

# **Holy Cross College (Autonomous), Nagercoil**

**Kanyakumari District, Tamil Nadu.**

**Accredited with A<sup>+</sup> 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)

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

### Mapping of PO'S and PSO'S

<b>POs</b>	<b>PSO1</b>	<b>PSO 2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	<b>PSO6</b>
<b>PO 1</b>	2	3	3	2	2	3
<b>PO 2</b>	3	3	3	3	3	3
<b>PO 3</b>	3	3	3	2	3	3
<b>PO4</b>	3	2	2	3	2	2
<b>PO5</b>	3	2	3	3	3	3
<b>PO6</b>	3	3	2	3	3	3
<b>Total</b>	17	16	16	16	16	17
<b>Average</b>	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
<b>Total Marks</b>		<b>2100</b>

### Course Structure

#### (i) Curricular Courses

#### Distribution of Hours and Credits

Course	Sem.I	Sem.II	Sem.III	Sem.IV	Total	
					Hours	Credits
Core– Theory	7 (5) +	5 (4)+	6 (5) +	5 (4) +		
Core Practical	7 (5) + 6 (4)	5 (4)+ 5 (4)	6 (5) + 6 (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
<b>Total</b>	<b>30 (20)</b>	<b>30 (22)</b>	<b>30 (26)</b>	<b>30 (23)</b>	<b>120</b>	<b>91</b>

#### (ii) Co-curricular Courses

Course	SEMESTER				Total Credits
	I	II	III	IV	
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: 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		
	<b>Total</b>	<b>20</b>	<b>30</b>

**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
BP232CP1	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
	<b>Total</b>	<b>22</b>	<b>30</b>

## Co-curricular Courses

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
<b>Total</b>			<b>10</b>

## 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
<b>Total</b>	<b>25</b>

## 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
<b>Total</b>	<b>40</b>	<b>Total</b>	<b>100</b>

**ii) Lab Course:**

Ratio of Internal and External= 25:75

Total: 100 marks

**Internal Components and Distribution of Marks**

<b>Internal Components</b>	<b>Marks</b>
Performance of the Experiments	10
Regularity in attending practical and submission of records	5
Record	5
Model exam	5
<b>Total</b>	<b>25</b>

**Question pattern**

<b>External Exam</b>	<b>Marks</b>
Major Practical	75
Minor Practical / Spotters /Record	
<b>Total</b>	<b>75</b>

**iii) Skill Enhancement Course**

Ratio of Internal and External = 25: 75

**Internal Components and Distribution of Marks**

<b>Components</b>	<b>Marks</b>
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
<b>Total</b>	<b>25</b>

**Question Pattern**

<b>Internal Test</b>	<b>Marks</b>	<b>External Exam</b>	<b>Marks</b>
Part A 2 x 2(No Choice)	4	Part A 5 x 2(No Choice)	10
Part B 3 x 4 (Open choice <b>Three</b> out of <b>Five</b> )	12	Part B 5 x 5 (Open choice any <b>Five</b> out of <b>Eight</b> )	25
Part C 1 x 9 (Open choice <b>One</b> out of <b>Three</b> )	9	Part C 5 x 8 (Open choice any <b>Five</b> out of <b>Eight</b> )	40
<b>Total</b>	<b>25</b>	<b>Total</b>	<b>75</b>

**iv) Internship/ Industrial Activity**

<b>Components</b>	<b>Marks</b>
Industry Contribution	50
Report & Viva-voce	50

v) **Core Project:**

Ratio of Internal and External 25 : 75

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

**Co-Curricular Courses:**

**(i) Life Skill Training  
Internal Component**

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

**External Component**

<b>Written Test</b>	Five out of Seven (5 x 10)	50
	<b>Total</b>	<b>50</b>

**(ii) Field Project:**

<b>Components</b>	<b>Marks</b>
Field Work	50
Report & Viva-voce	50

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

<b>Components</b>	<b>Marks</b>
Internal	25
External	75

**(iv) Community Engagement Activity-UBA**

<b>Internal Component</b>	
<b>Component</b>	<b>Marks</b>
Attendance (Field Work)	30
Participation	20
<b>Total</b>	<b>50</b>



### External Component

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

### Outcome Based Education

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

S. No	Level	Parameter	Description
1	K1	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	K1			K2			K3			K4, K5, K6			Total
		A	B	C	A	B	C	A	B	C	A	B	C	
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

- The performance of a student in each Course is evaluated in terms of percentage of marks with a provision for conversion to grade points.
- 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.
- 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:**

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

**For the entire programme:**

Cumulative Grade Point Average (CGPA)  $\frac{\sum_n \sum_i C_{ni} G_{ni}}{\sum_n \sum_i C_{ni}}$

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

Where

$C_i$  - Credits earned for course i in any semester

$G_i$  - Grade point obtained for course i in any semester

n - semester in which such courses were credited

### **Final Result**

#### **Conversion of Marks to Grade Points and Letter Grade**

<b>Range of Marks</b>	<b>Grade Points</b>	<b>Letter Grade</b>	<b>Description</b>
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

<b>CGPA</b>	<b>Grade</b>	<b>Classification of Final Results</b>
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+	
5.0 and above but below 5.5	B	Second Class
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:		
<b>1</b>	relate to the structural organizations of algae, fungi, lichens and Bryophytes	<b>K1</b>
<b>2</b>	demonstrate both the theoretical and practical knowledge in understanding the diversity of basic life forms and their importance.	<b>K2</b>
<b>3</b>	explain life cycle patterns in algae, fungi, lichens and Bryophytes	<b>K3</b>
<b>4</b>	compare and contrast the mode of reproduction in diverse groups of basic plant forms.	<b>K4</b>
<b>5</b>	discuss and develop skills for effective conservation and utilization of lower plant forms.	<b>K5&amp; K6</b>

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

Unit	Contents	No. of Hours
<b>I</b>	<b>ALGAE</b> 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: <i>Oscillatoria</i> , <i>Ulva</i> , <i>Diatoms</i> and <i>Dictyota</i> ..	<b>21</b>
<b>II</b>	<b>FUNGI</b> General Characteristics, occurrence and distribution. Mode of nutrition in fungi. Contributions of Indian Mycologists (C.V.Subramanian), Classification of Fungi by Alexopoulos and Mims (1979) & Recent trends in the classification of fungi - Phylogeny and inter-relationships of major groups of fungi. General	<b>21</b>

	<p>characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.</p> <p>Heterothallism in fungi, sexuality in fungi, Para sexuality, sex hormones in fungi.</p> <p>Structure, reproduction and life histories of the following genera: <i>Plasmodiophora</i>, <i>Phytophthora</i>, <i>Rhizopus</i>, <i>Taphrina</i>, <i>Polyporus</i> and <i>Colletotrichum</i>.</p>	
<b>III</b>	<p><b>LICHENS</b></p> <p>Introduction and Classification (Hale, 1969). Occurrence and inter-relationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basiodi lichens and Deuterolichens..</p>	<b>21</b>
<b>IV</b>	<p><b>BRYOPHYTES</b></p> <p>General characters and Classification of Bryophytes by Watson (1971). Distribution, Structural variations and evolution of gametophytes and sporophytes in Bryopsida, Anthocero psida 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: <i>Targionia</i>, <i>Porella</i> and <i>Polytrichum</i>.</p>	<b>21</b>
<b>V</b>	<p><b>ECONOMIC IMPORTANCE</b></p> <p>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 <i>Pleurotus</i>. Lichen –economic importance and as indicator pollution. Bryophytes – Ecological and economic importance – industry, horticulture and medicine.</p>	<b>21</b>

### 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. 20<sup>th</sup> 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](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
<b>CO1</b>	3	3	2	3	2	1	2	2	2	2
<b>CO2</b>	3	3	2	2	3	3	2	3	2	3
<b>CO3</b>	2	2	3	3	1	2	1	3	1	3
<b>CO4</b>	3	3	3	3	3	2	3	3	3	3
<b>CO5</b>	3	3	2	3	2	3	3	3	3	3
<b>Total</b>	14	14	12	14	11	11	12	15	11	14
<b>Average</b>	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 fundamentals 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.	<b>K1 &amp; K2</b>
CO2	learn the morphological/anatomical organization, life history of major types of Pteridophytes and Gymnosperms.	<b>K2 &amp; K4</b>
CO3	comprehend the economic importance of Pteridophytes, Gymnosperms and fossils.	<b>K3 &amp; K5</b>
CO4	understanding the evolutionary relationship of Pteridophytes and Gymnosperms.	<b>K4 &amp; K6</b>
CO5	awareness on fossil types, fossilization and fossil records of Pteridophytes and Gymnosperms.	<b>K5 &amp; K6</b>

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

Units	Contents	No. of Hours
<b>I</b>	<b>PTERIDOPHYTES:</b> 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.	<b>21</b>
<b>II</b>	<b>PTERIDOPHYTES:</b> Structure, anatomy, reproduction and life histories of the following genera: <i>Equisetum</i> , <i>Angiopteris</i> , <i>Pteris</i> and <i>Azolla</i> .	<b>21</b>
<b>III</b>	<b>GYMNOSPERMS:</b> General characters - A general account of distribution of Gymnosperms. Morphology, anatomy, reproduction, phylogeny and classification (K.R.Sporne, 1965). Economic importance of Gymnosperms.	<b>21</b>
<b>IV</b>	<b>GYMNOSPERMS:</b> Structure (Exomorphic and endomorphic), anatomy, reproduction and life histories of the following genera: <i>Cedrus</i> , <i>Cupressus</i> , <i>Araucaria</i> , <i>Podocarpus</i> , <i>Gnetum</i> and <i>Ephedra</i> .	<b>21</b>
<b>V</b>	<b>PALEOBOTANY:</b>	<b>21</b>

Geological Scale; Radiocarbon dating; Contribution of Birbal Sahni to Paleobotany. 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: <i>Rhynia</i> , <i>Lepidocarpon</i> , <i>Calamites</i> , <i>Cordaites</i> and <i>Lyginopteris</i> .
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### Text books

1. Vashishta, P.C. Sinha, A.K and Anil Kumar. (2016). Botany for Degree students.

<b>Self Study</b>	Morphology Characters of Pteridophytes and Gymnosperms, Economic importance of Gymnosperms, Gondwana flora of India, Fossilization and fossil types.
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- 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

### 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. (2<sup>nd</sup> 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.bsienviis.nic.in/Database/Pteridophytes-in-India\\_23432.aspx](http://www.bsienviis.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](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
<b>Total</b>	15	14	13	15	15	12	14	12	14	12
<b>Average</b>	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 level identification 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
<b>I</b>	<b>ALGAE</b> 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: <i>Oscillatoria</i> , <i>Ulva</i> , <i>Diatoms</i> , <i>Dictyota</i> , <i>Padina</i> and <i>Gelidium</i> (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).	<b>18</b>
<b>II</b>	<b>FUNGI</b> Study of morphological and reproductive structures of the following living forms: <i>Plasmodiophora</i> , <i>Phytophthora</i> , <i>Rhizopus</i> , <i>Taphrina</i> , <i>Polyporus</i> and <i>Colletotrichum</i> (depending on availability of the specimen).	<b>18</b>

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

<b>Self Study Portion</b>	<i>Oscillatoria</i> , <i>Usnea</i> , <i>Anthoceros</i> , <i>Rhynia</i> ((Fossil), <i>Araucaria</i>
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#### 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](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**

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	2	3	3	3	3	3	3	3	3	3
<b>CO2</b>	3	3	2	3	3	3	1	3	1	3
<b>CO3</b>	3	3	3	3	3	3	2	3	2	3
<b>CO4</b>	3	3	2	1	2	2	1	2	1	3
<b>CO5</b>	3	3	3	3	3	3	3	2	3	2
<b>Total</b>	14	15	13	13	14	14	10	13	10	14
<b>Average</b>	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**

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

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

Units	Contents	No. of Hours
<b>I</b>	<b>BACTERIA:</b> 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.	<b>15</b>
<b>II</b>	<b>VIRUSES:</b> 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	<b>15</b>

	Lysogenic cycle. Viroids and prions. Mycoplasma: Structure and classification.	
<b>III</b>	<p><b>FOOD MICROBIOLOGY:</b> Beneficial role of microbes – yoghurt, Olives, Cheese, Bread, Wine, Tempeh, Miso &amp; Fermented green tea. Spoilage of fruits, vegetables, meats, poultry, eggs, bakery products, dairy products and canned foods. Microbial toxins - Exotoxin, Endotoxin &amp; Mycotoxin. Action of Enterotoxin, Cytotoxin &amp; 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) &amp; with higher plants (rhizosphere &amp; 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 <b>Measles</b>. Microbial degradation of chemical pesticides and hydrocarbon.</p>	<b>15</b>
<b>IV</b>	<p><b>IMMUNOLOGY:</b> 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.</p>	<b>15</b>
<b>V</b>	<p><b>PLANT PATHOLOGY:</b> <b>History and significance of plant pathology. Classification of plant diseases, Symptomology (important symptoms of plant pathogens).</b> Causal agents of plant diseases - biotic causes (fungi, bacteria virus, mycoplasma, nematodes, parasitic algae, angiospermic parasites - Abiotic causes (Physiological, deficiency of nutrients &amp; 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).</p>	<b>15</b>

<b>Self Study</b>	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.
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## 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
<b>Total</b>	15	15	13	13	15	15	11	9	11	9
<b>Average</b>	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.	<b>K1</b>
CO2	critically analyze the sustainable utilization land, water, forest and energy resources	<b>K2 &amp; K6</b>
CO3	evaluate the management strategies of different natural Resources	<b>K3</b>
CO4	reflect upon the different national and international efforts in resource management and their conservation.	<b>K4</b>
CO5	state the various environmental policy passed to conserve the natural resources.	<b>K5</b>

UNIT	CONTENTS	No.of hours
<b>I</b>	<b>NATURAL RESOURCES:</b> 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.	<b>15</b>
<b>II</b>	<b>FOREST RESOURCES:</b> 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.	<b>15</b>
<b>III</b>	<b>LAND AND SOIL RESOURCES:</b> 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–	<b>15</b>

	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.	
<b>IV</b>	<b>MINERAL RESOURCES:</b> 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.	<b>15</b>
<b>V</b>	<b>ENVIRONMENTAL POLICY IN INDIA:</b> 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.	

<b>Self Study</b>	Equitable resource use for sustainable life system, Agroforestry – Social Forestry, Watershed Programme, Food Resources, National Land Use Policy 1988 – Industrial Policy 1991.
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### **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, Menu 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](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**

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>
<b>CO1</b>	3	3	3	3	2	3	2	3	2	3
<b>CO2</b>	3	3	3	3	2	2	1	3	1	3
<b>CO3</b>	3	3	3	2	2	2	1	3	1	3
<b>CO4</b>	3	3	3	2	2	2	1	3	1	3
<b>CO5</b>	3	3	3	2	2	2	1	3	1	3
<b>Total</b>	15	15	15	12	10	11	6	15	6	15
<b>Average</b>	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		
<b>CO 1</b>	knowledge on identification of edible and toxic mushrooms belonging to ascomycota and basidiomycota.	<b>K1, K3</b>
<b>CO2</b>	outline the nutraceutical properties of edible mushrooms.	<b>K2, K4</b>
<b>CO3</b>	knowledge on cultivation techniques of edible and medicinal mushrooms.	<b>K3, K6</b>
<b>CO4</b>	understand the harvest and post-harvest techniques of mushroom crops.	<b>K4</b>
<b>CO5</b>	knowledge on the production and marketing strategies for mushrooms.	<b>K5</b>

UNIT	CONTENTS	No. of Hours
<b>I</b>	<b>INTRODUCTION:</b> Mushroom, Edible Mushroom, commercial production, medicinal value of mushrooms, nutraceuticals and dietary supplements	<b>15</b>
<b>II</b>	<b>MORPHOLOGICAL AND MICROSCOPICAL IDENTIFICATION OF EDIBLE AND POISONOUS MUSHROOMS:</b> Keys for identification of edible mushrooms: <i>Agaricus bisporus</i> , <i>Pleurotus sajorcaju</i> , <i>Volvariella volvcea</i> and <i>Calocybe indica</i> . Key for identifying hallucinogenic mushroom ( <i>Psilocybe</i> sp.) Medicinal Mushroom – <i>Cordyceps</i> , <i>Ganoderma lucidum</i> and <i>Lentinus edodes</i> .	<b>15</b>
<b>III</b>	<b>CULTIVATION:</b> Substrate sterilization, bed preparation, cropping room and maintenance, raising of pure culture and spawn preparation, factors effecting button mushroom production (Temp, pH, air and water management, competitor moulds and other disease).	<b>15</b>
<b>IV</b>	<b>POST-HARVEST MANAGEMENT:</b> Harvest, storage, quality assurance of mushrooms. Pestmanagement.	<b>15</b>
<b>V</b>	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.	<b>15</b>

<b>Self study</b>	Nutraceuticals and dietary supplements, Medicinal Mushroom – <i>Cordyceps</i> , <i>Ganoderma lucidum</i> and <i>Lentinus edodes</i> , Substrate sterilization
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### 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. 2<sup>nd</sup> 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 4<sup>th</sup> 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](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](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
<b>Total</b>	15	15	10	13	11	12	11	14	11	13
<b>Average</b>	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.	<b>K1</b>
CO 2	understand the life style and traditional practices of plants by Indian tribals.	<b>K2&amp;K6</b>
CO3	highlight the role of Non-Timber Forest products for livelihood of tribal people of India	<b>K3</b>
CO 4	assess the methods to transform ethnobotanical knowledge into value added products	<b>K4</b>
CO 5	build idea to make digitization of ethnobotanical knowledge.	<b>K5</b>

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

Unit	Contents	No. of Hours
I	<b>ETHNOBOTANY:</b> 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	<b>PLANTS USED BY TRIBALS OF INDIA:</b> 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	<b>SOURCES OF ETHNOBOTANICAL DATA:</b> 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	<p><b>NATUROPATHIC MEDICINE:</b>  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</p> <p><b>TRADITIONAL HEALTH CARE:</b>  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.</p>	15
V	<p><b>BIOPROSPECTING AND VALUE ADDITION:</b>  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).</p>	15

<b>Self study</b>	Sub disciplines of ethnobotany, Plants used by tribals of Tamilnadu, Non Timber Forest Products (NTFP), Indian systems of medicine, Traditional Knowledge Digital Library (TKDL)
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### 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](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**

<b>Cos</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	2	3	3	3
<b>CO3</b>	3	3	3	2	3	3	3	3	3	3
<b>CO4</b>	3	3	3	3	2	3	3	3	2	3
<b>CO5</b>	3	3	3	3	3	3	3	3	3	3
<b>Total</b>	15	15	15	14	14	15	14	15	4	15
<b>Average</b>	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**

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

UNIT	CONTENTS	No of hours
<b>I</b>	<b>SCOPE OF ALGAL TECHNOLOGY :</b> Scope of algal technology – Commercial potential and utility of algae. Algae as sources for food, feed, pigments, Pharmaceuticals and nutraceuticals, fine chemicals, fuel, biofertilizers and hormones. Economic importance of algae in India.	<b>15</b>
<b>II</b>	<b>ALGAL PRODUCTS:</b> 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.	<b>15</b>
<b>III</b>	<b>ALGAL PRODUCTION AND UTILIZATION :</b> 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.	<b>15</b>
<b>IV</b>	<b>IMMOBILIZATION AND RDNA TECHNOLOGY IN ALGAE :</b> 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.	<b>15</b>
	<b>ROLE OF ALGAE IN ENVIRONMENT MANAGEMENT :</b> 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	<b>15</b>

<b>V</b>	ecosystem environment. Algal culture collection centers in India and abroad and their importance.	
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<b>Self study</b>	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.
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### 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., Wiczorek, 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](https://www.researchgate.net/publication/318449035_Algae_Biotechnology)
3. [https://www.energy.gov/sites/prod/files/2015/04/f21/algae\\_marrone\\_132100.pdf](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
<b>CO1</b>	3	3	3	3	3	3	3	1	3	1
<b>CO2</b>	3	3	3	2	3	3	3	2	3	2
<b>CO3</b>	3	2	3	2	2	3	1	1	1	1
<b>CO4</b>	3	3	3	3	3	3	3	2	3	2
<b>CO5</b>	3	2	3	3	3	3	3	1	3	1
<b>Total</b>	15	13	15	13	14	15	13	7	13	7
<b>Average</b>	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**

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

<b>UNIT</b>	<b>CONTENTS</b>	<b>No of hours</b>
<b>I</b>	<b>PHARMACOGNOSY:</b> 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.	<b>15</b>
<b>II</b>	<b>PLANT TISSUE CULTURE AS SOURCE OF MEDICINES:</b> Plant tissue culture as source of medicines, Role of plant tissue culture in enhancing secondary metabolite production ( <i>Withania somnifera</i> , <i>Rauwolfia serpentina</i> , <i>Catheranthus roseus</i> , <i>Andrographis paniculata</i> and <i>Dioscorea sp</i> ) - Elicitation - Biotransformation, Hairy root culture. Factors affecting secondary metabolites production. Biogenesis of phytopharmaceuticals.	<b>15</b>
<b>III</b>	<b>PLANT PROPAGATION ANALYSIS OF PHYTOCHEMICALS:</b> 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.	<b>15</b>
<b>IV</b>	<b>GENERAL METHODS OF PHYTOCHEMICAL AND BIOLOGICAL SCREENING:</b> Carbohydrates and derived products: Glycosides - extraction methods ( <i>Digitalis</i> , <i>Dioscorea</i> ); Tannins (Hydrolysable and Condensed types); Volatile oils - extraction methods (Clove, Mentha). Study of some herbal formulation techniques as drug cosmetics.	<b>15</b>

<b>V</b>	<b>TYPES OF PHYTOCHEMICALS</b> :Alkaloids - extraction methods ( <i>Taxus</i> , <i>Cinchona</i> ); Flavonoids- extraction methods, Resins- extraction method: Application of phytochemicals in phytopharmaceuticals; Biocides, Biofungicides, Biopesticides. Women entrepreneurship development – marketing cultivated medicinal plants – National Medicinal Plants Board of India.	<b>15</b>
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<b>Self study</b>	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 – National Medicinal Plants Board of India.
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### 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 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.kopykitab.com/Herbal-Science>
2. [https://kadampa.org/books/free-ebook-download-howtoty1?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurCIUCTdV9olKo9TbyAh4fsoFqPYWG5qBTbytD22z7lo0BoCYnUQAvD\\_BwE](https://kadampa.org/books/free-ebook-download-howtoty1?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurCIUCTdV9olKo9TbyAh4fsoFqPYWG5qBTbytD22z7lo0BoCYnUQAvD_BwE)
3. [https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/\\_/N-ry0Z8qaZ11iu](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
<b>Total</b>	15	15	15	15	15	15	15	7	12	15
<b>Average</b>	3	3	3	3	3	3	3	1.4	2.4	3

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

**SEMESTER I  
SPECIFIC VALUE ADDED COURSE**

**NATURAL RESOURCES AND THEIR CONSERVATION**

Course Code	Credits	Total Hours	Total Marks
<b>BP231V01</b>	<b>1</b>	<b>30</b>	<b>100</b>

**Course Outcomes**

<b>On completion of this course the student will be able to</b>		
<b>CO1</b>	explain the natural resources	<b>K1</b>
<b>CO2</b>	recognize the critical role natural resources play in supporting life and ecosystems.	<b>K2</b>
<b>CO3</b>	distinguish between various natural resource categories, including energy resources, and biological resources	<b>K3</b>
<b>CO4</b>	analyze the consequences of the over-exploitation of non renewable resources.	<b>K4</b>
<b>CO5</b>	evaluate the impacts of climate change on natural resources and ecosystems	<b>K5</b>

**Unit : 1**

Introduction to Natural Resources and Conservation- Definition and classification of natural resources Importance of natural resources for human well-being and ecosystem functioning, Overview of conservation goals and strategies, Introduction to ecological principles and systems thinking.

**Unit : 2**

Renewable Resources - Study of renewable resources: water, forests, wildlife, fisheries, and soil,, Sustainable management practices for renewable resources, Case studies of successful renewable resource conservation projects.

**Unit : 3**

Non-Renewable Resources - Exploration of non-renewable resources: minerals, fossil fuels, Environmental impacts of non-renewable resource extraction and utilization, Transitioning to alternative energy sources and sustainable mining practices, Biodiversity and Ecosystem services.

**Unit : 4**

Understanding biodiversity and its importance, Ecosystem services provided by diverse ecosystems, Threats to biodiversity and strategies for biodiversity conservation.

**Unit : 5**

Climate Change and Resource Conservation- Impacts of climate change on natural resources and ecosystems- Mitigation and adaptation strategies for resource conservation in a changing climate, International agreements and policies addressing climate change and resource conservation.

**Reference Books**

Daniel D.Chiras& John P.Regnoild 2016 Text book of Natural Resource Conservation : Management for a Sustainable future, 2nd Edition. Narosa Publisher

**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**

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

UNIT	CONTENTS	No. of hours
<b>I</b>	<b>TAXONOMY AND SYSTEMATICS:</b> Botanical exploration and contribution with special reference to India by William Roxburgh, J.D. Hooker, Robert Wright, Nathaniel 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.	<b>15</b>
<b>II</b>	<b>MODERN TRENDS IN TAXONOMY:</b> 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 amendments of code. Glossories and dictionaries, Taxonomic literature (Index Kewensis)	<b>15</b>
<b>III</b>	<b>SYSTEMATIC ANALYSIS OF PLANTS-I:</b> Polypetalae – Nymphaeaceae, Sterculiaceae, Portulacaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae, Turneraceae.	<b>15</b>
	<b>SYSTEMATIC ANALYSIS OF PLANTS-II:</b> Gamopetalae – Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae, Bignoniaceae,	<b>15</b>

<b>IV</b>	Convolvulaceae, Acanthaceae, Verbenaceae. Monochlamydeae – Nyctaginaceae, Aristolochiaceae, Casuarinaceae. Monocots – Orchidaceae, Amarylidaceae, Liliaceae, Commelinaceae, Cyperaceae.	
<b>V</b>	<b>ECONOMIC BOTANY:</b> General account on utilization of selected crop plants: (i) Cereals (rice and wheat) – (ii) Pulses (red gram and black gram), (iii) Drug yielding plants ( <i>Withania somnifera</i> and <i>Coleus aromaticus</i> ) (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.	<b>15</b>

<b>Self study</b>	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 ( <i>Withania somnifera</i> and <i>Coleus aromaticus</i> ) (iv) Oil yielding plants (Groundnut, sunflower).
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#### 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

<b>CO3</b>	3	3	2	3	1	2	3	3	2	3	3	1	1	3	2	2	2
<b>CO4</b>	3	2	3	3	2	3	2	3	3	1	3	3	3	3	2	2	3
<b>CO5</b>	3	3	2	2	1	1	3	2	1	3	2	1	2	2	3	1	2
<b>Total</b>	15	14	12	14	10	13	13	13	11	11	13	10	10	13	12	10	12
<b>Average</b>	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

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

UNIT	CONTENTS	No. of hours
<b>I</b>	<p><b>CELL WALL:</b> 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.</p>	<b>15</b>
<b>II</b>	<p><b>PERIDERM:</b> 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:</p>	<b>15</b>

	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.	
<b>III</b>	<b>MICROSPORANGIUM AND MALE GAMETOPHYTE:</b> 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.	<b>15</b>
<b>IV</b>	<b>MEGASPORANGIUM AND FEMALE GAMETOPHYTE:</b> Structure and development of Megasporangium; Types of ovules, Endothelium, obturator and nucellus. Megasporogenesis: Female gametophyte: Structure, types, haustorial behavior and Nutrition of embryo sacs. Fertilization: Double fertilization and triple fusion; Endosperm: Development of endosperm, types, physiological efficiency of endosperm haustoria and functions; Ruminant endosperm. Embryogeny: Development of monocot (Grass) and dicot (Crucifer) embryos.	<b>15</b>
<b>V</b>	<b>POLYEMBRYONY:</b> 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.	<b>15</b>

<b>Self study</b>	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.
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#### **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](https://faculty.etsu.edu/liuc/plant_anatomy_sites.htm)
4. [http://aryacollegeludhiana.in/E\\_BOOK/Botany/plant\\_anatomy.pdf](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	PS O2	PS O3	PS O4	PS O5	PS O6	PSO 7	PSO 8	PSO9	PSO10
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
<b>CO2</b>	3	1	3	3	3	3	2	3	3	3	3	3	2	3	3	2	3
<b>CO3</b>	3	1	3	3	3	3	2	3	3	2	3	1	1	3	3	3	2
<b>CO4</b>	3	3	3	1	1	2	3	2	3	2	2	1	3	2	2	2	2
<b>CO5</b>	3	3	3	3	3	3	2	3	2	3	3	2	2	3	2	1	2
<b>Total</b>	15	11	15	13	13	14	12	14	14	13	14	10	11	14	13	11	12
<b>Average</b>	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 ecosystem ecology.	<b>K1 &amp; K2</b>
CO2	understand the applied aspect of environmental botany.	<b>K1 &amp; K4</b>
CO3	spot the sources and pollution and seek remedies to mitigate and rectify them.	<b>K2 &amp; K6</b>
CO4	identify different plant communities, categorize plant biomes and identify threatened, endangered plant species and create awareness program in protection of biodiversity.	<b>K3 &amp; K6</b>
CO5	analyze insight into the vegetation types, species interaction and their importance and the factors influencing the environmental conditions.	<b>K5</b>

UNIT	CONTENTS	No. of hours
<b>I</b>	<b>ECOLOGICAL PRINCIPLES:</b> 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.	<b>15</b>
<b>II</b>	<b>ECOSYSTEM ECOLOGY AND RESOURCE ECOLOGY:</b> 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. <b>Resource Ecology:</b> Energy resources; renewable and non-renewable. <b>Soil:</b> Formation, types and profile - erosion and conservation, Water resources – conservation and management. <b>Environment Deterioration:</b> 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	<b>15</b>
	<b>PHYTOGEOGRAPHY:</b> Phytogeographical Zones - Vegetation types of India	<b>15</b>

<b>III</b>	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.	
<b>IV</b>	<b>BIODIVERSITY AND CONSERVATION ECOLOGY:</b> 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- <i>in situ</i> and <i>ex situ</i> methods.	<b>15</b>
<b>V</b>	<b>INTELLECTUAL PROPERTY RIGHTS:</b> 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.	<b>15</b>

**Textbooks:**

<b>Self study</b>	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.
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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 Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
3. 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
<b>CO1</b>	3	3	3	3	2	3	2	3	2	1	2	3	2	3	3	2	1
<b>CO2</b>	3	3	2	3	3	3	3	2	3	3	2	3	3	3	2	3	3
<b>CO3</b>	3	2	3	2	2	2	1	3	1	1	2	1	2	1	1	2	1
<b>CO4</b>	3	3	2	3	3	3	2	2	2	3	1	3	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3	3	3
<b>Total</b>	15	14	13	14	13	14	11	13	11	11	10	12	13	12	12	13	11
<b>Average</b>	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 completion of this course, the students will be able to:		
CO1	to gain recent advances in plant morphological and floral characteristics.	<b>K1</b>
CO2	understand about different floral characteristics and artificial key preparation which employed for plant identification and conservation.	<b>K2</b>
CO3	recall or remember the information including basic and advanced in relation with plant anatomy and embryology.	<b>K4 &amp; K5</b>
CO4	apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	<b>K3</b>
CO5	know about different vegetation sampling methods.	<b>K3</b>

UNIT	EXPERIMENTS
<b>I</b>	<p><b>TAXONOMY AND ECONOMIC BOTANY OF ANGIOSPERMS</b></p> <p>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.  <b>Field trip:</b>            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.</p>
<b>II</b>	<p><b>ANATOMY</b></p> <ol style="list-style-type: none"> <li>1. Study of shoot apex of <i>Hydrilla</i></li> <li>2. Observation of cambial types.</li> <li>3. Sectioning and observation of nodal types.</li> <li>4. Study of anomalous secondary growth of the following:              STEM- <i>Nyctanthus</i>, <i>Bouerhavia</i>, <i>Bignonia</i>, <i>Piper betal</i> and <i>Mirabilis</i>.              ROOT: <i>Acyranthus</i></li> <li>5. Observation of stomatal types by epidermal peeling.</li> </ol>

	6. Maceration of wood and observation of the components of xylem. 7. Double staining technique to study the stem anomaly.
<b>III</b>	<b>EMBRYOLOGY</b> 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.
<b>IV</b>	<b>ECOLOGY</b> 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.
<b>V</b>	<b>PHYTOGEOGRAPHY, CONSERVATION BIOLOGY &amp; INTELLECTUAL PROPERTY RIGHTS</b> 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.

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

**Web resources:**

- <https://www.kobo.com/gr/en/ebook/phytochemistry-2>
- <https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H>
- <https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ>
- <https://studyfrnd.com/pharmacognosy-and-phytochemistry-book/>
- <https://www.worldcat.org/title/textbook-of-pharmacognosy-and-phytochemistry/oclc/802053616>.
- <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
<b>Total</b>	15	14	13	15	15	14	13	14	13	11	14	14	13	12	12	14	14
<b>Average</b>	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 completion of this course, the students will be able to:		
CO1	create and interpret visual representations of quantitative information, such as graphs or charts.	<b>K5 &amp; K6</b>
CO2	solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods	<b>K3 &amp; K5</b>
CO3	know the latest version using in statistical tools and apply the tools to interpret the results	<b>K2</b>
CO4	develop their competence in hypothesis testing and interpretation.	<b>K4</b>
CO5	understand why biologists need a background in statistics.	<b>K1</b>

UNIT	CONTENTS	No. of hours
<b>I</b>	<b>INTRODUCTION TO STATISTICS</b> 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.	<b>12</b>
<b>II</b>	<b>DESCRIPTIVE STATISTICS</b> Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range of variation, standard deviation and standard error and coefficient variation.	<b>12</b>
<b>III</b>	<b>PROBABILITY</b> Basic principles - types - Rules of probability - addition and multiplication rules. <b>PROBABILITY DISTRIBUTION</b> Patterns of probability distribution; binomial - Poisson and normal.	<b>12</b>
<b>IV</b>	<b>HYPOTHESIS TESTING</b> 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).	<b>12</b>
<b>V</b>	<b>CORRELATION AND REGRESSION</b> 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.	<b>12</b>

<b>Self Study</b>	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
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### Textbooks

1. Gurumani. N, 2005. Biostatistics, 2<sup>nd</sup> 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. Scheffler, W.C, 1968. Statistics for biological sciences, Addison- Wesley 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. Freeman 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
<b>CO 1</b>	3	2	1	3	3	3	3	3	3	1	3	1	3	2	1	2	2
<b>CO 2</b>	3	2	2	3	3	1	1	3	2	1	2	1	1	3	1	3	2
<b>CO 3</b>	3	1	2	3	3	2	2	3	3	2	2	2	2	1	2	1	1
<b>CO 4</b>	3	2	1	3	2	3	3	2	3	3	3	3	3	1	3	1	2
<b>CO 5</b>	3	2	3	3	3	2	1	3	3	1	3	1	1	2	1	2	2
<b>Total</b>	15	9	9	15	14	11	10	14	14	8	13	8	10	9	8	9	9
<b>Average</b>	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 completion of this course, the students will be able to:		
CO1	recall the history and foundation of Intellectual Property.	<b>K1</b>
CO2	understand the differences of Property and Assets and Various categories of Intellectual Creativity.	<b>K2</b>
CO3	apply the methods to protect the Intellectual Property.	<b>K3</b>
CO4	differentiate if the Said Intangible property be protected under law or protected by strategy.	<b>K4</b>
CO5	create a recommendation document on the methods and procedures of protecting the said IP and search documents to substantiate them.	<b>K5 &amp; K6</b>

UNIT	CONTENTS	No.of hours
<b>I</b>	<b>INTRODUCTION TO IPR</b> 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.	<b>12</b>
<b>II</b>	<b>OVERVIEW OF THE IPR REGIME AND DESIGN</b> 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.	<b>12</b>
<b>III</b>	<b>TRADE MARK, LEGISLATIONS AND PATENT ACT</b> 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.	<b>12</b>

<b>IV</b>	<b>PRIOR ART SEARCH AND DRAFTING</b> 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.	<b>12</b>
<b>V</b>	<b>GI AND PATENT FILING PROCEDURES</b> 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.	<b>12</b>

<b>Self study</b>	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
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#### **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](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](https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf).
5. [https://swayam.gov.in/nd2\\_cec20\\_ge04/preview](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	PSO10
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
<b>Total</b>	15	12	13	13	12	12	11	14	11	13	12	12	11	11	12	12	12
<b>Average</b>	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 computers and MS office tools.

**Learning Objectives**

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

**Course Outcomes**

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

UNIT	CONTENTS	No. of hours
<b>I</b>	<b>BIOINFORMATICS AND INTERNET:</b> 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.	<b>12</b>
<b>II</b>	<b>GENBANK SEQUENCE DATABASE:</b> 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.	<b>12</b>
<b>III</b>	<b>STRUCTURE DATABASES:</b> Introduction to Structures - Protein Data Bank (PDB) - Molecular Modeling Database at NCBI Structure File Formats - Visualizing Structural Information - Database Structure Viewers - Advanced Structure Modeling - Structure Similarity Searching.	<b>12</b>
<b>IV</b>	<b>SEQUENCE ALIGNMENT AND DATABASE SEARCHING:</b> Introduction - Evolutionary Basis of Sequence Alignment - Modular Nature of Proteins - Optimal Alignment Methods - Substitution Scores and Gap Penalties- Database Similarity Searching - FASTA – BLAST (Blast P, Blast N, etc.,) - Position Specific Scoring Matrices, Spliced Alignments.	<b>12</b>
<b>V</b>	<b>PREDICTIVE METHODS:</b> 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.	<b>12</b>

<b>Self study</b>	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.
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### Textbooks

1. Baxevanis, A. D. & Ouellette, B. F, 2021. Bioinformatics: A practical guide to the analysis of genes 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 and Systems 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](https://books.google.co.in/books/about/Applied_Bioinformatics.html?id=PXZZDwAAQBAJ&redir_esc=y)

<b>Mapping with Programme Outcomes</b>																	
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
<b>CO2</b>	2	3	3	3	3	3	3	2	2	3	2	2	3	2	2	2	3
<b>CO3</b>	3	3	3	3	3	3	3	3	3	3	3	3	2	3	1	3	3
<b>CO4</b>	3	3	3	3	3	2	3	3	3	1	3	3	3	3	3	3	3
<b>CO5</b>	3	2	2	2	3	3	2	3	3	3	3	3	2	3	2	2	2
<b>Total</b>	14	14	14	14	15	14	14	14	14	13	14	14	13	14	11	13	14
<b>Average</b>	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 <i>de novo</i> 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

<b>V</b>	NCBI, EMBL, DDBJ, SWISSPORT, Protein prediction and Gene finding tools. Techniques in Bioinformatics- BLAST, FASTA, Multiple Sequence Analysis .	<b>12</b>
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#### 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; 4<sup>th</sup> 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.wikipedia.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
<b>CO1</b>	3	2	2	2	3	3	3	3	3	1	3	3	3	3	2	3	3
<b>CO2</b>	3	2	2	3	3	2	2	3	3	2	3	3	3	2	3	3	3
<b>CO3</b>	3	1	2	3	3	3	2	3	3	1	3	3	3	2	2	2	3
<b>CO4</b>	3	2	1	3	3	2	3	3	2	1	3	2	2	1	3	3	1
<b>CO5</b>	3	1	2	2	3	3	3	3	3	2	3	3	2	2	3	3	2
<b>Total</b>	15	8	9	13	15	13	13	15	14	7	15	14	13	10	13	14	12
<b>Average</b>	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:		
<b>CO1</b>	recognize plants and relate to their medicinal uses	<b>K1</b>
<b>CO2</b>	explain about the phytochemistry, pharmacognosy and bioprospecting of medicinal plant extracts.	<b>K2</b>
<b>CO3</b>	apply techniques for conservation and propagation of medicinal plants.	<b>K3</b>
<b>CO4</b>	analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	<b>K4</b>
<b>CO5</b>	develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India.	<b>K5 &amp; K6</b>

UNIT	CONTENTS	No. of Hours
<b>I</b>	<b>HISTORY AND TRADITIONAL SYSTEMS OF MEDICINE:</b> 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.	<b>12</b>
<b>II</b>	<b>PHYTOCHEMISTRY AND PHARMACOGNOSY:</b> 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.	<b>12</b>
	<b>ACTIVE PRINCIPLE &amp; DRUG DISCOVERY:</b> Brief description of selected plants, Active principles, biochemical properties and medicinal uses of Guggul ( <i>Commiphora</i> ) for hypercholesterolemia, <i>Boswellia</i> for inflammatory disorders, Arjuna ( <i>Terminalia arjuna</i> ) for cardio protection, turmeric ( <i>Curcuma longa</i> ) for wound healing, antioxidant and anticancer properties, Kutaki ( <i>Picrorhiza kurroa</i> ) for hepatoprotection, Opium	<b>12</b>



<b>III</b>	Poppy for analgesic and antitussive, <i>Salix</i> for analgesic, <i>Cinchona</i> and <i>Artemisia</i> for Malaria, <i>Rauwolfia</i> as tranquilizer, <i>Belladonna</i> as anticholinergic, <i>Digitalis</i> as cardiotonic, <i>Podophyllum</i> as antitumor, <i>Stevia rebaudiana</i> for antidiabetic, <i>Catharanthus roseus</i> for anticancer. Bioprospecting, drug discovery from plants with reference to diabetes and cancer. Product development and quality control.	
<b>IV</b>	<b>CONSERVATION AND AUGMENTATION:</b> Significance of Cultivation, management, policies for conservation and sustainable use of medicinal plants. Conservation of endemic and endangered medicinal plants, Red list criteria; <i>In situ</i> conservation: Biosphere reserves, sacred groves, National Parks; <i>Ex situ</i> conservation: Botanic Gardens, Ethno medicinal plant Gardens. Propagation of Medicinal Plants: seeds, cuttings, layering, grafting and budding.	<b>12</b>
<b>V</b>	<b>ETHNO BOTANY AND FOLK MEDICINE:</b> 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.	<b>12</b>

#### **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	PS O2	PS O3	PS O4	PS O5	PS O6	PS O7	PS O8	PS O9	PS O10
<b>CO1</b>	3	3	3	3	3	2	3	3	2	1	3	3	2	3	2	3	2
<b>CO2</b>	3	2	3	3	3	3	2	2	2	1	3	2	3	3	1	2	3
<b>CO3</b>	3	2	3	3	3	2	3	3	3	2	3	3	2	3	2	2	3
<b>CO4</b>	3	2	2	3	3	3	2	3	3	2	3	3	3	2	2	3	3
<b>CO5</b>	3	2	2	3	3	3	3	3	3	2	3	3	3	3	1	3	3
<b>Total</b>	15	11	13	15	15	13	13	14	13	10	15	14	13	14	10	13	14
<b>Average</b>	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 COURSE 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 completion of this course, the students will be able to:		
CO1	understand the role of plants in the survival of human beings and other organisms.	<b>K1</b>
CO2	recognition of the contribution made by primitive people in exploration of plant knowledge to alleviate common diseases and development of systems of medicine.	<b>K2</b>
CO3	gaining knowledge on different classes of phytochemicals present in higher and lower plants species.	<b>K3</b>
CO4	demonstrate the various aspects of extraction, isolation and characterization of secondary metabolites.	<b>K4 &amp; K5</b>
CO5	know the methods of screening of secondary metabolites for various biological properties.	<b>K6</b>

UNIT	CONTENTS	No. of hours
<b>I</b>	<b>SECONDARY METABOLITES AND CLASSIFICATION :</b> Phytochemistry: Definition, history, principles. Secondary metabolites: definition, classification, occurrence and distribution in plants, functions, chemical constituents. Alkaloids, terpenoids, flavonoids, steroids, and coumarins.	<b>12</b>
<b>II</b>	<b>ISOLATION AND QUANTIFICATION OF PHYTOCHEMICALS:</b> 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.	<b>12</b>
<b>III</b>	<b>BIOSYNTHETIC PATHWAYS AND APPLICATION OF PHYTOCHEMICALS :</b> Biosynthetic pathways of secondary compounds: Shikimic pathway; Mevalonic Acid Pathway; Pathways for commercially important phytochemicals: Taxol and <i>Vinca</i> alkaloids. Applications of phytochemicals in medicine, pharmaceuticals, food, flavour and cosmetic industries.	<b>12</b>

<b>IV</b>	<b>HERBALISM AND ETHNOBOTANY:</b> Herbs and healing: Historical perspectives: local, national and global level; Herbal cultures: 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.	<b>12</b>
<b>V</b>	<b>TRADITIONAL SYSTEM OF MEDICINE:</b> 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, <i>Athurvavritta</i> (disease management and treatment which involves eight specialties including Internal medicine and surgery); Fundamental principles of Ayurveda: Panchabhootha theory, Thridosha theory, Saptadhatu theory and <i>Mala</i> theory; Ayurvedic Pharmacology Ayurvedic Pharmacopoeia; <i>Vrikshayurveda</i> .	<b>12</b>

### 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<sup>th</sup> Edition) Blackie Academic & Professional London.
5. Wilson, K and J. Walker (Eds), 1994. Principles and Techniques of Practical Biochemistry (4<sup>th</sup> 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
<b>CO1</b>	3	3	3	3	2	2	3	1	3	3	3	3	2	3	2	2	2
<b>CO2</b>	3	3	3	2	2	3	2	1	2	3	2	3	3	3	3	3	3
<b>CO3</b>	3	3	3	3	3	2	3	2	1	2	1	3	3	3	1	2	3
<b>CO4</b>	2	3	3	3	3	3	3	2	2	3	2	3	3	2	2	3	3
<b>CO5</b>	2	3	3	3	3	2	2	2	2	2	3	2	2	3	3	3	3
<b>Total</b>	13	15	15	14	13	12	13	8	10	13	11	14	13	14	11	13	14
<b>Average</b>	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
<b>I</b>	<b>NURSERY:</b> Definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.	6
<b>II</b>	<b>SEED:</b> 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
<b>III</b>	<b>VEGETATIVE PROPAGATION:</b> 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
<b>IV</b>	<b>GARDENING:</b> 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

<b>V</b>	<b>GARDENING OPERATIONS:</b> 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
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<b>Self study</b>	Planting - direct seeding and transplants. Seed testing and certification.
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**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-Hall 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](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

<b>CO5</b>	3	3	2	3	2	3	3	3	1	2	3	2	3	3	2	2	3
<b>Total</b>	15	14	11	14	11	15	11	11	9	13	14	9	15	12	12	13	14
<b>Average</b>	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)**

**SEMESTER – I & II**  
**LIFE SKILL TRAINING – I ETHICS**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PG23LST1	1				1	1	15	-	50	100

**Prerequisites:** Value education-its purpose and significance in the present world

**Learning Objectives**

1. To familiarize students with values of the individual, society, culture, one's own health and life philosophy,
2. To impart knowledge of professional ethical standards, codes of ethics, obligations, safety, rights, and other worldwide challenges.

Course Outcomes	On completion of this course the student will be able to	
CO1	understand deeper insight of the meaning of their existence.	K1
CO2	recognize the philosophy of life and individual qualities	K2
CO3	acquire the skills required for a successful personal and professional life.	K3
CO4	develop as socially responsible citizens.	K4
CO5	create a peaceful, communal community and embrace unity.	K3

Unit	Contents	No. of Hours
I	<b>Goal Setting:</b> Definition - Brainstorming Session – Setting Goals – Few components of setting goals.	3
II	<b>Group Dynamics:</b> Definition - Nature of Groups – Types of Groups – Determinants of group behavior	3
III	<b>Conflict Resolution:</b> Definition – What is a conflict resolution – Why should conflicts be resolved? - Lessons for life	3
IV	<b>Decision Making:</b> Definition – 3C's of decision making – Seven Steps to effective decision making – Barriers in effective decision making	3
V	<b>Anger Management:</b> Effects of anger – Tips to reduce anger – Anger warning signs – Identify your triggers – Ways to cool down your anger.	3



<b>TOTAL</b>	<b>15</b>
<b>Self-Study Portion:</b> Salient values for life, Human Rights, Social Evils and how to tackle them, Holistic living, Duties and responsibilities.	

### **Textbooks**

Life Skill Training – I Ethics, Holy Cross College (Autonomous), Nagercoil

### **Reference Books**

1. Holy Cross College (Autonomous), Nagercoil (2007). Foundation Course Life's Challenges. Sipca Computers.
2. Mathew, Sam (2010). Self Help Life Book. Opus Press Publisher.
3. Swati Mehrotra. (2016). Inspiring Souls Moral Values and Life Skills (1st ed.) [English]. Acevision Publisher Pvt. Ltd.
4. Irai Anbu, v. (2010, August). Random Thoughts (1st ed.) [English]. THG Publishing Private Limited, 2019.
5. Holy Cross College (Autonomous), Nagercoil (2007). Foundation Course Life's Challenges. Sipca Computers.

### **Web Resources**

1. <https://positivepsychology.com/goal-setting-exercises/>
2. [https://www.gov.nl.ca/iet/files/CCB\\_GroupDynamicsGuide.pdf](https://www.gov.nl.ca/iet/files/CCB_GroupDynamicsGuide.pdf)
3. [https://en.wikipedia.org/wiki/Conflict\\_resolution](https://en.wikipedia.org/wiki/Conflict_resolution)
4. <https://asana.com/resources/decision-making-process>
5. <https://www.mayoclinic.org/healthy-lifestyle/adult-health/in-depth/anger-management/art-20045434>