Holy Cross College (Autonomous), Nagercoil

Kanyakumari District, Tamil Nadu.
Accredited with A$^+$ by NAAC - IV cycle – CGPA 3.35

Affiliated to
Manonmaniam Sundaranar University, Tirunelveli

Semester I & II

Guidelines & Syllabus

DEPARTMENT OF BOTANY

2023-2026

(With effect from the academic year 2023-2024)

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.

Programme Educational Objectives (PEOs)

PEOs	Upon completion of B.A/B.Sc. Degree Programme, the graduates will be able to:	Mapping with Mission
PEO 1	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**
PEO 2	use practical knowledge for developing professional empowerment and entrepreneurship and societal services.	**M2, M3, M4 & M5**
PEO 3	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**

Program Specific Outcomes (PSOs)

On successful completion of the B.Sc. Botany program, 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 PO'S and PSO'S

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 papers / Project	10 x 100	1000
	Practical (Core Applied)	7 x 100	700
	Discipline Specific Elective-Theory Papers	3 x 100	300
	Total Marks		**2000**
Elective Courses	Theory	4 x 100	400
	Practical	4 x 100	400
	Total Marks		**800**
	Total Marks		**2800**

- **Core and Elective Practical 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 Project	5(5) 3(3)	5(5) 3(3)	5(5) 3(3)	5(5) 3(3)	6 (4) + 6 (4) + 4 (4) 4(4)	5 (3) + 5 (3) + 5 (3) + 5 (4) 4 (3)	76	64
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)	4 (3)	36	29
Part IV								
Non Major Elective	2 (2)	2 (2)	-	-	-	-	4	4
Skill Enhancement Course	-	2 (2)	1 (1) 2 (2)	1 (1) 2 (2)	-	-	8	8
Foundation Course	2(2)	-	-	-	-	-	2	2
Value Education	-	-	-	-	2 (2)		2	2
Summer Internship /Industrial Training					(2)			2
Environmental studies	-	-	1	1 (2)	-	-	2	2
Extension activity	-	-	-	-	-	(1)	-	1
Professional Competancy Skill						2 (2)	2	2
Total	**30 (23)**	**30 (23)**	**30 (22)**	**30 (24)**	**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		(1)		(1)		(1)	3
Student Training Activity: Clubs & Committees / NSS				(1)			1
Community Engagement Activity: RUN				(1)			1
Human Rights Education					(1)		1
Gender Equity Studies						(1)	1
Total							**15**

Total number of Compulsory Credits = Academic credits + Non-academic credits: 140 + 15

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	EU231EL1	English	3	6
Part III	BU231CC1	Core Course I: Plant Diversity -I- Algae	5	5
	BU231CP1	Core Lab Course I: Plant Diversity -I- Algae	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	EU232EL1	English	3	6
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	3	3

		-II		
	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
Part II	EU233EL1	English	3	6
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 -III	3	3
	BU233EC1	Elective Course III: Allied Botany - III	3	4
	BU233EP1	Elective Lab Course III: Allied Botany Practical – III	2	2
Part IV	BU233SE1	Skill Enhancement Course SEC II:(Entrepreneurial Skills): Entrepreneurial Opportunities in Botany	1	1
	BU233SE2	Skill Enhancement Course SEC III: Herbal Technology	2	2
	UG234EV1	Environmental Studies	-	1
		Total	**22**	**30**

Semester IV

Course	Course Code	Title of the Course	Credits	Hours/Week
Part I	TU234TL1 FU234FL1	Language: Tamil French	3	6
Part II	EU234EL1	English	3	6
Part III	BU234CC1	Core Course IV: Plant Diversity – IV – Gymnosperms, Paleobotany and	5	5

		Evolution		
	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 I: Allied Botany Practicals -IV	2	2
Part IV	BU234SE1	Skill Enhancement Course SEC IV :Fermentation Technology	1	1
	BU234SE2	Skill Enhancement Course SEC V: Environment Impact Analysis	2	2
	UG234EV1	Environmental Studies	2	1
		Total	**24**	**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	6
	BU235CC2	Core Course VI: Plant Anatomy and Embryology	4	6
	BU235CP1	Core Lab Course V: Plant Morphology, Taxonomy and Economic Botany & Plant Anatomy and Embryology	4	4
	BU235PW1	Core Project	4	4
	BU235DE1	Discipline Specific Elective I: a) Bio-Analytical Technology	3	4
	BU235DE2	Discipline Specific Elective I: b) Aquatic Botany		
	BU235DE3	Discipline Specific Elective I: c) Entrepreneurial Botany		
	BU235DE4	Discipline Specific Elective II : a) Bio nanotechnology	3	4
	BU235DE5	Discipline Specific Elective II : b) Computer Application in Botany		
	BU235DE6	Discipline Specific Elective II : c) Forensic Botany		
Part IV	BU235VE1	Value Education	2	2
	BU235SI1 / BU235IT1	Summer Internship/Industrial Training	2	-
		Total	**26**	**30**

Semester VI

Course	Course Code	Title of the Course	Credits	Hours
Part III	BU236CC1	Core Course VII: Plant Ecology and Phytogeography	3	5
	BU236CC2	Core Course VIII: Plant Biotechnology and Molecular Biology	3	5
	BU236CC3	Core Course IX: Plant Physiology and Biochemistry	3	5
	BU236CP1	Core Lab VI: Plant Ecology and Phytogeography & Plant Biotechnology and Molecular Biology	4	5
	BU236CP3	Core Lab VII: Plant Physiology and Biochemistry	3	4
	BU236DE1	Discipline Specific Elective III: a) Horticulture	3	4
	BU236DE2	Discipline Specific Elective III: b) Natural Resource Management		
	BU236DE3	Discipline Specific Elective III: c) Forestry		
	BU236EA1	Extension Activity	1	-
	BU236PS1	Professional Competency Skill	2	2
		Total	**22**	**30**
TOTAL			**140**	**180**

Co-curricular Courses

Part	Semester	Code	Title of the Course	Credit
Part V	I & II	UG232LC1	Life Skill Training I: Catechism	1
		UG232LM1	Life Skill Training I: Moral	
	I	UG231C01 – UG231C--	Skill Development Training (SDT) - Certificate Course	1
	II	BU232FP1	Field Project	1
	I & III	BU231V01-BU231V--/ BU233V01 – BU233V--	Specific Value-added Course	1+1
	II, IV& VI	-	MOOC	1+1+1
	III & IV	UG234LC1	Life Skill Training II: Catechism	1
		UG234LM1	Life Skill Training II: Moral	
	IV & VI	UG234V01-UG234V--/ UG236V01-UG236V--	Generic Value-added Course	1 +1
	I - IV	UG234ST1	Student Training Activity – Clubs	1

			& Committees / NSS	
	IV	UG234CE1	Community Engagement Activity - RUN	1
	V	UG235HR1	Human Rights Education	1
	VI	UG236GS1	Gender Equity Studies	1
			Total	**15**

Specific Value Added Course

S. No.	Course code	Title of the course	Credits	Total hours
I	BU231V01	Art of Bonsai	1	30

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.

a. 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 3 x 4(Internal choice)	12	Part B 5 x 6 (Internal choice)	30
Part C 3 x 8 (Internal choice)	24	Part C 5 x 12(Internal choice)	60
Total	**40**	**Total**	100

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 Project

Ratio of Internal and External = 25:75

Components	**Marks**
Internal	25
External	
Report	40
Viva voce	35

Part - IV

i. Non-major Elective, Foundation Course, Skill Enhancement Course, Value Education, Professional Competency Skill

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

Internal Components and Distribution of Marks

Components	**Marks**
Internal test (2)	10
Quiz (2)	5
Assignment: (Model Making, Exhibition, Role Play, Album, Group Activity (Mime, Skit, Song) (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 5 (open choice any **Five** out **of Eight**)	25
Part C 1 x 9 (open choice O**ne** out of **Three**)	9	Part C 5 x 8 (open choice any **Five** out **of Eight**)	40
Total	**25**	**Total**	**75**

ii. Environmental Studies

Internal Components

Component	Marks
Project Report	15
Viva voce	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 5 (Open choice any **Five** out **of Eight**)	25
Part C 1 x 9 (Open choice O**ne** out of **Three**)	9	Part C 5 x 8 (Open choice any **Five** out **of Eight**)	40
Total	**25**	**Total**	**75**

iii. Summer Internship/Industrial Training

Components	Marks
Industry Contribution	50
Report & Viva-voce	50

Co-Curricular Courses:

i. Life Skill Training: Catechism & Moral, Human Rights Education & Gender Equity Studies

Internal Components

Component	Marks
Project - Album on current issues	25
Group Song/ Mime/ Skit	25
Total	**50**

External Components

Component	Marks
Quiz	20
Written Test: Open choice – 5 out of 7 questions (5 x 6)	30
Total	**50**

ii. Skill Development Training (SDT) - Certificate Course:

Components	Marks

Attendance & Participation	50
Skill Test	50

iii. Field Project:

Components	**Marks**
Field Work	50
Report & Viva-voce	50

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

Components	**Marks**
Internal	25
External	75

v. Community Engagement Activity: Reaching the Unreached Neighborhood (RUN)

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

vi. Student Training Activity: Clubs and Committees

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

Component	**Marks**
Attendance	25
Participation	25
Total	**50**

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	Internal	2	2		1	1	1	1	-	2	-	-	-	10
	External	5	2	1	3	2	2	2	1	2	-	-	-	20
II UG	Internal	1	-	1	1	2		1	-	1	1	1	1	10
	External	5	1	1	4	1	1	-	3	1	1	-	2	20
III UG	Internal	1	1	-	-	1	-	1	-	1	2	1	2	10

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:

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) $\Sigma_n\Sigma_i C_{ni}G_{ni} / \Sigma_{ni}\Sigma_i C_{ni}$

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**
	Algae as food and feed: Agar-agar, Alginic acid and Carrageenan;	**15**

V	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.	

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

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/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382
3. https://www.crcpress.com/Algae-Anatomy-Biochemistry-and-Biotechnology-Second-Edition/Barsanti-Gualtieri/p/book/9781439867327
4. https://www.crcpress.com/Marine-Algae-Biodiversity-Taxonomy-Environmental-Assessment-and-Biotechnology/Pereira-Neto/p/book/9781466581678
5. https://www.kopykitab.com/Botany-For-Degree-Students-ALGAE-by-B-R-Vashishta-Dr-A-K-Sinha-Dr-V-P-Singh
6. https://www.wileyindia.com/a-textbook-of-algae.html
7. https://www.kobo.com/in/en/ebook/algae-biotechnology
8. https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-algae/9788188237449/

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

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

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

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

Text Books:

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

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.

3.Course Outcomes

4.

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 andGymnosperms.	**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**

5.**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**

Self Study: General Characters of Algae, Fungi, Bacteria

Text Books:

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. SurjeetPublications, 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
6. https://www.us.elsevierhealth.com/medicine/cell-biology
7. https://www.us.elsevierhealth.com/medicine/genetics
8. https://www.kobo.com/us/en/ebook/plant-biotechnology-1

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.	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.	to study the classical taxonomy with reference to different parameters.	**K4**
4.	understand the fundamental concepts of plant anatomy and embryology	**K2**
5.	to study the effect of various physical factors on photosynthesis.	**K3**

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

	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**

Self Study Portion: Cultivation of Rose

Recommended Texts:

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.

References 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; **K5 -** Evaluate; **K6–** Create

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

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

Recommended Texts:

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.

References 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.
6. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes. Surjeet Publications, Delhi.

Web Resources:

1. 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
6. https://www.us.elsevierhealth.com/medicine/cell-biology
7. https://www.us.elsevierhealth.com/medicine/genetics
   https://www.kobo.com/us/en/ebook/plant-biotechnology-1

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	Credit	Total Hours	Total Marks
BU231V01	1	30	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 balancednutrition 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 MiniatureLandscapes (Saikei): Combining multiple trees and elements to tell a story.Bonsai Exhibition and Judging: Preparing bonsai for exhibitions, understanding evaluation criteria.	**6**

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:

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

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

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

Text Books:

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 typesprescribed 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 permanentslides. 13. Economic importance of Lichens - Dye and perfume.	45

Text Books:

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.

References 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_esc=y
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	to 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

Self-study	Economic importance of families prescribed in the syllabus

Recommended Texts:

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 the families prescribed in the syllabus and to identify the plants to their family. 2. To dissect a flower, construct floral diagram and write floral formula. 3. Demonstration experiments 1. Ganong's Light screen 2. Ganong's Respiroscope 4. To make suitable micro preparations of anatomy materials prescribed 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 valueassociated 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 insmall scale Industry.	**6**
III	Life cycle of *Pleurotus* spp and *Agaricus* spp.	**6**
IV	Spawn production, growth media, spawn running and harvesting ofmushrooms and marketing.	**6**
V	Diseases and post harvest technology, Insect pests, nematodes, mites,viruses, fungal competitors and other important diseases.	**6**

Self-study	Nutritive value of common edible mushrooms.

Text Books:

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.

References 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.	to know about the fundamental concepts of gardening and landscaping	**K1**
2.	to provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.	**K2**
3.	to illustrate the significance of garden adornments and propagation structures.	**K3 & K6**
4.	to create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.	**K4**
5.	to 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**

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)**

Holy Cross College (Autonomous), Nagercoil

Kanyakumari District, Tamil Nadu.

Accredited with A$^+$ by NAAC - IV cycle – CGPA 3.35

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

Semester I & II

Guidelines & Syllabus

DEPARTMENT OF BOTANY

2023-2026

(With effect from the academic year 2023-2024)

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.

Programme Educational Objectives (PEOs)

PEOs	Upon completion of M. Sc. Botany Programme, the graduates will be able to:	Mapping with Mission
PEO1	apply scientific and computational technology to solve social and ecological issues and pursue research.	M1, M2
PEO2	continue to learn and advance their career in industry both in private and public sectors.	M4 & M5
PEO3	develop leadership, teamwork, and professional abilities to become a more cultured and civilized person and to tackle the challenges in serving the country.	M2, M5 & M6

Programme Outcomes (POs)

POs	Upon completion of M.Sc. Botany Programme, the graduates will be able to:	Mapping with PEOs
PO1	apply their knowledge, analyze complex problems, think independently, formulate and perform quality research.	PEO1 & PEO2
PO2	carry out internship programmes and research projects to develop scientific and innovative ideas through effective communication.	PEO1, PEO2 & PEO3
PO3	develop a multidisciplinary perspective and contribute to the knowledge capital of the globe.	PEO2
PO4	develop innovative initiatives to sustain ecofriendly environment	PEO1, PEO2
PO5	through active career, team work and using managerial skills guide people to the right destination in a smooth and efficient way.	PEO2
PO6	employ appropriate analysis tools and ICT in a range of learning scenarios, demonstrating the capacity to find, assess, and apply relevant information sources.	PEO1, PEO2 & PEO3
PO7	learn independently for lifelong executing professional, social and ethical responsibilities leading to sustainable development.	PEO3

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Program Specific Outcomes (PSO)	
On successful completion of the M.Sc. Botany programme, the students are expected to	
PSO1	familiarize with the fundamental, advanced and emerging concepts in Botany.
PSO2	understand the role of plants and their interactions with other organisms in various ecosystems.
PSO3	identify the potency of plant resources in contemporary research and visualize future thrust areas in Botany.
PSO4	design scientific experiments independently and to generate useful information to address various issues in Botany.
PSO5	acquire basic knowledge on principles and applications of laboratory instruments and adequate skills to handle them.
PSO6	choose and apply appropriate tools, techniques, resources, etc. to perform various experiments in Botany.
PSO7	carryout scientific experiments independently or in collaboration with inter-disciplinary or multidisciplinary approaches.
PSO8	disseminate knowledge on conservation of biodiversity and protection of environment.
PSO9	awareness on the sustainable utilization of plant/microbial resources following the bioethical norms.
PSO10	demonstrate proficiency in communicating with various stakeholders like students, teachers, scientists and society.

Mapping of PO'S and PSO'S

POs	PSO1	PSO 2	PSO3	PSO4	PSO5	PSO6
PO 1	2	3	3	2	2	3
PO 2	3	3	3	3	3	3
PO 3	3	3	3	2	3	3
PO4	3	2	2	3	2	2
PO5	3	2	3	3	3	3
PO6	3	3	2	3	3	3
Total	17	16	16	16	16	17
Average	2.8	2.6	2.6	2.6	2.6	2.8

Eligibility

For Admission: A candidate who is a graduate of this college or any other recognized University in the main subject/ subjects as given below against each or who has passed an examination accepted as equivalent by the Syndicate of Manonmaniam Sundaranar University, Tirunelveli, is eligible for admission.

Components of M.Sc. Programme

Core Course	10x 100	1000
Core Lab Course	4 x 100	400
Elective Course	6 x 100	600
Elective Lab Course	-	-
Core Project	1 x 100	100
Total Marks		**2100**

Course Structure

(i) Curricular Courses

Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Total	
					Hours	Credits
Core– Theory Core Practical	7 (5) + 7 (5) + 6 (4)	5 (4)+ 5 (4)+ 5 (4)	6 (5) + 6 (5) + 6 (4)	5 (4) + 5 (4) + 3 (2)		
Elective Course	5 (3) 5 (3)	4 (2) 4 (2)	3(3)	4(3)	25	16
Core Project				9 (7)	9	7
Skill Enhancement Course		2 (2)	3 (2)	4 (2)	9	6
Internship/ Industrial Activity			(2)		-	2
Extension Activity				(1)	-	1
Total	**30 (20)**	**30 (22)**	**30 (26)**	**30 (23)**	**120**	**91**

(ii) Co-curricular Courses

Course	SEMESTER				Total
	I	II	III	IV	Credits
Life Skill Training –I	-	(1)	-	-	1
Life Skill Training –II	-	-	-	(1)	1
Field Project	(1)	-	-		1
Specific Value-Added Courses	(1)		(1)		2
Generic Value-Added Courses		(1)		(1)	2
MOOC		(1)		(1)	2
Community Engagement Activity (UBA)		(1)			1

Total Number of Hours = 120

Total Number of Credits = 91 + (10)

Courses Offered

Semester I

Course Code	Title of the Course	Credits	Hours / Week
BP231CC1	Core Course I: Plant Diversity-I Algae, Fungi, Lichens and Bryophytes	5	7
BP231CC2	Core Course II: Plant Diversity - II: Pteridophytes, Gymnosperms and Paleobotany	5	7
BP231CP1	Core Lab Course I: Laboratory course- I: Covering Core Papers - I and II	4 (2+2)	6 (3+3)
BP231EC1	Elective Course I: a) Microbiology, immunology and plant pathology	3	5
BP231EC2	Elective Course I: b) Conservation of natural resources and policies		
BP231EC3	Elective Course I: c) Mushroom cultivation		
BP231EC4	Elective Course II: a) Ethnobotany, naturopathy and Traditional Healthcare	3	5
BP231EC5	Elective Course II: b) Algal Technology		
BP231EC6	Elective Course II: c) Herbal Technology		
	Total	**20**	**30**

Semester II

Course Code	Title of the Course	Credits	Hours / Week
BP232CC1	Core Course III: Taxonomy of Angiosperms and Economic Botany	4	5
BP232CC2	Core Course IV: Plant Anatomy and Embryology of angiosperms	4	5
BP232CC3	Core Course V: Ecology, Phytogeography, Conservation Biology and Intellectual Property Rights	4	5
BP232CP2	Core Lab Course II: Lab Course (for Core III, IV& V)	4 (2+2)	5 (3+3)
BP232EC1	Elective Course III: : a) **Biostatistics**	2	4
BP232EC2	Elective Course III b) Intellectual Property Rights		
BP232EC3	Elective Course III c) Applied bioinformatics		
BP232EC4	Elective Course IV: a) **Research methodology, computer applications & bioinformatics**	2	4
BP232EC5	Elective Course IV : b).Medicinal Botany		
BP232EC6	Elective Course IV : c) Phytochemistry		
BP232SE1	Skill Enhancement Course I: Nursery and Gardening	2	2

	Total	**22**	**30**

Semester III

Course Code	Title of the Course	Credits	Hours / Week
BP233CC1	Core Course VI: Cell and Molecular Biology	5	6
BP233CC2	Core Course VII: Genetics, Plant Breeding and Biostatistics	5	6
BP233CC3	Core Course VIII: Recombinant DNA Technology	5	6
BP233CP1	Core Lab Course III: Laboratory course Covering Core Papers VI, VII and VIII	4	6
BP233EC1 BP233EC2 BP233EC3	Elective Course V: a)Secondary Plant Products and Fermentation Technology b) Applied plant cell and tissue culture c) Entrepreneurial opportunities in Botany	3	3
BP233EC2	Elective Course V: b) Applied plant cell and tissue culture		
BP233EC3	Elective Course V: c) Entrepreneurial opportunities in Botany		
BP233SE1	Skill Enhancement Course II: Agriculture and Food Microbiology	2	3
BP233IS1	Internship/ Industrial Activity	2	-
	Total	**26**	**30**

Semester IV

Course Code	Title of the Course	Credits	Hours / Week
BP234CC1	Core Course IX: Plant Physiology and Metabolism	4	5
BP234CC2	Core Course X: Biochemistry and Applied Biotechnology	4	5
BP234CP1	Core Course IV : Laboratory course Covering Core Papers IX, and X	2	3
BP234EC1 BP234EC2 BP234EC3	Elective Course VI: a) Organic farming b) Forestry and wood technology c)Gene cloning and gene therapy	3	4
BP234EC2	Elective Course VI: b) Forestry and wood technology c)Gene cloning and gene therapy		
BP234EC3	Elective Course VI: c) Gene cloning and gene therapy		
BP234PW1	Core Project	7	9
BP234SE1	Skill Enhancement Course III: Training for Competitive examination - Botany for NET/UGC-CSIR/SET/TRB	2	4
BP234EA1	Extension Activity	1	-
	Total	**23**	**30**
	TOTAL	**120**	**91**

Semester	Code	Title of the Course	Credit
I & II	PG23LST1	Life Skill Training	1
II & IV	-	MOOC	1+1
II	PG232CE1	Community Engagement Course (CEC)	1
III & IV	PG23LST2	Life Skill Training	1
I	BP231FP1	Field Project	1
I & III	BP231V01 / BP233V01	Specific Value-added Course	1+1
II & IV	PG232V01- PG232V12/ PG234V01- PG234V12	Generic Value-added Course	1+1
		Total	**10**

Co-curricular Courses

Specific Value added Course

S. No.	Course code	Title of the course	Total hours
I	BP231V01	Natural Resources and their Conservation	30

Examination Pattern

i) Core Course / Elective Course

Internal: 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
Seminar (10 marks)	5
Assignment: (Model Making, Exhibition, Role Play, Group Discussion, Problem Solving, Class Test, Open Book Test (Minimum three items per course) (30 marks)	5
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 3 x 4(Internal choice)	12	Part B 5 x 6 (Internal choice)	30
Part C 3 x 8 (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	75
Minor Practical / Spotters /Record	
Total	**75**

iii) Skill Enhancement Course

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

Internal Components and Distribution of Marks

Components	**Marks**
Internal test (2)	10
Quiz (2)	5
Assignment: (Model Making, Exhibition, Role Play, Album, Group Activity (Mime, Skit, Song) (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 5 (Open choice any **Five** out **of Eight**)	25
Part C 1 x 9 (Open choice O**ne** out of **Three**)	9	Part C 5 x 8 (Open choice any **Five** out **of Eight**)	40
Total	**25**	**Total**	**75**

iv) Internship/ Industrial Activity

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

v) Core Project:

Ratio of Internal and External 25 : 75

Internal (Supervisor)	**Marks**
I Review	5
II Review	5
Report	15
External (External Examiner)	
Report	40
Viva-voce (individual, open viva-voce)	35
Total	**100**

Co-Curricular Courses:

(i) Life Skill Training

Internal Component

Components		Marks
Life Skill Training -I	Album (20 pages)	30
	Group Song, Mime, Skit (Group of 5students)	20
	Total	**50**
Life Skill Training -II	Case Study (30 pages)	50
	Total	**50**

External Component

Written Test	Five out of Seven (5 x 10)	50
	Total	**50**

(ii) Field Project:

Components	**Marks**
Field Work	50
Report & Viva-voce	50

(iii) Specific Value-Added Courses & Generic Value-Added Courses:

Components	**Marks**
Internal	25
External	75

(iv) Community Engagement Activity-UBA

Internal Component	
Component	**Marks**
Attendance (Field Work)	30
Participation	20
Total	**50**

External Component

Component	Marks
Group Project Report/ Case Study (10-15 pages in print)	50
Total	**50**

Outcome Based Education

(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:

Assessment	Cognitive Level	KI			K2			K3			K4, K5, K6			Total
Internal Test	Part	A	B	C	A	B	C	A	B	C	A	B	C	
	No. Of Questions	1	1			1		1		1	2	1	2	10
External Examination	Part	A	B	C	A	B	C	A	B	C	A	B	C	
	No. Of Questions	3	-	1	3	1	1	1	2	1	3	2	2	20

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 for each Course shall be done by a 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 re-appear in such failed course (s) in the subsequent examination to be held in October / November or April / May. However, candidates who have arrears in Practical Examination(s) shall be permitted to re-appear for their arrears only along with Regular Practical examinations in the respective semester.

iv. Viva- voce: Each candidate shall be required to appear for Viva-voce Examination in defense of the Project.

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

Conferment of the Master's Degree

A candidate shall be eligible for the conferment of the Degree of Master of Arts / Science / Commerce only if the minimum required credits for the programme thereof (91 +10 credits) is earned.

Grading System

For a semester examination:

Calculation of Grade Point Average for End Semester Examination:

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

For the entire programme:

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

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

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
00-49	0.0	U	Re-Appear
ABSENT	0.0	AAA	ABSENT

Overall Performance

CGPA	Grade	Classification of Final Results
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+	
6.0and above but below 6.5	A	
5.5and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
0.0 and above but below 5.0	U	Re-appear

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

SEMESTER – I

CORE COURSE I : PLANT DIVERSITY – I:

ALGAE, FUNGI, LICHENS AND BRYOPHYTES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP231CC1	5	2	-	-	5	7	105	25	75	100

Prerequisite:

Students should be familiar with the basics of algae, fungi, lichens and bryophytes.

Learning objectives:

1. To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.
2. To gain knowledge about the ecological and economic importance of algae, fungi, lichens and bryophytes

Course Outcomes

On the successful completion of the course, student will be able to:		
1	relate to the structural organizations of algae, fungi, lichens and Bryophytes	**K1**
2	demonstrate both the theoretical and practical knowledge in understanding the diversity of basic life forms and their importance.	**K2**
3	explain life cycle patterns in algae, fungi, lichens and Bryophytes	**K3**
4	compare and contrast the mode of reproduction in diverse groups of basic plant forms.	**K4**
5	discuss and develop skills for effective conservation and utilization of lower plant forms.	**K5& K6**

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

Unit	Contents	No. of Hours
I	**ALGAE** General account of algology, Contributions of Indian Phycologist (T.V.Desikachary, V.Krishnamurthy and V.S. Sundaralingam), Classification of algae by F.E. Fritsch (1935-45) & Silva (1982). Salient features of major classes: Cyanophyceae, Chlorophyceae, Xanthophyceae, Chrysophyceae, Cryptophyceae, Dinophyceae, Chloromonadineae, Euglenophyceae, Charophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Range of thallus organization, algae of diverse habitats, reproduction (vegetative, asexual and sexual) and life cycles. Phylogeny and inter-relationships of algae, origin and evolution of sex in algae. Structure, reproduction and life histories of the following genera: *Oscillatoria*, *Ulva*, *Diatoms* and*Dictyota*..	**21**
II	characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Heterothallism in fungi, sexuality in fungi, Para sexuality, sex hormones in fungi. Structure, reproduction and life histories of the following genera: *Plasmodiophora, Phytophthora, Rhizopus, Taphrina, Polyporus* and *Colletotrichum.*	**21**
III	**LICHENS** Introduction and Classification (Hale, 1969). Occurrence and inter-relationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basiodiolichens and Deuterolichens..	**21**
IV	**BRYOPHYTES** General characters and Classification of Bryophytes by Watson (1971). Distribution, Structural variations and evolution of gametophytes and sporophytes in Bryopsida, Anthoceropsida and Mosses. General characters of major groups - Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Reproduction - Vegetative and sexual, spore dispersal mechanisms in bryophytes, spore germination patterns in bryophytes. Structure, reproduction and life histories of the following genera: *Targionia*, *Porella*and *Polytrichum.*	**21**
V	**ECONOMIC IMPORTANCE** Algae - Economic importance in Food and feed - Single cell protein, Industrial products (Agar-Agar, Carrageenan, Alginic acid, Iodine, biofertilizers, Vitamins and biofuel), Medicinal value and Diatomaceous earth. Fungi – Economic importance in food, industries and medicine. Culturing and cultivation of mushrooms *Pleurotus.* Lichen –economic importance and as indicator pollution. Bryophytes – Ecological and economic importance – industry, horticulture and medicine.	**21**

Self Study Portion:
Structure, reproduction and life histories of the genera:*Diatoms,* General characters of major groups – Marchantiales and Anthocerotales, Culturing and cultivation of mushrooms *Pleurotus.*

Textbooks

1. Vashishta, D.R. 1988. Botany for degree students – Algae. S. Chand Publishing, New Delhi: pp.568.
2. Pandey, P.B. 2014. College Botany-1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. 20th Edition, New Delhi:S. Chand Publishing, pp.936.
3. Kevin K. 2018. Fungi biology and Application. 3rd Edition, Wiley Blackwell, New Jersey pp. 416.
4. Sharma, O.P. 2014. Bryophyta. Published by McGraw Hill Education (India) Private Limited, pp.396.
5. Singh, Pandey and Jain. 2020. A text book of Botany. 5th Edition. Meerut: Rastogi Publication,pp.412

Reference Books

1. Sundaralingam,V. 1990. Marine Algae: Morphology, Reproduction and Biology. Lubrecht & Cramer
   Ltd, India,pp.258.
2. Nash, T.H. 2008. Lichen Biology (Second Edition), Cambridge University press, London, pp.477.
3. Malhotra,M and Pathak, C. 2012. A Textbook of Bryophyta. Dominant Publishers & Distributors Pvt., Ltd, New Delhi.
4. Alexopoulos, C.J. and Mims, M. Blackwell, M. 2007. Introductory Mycology(Fourth Edition), Wiley Publishers, New Delhi, pp.880.
5. Edward Lee, R. 2018.Phycology. (Fifth Edition),Cambridge University Press, London.

Web Resources

1. https://www.britannica.com/science/algae
2. https://www.livescience.com/53618-fungus.html.
3. http://www.uobabylon.edu.iq/eprints/paper_11_20160_754.pdf
4. https://www.youtube.com/watch?v=vcYPI6y-Udo
5. . http://www-plb.ucdavis.edu/courses/bis/1c/text/Chapter22nf.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2	1	2	2	2	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	2	2	3	3	1	2	1	3	1	3
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3
Total	14	14	12	14	11	11	12	15	11	14
Average	2.8	2.8	2.4	2.8	2.2	2.2	2.4	3	2.2	2.8

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

SEMESTER I

CORE COURSE II: PLANT DIVERSITY – II: PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP231CC2	5	2	-		5	7	105	25	75	100

Pre-requisite: Students should know about the fundaments of Pteridophytes, Gymnosperms and fossil records.

Learning Objectives:

1. To investigate the classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms.
2. To identify and characterize diversity of lower vascular plants in order to comprehend the dynamics of diversity to realize the importance of diversity.

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	recall classification, recent trends in phylogenetic relationship, general characters of Pteridophytes and Gymnosperms.	**K1 & K2**
CO2	learn the morphological/anatomical organization, life history of major types of Pteridophytes and Gymnosperms.	**K2 & K4**
CO3	comprehend the economic importance of Pteridophytes, Gymnosperms and fossils.	**K3 & K5**
CO4	understanding the evolutionary relationship of Pteridophytes and Gymnosperms.	**K4 & K6**
CO5	awareness on fossil types, fossilization and fossil records of Pteridophytes and Gymnosperms.	**K5 & K6**

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

Units	Contents	No. of Hours
I	**PTERIDOPHYTES:** General characteristics and classification (Reimer, 1954). Range of structure, reproduction and evolution of the gametophytes, Gametophyte types – sex organs. Apogamy and Apospory. Life cycles. Stellar evolution. Heterospory and seed habit, Telome theory, morphogenesis, Economic importance of Pteridophytes.	**21**
II	**PTERIDOPHYTES:** Structure, anatomy, reproduction and life histories of the following genera: *Equisetum, Angiopteris, Pteris* and *Azolla*.	**21**
III	**GYMNOSPERMS:** General characters - A general account of distribution of Gymnosperms. Morphology, anatomy, reproduction, phylogeny and classification (K.R.Sporne, 1965). Economic importance of Gymnosperms.	**21**
IV	**GYMNOSPERMS:** Structure (Exomorphic and endomorphic), anatomy, reproduction and life histories of the following genera: *Cedrus, Cupressus, Araucaria, Podocarpus, Gnetum* and *Ephedra*.	**21**
V	**PALEOBOTANY:**	**21**
VI	Geological Scale; Radiocarbon dating; Contribution of Birbal Sahni to Paleobotany.	**21**

	Gondwana flora of India. Study of fossils in understanding evolution. Fossilization and fossil types. Economic importance of fossils – fossil fuels and industrial raw materials and uses. Study of organ genera: *Rhynia*, *Lepidocarpon*, *Calamites*, *Cordaites* and *Lyginopteris.*	

Text books

1. Vashishta, P.C. Sinha, A.K and Anil Kumar. (2016). Botany for Degree students. Gymnosperms. New Delhi: S. Chand and Company Ltd. Pp:592
2. Singh,V.,Pande,P.C andJain,D.K. (2021). A Text Book of Botany. Meerut: Rastogi Publications. Pp:1266.
3. Bhatnagar, S.P and Alok Moitra. (2020). Gymnosperms. Bengaluru: New Age International (P) Ltd., Publishers. Pp:470.
4. Sharma, O.P. (2017). Pteridophyta. New York: McGraw Hill Education. Pp:64.
5. Vashishta.P.C.,A.K.Sinha and AnilKumar. (2018).Botany for Degree students-Gymnosperms. New Delhi: S. Chand and Company Ltd. Pp:580

Self Study	Morphology Characters of Pteridophytes and Gymnosperms, Economic importance of Gymnosperms, Gondwana flora of India, Fossilization and fossil types.

Reference Books

1. Parihar, N.S., 2019. An Introduction to Embryophyta, Pteridophytes (5th Edition). Surjeet Publication, New Delhi. Pp:377
2. Pandey, S.N., P.S. Trivedi, 2015. A Text Book of BotanyVol. II- (12 th edition). Vikas Publishing, New Delhi. Pp:752.
3. Rashid, A., 2013. An introduction to Pteridophyta – Diversity, Development and differentiation. (2nd edition). Vikas Publications. New Delhi.Pp:400
4. Arnold, A.C. 2005. An Introduction to Paleobotany. Agrobios (India). Jodhpur. Pp:212
5. Sporne, K.R. 2017. The morphology of Pteridophytes- The structure of Ferns and Allied Plants. Vikas Publications, New Delhi. Pp: 328.

Web Resources

1. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
2. http://www.bsienvis.nic.in/Database/Pteridophytes-in-India_23432.aspx
3. https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y
4. https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC
5. https://www.palaeontologyonline.com/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	1	3	3	3	3
CO4	3	3	2	3	3	3	3	2	3	2
CO5	3	2	2	2	2	2	2	1	2	1
Total	15	14	13	15	15	12	14	12	14	12
Average	3	2.8	2.6	3	3	2.4	2.8	2.4	2.8	2.4

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

SEMESTER I
CORE LAB COURSE–I: LABORATORY COURSE
COVERING CORE PAPERS- I AND II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP231CP1			6		4	6	90	25	75	100

Pre requisite

Students should be familiar with the fundamentals of algae, fungi, lichens, Bryophytes, Pteridophytes, Gymnosperms, Paleobotany and microbes in addition to essential laboratory techniques

Learning Objectives :

1. To learn how to employ the use of instruments, technologies and methodologies related to thallophytes and non-flowering plant groups.
2. To comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	recall and applying the basic keys to distinguish at species levelidentification of important algae and fungi through its structural organizations.	**K1&K4**
CO2	demonstrate practical skills in thallophytes, Pteridophytes and Gymnosperms.	**K2**
CO3	describe the structure of algae, fungi, lichens, Bryophytes, Pteridophytes and Gymnosperms. .	**K3**
CO4	determine the importance of structural diversity in the evolution of plant forms.	**K5**
CO5	formulate techniques to isolate and culture of alga and fungi as well as to understand the diversity of plant forms.	**K5&K6**

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

Units	Contents	No. of Hours
1	**ALGAE** Study of algae in the field and laboratory of the genera included in theory. External morphology and internal anatomy of the vegetative and reproductive structures of the following living forms: *Oscillatoria, Ulva, Diatoms, Dictyota, Padina and Gelidum* (depending on availability of the specimen). To record the local algal flora–Study of their morphology and structure. Identification of algae to species level (at least One). Preparation of culture media and culture of green algae and blue green algae in the laboratory (Demonstration).	**18**
II	**FUNGI** Study of morphological and reproductive structures of the following living forms: *Plasmodiophora*, *Phytophthora*, *Rhizopus*,*Taphrina*, *Polyporus* and *Colletotrichum* (depending on availability of the specimen).	**18**

	Isolation and identification of fungi from soil, air, and Baiting method.Preparation of culture media. Cultivation of mushroom in the laboratory (Demonstration). **LICHENS** Study of morphological and reproductive structures of the genera *Usnea*	
III	**BRYOPHYTES** External morphology and internal anatomy of the vegetative and reproductiveorgans of the following living forms: *Riccia, Targionia Anthoceros* and *Polytrichum* (depending on availability of the specimen).	**18**
IV	**PTERIDOPHYTES** External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Isoetes, Pteris, Equisetum* and *Azolla* (depending on availability of the specimen). Fossil slides observation: *Rhynia, Lepidocarpon, Calamites.*	**18**
V	**GYMNOSPERMS** External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Cupressus, Araucaria, Podocarpus* (depending on availability of the specimen). Fossil slides observation*:* *Cordaites* and *Lyginopteris*	**18**

Self Study Portion	*Oscillatoria, Usnea, Anthoceros, Rhynia* ((Fossil), Araucaria

Textbooks

1. Vashishta, D.R. 1988. Botany for degree students – Algae. S. Chand Publishing, New Delhi: pp -568.
2. Saha, R and Das, S.2020. Microbiology Practical Manual (First Edition), CBS Publishers and Distributors (P) Ltd, New Delhi.
3. Sharma, O.P. (2012). Pteridophyta. Tata McGraw-Hills Ltd, New Delhi.
4. Tyagi, K, Johri, R.M, Lata, S, 2005. A text book of Gymnosperms. Dominant Publishers & Distributors, New Delhi.
5. Sharma, O.P. and S, Dixit. (2002).Gymnosperms (Fifteen Edition), Pragati Prakashan Publishers, New Delhi. pp - 358

Reference Books

1. Chmielewski, J.G. and Krayesky, D. 2013. General Botany laboratory Manual. Author House, Bloomington, USA.pp-300
2. Webster,J and Weber, R. 2007. Introduction to Fungi. (Third Edition), Cambridge University, Cambridge, London. Press,pp- 867.
3. Sharma, O.P. (2017). Bryophyta, McGraw Hill Education, New York. pp-416.
4. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae,Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication, . New Delhi.
5. Gangulee, H.C and A.K. Kar.2013. College Botany (Fifth Edition), S. Chand Publications, New Delhi

Web Resources

1. https://www.frontiersin.org/articles/10.3389/fmicb.2017.00923/full
2. https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf
3. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
4. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4
5. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	1	3	1	3
CO3	3	3	3	3	3	3	2	3	2	3
CO4	3	3	2	1	2	2	1	2	1	3
CO5	3	3	3	3	3	3	3	2	3	2
Total	14	15	13	13	14	14	10	13	10	14
Average	2.8	3	2.6	2.6	2.8	2.8	2	2.6	2	2.8

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

SEMESTER I

ELECTIVE COURSE I a)- MICROBIOLOGY, IMMUNOLOGY AND PLANT PATHOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP231EC1	3	2	-	-	3	5	75	25	75	100

Pre-requisite:

The goal of the course is to provide students with basic understanding of microbiology, immunology, plant pathology and the etiology of specific plant diseases.

Learning Objectives:

1. To provide comprehensive knowledge about microbes and its effect on man and environment.
2. To provide comparative analysis of major groups of microbes.

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	recognize the general characteristics of microbes, plant defense and immune cells.	**K1**
CO2	explain about the stages in disease development and various defense mechanisms in plants and humans.	**K2**
CO3	elucidate concepts of microbial interactions with plant and humans	**K3**
CO4	analyze the importance of harmful and beneficial microbes and immune system	**K4**
CO5	determine and interpret the detection of pathogens and appreciate their adaptive strategies.	**K5 & K6**

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

Units	Contents	No. of Hours
I	**BACTERIA:** Types of microorganisms. General characteristic of bacteria – Outline classification of Bergey's manual of 9th edition. Classification of bacteria based on Morphological, cultural, physiological and molecular characteristics. Bacterial growth – batch culture and continuous culture. Growth Curve. Factors affecting growth. Determination of bacterial growth – Direct method: Haemo cytometer, Viable plate count; Indirect method: Turbidity. Nutritional types. Reproduction - Fission and sporulation. Genetic recombination- Transformation, Transduction and Conjugation. Isolation and cultivation of bacteria. Maintenance of bacterial culture.	15
II	**VIRUSES:** General characters, Classification, Structure, Multiplication. Overview of Phycoviruses and Mycoviruses. Viruses of Eukaryotes – Animal & Plant viruses. Cultivation of viruses – in embryonated egg and in plants. Control of viral infections. Bacteriophages- classification, replication of DNA and RNA phages -Lytic and	15

	Lysogenic cycle. Viroids and prions. Mycoplasma: Structure and classification.	
III	**FOOD MICROBIOLOGY:** Beneficial role of microbes – yoghurt, Olives, Cheese, Bread, Wine, Tempeh, Miso & Fermented green tea. Spoilage of fruits, vegetables, meats, poultry, eggs, bakery products, dairy products and canned foods. Microbial toxins - Exotoxin, Endotoxin & Mycotoxin. Action of Enterotoxin, Cytotoxin& Neurotoxin. Food Preservation – temperature, drying, radiation and chemicals. Soil Microbiology: Importance of Microbial flora of soil and factors affecting the microbial community in soil. Interaction among soil microbes (positive and negative interactions) & with higher plants (rhizosphere &phyllosphere). Microorganisms in organic matter decomposition. Environmental Microbiology: Microbiology of water and air. Water borne diseases - diphtheria, chicken pox. Air borne diseases - Swine flu and **Measles**. Microbial degradation of chemical pesticides and hydrocarbon.	**15**
IV	**IMMUNOLOGY:** Introduction; Immune System; Types of Immunity - Innate and Acquired.Immune Cells - Hematopoiesis, B and T lymphocytes - Maturation, NK cells. Introduction to inflammation, Adaptive immune system, Innate Immune system. Antigen: Definition, Properties and types. Antibody – Structure, types and function. Generation of antibody diversity. Antigen - Antibody interactions: definition, types- Precipitation, Agglutination, Complement fixation. Immune Response – Humoral and Cell Mediated. Vaccines – history, types and recombinant vaccines. Immuno diagnosis – Blood Grouping, Widal test, Enzyme-Linked Immunosorbent Assay (ELISA), Immuno electrophoresis and Immunodiffusion.	**15**
V	**PLANT PATHOLOGY:** **History and significance of plant pathology. Classification of plant diseases, Symptomology (important symptoms of** plant pathogens). Causal agents of plant diseases - biotic causes (fungi, bacteria virus, mycoplasma, nematodes, parasitic algae, angiospermic parasites - Abiotic causes (Physiological, deficiency of nutrients & minerals and pollution).Mechanism of penetration- Disease development of pathogen (colonization) and dissemination of pathogens. Role of enzymes and toxins in disease development. Important diseases of crop plants in India - Sheath blight of rice, Late blight of potato, Little leaf of Brinjal and Red rust of tea. Principles of disease management – Cultural practices, physical, chemical and biological methods, disease controlled by immunization. Biocontrol - merits and demerits; Diagnostic technique to detect pest/pathogen infection - Immunofluorescence (IF).	**15**

Self Study	Genetic recombination- Transformation, Transduction and Conjugation. Isolation and cultivation of bacteria. Maintenance of bacterial culture, Bacteriophages- classification, replication of DNA and RNA phages -Lytic and Lysogenic cycle. Viroids and prions.

Text Books

1. Singh, R.S. 2018. Introduction to Principles of Plant Pathology, 4th Edition.
2. Bilgrami, K.S and H.C. Dube. 2010 A text book of Modern Plant Pathology – Vikas Publishing House (P) Ltd., New Delhi
3. Mehrotra, R.S. and Aggarwal, A. 2017. Plant Pathology. McGraw Hill Publisher. New Delhi
4. Dube, H.C. 2010. A text Book of Fungi ISBN: 8188826383.
5. Vaman Rao, C. 2006. Immunology. 2nd Edition. Narosa Publisher.

Reference Books

1. Jeffery, C., Pommerville. 2014. Alcamos Fundamentals of Microbiology. 10th Edition. Johns and Bartlett Learning.
2. Pelczar, M. J. 2007. Microbiology. 35th Edition, Tata-McGraw Hill Publications, New York, ISBN: 0074623260.
3. Ravi Chandra, N.G. 2013. Fundamentals of Plant Pathology, Phi Learning, ISBN:812034703X.
4. Willie, J. and Sherwood, L. 2016. Prescott's Microbiology McGraw-Hill Education; 10th Edition, ISBN: 978-1259281594
5. Chaube, H.S. and Singh, R. 2015. Introductory Plant Pathology CBS Publishers, ISBN: 978-8123926704.
6. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi.

Web Resources

1. https://www.wileyindia.com/a-textbook-of-plant-pathology.html
2. https://www.britannica.com/science/plant-disease.
3. https://www.planetatural.com/pest-problem-solver/plant-disease/
4. https://www.elsevier.com/books/plant-pathology/agrios/978-0-08-047378-9
5. https://www.elsevier.com/life-sciences/immunology-and-microbiology/books

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	3	2
CO2	3	3	2	2	3	3	2	1	2	1
CO3	3	3	3	3	3	3	1	3	1	3
CO4	3	3	2	2	3	3	2	1	2	1
CO5	3	3	3	3	3	3	3	2	3	2
Total	15	15	13	13	15	15	11	9	11	9
Average	3	3	2.6	2.6	3	3	2.2	1.8	2.2	1.8

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

SEMESTER I

ELECTIVE COURSE-I(b) CONSERVATION OF NATURAL RESOURCES AND POLICIES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP231EC2	3	2	-	-	3	5	75	25	75	100

Pre-requisite

To create awareness of environmental problems and their consequences.

Learning Objectives

1.To know about natural resources.

2.To predict the reasons for degradation of natural resources and suggest measures to prevent these.

Course Outcomes

On completion of this course the student will be able to		
CO1	understand the concept of different natural resources and their utilization.	**K1**
CO2	critically analyze the sustainable utilization land, water, forest and energy resources	**K2 & K6**
CO3	evaluate the management strategies of different natural Resources	**K3**
CO4	reflect upon the different national and international efforts in resource management and their conservation.	**K4**
CO5	state the various environmental policy passed to conserve the natural resources.	**K5**

UNIT	CONTENTS	No.of hours
I	**NATURAL RESOURCES:** Definition – Importance – Classification – Human physiological socio-economic and cultural development – Human Population Explosion – Natural Resource Degradation – Concept of conservation – Value system – Equitable resource use for sustainable life system.	**15**
II	**FOREST RESOURCES:** Forest cover in India and the World – Importance – Desertification – Forest Wealth – Afforestation – Vanasamrakshna Samithi– Agroforestry – Social Forestry – Joint Forest Management Strategy for Forest Conservation. Wild Life: Resources – Importance – Benefits – Wild life Extinction – Causes for Extinction – List of Endanger species in India and in the World – Ecological approach in wild life management – Eco Tourism – Wild Life projects in India – Sanctuaries and National Parks In India – Man and Bio sphere Programme.	**15**
III	**LAND AND SOIL RESOURCES:** Soil, Complexity of soil nature, regional deposits, Land use and capability classification systems, Land use Planning models and their limitations. Impacts of natural and man-made activities on land characteristics and land use planning–	**15**

	Soil Erosion – Loss of Soil Nutrients – Restoration of Soil Fertility – Soil Conservation Methods and Strategies in India. Wet Land Conservation and Management – Ecological Importance of wet lands in India – Conservation Strategy and ecological Importance. Water Resources: Rivers and Lakes In India – Water Conservation and ground water level increase - Watershed Programme.	
IV	**MINERAL RESOURCES:** Use and exploitation – Environmental effects of extracting and using mineral resources – Restoration of mining lands – Expansion of supplies by substitution and conservation. Food Resources: World Food Problems – Changes caused by agriculture – overgrazing effects of modern agriculture – Fertilizer-Pesticide problems – Water Logging – Salinity – Sustainable agriculture, life stock breeding and farming.	**15**
V	**ENVIRONMENTAL POLICY IN INDIA:** Need for policies- Public Policy – Economic policies – Relationship between economic development and environment – Implementing Environmental Public Policy Strategies in pollution control – Constitutional provisions in India regarding environment – Public Awareness and Participation in Environmental Management – National Land Use Policy 1988 – Industrial Policy 1991.	

Self Study	Equitable resource use for sustainable life system, Agroforestry – Social Forestry, Watershed Programme, Food Resources, NationalLand Use Policy 1988 – Industrial Policy 1991.

Textbooks

1. Trivedi R.K.1994. Environment and Natural Resources Conservation.
2. Murthy J.V.S.1994. Watershed Management in India.
3. Raymond, F Dasmann. 1984. Environmental Conservation, John Wiley.
4. Nalini, K.S. 1993. Environmental Resources and Management, Anmol Publishers, New Delhi.
5. Shyam Divan and Armin Rosencranz. 2001. Environmental Law and Policy in India, Oxford Uni.Press.

Reference Books:

1. Haue, R and Freed V.H. 1975. Environmental Dynamics of Pesticides, Menum Press, London
2. Singh, B. 1992. Social Forestry for Rural Development, Anmol Publishers, New Delhi.
3. Shafi. R. 1992. Forest Ecosystem of the World.
4. Stacy Keach. 2016. Natural Resources Management. Syrawood Publishing House.
5. Rathor B.S. 2013. Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.

Web resources:

1. https://www.amazon.in/conservation-natural-resources-Gifford-Pinchot-ebook/dp/B07HX76TVN
2. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y
3. https://www.kobo.com/ww/en/ebook/natural-resources-conservation-law

4. https://www.scribd.com/book/552185119/Natural-Resources-Conservation-and-Advances-for-Sustainability
5. https://www.scribd.com/document/354699536/Conservation-of-Natural-Resources

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	3	2	3	2	3
CO2	3	3	3	3	2	2	1	3	1	3
CO3	3	3	3	2	2	2	1	3	1	3
CO4	3	3	3	2	2	2	1	3	1	3
CO5	3	3	3	2	2	2	1	3	1	3
Total	15	15	15	12	10	11	6	15	6	15
Average	3	3	3	2.4	2	2.2	1.4	3	1.4	3

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

SEMESTER I

ELECTIVE COURSE-I c) MUSHROOM CULTIVATION

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP231EC3	**3**	**2**	**-**	**-**	**3**	**5**	**75**	**25**	**75**	**100**

Pre-requisite

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

Learning Objectives

1. To teach the identification of mushrooms.
2. To differentiate the edible mushrooms with toxic and hallucinating fungi

Course Outcomes

On completion of this course the student will be able to		
CO 1	knowledge on identification of edible and toxic mushrooms belonging to ascomycota and basidiomycota.	**K1, K3**
CO2	outline the nutraceutical properties of edible mushrooms.	**K2, K4**
CO3	knowledge on cultivation techniques of edible and medicinal mushrooms.	**K3, K6**
CO4	understand the harvest and post-harvest techniques of mushroom crops.	**K4**
CO5	knowledge on the production and marketing strategies for mushrooms.	**K5**

UNIT	CONTENTS	No. of Hours
I	**INTRODUCTION:** Mushroom, Edible Mushroom, commercial production, medicinal value ofmushrooms, nutraceuticals and dietary supplements	**15**
II	**MORPHOLOGICAL AND MICROSCOPICAL IDENTIFICATION OF EDIBLE AND POISONOUS MUSHROOMS**: Keys for identification of edible mushrooms: *Agaricus bisporus*, *Pleurotus sajorcaju*, *Volvariella volvcea* and *Calocybe indica.* Key for identifying hallucinogenic mushroom (*Psilocybe* sp.) Medicinal Mushroom – *Cordyceps, Ganoderma lucidum* and *Lentinus edodes.*	**15**
III	**CULTIVATION:** Substrate sterilization, bed preparation, cropping room andmaintenance, raising of pure culture and spawn preparation, factors effecting button mushroom production (Temp, pH, air and water management, competitor moulds and other disease).	**15**
IV	**POST-HARVEST MANAGEMENT:** Harvest, storage, quality assurance of mushrooms. Pestmanagement.	**15**
V	World production edible mushroom, Legal and regulatory issues of introducing the medicinal mushrooms in different countries. Developing small scale industry and Government schemes. Mushroom Research Centres – International and National levels.	**15**

Self study	Nutraceuticals and dietary supplements, Medicinal Mushroom – *Cordyceps, Ganoderma lucidum* and *Lentinus edodes,* Substrate sterilization

Textbooks

1. Cheung, P. C.K. 2008. Mushrooms as functional food. A John Wiley & Sons, Inc., Publication.
2. Dijksterhuis, J. and Samson, R.A. 2007. Food Mycology: A multifaceted approach in fungi and food. CRC press, Newyork.
3. Hall., R.I., Stepheson, S.L., Buchanan, P.K., Yun, W. and Cole, A.L.J. 2003. Edible and poisonous mushrooms of the world. Timber Press, Portland, Cambridge.
4. Ting, S. and Miles, P.G. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and nutritional environmental impact. CRC press, Newyork.
5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.

Reference books

1. Tiwari., SC., Pandey K. 2018. Mushroom cultivation. Mittal publisher, New Delhi.
2. Philips, G., Miles, Chang, S-T. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and environmental effect. 2nd ed. CRC Press.
3. Diego, C.Z., Pando-Gimenez, A. 2017. Edible and medicinal mushrooms: Technology and Application. Wiley-Blackwell publishers.
4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.
5. Suman. 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	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	3	3	2	2	1	3	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3
Total	15	15	10	13	11	12	11	14	11	13
Average	3	3	2	2.6	2.2	2.4	2.2	2.8	2.2	2.6

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

SEMESTER I

ELECTIVE COURSE II: a) ETHNOBOTANY, NATUROPATHY AND TRADITIONAL HEALTH CARE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP231EC4	4	1	-	-	3	5	75	25	75	100

Prerequisite:

The training imparts the knowledge and abilities required to conduct field studies on how humans use plants.

Learning Objectives

1. Understand the concept of ethnobotany and the life style and traditional practices of plants by Indian tribals.
2. Emphasize the importance of non-timber forest products for Indian tribal people livelihoods.

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	recall or remember concept of ethnobotany.	**K1**
CO 2	understand the life style and traditional practices of plants by Indian tribals.	**K2&K6**
CO3	highlight the role of Non-Timber Forest products for livelihood of tribal people of India	**K 3**
CO 4	assess the methods to transform ethnobotanical knowledge into value added products	**K4**
CO 5	build idea to make digitization of ethnobotanical knowledge.	**K5**

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

Unit	Contents	No. of Hours
I	**ETHNOBOTANY:** Concept, important landmarks in the development, scope, sub disciplines of ethno botany. Interdisciplinary approaches. Knowledge of following sociological and anthropological terms: culture, values and norms, institutions, culture diffusion and ethnocentrism. History of ethnobotany: A brief history of ethno botanical studies in the world and in India.	**15**
II	**PLANTS USED BY TRIBALS OF INDIA:** Distribution of tribes in India. Basic knowledge of following tribes of Tamil Nadu: Irulas, Kanis, Paliyars Badagas, Kurumbres, Thodas and Malayalis. Plants used by tribals of Tamil Nadu.	**15**
III	**SOURCES OF ETHNOBOTANICAL DATA:** Primary - archeological sources and inventories, Secondary - travelogues, folklore and literary sources, herbaria, medicinal texts and official records. Methods in ethnobotanical research. Prior Informed Consent, PRA techniques, interviews and questionnaire methods, choice of	**15**

	resource persons. Folk taxonomy – plants associated with culture and socio- religious activities. Non – timber forest products (NTFP) and livelihood – Sustainable harvest and value addition.	
IV	**NATUROPATHIC MEDICINE:** Role of plants in naturopathy- Importance and relevance of medicinal drugs in India. Indian Systems of Medicine (Ayurveda, Siddha, Allopathy, Homeopathy, Unani, Tibetan, Yoga and Naturopathy). Disease diagnosis, treatment, and cure using natural therapies including dietetics, botanical medicine, homeopathy, fasting, exercise, lifestyle counseling, detoxification, and chelation, clinical nutrition, hydrotherapy and spiritual healing, environmental Assessment **TRADITIONAL HEALTH CARE:** Health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral based medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illnesses or maintain well-being.	**15**
V	**BIOPROSPECTING AND VALUE ADDITION:** Bioprospecting of drug molecules derived from Indian traditional plants; Methods for bioprospecting of natural resources; From folk Taxonomy to species confirmation - evidences based on phylogenetic and metabolomic analyses; Ethno botanical databases and Traditional knowledge Digital Library (TKDL).	**15**

Self study	Sub disciplines of ethnobotany, Plants used by tribals of Tamilnadu, Non Timber Forest Products (NTFP), Indian systems of medicine, Traditional Knowledge Digital Library (TKDL)

Textbooks

1. Jain, A. and Jain, S.K. 2016, Indian Ethno botany- Bibliography of 21st Century (First Edition), Scientific Publishers, India, pp- 208.
2. Gringauz, A. 2012, Introduction to Medicinal Chemistry: How Drugs Act & Why?, Wiley India Pvt Ltd, Noida. pp – 736.
3. Subramaniam, S.V , Madhavan. V.R.1983. Heritage of the Tamil Siddha Medicine, International Institute of Tamil Studies, Madras, pp -128.
4. Joshi, S.G. 2018, Medicinal Plants (First Edition),Oxford & IBH Publishing Co Pvt., Ltd, New Delhi, pp -491.

Reference Books

1. CSIR (1940-1976). The Wealth of India: A Dictionary of Indian Raw Materials and Industrial Products, CSIR Publication, New Delhi, pp -483.
2. Gokhale, S.B., Kokate, C.K. and Gokhale, A, 2016, Pharmacognosy of Traditional Drugs(First Edition), Nirali Prakashan, Pune, pp – 192.
3. Laird, S.A. 2002. Biodiversity and Traditional knowledge equitable partnerships in Practice (First Edition), Earths can Publications Ltd, London, pp- 546.

4. Ministry of Environment and Forests. 1994. Ethno biology in India. A Status Report. All India Coordinated Research Project on Ethno biology, Ministry of Environment and Forests, New Delhi, pp -68.
5. Kumar, N. 2018, A Textbook of Pharmacognosy (Third Edition), Aitbs Publishers, India.

Web Resources

1. https://shodhganga.inflibnet.ac.in/bitstream/10603/116454/7/07_chapter%201.pdf
2. https://www.cell.com/action/showPdf?pii=S1360-1385%2817%2930001-8 5
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3465383/pdf/pnas.201202242.pdf 6
4. http://www.plantsjournal.com/archives/2017/vol5issue3/PartB/5-3-8-217.pdf 3
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3465383/pdf/pnas.201202242.pdf 6

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	3	2	3
CO5	3	3	3	3	3	3	3	3	3	3
Total	15	15	15	14	14	15	14	15	4	15
Average	3	3	3	2.8	2.8	3	2.8	3	2.8	3

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

SEMESTER I

ELECTIVE COURSE-II b) ALGAL TECHNOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP231EC5	4	1	-	-	3	5	75	25	75	100

Pre-requisite

Students should be familiar with the basic and applied knowledge on algal biotechnology.

Learning Objectives

1.To provide a basic overview of algae cultivation techniques and resource potentials.

2.To educate people about the widespread commercial uses of algae

Course Outcomes

	On completion of this course, the students will be able to:	
CO1	understand the applied facet of botany and acquire a complete knowledge about the cultivation methods in algae.	**K1& K3**
CO2	realization of the commercial potential of algal products.	**K5**
CO3	analyze emerging areas of algal biotechnology for identifying therapeutic importance of algal products and their uses.	**K2 & K4**
CO4	gain more information about algae genetics.	**K4**
CO5	translate various algal technologies for the benefit of the ecosystem.	**K3 & K6**

UNIT		CONTENTS	No of hours
I		**SCOPE OF ALGAL TECHNOLOGY :** Scope of algal technology – Commercial potential and utility of algae. Algae as sources for food, feed, pigments, Pharmaceuticals and neutraceuticals, fine chemicals, fuel, biofertilizers and hormones. Economic importance of algae in India.	**15**
II		**ALGAL PRODUCTS:** Industrial application of algae - fuel, algal lipids - transesterification to ester fuel - substitutes for petroleum derived fuel. Algal products - Spirulina mass cultivation and its applications. Mass cultivation of micro-algae as source of protein and as feed. Liquid seaweed fertilizers - method of preparation, applications and its advantages over inorganic fertilizers.	**15**
III		**ALGAL PRODUCTION AND UTILIZATION :**Algal production systems; Strain selection; Algal growth curve; Culture media; cultivation methods – small scale and Large-scale cultivation of algae. Harvesting and packing. Therapeutic uses - antioxidant, anti-ulcerogenic, antifungal, antibiotics, antitumor and antiviral compounds. Production of pigments and their utilization.	**15**
IV		**IMMOBILIZATION AND RDNA TECHNOLOGY IN ALGAE :** Algal immobilization and its applications - culturing for metabolite production and natural compounds. Methods of immobilization - alginate beads-extraction of compounds. Recombinant DNA technology in algae - Transformation systems in algae. Isolation of protoplasts, regeneration of fusion of macro algae. Role of algae in nanobiotechnology.	**15**
		ROLE OF ALGAE IN ENVIRONMENT MANAGEMENT : Role of algae in environmental health - Sewage treatment, treating industrial effluent, Phytoremediation-heavy metal removal, algae as indicators in assessing water quality and pollution; Saprobic index; Monitoring, assessment, restoration and management of coastal and marine	**15**

V	ecosystem environment. Algal culture collection centers in India and abroad and their importance.	

Self study	Economic importance of algae in India, Mass cultivation of micro-algae as source of protein and as feed, Recombinant DNA technology in algae, Algal culture collection centers in India and abroad and their importance.

Textbooks

1. Trivedi, P.C. 2001. Algal Biotechnology. Point publisher, Jaipur. India.
2. Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi.
3. Sahoo, D. 2000. Farming the ocean: seaweed cultivation and utilization. Aravali International, New Delhi.
4. Bast, F. 2014. An Illustrated Review on Cultivation and Life History of Agronomically Important Sea plants. In Seaweed: Mineral Composition, Nutritional and Antioxidant Benefits and Agricultural Uses, Eds. Vitor Hugo Pomin, 39-70. Nova Publishers, New York. ISBN: 978-1-63117-571-8**.**
5. Rapouso, M.F.J., Morais, R.M.S.C., Morais, A.M.M.B. 2013. Bioactivity and applications of sulphated polysaccharides from marine microalgae. Marine Drugs, 11, 233-252.

Reference books

1. Kumar H.D and H.N. Singh.1982. A text Book on Algae. Affiliated East- West Press Pvt. Ltd
2. Suganya, T and Renganathan, S. 2015. Biodiesel production using algal technology. Academic Press. ISBN: 0128009713.
3. Bajpai, Rakesh K., Prokop, Ales, Zappi, Mark E. 2014. Algal Biorefineries Volume 1: Cultivation of Cells and Products. Springer. ISBN: 9400774931.
4. Hojnacka, K., Wieczorek, P.P., Schroeder, G., Michalak, I. (Eds.). 2018. Algae Biomass: Characteristics and Applications. Developments in Applied Phycology.
5. Aziz, Farhad and Rasheed, Rezan. 2019. A Course Book of Algae. Publisher: University of Sulaimani. ISBN: 978-9922-20-391-1.

Web resources

1. https://www.springer.com/gp/book/9783319123332
2. https://www.researchgate.net/publication/318449035_Algae_Biotechnology
3. https://www.energy.gov/sites/prod/files/2015/04/f21/algae_marrone_132100.pdf
4. https://www.amazon.in/Prospects-Challenges-Algal-Biotechnology-Tripathi-ebook/dp/B0779BF366
5. https://www.degruyter.com/view/product/177050

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	1	3	1
CO2	3	3	3	2	3	3	3	2	3	2
CO3	3	2	3	2	2	3	1	1	1	1
CO4	3	3	3	3	3	3	3	2	3	2
CO5	3	2	3	3	3	3	3	1	3	1
Total	15	13	15	13	14	15	13	7	13	7
Average	3	2.6	3	2.6	2.8	3	2.6	1.4	2.6	1.4

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

SEMESTER I
ELECTIVE COURSE -II c) HERBAL TECHNOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP231EC6	4	1	-	-	3	5	75	25	75	100

Pre-requisite

To understand the importance of herbal technology.

Learning Objectives

1. To understand various plants based drugs used in ayurvedha, unani, homeopathy, siddha etc.
2. To apply the knowledge to cultivate medical plants.

Course Outcomes

On completion of this course, the students will be able to:		
CO1	recollect the importance of herbal technology.	**K1**
CO2	understand the classification of crude drugs from various botanical sources.	**K2**
CO3	analyze on the application of secondary metabolites in modern medicine.	**K3**
CO4	create new drug formulations using therapeutically valuable phytochemical compounds for the healthy life of society.	**K4**
CO5	comprehend the current trade status and role of medicinal plants in socio economic growth.	**K5 & K6**

UNIT	CONTENTS	No of hours
I	**PHARMACOGNOSY:** Pharmacognosy scope and importance - source - Crude Drugs – Scope and Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection and processing of crude drugs. Cultivation and utilization of medicinal and aromatic plants in India.	**15**
II	**PLANT TISSUE CULTURE AS SOURCE OF MEDICINES:** Plant tissue culture as source of medicines, Role of plant tissue culture in enhancing secondary metabolite production (*Withania somnifera, Rauwolfia serpentina, Catheranthus roseus, Andrographis paniculata* and *Dioscorea sp*) - Elicitation - Biotransformation, Hairy root culture. Factors affecting secondary metabolites production. Biogenesis of phytopharmaceuticals.	**15**
III	**PLANT PROPAGATION ANALYSIS OF PHYTOCHEMICALS:** Methods of Drug evaluation (Morphological, microscopic, physical and chemical). Phytochemical investigations – standardization and quality control of herbal drugs. Preliminary screening, Assay of Drugs - Biological evaluation/assays, Microbiological methods - Chemical Methods of Analysis, Detection of Adulterants: Chemical estimations, Spectrophotometry and fluorescence analysis. Drug adulteration - Types of adulterants.	**15**
IV	**GENERAL METHODS OF PHYTOCHEMICAL AND BIOLOGICAL SCREENING:** Carbohydrates and derived products: Glycosides - extraction methods (*Digitalis, Dioscorea*); Tannins (Hydrolysable and Condensed types);Volatile oils - extraction methods (Clove, Mentha). Study of some herbal formulation techniques as drug cosmetics.	**15**

V	**TYPES OF PHYTOCHEMICALS :** Alkaloids - extraction methods (*Taxus*, *Cinchona*); Flavonoids- extraction methods, Resins- extraction method: Application of phytochemicals in phytopharmacueticals; Biocides, Biofungicides, Biopesticides. Women entrepreneurship development – marketing cultivated medicinal plants – National Medicinal Plants Board of India.	**15**

Self study	Collection and processing of crude drugs, Biogenesis of phytopharmaceuticals, Microbiological methods - Chemical Methods of Analysis, Detection of Adulterants, Women entrepreneurship development – marketing cultivated medicinal plants – NationalMedicinal Plants Board of India.

Textbooks

1. Kokate, C.K., Purohit, A.P and S.B. Gokhale. 1996. Pharmacognosy. NiraliPrakashan, 4th Ed.
2. Roseline, A. 2011. Pharmacognosy. MJP publishers, Chennai.
3. Tilgner, Sharol Marie. 2018. Herbal ABC's: The Foundation of Herbal Medicine.
4. Natural Products in medicine: A Biosynthetic approach. 1997. Wiley. Hornok, L. (ed.).
5. Chichister, U.K.J. 1999. Cultivation and Processing of Medicinal Plants, Wiley & Sons. Trease and Evans.

Reference Books:

1. Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.
2. Kumaresan, V and Annie Regland. 2004. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany &Ethnobotany.
3. Anonymous, 2004. Cultivation of Selected Medicinal Plants. National MedicinalPlants Board, Govt. of India, New Delhi.
4. Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.
5. Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.

Web resources:

1. https://www.kopykitab.com/Herbal-Science
2. https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurClUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_BwE
3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu
4. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404
5. https://www.dattanibookagency.com/books-herbs-science.html

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	1	3
CO2	3	3	3	3	3	3	3	1	3	3
CO3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	1	3	3
CO5	3	3	3	3	3	3	3	1	2	3
Total	15	15	15	15	15	15	15	7	12	15
Average	3	3	3	3	3	3	3	1.4	2.4	3

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

SEMESTER – II

CORE COURSE III: TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232CC1	2	3	-	-	4	5	75	25	75	100

Pre-requisite

Prior knowledge on morphological, anatomical characteristics and uses of plants.

Learning Objectives

1. To be familiar with the basic concepts and principles of plant systematic.
2. To develop a suitable method for correct characterization and identification of plants.

Course Outcomes

On completion of this course, the students will be able to:		
1	recollect the basic concepts of morphology of leaves, flowers. identify the types of compound leaves, inflorescence and fruits describe their characteristic features	**K1, K2 K3**
2	explain the principles of taxonomy. summarize the taxonomic hierarchy. define binomial nomenclature. group activity – construct key preparation	**K1, K2 K5, K6**
3	explain the various types of classification. distinguish its advantages and disadvantages construction of floral formula and floral diagram.	**K1, K2 K3, K4**
4	illustrate and explain the characteristic features and list out the economic importance of the families field trip to local botanical garden and regional botanical garden.	**K1, K2 K3, K4**
5	illustrate and explain the characteristic features and list out the economic importance of the families.	**K1, K2 K3, K5**

UNIT	CONTENTS	No. of hours
I	**TAXONOMY AND SYSTEMATICS:** Botanical exploration and contribution with special reference to India by William Roxburgh, J.D. Hooker, Robert Wright, Nathanial Wallich and Gamble, J.S. Principles of classification as proposed – Artificial – Linnaeus, Natural – Bentham and Hooker, Phylogenetic system - Hutchinson, Modern – Takhtajan. Botanical gardens and herbaria of world, preparation and maintenance of Herbarium, Botanical survey of India – its organization and role.	15
II	**MODERN TRENDS IN TAXONOMY:** Modern trends in taxonomy, chemotaxonomy, numerical taxonomy, biosystemics. ICBN uninominal systems- genesis binomial nomenclature, importance and principle. Important articles, typification, principles of priority, effective and valid publication, author citation, recommendations and amendents of code. Glossories and dictionaries, Taxonomic literature (Index Kewensis)	15
III	**SYSTEMATIC ANALYSIS OF PLANTS-I:** Polypetalae – Nympheaceae, Sterculiaceae, Portulaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae, Turneraceae.	15
	SYSTEMATIC ANALYSIS OF PLANTS-II: Gamopetalae – Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae, Bignoniaceae,	15

IV	Convolvulaceae, Acanthaceae, Verbenaceae. Monochlamydeae – Nyctaginaceae, Aristolochiaceae, Casuarinaceae. Monocots – Orchidaceae, Amarylidaceae, Lilliaceae, Commelinaceae, Cyperaceae.	
V	**ECONOMIC BOTANY:** General account on utilization of selected crop plants: (i) Cereals (rice and wheat) – (ii) Pulses (red gram and black gram), (iii) Drug yielding plants (*Withania somnifera* and *Coleus aromaticus*) (iv) Oil yielding plants (Groundnut, sunflower). (v) Sugar yielding plants (sugarcane and sugar beet), (vi) Spices and condiments (cardamom, cinnamon). (vii) Commercial crops - fibre (jute), (viii) Timber (Teak and red sanders wood), (ix) Resins and gums (Asafoetida and gum arabic) – (x) Essential oils (lemon grass and menthol), (xi) Beverages (tea, coffee), (xii) Plants used as avenue trees for shade, pollution control and aesthetics (xiii) Energy plantation - uses of Casuarina.	**15**

Self study	Botanical gardens and herbaria of world, preparation and maintenance of Herbarium. Taxonomic literature (Index Kewensis). General account on utilization of selected crop plants: (i) Cereals (rice and wheat) – (ii) Pulses (red gram and black gram), (iii) Drug yielding plants (*Withania somnifera* and *Coleus aromaticus*) (iv) Oil yielding plants (Groundnut, sunflower).

Textbooks

1. Pandey, B.P. 2013. Taxonomy of Angiosperms, S. Chand Publishing, New Delhi.
2. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.
3. Singh, G. 2007. Plant systematics theory and practices. Oxford and IBH Publishing Co.
4. Jain, S.K and Rao R.R. 2017. A handbook of field and herbarium methods. Today and Tomorrow Publ.
5. Pandurangan, A.G., Vrinda, K.B and Mathew Dan. 2013. Frontiers in plant taxonomy. JNTBGRI, Thiruvananthapuram, Kerala.

Reference Books:

1. Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.
2. Kumaresan, V and Annie Regland. 2013. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany & Ethnobotany.
3. Anonymous, 2004. Cultivation of Selected Medicinal Plants. National Medicinal Plants Board, Govt. of India, New Delhi.
4. Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.
5. Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.

Web Resources:

1..https://www.ipni.org/
2.http://www.theplantlist.org/
3.https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592
4. .https://www.tropicos.org/home
5. .http://apps.kew.org/herbcat/gotoHerbariumGrowthPage.do

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PSO1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10
CO1	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO2	3	3	2	3	3	3	2	2	2	1	2	2	2	2	2	2	2
CO3	3	3	2	3	1	2	3	3	2	3	3	1	1	3	2	2	2
CO4	3	2	3	3	2	3	2	3	3	1	3	3	3	3	2	2	3
CO5	3	3	2	2	1	1	3	2	1	3	2	1	2	2	3	1	2
Total	15	14	12	14	10	13	13	13	11	11	13	10	10	13	12	10	12
Average	3	2.8	2.4	2.8	2	2.6	2.6	2.6	2.2	2.2	2.6	2	2	2.6	2.4	2	2.4

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

SEMESTER – II

CORE COURSE IV: PLANT ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232CC2	2	3	-	-	4	5	75	25	75	100

Pre-requisite

To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.

Learning Objectives

1. Learn the importance of plant anatomy in plant production systems.
2. Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants.

Course Outcomes

On completion of this course, the students will be able to:		
CO1	learn the structures, functions and roles of apical *vs* lateral meristems in monocot and dicot plant growth.	**K1& K2**
CO2	study the function and organization of woody stems derived from secondary growth in dicot and monocot plants.	**K1&K4**
CO3	apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	**K2& K6**
CO4	understand the various concepts of plant development and reproduction.	**K3& K6**
CO5	profitably manipulate the process of reproduction in plants with a professional and entrepreneurial mindset.	**K5**

UNIT	CONTENTS	No. of hours
I	**CELL WALL:** Morphological and physico-chemical changes; Plasmodesmata- types of pits – growth of cell wall – formation of intercellular spaces; Meristems: Classifications: Theories of shoot and root apices, Cytological zonation in shoot apex. Vascular Cambium: Composition and organization – multiplicative and additive divisions. Xylem: Primary and secondary xylem – tracheary elements and vessels – vesselless dicots – xylem rays and axial parenchyma of angiosperm wood; Dendrochronology – grain, texture and figure in wood; reaction wood; ring porous and diffuse porous wood. Phloem: Ultra structure and ontogeny of sieve tube elements and companion cell. Evolution of tracheary elements.	15
II	**PERIDERM:** Structure, organization and activity of phellogen. Polyderm and Rhytiderm – wound periderm. Normal secondary thickening in Dicots; Anomalous secondary growth in Dicots (Amaranthaceae, Aristolochiaceae, Bignoniaceae, Piperaceae, Nyctaginaceae) and arborescent Monocots. Primary thickening in palms; Ontogeny of leaf, Structure and types of Stomata; Leaf abscission; Major nodal types; Kranz anatomy and its significance. Microtechnique:	15
	Principle of killing and fixation, dehydration and rehydration of botanical specimens. Stains: Principle of double staining (fast-green and light green) of free hand sections; Protocol for serial sectioning of paraffin wax impregnated specimens; Mounting and mounting media.	
III	**MICROSPORANGIUM AND MALE GAMETOPHYTE:** Structure and development of Anther; Ultrastructure and physiology of anther tapetum; Male gametophyte; Palynology: Morphology and ultrastructure of pollen wall, pollen kitt, pollen analysis, pollen storage, pollen sterility and pollen physiology.	15
IV	**MEGASPORANGIUM AND FEMALE GAMETOPHYTE:** Structure and development of Megasporangium; Types of ovules, Endothelium, obturator and nucellus. Megasporogenesis: Female gametophyte: Structure, types, haustorialbehavior and Nutrition of embryo sacs. Fertilization: Double fertilization and triple fusion; Endosperm: Development of endosperm, types, physiological efficiency of endosperm haustoria and functions; Ruminate endosperm. Embryogeny: Development of monocot (Grass) and dicot (Crucifer) embryos.	15
V	**POLYEMBRYONY:** Causes of Polyembryony, classification, induction and practical application. Apomixis and its significance. Seed and Fruit development and role of growth substances. Parthenocarpy and its importance.	15

Self study	Theories of shoot and root apices, Cytological zonation in shoot apex, Anomalous secondary growth in Dicots (Amaranthaceae, Aristolochiaceae, Bignoniaceae, pollen sterility, Types of ovules, Parthenocarpy and its importance.

Textbooks

1. 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.
2. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.
4. Pandey.S.N and Ajanta Chandha. 2006. Plant Anatomy and Embryology. Vikas Publishinf House Pvt. Ltd, New Delhi.
5. Narayanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi.

Reference Books:

1. Krishnamurthy, K.V. 1988. Methods in Plant Histochemistry. S. Viswanathan & Co., Madras.
2. Swamy, B.G.L and Krishnamurthy. K.V 1990. From flower to fruits, Tata – McGraw Hill publishing Co Ltd, New Delhi.
3. Pullaiah, T., Lakshiminarayana, K and Hanumantha Rao, B. 2006. Text book of Embryology of Angiosperms. Regency Publications, New Delhi.
4. Bierhorst, D.W. 1971. Morphology of Vascular Plants. Macmillan publishers, New York.
5. Crang, R., Lyons-Sobaski, S and Wise, R. 2018. Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants. Springer International Publishing.

Web resources:

1. https://www.ipni.org/
2. http://www.theplantlist.org/
3. https://faculty.etsu.edu/liuc/plant_anatomy_sites.htm
4. http://aryacollegeludhiana.in/E_BOOK/Botany/plant_anatomy.pdf
5. https://www.uou.ac.in/sites/default/files/slm/BSCBO-202.pdf

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	1	3	3	3	3	2	3	3	3	3	3	2	3	3	2	3
CO3	3	1	3	3	3	3	2	3	3	2	3	1	1	3	3	3	2
CO4	3	3	3	1	1	2	3	2	3	2	2	1	3	2	2	2	2
CO5	3	3	3	3	3	3	2	3	2	3	3	2	2	3	2	1	2
Total	15	11	15	13	13	14	12	14	14	13	14	10	11	14	13	11	12
Average	3	2.2	3	2.6	2.6	2.8	2.4	2.8	2.8	2.6	2.8	2	.2.2	2.8	2.6	2.2	2.4

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

SEMESTER – II

CORE COURSE V: ECOLOGY, PHYTOGEOGRAPHY, CONSERVATION BIOLOGY & INTELLECTUAL PROPERTY RIGHTS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232CC3	2	3	-	-	4	5	75	25	75	100

Pre-requisite

Understanding the environmental factors impacting biodiversity is crucial after taking this course and Basic understanding of how laws are structured and interpreted.

Learning Objectives

1. To analyze and comprehend the fundamental ideas of plant ecology as a scientific study of environment(Knowledge).
2. To study the plant communities and plant succession stages(Skill).

Course Outcomes

On	completion of this course, the students will be able to:	
CO1	understand the scope and importance of population ecology, plant communities and ecosystemecology.	**K1 & K2**
CO2	understand the applied aspect of environmental botany.	**K1 & K4**
CO3	spot the sources and pollution and seek remedies to mitigate and rectify them.	**K2 & K6**
CO4	identify different plant communities, categorize plant biomes and identify threatened, endangered plant species and create awareness program in protection of biodiversity.	**K3 & K6**
CO5	analyze insight into the vegetation types, species interaction and their importance and the factors influencing the environmental conditions.	**K5**

UNIT	CONTENTS	No. of hours
I	**ECOLOGICAL PRINCIPLES:** Introduction – History, scope, concepts. Diversity of plant life; growth form, life form. Basic concepts of population ecology– population dynamics – Regulation of population density. Basics concepts of community – characteristics, composition, structure, origin and development – community dynamics – trends of succession.	**15**
II	**ECOSYSTEM ECOLOGY AND RESOURCE ECOLOGY:**Introduction – kinds – major types – functional aspects of ecosystem: Food chain and food web, energy flow, laws of thermodynamics. Productivity – primary and secondary productivity – GPP & BPP. **Resource Ecology:** Energy resources; renewable and non-renewable. **Soil**: Formation, types and profile - erosion and conservation, Water resources – conservation and management. **Environment Deterioration:** Climate change - Greenhouse effect and global warming, ozone depletion and acid rain. Waste management - Solid and e-waste, recycling of wastes. Eco-restoration/remediationecological foot prints - carbon foot print - ecolabeling - environmental auditing	**15**

III	**PHYTOGEOGRAPHY:** Phytogeographical Zones - Vegetation types of India and Tamil Nadu, Distribution: Continuous, Discontinuous and Endemism. Theories of discontinuous distribution: Continental drift, Age and area hypothesis. Geographical Information System (GIS) Principles of remote sensing and its applications.	**15**
IV	**BIODIVERSITY AND CONSERVATION ECOLOGY:** Definition, types of biodiversity – values of biodiversity – Hot spots – Threats to biodiversity: habitat loss. Poaching of wild life – Invasion of exotic species, man and wild life conflicts - endangered and endemic plant species of India, Red list categories of IUCN, Biotechnology assisted plant conservation- *in situ* and *ex situ* methods.	**15**
V	**INTELLECTUAL PROPERTY RIGHTS:** Intellectual Property Rights – Introduction, Kinds of Intellectual Property Rights- Patents, Trademarks, Copyrights, Trade Secrets. Need for intellectual property right, Advantages and Disadvantages of IPR. International Regime Relating to IPR – TRIPS, WIPO, WTO, GATTS. IPR in India genesis and development. Geographical Indication – introduction, types. Patent filing procedure for ordinary application.	**15**

Self study	Basics concepts of community, Food chain and food web, energy flow, laws of thermodynamics, Vegetation types of India and Tamil Nadu, Red list categories of IUCN, Regime Relating to IPR – TRIPS, WIPO, WTO, GATTS.

Textbooks:

1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
2. Pushpa Dahiya and Manisha Ahlawat. 2013. Environmental Science- A New Approach, Narosa Pub. House, New Delhi.pp.2.1-2.60.
3. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru.
4. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut.
5. Neeraj Nachiketa, 2018. Environmental & Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.

Reference books

1. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.
2. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and
3. Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.

4.Ahuja, V.K. 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

Mapping with Programme Outcomes:

COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PS O2	PS O3	PS O4	PS O5	PS0 6	PS O7	PS O8	PS O9	PS O10
CO1	3	3	3	3	2	3	2	3	2	1	2	3	2	3	3	2	1
CO2	3	3	2	3	3	3	3	2	3	3	2	3	3	3	2	3	3
CO3	3	2	3	2	2	2	1	3	1	1	2	1	2	1	1	2	1
CO4	3	3	2	3	3	3	2	2	2	3	1	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3	3	3
Total	15	14	13	14	13	14	11	13	11	11	10	12	13	12	12	13	11
Average	3	2.8	2.6	2.8	2.6	2.8	2.2	2.6	2.2	2.2	2	2.4	2.6	2.4	2.4	2.6	2.2

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

SEMESTER – II

CORE LAB COURSE-II: Lab Course (For Core III, IV & V)

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232CP1	-	2	3	-	4	5	75	25	75	100

Pre-requisite

Theoretical understanding of plant taxonomy, ecology and phytogeography, plant anatomy and embryology as well as basic laboratory skills for the relevant core course.

Learning Objectives

1.Understand and develop skill sets in plant morphological, floral characteristics and artificial key preparation.

2. Expedite skilled workers to carry out research in frontier areas of plant science.

Course Outcomes

On complet	on of this course, the students will be able to:	
CO1	to gain recent advances in plant morphological and floral characteristics.	**K1**
CO2	understand about different floral characteristics and artificial key preparation which employed for plant identification and conservation.	**K2**
CO3	recall or remember the information including basic and advanced in relation with plant anatomy and embryology.	**K4 & K5**
CO4	apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	**K3**
CO5	know about different vegetation sampling methods.	**K3**

UNIT	EXPERIMENTS
I	**TAXONOMY AND ECONOMIC BOTANY OF ANGIOSPERMS** Preparation of artificial keys. Description of a species, based on virtual herbarium and live specimens of the families mentioned in the theory. Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family. Solving nomenclature problems. **Field trip:** A field trip at least 3-4 days to a floristically rich area to study plants in nature and field report submission of not less than 20 herbarium sheets representing the families studied.
II	**ANATOMY** 1. Study of shoot apex of *Hydrilla* 2. Observation of cambial types. 3. Sectioning and observation of nodal types. 4. Study of anomalous secondary growth of the following: STEM- *Nyctanthus, Bouerhhavia, Bignonia, Piper betal* and *Mirabilis*. ROOT: *Acyranthus* 5. Observation of stomatal types by epidermal peeling.

	6. Maceration of wood and observation of the components of xylem. 7. Double staining technique to study the stem anomali.
III	**EMBRYOLOGY** 1. Observation of T.S. of anther. 2. Observation of ovule types. 3. Observation of mature embryo sacs. 4. Dissection and observation of embryos (globular and cordate embryos). 5. Study of pollen morphology 6. Study of in vitro pollen germination. 7. Observation of endosperm types.
IV	**ECOLOGY** 1. Determination of the quantitative characters of a plant community by random quadrat method (abundance, density, dominance, species diversity, frequency) in grazing land, forests. 2. Estimation of above ground and below ground biomass in a grazing land employing minimum size of quadrat. 3. To determine soil moisture, porosity and water holding capacity of soil collected from varying depth at different locations. 4. Determination of pH of soil and water by universal indicator (or) pH meter. 5. Determination of dissolved oxygen. 6. Estimation of carbonate. 7. Estimation of bicarbonate.
V	**PHYTOGEOGRAPHY, CONSERVATION BIOLOGY & INTELLECTUAL PROPERTY RIGHTS** 1. Mapping of world vegetation 2. Mapping of Indian vegetation. 3. Remote sensing – Analyzing and interpretation of Satellite photographs-Vegetation/ weather. 4. Visit to remote sensing laboratory (at Anna University, Regional Meteorological Centre at Numgambakkam).

Textbooks

1. Subramaniam, N.S, 1996. Laboratory Manual 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. NiraliPrakashan, 1st Edition. ISBN: 9351642062.
3. Joshi, S.G, 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi. ISBN: 9788120414143.
4. Cutler, D.F., Botha, C.E.J., Stevenson, D.W., and William, D, 2008. Plant anatomy: an applied approach (No. QK641 C87). Oxford: Blackwell, UK.
5. Sundara, R. S, 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.

Reference books

1. Sathya, S., Jaiganesh, K.P and Sudha. T,2019. Current Trends in Herbal Drug Technology. Pharmacy Council of India New Delhi..
2. Mann J. Davidson, R.S and J.B. Hobbs, D.V. Banthorpe, J.B. Harborne.,1994. *Natural Products*. Longman Scientific and Technical Essex.

3. Gopalan, C., B.V. Ramasastri and S.C. Balasubramanian, 1985. NutritiveValue of Indian Foods. National Institute of Nutrition, Hyderabad.
4. Harborne. J.B, 1998. Phytochemical methods. A guide to modern techniques of Plant Analysis, Chapman and Hall publication, London.
5. Traditional plant medicines as sources of new drugs. P.J Houghton in Pharmacognosy. Trease and Evan's.16 Ed, 2009.

Web resources:

1. https://www.kobo.com/gr/en/ebook/phytochemistry-2
2. https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H
3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ
4. https://studyfrnd.com/pharmacognosy-and-phytochemistry-book/
5. https://www.worldcat.org/title/textbook-of-pharmacognosy-and-phytochemistry/oclc/802053616.
6. https://www.worldcat.org/title/phytochemistry/oclc/621430002

Mapping with Programme Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PSO 1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	PS O10
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	2	2	2	1	2	3	2	2	3	3	3	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	2	3	2	2	3
CO5	3	2	2	3	3	3	3	3	3	2	3	3	3	1	2	3	3
Total	15	14	13	15	15	14	13	14	13	11	14	14	13	12	12	14	14
Average	3	2.8	2.6	3	3	2.8	2.6	2.8	2.6	2.2	1.8	2.8	2.6	2.4	2.4	1.8	2.8

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

SEMESTER – II

ELECTIVE COURSE III: a) BIOSTATISTICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232EC1	2	2	-	-	2	4	60	25	75	100

Pre-requisite

Fundamental knowledge on using in statistical tools and apply the tools to interpret the results.

Learning Objectives

1. To provide the student with a conceptual overview of statistical methods.
2. To emphasis on usefulness of commonly used statistical software for analysis, research, and experimentation.

Course Outcomes

On completi	n of this course, the students will be able to:	
CO1	create and interpret visual representations of quantitative information, such as graphs or charts.	**K5 & K6**
CO2	solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods	**K3 & K5**
CO3	know the latest version using in statistical tools and apply the tools to interpret the results	**K2**
CO4	develop their competence in hypothesis testing and interpretation.	**K4**
CO5	understand why biologists need a background in statistics.	**K1**

UNIT	CONTENTS	No. of hours
I	**INTRODUCTION TO STATISTICS** Introduction to biostatistics, basic principles, variables - Collection of data, sample collection and representation of Data - Primary and Secondary - Classification and tabulation of Data – Diagrams, graphs and presentation.	**12**
II	**DESCRIPTIVE STATISTICS** Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range of variation, standard deviation and standard error and coefficient variation.	**12**
III	**PROBABILITY** Basic principles - types - Rules of probability - addition and multiplication rules. **PROBABILITY DISTRIBUTION** Patterns of probability distribution; binomial - Poisson and normal.	**12**
IV	**HYPOTHESIS TESTING** Chi-square test for goodness of fit; Null hypothesis, level of Significance - Degrees of Freedom. Student 't' test – paired sample and mean differences 't' tests. ANOVA. Basic introduction to Multivariate Analysis of Variance (MANOVA).	**12**
V	**CORRELATION AND REGRESSION** Correlation - types of correlation - methods of study of correlation - testing the significance of the coefficients of correlation. Regression and types. Sampling and experimental designs of research-Randomized block design and split plot design.	**12**

Self Study	Classification and tabulation of Data – Diagrams, graphs and presentation., Mean, median and mode, Rules of probability, Student 't' test – paired sample and mean differences, Correlation - types of correlation

Textbooks

1. Gurumani. N, 2005. Biostatistics, 2nd edn. MJP publications, India.
2. Datta, A.K, 2006. Basic Biostatistics and Its Applications. New Central Book Agency. ISBN 8173815038.
3. Pillai, R.S.N and Bagavathi, V.S, 2010. Statistics theory and practice. Chand & Co. Ltd, New Delhi.
4. Mahajan, B.K, 1984. Methods in Biostatistics for Medical students and Research works. Smt. Indu Mahajan, New Delhi.
5. Pillai, R.S.N and Bagavathi, V.S, 2010. Statistics theory and practice. Chand & Co. Ltd, New Delhi.

Reference books

1. Crang, R., Lyons-Sobaski, S and Wise, R. 2018. Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants. Springer International Publishing.
2. Schefler, W.C, 1968. Statistics for biological sciences, Addision- Wesely Publication Co., London.
3. Spiegel, M.R, 1981. Theory and Problems of statistics, Schaum's Outline series McGraw-Hill International Book Co., Singapore.
4. Pillai, R.S.N and Bagawathi, V, 1987. Practical Statistics (For B.Com. and B.A., Students) S.Chand & Co. (Pvt.) Ltd., New York.
5. Sobl. R.R and Rohif, F.J, 1969. Biometry. The principles and Practice and Statistics in Biological Research. W.H. Freman and Co., San Francisco.

Mapping with Programme Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PSO1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	PS O10
CO 1	3	2	1	3	3	3	3	3	3	1	3	1	3	2	1	2	2
CO 2	3	2	2	3	3	1	1	3	2	1	2	1	1	3	1	3	2
CO 3	3	1	2	3	3	2	2	3	3	2	2	2	2	1	2	1	1
CO 4	3	2	1	3	2	3	3	2	3	3	3	3	3	1	3	1	2
CO 5	3	2	3	3	3	2	1	3	3	1	3	1	1	2	1	2	2
Total	15	9	9	15	14	11	10	14	14	8	13	8	10	9	8	9	9
Average	3	1.8	1.8	3	2.8	2.2	2	2.8	2.8	1.6	2.6	1.6	2	1.8	1.6	1.8	1.8

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

SEMESTER – II

ELECTIVE COURSE III: b) INTELLECTUAL PROPERTY RIGHTS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232EC2	2	2	-	-	2	4	60	25	75	100

Pre-requisite

Intent to understand the legal systems governing the knowledge economy. Basic understanding of how laws are structured and interpreted.

Learning Objectives

1. Cater to the needs of the stakeholders of knowledge economy is designed for those interested in managers and similar individuals.
2. Create awareness of current IPR and innovation trends.

Course Outcomes

On completi	n of this course, the students will be able to:	
CO1	recall the history and foundation of Intellectual Property.	**K1**
CO2	understand the differences of Property and Assets and Various categories of Intellectual Creativity.	**K2**
CO3	apply the methods to protect the Intellectual Property.	**K3**
CO4	differentiate if the Said Intangible property be protected under law or protected by strategy.	**K4**
CO5	create a recommendation document on the methods and procedures of protecting the said IP and search documents to substantiate them.	**K5 & K6**

UNIT	CONTENTS	No.of hours
I	**INTRODUCTION TO IPR** History and Development of IPR. Theories on concept of property: Tangible *vs* Intangible. Subject matters patentable in India. Non patentable subject matters in India. Patents: Criteria of Patentability, Patentable Inventions - Process and Product. Concept of Copyright. Historical Evolution of Copyright Ownership of copyright, Assignment and license of copyright.	**12**
II	**OVERVIEW OF THE IPR REGIME AND DESIGN** International treaties signed by India. IPR and Constitution of India. World Intellectual Property Organization (WIPO): Functions of WIPO, Membership, GATT Agreement. Major Conventions on IP: Berne Convention, Paris Convention. TRIPS agreement. Industrial Designs – Subject matter of Design – Exclusion of Designs – Novelty and originality – Rights in Industrial Design.	**12**
III	**TRADE MARK, LEGISLATIONS AND PATENT ACT** History of Indian Patent Act 1970. Overview of IP laws in India. Major IP Laws in India. Patent Amendment Act 2005. WTO-TRIPS – Key effect on Indian Legislation. Organization of Patent System in India. Concept of Trademarks, Different kinds of marks, Criteria for registration, Non Registrable Trademarks, Registration of Trademarks. Infringement: Remedies and Penalties.	**12**

IV	**PRIOR ART SEARCH AND DRAFTING** Overview of Patent Search. Advantages of patent search. Open source and paid databases for Patent Search. International Patent classification system. Types of specifications: Drafting of Provisional specifications. Drafting of complete specifications. Drafting of claims.	**12**
V	**GI AND PATENT FILING PROCEDURES** Geographical Indications of Goods (Registration and Protection) Infringement – Offences and Penalties Remedies. Plant Variety and Farmers Right Act (PPVFR). Plant variety protection: Access and Benefit Sharing (ABS). Procedure for registration, effect of registration and term of protection. Role of NBA. Filing procedure for Ordinary application. Convention application. PCT National Phase application. Process of Obtaining a Patent. Infringement and Enforcement.	**12**

Self study	Ownership of copyright, Assignment and license of copyright, Subject matter of Design – Exclusion of Designs – Novelty and originality – Rights in Industrial Design, Criteria for registration, Non Registrable Trademarks, Registration of Trademarks. Infringement: Remedies and Penalties, Drafting of complete specifications. Drafting of claims, Process of Obtaining a Patent. Infringement and Enforcement

Textbooks

1. Kalyan, C.K, 2010. Indian Patent Law and Practice, India, Oxford University Press.
2. Ahuja, V.K, 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
3. Arthur Raphael Miller, Micheal Davis H, 2000. Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers.
4. Margreth. B, 2009. Intellectual Property, 3nd, New York Aspen publishers.
5. Nithyananda, K.V, 2019. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.

Reference Books

1. World Intellectual Property Organization, 2004. WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf Journal of Intellectual Property Rights (JIPR): NISCAIR.
2. Anant Padmanabhan, 2012. Intellectual Property Rights: Infringement and Remedies LexisNexis Butterworths Wadhwa.
3. Nithyananda, K.V, 2019. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
4. Pradeep, S. Mehta (ed.), 2005. Towards Functional Competition Policy for India, Academic Foundation, Related.
5. Ramakrishna B and Anil Kumar, H.S, 2017. Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers, Notion Press, Chennai.

Web resources:

1. http://cipam.gov.in/
2. https://www.wipo.int/about-ip/en/
3. http://www.ipindia.nic.in/
4. https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.
5. https://swayam.gov.in/nd2_cec20_ge04/preview

Mapping with Programme Outcomes

COs	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PSO1	PS O2	PS O3	PS O4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO1 0
CO 1	3	3	3	3	3	3	3	2	3	2	3	2	3	3	3	3	3
CO 2	3	3	3	3	3	2	2	3	2	2	3	3	2	2	2	2	2
CO 3	3	2	3	2	2	3	1	3	3	3	2	1	3	1	2	2	3
CO 4	3	2	3	2	2	2	3	3	1	3	2	3	2	2	2	2	2
CO 5	3	2	1	3	2	2	2	3	2	3	2	3	1	3	3	3	2
Total	15	12	13	13	12	12	11	14	11	13	12	12	11	11	12	12	12
Aver age	3	2.4	2.6	2.6	2.4	2.4	2.2	2.8	2.2	2.6	2.4	2.4	2.2	2.2	2.4	2.4	2.4

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

SEMESTER – II

ELECTIVE COURSE III: c) - APPLIED BIOINFORMATICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232EC3	2	2	-	-	2	4	60	25	75	100

Pre-requisite

Basic knowledge in molecular biology. Familiarity with operations of computersand MS office tools.

Learning Objectives

1. To learn about the bioinformatics databases, databanks, data format and data retrieval from theonline sources.
2. To explain the essential features of the interdisciplinary field of science for better understandingbiological data.

Course Outcomes

SSOn completion of this course, the students will be able to:		
CO1	familiarize with the tools of DNA sequence analysis.	**K1 & K2**
CO2	use and explain the application of bioinformatics.	**K2 & K3**
CO3	master the aspects of protein-protein interaction, BLAST and PSI-BLAST.	**K3 & K4**
CO4	describe the features of local and multiple alignments.	**K3 & K4**
CO5	interpret the characteristics of phylogenetic methods and bioinformatics applications.	**K4 & K5**

UNIT	CONTENTS	No.of hours
I	**BIOINFORMATICS AND INTERNET:** Internet Basics - File Transfer Protocol - The World Wide Web - Internet Resources –databases – types- Applications - NCBI Data Model - SEQ-Ids – Biosequences- Biosequence sets – Sequence annotation – Sequence description.	**12**
II	**GENBANK SEQUENCE DATABASE:** Introduction- Primary And Secondary Databases - Format Vs. Content - Genbank Flatfile- Submitting DNA Sequences to the Databases - DNA/RNA - Population, Phylogenetic, and Mutation Studies - Protein-Only Submissions - Consequences of DNA Model - EST/STS/GSS/HTG/SNP and Genome Centers - Contact points for submission of sequence data to DBJ/EMBL/Genbank.	**12**
III	**STRUCTURE DATABASES:** Introduction to Structures - Protein DataBank (PDB) - Molecular Modeling Database at NCBI Structure File Formats - Visualizing Structural Information - Database Structure Viewers - Advanced Structure Modeling - Structure Similarity Searching.	**12**
IV	**SEQUENCE ALIGNMENT AND DATABASE SEARCHING:** Introduction - Evolutionary Basis of SequenceAlignment - Modular Nature of Proteins - Optimal Alignment Methods - Substitution Scores and Gap Penalties- Database Similarity Searching - FASTA – BLAST (Blast P, Blast N, etc.,) - Position SpecificScoring Matrices, Spliced Alignments.	**12**
V	**PREDICTIVE METHODS:** Using Protein Sequences Protein Identity Based on Composition - Physical Properties Based on Sequence - Motifs and Patterns - Secondary Structure and Folding Classes - Specialized Structures or Features - Tertiary Structure.	**12**

Self study	Biosequence sets – Sequence annotation – Sequence description, Genome Centers - Contact points for submission of sequence data to DBJ/EMBL/Genbank., Advanced Structure Modeling - Structure Similarity Searching., Spliced Alignments, Secondary Structure and Folding Classes - Specialized Structures or Features - Tertiary Structure.

Textbooks

1. Baxevanis, A. D. & Ouellette, B. F, 2021. Bioinformatics: A practical guide to the analysis ofgenes and proteins. New York: Wiley-Interscience.
2. Bourne, P. E., & Gu .J, 2009. Structural bioinformatics. Hoboken, NJ: Wiley-Liss.
3. Lesk, A. M. 2002. Introduction to bioinformatics. Oxford: Oxford University Press.
4. Mount, D. W, 2001. Bioinformatics: Sequence and genome analysis. Cold Spring Harbor, NY:Cold Spring Harbor Laboratory Press.
5. Pevsner. J, 2015. Bioinformatics and functional genomics. Hoboken, NJ: Wiley-Blackwell.

Reference books

1. Campbell, A.M and Heyer, L.J, 2003. Discovering genomics, proteomics, and bioinformatics. San Francisco: Benjamin Cummings.
2. Green, M.R and Sambrook. J, 2012. Molecular cloning: A laboratory manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
3. Liebler, D.C, 2002. Introduction to proteomics: Tools for the new biology. Totowa, NJ: Humana Press.
4. Old, R.W., Primrose, S.B., and Twyman, R.M, 2001. Principles of gene manipulation: An introduction to genetic engineering. Oxford: Blackwell Scientific Publications.
5. Primrose, S.B., Twyman, R.M., Primrose, S.B., and Primrose, S.B, 2006. Principles of gene manipulation and genomics. Malden, MA: Blackwell Pub.

Web resources:

1. Bioinformatics: Algorithms & Applications by Prof. M. Michael Gromiha IIT-Madras. https://nptel.ac.in/courses/102/106/102106065/#.
2. Christopher Burge, David Gifford, and Ernest Fraenkel. *7.91*.J Foundations of Computational andSystems *Biology*. Spring 2014. Massachusetts Institute of Technology: MIT Open Course Ware, https://ocw.mit.edu.
3. https://link.springer.com/book/10.1007/978-3-540-72800-9.
4. https://www.amazon.in/Applied-Bioinformatics-Paul-Maria-Selzer-ebook/dp/B001AUOYY2.
5. https://books.google.co.in/books/about/Applied_Bioinformatics.html?id=PXZZDwAAQBAJ&redir_esc=y

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO 2	PSO 3	PS O4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO1 0
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	2	3	3	3	3	3	3	2	2	3	2	2	3	2	2	2	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	1	3	3
CO4	3	3	3	3	3	2	3	3	3	1	3	3	3	3	3	3	3
CO5	3	2	2	2	3	3	2	3	3	3	3	3	2	3	2	2	2
Total	14	14	14	14	15	14	14	14	14	13	14	14	13	14	11	13	14
Average	2.8	2.8	2.8	2.8	3	2.8	2.8	2.8	2.8	2.6	2.8	2.8	2.6	2.8	2.2	2.6	2.8

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

SEMESTER – II

ELECTIVE COURSE IV: a)- RESEARCH METHODOLOGY, COMPUTER APPLICATIONS & BIOINFORMATICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232EC4	2	2	-	-	2	4	60	25	75	100

Pre-requisite

To impart expertise about analysis and research.

Learning Objectives

1. To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.
2. To provide an overview on modern equipments that they would help students gain confidence to instantly commence research careers and/or start entrepreneurial ventures.

Course Outcomes

On completion of this course, the students will be able to:		
CO1	realize the need of centrifuges and chromatography and their uses in research	**K1 & K2**
CO2	learn the principles and applications of electrophoresis	**K2 & K3**
CO3	construct the phylogenetic trees for similar characteristic feature of plant genomes and study *de novo* drug design through synthetic biology.	**K5 & K6**
CO4	understand the concept of pairwise alignment of DNA sequences using algorithms.	**K3 & K4**
CO5	interpret the features of local and multiple alignments.	**K4 & K5**

UNIT	CONTENTS	No. of hours
I	Literature collection and citation: bibliography —bibliometrics (scientometrics): definition-laws — citations and bibliography - *biblioscape— plagiarism— project proposal writing — dissertation writing – paper presentation (oral/poster) - E-learning tools- monograph — introduction and writing-Standard operating procedure (SOP) – introduction and preparation — Research Institutions - National and International.	**12**
II	Basic principles and applications of pH meter, UV-visible spectrophotometer, centrifuge, lyophilizer, chromatography- TLC, Gas chromatography with mass spectrum (GC/MS), and HPLC-Scanning electron microscopy-Agarose gel Electrophoresis — Polyacrylamide Gel Electrophoresis –Polymerase chain reaction	**12**
III	Introduction to computers and Bioinformatics. Types of hardware and software operating systems. Fundamentals of networking, operation of networks, telnet, ftp, www, Internet. Biological Research on the web: Using search engines, finding scientific articles.	**12**
IV	Public biological databases, searching biological databases. Use of nucleic acid and protein data banks.	**12**

V	NCBI, EMBL, DDBJ, SWISSPORT, Protein prediction and Gene finding tools. Techniques in Bioinformatics- BLAST, FASTA, Multiple Sequence Analysis **.**	**12**

Textbooks

1. Veerakumari, L,2017. Bioinstrumentation. MJP Publisher, India. p578.
2. Sree Ramulu, V.S, 2019. Thesis Writing, Oxford& IBH Pub. New Delhi.
3. Kothekar, V and T.Nandi, 2009. An introduction to Bioinformatics. Panima publishing crop, New Delhi.
4. Mani, K and N. Vijayaraj, 2004. Bioinformatics – A Practical Approach.1st Edn. Aparna publication, Coimbatore.
5. Gurumani. N, 2019. Research Methodology: For Biological Sciences, MP. Publishers.

Reference books

1. Narayana, P.S.D. Varalakshmi, T. Pullaiah, 2016. Research Methodology in Plant Science, Scientific Publishers, Jaipur, Rajasthan.
2. Pevsner. J, 2015.Bio informatics and functional genomics .Hoboken,NJ:Wiley-Blackwell.
3. Arthur Conklin W.M and Greg White, 2016. Principles of computer security. TMH. McGraw-Hill Education; 4 edition.
4. Irfan Ali Khan and Attiya Khanum (eds.), 2004. Introductory Bioinformatics. Ukaaz Publications, Hyderabad.
5. Arthur Conklin W.M., and Greg White. 2016. Principles of computer security. TMH., McGraw-Hill Education; 4th edition

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://en.wikipdia.org/wiki/bioinstrumentation
5. https://www.britannica.com/science/chromatography

Mapping with Programme Outcomes

Cos	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PSO1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	PS O10
CO1	3	2	2	2	3	3	3	3	3	1	3	3	3	3	2	3	3
CO2	3	2	2	3	3	2	2	3	3	2	3	3	3	2	3	3	3
CO3	3	1	2	3	3	3	2	3	3	1	3	3	3	2	2	2	3
CO4	3	2	1	3	3	2	3	3	2	1	3	2	2	1	3	3	1
CO5	3	1	2	2	3	3	3	3	3	2	3	3	2	2	3	3	2
Total	15	8	9	13	15	13	13	15	14	7	15	14	13	10	13	14	12
Average	3	1.6	1.8	2.6	3	2.6	2.6	3	2.8	1.4	3	2.8	.6	2	2.6	2.8	2.4

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

SEMESTER – II

ELECTIVE COURSE IV: b)- MEDICINAL BOTANY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232EC5	2	2	-	-	2	4	60	25	75	100

Pre-requisite

Understanding the uses of medicinal plants and its conservation.

Learning Objectives

1.To understand the uses and effects of medicinal plants and herbal supplements.

2.To gain knowledge about the historical and modern uses of plants in medicine.

Course Outcomes

On completion of this course, the students will be able to:		
CO1	recognize plants and relate to their medicinal uses	K1
CO2	explain about the phytochemistry, pharmacognosy and bioprospecting of medicinal plant extracts.	K2
CO3	apply techniques for conservation and propagation of medicinal plants.	K3
CO4	analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	K4
CO5	develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India.	K5 & K6

UNIT	CONTENTS	No. of Hours
I	**HISTORY AND TRADITIONAL SYSTEMS OF MEDICINE:** Historical Perspectives – European, African, American, Southeast Asian Practices. Scope and Importance of Medicinal Plants; Traditional systems of medicine - Definition and Scope. Classical health traditions - Naturopathy, Siddha, Ayurveda, Homeopathy, Unani and MateriaMedica. Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in Ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e-tabiya, tumors treatments/ therapy, polyherbal formulations.	12
II	**PHYTOCHEMISTRY AND PHARMACOGNOSY:** Phytochemistry, important phytoconstituents, their plant sources, medicinal properties. Histochemistry – definition, principles, staining methods. Biological stains – bright field dyes and flurochromes, detection and localization of phytochemicals. Raw drugs, authenticity, study through physical, microscopic and analytical methods. Different types of formulations. Adulteration and Admixtures.	12
	ACTIVE PRINCIPLE & DRUG DISCOVERY: Brief description of selected plants, Active principles, biochemical properties and medicinal uses of Guggul (*Commiphora*) for hypercholesterolemia, *Boswellia*for inflammatory disorders, Arjuna (*Terminalia arjuna*) for cardio protection, turmeric (*Curcuma longa*) for wound healing, antioxidant and anticancer properties, Kutaki (*Picrorhiza kurroa*) for hepatoprotection, Opium	12

III	Poppy for analgesic and antitussive, *Salix* for analgesic, *Cinchona* and *Artemisia* for Malaria, *Rauwolfia*as tranquilizer, *Belladona* as anticholinergic, *Digitalis* as cardiotonic, *Podophyllum* as antitumor, *Stevia rebaudiana* for antidiabetic, *Catharanthus roseus* for anticancer. Bioprospecting, drug discovery from plants with reference to diabetes and cancer. Product development and quality control.	
IV	**CONSERVATION AND AUGMENTATION:** Significance of Cultivation, management, policies for conservation and sustainable use of medicinal plants. Conservation of endemic and endangered medicinal plants, Red list criteria; *In situ* conservation: Biosphere reserves, sacred groves, National Parks; *Ex situ* conservation: Botanic Gardens, Ethno medicinal plant Gardens. Propagation of Medicinal Plants: seeds, cuttings, layering, grafting and budding.	**12**
V	**ETHNO BOTANY AND FOLK MEDICINE:** Concepts and definition of Ethno botany and folk medicines. A brief history of ethnobotanical studies – globally & locally. Methods to study ethno botany; Applications of Ethno botany: Folk medicines of ethno botany, ethno medicine, ethno ecology, ethnic communities of India. Understanding the traditions of tribes in Tamil Nadu – Irulas and Kanis. Repository of Ethnobotanical data – Archeology, inventories, folklore and literature. Traditional Knowledge Sharing - Prior information consent, interviews, questionnaires and knowledge partners.Plants associated with culture, social, religious and medicinal purposes.Commercial use of traditional knowledge – ethics, IPR, biopiracy, equitable benefit sharing models.	**12**

Text books

1. AYUSH (www.indianmedicine.nic.in), 2022. *About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy*. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.
2. Bhat, S.V., Nagasampagi, B.A., & Meenakshi. S, 2009. Natural Products – Chemistry and Applications. Narosa Publishing House, India Ltd.
3. CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow, 2016. *AushGyanya*: Handbook of Medicinal and Aromatic Plant Cultivation.
4. Kapoor, L. D, 2001. Handbook of Ayurvedic medicinal plants. Boca Raton, FL: CRC Press.
5. Saroya, A.S, 2017. Ethno botany. ICAR publication.

Reference books

1. Akerele, O., Heywood, V and Synge, H. 1991. The Conservation of Medicinal Plants. Cambridge University Press.
2. Evans, W.C, 2009. Trease and Evans Pharmacognosy, 16th edn. Philadelphia, PA: Elsevier Saunders Ltd.
3. Jain, S.K. and Jain, Vartika. (eds.), 2017. Methods and Approaches in Ethnobotany: Concepts, Practices and Prospects. Deep Publications, Delhi
4. Amruth, 1996. The Medicinal plants Magazine (All volumes) Medicinal plant Conservatory Society, Bangalore.
5. Bhattacharjee, S.K, 2004. Hand Book of Medicinal plants. Pointer Publishers, Jaipur.

Web resources:

1. https://www.amazon.in/Medical-Botany-Plants-Affecting-Health/dp/0471628824
2. https://www.amazon.in/Current-Trends-Medicinal-Botany-Muhammad/dp/9382332502
3. https://link.springer.com/book/10.1007/978-3-030-74779-4
4. https://www.elsevier.com/books/medicinal-plants/da/978-0-08-100085-5.
   5.https://www.pdfdrive.com/medicinal-plants-books.html

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	3	2	3	3	2	1	3	3	2	3	2	3	2
CO2	3	2	3	3	3	3	2	2	2	1	3	2	3	3	1	2	3
CO3	3	2	3	3	3	2	3	3	3	2	3	3	2	3	2	2	3
CO4	3	2	2	3	3	3	2	3	3	2	3	3	3	2	2	3	3
CO5	3	2	2	3	3	3	3	3	3	2	3	3	3	3	1	3	3
Total	15	11	13	15	15	13	13	14	13	10	15	14	13	14	10	13	14
Average	3	2.2	2.6	3	3	2.6	2.6	2.8	2.6	2	3	2.8	2.6	2.8	2	2.6	2.8

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

SEMESTER – II

ELECTIVE COURSSE IV: c) PHYTOCHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232EC6	2	2	-	-	2	4	60	25	75	100

Pre-requisite

Basic understanding of plant metabolites.

Learning Objectives

1. To comprehend the various classes of phytochemicals present in the plant kingdom
2. To understand the biosynthetic processes through which diverse phytochemicals are synthesized and to study their structural and functional characteristics

Course Outcomes

On com	letion of this course, the students will be able to:	
CO1	understand the role of plants in the survival of human beings and other organisms.	**K1**
CO2	recognition of the contribution made by primitive people in exploration of plantknowledge to alleviate common diseases and development of systems of medicine.	**K2**
CO3	gaining knowledge on different classes of phytochemicals present in higher andlower plants species.	**K3**
CO4	demonstrate the various aspects of extraction, isolation and characterization of secondary metabolites.	**K4 & K5**
CO5	know the methods of screening of secondary metabolites for various biological properties.	**K6**

UNIT	CONTENTS	No. of hours
I	**SECONDARY METABOLITES AND CLASSIFICATION :** Phytochemistry: Definition, history, principles. Secondary metabolites: definition, classification, occurrence and distribution in plants, functions, chemical constituents. Alkaloids, terpenoids, flavonoids, steroids, and coumarins.	**12**
II	**ISOLATION AND QUANTIFICATION OF PHYTOCHEMICALS:** Techniques for isolation of medicinally important biomolecules: solvent extraction, chemical separations, steam distillation, soxhlet extraction. Purification, concentration, determination and quantification of compounds (TLC, Column, HPLC). Characterization of phytochemicals: spectroscopic methods.	**12**
III	**BIOSYNTHETIC PATHWAYS AND APPLICATION OF PHYTOCHEMICALS :** Biosynthetic pathways of secondary compounds: Shikimic pathway; Mevalonic Acid Pathway; Pathways for commercially important phytochemicals: Taxol and *Vinca* alkaloids. Applications of	**12**

	phytochemicals in medicine, pharmaceuticals, food, flavour and cosmetic industries.	
IV	**HERBALISM AND ETHNOBOTANY:** Herbs and healing: Historical perspectives: local, national and global level; Herbalcultures: origin and development of human civilizations; Ethnobotany and Ethno medicine; Development of European, South and Central American, African, Indian, Chinese, and South East Asian Herbal Cultures.	**12**
V	**TRADITIONAL SYSTEM OF MEDICINE:** Classical health traditions: Systems of medicine: origin and development of biomedicine; Indian Systems of Medicine (Ayurveda, Siddha, Unani, Tibetan, Yoga and Naturopathy) Ayurveda: Historical perspective, *Athuravritta* (disease management and treatment which involves eight specialties including Internal medicine and surgery); Fundamental principles of Ayurveda: Panchabhootha theory, Thridosha theory, Saptadhatu theory and *Mala* theory; Ayurvedic Pharmacology Ayurvedic Pharmacopoeia; *Vrikshayurveda.*	**12**

Textbooks

1. Kokate, C.K., Purohit, A.P and Gokhale, S.B, 2020. Pharmacognosy. Vol. I & II. NiraliPrakashan, Pune.
2. Mohamed Ali, 2022. Textbook of Pharmacognosy. CBS Publishers & Distributors Pvt. Ltd., New Delhi.
3. Gokhale, S.B., Kokate, C.K. and Gokhale. A, 2016. Pharmacognosy of Traditional Drugs. NiraliPrakashan, 1st Edition. ISBN: 9351642062.
4. Joshi, S.G, 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi.
5. Kumar. N, 2018. A Textbook of Pharmacognosy. Aitbs Publishers, India.

Reference books

1. Shah, B.N, 2005. Textbook of Pharmacognosy and phytochemistry. Cbs Publishers & Distributors, New Delhi.
2. Harshal A and Pawar, 2018. Practical book of pharmacognosy and phytochemistry-Everest Publishing house.
3. Varsha Tiwari and Shamim Ahmad, 2018. A practical book of pharmacognosy and phytochemistry. Nirali prakashan advancement of knowledge.
4. Braithwaite, A and F.J. Smith, 1996. *Chromatographic Methods* (5^{th} Edition) Blackie Academic & Professional London.
5. Wilson, K and J. Walker (Eds), 1994. Principles and Techniques of PracticalBiochemistry (4^{th}Edition) Cambridge University Press, Cambridge.

Mapping with Programme Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PSO1	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	PS O10
CO1	3	3	3	3	2	2	3	1	3	3	3	3	2	3	2	2	2
CO2	3	3	3	2	2	3	2	1	2	3	2	3	3	3	3	3	3
CO3	3	3	3	3	3	2	3	2	1	2	1	3	3	3	1	2	3
CO4	2	3	3	3	3	3	3	2	2	3	2	3	3	2	2	3	3
CO5	2	3	3	3	3	2	2	2	2	2	3	2	2	3	3	3	3
Total	13	15	15	14	13	12	13	8	10	13	11	14	13	14	11	13	14
Averag	2.6	3	3	2.8	2.6	2.4	2.6	1.6	2	2.6	2.2	2.8	2.6	2.8	2.2	2.6	2.8

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

Semester II

SKILL ENHANCEMENT (SE1)

NURSERY AND GARDENING

Course Code	L	T	P	S	Credits	Inst.Hours	Total Hours	Marks		
								CIA	External	Total
BP232SE1	2		-	-	2	2	30	25	75	100

Pre-requisite

Students should know nursery and gardening practices

Learning Objectives

1. To recognize the importance of nursery and gardening (Knowledge).

2. To gain an understanding of nursery management(Skill).

Course outcomes

On completion of this course, the students will be able to:		
1	recognize the basic process required for growing and maintaining plants in nurseries.	K1
2	explain the different methods of plant propagation and various gardening styles.	K2
3	apply techniques for effective hardening of plants and computer applications for creative gardening.	K3& K6
4	compare and contrast cultivation of different vegetables and growth of plants in nursery and gardening.	K4
5	develop new strategies to enhance growth and quality of nursery plants.	K5 & K6

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

UNIT	CONTENTS	No.of hours
I	**NURSERY:** Definition, objectives and scope and building up of infrastructure for nursery,	6

	planning and seasonal activities - Planting - direct seeding and transplants.	
II	SEED: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion - Seed production technology - seed testing and certification.	6
III	**VEGETATIVE PROPAGATION:** Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber, shed root, shade house and glasshouse.	6
IV	**GARDENING:** definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping.	6
V	**GARDENING OPERATIONS:** Soil laying, manuring, watering, management of pests and diseases and harvesting. Sowing/raising of seeds and seedlings: Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.	6

Self study	Planting - direct seeding and transplants. Seed testing and certification.

Textbooks

1. Bose T.K and Mukherjee, D. 2000. *Gardening in India*, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K. 2005. *Plant Propagation*, Wile Eastern Ltd., Bengaluru.
3. Kumar, N. 2007. *Introduction to Horticulture*, Rajalakshmi Publications, Nagercoil.

Reference Books:

1. N.L. Patel, S.L. Chawla, T.R. Ahlawat. 2016. *Commercial Horticulture*, ASPEE College of Horticulture, Navsari Agricultural University, Navsari 396 450, Gujarat,
2. Prasad S & Kumar U. 2005. *Greenhouse Management for Horticultural Crops*. 2nd Ed. Agrobios.
3. George Acquaah, 2002, *Horticulture-principles and practices*. Prentice-Half of India pvt. Ltd., New Delhi.

Web resources:

1. https://www.kopykitab.com/Nursery-And-Gardening-SEC-by-Prof-C-D-Patil-Dr-G-M-Rane-Dr-S-A-Patil
2. https://www.wonderslate.com/nursery-and-gardening-management/ebook-details?siteName=books&bookId=38078&preview=true
3. https://books.google.co.in/books/about/Nursery_Hindi_Book_Bonsai_Plants_Nursery.html?id=-nfDDwAAQBAJ&redir_esc=y
4. https://www.amazon.in/Gardening-Books/b?ie=UTF8&node=1318122031
5. https://www.worldcat.org/title/handbook-of-horticulture/oclc/688653648

Mapping with Programme Outcomes:

COs	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PSO 1	PS O2	P S O 3	PS O4	PSO 5	PSO 6	PS O7	PS O8	PS O9	PS O1 0
CO1	3	3	1	3	2	3	1	1	2	2	3	2	3	2	2	3	2
CO2	3	3	2	2	3	3	3	3	2	3	2	3	3	2	3	3	3
CO3	2	2	3	3	1	3	2	2	1	3	3	1	3	2	2	3	3
CO4	3	3	3	3	3	3	2	2	3	3	3	1	3	3	3	2	3
CO5	3	3	2	3	2	3	3	3	1	2	3	2	3	3	2	2	3
Total	15	14	11	14	11	15	11	11	9	13	14	9	15	12	12	13	14
Average	3	2.8	2.2	2.8	2.2	3	2.2	2.2	1.8	2.6	2.8	1.8	3	2.4	2.4	2.6	2.8

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