14**	**10**	**15**	**15**	**5**
AVERAGE	**3**	**1.4**	**2.8**	**2.0**	**3**	**3**	**1.0**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	2	2	1	1	2	3	2	3
CO2	3	3	3	2	2	2	2	3	2	3
CO3	3	3	3	1	2	2	3	3	3	3
CO4	3	2	3	1	2	3	3	3	3	3
CO5	3	2	2	2	1	3	1	3	3	3
TOTAL	**15**	**12**	**13**	**8**	**8**	**11**	**11**	**15**	**13**	**15**
AVERAGE	**3**	**2.4**	**2.6**	**1.6**	**1.6**	**2.2**	**2.2**	**3**	**2.6**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

CORE COURSE VI: CELL BIOLOGY, PLANT ANATOMY AND EMBRYOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU235CC2	4	1	-	-	4	5	75	25	75	100

Pre-requisite: A fundamental understanding of cell structure, plant tissues, and reproductive processes.

Learning Objectives:

1. To understand the ultrastructure of prokaryotic and eukaryotic cells, including their organelles, cell cycle, and modes of cell division.
2. To explain the organization of plant tissues, primary and secondary growth, and reproductive structures, including embryological processes like megasporogenesis, double fertilization, and endosperm formation.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	explain the ultrastructure of prokaryotic and eukaryotic cells, including the structure and function of the cell wall, plasma membrane, and cell organelles.	**K1**
2.	illustrate the process of cell cycle, mitosis, and meiosis, and analyze their significance in growth and reproduction.	**K2**
3.	differentiate between various plant tissues and interpret apical organization theories, including the Tunica-Corpus and Histogen theories.	**K3**
4.	compare the primary and secondary structures of dicot and monocot roots and stems, leaves and examine anomalous secondary growth in plants	**K4**
5.	assess the process of megasporogenesis and megagametogenesis, and evaluate the role of double fertilization, triple fusion, and types of endosperm in seed development.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	Ultra structure of Prokaryotic cell and Eukaryotic cell. Cell wall- Structure, and functions of cell wall, Plasma membrane - structure (fluid mosaic model) and function. Cell cycle, Cell division, Mitosis and Meiosis- their significance	**15**
II	Structure and function of Endoplasmic reticulum, Ribosomes, Mitochondria, Chloroplast, Nucleus, and Chromosomes. Cell inclusions– starch grains, crystals- cystolyth and raphide.	**15**
III	Tissues - Definition, types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem. Meristem: definition, structure, function,. Apical organization and theories:Tunica-Corpus theory. Root apex: Histogen theory. Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni-and multicellular, glandular and nonglandular, two examples of each), stomata and its types; Nodal anatomy types - unilacunar (*Justicia*), trilacunar (*Azadirachta*) and multilacunar (*Aralia*), Hydathodes and laticifers.	**15**
	Primary growth; Primary structure of dicot and monocot stem, root and leaf. Secondary growth in stem and root – Formation of cambial ring, activity of cambial	

IV	ring, secondary vascular tissue, formation of periderm, lenticels, dendrochronology, annual ring, Wood (heartwood and sapwood). Anomalous secondary growth of stem- *Boerhaavia*, and *Dracaena*.	**15**
V	Structure of mature anther and ovule**,** types of ovules. Female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (*Polygonum* type in detail); Double fertilization and triple fusion. Endosperm and its types-free nuclear, cellular, helobial. Endosperm haustoria. Apomixis and polyembryony.	**15**
Total		**75**

Self-study	Cell cycle, Apomixis and polyembryony.

Textbooks:

1. Bhatnagar,S.P.,Dantu,P.K,Bhojwani,S.S.2014.*TheEmbryologyof Angiosperms*, (6th edition) Vikas Publishing House, Delhi.
2. Raghavan,V.1999. *Developmental Biology of Flowering Plants*, Springer-Verlag, New York.

Reference Books:

1. Arthur J Eames., & Laurence H Macdaniels. 2005. *An Introduction to Plant Anatomy*, Tata McGraw-Hill Publishing Company, New Delhi.
2. Mauseth, J.D. 1988. *Plant Anatomy*, The Benjamin/Cummings Publisher, USA.
3. Pandey, B.P. 2002.*Plant Anatony*, S. Chand & Co, New Delhi.
4. Fahn, A. 1987. *Plant Anatomy*, Maxwell House,New York.
5. Raghavan, V.1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.

Web Resources:

1. https://www.amazon.in/PLANT-ANATOMY- EMBRYOLOGY-BIOTECHNOLOGYebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/ ?tag=googleshopdes-2
2. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy
3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp
4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar- ebook/dp/B00UN5KPQG
5. https://www.worldca t.org/title/embryology-of- angiosperms/oclc/742342811

MAPPING WITH PROGRAMME OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	1	3	2	3	2	1
CO2	3	2	2	2	3	1	1
CO3	3	1	2	2	3	2	1
CO4	3	2	3	2	3	2	1
CO5	3	2	3	2	3	2	1
TOTAL	**15**	**8**	**13**	**10**	**15**	**9**	**5**
AVERAGE	**3**	**1.6**	**2.6**	**2.0**	**3**	**1.8**	**1.0**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	2	2	2	1	1	2	2	2	3
CO2	3	3	3	1	1	2	2	1	1	3
CO3	3	2	2	2	2	2	2	2	2	3
CO4	3	3	2	1	2	2	2	2	2	3
CO5	3	2	3	2	1	2	2	1	3	3
TOTAL	**15**	**12**	**12**	**8**	**7**	**9**	**10**	**8**	**10**	**15**
AVERAGE	**3**	**2.4**	**2.4**	**1.6**	**1.4**	**1.8**	**2.0**	**1.6**	**2.0**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

CORE LAB COURSE V: PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
BU235CP1	1	-	2	-	2	3	45	25	75	100

Pre-requisites: Theoretical understanding of plant taxonomy as well as basic laboratory skills.

Learning Outcomes:

1. To understand the morphological modifications of plant organs, types of inflorescence, and economic importance of plants.
2. To develop practical skills in plant identification, herbarium preparation, and field-based botanical studies.

On the successful completion of the course, student will be able to:		
1.	explain the morphological modifications of roots, stems, and leaves, along with different types of inflorescence.	**K1, K2**
2.	perform dissections and identify floral parts of selected plant families based on key diagnostic characteristics.	**K3**
3.	analyze and document plant specimens through herbarium preparation and maintain a field notebook.	**K4**
4.	examine the economic importance of selected plants by studying their morphology, botanical names, and family classification.	**K4**
5.	assess plant diversity through field trips and critically evaluate plant specimens based on field observations.	**K5**

K1-Remember; **K2**-Understand;**K3**-Apply; **K4**-Analyze; **K5**-Evaluate

EXPERIMENTS	No. of Hours
1. Morphology of root, stem and leaf modification, types of inflorescence as mentioned in the theory. 2. Dissection, identification, observation of the floral parts of the plants belonging to the families included in the syllabus. 3. Preparation and submission of ten Herbarium sheets and field note book 4. Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family. 5. Field trips to places for observation, study and collection of plants prescribed in the syllabus for1 to 2 days under the guidance of faculties and submission of field note book.	45

Textbooks:

1. Subramaniam, N.S.1996.*LaboratoryManual of Plant Taxonomy*, Vikas Publishing House Pvt. Ltd., New Delhi.
2. Gokhale, S.B., Kokate, C.K. and Gokhale, A.2016. *Pharmacognosy of Traditional Drugs*, Nirali Prakashan, New Delhi.

Reference Books:

1. Gopalan, C., B.V. Ramasastri and S.C. Balasubramanian. 1985. *Nutritive Value of Indian Foods*, National Institute of Nutrition, Hyderabad.
2. Grant, W.E. 1984. *Plant Biosystematics*, Academic Press, London.
3. Harrison, H.J.1971. *New Concepts in Flowering Plant Taxonomy*, Rieman Educational Book Ltd., London.
4. Jones, A.D. and Wilbins, A.D.1971. *Variations and Adaptations in Plant Species*, Hiemand

& Co. Educational Books Ltd., London.

5. Rendle, A.B. 1980. *The Classification of Flowering Plants* (Vol. I & II), Vikas Students Education, New Delhi.

Web Resources:

1. https://www.amazon.in/Practical-Taxonomy-Angiosperms-R-Sinha/dp/9380578210
2. https://www.wileyindia.com/plant-science/practical-taxonomy-of-angiosperms-2ed.html
3. https://www.flipkart.com/practical-taxonomy- angiosperms/p/itm194794e7a76e8
4. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=uWg76rCqA68C
5. https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	1	2	1	2
CO2	3	3	2	1	3	2	2
CO3	3	2	3	2	2	2	1
CO4	3	3	3	2	3	1	3
CO5	3	3	3	2	2	2	2
Total	**15**	**13**	**14**	**8**	**12**	**8**	**10**
Average	**3**	**2.6**	**2.8**	**1.6**	**2.4**	**1.6**	**2.0**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	3	3	3	3	3	2	2	2	3
CO2	2	2	3	3	3	2	3	2	1	3
CO3	3	2	3	3	3	3	3	2	2	3
CO4	3	3	3	3	3	2	2	1	2	3
CO5	2	2	3	3	3	3	2	1	2	3
Total	**12**	**12**	**15**	**15**	**15**	**13**	**12**	**8**	**9**	**15**
Average	**2.4**	**2.4**	**3**	**3**	**3**	**2.6**	**2.4**	**1.6**	**1.8**	**3**

S-Strong (3) M-Medium (2) L-Low (1)

SEMESTER V
CORE LAB COURSE V1: CELL BIOLOGY, PLANT ANATOMY AND EMBRYOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
BU235CP2	-	-	2	-	2	2	30	25	75	100

Pre-requisite: Theoretical understanding of anatomy, embryology and cell biology as well as basic laboratory skills.

Learning Objectives:

1. To understand the structural organization of cells, tissues, and embryological structures through microscopic observations and sectioning techniques.
2. To develop practical skills in slide preparation, tissue sectioning, and identification of different plant structures at various developmental stages.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	explain the ultrastructure of cell organelles and cell inclusions by studying photomicrographs and permanent slides.	**K2**
2.	perform squash and smear techniques to identify different stages of mitosis using onion root tip cells.	**K3**
3.	examine simple and complex tissues, meristems, and secondary structures in dicot and monocot plants through sectioning and microscopic analysis.	**K4**
4.	differentiate between various types of ovules and endosperms using permanent slides and photomicrographs.	**K4**
5.	assess embryological structures by sectioning and dissecting anthers, ovules, and embryos to understand plant reproductive development.	**K5**

K1-Remember; **K2**-Understand; **K3**-Apply; **K4**-Analyze; **K5**-Evaluate

EXPERIMENTS	No. of Hours
Cell Biology 1. Study of photo micrographs of cell organelles mentioned in the theory. 2. Observation of cell inclusions through permanent slides- starch grains, crystals- cystolyth and raphide. 3. Identification of different stages of mitosis by using squash and smear techniques (acetocarmine)– onion root tip.	**30**
Anatomy 4. Observation of Simple and complex (Primary and Secondary) tissues through permanent slides. 5. Observation of Meristems–Shoot apex and Root apex through permanent slides 6. Sectioning: Internal structure of young root, stem and leaf of dicot and monocot plant. 7. Sectioning: Secondary structure of dicot and monocot root. 8. Sectioning of Anomalous secondary growth in the stems of *Boerhaavia* and *Dracaena*. **Embryology** 9. Sectioning mature anther- *Datura* 10. Types of ovules-Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous (Permanent slides). 4. Types of Endosperm - Nuclear, cellular and helobial(photograph) Dissection and display of any one stage of embryo in *Tridax.*	

Text Books:

1. Sundara, R. S. 2000. *Practical manual of plant anatomy and embryology*, Anmol Publ. PVT LTD, New Delhi.
2. Sharma, H.P. 2009. *Plant Embryology: Classical and Experimental,* Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.
3. Gupta P.K. 2017. *Cell and Molecular Biology* (5th ed.), Rastogi Publications, Meerut.

Reference Books:

1. Katherine Esau. 2006. *Anatomyof Seed Plants*. (2ndedition), JohnWileyandSons, UK
2. De Robertis E.D.P. and De Robertis E.M.P. 2017. *Cell and Molecular Biology* (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
3. Sharma, H.P. 2009. *Plant Embryology: Classical and Experimental,* Popular Prakashan, Mumbai.
4. Gupta P.K. 2017. *Cell and Molecular Biology* (5th ed.), Rastogi Publications, Meerut.
5. Krebs J.E., Goldstein E.S and Kilpatrick S.T. 2017. *Lewin's GENES XII*(12th ed.). Jones & Bartlett Learning, USA.

Web Resources:

1. https://www.amazon.in/Practical-Anatomy-driance-1901-1973- Foster/dp/1341784509
2. https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_Em.html?i d =Cq1KPwAACAAJ&redir_esc=y
3. https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219
4. https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/932727248X
5. https://www.amazon.in/Practical-Handbook-Plant-Breeding-Vikas/dp/9327272498

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	1	2	1	2
CO2	3	1	2	1	3	1	2
CO3	3	2	3	2	3	1	2
CO4	3	3	2	2	3	1	3
CO5	3	3	2	2	2	2	3
Total	**15**	**11**	**11**	**8**	**13**	**6**	**12**
Average	**3**	**2.2**	**2.2**	**1.6**	**2.6**	**1.2**	**2.4**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	3	3	3	3	3	2	1	2	3
CO2	2	3	3	3	3	2	3	1	1	3
CO3	3	3	3	3	3	3	1	1	2	3
CO4	3	3	3	3	3	2	2	1	2	3
CO5	2	3	3	3	3	3	1	1	1	3
Total	**12**	**15**	**15**	**15**	**15**	**13**	**9**	**6**	**8**	**15**
Average	**2.4**	**3**	**3**	**3**	**3**	**2.6**	**1.8**	**1.2**	**1.6**	**3**

Strong(3) M-Medium (2) L-Low(1)

SEMESTER V
CORE RESEARCH PROJECT

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
BU235RP1	-	2	1	2	4	5	75	25	75	100

Objectives:

1. To develop skills to identify subject related problems applying appropriate tools and techniques.
2. To enable the students to synthesize technical knowledge to identify, formulate and solve problems of professional interest and importance

On the successful completion of the course, student will be able to:		
1.	identify a research problem relevant to Botany	**K1**
2.	design and conduct an experiment to analyse the problem.	**K2**
3.	write research reports and present results in the scientific community.	**K3**
4.	develop skills to serve in Life science related industries and agencies.	**K4**
5.	develop required skills to present and publish articles.	**K5**

The report - dissertation will have three main parts:

I. Initial Pages - in the following sequence

i. Title Page

ii. Certificate from the Supervisor

iii. Declaration by the candidate endorsed by the Supervisor and HoD.

iv. Acknowledgement (within one page - signed by the candidate).

v. Table of Contents

vi. List of abbreviations

Abstract

II. Main body of the dissertation

i) Introduction with Literature review and Objectives

ii) Methodology

iii) Results

iv) Discussion

v) Summary

vi) References (DOI number of the journals can be included)

The guidelines for References

1. Journal Article: with Single Author Waldron, S 2008, 'Generalized Welch bound equality sequences are tight frames', IEEE Transactions on Information Theory, vol. 49, no. 9, pp. 2307-2309.
2. **Journal Article: with Two Authors**

   Conley, TG &Galeson, DW 1998, 'Nativity and wealth in mid-nineteenth century cities', Journal of Economic History, vol. 58, no. 2, pp. 468-493.
3. **Journal Article: with more than two Authors**

Alishahi, K, Marvasti, F, Aref, VA & Pad, P 2009, 'Bounds on the sum capacity Of synchronous binary CDMA channels', Journal of Chemical Education, vol. 55, no. 8, 3577-3593.

4. **Books**

Holt, DH 1997, Management Principles and Practices, Prentice-Hall, Sydney.

5. **E-book**

Aghion, P &Durlauf, S (eds.) 2005, Handbook of Economic Growth, Elsevier, Amsterdam. Available from: Elsevier books. [4 November 2004].

6. **Conference Proceeding Paper with editors**

Riley, D 1992, 'Industrial relations in Australian education', in Contemporary Australasian industrial relations: proceedings of the sixth AIRAANZ conference, ed. D. Blackmur, AIRAANZ, Sydney, pp. 124-140.

7. **Conference Proceeding Paper without editors**

Fan, W, Gordon, MD & Pathak, R 2000, 'Personalization of search engine services for effective retrieval and knowledge management', Proceedings of the twenty-first international conference on information systems, pp. 20-34.

8. **Website**

Australian Securities Exchange 2009, Market Information. Available from:

<http://www.asx.com.au/professionals/market_information/index.htm>. [5 July 2009].

9. **Patent**

Cookson, AH 1985, Particle trap for compressed gas insulated transmission systems, US Patent 4554399.

10. **Thesis**: Unpublished

Hos, JP 2005, Mechano chemically synthesized nanomaterials for intermediate temperature solid oxide fuel cell membranes. Ph.D. thesis, University of Western Australia.

11. **Newspaper**: Print

Ionesco, J 2001, 'Federal election: new Chip in politics', The Advertiser 23 October

Reference List Order

Arrange entries in alphabetical order by the surname of the first author followed by the initials of the author's given name(s).

III. Appendices (if any – the primary data,article published during the tenure of this programme**)**

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE I: a) BIO-ANALYTICAL TECHNIQUES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU235DE1	3	1	-	-	3	4	60	25	75	100

Pre-requisites:

To impart expertise about analysis and research.

Learning Objectives

1. To understand the principles, operation, and maintenance of laboratory tools and equipment.
2. To expose students to various field research methods, data analysis techniques, and modern equipment, fostering confidence to pursue research careers or entrepreneurial ventures.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	relate to the various biological techniques and its importance.	**K1**
2.	explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and electron microscopy.	**K2**
3.	apply suitable strategies in data collections and disseminating research findings	**K3**
4.	compare and contrast the significance of different types of chromatography techniques.	**K4**
5.	develop methodologies for extraction and analysis of biochemical compounds.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 –** Analyze **K5** - Evaluate

Units	Contents	No. of Hours
I	**MICROSCOPY:** Principles of microscopy; Light microscopy; compound microscopy, bright field microscope, dark field microscope, phase-contrast microscope, Fluorescence microscopy; Transmission and Scanning electron microscopy. Microscopic measurements-micrometry, Microscopy drawing: Camera Lucida.	12
II	**CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS:** Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).	12
III	**ELECTROPHORESIS AND PH METER:** Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis (PAGE), Agarose Gel Electrophoresis.	12
IV	**SPECTROPHOTOMETRY AND CENTRIFUGATION TECHNIQUE:** Principle and law of absorption, construction, operation and uses of colorimeter and UV–Visible spectrophotometer, Principles, methods of centrifugation, types of centrifuge and applications.	12
V	**BIOSTATISTICS:** Data collection methods, population samples, parameters; Representation of Data: Tabular, Graphical– Histogram – frequency curve – Bar diagram–measures of central tendency – Mean, Median and Mode; Standard deviation, Standard error, Chi-square test and t–test.	12
	Total	60

Self-study	Principles of microscopy; Light microscopy; compound microscopy

Textbooks:

1. Sharma, V.K. 1991. Techniques in microscopy and cell biology, Tata McGraw Hill, New Delhi.
2. Sawhney, S.K. and Randhir Singh. 2000. Introductory practical biochemistry, Narosa Publishing House. New Delhi.

References Books:

1. Rana, S.V.S. 2009. Biotechniques: Theory and Practice. Rastogi Publications. Meerut.
2. Zar, J.H. 2012. Biostatistical Analysis. (4th Ed.) Pearson Publication. U.S.A.
3. Sundar Rao, P.S.S and Richard, J. 2011. Introduction to Biostatistics and research methods, PHI learning Private Ltd., New Delhi.
4. Peter Gray. 1964. Handbook of Basic Micro technique. McGraw Hill publication, New York.
5. Cooper, T.G. 1991. The Tools of Bio - chemistry, (2nd Ed.). John Wiley & sons, London. USA.

Web Resources:

1. https://www.kobo.com/in/en/ebook/bioinstrumentation-1
2. https://www.worldcat.org/title/bioinstrumentation/oclc/74848857
3. https://www.amazon.in/Bioinstrumentation-M-H-Fulekar-Bhawana-Pandey-ebook/dp/B01JP3M9TW
4. https://www.amazon.in/Handbook-Biomedical-Instrumentation-R-S-Khandpur-ebook/dp/B0129ZDO9W?ref=kindlecontentin50-21&tag=kindlecontentin50-21&gclid=CjwKCAiAx_DwBRAfEiwA3vwZYkqkwRb_EGf73exaWpY8D9JNpJZsOcXQCQ4pZlRzTrYH2lopaVP1xxoClPgQAvD_BwE
5. https://www.kobo.com/us/en/ebooks/biostatistics

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	3	2	1	2
CO 2	3	3	2	2	1	1	3
CO 3	2	2	3	2	1	2	2
CO 4	3	2	1	1	3	1	3
CO 5	3	2	1	3	2	1	3
Total	**14**	**11**	**9**	**11**	**9**	**6**	**13**
Average	**2.8**	**2.2**	**1.8**	**2.2**	**1.8**	**1.2**	**2.6**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	1	2	2	3	2	1	3	1	1	3
CO 2	3	2	3	3	3	1	3	2	2	2
CO 3	2	1	3	2	2	3	3	3	2	3
CO 4	2	1	3	3	2	3	3	1	2	2
CO 5	2	3	3	3	2	2	3	1	2	2
Total	**10**	**9**	**14**	**14**	**11**	**10**	**15**	**8**	**9**	**12**
Average	**2**	**1.8**	**2.8**	**2.8**	**2.2**	**2**	**3**	**1.6**	**1.8**	**2.4**

S-Strong (3) M-Medium (2) L-Low(1)

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE I: b) IKS: HERBAL THERAPEUTICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU235DE2	3	1	-	-	3	4	60	25	75	100

Pre-requisites:

Basic knowledge of plants, herbal preparation, safety, and practical experience.

Learning Objectives:

1. Understand the evolution, significance, and conservation of herbal medicine along with traditional healthcare systems such as Ayurveda, Siddha, Unani, and Homeopathy.
2. Explore the therapeutic applications of medicinal, drug-yielding, and aromatic plants, including their role in folk medicine, cosmetics, and wellness industries.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	explain the evolution, significance, and conservation of herbal medicine in traditional and modern healthcare systems.	**K1**
2.	illustrate the traditional healing practices, home remedies, and ethnomedicinal plants, emphasizing their role in local healthcare.	**K2**
3.	analyze the botanical classification, active principles, and therapeutic uses of important medicinal and drug-yielding plants.	**K3**
4.	assess the medicinal plant processing techniques, adulteration issues, and health hazards of toxic plant-based substances.	**K4**
5.	evaluate the aromatic and cosmetic applications of herbal medicine, including their role in skincare, haircare, and wellness.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 –** Analyze, **K5 -** Evaluate

Unit	Contents	No. of Hours
I	Fundamentals of Herbal Medicine: Evolution and significance of herbal medicine in traditional and modern healthcare. Overview of Ayurveda, Siddha, Unani, and Homeopathy. Ethnomedicinal plants of Kanyakumari District, and their role in local healthcare. Conservation of Medicinal Plant *in situ* and *ex situ*, Medicinal Plant Conservation Areas (MPCA).	**12**
II	Traditional and Practical Applications of Herbal Medicine: Folk Medicine & Home Remedies: Traditional healing practices, including grandmother's remedies for common ailments such as cold, fever, cough, and diarrhoea. Herbal Skin & Hair Care: Preparation and uses of herbal decoctions, extracts, infusions, oils, shampoos, and powders for skincare and hair health.	**12**
III	Medicinal Plants and Drug-Yielding Species: Medicinal Herbs: Botanical classification, family, morphology, useful parts, active compounds, and therapeutic applications of *Catharanthus roseus, Withania somnifera, Clerodendrum phlomidis,* and *Centella asiatica.* Drug-Yielding Plants: Overview of therapeutic and habit-forming drugs, with a special focus on *Cinchona officinalis, Rauvolfia serpentina, Cannabis sativa,* and *Terminalia arjuna.* Masticatories and fumitories. Tobacco and health hazards.	**12**
IV	Aromatic and Cosmetic Applications of Herbal Medicine:Aromatic and Cosmetic Products: Overview of raw materials used in perfumes, essential oils, and herbal cosmetics (skincare, haircare, and wellness products). Aromatic Plants of India: Classification of major, minor, and lesser-known aromatic plants. Taxonomy and Uses of Key Aromatic Plants: Taxonomic descriptions and uses of *Citronella, Artemisia, Damask Rose, Large Cardamom, Lavender, Lemongrass, Mentha, Holy Basil, Rosemary, Vetiver,* and *Eucalyptus.* Aromatic Spices and their Applications: Medicinal and culinary uses of *Clove, Cinnamon, Nutmeg, Ajwain, Dill, Celery,*	**12**

	Curry Leaf, and *Saffron.*	
V	Medicinal Plant Analysis: Classification, chemical properties, medicinal uses, adulterants, cultivation, harvesting, processing, storage, and marketing of key drug plants of Leaf: *Aloe vera,* Stem- *Adathoda vasica,* Rhizome – *Acorus calamus, Gloriosa superba,* and *Curcuma longa* Seed- *Strychnos nux-vomica,* Adulteration: Identification of 10 common herbal adulterants.	**12**
	Total	**60**

Self-study	Preparation and uses of herbal decoctions, extracts, infusions, oils, shampoos, and powders for skincare and hair health.

Textbooks:

1. Kokate C.K., Purohit A.P., Gokhale S.B., 2019. *Pharmacognosy*, (53rd Ed.), Nirali Prakashan, Pune.
2. Trease G.E., Evans W.C., 2020. *Pharmacognosy*, (17th Ed.), Elsevier, London.

Reference Books:

1. Kirtikar K.R., Basu B.D., 2021. *Indian Medicinal Plants*, Volume 1-4, (Revised Ed.), International Book Distributors, Dehradun.
2. Pulok K. Mukherjee, 2019. *Quality Control and Evaluation of Herbal Drugs*, (2nd Ed.), Elsevier, London.
3. Pandey B.P., 2022. *Economic Botany*, (6th Ed.), S. Chand Publishing, New Delhi.
4. Chopra R.N., Nayar S.L., Chopra I.C., 2020. *Glossary of Indian Medicinal Plants*, (4th Ed.), National Institute of Science Communication and Information Resources (NISCAIR), New Delhi.
5. Sharma R., 2021. *Medicinal Plants of India: An Encyclopedia*, (3rd Ed.), Daya Publishing House, New Delhi.

Web Resources:

1. https://www.who.int/health-topics/traditional-complementary-and-integrative-medicine
2. https://www.nccih.nih.gov/
3. https://pfaf.org/
4. https://www.ayush.gov.in/
5. https://phytochem.nal.usda.gov/phytochem/search

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**3**	**3**	**2**	**2**	**3**	**3**
CO2	3	3	3	3	3	3	3
CO3	3	3	1	3	3	1	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
TOTAL	**15**	**15**	**13**	**15**	**14**	**13**	**15**
AVERAGE	**3**	**3**	**2.6**	**3**	**2.8**	**2.6**	**5**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	2	2	3	3	2	2	3
CO2	3	2	2	3	3	3	2	2	3	2
CO3	3	2	3	3	3	2	1	3	2	2
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	1	1	2
TOTAL	**15**	**13**	**15**	**15**	**14**	**14**	**12**	**11**	**11**	**11**
AVERAGE	**3**	**3**	**3**	**3**	**2.8**	**2.8**	**2.4**	**2.8**	**2.2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE I: c) FERMENTATION TECHNOLOGY

Course Code	L	T	P	S	Credit	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU235DE3	3	1	-	-	3	4	60	25	75	100

Pre-requisites:

Basic knowledge on microbiology, industrial biotechnology and fermentation processes and their applications.

Learning Objectives

1. To understand the principles, types, and significance of fermentation technology, along with the role of microbial metabolism.
2. To explore fermenter design, industrial applications, and advancements in fermentation technology.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	explain the principles of fermentation, types, and microbial metabolism involved in fermentation.	**K1&K2**
2.	describe fermenter design, operation, and industrial fermentation processes for alcohol, vinegar, and organic acids.	**K3**
3.	analyze the production and application of antibiotics, enzymes, and fermented beverages.	**K4**
4.	avaluate downstream processing techniques such as purification, separation, and quality control in fermentation industries.	**K5**
5.	assess the industrial significance, future trends, and applications of fermentation in pharmaceuticals, food, and biotechnology	**K6**

K1-Remember;**K2-**Understand; **K3-**Apply;**K4 -**Analyze; **K5 -**Evaluate;**K6–** Create

Unit	Contents	No.of Hours
I	Fundamentals of Fermentation: Introduction to fermentation and its significance. Scope and opportunities of fermentation technology, Principles of fermentation, Types of fermentation: Aerobic, anaerobic, submerged, and solid-state fermentation. Microbial metabolism and its role in fermentation. Isolation and screening of industrially important microorganisms.	**12**
II	Fermenter Design and Operation: Components of a fermenter and bioreactor. Fermentative production of alcohol: Wine: crushing, fermentation, aging, and bottling. Fermentative production of vinegar. Types of fermenters: Stirred tank, airlift, packed bed, and fluidized bed reactors. Monitoring and control of fermentation parameters (pH, temperature, aeration, agitation), Sterilization of fermenters and media.	**12**
III	Fermentation Products and Processes: Primary and secondary metabolites. Production of antibiotics (Penicillin, Streptomycin). Enzyme fermentation (Amylase, Protease). Fermented beverages (Beer, Palm Wine). Production of organic acids (Citric acid, Lactic acid) and amino acids.	**12**
IV	Downstream Processing and Product Recovery: Steps in downstream processing: Separation, purification, and recovery. Filtration, centrifugation, and precipitation techniques. Chromatographic techniques in fermentation product recovery. Lyophilization and spray drying. Quality control and regulatory aspects of fermentation products.	**12**

V	Industrial Applications and Future Trends: Role of fermentation in pharmaceuticals, food, and agriculture. Probiotics and microbial fermentation in health care. Genetically modified microbes in industrial fermentation. Bioplastics and biofuel production through fermentation. Recent advancements and future trends in fermentation technology.	**12**
	Total	**60**

Self-study	Fermentative production of alcohol: Wine, Vinegar.

Textbooks:

1. Stanbury, P.F., & Whitaker, **A.** (2016). *Principles of Fermentation Technology* (3rd Ed). Elsevier, UK.
2. Casida, L.E**.** (2018). *Industrial Microbiology* (Revised Ed.). New Age International Publishers, India.

Reference Books:

1. Crueger, W., & Crueger, A. (2017). *Biotechnology: A Textbook of Industrial Microbiology* (2nd Ed.). Sinauer Associates, USA.
2. Prescott, S.C., & Dunn, C.G. (2015). *Industrial Microbiology* (4th Ed.).. McGraw-Hill, USA.
3. Rao, D.G. (2014). *Introduction to Biochemical Engineering* (1st Ed.). Tata McGraw Hill, India.
4. Peppler, H.J., & Perlman, D. (2015). *Microbial Technology* (2nd Ed.). Academic Press, USA.
5. Willey, J., Sherwood, L., & Woolverton, C**.** (2019). *Prescott's Microbiology* (11th Ed.). McGraw Hill, USA.

Web Resources:

1. https://www.ncbi.nlm.nih.gov
2. https://www.fao.org/home/en
3. https://www.who.int
4. https://link.springer.com/journal/10295
5. https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/ fermentation

MAPPINGWITHPROGRAMMESPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	1	3	2	1
CO2	3	3	3	3	3	2	2
CO3	3	3	3	2	2	1	2
CO4	3	3	3	3	3	2	1
CO5	3	3	3	2	3	2	3
Total	**15**	**15**	**15**	**11**	**14**	**9**	**9**
Average	**3**	**3**	**3**	**2.2**	**2.8**	**1.8**	**1.8**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	2	2	2	2	2	3
CO2	3	3	3	3	3	1	1	2	1	2
CO3	3	3	3	3	2	2	2	2	2	3
CO4	3	3	3	3	1	1	2	2	2	2
CO5	3	3	3	3	1	2	1	1	2	2
Total	**15**	**15**	**15**	**15**	**9**	**8**	**6**	**9**	**9**	**12**
Average	**3**	**3**	**3**	**3**	**1.8**	**1.6**	**1.6**	**1.8**	**1.8**	**2.4**

3-Strong 2-Medium 1-Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE II: a) PHYTOBIORESOURCES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU235DE4	3	1	-	-	3	4	60	25	75	100

Pre-requisites:

Basic knowledge of biology, chemistry, and ecological interactions.

Learning Objectives:

1. To understand the scope, significance, and sustainable management of plant bioresources, including their role in agriculture, biofertilizers, and conservation.
2. To explore the applications of plant bioresources in biofuels, bioplastics, and biopesticides for environmental sustainability.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	define and explain the scope, significance, and bioprospecting of plant bioresources.	**K1**
2.	demonstrate knowledge of biofertilizers, single-cell proteins, and their applications in sustainable agriculture.	**K2**
3.	analyze the production and utilization of biofuels and bioplastics from plant sources.	**K4**
4.	assess the applications, advantages, and limitations of biopesticides in sustainable agriculture.	**K3**
5.	evaluate biodiversity conservation strategies, plant genetic resource management, and global policies	**K5**

Create **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4 –** Analyze, **K5** - Evaluate; **K6**

Unit	Contents	No. of Hours
I	Introduction to Plant Bioresources: Definition, scope, and importance of plant bioresources. Sustainable agriculture and organic farming. Green revolution. Bioprospecting: Concept; Role of traditional knowledge in bioprospecting; Traditional Knowledge Digital Library (TKDL).	**12**
II	Biofertilizers: Scope and importance. Bacterial Fertilizer – *Rhizobium* – mass production and uses. Cyanobacterial Biofertilizer- *Nostoc* - mass production and application. *Azolla*- mass production and application. Single Cell Protein and Mycoprotein: Mass Cultivation of *Spirulina*. Mushroom Cultivation-*Pleurotus* and *Agaricus*.	**12**
III	Biofuels and bioplastics: Importance of biofuel, Biodiesel Production *Pongamia* and *Jatropa*. Alcohols – the liquid fuel- ethanol production. Gaseous fuels: Biogas production and Hydrogen fuel. Plant-derived bioplastics	**12**
IV	Biopesticides: Introduction, desirable qualities of biopesticides. Microbial Pesticides – fungi, viruses and bacteria. Advantages and disadvantages of Microbial Pesticides, Application of Biopesticides.	**12**
V	Biodiversity conservation: Species extinction, causes of Biodiversity loss; IUCN threat categories; Red data book; Biodiversity surrogates; In situ conservation strategies— National parks; Ex situ conservation strategies— Botanical gardens Role of botanical gardens, gene banks, and seed banks in plant conservation. Strategies for biodiversity conservation and plant genetic resource management.	**12**
	Total	**60**
Self-study	Mushroom Cultivation-*Pleurotus* and *Agaricus*, Application of Biopesticides.	

Textbooks:

1. Sharma, P. D. (2022). *Plant Resources and Utilization*. (3rd Ed.), Rastogi Publications, Meerut.
2. Singh, B. D. (2023). *Plant Biotechnology and Resource Management*. (2nd Ed.), Kalyani Publishers, New Delhi.

Reference Books:

1. Kumar, H. D. (2021). *Biodiversity and Sustainable Utilization*. (2nd Ed.), Oxford & IBH Publishing, New Delhi.
2. Trivedi, P. C. (2023). *Medicinal Plants: Conservation and Utilization*. (4nd Ed.), Scientific Publishers, Jodhpur.
3. Rai, M., & Carpinella, C. (2022). *Naturally Occurring Bioactive Compounds*. Springer, Berlin.
4. Dutta, A. C. (2021). *Botany for Degree Students*. Oxford University Press, New Delhi.
5. Subramaniam, N. S. (2023). *Agricultural Microbiology and Biotechnology*. New Age International Publishers, New Delhi.

Web Resources:

1. https://nbaindia.org
2. https://www.csir.res.in/tkdl
3. https://www.fao.org
4. https://www.iucn.org
5. https://bbsrc.ukri.org

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**3**	**3**	**2**	**2**	**2**	**2**
CO2	3	3	3	3	3	2	2
CO3	3	3	3	1	1	1	2
CO4	3	3	3	1	2	2	1
CO5	3	3	3	3	3	2	2
TOTAL	**15**	**15**	**13**	**10**	**11**	**9**	**9**
AVERAGE	**3**	**3**	**2.6**	**2**	**2.2**	**1.8**	**1.8**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	PSO 2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	2	2	3	3	2	2	3
CO2	3	2	2	3	3	3	2	2	3	2
CO3	3	2	3	3	3	2	1	3	2	2
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	1	1	2
TOTAL	**15**	**13**	**15**	**15**	**14**	**14**	**12**	**11**	**11**	**11**
AVERAGE	**3**	**3**	**3**	**3**	**2.8**	**2.8**	**2.4**	**2.8**	**2.2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE II: b) SEED BIOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
BU235DE5	3	1	-	-	3	4	60	25	75	100

Pre-requisite:

Basic knowledge of plant physiology, genetics, and plant reproductive biology.

Objectives:

1. To understand the structure, development, dormancy, and germination mechanisms of seeds.
2. To explore the applications of seed biology in agriculture, biotechnology, and conservation.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	define and describe the structure, types, and development of seeds.	**K1**
2.	explain the physiological and biochemical processes involved in seed dormancy and germination.	**K2**
3.	apply techniques for breaking dormancy, seed testing, and seed enhancement in agricultural and research settings.	**K3**
4.	analyze the role of hormones and metabolic pathways in seed germination and storage.	**K4**
5.	evaluate the significance of seed conservation strategies, genetic seed banks, and biotechnology applications in sustainable agriculture	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 –** Analyze, **K5** - Evaluate

Units	Contents	No. of Hours
I	**INTRODUCTION TO SEED BIOLOGY:** Structure and Types of Seeds (Monocot vs. Dicot) Seed Development: Embryogenesis and Endosperm Formation, Seed Coat Formation and Maturation, Seed Dispersal Mechanisms, Importance of Seeds in Agriculture and Biodiversity	**12**
II	**SEED DORMANCY AND GERMINATION:** Definition and Types of Seed Dormancy, Causes and Mechanisms of Dormancy, Methods to Break Dormancy (Physical, Chemical, and Biological), Seed Germination Process: Physiological and Biochemical Changes, Factors Affecting Germination: Temperature, Water, Oxygen, and Light	**12**
III	**SEED PHYSIOLOGY AND METABOLISM:** Metabolic Changes During Seed Germination, Role of Enzymes in Seed Germination, Seed Storage Proteins, Lipids, and Carbohydrates, Hormonal Regulation in Seed Dormancy and Germination (ABA, GA, Cytokinins), Seed Aging and Deterioration Mechanisms.	**12**
IV	**SEED TECHNOLOGY AND CONSERVATION:** Principles of Seed Storage and Viability, Seed Testing Methods: Purity, Viability, and Germination Tests, Seed Certification and Quality Control, Genetic Conservation: Gene Banks and Seed Vaults, Seed Priming, Coating, and Enhancement Technologies	**12**
V	**APPLICATIONS AND FUTURE PERSPECTIVES IN SEED BIOLOGY:** Role of Seed Biology in Sustainable Agriculture, Advances in Seed Biotechnology (GM Seeds, CRISPR Applications), Synthetic Seeds and Artificial Seed Production, Climate Change and Its Impact on Seed Biology, Future Trends in Seed Research and Conservation.	**12**
	Total	**60**

Textbooks:

1. Kumar, A., & Purohit, S. 2022. *Seed Biology and Biotechnology.* Springer, New York.
2. Bewley, J. D., Bradford, K. J., Hilhorst, H. W. M., & Nonogaki, H. 2013. *Seeds: Physiology of Development, Germination, and Dormancy.* Springer, New York.

Reference Books:

1. Copeland, L. O., & McDonald, M. B. 2020. *Principles of Seed Science and Technology*. Springer, Switzerland.
2. Fenner, M., & Thompson, K. 2019. *The Ecology of Seeds.* Cambridge University Press, UK.
3. Basra, A. S. 2018. *Seed Quality: Basic Mechanisms and Agricultural Implications.* CRC Press, Florida, USA.
4. Shivanna, K. R. 2019. *Reproductive Biology of Plants.* CRC Press, India.

Web Resources:

1. International Seed Testing Association (ISTA) – https://www.seedtest.org
2. FAO Seed and Plant Genetic Resources – https://www.fao.org/agriculture/crops/thematic-sitemap/theme/seeds-pgr/en/
3. The Seed Biology Place – https://www.seedbiology.de
4. USDA National Seed Lab – https://www.fs.usda.gov/nsl/
5. Kew Seed Information Database (SID) – https://www.kew.org/data/sid/

MAPPING WITH PROGRAMME OUTCOMES:

COs	PO1	PO2	PO3	PO4	PO5	PSO6	PSO7
CO1	2	2	3	2	1	2	3
CO 2	3	3	2	2	1	2	3
CO 3	3	3	3	1	1	1	3
CO 4	3	3	3	1	1	2	2
CO 5	3	3	3	1	2	1	2
Total	**15**	**15**	**11**	**8**	**6**	**8**	**13**
Average	**3**	**3**	**2.2**	**1.6**	**1.2**	**1.6**	**2.6**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PS10
CO1	3	3	2	3	2	2	2	2	1	2
CO2	3	3	2	2	2	2	2	1	1	2
CO3	3	2	3	1	2	1	1	1	1	1
CO4	3	3	2	2	2	2	3	1	2	1
CO5	3	3	3	2	2	1	2	1	2	2
Total	**15**	**15**	**12**	**10**	**10**	**8**	**10**	**6**	**7**	**8**
Average	**3**	**3**	**2.6**	**2**	**2**	**1.6**	**2**	**1.2**	**1.4**	**1.6**

3 -Strong 2 - Medium 1 - Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE II: c) POMOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU235DE6	**3**	**1**	**-**	**-**	**3**	**4**	**60**	**25**	**75**	**100**

Pre-requisites: Basic knowledge of fruit cultivation, harvesting and post-harvest management.

Learning Objectives

1. To provide knowledge on the principles, practices, and techniques of fruit cultivation, propagation, management, and harvesting.
2. To emphasize the economic importance, nutritional value, and post-harvest processing of fruit crops.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	describe the importance, scope, and classification of fruit crops.	**K1**
2.	explain the methods of propagation and management of fruit crops.	**K2**
3.	classify different fruit crops based on season and climate.	**K3**
4.	illustrate the physiological and biochemical processes involved in fruit development.	**K4**
5.	apply post-harvest technology and value-addition techniques in fruit production.	**K5**

Units	Contents	No. of Hours
I	Introduction to Pomology: Definition, scope, and importance of Pomology. Classification of fruit crops based on climate (Tropical, Subtropical, and Temperate). Economic and nutritional value of fruit crops.	**12**
II	Propagation Techniques: Methods of propagation: Seed propagation, Vegetative propagation (Grafting, Budding, Layering, and Cuttings). Advantages and limitations of different propagation methods.	**12**
III	Orchard Management: Planning and layout of orchards. Cultural practices in fruit production: Pruning, Training, Irrigation, Fertilizer application, and Pest management. Major diseases and pests of important fruit crops.	**12**
IV	Post-harvest Management: Maturity indices and harvesting methods of major fruit crops. Post-harvest handling, packaging, and storage of fruits. Processing and value addition of fruits (Juices, Jams, Pickles, Dehydrated fruits, etc.).	**12**
V	Major Fruit Crops: Cultivation practices of major fruit crops: Mango, Banana, Guava, Citrus, Grape, and Papaya. Economic importance and production statistics of major fruit crops.	**12**
Total		**60**

Self-Study Portion	Cultivation of Banana, Seed propagation.

Text books:

1. Bose T.K., Mitra S.K., Sanyal D., 2002. Fruits: Tropical and Subtropical, Naya Udyog, Kolkata, India.
2. Chadha K.L., 2006. Handbook of Horticulture, ICAR, New Delhi, India.

References Books:

1. Hartmann H.T., Kester D.E., Davies F.T., Geneve R.L., 2011. Plant Propagation: Principles and Practices, 8th Edition, Pearson, New Delhi, India.

2. Janick J., Schaffer B., Carle R.B., 2008. Temperate Fruit Crops in Warm Climates, Springer, New York, USA.
3. Kumar N., 2002. Horticulture – Principles and Practices, Rajalakshmi Publications, Nagercoil, India.
4. Bal J.S., 2011. Fruit Science: Advanced Concepts, Kalyani Publishers, New Delhi, India.
5. Peter K.V., 2012. Basics of Horticulture, New India Publishing Agency, New Delhi, India.

Web Resources:

1. https://www.icar.org.in
2. https://agritech.tnau.ac.in
3. https://www.fao.org
4. https://www.nabard.org
5. https://www.apeda.gov.in

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	2	1	1
CO2	3	3	3	2	2	2	2
CO3	3	2	3	3	3	2	2
CO4	2	3	2	3	3	2	2
CO5	2	3	3	2	2	2	3
Total	**13**	**14**	**14**	**12**	**12**	**9**	**10**
Average	**2.6**	**2.8**	**2.8**	**2.4**	**2.4**	**1.8**	**2**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	3	2	2	3	3	3	3	3
CO2	3	3	3	2	2	2	2	2	1	2
CO3	3	3	3	3	2	2	2	2	2	2
CO4	3	3	2	3	2	2	2	2	2	1
CO5	3	3	3	3	2	2	3	3	1	2
Total	**15**	**14**	**14**	**13**	**10**	**11**	**12**	**12**	**9**	**10**
Average	**3**	**2.8**	**2.8**	**2.6**	**2**	**2.2**	**2.4**	**2.4**	**1.8**	**2**

S-Strong (3) M-Medium (2) L-Low(1)

SEMESTER V

PROFESSIONAL COMPETENCY SKILL I- CAREER SKILLS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG235PS1	1	1	-	-	2	2	30	25	75	100

Pre-requisite: A foundational understanding of the basic communication skills and computer literacy.

Learning Objectives

1. To develop effective communication and interpersonal skills to enhance workplace interactions and teamwork
2. To build job readiness skills such as resume writing, interview techniques, and professional ethics

Course Outcomes

On the successful completion of the course, students will be able to:		
1	outline key career skills such as communication, teamwork, and problem-solving	**K1**
2	explain the importance of professional ethics, workplace etiquette, and time management	**K2**
3	demonstrate effective resume writing, interview techniques, and job application strategies	**K3**
4	assess different workplace scenarios to determine appropriate communication and conflict resolution strategies	**K4**
5	develop a personal career plan with clear goals, skills assessment, and strategies for professional growth	**K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**- Analyse; **K5**- Evaluate

Units	Contents	No. of Hours
I	**Linguistic Skills** Vocabulary, Resume Writing, Report Writing, Technical Writing, Agenda Preparation, Preparing Minutes, E-mail.	**6**
II	**Employability Skills** Social Etiquette, Telephone Etiquette, Interview Skills, Types of Interviews, Mock Interview, Group Discussion.	**6**
III	**Digital Capabilities** Digital Learning, Digital Participation, ICT Proficiency, Creative Production, Digital Identity, Digital well-being	**6**
IV	**Body Language** Defining Body Language, Scope and Relevance, Proxemics, Oculesics, Haptics, Kinesics, Paralanguage, Chronemics, Chromatics and Olfactics	**6**
V	**Coping Mechanisms** Goal Setting, Emotional Intelligence, Team Management, Stress Management, Time Management, Leadership Skills, Problem solving Skills, Decision Making.	**6**
	Total	**30**

Self-study	Basic language skills and communication skills

Textbook

Virgin Nithya Veena. V & Jemi A.R. 2025. *New Age Career Skills*.

Reference Books

1. Herta A. Murphy and Herbert W. Hildebrandt. 1997. *Effective Business Communication*. 7th edition. McGraw- Hill.
2. Jeff Butterfield. 2020. *Soft Skills for Everyone*. Cengage India Pvt. Ltd.
3. Jayaprakash N Satpathy. 2024. *Soft Skills for Career*. Urania Publishing House.
4. S. Xavier Alphonse S. J. 2008. *Change or Be Changed*. ICRDCE. Sri Venkateswara Printers. Chennai.
5. AK. Xavier. 2025. *Employability Skills*. JKP Publications. Madurai.

Web Resources

1. https://exchange.nottingham.ac.uk/content/uploads/Professional-Competencies-Handbook-Sept-2018.pdf
2. https://vpge.stanford.edu/professional-development/competencies-grad-grow
3. https://vpge.stanford.edu/professional-development/competencies-grad-grow
4. https://www.indeed.com/career-advice/resumes-cover-letters/core-competencies-and-skills-valued-by-employers
5. https://resources.hrsg.ca/blog/what-s-the-difference-between-skills-and-competencies

SEMESTER V
INTERNSHIP

Course Code	L	T	P	S	Credits	Inst. Hours	Marks
CU235IS1	**-**	**-**	**-**	**-**	**2**	**-**	**100**

FRAMEWORK FOR INTERNSHIP

- Preparatory Inputs
- Industrial Visit
- Internship
- Periodic reviews by industry supervisor and faculty guide
- Report Writing
- Viva-voce

Note: Industries allowed – Govt./NGO/MSME/Rural Internship/Innovation / Entrepreneurship / Private Industry.

S.No.	Components	Marks
1	Industry Contribution	50
2	Report & Viva-voce	50

GUIDELINES FOR PREPARING INTERNSHIP REPORT

The training report should be presented in the following format only:

a) The report should be printed in A4 sheets.

b) Text Format in the report:
   - Times New Roman 12 Font size, with 1.5 line spacing.
   - Margins 1.5” left and 1” all other sides of the report.

c) Page numbers should be placed at the bottom middle position.

d) Chapters should be numbered as I, II, III and IV.

e) The tables and charts should be in the format of 1.1, 1.2, etc.

f) The training report should have a minimum of 25 pages and should not exceed 50 pages.

g) Students should submit 2 hard copies of report (department copy + student copy) duly signed by the faculty guide and the HOD.

h) The hard copy should be in bound format with soft binding as the cover page.

i) Students are eligible for training evaluation only if she has completed 25 days of training.

FORMAT FOR INTERNSHIP REPORT

The report should be bound with pages in the following sequence:

1) Cover page - Outer cover of the report.
2) Front page - The format of cover page and front page should be one and the same.
3) Certificate
4) Company Certificate
5) Declaration
6) Acknowledgement
7) Contents
8) List of Tables if any
9) List of Figures/Charts if any
10) List of Abbreviations, if any
11) Chapter I, II, III and IV
12) Appendices
13) Bibliography

GUIDELINES FOR WRITING ACKNOWLEDGEMENT

The summer training report should contain acknowledgements in the following order:

- Principal & Secretary, College Management
- The Head of the Department
- Faculty guide and Industry supervisor
- Management of the organization in which training was taken up.

GUIDELINES FOR WRITING CHAPTERWISE REPORT

- **Chapter I** of the report should be titled as "**INTRODUCTION**". The Introduction chapter should include Introduction, Importance, Objectives, Scope and Period of the training.
- **Chapter II** of the report should be titled as "**COMPANY PROFILE**".
- **Chapter III** of the report should be titled as "**ACTIVITIES DONE."** The third chapter should cover the objectives of the different departments and its functioning and also the learning outcome.

  Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited.
- **Chapter IV should be titled as "CONCLUSION".** The Conclusion part should include the observations made by the trainee in each department and the extent of fulfillment of training objectives and also reflections.

SEMESTER V

HUMAN RIGHTS, JUSTICE AND ETHICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG235HR1	1	-	-	-	1	1	15	50	50	100

Learning Objectives

1. To identify issues, problems, and violations of human rights.
2. To promote awareness of social justice, equality and human dignity.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	explain human rights principles and the role of the UN, with a focus on human rights issues in India.	**K1, K2**
2.	apply ethical principles in social, national, and professional contexts.	**K3**
3.	analyse social justice issues like untouchability, casteism, and discrimination.	**K4**
4.	examine legal frameworks for women's and child rights in India.	**K4**
5.	assess media's influence on values, digital rights, and consumerism.	**K5**

K1-Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Social Justice:** Concept and need for social justice-Parameters of social justice - Issues: untouchability, casteism, and discrimination	**3**
II	**Foundations of Human Rights:** Concept and principles of human rights- United Nations and Human Rights- Human rights concerns in India	**3**
III	**Women's Rights and Child Rights:** UN and women's rights – major issues -Constitutional and legal provisions for women in India - Child rights in India – Major Issues -legal framework and enforcement	**3**
IV	**Values and social media:** Media Power- Socio, cultural and political consequences of mass mediated culture - New media prospects and challenges - Role of media in value building -Digital Rights and Privacy- Consumerist culture	**3**
V	**Ethics:** Meaning and Importance- Social ethics: Tolerance, equity, justice for all -Nationalism: love for nation, pride for nature- Professional ethics: Dedication to work and duty**.**	**3**
	Total	**15**

Self-study	Mass Media: Effects and Influence on youth and children

1. Baxi, Upendra. 2008 *The Future of Human Rights*. Oxford University Press,.
2. Donnelly, Jack. 2013. *Universal Human Rights in Theory and Practice*. Cornell University Press.
3. Agnes, Flavia. *Law and Gender Inequality: The Politics of Women's Rights in India*. Oxford University Press, 2001.
4. *State of the World's Children 2021*. UNICEF
5. McLuhan, Marshall. *Understanding Media: The Extensions of Man*. MIT Press, 1994.
6. Zuboff, Shoshana. *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power*. PublicAffairs, 2019.
7. Singer, Peter. *Practical Ethics*. Cambridge University Press, 2011.

Web Recourses

1. http://www.oxfordreference.com/views/BOOK_SEARCH.html?book=t286
2. http://globetrotter.berkeley.edu/humanrights/bibliographies/
3. https://libguides.princeton.edu/history/humanrights

SEMESTER VI

CORE COURSE VII: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU236CC1	3	3	-	-	5	6	90	25	75	100

Pre-requisite:

Basic knowledge of plant biology, cell structure, and fundamental chemistry.

Objectives:

1. To understand the fundamental concepts of water relations, respiration, growth, biomolecules, and enzymatic functions in plants.
2. To explore the biochemical processes and mechanisms that regulate plant metabolism, water movement, and growth

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	understand about the biomolecules, enzyme kinetics, and metabolic regulations in plants.	**K1**
2.	explain the role of water in plants, including imbibition, osmosis, and water absorption mechanisms.	**K2**
3.	illustrate the biochemical pathways of photosynthesis and respiration, including the light and dark reactions.	**K3**
4.	compare and contrast different theories of the ascent of sap and transpiration mechanisms.	**K4**
5.	evaluate the functions of plant growth regulators and their impact on plant development.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 –** Analyze; **K5-** Evaluate

Unit	Contents	No. of Hours
I	Water Relations: Introduction to Water in Plants, Water Movement in Plants, Imbibition, diffusion, osmosis, and plasmolysis. Mechanism of Water Absorption. Active and passive absorption. Apoplast and symplast pathways. Role of root hairs and mycorrhizae. Ascent of Sap. Theories explaining the ascent of sap: Cohesion-Tension Theory. Root Pressure Theory. Capillary Action.	**18**
II	Transpiration: Types of Transpiration: Stomatal, Cuticular, Lenticular: Factors Affecting Transpiration: Internal, External: Mechanism of Transpiration: Evaporation, Diffusion. Measurement of Transpiration: Potometer, Weighing Method, Gas Exchange Analysis: Anti-Transpirants. Guttation, mechanism of stomatal regulation. Mineral nutrition: Essential elements (micro and macro nutrients). general functions, specific role and deficiency symptoms of macronutrients (Nitrogen, Phosphorus and Potassium) and micronutrients (Iron, Magnesium, Molybdenum and Zinc).	**18**
III	Respiration: Glycolysis, Krebs cycle and generation of ATP synthesis through oxidative electron transferchain (Cytochrome system) Photosynthesis: Light Reaction: Photosystems I & II, Electron Transport, ATP Synthesis, Water Photolysis: Dark Reaction: Calvin Cycle (C3), C4, CAM Pathways. Growth: Growth – plant growth regulators (auxins, gibberellins, cytokinins, ethylene and abscisic acid) - Photo morphogenesis – photoperiodism – vernalization – dormancy- phytochromes.	**18**
IV	Biomolecules and Chemical Bonds: Chemical Bonds – Covalent, Ionic, Hydrogen, Van der Waals, Hydrophobic Interactions: Amino Acids – Structure, Classification, Properties, Zwitterions, Essential & Non-Essential Amino Acids: Proteins – Peptide Bonds, Primary, Secondary, Tertiary, and Quaternary Structures: Protein Folding & Denaturation – Factors affecting structure and stability: Protein Functions – Enzymes, Structural, Transport, Regulatory Proteins**.**	**18**
	Lipids and Enzymes: Lipids – Classification (Simple, Complex, Derived), Fatty Acids,	**18**

V	Phospholipids, Steroids: Biological Functions of Lipids: Energy Storage, Membrane Structure, Signaling Molecules: Enzymes: Nomenclature, Classification, Structure, Active Sites**:** Enzyme Kinetics: Michaelis-Menten Equation, Enzyme Inhibition: Enzyme Regulation: Allosteric Regulation, Feedback Inhibition, Cofactors & Coenzymes.	
	Total	**90**

Self-study	Types of transpiration, Imbibition, Diffusion, Osmosis, and Plasmolysis

Textbooks:

1. Lincoln Taiz, Ian Max Møller, Angus Murphy, Eduardo Zeiger 2022. *Plant Physiology and Development.* 7th Edition. Oxford University Press, Oxford, UK.
2. David L. Nelson, Michael M. Cox 2021. *Lehninger Principles of Biochemistry.* 7th Edition. W.H. Freeman & Company, New York, USA.

Reference Books:

1. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr., Lubert Stryer 2019. "Biochemistry". 9th Edition: W.H. Freeman & Company. New York.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter 2014. "Molecular Biology of the Cell". Garland Science. New York, USA.
3. Hans-Walter Heldt, Birgit Piechulla 2010. "Plant Biochemistry"4th Edition. Academic Press. San Diego, USA.
4. Bob B. Buchanan, Wilhelm Gruissem, Russell L. Jones 2015. "Biochemistry and Molecular Biology of Plants". Wiley, Hoboken, USA
5. C. Neal Stewart Jr. 2016."Plant Biotechnology and Genetics: Principles, Techniques, and Applications" . Wiley-Blackwell . Hoboken, USA

Web Resources:

1. https://plantphys.info/
2. https://www.khanacademy.org/science/biology/photosynthesis
3. https://ib.bioninja.com.au/
4. https://www.brenda-enzymes.org/
5. https://www.ncbi.nlm.nih.gov/

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	1	1	1	1	1
CO 2	3	3	3	1	1	2	3
CO 3	2	2	3	1	1	1	2
CO 4	1	2	3	1	1	2	2
CO 5	1	3	3	3	1	1	2
Total	**8**	**13**	**13**	**7**	**5**	**7**	**10**
Average	**1.6**	**2.6**	**2.6**	**1.4**	**1**	**1.4**	**2**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	2	1	3	1	1	1
CO 2	3	3	3	2	3	2	3	1	2	1
CO 3	3	3	3	2	2	2	2	1	2	1
CO 4	2	3	3	2	2	3	2	1	2	1
CO 5	3	3	3	3	3	3	2	1	2	1
Total	**14**	**15**	**15**	**12**	**12**	**11**	**12**	**5**	**9**	**5**
Average	**2.8**	**3**	**3**	**2.4**	**2.4**	**2.2**	**2.4**	**1**	**1.8**	**1**

S-Strong (3) M-Medium (2) L-Low(1)

SEMESTER VI

CORE COURSE VIII: GENETICS, PLANT ECOLOGY AND PHYTOGEOGRAPHY

Course Code	L	T	P	S	Credits	Inst. hours	Total Hours	Marks		
								CIA	External	Total
BU236CC2	4	2	-	-	5	6	90	25	75	100

Pre-requisites: Basic knowledge of genetics, ecological principles, plant diversity, and environmental interactions to understand inheritance patterns, ecosystem dynamics, and plant distribution.

Learning Objectives:

1. To impart comprehensive knowledge of genetics, inheritance, and the ecological principles governing plant distribution and succession.
2. To enhance practical understanding of biodiversity conservation, ecosystem dynamics, and the factors influencing plant distribution.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	describe the basic principles of genetics and inheritance.	K1
2	explain genetic variations, mutations, and gene transfer mechanisms.	K2
3	classify the phytogeographic regions and distribution of plants.	K3
4	interpret the ecological interactions in different plant communities.	K4
5	evaluate the role of genetic and ecological studies in developing conservation strategies.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5**- Evaluate

Units	Contents	No. of Hours
I	Definition, scope, and significance of genetics. Mendelian principles of inheritance - monohybrid and dihybrid crosses. Test cross and back cross. Incomplete dominance – *Mirabilis jalapa*,Co-dominance – MN blood group in man,Lethal genes: Dominant lethality - Coat colour in Mice, Recessive lethality – Chlorophyll content in Maize, independent assortment.	18
II	Sex Linked inheritance (eye colour in Drosophila) Polygenic inheritance with reference to (ear length in maize), Multiple alleles -ABO blood group in man, Rh factor. Non-Mendelian inheritance Extra-chromosomal inheritance: chloroplast mutation –variegation in 4 O'clock plant; mitochondrial mutations in yeast. Maternal effects – shell coiling in snail. Linkage: Morgan's views on linkage, crossing over – types, mechanism of crossing over and its significance, Holliday model for genetic recombination. Mutations - types, physical and chemical mutagens. Chromosomal aberrations - deletion, duplication, inversion, and translocation.	18
III	Ecosystem: components of ecosystem. Fresh water (pond) ecosystem; marine ecosystem; autotrophy, heterotrophy, Ecological succession - types and process. Ecosystem - components, energy flow, food chain, and food web.	18
IV	Plant adaptations to different environments: Hydrophytes, Xerophytes and Halophytes with reference to their morphological, anatomical and physiological adaptations. Study of vegetation- Quadrat and Transect.	18
V	Phytogeography- principles of phytogeography; Types of plants distribution - continuous, discontinuous and endemic. Plate tectonics,	18

	Continental drift, Theory of land bridges, Age and Area Hypothesis. Major phytogeographic regions of India. Vavilov's Theory of Centers of Origin of Cultivated Plants.	
Total		**90**

Self-Study	Plate tectonics, Continental drift, Food chain

Textbooks:

1. Odum E.P., 2005. *Fundamentals of Ecology*, 5th Edition, Cengage Learning India Pvt. Ltd., New Delhi, India.
2. Verma, P.S. Agarwal, V.K., 1994. *Genetics*. S. Chand and Company Ltd. New Delhi.

References Books:

1. Kumar H.D., 1990. *Modern Concepts of Ecology*, Vikas Publishing House Pvt. Ltd., New Delhi, India.
2. Vickery M.L., 1984. *Ecology of Tropical Plants*, John Wiley & Sons, New York, U.S.A.
3. Melchias G., 2001. *Biodiversity and Conservation*, Science Publishers Inc., U.S.A.
4. Asthana D.K., Meera Asthana, 2006. *A Textbook of Environmental Studies*, S. Chand and Company Ltd., New Delhi, India.
5. Gardner, E.J. Simmons, M.J. Snustad, D.P. 1991. *Principles of Genetics*. 8th ed. John Wiley &Sons Inc., New Delhi.

Web Resources:

1. https://www.ncbi.nlm.nih.gov/
2. https://www.elsevier.com/
3. https://www.khanacademy.org/science/biology
4. https://nptel.ac.in/courses/
5. https://openstax.org/

MAPPING WITH PROGRAMME OUTCOMES:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	1	1	2
CO2	3	2	3	3	2	2	2
CO3	3	2	3	3	2	2	2
CO4	3	3	3	3	2	3	3
CO5	3	3	3	3	2	3	3
Total	**15**	**12**	**14**	**14**	**9**	**11**	**12**
Average	**3**	**2.4**	**2.8**	**2.8**	**1.8**	**2.2**	**2.4**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	2	2	2	2	2	2	1	2
CO2	3	3	3	3	2	3	3	2	2	2
CO3	3	3	3	3	2	3	3	2	2	2
CO4	3	3	3	3	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	2	2	2
Total	**15**	**15**	**14**	**14**	**12**	**14**	**14**	**10**	**9**	**10**
Average	**3**	**3**	**2.8**	**2.8**	**2.4**	**2.8**	**2.8**	**2**	**1.8**	**2**

S-Strong (3) M-Medium (2) L-Low(1)

SEMESTER VI

CORE LAB COURSE VII: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
BU236CP1	-	1	2	-	2	3	45	25	75	100

Prerequisite:

Basic understanding of plant physiology and biochemical principles, including spectrophotometry, chromatography, and colorimetry.

Objectives:

1. To understand and analyse key physiological and biochemical processes in plants, such as photosynthesis, respiration, and osmosis.
2. To develop practical skills in laboratory techniques like spectrophotometry, colorimetry, chromatography, and titration.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	develop technical skills in handling laboratory instruments such as Ganong's respirometer, colorimeter, and chromatography apparatus	**K1,K2**
2.	demonstrate proficiency in measuring physiological processes like imbibition, water potential, and respiration using standard laboratory techniques.	**K3**
3.	apply spectrophotometry and colorimetry to quantify plant pigments, starch, sugar, and protein content	**K3**
4.	conduct biochemical estimations and titrations to analyze macromolecules and buffer solutions.	**K4**
5.	interpret experimental data and relate findings to fundamental biological and biochemical concepts.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 –** Analyze: **K5**-Evaluate

Major Plant Physiology Experiments	
1.	Imbibition- by direct weighing method
2.	Determination of water potential by Chardakov's method
3.	Rate of photosynthesis under varying concentration of Co2
4.	Effect of quality of light on evolution of Co2 during photosynthesis-colour filter
5.	Quantification of plant pigments by-Spectrophotometric method
6.	Respiration -R.Q using Ganong's respirometer.

Biochemistry Major Experiment

Verification of beer's Law

1. Estimation of Starch by Colorimeter
2. Estimation of Sugar by Colorimeter
3. Estimation of protein by Colorimeter
4. Preparation of buffer
5. Titration of week acid against strong acid
6. Paper chromatography

Quantitative Estimation of Insoluble starch

1. Estimation of Sugar by Colorimeter
2. Estimation of protein by Colorimeter
3. Preparation of buffer
4. Titration of week acid against strong acid
5. Paper chromatography
6. Quantitative Estimation of Insoluble starch by Colorimeter

Demonstration and Spotters only
1. Imbibition -Dialatometer 2. Tissue Tension 3. Suction due to transpiration 4. Ganong's respirometer 5. Hydroponics 6. Khune's fermentation apparatus 7. Anaerobic respiration a. Colorimeter 8. Enzyme model Lock and Key Method 9. Koshland's Induced Fit Model 10. Effect of Enzyme Action 11. Fluorescence 12. Phosphorescence

Textbooks:

1. Plummer, D. 1988. *An introduction to Practical Biochemistry*, Tata McGraw Hill Publishing Company Ltd, New Delhi.
2. Palanivelu, P. 2004. *Laboratory Manual for Analytical Biochemistry and Separation Techniques, School of Biotechnology*, Madurai Kamaraj University, Madurai.
3. Bendre, A.M. and Ashok Kumar, 2009. (9thEdition). *A Textbook of Practical Botany*. Vol. I & II. Rastogi Publication. Meerut.

Reference Books:

1. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. *Practical in Plant Physiology and Biochemistry*. Scientific Publishers, Jodhpur.
2. Wilson, Kand J. Walker.1994. (4th Edition). *Principles and Techniques of Practical Biochemistry* Cambridge University Press, Cambridge.
3. Bendre, A. M and Ashok Kumar. 2009. (9thEdition). *A textbook of practical Botany.* Vol. I & II. Rastogi Publication, Meerut.
4. Manju Bala,

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	3	1	3
CO2	3	2	2	2	3	2	3
CO3	3	2	2	2	3	2	3
CO4	3	2	2	2	3	1	3
CO5	3	2	2	2	3	1	3
Total	**15**	**10**	**10**	**10**	**15**	**7**	**15**
Average	**3**	**2**	**2**	**2**	**3**	**1.4**	**3**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	3	2	2	3	2	3
CO2	3	3	3	3	3	2	2	3	2	3
CO3	3	3	3	3	3	2	2	3	2	3
CO4	3	3	3	3	3	2	2	3	1	3
CO5	3	3	3	3	3	2	2	3	2	3
Total	15	15	15	15	15	10	10	15	9	15
Average	3	3	3	3	3	2	2	3	1.8	3

Strong (3) Medium (2) Low(1)

SEMESTER VI
CORE LAB COURSE VIII: GENETICS, PLANT ECOLOGY AND PHYTOGEOGRAPHY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU236CP2	-	-	3	-	2	3	45	25	75	100

Pre-requisite: Basic knowledge of Mendelian inheritance, gene interactions, linkage, plant adaptations, phytogeographical regions, ecological data collection methods, and field study techniques.

Learning Objectives:

1. To understand genetic principles, inheritance patterns, and gene interactions through problem-solving and analysis.
2. To study plant adaptations, ecological methods, and phytogeographical distribution through practical exploration and field studies.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recall and describe the principles of monohybrid, dihybrid ratios, and gene interactions.	**K1**
2	explain the morphological and anatomical adaptations of hydrophytes, xerophytes, and halophytes in relation to their habitats.	**K2**
3	apply knowledge to identify and map the phytogeographical regions of India.	**K3**
4	analyze plant distribution patterns using quadrat study and line transect methods.	**K4**
5	evaluate plant diversity and ecological interactions through field observations in natural habitats.	**K5**

Contents	
Genetics 1. Solving genetic problems related to monohybrid, dihybrid ratio and interaction of genes (minimum of five problems in each category).	**45**
Plant Ecology and Phytogeography 1. Study of morphological and anatomical adaptations of the following hydrophytes, xerophytes, and halophytes and correlate to their particular habitats. Hydrophytes :*Nymphaea, Hydrilla* Xerophytes :*Nerium, Casuarina* Halophytes :*Avicennia, Rhizophora* 2. Study of Photos/ Models in Phytogeography 3. Quadrat study and line transect. 4. Field trip to places under the guidance of teachers to study plants in their natural habitat	

Text books:

1. Gardner E.J., Simmons M.J., Snustad D.P. 2006. *Principles of Genetics*, 8th Edition, John Wiley & Sons, New Delhi.
2. Verma P.S., Agarwal V.K. 2010. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*, S. Chand & Company Ltd., New Delhi.

References Books:

1. Allard R.W. 1999. *Principles of Plant Breeding*, John Wiley & Sons, New York.
2. Peter H. Raven, Ray F. Evert, Susan E. Eichhorn. 2013. *Biology of Plants*, 8th Edition, W.H. Freeman and Company, New York.
3. Kormondy E.J. 2005. *Concepts of Ecology*, 4th Edition, Pearson Education, New Delhi.
4. Odum E.P. 2005. *Fundamentals of Ecology*, 5th Edition, Cengage Learning, New Delhi.
5. Brown T.A. 2020. *Gene Cloning and DNA Analysis: An Introduction*, 8th Edition, Wiley- Blackwell, Hoboken, NJ.

Web Resources:

1. https://nptel.ac.in/courses/102/105/102105034/
2. https://www.ncbi.nlm.nih.gov/books/NBK21134/
3. https://www.coursera.org/learn/genetics
4. https://link.springer.com/journal/10265
5. https://www.biologydiscussion.com

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	3	2
CO2	3	2	3	3	3	2	3
CO3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	2	2
CO5	3	3	2	2	3	2	2
Total	**15**	**14**	**13**	**13**	**13**	**12**	**12**
Average	**3**	**2.8**	**2.6**	**2.6**	**2.6**	**2.4**	**2.4**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	1	2	3	2	1	3	3	2	3	3
CO2	3	2	3	3	3	2	3	3	2	3
CO3	2	2	2	2	2	2	3	2	2	2
CO4	2	2	2	3	2	2	2	3	3	3
CO5	3	3	3	2	3	2	2	2	2	2
Total	**11**	**11**	**13**	**12**	**11**	**11**	**13**	**12**	**12**	**13**
Average	**2.2**	**2.2**	**2.6**	**2.4**	**2.2**	**2.2**	**2.6**	**2.4**	**2.4**	**2.6**

3 -Strong 2 - Medium 1 – Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE III: a) HORTICULTURE AND PLANT BREEDING

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU236DE1	3	2	-	-	3	5	75	25	75	100

Pre-requisite: Students should have a fundamental knowledge on horticulture and plant breeding applications.

Learning Objectives:

1. To gain knowledge on horticulture and techniques needed to grow and maintain plants.
2. To impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement.

Course Outcomes

	On the successful completion of the course, students will be able to:	
1.	understand the concepts in horticulture and nursery management.	**K1**
2.	describe the importance of floriculture and evaluate the contribution of spices and condiments on economy.	**K2**
3.	apply the principles of vegetable culture to design, implement, and manage vegetable cultivation systems.	**K3**
4.	distinguish the concept of conventional methods of horticultural techniques	**K4**
5.	analyze the various plant breeding methods and their applications.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Units	Contents	No. of Hours
I	Scope of Horticulture; Classification of horticultural crops –fruits and vegetables Nutritive value of horticultural crops, Horticultural zones of Tamil Nadu. National and regional agencies involved in promotion of horticultural Industry in India (NHB, APEDA and Commodity Boards). Protected and precision horticulture – Hydroponics, Aeroponics.	**15**
II	Importance and objectives of vegetable culture. Kitchen garden - site, layout and choice of plants. Vegetable cultivation - Brinjal, Carrot and Tomato. Plantation crops - Tea, Cardamom, Pepper and Cloves.	**15**
III	Propagation by Cutting- Stem Cutting, Leaf Cutting and Root Cutting. Propagation by layering -simple, compound and air. Propagation by Grafting - tongue, wedge and veneer. Propagation by Budding- T budding, chip and ring. Vegetative propagules - tubers, suckers, bulbs and corm.	**15**
IV	Principles and components of ornamental garden - Layout of lawns, topiary, pergolas, edges and hedges. Rockery, bonsai, water garden and hanging basket. Commercial floriculture with reference to Chrysanthemum, Jasmine, Orchid and Rose.	**15**
V	Definition, scope and objectives of plant breeding; Methods of selection – pure line, mass and back cross methods. Advanced Plant Breeding Techniques - Marker-assisted selection (MAS), CRISPR and gene editing technologies, Tissue culture and in vitro breeding methods (somaclonal variation, embryo rescue).	**15**
	Total	**75**

Self-Study :	Vegetable cultivation - Brinjal, Carrot and Tomato. Plantation crops - Tea, Cardamom, Pepper and Cloves.

Text books:

1. Chadha, K.L. 1986. *Ornamental Horticulture in India*, (1st Edition). ICAR, Krishi Bhavan, New Delhi.

2. Bose, T.K., & Mukherjee, D. 1977. *Gardening in India*, (1st Edition). Oxford & IBH Publishing Co., Calcutta.

3. Sharma, S.D. 2013. *Plant Breeding: Theory and Techniques*, (1st Edition). New India Publishing Agency, New Delhi.

Reference Books:

1. Bailey, S. 1971. *Perpetual Flowering Carnation*, (1st Edition). Fabner and Fabner, London.

2. Laurie, A., Kiplinger, D.D., & Nelson, K.S. 1968. *Commercial Flower Forcing*, (1st Edition). McGraw-Hill Book, London.

3. Hartman, H.T., & Kester, D.E. 1989. *Plant Propagation*, (1st Edition). Prentice Hall Ltd., New Delhi.

4. Bose, T.K., & Yadav, L.P. 1989. *Commercial Flowers*, (1st Edition). Naya Prakash, Calcutta.

5. Fehr, W.R. 1987. *Principles of Cultivar Development, Volume 1: Theory and Technique*, (1st Edition). Macmillan Publishing Company, New York.

Web Resources:

1. https://www.kopykitab.com/Precision-Horticulture-by-Archarya-SK
2. https://www.ebooks.com/en-us/subjects/science-horticulture-ebooks/423/
3. http://www.agrimoon.com/horticulture-icar-ecourse-pdf-books/
4. https://www.worldcat.org/title/handbook-of-horticulture/oclc/688653648
5. https://cbseportal.com/ebook/vocational-books-horticulture
6. http://www.digitalbookindex.org/_search/search010agriculhortigardena.asp

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	3	2	2
CO2	2	3	3	1	2	2	3
CO3	2	3	3	2	2	2	2
CO4	3	3	3	2	2	2	2
CO5	3	3	3	2	2	2	2
Total	13	15	15	9	11	10	11
Average	2.6	3	3	1.8	2.2	2	2.2

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	2	3	2	2	2	2	2	2
CO2	3	3	3	3	2	1	2	2	2	2
CO3	3	3	3	2	2	2	1	2	2	2
CO4	2	3	2	3	2	2	2	3	2	3
CO5	3	3	3	2	3	2	2	2	2	2
Total	14	15	13	13	11	9	9	11	10	11
Average	2.8	3	2.6	2.6	2.2	1.8	1.8	2.2	2	2.2

3 -Strong 2 - Medium 1 – Low

SEMESTER VI
DISCIPLINE SPECIFIC ELECTIVE III: b) SUSTAINABLE MANAGEMENT OF BIORESOURCES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU236DE2	3	2	-	-	3	5	75	25	75	100

Pre-requisite: Students should know the concept of different natural resources and their utilization.

Learning Objectives:

1. To gain knowledge on various strategies of natural resource management and their ecological and economic impact.
2. To study the significance of natural resources pertaining to economy and environment.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the significance of natural resources pertaining to economy and environment	**K1**
2.	understand the concept of different natural resources and their utilization.	**K2**
3.	implement the management strategies of different natural resources.	**K3**
4.	analyze the sustainable utilization land, water, forest and energy resources.	**K4**
5.	design new models of natural resource conservation and maintenance.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate

Units	Contents	No. of Hours
I	Concept of natural resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Ecological, social and economic dimension of resource management.	**15**
II	Forest vegetation, status and distribution, major forest types and their characteristics. Use and over-exploitation, deforestation, Timber extraction, mining, dams and their effects on forest and tribal people, forest management. Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification.	**15**
III	Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Energy resources: renewable and non-renewable energy sources, use of alternate energy sources. Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.	**15**
IV	Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies.	**15**
V	International Fisheries and Management Commissions; Case Studies: 1. Resource management in mountain ecosystem 2. Dry-land ecosystem 3. Case study of shifting Cultivation 4. Mangrove ecosystem and their management.	**15**
	Total	**75**

Self-Study Portion:	Timber extraction, mining, dams and their effects on forest and tribal people, forest management.

Text Books:

1. Vasudevan, N. 2006. *Essentials of Environmental Science*, (1st Edition). Narosa Publishing House, New Delhi.

2. Singh, J.S., Singh, S.P., & Gupta, S. 2006. *Ecology, Environment and Resource Conservation*, (1st Edition). Anamaya Publications, New Delhi.

Reference Books:

1. Vitousek, P.M. 1994. *Beyond Global Warming: Ecology and Global Change*, *Ecology*, Volume 75.

2. Agarwal, K.C. 2001. *Environmental Biology*, (1st Edition). Nidhi Publication Ltd., Bikaner.

3. Heywood, V.H., & Watson, R.T. 1995. *Global Biodiversity Assessment*, (1st Edition). Cambridge University Press, Cambridge.

4. Miller, T.G. Jr. 1997. *Environmental Science*, (1st Edition). Wadsworth Publishing Co, Belmont.

5. Odum, E.P. 1971. *Fundamentals of Ecology*, (1st Edition). W.B. Saunders Co., USA.

Web Resources:

1. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y
2. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE
3. https://www.kobo.com/us/en/ebooks/natural-resources
4. https://www.igi-global.com/chapter/natural-resources-management/1951836crLIC&redir_esc=y
5. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	2	3	2
CO2	3	2	3	3	3	2	3
CO3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	2	2
CO5	3	3	2	2	3	2	2
Total	15	14	13	13	13	12	12
Average	3	2.8	2.6	2.6	2.6	2.4	2.4

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	1	2	3	2	1	3	3	2	3	3
CO2	3	2	3	3	3	2	3	3	2	3
CO3	2	2	2	2	2	2	3	2	2	2
CO4	2	2	2	3	2	2	2	3	3	3
CO5	3	3	3	2	3	2	2	2	2	2
Total	11	11	13	12	11	11	13	12	12	13
Average	2.2	2.2	2.6	2.4	2.2	2.2	2.6	2.4	2.4	2.6

3 -Strong 2 - Medium 1 – Low

SEMESTER VI
DISCIPLINE SPECIFIC ELECTIVE III: c) FORENSIC BOTANY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU236DE3	3	2	-	-	3	5	75	25	75	100

Pre-requisite: A basic understanding of plant anatomy, taxonomy, ecology, genetics, and forensic science principles.

Learning Objectives:

1. To understand the principles of plant classification schemes, plant morphology, anatomy, systematics, and their applications in forensic investigations.
2. To develop skills in the identification, collection, preservation, and analysis of botanical evidence using techniques such as DNA analysis, palynology, and plant ecology.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	explain morphological and anatomical features of plants, which could be useful for forensic investigations.	**K1**
2.	understand the forensic importance of different parts of plants.	**K2**
3.	apply techniques for the collection and preserve of botanical evidences of crime.	**K3**
4.	analyze and decipher the significance of classic and DNA based forensic botany cases.	**K4**
5.	interpret and deduce new methods for the detection of plant poisons used in crime.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Units	Contents	No. of Hours
I	Introduction to Forensic Science- Locard's exchange principle. General plant classification schemes, Sub specialization of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology, limnology, Plant architecture- roots, stems, flowers, leaves. Practical plant classification schemes: - vegetables and herbs, fruits bearing trees and plants, landscaping plants: trees, shrubs and vines, grasses, plant cell structure and functions.	**15**
II	Woods and Fibers: Various types of woods, timbers, seeds and leaves and their forensic importance, Identification and matching of various types of wood, timber varieties, seeds and leaves. Types of fibers – forensic aspects of fiber examinations, Various types of planktons and diatoms and their forensic importance.	**15**
III	Poisonous plants: *Anacardium occidentale*, *Argemone mexicana*, *Cannabis sativa*, *Atropa belladonna*, *Gloriosa superba*, *Jatropha curcas*, *Lathyrus sativus*, *Nerium indicum*, *Nicotiana tabacum*, *Strychnos nux vomica.*	**15**
IV	Botanical Evidences: Use of Botanical Evidence in Criminal Investigation: Botanical evidence and crime scene; source, transfer, evidence recognition, collection, preservation and documentation of botanical evidences in criminal investigation.	**15**
V	Analysis of samples: Pollen Analysis, Anatomical Structures, DNA analysis, Plant DNA typing, DNA fingerprinting, RFLP analysis, RAPD analysis, Botanical contributions to Drug enforcement.	**15**
	Total	**75**

Self-Study:	Types of fibers – forensic aspects of fiber examinations, Various types of planktons and diatoms and their forensic importance.

Textbooks:

1. James, S.H., Nordby, J.J., & Bell, S. 2015. *Forensic Science: An Introduction to Scientific and Investigative Techniques*, (4th Edition). CRC Press, Boca Raton.
2. Hall, D.W., & Byrd, J.H. 2012. *Forensic Botany*, (1st Edition). Wiley-Blackwell, United Kingdom.

Reference Books:

1. Hall, D.W., & Byrd, J. 2012. *Forensic Botany: A Practical Guide*, (1st Edition). Wiley-Blackwell, United Kingdom.
2. Bock, J.H., & Norris, D.O. 2016. *Forensic Plant Science*, (1st Edition). Academic Press, London.
3. Marquez-Grant, N. 2012. *Forensic Ecology Handbook*, (1st Edition). Wiley-Blackwell, United Kingdom.
4. Hall, D.W., & Byrd, J. 2012. *Forensic Botany: A Practical Guide*, (1st Edition). Wiley-Blackwell, United Kingdom.
5. Coyle, H.M. 2007. *Forensic Botany: Principles and Applications to Criminal Casework*, *AASP Newsletter*, Volume 40, No. 2.

Web Resources:

1. https://www.kobo.com/us/en/ebook/forensic-botany
2. https://www.worldcat.org/title/forensic-botany-a-practical-guide/oclc/796086574
3. https://www.buecher.de/shop/pflanzenoekologie/forensic-botany-ebook-pdf/hall-david-w--byrd-jason/products_products/detail/prod_id/37354547/
4. https://www.crcpress.com/Forensic-Botany-Principles-and-Applications-to-Criminal-Casework/Miller-Coyle/p/book/9780849315299
5. http://docshare02.docshare.tips/files/25818/258183613.pdf

MAPPING WITH PROGRAMME OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	2	1	3	2	2	1
CO2	3	3	3	1	2	2	2
CO3	2	2	2	3	2	2	3
CO4	3	3	3	3	2	2	2
CO5	3	3	2	3	2	2	2
Total	**14**	**13**	**11**	**13**	**10**	**10**	**10**
Average	**2.8**	**2.6**	**2.2**	**2.6**	**2**	**2**	**2**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMEs

COs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	2	3	3	3	3	2	3	2
CO2	3	3	3	1	3	2	3	2	2	3
CO3	2	2	3	3	2	2	2	2	2	2
CO4	1	3	3	2	1	2	2	3	2	3
CO5	3	1	2	2	3	2	2	2	1	2
Total	**12**	**12**	**13**	**11**	**12**	**11**	**12**	**11**	**10**	**12**
Average	**2.4**	**2.4**	**2.6**	**2.2**	**2.4**	**2.2**	**2.4**	**2.2**	**2**	**2.2**

3 -Strong 2 - Medium 1 – Low

SEMESTER VI
DISCIPLINE SPECIFIC ELECTIVE IV: a) PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY

Course Code	L	T	P	S	Credits	Inst. hours	Total Hours	Marks		
								CIA	External	Total
BU236DE4	3	2	-	-	3	5	75	25	75	100

Pre-requisites: Basic understanding of cell biology, genetics, recombinant DNA technology, plant tissue culture techniques, and molecular biology concepts.

Learning Objectives

1. To provide fundamental knowledge of plant biotechnology, including genetic engineering, tissue culture, and their applications.
2. To develop an understanding of molecular biology concepts and biotechnological tools for research and innovation.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recognize the fundamental concepts of plant biotechnology and genetic engineering.	K1
2	explain various steps in transcription, protein synthesis, and protein modification.	K2
3	elucidate gene cloning and evaluate different methods of gene transfer.	K3
4	analyse the major concerns and applications of transgenic technology.	K4
5	assess different types of plant tissue culture and their applications.	K5

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate

Units	Contents	No. of Hours
I	Biotechnology – Definition, history, scope, and significance. Principles of recombinant DNA technology, steps and Applications of rDNA technology, Restriction Enzymes - Nomenclature and classification. Vectors in Genetic Engineering – Plasmid, bacteriophage, viral vectors, cosmids. Gene Transfer Methods – Agrobacterium-mediated gene transfer, Biolistic method.	15
II	Biotechnology in Medicine – Role in vaccine production, gene therapy, and diagnostics. Biotechnology in industry – Applications in enzyme production, biopolymers, and bioplastics. Bioethics and Safety Regulations – Ethical concerns, GMO regulations, and biosafety guidelines.	15
III	Plant Tissue Culture – Introduction, scope, importance, and concept of totipotency. Preparation and composition of M.S media, sterilization, explant preparation, and inoculation. Micropropagation – Callus induction, synthetic seed technology, and its applications. Cryopreservation techniques.	15
IV	Genetic Material –Structure, and types of DNA and RNA. Base pairing (Chargaff's Rule), DNA denaturation - renaturation, DNA replication in prokaryotes, and DNA repair mechanisms- Photoreactivation, Mismatch repair. Mutations - Gene mutation and Chromosomal mutation; Mutagens; Chromosomal abnormalities - Down syndrome and Klinefelter syndrome.	15
V	**DNA transfer techniques:** Physical methods (Microinjection), Chemical method (Calcium Phosphate Method), Electrical method (Electroporation); Gene transfer in Plants *Agrobacterium* transformation; GM Plants - Bt Brinjal, Btcotton; Transgenic crops with improved quality traits in major crops (Flavrsavr Tomato, Golden Rice), IPR- scope and different kinds of IPR.	15
Total		75

Self-Study	Composition of M.S Media, biosafety guidelines.

Textbooks:

1. Ignacimuthu, S. 2015. *Plant Biotechnology*, 2nd Edition, Oxford & IBH Publishing, New Delhi.
2. Purohit, S.S 2018. *Introduction to Plant Biotechnology*, 4th Edition, Jodhpur.
3. Bhojwani, S.S. and Razdan, M.K., 2004. *Plant Tissue Culture*, Elsevier India Pvt. Ltd.

References Books:

1. Bernard R. Glick, Jack J. Pasternak, 2010. *Molecular Biotechnology: Principles and Applications of Recombinant DNA*, 4th Edition, ASM Press, Washington, D.C.
2. Sambrook, J., Russell, D.W., 2012. *Molecular Cloning: A Laboratory Manual*, 4th Edition, Cold Spring Harbor Laboratory Press, New York.
3. T.A. Brown, 2020. *Gene Cloning and DNA Analysis: An Introduction*, 8th Edition, Wiley-Blackwell, Hoboken, NJ.
4. Jogdand, S.N., 1997. *Gene Biotechnology*, Himalaya Publishing House, New Delhi.
5. Ernst L. Winnaccker, 2002. *From Genes to Clones: Introduction to Gene Technology*, VCR Publications, Weintein.

Web Resources:

1. http://www.freebookcentre.net/Biology/BioTechnology-Books.html
2. https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.html?id =RgQLISN8zT8C
3. https://www.kobo.com/us/en/ebook/plant-biotechnology-1
4. https://www.kobo.com/us/en/ebook/plant-biotechnology-1
5. https://www.worldcat.org/title/molecular-biology/oclc/1062496183

MAPPING WITH PROGRAMME OUTCOMES:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	2	3	3	3	1	2
CO 2	3	2	3	3	3	1	2
CO 3	3	3	3	3	3	1	3
CO 4	3	3	3	3	3	1	3
CO 5	3	3	3	3	3	1	3
Total	**15**	**13**	**15**	**15**	**15**	**5**	**13**
Average	**3**	**2.6**	**3**	**3**	**3**	**1**	**2.6**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

Cos	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	3	3	3	2	3	3	2
CO 2	3	3	3	3	3	3	3	3	3	2
CO 3	3	3	3	3	2	3	2	3	3	2
CO 4	3	3	3	3	3	3	2	3	2	2
CO 5	3	3	2	3	3	3	2	3	3	2
Total	**15**	**15**	**14**	**15**	**14**	**15**	**11**	**15**	**14**	**10**
Average	**3**	**3**	**2.8**	**3**	**2.8**	**3**	**2.2**	**3**	**2.8**	**2**

S-Strong (3) M-Medium (2) L-Low(1)

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE IV: b) FORESTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU236DE5	3	2	-	-	3	5	75	25	75	100

Pre-requisite: Students should have a basic knowledge on trees, forests and their importance.

Learning Objectives:

1. To understand the method of forest management principles and conservation.
2. To enable them to meaningfully contribute in the forest conservation.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	define the basic concepts related to forest distribution, degradation, protection, management and resource utilization.	**K1**
2.	understand complex interactions of humans and forest ecosystems in a global context.	**K2**
3.	demonstrate skills for ecological measurements and interpretation of forest ecology management.	**K3**
4.	examine and decipher the factors influencing forest vegetation, forest degradation, wood processing and methods of wood preservation	**K4**
5.	develop new strategies and apply the knowledge gained for problem-solving analysis in the conservation and management of forest ecosystems.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze; **K5 -** Evaluate; **K6–** Create

Units	Contents	No. of Hours
I	Forests - Forest types of India and Tamil Nadu - classification of forest, Role of forests. Silviculture – Definition and scope. Regeneration - natural and artificial. Nursery techniques - containerized seedling production, Vegetative and clonal propagation techniques - macro and micro propagation techniques.	**15**
II	Forest Mensuration - Definition and objectives. Measurement of diameter, girth, height, crown and volume of trees. Volume estimation of stand - age - basal area determinations. Stem and Stump Analysis. Forest inventory - sampling techniques and methods - measurement of crops - sample plots. Yield calculation - CAI and MAI.	**15**
III	Processing of wood - Felling of trees, Conversion of timber, Wood seasoning, wood preservation. Forest products - timber, fuel, pulp, paper, rayon and match. Wood Composites - plywood, particle board, fiber boards, hardboard, insulation boards. Non timber forest products (NTFP) – collection, processing and storage of NTFP, bamboos and canes - bidi leaves. gums, resins and dyes.	**15**
IV	Forest ecology - definition - biotic and abiotic components, forest ecosystem - forest community - primary productivity. Restoration ecology - global warming - green house effects - ozone layer depletion - acid rain -role of trees in environmental conservation. Biodiversity - Definition, origin, types - factors endangering biodiversity - biodiversity hotspots - endemism - Red Data Book.	**15**
V	Forest utilization – Harvesting, conservation, storage and disposal of wood in Forest; major and minor forest Products; Forest based Industries_ Paper and pulp industry; resin tapping and turpentine manufacture; Forest education in India.	**15**
	Total	**75**

Self-Study Portion:	Restoration ecology - global warming - green house effects - ozone layer depletion - acid rain - role of trees in environmental conservation.

Text Books:

1. Balakathiresan, S. 1986. *Essentials of Forest Management*, (1st Edition). Natraj Publishers, Dehradun.
2. Agarwala, V.P. 1990. *Forests in India, Environmental and Protection Frontiers*, (1st Edition). Oxford & IBH Publishing Co., New Delhi.

Reference Books:

1. Grebner, D.L., Siry, J.P., & Bettinger, P. 2012. *Introduction to Forestry and Natural Resources*, (1st Edition). Academic Press, New York.
2. West, P.W. 2015. *Tree and Forest Measurement*, (1st Edition). Springer International Publishing, Switzerland.
3. Kollmann, F.F.P., & Cote, W.A. 1988. *Wood Science and Technology, Volume I & II*, (1st Edition). Springer Verlag, New York.
4. Agarwala, V.P. 1990. *Forests in India, Environmental and Protection Frontiers*, (1st Edition). Oxford & IBH Publishing Co., New Delhi.
5. Chundawat, B.S., & Gautham, S.K. 1996. *Textbook of Agroforestry*, (1st Edition). Oxford & IBH Publishers, New Delhi.

Web Resources:

1. http://wwwwds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/10/19/000112742_2006 019150049/Rendered/PDF/367890Loggerheads0Report.pdf.
2. https://www.britannica.com/science/forestry
3. https://en.wikipedia.org/wiki/Forestry.
4. https://www.biologydiscussion.com/forest/essay-forest-importance.major- products-and-its-conservation/25119
5. https://academic.oop.com

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	3	3	2	2
CO2	3	3	3	3	2	1	2
CO3	3	3	3	2	3	2	3
CO4	3	2	3	1	2	2	1
CO5	3	2	2	3	1	2	2
Total	**15**	**13**	**13**	**12**	**11**	**9**	**10**
Average	**3**	**2.6**	**2.6**	**2.4**	**2.2**	**1.8**	**2**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	3	3	2	3	3	2	2	2
CO2	3	2	2	3	2	3	3	2	2	2
CO3	3	3	3	3	3	2	3	2	2	2
CO4	3	1	2	3	2	2	2	3	2	3
CO5	2	2	3	1	2	2	2	2	1	2
Total	**14**	**10**	**13**	**13**	**11**	**12**	**13**	**11**	**9**	**11**
Average	**2.8**	**2**	**2.6**	**2.6**	**2.2**	**2.4**	**2.6**	**2.2**	**1.8**	**2.2**

S-Strong (3) M-Medium (2) L-Low(1)

SEMESTER VI
DISCIPLINE SPECIFIC ELECTIVE IV: c) COMPUTATIONAL TOOLS AND ARTIFICIAL INTELLIGENCES IN BOTANY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
BU236DE6	3	1	1	-	3	5	75	25	75	100

Prerequisite: Basic knowledge of Botany, Plant Taxonomy, and fundamental understanding of Computers and Data Management.

Objectives

1. To introduce students to computer applications, AI, and bioinformatics in botanical studies.
2. To equip students with skills in statistical analysis, image processing, and plant identification using modern computational tools.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	understand the role of computers, AI, and bioinformatics in botanical research.	**K1**
2.	explain the use of computer-aided design (CAD) tools in landscaping and herbarium management in botany.	**K2**
3.	apply statistical and image analysis tools for plant studies.	**K3**
4.	utilize programming and bioinformatics databases for analyzing plant data.	**K4**
5.	demonstrate the use of AI-based tools for taxonomy, phylogenetics, and plant recognition.	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 –** Analyze: K5-Evaluate

Units	Contents	No. of Hours
I	**INTRODUCTION TO COMPUTER APPLICATIONS IN BOTANY:** Basics of Computers: Hardware, Software, and Operating Systems (Windows, Linux, Mac OS)' MS Office Applications (Word, Excel, PowerPoint) for Botanical Studies: Role of Computers in Botanical Research: Data Collection, Management, and Analysis: Introduction to Artificial Intelligence (AI) in Botany: AI-based Plant Identification and Automated Data Processing.	15
II	**STATISTICAL AND IMAGE ANALYSIS TOOLS IN BOTANY:** Basics of Biostatistics in Botanical Research: Statistical Software: MS Excel, SPSS, R: Image Processing in Botany: ImageJ, Photoshop: Digital Herbarium and AI-based Plant Recognition: GIS & Remote Sensing for Plant Ecology and Conservation.	15
III	**COMPUTER FUNDAMENTALS & BIOINFORMATICS:** Programming in Bioinformatics (Python, R): Role of Supercomputers & AI in Biological Research: Scope of Bioinformatics: Genomics, Transcriptomics, Proteomics, Metabolomics: AI in Bioinformatics: Predictive Modeling, Drug Design, and Systems Biology: Applications and Limitations of Bioinformatics.	15
IV	**BIOINFORMATICS & BOTANICAL DATABASES:** Botanical Databases: NCBI, EMBL, KEW Herbarium, Plant Ontology: Sequence Alignment and Phylogenetics (BLAST, ClustalW): DNA & Protein Databases for Plant Studies: AI-driven Online Tools for Plant Taxonomy & Identification.	15
V	**APPLICATIONS:** Use of Taxonomic Software for Dichotomous Key Preparation: AI-based Phylogenetic Analysis: Digital Plant Drawings & Identification Apps (Android & AI-powered tools): Computer-Aided Biostatistics (Excel, SPSS): CAD for Indoor & Outdoor Landscaping (Exposure to AI-enhanced CAD tools).	15
	Total	75

Self-Study	Biological databases- NCBI, EMBL and DDBJ. Data Generation and Data Retrieval.

Textbooks

1. Pandey, B.P. 2021. *Computer Applications in Botany*. S. Chand & Company. New Delhi.
2. Kumar, S. & Gupta, P. 2022. *Bioinformatics and AI in Plant Sciences*. Oxford, Oxford University Press. UK:

References Books:

1. Baxevanis, A.D. & Ouellette, B.F.F. 2020. *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*. Wiley, New Jersey.
2. Lesk, A.M. 2021. *Introduction to Bioinformatics*. Cambridge, Cambridge University Press, UK.
3. Jones, N. & Pevzner, P. 2022. *An Introduction to Bioinformatics Algorithms*. Massachusetts, MIT Press, USA.
4. Dey, A. & Das, P. 2023. *AI and Machine Learning in Plant Sciences*. Springer, New York.
5. Singh, R. 2021. *Computational Botany: Applications and Innovations*. London, CRC Press, UK.

Web Resources:

1. https://www.ncbi.nlm.nih.gov/
2. https://www.kew.org/science/collections-and-resources/herbarium
3. https://imagej.nih.gov/ij/
4. https://phytozome-next.jgi.doe.gov/
5. https://cran.r-project.org/

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PSO6	PSO7
CO1	3	3	1	3	1	2	3
CO 2	3	3	2	2	1	2	3
CO 3	3	3	2	1	1	1	3
CO 4	3	3	3	1	1	2	2
CO 5	3	3	3	1	2	1	2
Total	**15**	**15**	**11**	**8**	**6**	**8**	**13**
Average	**3**	**3**	**2.2**	**1.6**	**1.2**	**1.6**	**2.6**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PS10
CO1	3	3	2	3	2	2	2	2	1	2
CO2	3	3	2	2	2	2	2	1	1	2
CO3	3	2	3	1	2	1	1	1	1	1
CO4	3	3	2	2	2	2	3	1	2	1
CO5	3	3	3	2	2	1	2	1	2	2
Total	**15**	**15**	**12**	**10**	**10**	**8**	**10**	**6**	**7**	**8**
Average	**3**	**3**	**1.6**	**2**	**2**	**1.6**	**2**	**1.2**	**1.4**	**1.6**

3 -Strong 2 - Medium 1 - Low

SEMESTER VI

PROFESSIONAL COMPETENCY SKILL: BOTANY FOR ADVANCED RESEARCH

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BU236PS1	1	1	-	-	2	2	30	25	75	100

Pre-requisite: Students should to improve their career prospects, or pursuing a passion.

Learning Objectives:

1. To gain knowledge of plant systematics, anatomy, and physiological processes essential for plant growth and production.
2. To understand molecular techniques and the mechanisms of energy production and utilization in plants.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the concepts and techniques involved in molecular taxonomy, chemotaxonomy, and serological methods in plant classification.	**K1**
2.	understand the principles of reproductive biology including apomixis, sterility types, and incompatibility systems in plants.	**K2**
3.	apply molecular biology techniques such as DNA isolation, PCR, blotting methods, and spectroscopy in plant studies.	**K3**
4.	analyze enzyme kinetics, immunological techniques, and chromosomal analysis methods in relation to plant biotechnology.	**K4**
5.	evaluate the application of advanced molecular and cytogenetic tools like NMR, ELISA, mass spectrometry, and DNA sequencing in plant research.	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	Molecular trends in Biosystematics: techniques used in molecular taxonomy, molecular systematics in crop evolution, Serology in relation to plant taxonomy. Cladistics and Phenetics, Chemotaxonomy	**6**
II	Molecular trends in Reproductive Biology: Apomixis – Types, cytogenetic basis and induction of apomixes, applications. Biochemistry and genetics of incompatibility, methods to overcome incompatibility. Sterility – Male sterility, CMS, GMS, CGMS, transgenic male sterility, female sterility and zygotic sterility Palynology: Sporopollenin, Pollenkit, NPC system	**6**
III	Molecular Biology: DNA isolation, chromosome walking, chromosome jumping, principles and applications of recombinant DNA technology, DNA fingerprinting, DNA foot printing, DNA sequencing, PCR, RFLP, RAPD, AFLP, ISSR, Southern, Northern and Western blotting techniques. Exon shuffling, exon trapping, protein isolation.	**6**
IV	Spectroscopy-nature of Electromagnetic Radiation.– UV and visible spectroscopy, IR spectroscopy. Spectroflurometry. Electron spin Resonance-NMR-Mass spectrometry and spectrophotometry.	**6**
V	Enzyme assay and kinetics, ELISA, RIA, calorimetric studies, Karyotype and pachytene analysis, acetolysis, banding techniques, scoring of chromosomal aberrations	**6**
Total		**30**

Self-study	Pollenkit, Northern and Western blotting techniques.

Text Books:

1. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2018. Fundamentals of Plant Physiology. Sinauer Associates Inc., US.
2. Becker, W.M., Kleinsmith L.J. & Hardin J. 2005. The World of the Cell (6th edition). Benjamin/Cummings Pub. Co. New York.
3. Mabberley, J.D. 2014. Mebberley's Plant-Book: A portable dictionary of plants, their classification and uses, 3rd ed. Cambridge University Press, Cambridge, U.K.

Reference Books:

1. Hopkins, W.G and Huner, N.P. 2009. Introduction to Plant Physiology (4th ed.). John Wiley & Sons. U.S.A.
2. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the embryology of angiosperms. Springer Science & Business Media, Germany.
3. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman &Co. New York.
4. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd edition). Pearson/Benjamin Cumming, San Francisco.
5. Snustad, D. P. & Simmons M.J. 2003.Principles of Genetics. John Hailey & Sons Inc. U.S.A.

Web Resources:

1. http:// www.ornl.gov.
2. http:// ash. gene. ncl.ac.nk.
3. http://tor. cshl. org. http:www.gdb. org.
4. http: //www. neg r. org.
5. http: // www. genetics. wustl.edu.

MAPPING WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	2	3	3	1	3
CO2	3	2	2	3	3	1	3
CO3	3	1	3	3	3	2	3
CO4	3	2	3	3	3	2	3
CO5	3	2	3	3	3	1	3
TOTAL	**15**	**8**	**13**	**15**	**15**	**7**	**15**
AVERAGE	**3**	**1.6**	**2.6**	**3**	**3**	**1.4**	**3**

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	2	2	2	2	2	3	2	2
CO2	3	2	2	1	2	2	2	2	2	2
CO3	3	2	2	2	2	2	3	2	2	2
CO4	3	3	2	1	2	2	3	2	2	3
CO5	3	3	2	2	1	2	3	2	2	3
TOTAL	**15**	**12**	**10**	**8**	**9**	**10**	**13**	**11**	**10**	**12**
AVERAGE	**3**	**2.4**	**2**	**1.6**	**1.8**	**2**	**2.6**	**2.2**	**2**	**2.4**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

GENDER EQUITY AND INCLUSIVITY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG236GE1	1	-	-	-	1	1	15	50	50	100

Learning Objectives

1. To understand the challenges faced by women in the society.
2. To analyze the legitimate rights and laws that aid women to march towards emancipation and empowerment.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	interpret the life struggles of women and to promote equality	K1
2	identify the socio-cultural and religious practices that subjugate women	K2
3	probe deep into the root cause of marginalization of women and to promote an inclusive nature	K3
4	investigate the challenges faced by women in practical life	K4
5	evaluate exploitation of women as commercial commodities in advertisements and media	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate

Unit	Contents	No. of Hours
I	**Life Struggle of a Woman:** Challenges faced by girl students, education and religion, woman and society, working environment.	3
II	**Cultural Traits:** Myths and religious texts, opposition and rebuttal, contemporary literature, cultural decay, opportunities provided by social media.	3
III	**Women's Rights:** Democratic women's association, Laws for women's rights, essential legal rights of girl child in India, gender justice, millennium development goals, Political parties.	3
IV	**Women's Liberation:** Struggle for social rebirth, role of government and NGO's- self-help group for women, Indian political of legal profession and gender representation. the supreme courts efforts, challenging patriarchal narratives, global responsibility, women in sustainable development.	3
V	**Inclusivity:** Equal opportunities for women and men, equal access and opportunities for disabled people, indigenous populations, refugees and migrants - Importance of challenging and redefining gender roles - value and respect towards all gender identities.	3
	TOTAL	15

Reference Books

1. Hosoda, M. 2021. Promoting Gender Diversity and Inclusion at Workplace: A Case Study of Japanese Retail and Financial Service Company. Rikkyo University
2. Palo, S., Jha, K. K. 2020. Introduction to Gender. Tata Institute of Social Sciences.
3. Debois, E. and L. Dumenil. 2005. Through Women's Eyes: An American History With Documents. St. Martin Press.
4. Carter, Sarah. Mansell, 1990. Women's Studies: A Guide to Information Sources
5. .Datchana Moorthy Ramu.2020. Gender Equality and Sustainable development Goals,Notion Press.

Web Resources

1. https://en.wikipedia.org/wiki/Women%27s_studies
2. https://libguides.berry.edu/wgs/reference
3. https://www.albany.edu/~dlafonde/women/wssresguide9602
4. https://openbooks.library.umass.edu/introwgss/chapter/references-feminist-movements/
5. https://libguides.niu.edu/womensandgenderstudies/ReferenceSources