



# DEPARTMENT OF BOTANY

SYLLABUS FOR B.Sc BOTANY

UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

FOR CANDIDATES ADMITTED IN THE ACADEMIC YEAR

2022-2023



## **Bishop Heber College (Autonomous)**

(Nationally Reaccredited at the A Grade by NAAC with CGPA 3.58/4)

(Recognized by UGC as “College of Excellence”)

(Affiliated to Bharathidasan University, Tiruchirappalli)

Tiruchirappalli- 620 017.

## **VISION**

Inculcate fundamental knowledge of the plant sciences that will transform the understanding about the planet earth, providing holistic approach on innovative teaching, entrepreneurship skills and research with social ethics that reaches the society with a focus on plants and their role in balancing and protecting the Environment.

## **MISSION**

- Our mission is to foster an ambience of distinction by attracting and supporting the outstanding students, faculty and staff needed to sustain our vision.
- Provision of knowledge that bestows academic environment that contribute towards creating socially responsible citizens who have adequate skills in reflective thinking, leadership, team play, scientific temper with lifelong learning affinity.
- Create a stimulating environment that facilitates intellectual growth of students; provide students with the time and freedom to experience 'powerful pedagogies' such as research, service-learning and internships; encourage students with scientific approach to learning.
- To foster an environment of excellence by providing a comprehensive set of courses in Botany that enhances the understanding, fundamental and in-depth knowledge and technical competency.
- To inculcate the students with an environment that fosters nature conscious stewardship responsibility and Entrepreneurial skill development, multidisciplinary research competency through interdisciplinary learning and teaching positions in biological science.

## **Program Outcomes –B.Sc- BOTANY**

On Successful completion of the Program the under grandaunt of Botany will be able to,

### **Knowledge**

- PO1-** Comprehend Knowledge on Basic concepts, development and application aspects of Plant Science.
- PO2-** Interpret the scientific classifications for better understanding, conservation and identifying plants around us.
- PO3-** Discuss the importance of plants in the modern life science, aero science and energy needs of humans. Graduate will reiterate the plants as core essentials to maintain the life on earth.

### **Skills**

- PO4-** Make use of the hands-on experience acquired in fundamental botany, advanced biotechnological methods and *in vitro* studies to promote new variants in crop plants and for environmental development.
- PO5-** Analyse the plant-microbial-animal and environmental interactions for sustainable development.
- PO6-** Evaluate the potentialities of green wealth by incorporating other branches of science to utilize it for the society.

### **Attitudes**

- PO7-** Develop technical skills in expression, team work, Informatics, and report botanical values of plants through lifelong investigation and dissemination of learning.

### **Ethical and social values**

- PO8-** Formulate phytochemicals, evaluate the plant resources for the welfare of human life, report on the genetic engineering, bio-war, bioethics in designing experiments and maintain the proper functioning of the natural ecosystem.
- PO9-** Defend ethical and socio-ecological values of nature and appraise the significance of plants in the wellbeing of environment.

## **Program Specific Outcomes**

### **Knowledge & Skills**

- PSO1** - Analyse the theories in Plant science, development of plants, their adaptations and strategy for conservation and interaction of plants to the abiotic components and nutrient cycling in the environment.
- PSO2**- Classify the plants scientifically, attain knowledge on the systematics, evolution of plants from lower to higher forms and their interrelationships and the economic importance of various plants and plant- based traditional drugs.
- PSO3**- Interpret the scope of plant biodiversity Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms, their Physiological process (photosynthesis, respiration, multiplication, environmental responses), ecological, biochemical, cytological and molecular interactions on plants.
- PSO4**-Evaluate the phytochemicals and develop skills on nursery management, herbarium development, handling microscopes, sketching the anatomical structures of plants. Execute the facts of plant growth, their physiological- hormonal and enzymatic actions in the growth and development of plant.

## B.Sc- BOTANY ARTICULATION MATRIX

Course name	Course code	Correlation with programme outcomes and programme specific outcomes													
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4
PHYCOLOGY, ARCHEGONIATE AND PALEOBOTANY	U20BY101	H	M	M	M	H	H	H	L	M	H	H	H	M	
CORE PRACTICAL-I	U21BY1P1	H	M	L	L	L	M	M	L	M	H	M	H	M	
MICROBIOLOGY AND PLANT PATHOLOGY	U20BY202	H	M	H	M	H	H	M	M	H	H	H	H	H	
CORE PRACTICAL-II	U21BY2P2	H	H	H	H	H	H	H	H	H	H	H	M	H	
ALLIED -I	U20 ESBY1	H	H	H	L	M	M	H	M	H	H	H	H	H	
ALLIED PRACTICAL-I	U20BYYP1	-	H	M	H	M	-	M	H	H	H	L	H	H	
ALLIED-II	U20BYYY11	H	H	M	M	-	M	M	-	M	H	M	H	H	
PLANT SYSTEMATICS AND ECONOMIC BOTANY	U20BY303	H	H	M	L	-	L	L	-	M	M	H	H	H	
CORE PRACTICAL-III	U20BY3P3	M	H	M	L	L	H	H	H	L	M	H	H	H	
NMEC- I – NURSERY TECHNOLOGY	U20BYPE1	H	L	L	H	M	M	M	L	H	M	H	H	L	
PLANT ANATOMY AND DEVELOPMENTAL BOTANY	U20BY404	H	H	H	L	M	H	H	M	M	H	H	H	H	
CORE PRACTICAL-IV	U20BY4P4	L	L	-	L	L	L	H	L	M	M	M	H	H	
NMEC-II- MUSHROOM CULTIVATION	U20BYPE2	M	L	H	L	M	L	L	H	M	M	L	H	L	
SBEC I – MUSHROOM AND NURSERY TECHNOLOGY	U20BYPS1	L	-	H	M	M	H	H	H	M	L	M	H	H	
PLANT PHYSIOLOGY AND PLANT METABOLISM	U20BY505	H	H	L	-	H	M	-	L	-	H	-	H	H	
GENETICS, EVOLUTION AND PLANT BREEDING	U20BY506	H	H	L	L	H	H	M	H	H	H	M	H	H	
CORE PRACTICAL-V	U20BY5P5	H	L	-	L	H	L	H	L	L	M	M	H	H	
BIOSTATISTICS, COMPUTER APPLICATIONS	U22BY5:A	H	L	L	M	M	L	H	M	L	H	L	M	M	
BIOINSTRUMENTATION.	U22BY5:B	H	M	H	H	H	M	H	M	L	M	H	L	H	
BIOFERTILIZERS AND BIOPESTICIDES	U22BY5:C	H	M	H	H	H	M	H	M	L	M	H	L	H	
COMPETITIVE BIOLOGY	U20CAC5:1	H	M	M	L	L	M	M	L	M	M	M	H	H	
ECOLOGY AND PHYTOGEOGRAPHY	U20BY607	H	M	M	-	H	M	H	M	H	H	L	-	H	

CYTOLOGY AND MOLECULAR BIOLOGY	U20BY608	H	M	M	H	M	H	H	H	M	M	M	H	H
ETHNOBOTANY	U20BY6:A	H	H	H	M	M	H	M	M	H	H	H	H	M
HORTICULTURE AND ORGANIC FARMING	U20BY6:B	H	L	L	-	L	L	H	H	-	H	-	-	M
MICROSCOPY AND PLANT MICROTECHNIQUES	U22BY6:C	H	M	M	M	H	H	L	H	H	H	H	M	H
BIOTECHNOLOGY	U22BY6:D	H	M	M	M	H	H	L	H	H	H	H	M	H
NANOTECHNOLOGY	U22BY6:E	H	L	M	L	M	H	M	L	M	M	M	M	L
NATURAL RESOURCE MANAGEMENT	U22BY6:F	H	L	M	L	M	H	M	L	M	M	M	M	L
SBEC II – MOLECULAR AND PLANT TISSUE CULTURE TECHNIQUES	U16BYPS2	H	M	M	H	-	L	H	M	H	M	M	L	H
SBEC III – PLANTS AND HUMAN WELFARE	U20BYPS3	H	H	M	-	L	H	M	M	M	-	H	L	L



## B.Sc BOTANY – COURSE STRUCTURE

Sem.	Part	Course	Course Title	Course Code	Hours / week	Credits	Marks		
							CIA	ESE	Total
I	I	Tamil I /*	செய்யுள், இலக்கிய வரலாறு, உரைநடை, மொழிப்பயிற்சியும் படைப்பாக்கமும்	U22TM1L	6	3	25	75	100
	II	English I	Language through Literature : Pros and Short stories	U22EGNL1	6	3	40	60	100
	III	<b>Core I</b>	<b>Phycology, Archegoniate and Paelobotany (Algae, Bryophytes, Pteridophytes, Gymnosperm, Paleobotany)</b>	<b>U20BY101</b>	6	<b>6</b>	25	75	100
		<b>Core Prac. I</b>	<b>Major Practical – I</b>	<b>U21BY1P1</b>	<b>3</b>	<b>2</b>	<b>40</b>	<b>60</b>	<b>100</b>
		Allied I	Biology of Invertebrates and Chordates	U19ZYY11	4	3	25	75	100
		Allied Prac. I	Biology of Invertebrates ,Chordates, Human Physiology and Economic Zoology	U22ZYY1	3	--	--	--	--
	Val. Edu.	Abundant Life/ Human Values	U22VLO11/ U22VLO12	2	2	25	75	100	
II	I	Tamil II /*	செய்யுள், பக்தி இலக்கியம், சிற்றிலக்கியம், இலக்கிய வரலாறு, சிறுகதைத் திரட்டு, மொழிப்பயிற்சியும் படைப்பாக்கமும்	U22TM2L2	6	3	25	75	100
	II	English II	Language through Literature : Poetry and Shakespeare	U22EGNL2	6	3	40	60	100
	III	<b>Core II</b>	<b>Microbiology and Plant Pathology</b>	<b>U20BY202</b>	<b>6</b>	<b>6</b>	25	75	100
		<b>Core Prac. II</b>	<b>Major Practical – II</b>	<b>U21BY2P2</b>	<b>3</b>	<b>2</b>	<b>40</b>	<b>60</b>	<b>100</b>
		Allied II	Human Physiology and Economic Zoology	U22ZYY22	4	4	25	75	100
		<b>Allied Prac. I</b>	<b>Biology of Invertebrates ,Chordates, Human Physiology and Economic Zoology</b>	<b>U22ZYY1</b>	<b>3</b>	<b>3</b>	<b>40</b>	<b>60</b>	<b>100</b>
IV	Env. Studies	Environmental Studies	U16EST21	2	2	25	75	100	
III	I	Tamil III /*	செய்யுள்-காப்பியம், புராணம், சிற்றிலக்கியம், இலக்கிய வரலாறு, புதினம், மொழிப்பயிற்சி	U22TM3L3	6	3	25	75	100
	II	English III	English for Competitive Examinations	U22EGNL3	6	3	40	60	100
	III	<b>Core III</b>	<b>Plant systematics and Economic Botany</b>	<b>U20BY303</b>	<b>6</b>	<b>6</b>	25	75	100
		<b>Core Prac. III</b>	<b>Major Practical – III</b>	<b>U20BY3P3</b>	<b>3</b>	<b>2</b>	<b>40</b>	<b>60</b>	<b>100</b>
		Allied III	Allied Chemistry – I	U19CHY33	4	4	25	75	100
		Allied Prac. II	Volumetric and Organic analysis	U19CHYP2	3	--	--	--	--
IV	<b>NMEC I</b>	<b>Nursery Technology</b>	<b>U20BYPE1</b>	<b>2</b>	<b>2</b>	<b>40</b>	<b>60</b>	<b>100</b>	
IV	I	Tamil IV /*	செய்யுள், பண்டைய இலக்கியம், நாடகம், மொழிப்பயிற்சி	U22TM4L4	5	3	25	75	100
	II	English IV	Language through Literature	U22EGNL4	5	3	40	60	100
	III	<b>Core IV</b>	<b>Plant Anatomy and Developmental Botany</b>	<b>U20BY404</b>	<b>6</b>	<b>5</b>	25	75	100
		<b>Core Prac. IV</b>	<b>Major Practical – IV</b>	<b>U20BY4P4</b>	<b>3</b>	<b>2</b>	<b>40</b>	<b>60</b>	<b>100</b>
		Allied IV	Chemistry for Life Sciences	U19CHY44	4	4	25	75	100
		Allied Prac. II	Volumetric and Organic analysis	U19CHYP2	3	<b>3</b>	<b>40</b>	<b>60</b>	<b>100</b>
	IV	<b>NMEC II</b>	<b>Mushroom Cultivation</b>	<b>U20BYPE2</b>	<b>2</b>	<b>2</b>	<b>40</b>	<b>60</b>	<b>100</b>
		Life skills	Introduction to Life skills	U22LFS41	2	<b>1</b>	-	-	<b>100</b>
V	<b>Extension Activities</b>	<b>NSS, NCC, Rotaract, Leo Club etc</b>	<b>U16ETA41</b>	-	<b>1</b>	-	-	-	

V	III	<b>Core V</b>	<b>Plant Physiology and Plant metabolism</b>	<b>U20BY505</b>	7	6	25	75	100
		<b>Core VI</b>	<b>Genetics, Evolution and Plant Breeding</b>	<b>U20BY506</b>	7	6	25	75	100
		<b>Core Prac. V</b>	<b>Major Practical – V</b>	<b>U20BY5P5</b>	3	2	<b>40</b>	<b>60</b>	<b>100</b>
		Core Project	Project	U20BY5PJ	5	5	20	80	100



		Elective I	Biostatistics, Computer Application and Bioinformatics (Optional)	U22BY5:A	6	5	25	75	100
			Bioinstrumentation (Optional)	U22BY5:B					
			Bio fertilizer and Bio pesticides (Optional)	U22BY5:C					
IV	SBEC I	Mushroom and Nursery Technology	U20BYPS1	2	2	40	60	100	
VI	III	Core VII	Ecology and Phytogeography	U20BY607	6	6	25	75	100
		Core VIII	Cytology and Molecular Biology	U20BY608	6	5	25	75	100
		Core Prac. VI	Major Practical – VI	U20BY6P6	3	2	40	60	100
		Elective II	Ethnobotany (Optional)	U22BY6:A	5	5	25	75	100
			Horticulture and organic farming (Optional)	U22BY6:B					
			Microscopy and Plant Micro techniques	U22BY6:C					
		Elective III	Biotechnology	U20BY6:D	5	5	25	75	100
			Nanotechnology	U20BY6:E					
			Natural Resource Management	U22BY6:F					
		SBEC II	Molecular and Plant Tissue Culture Techniques	U20BYPS2	2	2	40	60	100
SBEC III	Plant Wealth for Human Life /Organic Farming	U20BYPS3	2	2	40	60	100		
V	Gender Studies	Gender Studies	U16GST61	-	1	-	-	100	

SBEC : Skill Based Elective Courses    NMEC : Non Major Elective Courses    Total Credits :    142

* Other Languages :	Hindi	Sanskrit	French
Semester I	: U14HD1L1	U14SK1L1	U14FR1L1
Semester II	: U14HD2L2	U14SK2L2	U14FR2L2
Semester III	: U14HD3L3	U14SK3L3	U14FR3L3
Semester IV	: U14HD4L4	U14SK4L4	U14FR4L4

Part I : 4    Core Theory : 8    Core Project : 1    Allied Theory : 5    NMEC : 2    Env. Studies : 1    Value Education : 1	Total : 41
Part II : 4    Core Prac. : 6    Allied Prac.: 1    Elective : 3    SBEC : 3    Exten. Act. : 1    Gender Studies : 1	

1. Nursery Technology - U20BYPE1
2. Mushroom Cultivation - U20BYPE2
3. Career Advancement course - U20 CAC5

**CORE – I -PHYCOLOGY, ARCHEGONIATE AND PALEOBOTANY**

**Course code: U20BY101**

**Semester: I**

**Credits: 6**

**Hours/Week: 6**

**Course Outcomes:**

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

<b>No</b>	<b>COURSE OUTCOMES (CO)</b>	<b>Level</b>	<b>Unit</b>
<b>CO 1</b>	Classify the algae, explain their characteristics, interpret the cell structure and its development.	<b>K5</b>	<b>I</b>
<b>CO 2</b>	Identify characters, classify Bryophytes and conclude	<b>K4</b>	<b>II</b>

	the developments in Plant from lower to higher plants		
<b>CO 3</b>	Analyze anatomical structure and evolutionary modification occurred in Pteridophytes.	<b>K4</b>	III
<b>CO 4</b>	Assess the living Gymnosperms and their morpho-anatomical adaptations for development.	<b>K5</b>	IV
<b>CO 5</b>	Interpret plant remains, connections in plant evolution and conserve the linking plant forms from extinction.	<b>K2</b>	V
<b>CO 6</b>	Appraise the adaptations of plants in various habitat and their ecological and economic importance	<b>K5</b>	I - V

## **SYLLABUS:**

### **Unit 1- PHYCOLOGY**

**(18 hours)**

- 1.1 General characteristics of Algae: 1.1.1- Ecological distribution, 1.1.2- range of thallus organization {motile and non-motile, coenobium, palmelloid, dendroid, filamentous, heterotrichous, siphonous, parenchymatous, pseudo-parenchymatous}, 1.1.3- Cell structure and components- cell wall, pigment system, reserve food, flagella, reproduction (vegetative-asexual-sexual).
- 1.2 1.2.1-Outline on the Classification of algae (F.E. Fritsch, 1935), 1.2.2- salient features of the selected classes- Cyanophyta, Chlorophyta, Pheophyta, Bacillariophyta, Rhodophyta. 1.2.3- Lifecycle patterns in algae using examples
- 1.3 Study on the- habit, habitat, External and Internal Structure, Reproductive and life cycle of: (Development not required);  
(a) *Oscillatoria* (b) *Chlamydomonas* (c) *Chara* (d) *Vaucheria* (e) *Sargassum* (f) *Polysiphonia*
- 1.4 1.4.1- Algal biotechnology, 1.4.2- *In-vitro* algal culture in various Culture medium (BG, MN) for fresh water and marine Algae. 1.4.3-Economic Importance of Algae.

### **Unit II- BRYOPHYTES**

**(18 Hours)**

- 2.1 General Characteristics: 2.1.1- Adaptation to land habit, Sporophytic evolution of Bryophytes, 2.1.2- range of thallus organization, 2.1.3-ecological adaptations of Bryophytes, 2.1.4- life cycle pattern in Bryophytes
- 2.2 Outline of Rothmaler's classification of Bryophytes
- 2.3 Study on the habit, habitat, external and internal structure, reproduction (development not required) of; (a) *Marchantia* (b) *Anthoceros* (c) *Funaria*
- 2.4 Ecological and economic importance of Bryophytes,

### **Unit III – PTERIDOPHYTES**

**(18 Hours)**

- 3.1 3.1.1- General characteristics- Habit, Habitat, Sporophyte- external and internal characters, alternation of generation, 3.1.2- Sporangium types- (i. Based on development-Leptosporangium/Eusporangium, ii. Based on structure-Homosporous/ Heterosporous)-{Development not required}, 3.1.3-Life cycle pattern in Pteridophytes.
- 3.2 3.2.1- Telome theory, 3.2.2-Stelar evolution in Pteridophytes, 3.2.3- Apogamy and

- Apospory, 3.2.4- Heterospory and seed habit in Pteridophytes.
- 3.3. Outline on Classification of Pteridophytes – Sporne’s classification, 1975 (Six classes)-  
Morphology, Anatomy and Reproduction (Division and Development not required) of; (a) *Psilotum*, (b) *Lycopodium* (c) *Selaginella* (d) *Equisetum*
- 3.4 Ecological and Economic Importance of Pteridophytes.

**Unit- IV- GYMNOSPERMS (18 Hours)**

- 4.1 General characteristics of Gymnosperms
- 4.2 Outline on Classification of Gymnosperms, Sporne, 1975
- 4.3 Morphology, anatomy, reproduction of:  
(a) *Cycas*, (b) *Pinus* (c) *Gnetum*- Development details not required.
- 4.4 Ecological and economic importance of Gymnosperms.

**Unit- V: PALEOBOTANY (18 Hours)**

- 5.1 Fossilization, Methods of fossilization- Petrification, Compressions, Impressions.
- 5.2 Contribution of Birbal Sahni
- 5.3 Geological time scale, Radio carbon dating,
- 5.4 Study on fossil forms; (a) Rhynia (b) Lepidodendron (c) Lepidocarpon(d)Williamsonia (e)Calamites

**Topics for Self-Study:**

Topics	References/Web links
Extremophilic algae	<a href="https://www.sciencedirect.com/science/article/abs/pii/S0960852414016423">https://www.sciencedirect.com/science/article/abs/pii/S0960852414016423</a> Barsanti, L., and Gualtieri, P. 2014. <i>Algae - Anatomy, Biochemistry, and Biotechnology</i> , second edition, CRC press, Taylor and Francis group, eBook – PDF.
Biofuel from Algae	<a href="https://www.power-technology.com/features/algae-biofuels-challenges-opportunities/">https://www.power-technology.com/features/algae-biofuels-challenges-opportunities/</a> <a href="https://farm-energy.extension.org/algae-for-biofuel-production/">https://farm-energy.extension.org/algae-for-biofuel-production/</a>
Contribution of Takhtajan	<a href="https://plantlet.org/takhtajans-system-of-classification/">https://plantlet.org/takhtajans-system-of-classification/</a> <a href="http://eobotany.blogspot.com/2014/02/the-takhtajan-system-of-classification.html">http://eobotany.blogspot.com/2014/02/the-takhtajan-system-of-classification.html</a>
living fossils - <i>Gingko biloba</i>	<a href="https://palaeobotany.org/index.php/living-fossils/">https://palaeobotany.org/index.php/living-fossils/</a> <a href="https://motherearthworks.com/healthy-living-learning-center/healthy-living-center-articles/gingko-biloba-a-living-fossil/">https://motherearthworks.com/healthy-living-learning-center/healthy-living-center-articles/gingko-biloba-a-living-fossil/</a>
Bio fertilizers	<a href="http://www.iffco.in/index.php/ourproducts/index/bio-fertiliser">http://www.iffco.in/index.php/ourproducts/index/bio-fertiliser</a> <a href="https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/biofertilizers">https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/biofertilizers</a>
Nitrogen fixation	<a href="https://www.nature.com/scitable/knowledge/library/biological-nitrogen-fixation-23570419/">https://www.nature.com/scitable/knowledge/library/biological-nitrogen-fixation-23570419/</a> <a href="https://www.sciencedirect.com/topics/earth-and-planetary-sciences/nitrogen-fixation">https://www.sciencedirect.com/topics/earth-and-planetary-sciences/nitrogen-fixation</a>

**TEXT BOOKS:**

**Algae:**

1. Fritsch, F.E. 1965. *The Structure and Reproduction of Algae*, Cambridge University press, Cambridge, London.
2. Kumar, H.D. and Sing, H. N.A. 1976. *Text book of Algae*. Affiliated East West press Pvt. Ltd., New Delhi, India.
3. Kumaresan, V. 1997. *Algae and Bryophytes*. Saras Publications, Nagercoil, India.
4. Pandey, B.P. 2002. *A Text book of Botany – Algae*. S. Chand and Co., (P) Ltd., New Delhi.
5. Sharma, O.P. 1990. *Text book of Algae*. Tata McGraw Hill Publishing Co., Ltd., New Delhi.
6. Singh, V. 1992. *A Text book of Botany*. S. Chand and Co., (P) Ltd., New Delhi.
7. Vashishta, B.R. 2008. *Botany for Degree Students – Algae*. Chand and Co. Ltd., New Delhi, India.

#### **Bryophytes:**

1. Chopra, G.L. 1968. *A Class Book of Bryophyta*. Hari singh and Bros Publications.
2. Kumar, P.K. 1988. *Biology of Bryophytes*. Wiley Easter Ltd., New Delhi.
3. Parihar, N.S. 1965. *An introduction to Embryophyta –Vol. II. Bryophyta*. Central Book Depot, Allahabad, India.
4. Srivastava, N.N. 1996. *Bryophyta*. Pradeep Prakashan, Meerut, India.
5. Vashista, B.R.2000. *Botany for Degree Students – Bryophytes*. S. Chand and Co., New Delhi, India.

#### **Pteridophytes**

1. Parihar, N.S. 1965. *An introduction to Embryophyta Vol. I Pteridophyta*. Central Book Depot. Allahabad, India.
2. Smith, G.M. 1956. *Cryptogamic Botany Vol. II. (Bryophytes & Pteridophytes)*. McGraw Hill Book Co., N.Y.
3. Sporne, K. R. 1970. *The Morphology of Pteridophytes. (The structure of Ferns and Allied Plants)*. Hutchinson University Library, London.
4. Sharma, O. P. 1990. *Text Book of Pteridophyta*. Macmillan India Ltd., Delhi.
5. Sundararajan, S. 2007. *Introduction to Pteridophyta*. New Age International Publishers, New Delhi, India.
6. Vashista, P.C. 2008. *Botany for Degree Students - Pteridophyta*. S. Chand and Co., New Delhi, India.

#### **Gymnosperms**

1. Coulter, J. M. and C. J. Chamberlain. 1964. *Morphology of Gymnosperms*. Central Book Depot, Allahabad, India.
2. Sporne, K. R. 1971. *The Morphology of Gymnosperms. (The structure and Evolution of Primitive seed Plants)*. Hutchinson University Library, London.
3. Sharma, O.P. 1997. *Gymnosperms*. Pragati Prakashan, Meerut, India.
4. Vashista, P.C. 2006. *Botany for Degree Students Gymnosperms (2<sup>nd</sup> Edn.,)* S. Chand & Co., New Delhi, India.

#### **Paleobotany**

1. Arnold, C.A. 1947. *An Introduction to Paleobotany*. McGraw Hill Book Co., New York.
2. Delevoryas, T. 1962. *Morphology and Evolution of Fossil Plants*. Holt, Rinehart and Winston. New York.
3. Shukla, A.C. and Misra, S. P. 1975. *Essentials of Paleobotany*. Vikas Publishing House (P) Ltd., Delhi, 1975.
4. Venkatachala, B. S., Shukla, M. and Sharma, M. 1992. *Plant Fossils – a Link with the past (A Birbal Sahni Birth Centenary Tribute)*. Birbal Sahni Institute of Paleobotany, Lucknow, India

**REFERENCE BOOKS:**

1. *Plant Diversity and Evolution*, 2016. Martin Ingrouille, Bill Eddie, Cambridge University Press, ISBN-13: 978-0521794336.
2. *Plant Diversity*, 2007. Andrew Hipp, Phil Gibson J, Terri R Gibson, Infobase Publishing.

**WEB LINK:**

<https://nptel.ac.in/content/storage2/courses/102103012/module1/lec1/7.html>

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit/Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>I.</b>	<b>Phycology</b>		
1.1	<p><b>General characteristics of Algae:-</b> Ecological distribution, -range of thallus organization {motile and non-motile, coenobium, palmelloid, dendroid, filamentous, heterotrichous, siphonous, parenchymatous, pseudo-parenchymatous}, -Cell structure and components-cell wall, pigment system, reserve food, flagella, reproduction (vegetative-aseexual-sexual) [only for the group represented in the syllabus].</p>	<ul style="list-style-type: none"> <li>• Compare the various habitats of Algae</li> <li>• List out the systematic characteristics of Algae</li> </ul>	K2  K2
1.2	<p><b>Classification of algae:</b> - salient features of various classes, - Lifecycle patterns in algae using examples</p>	<ul style="list-style-type: none"> <li>• Classify the Algae according to their habit, pigment and size.</li> </ul>	K2
1.3	<p><b>Type study:</b> External and Internal Structure, Reproductive and life cycle of: (Development not required); <i>Oscillatoria</i> (b) <i>Chlamydomonas</i> (c) <i>Chara</i> (d) <i>Vaucheria</i> (e) <i>Sargassum</i> (f) <i>Polysiphonia</i></p>	<ul style="list-style-type: none"> <li>• Explain the special characters and life forms of various algae</li> <li>• Interpret the land adaptations occurred in Algae</li> </ul>	K2  K5
1.4	<b>Algal biotechnology</b>	<ul style="list-style-type: none"> <li>• Discuss the morpho-</li> </ul>	K5

	<p>- <i>In-vitro</i> algal culture for various Culture medium (BG, MN, F/2) for fresh water and marine Algae.</p> <p>- Economic Importance of Algae- Useful (food and fodder, agriculture and space research, Industry – (Agar Agar, Carrageenin, diatomite, Alginates, EPS, Biofuel, minerals and elements), Medicine, sewage treatment) and Harmful effects (Eutrophication, Algal bloom, bioaccumulation)</p>	<p>anatomical evolution of Algae their adaptations and their economic importance</p>	
<b>II</b>	<b>Bryophytes</b>		
2.1	<p><b>General Characteristics</b></p> <p>- Adaptation to land habit</p> <p>- range of thallus organization and ecological adaptation</p> <p>- life cycle pattern in Bryophytes</p>	<ul style="list-style-type: none"> <li>• Recall the morphological structure of Bryophytes.</li> <li>• Compare the life cycles of Bryophytes.</li> <li>• Justify Bryophytes are amphibians of plant kingdom.</li> </ul>	<p>K2</p> <p>K4</p>
2.2	<p><b>Classification:</b></p> <p>- Rothmaler’s classification of Bryophytes</p>	<ul style="list-style-type: none"> <li>• Classify Bryophytes using the characters.</li> <li>• Identify the plants by their thallus.</li> </ul>	<p>K2</p> <p>K3</p>
2.3	<p><b>Type study:</b></p> <p>- Study on the habit, habitat, external and internal structure, reproduction (development not required) of;</p> <p>(a) <i>Marchantia</i> (b) <i>Anthoceros</i> (c) <i>Funaria</i></p>	<ul style="list-style-type: none"> <li>• Explain the habit and habitat of Bryophytes.</li> <li>• Relate the morphology of Bryophytes.</li> <li>• Compare the similarities and dissimilarities with lower and higher forms</li> </ul>	<p>K2</p> <p>K4</p>
2.4	<p>Economic and ecological importance</p>	<ul style="list-style-type: none"> <li>• Recognize the importance.</li> <li>• Appraise the economic importance of Bryophytes</li> </ul>	<p>K2</p> <p>K4</p>
<b>III</b>	<b>Pteridophytes</b>		
3.1	<p><b>General characteristics:</b></p> <p>- Habit, Habitat, Sporophyte- external and internal characters,</p> <p>- alternation of generation, - Sporangium types-</p> <p>(i. Based on development- Leptosporangium/Eusporangium, ii. Based on structure- Homosporous/ Heterosporous)- {Development not required},</p> <p>- Life cycles in Pteridophytes</p>	<ul style="list-style-type: none"> <li>• Identify the habit, habitat characters.</li> <li>• Examine the sporogenesis in Pteridophytes.</li> </ul>	<p>K3</p> <p>K5</p>

3.2	<b>Telome theory</b> - Stellar evolution in Pteridophytes, - Apogamy and Apospory, -Heterospory and seed habit in Pteridophytes	<ul style="list-style-type: none"> <li>• Discuss various theories on stellar evolution.</li> <li>• Examine each theories related to evolution.</li> </ul>	K2
3.3	<b>classification:</b> - Sporne's classification, 1975 (Six classes)- - Morphology, Anatomy and Reproduction of; (a) <i>Psilotum</i> , (b) <i>Selaginella</i> (c) <i>Equisetum</i> (d) <i>Pteris</i>	<ul style="list-style-type: none"> <li>• Classify major Pteridophytic forms</li> <li>• Differentiate ferns according to their habit.</li> <li>• Inspect the evolution of seeds.</li> </ul>	K2 K4
3.4	Ecological and Economic importance	<ul style="list-style-type: none"> <li>• Recognize the importance of ferns.</li> <li>• Conclude the value of ferns in dominant periods.</li> </ul>	K4
<b>IV</b>	<b>Gymnosperms</b>		
4.1	<b>General characteristics</b>	<ul style="list-style-type: none"> <li>• Recall the habit, habitat characters.</li> <li>• Explain the anatomical and evolutionary aspects of Gymnosperms.</li> </ul>	K1 K5
4.2	<b>Classification</b>	<ul style="list-style-type: none"> <li>• Classify using the characters.</li> <li>• Differentiate the plants by their morphology.</li> </ul>	K2
4.3	<b>Type study</b> Morphology, anatomy, reproduction and phylogenetic studies of: (a) <i>Cycas</i> , (b) <i>Pinus</i> (c) <i>Gnetum</i> - Development details not required.	<ul style="list-style-type: none"> <li>• Explain the habit and habitat of Gymnosperms.</li> <li>• Relate the morphology.</li> <li>• Assess the similarities and dissimilarities with lower and higher forms</li> </ul>	K2 K5
4.4	Economic importance	<ul style="list-style-type: none"> <li>• Recognize the importance.</li> <li>• Enumerate the economic importance of Gymnosperms.</li> </ul>	K2 K5
<b>V</b>	<b>Paleo botany</b>		
5.1	Methods of fossilization- Petrification, Compressions, Impressions	<ul style="list-style-type: none"> <li>• Select the known fossils</li> <li>• Compare the various fossil formation process</li> </ul>	K2
5.2	Contributions of Prof. Birbal Sahni to Paleobotany.	<ul style="list-style-type: none"> <li>• Discuss the works of scientist.</li> </ul>	K2



5.3	Geological time scale, Radio carbon dating,	<ul style="list-style-type: none"> <li>Explain geological time scale and the process of carbon dating</li> </ul>	K2
5.4	Study on fossil forms: (a) <i>Rhynia</i> (b) <i>Lepidodendron</i> (c) <i>Lepidocarpon</i> (d) <i>Calamites</i> (e) <i>Williamsonia</i>	<ul style="list-style-type: none"> <li>Summarize the fossilization using the examples</li> </ul>	K2

### Mapping Scheme (Course Code: U20BY101)

U20BY101	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	-	H	L	M	H	L	L	M	M	L	H	-
CO2	H	M	L	-	-	L	L	-	L	H	M	H	-
CO3	H	L	-	-	L	-	-	-	M	H	L	H	L
CO4	H	L	L	-	M	-	-	-	M	M	-	H	L
CO5	M	L	-	M	-	L	M	L	-	M	H	-	L
CO6	M	-	-	L	L	M	L	L	M	-	-	L	-

L-Low (1) M-Medium (2) H-High (3)

### Course Assessment Methods:

#### Direct

- Continuous Assessment in** Class test, Group Discussion and Quiz.
- Assessment also done through Seminar Presentation, submission of Assignments and Model Making and Model exams.
- End Semester Examination**

#### Indirect

- Course-end survey

## PHYCOLOGY, ARCHEGONIATE AND PALEOBOTANY

### [CORE PRACTICAL – I]- MAJOR PRACTICAL - I

Course code: U21BY1P1

Credits: 2

Semester: I

Hours/Week:3

### Course Outcomes:

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Compare and Interpret the different group of Algae and	K 4	I

	its diversity.		
<b>CO 2</b>	Distinguish the various habitat in Bryophytes and their anatomical form.	<b>K 4</b>	II
<b>CO 3</b>	Examine the different types of spore formation, life cycles in Pteridophytic forms and fossilised plants.	<b>K 4</b>	III
<b>CO 4</b>	Discuss the morphological and anatomical structures of various Gymnosperm plant groups.	<b>K4</b>	IV
<b>CO 5</b>	Compare the external and internal characteristics features of selected species.	<b>K 2</b>	V
<b>CO 6</b>	Importance of Plant diversity in maintaining the ecosystem.	<b>K5</b>	I - IV

## **SYLLABUS:**

### **Unit-1**

**(6 Hours)**

Observing the thallus by preparing the whole mounts of- *Oscillatoria*, *Chlamydomonas*, *Chara*, *Vaucheria*, *Sargassum*, *Polysiphonia*, Diatoms (*Nitzschia*) – temporary slide preparation and observing permanent slides.

### **Unit-2**

**(6 Hours)**

Study the morphology- (habit – both ventral and dorsal view), internal anatomy- Vertical sections of *Marchantia*, *Anthoceros*, by temporary slide preparations, Observing permanent slides. Antheridiophore Archegoniophore, L.S of Columella- *Funaria* (permanent slides). *Funaria* - gametophyte with sporophyte picture/specimen.

### **Unit-3**

**(6 Hours)**

Study on; 1: *Psilotum*- whole habit (Specimen), T.S of Stem (picture/slide), Synangium (permanent slide). 2: *Lycopodium*- whole habit (specimen), temporary slide preparation of T.S of Stem, L.S of Sporophyll, L.S of Strobilus (permanent slide). 3: *Selaginella*- whole habit (specimen), T.S of Stem- temporary slide preparation, L.S of Sporophyll - permanent slide. 4: *Equisetum*- habit, T.S of internode (temporary slide preparation), L.S of Strobilus, Spores- permanent slides.

### **Unit -4**

**(6 Hours)**

Study on; 1: *Cycas*- habit (Pictures), T.S of Coralloid root, Rachis, leaflet, V.S of Microsporophyll, whole mount of spores (Temporary slides), L.S of Ovule, T.S of root (permanent slides). 2: *Pinus*- habit, long shoot, dwarf shoot, male and female cones, microspores (Specimens), T.S of needle, microsporophyll, TLS, RLS of Stem, L.S of male cone, female cone (permanent slides). 3: *Gnetum*- Morphology (stem, male & female cones), T.S of stem (temporary slide), V.S of Ovule (permanent slide).

### **Unit -5**

**(6 Hours)**

Observing the fossilized slides of; Rhynia, Lepidodendron, Calamites, Lepidocarpon, Williamsonia.

Visit to a Botanical Garden to study the Biodiversity of Plant forms.

### TOPICS FOR SELF STUDY:

Topics	References
Macroalgae	<a href="http://www.gbrmpa.gov.au/_data/assets/pdf_file/0019/3970/SORR_Macroalgae.pdf">http://www.gbrmpa.gov.au/_data/assets/pdf_file/0019/3970/SORR_Macroalgae.pdf</a> <a href="https://www.sciencedirect.com/topics/earth-and-planetary-sciences/macroalgae">https://www.sciencedirect.com/topics/earth-and-planetary-sciences/macroalgae</a>
Development in <i>Polysiphonia</i>	<a href="https://www.easybiologyclass.com/polysiphonia-thallus-structure-reproduction-post-fertilization-changes-and-life-cycle/#:~:text=Structure%20and%20Development%20of%20Carpogonium,cell%20of%20a%20reduced%20trichoblast.">https://www.easybiologyclass.com/polysiphonia-thallus-structure-reproduction-post-fertilization-changes-and-life-cycle/#:~:text=Structure%20and%20Development%20of%20Carpogonium,cell%20of%20a%20reduced%20trichoblast.</a>
<i>Anthoceros</i>	<a href="https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/anthoceros">https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/anthoceros</a>

#### TEXT BOOKS:

1. Sharma. O.P. 2011. *Algae*. McGraw Hill Education Pvt. Limt. Chennai.
2. Annie Ragland. 2000. *Algae and Bryophytes*. Saras Publication, Tamil Nadu
3. Sanjay Kumar Singh. 2008. *Bryophyta*. Campus Books Publishing, New Delhi
4. Pandey, B.P.2002. *A Text book of Botany* –S. Chand & amp; Co., (P) Ltd., New Delhi.
5. Pandey. S. N, Misra. S.P, Trivedi P.S. 2002. *A Text Book of Botany*, Vikas Publishing House Pvt. Ltd. New Delhi.

#### REFERENCE BOOKS:

1. Fritsch, F.E. 1965. *The Structure and Reproduction of Algae 1945*: Cambridge University press, Cambridge, U.K.
2. Rashid. A. 1998. *An introduction to Bryophytes*. Vikas Publishing Co. New Delhi.

#### Web Links:

[https://onlinecourses.swayam2.ac.in/cec20\\_bt11/preview](https://onlinecourses.swayam2.ac.in/cec20_bt11/preview)

#### SPECIFIC LEARNING OUTCOMES (SLO):

Unit/ Section	Course Content	Learning Outcomes	Highest Blooms Taxonomic level of transaction
1	Observing the thallus by preparing the whole mounts of- <i>Oscillatoria</i> , <i>Chlamydomonas</i> , <i>Chara</i> , <i>Vaucheria</i> , <i>Sargassum</i> , <i>Polysiphonia</i> , <i>Diatoms</i> ( <i>Nitzchia</i> )– temporary side preparation and observing permanent slides.	<ul style="list-style-type: none"> <li>• Recall and identify the morphology and anatomy of various Algae</li> <li>• Sketch the Algal morphology.</li> <li>• Analyse the structure of various Algal forms.</li> </ul>	K4  K3  K4
2	Study the morphology- (habit – both ventral and dorsal view),	<ul style="list-style-type: none"> <li>• Discuss the internal parts of Bryophytes</li> </ul>	K4

	<p>internal anatomy- Vertical sections of <i>Marchantia</i>, <i>Anthoceros</i>, by temporary slide preparations, Observing permanent slides. Antheridiophore Archegoniophore, L.S of Columella- <i>Funaria</i> (permanent slides). <i>Funaria</i> - gametophyte with sporophyte picture/specimen.</p>	<ul style="list-style-type: none"> <li>Analyse the adaptations evolved for land habitat.</li> <li>Relate the evolutionary aspects of the Bryophytes</li> </ul>	<p><b>K4</b></p> <p><b>K2</b></p>
<b>3</b>	<p>Study on; 1: <i>Psilotum</i>- whole habit (Specimen), T.S of Stem (picture/slide), Synangium (permanent slide). 2: <i>Lycopodium</i>- whole habit (specimen), temporary slide preparation of T.S of Stem, L.S of Sporophyll, L.S of Strobilus (permanent slide). 3: <i>Selaginella</i>- whole habit (specimen), T.S of Stem- temporary slide preparation, L.S of Sporophyll- permanent slide. 4: <i>Equisetum</i>- habit, T.S of internode (temporary slide preparation), L.S of Strobilus, Spores- permanent slides. 5: <i>Pteris</i>- habit, T.S of Rachis, Rhizome, V.S of Sporophyll, whole mount of spores (temporary slides), prothallus bearing sex organs (Permanent slides).</p>	<ul style="list-style-type: none"> <li>Recall the internal and external modifications evolved in the Pteridophytes.</li> <li>Sketch the internal external structure of the Pteridophytes to get an idea on the cellular arrangement, their modifications and evolution.</li> <li>Examine the leaf, stele, and spore evolution and habitat adaptation of various Pteridophytes under the specific Class.</li> <li>Discuss the stellar evolution from lower to higher forms of plants</li> </ul>	<p><b>K2</b></p> <p><b>K3</b></p> <p><b>K4</b></p> <p><b>K4</b></p>
<b>4</b>	<p>Study on; 1: <i>Cycas</i>- habit (Pictures), T.S of Coralloid root, Rachis, leaflet, V.S of Micosporophyll, whole mount of spores (Temporary slides), L.S of Ovule and T.S of root (permanent slides). 2: <i>Pinus</i>- habit, long shoot, dwarf shoot, male and female cones, microspores (Specimens), T.S of needle, microsporophyll, TLS, RLS of Stem, L.S of male cone, female cone (permanent slides). 3: <i>Gnetum</i>- Morphology (stem, male &amp; female cones), T.S of stem (temporary slide), V.S of Ovule (permanent slide).</p>	<ul style="list-style-type: none"> <li>Define the internal-external structure of Gymnosperms.</li> <li>Compare the difference on Pycnoxylic and manoxylic woods.</li> <li>Examine the anatomical sectioning of coralloid roots, Internal leaf structure, sporophyll, ovule of the Gymnosperms.</li> <li>Interpret the adaptations of <i>Gnetum</i> as a connection link between Gymnosperm and Angiosperm.</li> </ul>	<p><b>K2</b></p> <p><b>K2</b></p> <p><b>K4</b></p> <p><b>K2</b></p>

<b>5</b>	Observing the fossilized slides of; <i>Rhynia</i> , <i>Lepidodendron</i> , <i>Calamites</i> , <i>Lepidocarpon</i> , <i>Williamsonia</i> .	<ul style="list-style-type: none"> <li>Recall the methods of fossilization in Plants.</li> </ul>	<b>K 2</b>
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### Mapping Scheme Course Code: U21BY1P1

U21BY1P1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	L	-	M	-	L	M	M	L	H	-
CO2	H	L	-	-	-	L	L	L	-	M	L	H	L
CO3	H	L	L	-	L	-	L	-	L	M	L	H	L
CO4	H	-	L	-	L	-	L	-	L	M	L	H	L
CO5	M	-	-	-	L	-	-	-	L	L	-	M	-
CO6	L	-	-	L	-	L	-	L	L	M	M	H	-

L-Low (1) M-Medium (2) H-High (3)

### COURSE ASSESSMENT METHODS:

#### Direct

Continuous Assessment in Practical works, sectioning, record submission.

Practical tests, Records etc. (as applicable), Class tests, Model Exams.

End Semester Examination

#### Indirect

#### 1. Course-end survey

### CORE II - MICROBIOLOGY AND PLANT PATHOLOGY

Semester : II

Course Code : U20BY202

Credits : 6

Hours/Week: 6

### Course Outcome

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Interpret and explain various forms of Microorganisms	K2	I, II, III
CO 2	Classify the structure, functions and various relationship between the microbes	K4	I, II, III
CO 3	Compare and contrast the various types reproductive cycle.	K2	I and III
CO 4	Distinguish the various microbes used in biofertilizer preparation.	K5	IV
CO 5	Identify the causal agent of microbes and control the	K3	V

	mechanisms of plant pathogens and diseases.		
<b>CO 6</b>	Examine the evidences of management and host resistance of diseases.	K4	V

## **SYLLABUS:**

### **Unit I : Introduction to Microbiology**

**(18 Hours)**

- 1.1. Microbiology- Definition, Scope of microbiology and Importance of microbiology
- 1.2 Classification of Microorganisms based on R. H. Whittaker
- 1.3 Bacteria – General characteristics, Cell Structure, Reproduction – Asexual and sexual methods, Economic Importance of Bacteria,
- 1.4 Virus – General characteristic, Morphology, Cell Structure, Reproduction -Lytic and Lysogenic cycle
- 1.5 Yeast– General characteristics, Cell Structure, Reproduction –Vegetative, Asexual and Sexual methods, Economic importance of Yeast.
- 1.6 Cyanobacteria – General characteristics, Cell Structure, Reproduction, Vegetative and Asexual methods, Economic Importance of cyanobacteria.
- 1.7 Microscope- Basic Principles of microscopy Light Microscopes: Principle, Structure and applications Compound and Electron microscope and Micrometer- Definition and types (Ocular and Stage micrometer)
- 1.8 Staining- Definition, procedure and Types- Simple, Gram staining and Acid fast staining
- 1.9 Sterilization- Definition, Methods of sterilization- Physical and chemical methods
- 1.10 Culture media- Definition and its types, Liquid, Solid and semisolid medium and Pure culture techniques
- 1.11 Wet Mound preparation for fungal culture and Hanging drop techniques for bacterial modality and Isolation of microbes from soil, air and water.

### **Unit II: Mycology**

**(18 Hours)**

- 2.1 Fungi- General Characters and Ainsworth's Classification (1970)
- 2.2 Thallus organization - Unicellular (b) Filamentous; Mycelium- (a) Aseptate Mycelium (b) Septate Mycelium (c) Septal pore; Fungal Flagella- Structure (b) Kinds of Flagella (i) Whiplash (ii) Tinsel
- 2.3 Mode of Nutrition
- 2.4 Reproduction- Asexual and Sexual and Economic Importance

### **Unit III: Fungi and Lichens**

**(18 Hours)**

3.1 Study of Selected fungal species in the following aspects- (a) *Phytophthora* (b) *Mucor* (c) *Peziza* (d) *Polyporus* (e) *Cercospora* - Habit and habitat, External and internal Structure, Asexual and sexual reproduction and Life Cycles (Development not required).

3.2 Lichens - General characters, Thallus Structure- (a) Crustose (b) Foliose (c) Fruticose, Structure and reproduction of *Usnea*, Economic importance.

**Unit –IV: Applied Microbiology (18 Hours)**

4.1 Biogeochemical cycle: Definition and Role of microorganisms in biogeochemical cycle and Type Nitrogen cycle and Carbon cycle

4.2 Biofertilizers- definition and Importance of Biofertilizers

4.3 Common Microorganisms used as Biofertilizers- Mass culture and Commercial production- *Rhizobium*, *cyanobacteria* and *Mycorrhiza*,

4.4 Biodegradation- Definition, Degradation of Xenobiotics,

4.5 Bioremediation – definition and Advantages of bioremediation.

4.6 Bioleaching-Definition and Types - Direct bioleaching, Indirect bioleaching and Advantages of bioleaching

**Unit V: Plant pathology and Protection (18 Hours)**

5. 1 Plant Pathology definition, Classification plant diseases- Types of infections, types of perpetuation and spread,

5.2 Survival and dispersal of plant pathogen, phenomenon of infection- pre penetration, penetration and post penetration

5.3 Pathogenesis- role of enzymes, toxins, growth regulators and polysaccharides,

5.4 Defence mechanisms of plants- structural and biochemical (Pre and post infection),

5.5 Plant disease management- general principle, regulatory methods, cultural methods, biological control, physical and chemical methods,

5.6 Host plant resistance- Importance – disease resistance, tolerance, susceptibility and disease escape.

5.7 Study of the following diseases with reference to causal agents, symptoms and prevention and control methods- Little leaf of Brinjal, Tobacco Mosaic virus, Citrus Canker and Red rot of Sugarcane.

**Topics for self-study:**

TOPICS	References
Kingdom concepts of classification	1. Sharma O.P.,2006. <i>Text book of Fungi</i> , McGrewHillEducation Private Limited, New Delhi, India 2. Michael.J.Pelczar,J.R.,E.C.S.Chanand NøRKrieg. 2013. <i>Microbiology</i> , McGrewHillEducation Private Limited, New Delhi, India.
Arboviruses	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7180381/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7180381/</a> <a href="https://www.sciencedirect.com/topics/medicine-and-dentistry/arbovirus">https://www.sciencedirect.com/topics/medicine-and-dentistry/arbovirus</a> <a href="https://www.microbiologyresearch.org/content/arboviruses-and-their-">https://www.microbiologyresearch.org/content/arboviruses-and-their-</a>

	<a href="#">vectors</a>
Dualistic activity of <i>Enterococcus</i> in food	<a href="https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/enterococcus">https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/enterococcus</a> <a href="https://cmr.asm.org/content/32/2/e00058-18">https://cmr.asm.org/content/32/2/e00058-18</a>
Listeriosis	<a href="https://www.cdc.gov/listeria/index.html">https://www.cdc.gov/listeria/index.html</a>
Vermicomposting	<a href="https://www.sciencedirect.com/topics/earth-and-planetary-sciences/vermicomposting">https://www.sciencedirect.com/topics/earth-and-planetary-sciences/vermicomposting</a>
Environmental reclamation	<a href="http://www.fao.org/3/x5872e/x5872e0c.htm">http://www.fao.org/3/x5872e/x5872e0c.htm</a>
Innate mechanisms in plants	<a href="https://pubmed.ncbi.nlm.nih.gov/23660678/">https://pubmed.ncbi.nlm.nih.gov/23660678/</a> <a href="https://www.nature.com/subjects/plant-immunology">https://www.nature.com/subjects/plant-immunology</a>
Crown Oomycetes	<a href="https://link.springer.com/article/10.1007/s13225-011-0128-7">https://link.springer.com/article/10.1007/s13225-011-0128-7</a> <a href="https://bsppjournals.onlinelibrary.wiley.com/doi/full/10.1111/mpp.12190?scrollTo=references">https://bsppjournals.onlinelibrary.wiley.com/doi/full/10.1111/mpp.12190?scrollTo=references</a>

### TEXT BOOKS:

1. Arumugam. N, A. Mani, A. M. Selvaraj and Narayanan. L. M. 2014. *Microbiology*, Saras publication, Nagarcoil, Kanyakumari district.
2. Sharma O.P.,2006. *Text book of Fungi*, McGrew Hill Education Private Limited, New Delhi, India

### REFERENCES BOOKS-

#### Microbiology

1. Michael. J. Pelczar, J.R., E.C.S. Chan and Ned R.Krieg. 2013. *Microbiology*, Mc Grew Hill Education Private Limited, New Delhi, India.
2. Lansing M. Prescott, John P. Harley, Donald A. Klein. 2005. *Microbiology* 6<sup>th</sup> Edition, Mc Grew Hill Companies, New York.
3. Moshrafuddin Ahmed and Basumatary. S. K. 2006. *Applied Microbiology*, MJP Publishers, Chennai.
4. Ananthanarayan and Panikers, 2012. *Text book of Microbiology* 9<sup>th</sup> Edition. Orient Publication.
5. Kathleen P.Talaro and Berry Chess. 2017. *Foundations in Microbiology*. McGraw-Hill.

#### Fungi

1. Vashishta. B.R., and Singha A.K. 1992. *Botany for Degree students*, S. Chand Publication, New Delhi.
2. Arumugam.N, Kumarasen. V and Annie Ragland. 2016. *Fungi and Plant Pathology*, Saras Publication, Nagar Coil, Kanyakumari.
3. Sharma, O.P. 1986. *Text book of Fungi*. New Delhi: Tata McGraw – Hill,
4. Alexopoulos, C. J. 1962. *Introductory Mycology*. New York: John Wiley Publication.
5. Bhattacharya and Gopal. 2013. *Textbook of Mycology*. Agrotech.

#### Plant Pathology



1. Mehrotra R.S., and Ashok Agarwal, 2008. *Plant pathology*, Tata Mc Grew Hill Education Private Limited, New Delhi, India.
2. Sambamurthy A.V.S.S. 2020. *Text book of Plant Pathology*, I. K. International Pvt. Ltd. New Delhi.
3. Singh R. S., 2019. *Introduction to principle of Plant Pathology*. 4<sup>th</sup> Edition, Oxford IBH publishing, New Delhi.

**WEB LINK:**

<https://nptel.ac.in/courses/102/103/102103015/>

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>I</b>	<b>Introduction to Microbiology</b>		
1.1	Microbiology- Definition, Scope of microbiology, Golden Period of Microbiology and importance of Microbiology.	<ul style="list-style-type: none"> <li>• Illustrate the general characteristic feature of micro-organisms</li> <li>• Compare the various period of microbiology</li> <li>• apply the scope of microbiology</li> </ul>	K2 K3
1.2	Classification of Microorganisms based on R.H. Whittaker (1969) – Five kingdom concept.	<ul style="list-style-type: none"> <li>• Classify and explain the Whittaker's five kingdom concept</li> </ul>	K2
1.3	Bacteria- General Characteristic, Cell structure, Reproduction- Asexual and Sexual methods and Economic importance of Bacteria.	<ul style="list-style-type: none"> <li>• Explain the morphology and structure of bacteria</li> <li>• Interpret the various types of reproduction.</li> <li>• Apply the various use of bacteria</li> </ul>	K2 K3
1.4	Plant virus – General characteristic, Morphology, Cell Structure, Reproduction – Bacteriophage, Lytic and Lysogenic cycle	<ul style="list-style-type: none"> <li>• Illustrate the structure and characteristic of virus</li> <li>• Examine the various types of reproduction in virus.</li> </ul>	K2 K4
1.5	Yeast – General characteristics. Cell Structure, Reproduction – Vegetative, Asexual and Sexual methods, Economic importance of Yeast.	<ul style="list-style-type: none"> <li>• List out characteristic of yeast.</li> <li>• Classify the structure of yeast.</li> </ul>	K1 K2

		<ul style="list-style-type: none"> <li>• Explain the types of reproduction in yeast.</li> <li>• Utilize the importance of yeast.</li> </ul>	K3
1.6	Cyanobacteria – General characteristics, Cell Structure, Reproduction, Vegetative and Asexual methods, Economic Importance of cyanobacteria.	<ul style="list-style-type: none"> <li>• Label the structure of cyanobacteria.</li> <li>• Demonstrate the reproduction and application of blue green algae.</li> </ul>	K2 K4
1.7	Microscope- Basic Principles of microscopy Light Microscopes: Principle, Structure and applications Compound and Electron microscope and Micrometer- Definition and types (Ocular and Stage micrometer)	<ul style="list-style-type: none"> <li>• Label the various parts of light and electron microscopes.</li> <li>• Explain the structure and application of microscopes.</li> <li>• Compare and contrast of light and electron microscope.</li> </ul>	K2 K2 K4
1.8	Staining- Definition, procedure and Types- Simple, Gram staining and Acid fast staining.	<ul style="list-style-type: none"> <li>• List out the various types of staining methods.</li> <li>• Explain the types of staining methods.</li> <li>• Apply the use of bacterial based staining.</li> </ul>	K2 K2 K3
1.9	Sterilization- Definition, Methods of sterilization- Physical and chemical methods	<ul style="list-style-type: none"> <li>• Compare and contrast of physical and chemicals methods of sterilization.</li> <li>• Relate and apply the types of sterilization techniques.</li> <li>• Apply various types physical sterilization.</li> </ul>	K2 K1 K3
1.10	Culture media- Definition and its types, Liquid, Solid and semisolid medium and Pure culture techniques.	<ul style="list-style-type: none"> <li>• Define and classify the types of culture media.</li> <li>• Explain the types of culture media for pure culture isolation.</li> <li>• Interpret various</li> </ul>	K2 K2

		form of pure culture and apply in isolation microbes.	K2
1.11	Wet Mound preparation for fungal culture and Hanging drop techniques for bacterial modality and Isolation of microbes from soil, air and water.	<ul style="list-style-type: none"> <li>Summarize the wet mound preparation techniques for fungi.</li> <li>Solve the separation of fungi and bacteria from soil.</li> <li>List out the relationships between fungal and bacterial isolation.</li> <li>Solve and correlate the role of microbes in soil, air and water</li> </ul>	K2 K4 K3
<b>II</b>	<b>Mycology</b>		
2.1	Fungi- General Characters and Ainsworth's Classification (1970)	<ul style="list-style-type: none"> <li>Illustrate the morphology and structure of fungi.</li> <li>Demonstrate the general characteristic of fungi.</li> <li>Outline the Ainsworth's classification.</li> </ul>	K2
2.2	Thallus organization - Unicellular (b) Filamentous; Mycelium- (a) Aseptate Mycelium (b) Septate Mycelium (c) Septal pore; Fungal Flagella- Structure (b) Kinds of Flagella (i) Whiplash (ii) Tinsel	<ul style="list-style-type: none"> <li>Define Mycelium.</li> <li>Compare the relationship between Aseptate and Septate mycelium.</li> <li>Relationship between the various types of thallus variation.</li> </ul>	K2 K2
2.3	Mode of Nutrition	<ul style="list-style-type: none"> <li>Explain the types and nutrition in fungi.</li> </ul>	K2
2.4	Reproduction- Asexual and Sexual and Economic Importance	<ul style="list-style-type: none"> <li>Analyse the types of reproduction in fungi.</li> <li>Interpret heterothallism.</li> <li>Explain in detail study of spore dispersal mechanisms in fungi.</li> </ul>	K4 K2 K2

		<ul style="list-style-type: none"> <li>Apply the various beneficial aspects of fungi.</li> </ul>	K3
<b>III</b>	<b>Fungi and Lichens</b>		
3.1	Study of Selected fungal species in the following aspects- (a) <i>Phytophthora</i> (b) <i>Mucor</i> (c) <i>Peziza</i> (d) <i>Polyporus</i> (e) <i>Cercospora</i> - Habit and habitat, External and internal Structure, Asexual and sexual reproduction and Life Cycles (Development not required)	<ul style="list-style-type: none"> <li>List the out external characteristic of fungal species.</li> <li>Outline the various internal structure of fungal species.</li> <li>Experiment with various types of reproduction in the selected fungal species.</li> <li>Relationship between various class of fungal species</li> </ul>	K3 K4
3.2	Lichens - General characters, Thallus Structure- (a) Crustose (b) Foliose (c) Fruticose, Structure and reproduction of <i>Usnea</i> , Economic importance.	<ul style="list-style-type: none"> <li>Define phycobiont and mycobiont.</li> <li>List out the general feature of lichen.</li> <li>Determine the structure of lichen.</li> <li>Explain apothecium.</li> <li>Interpret the various types of reproduction in lichen.</li> <li>Make use of lichen used indicator for pollution</li> </ul>	K1 K2 K4 K2 K3 K3
<b>IV</b>	<b>APPLIED MICROBIOLOGY</b>		
4.1	Biogeochemical cycle: Definition and Role of microorganisms in biogeochemical cycle and Type Nitrogen cycle and Carbon cycle	<ul style="list-style-type: none"> <li>List out the types of biogeochemical cycle</li> <li>Explain the role of microbes in biogeochemical cycle.</li> <li>Outline the types of Nitrogen cycle and carbon cycle</li> <li>Interpret relationship between nitrogen and carbon cycle.</li> </ul>	K4 K2 K2 K2
4.2	Biofertilizers- definition and Importance of Biofertilizers	<ul style="list-style-type: none"> <li>Define Biofertilizer</li> <li>Classify and explain</li> </ul>	K2

		of biofertilizer	K2
4.3	Common Microorganisms used as Biofertilizers- Mass culture and Commercial production- Rhizobium,, cyanobacteria and Mycorrhiza	<ul style="list-style-type: none"> <li>• Illustrate the mass cultivation <i>Rhizobium</i></li> <li>• Summarize the relationship between mass and commercial production biofertilizer.</li> <li>• Estimation of various production of cultivation process.</li> </ul>	K2 K2 K5
4.4	Biodegradation- Definition, Degradation of Xenobiotics	<ul style="list-style-type: none"> <li>• Comment on Biodegradation</li> <li>• Explain Xenobiotics</li> </ul>	K5
4.5	Bioremediation – definition and Advantages of bioremediation	<ul style="list-style-type: none"> <li>• List out types of bioremediation.</li> <li>• Explain the advantage of bioremediation.</li> </ul>	K4 K5
4.6	Biobleaching-Definition and Types - Direct biobleaching, Indirect biobleaching and Advantages of biobleaching	<ul style="list-style-type: none"> <li>• Discover the various types of biobleaching methods</li> <li>• Make use of the advantage of biobleaching.</li> <li>• Explain biobleaching</li> </ul>	K4 K3
<b>V</b>	<b>Plant pathology and Protection</b>		
5.1	Plant Pathology definition, Classification plant diseases- Types of infections, types of perpetuation and spread,	<ul style="list-style-type: none"> <li>• Define plant pathology</li> <li>• Outline the classification of plant diseases</li> <li>• Interpret the types of infections</li> </ul>	K2
5.2	Survival and dispersal of plant pathogen, phenomenon of infection- pre penetration, penetration and post penetration	<ul style="list-style-type: none"> <li>• Explain the dispersal of plant pathogen.</li> <li>• Classify and compare various types of penetrations.</li> </ul>	K2
5.3	Pathogenesis- role of enzymes, toxins, growth regulators and polysaccharides	<ul style="list-style-type: none"> <li>• Understanding and interpretation of pathogenesis.</li> <li>• Classify and</li> </ul>	K2

		compare the role of enzymes	
5.4	Defence mechanisms of plants- structural and biochemical ( Pre and post infection),	<ul style="list-style-type: none"> <li>Identify major principles of plant pathology.</li> <li>Explain pre and post infection</li> </ul>	K2
5.5	Plant disease management- general principle, regulatory methods, cultural methods, biological control, physical and chemical methods,	<ul style="list-style-type: none"> <li>Classify the methods to diagnose and manage a wide range of plant diseases.</li> <li>Describe aspects of integrated pest management.</li> <li>Interpret the relationship between physical and chemical methods</li> </ul>	K4
5.6	Host plant resistance- Importance – disease resistance, tolerance, susceptibility and disease escape.	<ul style="list-style-type: none"> <li>Outline the structure of host resistance mechanisms.</li> <li>Apply various diseases resistance tolerance in plants</li> <li>Analysis the susceptibility and disease escape</li> </ul>	K3  K4
5.7	Study of the following diseases with reference to causal agents, symptoms and prevention and control methods- Little leaf of Brinjal, Tobacco Mosaic virus, Citrus Canker and Red rot of Sugarcane.	<ul style="list-style-type: none"> <li>List out the disease causing agents in plants.</li> <li>Compare and contrast various mechanisms of diseases managements.</li> <li>Relationship between symptoms and prevention measure of various disease</li> </ul>	K4  K2

### Mapping Scheme Course Code: U20BY202

U20BY 202	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	-	H	L	M	H	L	L	M	M	L	H	-
CO2	H	M	L	-	-	L	L	-	L	H	M	H	-
CO3	H	L	-	-	L	-	-	-	M	H	L	H	H

CO4	H	L	L	-	M	-	-	-	M	M	-	H	H
CO5	M	L	-	M	-	L	M	L	-	M	H	-	L
CO6	M	-	-	L	L	M	L	L	M	-	-	L	-

L-Low (1) M-Medium (2) H-High (3)

#### COURSE ASSESSMENT METHODS:

##### Direct

**Continuous Assessment in Practical works, sectioning, record submission.**

**Practical tests, Records etc. (as applicable), Class tests, Model Exams.**

**End Semester Examination**

##### Indirect

#### 1. Course-end survey

### CORE PRACTICAL – II- MAJOR PRACTICAL - II

(Microbiology and Plant pathology)

Semester : II

Course Code: U21BY2P2

Credits : 2

Hours/Week:3

#### Course Outcomes:

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Identify the interaction of microorganisms and analysis of various microorganisms	K3	I - V
CO 2	Understand and application of various microbiological laboratory equipment.	K2	I - V
CO 3	Interpret various fungal organisms and their internal structure and functions	K2	I - V
CO 4	Distinguish the internal structure of pathogenic organisms and their mode of entry into the plants	K4	I - V
CO 5	Evaluate various pathogen and their controls measure	K5	I - V
CO 6	Analyse and preparation of culture medium to isolate the microorganisms	K4	I - V

#### SYLLABUS:

##### Unit- I-Microbiology Practical

(9 Hours)

Basic requirements of a microbiology laboratory Preparation of temporary cotton plugs

Preparation of culture media- Nutrient broth medium and PDA medium Methods of sterilization

Fungal spore identification and germination.

Isolation of Microorganism from soil, air, water, food, vegetables and plants Techniques for pure culture of microorganisms

Serial Dilution -Agar plate method, Disc diffusion, Agar well diffusion, maintenance Measurement of Microorganisms

Methods of culture, preservation and using micrometer.

Measurement of fungal growth by colony diameter method. Completed Test for coliformbacteria.

**Unit II: Fungi (9 Hours)**

To study the fungal specimens in reference to plant disease and their spore structure  
*Phytophthora*, *Cersospora* and *Mucor*.

To disseminate knowledge on fruiting bodies of *Peziza* and *Polyporus* and to study the morphological features.

Taking cross section and structural features- *Peziza* and *Polyporus*

**Unit III: Lichens (9 Hours)**

To study the morphological and general characteristics of lichens  
To describe the fruiting bodies of Lichen- Apothecium

**Unit IV: Plant Pathology (9 Hours)**

Name of the disease, casual organism, symptoms of the disease, control and prevention methods of the following diseases.

Live diseased specimens for spotters

1. Little leaf of Brinjal
2. Tobacco Mosaic Virus
3. Citrus canker
4. Red rot of Sugarcane

**Unit V: Plant Protection- Spotters (9 Hours)**

1. Knapsac Sprayer
2. Duster

**TEXT BOOKS:**

1. Dubey R.C., and D. K. Maheswari, 2010. *Practical microbiology*, S. Chand and Company Ltd, New Delhi.
2. Sharma O.P., 2006. *Text book of Fungi*, McGrew Hill Education Private Limited, New Delhi, India.



**REFERENCES BOOKS:**

**Microbiology**

1. Michael. J. Pelczar, J.R., E.C.S. Chan and Noel R. Krieg. 2013. *Microbiology*, Mc Grew Hill Education Private Limited, New Delhi, India.
2. Lansing M. Prescott, John P. Harley, Donald A. Klein. 2005. *Microbiology* 6<sup>th</sup> Edition, Mc Grew Hill Companies, New York.
3. Moshrafuddin Ahmed and S.K. Basumatary. 2006. *Applied Microbiology*, MJP Publishers, Chennai.
4. Ananthanarayan and Panikers, *Text book of Microbiology* 9<sup>th</sup> Edition. 2012. Editor – Arti Kapil.

Kathleen P.Talaro and Berry Chess, *Foundations in Microbiology*. McGraw-Hill.

**Fungi**

1. Vashishta. B.R., and A.K. Singha, 1992. *Botany for Degree students*, S. Chand Publication, New Delhi.
2. Arumugam. N, Kumarasen. V and Annie Ragland. 2016. *Fungi and Plant Pathology*, Saras Publication, Nagar Coil, Kanyakumari.
3. Sharma, O.P. 1986. *Text book of Fungi*. New Delhi: Tata McGraw – Hill.
4. Alexopoulos, C. J. 1962. *Introductory Mycology*. New York: John Wiley.
5. Bhattacharya Gopal. 2013. *Textbook of Mycology*. Agrotech. 2013.

**Plant Pathology**

1. Mehrotra R.S., and Ashok Agarwal. 2008. *Plant pathology*. Tata McGrawHill Education Private Limited, New Delhi, India.
2. Sambamurthy A.V.S.S. 2020. *Text book of Plant Pathology*, I. K. International Pvt. Ltd. New Delhi.
3. Singh R. S. 2019. *Introduction to principle of Plant Pathology* 4<sup>th</sup> Edition, Oxford IBH publishing, New Delhi.

**WEB LINK:**

[https://onlinecourses.swayam2.ac.in/cec19\\_bt11/preview](https://onlinecourses.swayam2.ac.in/cec19_bt11/preview)

**SPECIFIC LEARNING OUTCOME (SLO):**

Unit/ Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of
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			transaction
I	Microbiology		
1.1	Basic requirements of a microbiology laboratory	<ul style="list-style-type: none"> <li>Recall the parts of microbiological instruments.</li> <li>Make use of these laboratory apparatus</li> <li>List out the application of chemicals and glassware</li> </ul>	K3 K4
1.2	Preparation of temporary cotton plugs	<ul style="list-style-type: none"> <li>Explain the preparation of cotton plugs</li> </ul>	K5
1.3	Preparation of culture media- Nutrient broth medium and PDA medium	<ul style="list-style-type: none"> <li>Compare synthetic and natural medium</li> <li>Recall the names of fungal and bacterial media</li> <li>Apply the types of culture medium used for fungi and bacteria</li> </ul>	K3
1.4	Methods of sterilization	<ul style="list-style-type: none"> <li>Interpret the important parts of autoclave</li> <li>Explain principle of sterilization procedure</li> <li>Compare and contrast between precaution methods of sterilization</li> <li>Demonstrate the process of disinfection</li> </ul>	K2 K4 K2
1.5	Fungal spore identification and germination	<ul style="list-style-type: none"> <li>Define principle of micrometry</li> <li>List out the types of fungal culture preserved</li> <li>Identify the various types fungal spore</li> </ul>	K3 K4
1.6	Isolation of microorganism from soil, air, water, food, vegetable and plants for pure culture microbes	<ul style="list-style-type: none"> <li>Name some soil and air living microorganisms.</li> <li>Classify suitable media for isolation of soil fungi</li> <li>Identify the types of pure cultures used for microbes</li> </ul>	K2 K3
1.7	Serial dilution – Agar plant, disc diffusion and agar well diffusion	<ul style="list-style-type: none"> <li>Explain the various method of zone of inhibition.</li> <li>Apply the types of antibiotic assay preparation</li> </ul>	K5 K3
1.8	Methods of culture,	<ul style="list-style-type: none"> <li>identify the types of</li> </ul>	K3

	preservation and maintenance	<ul style="list-style-type: none"> <li>• culture preservation</li> <li>• Explain the types of culture maintenance</li> </ul>	K5
1.9	Measurement of Microorganism using micrometer	<ul style="list-style-type: none"> <li>• Define ocular and stage micrometer</li> <li>• Illustrate the measurement of microorganisms</li> <li>• Distinguish the calibration and standardization of micrometer.</li> </ul>	K2 K4
1.10	Measurement of fungal growth by colony diameter methods	<ul style="list-style-type: none"> <li>• Explain measurement of dimension of the fungi</li> <li>• Name the main components of micrometry</li> </ul>	K4 K1
1.11	Completed test for coliform bacteria	<ul style="list-style-type: none"> <li>• Interpret the coliform bacteria by membrane filter methods</li> <li>• Evaluate the chemical oxygen demand of water</li> </ul>	K5
<b>II</b>	<b>Fungi</b>		
2.1	To study the fungal specimens in reference to plant disease and their spore structure <i>Phytophthora, Cercospora</i> and <i>Mucor</i> .	<ul style="list-style-type: none"> <li>• List the out external characteristic of fungal spores and mycelium.</li> <li>• Outline the various internal structure of fungal species.</li> <li>• Experiment with various types of reproduction in fungi.</li> </ul>	K4 K3
2.2	To disseminate knowledge on fruiting bodies of <i>Peziza</i> and <i>Polyporus</i> and to study the morphological features.	<ul style="list-style-type: none"> <li>• Compare types fruiting bodies of <i>Peziza</i> and <i>Polyporus</i>.</li> <li>• Demonstrate the morphological feature of <i>Peziza</i> and <i>Polyporus</i></li> </ul>	K2
2.3	Taking cross section and structural features- <i>Peziza</i> and <i>Polyporus</i>	<ul style="list-style-type: none"> <li>• Determine the internal structure of <i>Polyporus</i></li> <li>• Evaluate the variation between <i>Peziza</i> and <i>Polyporus</i> internal structure</li> </ul>	K5
<b>III</b>	<b>Lichens</b>		
3.1	To study the morphological and general characteristics of lichens	<ul style="list-style-type: none"> <li>• Define phycobiont and mycobiont.</li> <li>• List out the general feature of lichen.</li> </ul>	K4

3.2	To describe the fruiting bodies of Lichen- Apothecium	<ul style="list-style-type: none"> <li>Determine the structure of lichen.</li> <li>Explain Apothecium.</li> <li>Evaluate the various types of fruit bodies in lichen.</li> <li>List out the importance of lichen</li> </ul>	K2 K5
<b>IV</b>	<b>Plant Pathology and Plant Protection</b>		
4.1	Name of the disease, casual organism, symptoms of the disease, control and prevention methods of the following diseases. Live diseased specimens for spotters  Little leaf of Brinjal,  Tobacco Mosaic Virus, Citrus canker and Red rot of Sugarcane	<ul style="list-style-type: none"> <li>List the out external characteristic of bacterial and fungal pathogen.</li> <li>Outline the internal structure of bacterial and fungal mode of entry</li> <li>Summarize the various types of reproduction in bacteria and fungus,</li> </ul>	K4 K2
<b>V</b>	<b>Plant Protection</b>		
5.1	Knapsac sprayer and Duster,	<ul style="list-style-type: none"> <li>List out the significance of physical controller</li> <li>Explain the working mechanism of knapsac sprayer and duster</li> </ul>	K4

**Mapping Scheme Course Code: U21BY2P2**

U21BY 2P2	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO2	PSO3	PSO 4
CO 1	H	H	-	M	L	H	M	-	L	H	L	-	M
CO 2	H	H	L	H						H	H	-	H
CO 3	L	M	H		H	L		H	M	-	H	M	
CO 4	-	L	M	H	-	H	-	H	M	-	H	M	-
CO 5	M	M	H	H	L	-	M	-	-	L	-	-	H
CO 6	-	H	H	-	-	L	H	L	H	M	H	L	-

**COURSE ASSESSMENT METHODS:**

**Direct**

**Continuous Assessment in Practical works, sectioning, record submission.  
Practical tests, Records etc. (as applicable), Class tests, Model Exams.  
End Semester Examination**

**Indirect**

**1. Course-end survey**

## ALLIED I: ENVIRONMENTAL BOTANY

### THEORY

Semester I  
Credits: 3

Course Code: U20ESBY1  
Hours/Week : 4

#### Course Outcomes:

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Interpret the basics of Plant diversity	K2	I
CO 2	Describe the concept of Plant morphology and its Modifications	K2	II
CO 3	Explain various aspects of inflorescence and plant taxonomy	K2	II
CO 4	Discuss the basic concepts of plant Anatomy and plant Embryology	K2	III
CO 5	Analyze the various concepts of Plant physiology	K4	IV
CO 6	Describe the various plant diseases and also plant as ecological indicator.	K4	V

#### SYLLABUS:

##### Unit I – Plant Diversity

(9 Hours)

**Plant Diversity:** Structure, reproduction and life cycle of Algae - *Chlamydomonas*, Fungi - *Penicillium*, Bryophyte -*Riccia*, Pteridophyte – *Lycopodium* and Gymnosperm -*Cycas*.

##### Unit II – Morphology

(9 Hours)

Morphology: Root, shoot system and its modification. Inflorescence – Simple and compound and Special types – one example each. Flower description. Taxonomy: Nomenclature (Binomial), Systems of Classification (Bentham and Hooker), Study of following families – Annonaceae, Apocynaceae, Lamiaceae, and Poaceae.

##### Unit III – Anatomy

(9 Hours)

Anatomy: Tissue (Meristematic and Permanent), primary structures of Dicot and Monocot Stem and Root. Embryology: Structure of Anther and Ovule; Types of Pollination, Fertilization and development of Dicot Embryo.

##### Unit IV – Physiology

(9 Hours)

Plant physiology: Absorption of water and salts. Role of mineral elements; Transpiration. Photosynthesis, Light and Dark Reactions – C<sub>3</sub> Cycle, Respiration – aerobic, anaerobic, Krebs cycle.

##### Unit V – Plant as an ecological indicator

(9 Hours)

Plant as an ecological indicator – characteristics, type and physiological changes. Plant pathology: Detailed study of the following plant diseases, symptoms, causal agents and control measures of white rust, citrus canker and tobacco Mosaic disease.

**TEXT BOOKS:**

1. Mathawat, G.S.P., Sharma, D. and Sahni. R.K. 1996. *A text book of Botany*, Ramesh Book depot, Jaipur.
2. Mehrotra, R.S. 1991. *Plant Pathology*, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
3. Muneeswaran, A., 2004. *Allied Botany*, Titan Books, Madurai, India.
4. Pandey, B.P. 1999. *Economic Botany*, S. Chand and Co., New Delhi.
5. Rao, K.N. Krishnamoorthy, K. and Rao. G.S. 1979. *Ancillary Botany*, Rajalakshmi Publication, Nagerkoil.

**REFERENCES BOOKS:**

- 1.S K Verma and Mohit Verma. 1995. *A Textbook of Plant Physiology, Biochemistry and Biotechnology*. S Chand Publications.
- 2.Vinod Kumar Jain. 2009. *Laboratory Manual of Plant Pathology*. Oxford Book Company.

**Web Link:**

<https://nptel.ac.in/content/storage2/courses/122103039/pdf/mod1.pdf>

Topics for Self-Study	Reference Link
Hill reactions	<a href="https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/hill-reaction">https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/hill-reaction</a>
secondary wall thickening	<a href="https://www.biologydiscussion.com/plants/cell-wall/thickening-of-cell-wall-in-plants-with-diagram-botany/68837">https://www.biologydiscussion.com/plants/cell-wall/thickening-of-cell-wall-in-plants-with-diagram-botany/68837</a>
Vegetative propagation	<a href="https://www.toppr.com/en-in/content/concept/vegetative-propagation-201517/">https://www.toppr.com/en-in/content/concept/vegetative-propagation-201517/</a>

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit/Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
I	Plant Diversity		

1.0	Structure, reproduction and life cycle of Algae - <i>Chlamydomonos</i> , Fungi - <i>Penicillium</i> , Bryophyte - <i>Riccia</i> , Pteridophyte – <i>Lycopodium</i> and Gymnosperm - <i>Cycas</i> .	<ul style="list-style-type: none"> <li>Explain lower group of plant kingdom and their reproduction systems.</li> </ul>	K2
<b>II</b>	<b>Morphology</b>		
2.0	Root, shoot system and its modification.	<ul style="list-style-type: none"> <li>Explain the importance and study morphological features of plants</li> </ul>	K2
2.1	<b>Inflorescence</b> – Simple and compound and Special types – one example). Flower description.	<ul style="list-style-type: none"> <li>Tell the inflorescence pattern.</li> </ul>	K1
2.2	<b>Taxonomy:</b> Nomenclature (Binomial), Systems of Classification (Bentham and Hooker), Study of following families – <i>Annonaceae</i> , <i>Apocynaceae</i> , <i>Lamiaceae</i> , and <i>Poaceae</i> .	<ul style="list-style-type: none"> <li>Explain the various taxonomical information of plants.</li> </ul>	K2
<b>III</b>	<b>Anatomy</b>		
3.0	<b>Anatomy:</b> <b>Tissue</b> (Meristematic and Permanent), primary structures of Dicot and Monocot Stem and Root.	<ul style="list-style-type: none"> <li>Demonstrate understanding of fundamental concepts of plant anatomy</li> </ul>	K2
3.1	<b>Embryology:</b> Structure of Anther and Ovule; Types of Pollination, Fertilization and development of Dicot Embryo.	<ul style="list-style-type: none"> <li>Explain the simple concepts of embryology</li> </ul>	K2
<b>IV</b>	<b>Physiology</b>		
4.0	Absorption of water and salts. Role of mineral elements; Transpiration. Photosynthesis, Light and Dark Reactions – C3 Cycle, Respiration – aerobic, anaerobic, Krebs cycle.	<ul style="list-style-type: none"> <li>Analyse fundamentals of plant physiology in plants.</li> </ul>	K4
<b>V</b>	<b>Plant as an ecological indicator</b>		
5.0	<b>Plant as an ecological indicator</b> – characteristics, type and physiological changes.	<ul style="list-style-type: none"> <li>Distinguish different Plants as ecological indicator</li> </ul>	K4

5.1	<b>Plant pathology:</b> Detailed study of the following plant diseases, symptoms, causal agents and control measures of <i>white rust</i> , <i>citrus canker</i> and <i>tobacco Mosaic</i> disease.	<ul style="list-style-type: none"> <li>Demonstrate the various plant diseases in India.</li> </ul>	K4
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**Mapping Scheme Course Code: U20ESBY1**

U20ESBY1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	M	L	-	L	H	-	L	M	H	H	M
CO2	H	H	M	-	-	M	H	L	M	M	H	M	L
CO3	H	M	M	-	-	L	H	M	H	H	H	L	L
CO4	M	H	L	-	-	L	H	-	M	M	L	L	M
CO5	H	M	M	-	L	L	L	M	L	M	M	-	H
CO6	M	L	M	-	H	M	L	M	M	M	L	L	M

L-Low (1) M-Medium (2) H-High (3)

**COURSE ASSESSMENT METHODS:**

**Direct**

**Continuous Assessment in Practical works, sectioning, record submission.**

**Practical tests, Records etc. (as applicable), Class tests, Model Exams.**

**End Semester Examination**

**Indirect**

**1. Course-end survey**

**Allied Practical I: ENVIRONMENTAL BOTANY LAB**

**Semester I**  
**Credits: 2**

**Code: U20ESBP1**  
**Hours/Week: 3**

**Course Outcomes:**

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Compare and Interpret the different group of Species diversity.(Plant diversity – Algae, Fungi, Bryophytes, Pteridophyte and Gymnosperms )	K 4	I
CO 2	Distinguish the various habitat in Plants and their Taxonomical form.	K 4	II
CO 3	Discuss the different anatomical structures of various mature plant groups.	K 4	III



<b>CO 4</b>	Examine the different types of Plant functions	<b>K4</b>	IV
<b>CO 5</b>	Importance of Plant pathology ( <i>White rust, Citrus canker</i> and <i>Tobacco</i> ) Plant specimens for the ecological indicators	<b>K 2</b>	V
<b>CO 6</b>	Understand the importance of plant conservation	<b>K2</b>	I, IV

**SYLLABUS:**

**Unit I- Plant diversity: (9 Hours)**

Plant diversity: Habit, stem, root and reproductive parts of Algae- *Chlamydomonos*; Fungi –*Penicillium*; Bryophyte - *Riccia* – habit, thallus and Capsule; Pteridophyte - *Lycopodium* – habit and stem; Gymnosperm – *Cycas*.

**Unit II- Plant Taxonomy (9 Hours)**

Plant Taxonomy: Annonaceae – *Polyalthia longifolia*; Apocyanacea – *Vinca rosea*; Lamiaceae –*Leucas aspera*; Euphorbiaceae – *Euphorbia hirta* :Poaceae – *Chloris barbata*

**Unit III- Plant Anatomy (9 Hours)**

Plant Anatomy: T. S of monocot root - monocot stem - dicot stem - dicot leaf - Embryology: T. S of mature anther - Ovule L. S – Fertilization - Globular – embryo - Cordate embryo

**Unit IV- Plant physiology (9 Hours)**

Plant physiology (Demo only): Bell Jar, Thistle funnel, TA balance, Test tube funnel, Ganong light screen and respiroscope.

**Unit V- Plant pathology (9 Hours)**

Plant specimens for the ecological indicators; Plant pathology: *White rust, Citrus canker* and *Tobacco Mosaic* disease.

**TOPICS FOR SELF STUDY:**

<b>Topics</b>	<b>References</b>
Plant diversity	<a href="https://www.biologydiscussion.com/algae/algae-definition-characteristics-and-structure-with-diagram/46727">https://www.biologydiscussion.com/algae/algae-definition-characteristics-and-structure-with-diagram/46727</a>
Plant Taxonomy	<a href="https://www.biologydiscussion.com/plant-taxonomy/plant-taxonomy-history-classification-and-plant-kingdom/41749">https://www.biologydiscussion.com/plant-taxonomy/plant-taxonomy-history-classification-and-plant-kingdom/41749</a>
Plant Anatomy	<a href="https://www.biologydiscussion.com/plants/anatomical-structure-of-plants-with-diagram/6450">https://www.biologydiscussion.com/plants/anatomical-structure-of-plants-with-diagram/6450</a>
Plant physiology	<a href="https://www.biologydiscussion.com/plant-physiology-2/notes-plant-physiology/34597">https://www.biologydiscussion.com/plant-physiology-2/notes-plant-physiology/34597</a>
Plant pathology	<a href="https://www.biologydiscussion.com/plant-pathology/biology-notes-on-plant-pathology/46320">https://www.biologydiscussion.com/plant-pathology/biology-notes-on-plant-pathology/46320</a>

**TEXT BOOKS:**

1. Mathawat, G. Sharma. S. P, and R.K. Sahni. R.K. 1996. *A text book of Botany*, Ramesh Book depot, Jaipur.
2. Mehrothra, R.S. 1991. *Plant Pathology*, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
3. Muneeswaran, A. 2004. *Allied Botany*, Titan Nooks, Madurai, India.
4. Pandey, B.P. 1999. *Economic Botany*, S. Chand and Co., New Delhi.
5. Rao, K.N. Krishnamoorthy, K. and Rao. G.S. 1979. *Ancillary Botany*, Rajalakshmi Publication, Nagerkoil.
6. Verma, V. 1980. *A Text Book of Economic Botany*, Emkay Publications, New Delhi.

#### REFERENCE BOOKS:

1. Chattopadhyaya, S.B., 1991. *Principles and Procedures of Plant protection*, (3rd Ed.), Oxford and IBH Publishing (P) Ltd., New Delhi.
2. Edmond, J.B., Musser, A.M. and Andres, F.S. 1957. *Fundamentals of Horticulture*, McGraw Hill Book Co., New Delhi.
3. Fuller, H.J. and Tippo, O.1967. *College Botany*, Henry Holt and Co., New York.
4. Gangully, A.K. 1971. *General Botany*, The New Book Stall Calcutta, Vol I and II. Rajalakshmi Publication., Nagerkoil.
5. Kumar, N. 1997. *Introduction to Horticulture*, Rajalakshmi Publications, Nagarkoil, India.

#### WEB LINKS:

[https://onlinecourses.nptel.ac.in/noc19\\_ag04/preview](https://onlinecourses.nptel.ac.in/noc19_ag04/preview)

#### SPECIFIC LEARNING OUTCOMES (SLO):

Unit/ Section	Course Content	Learning Outcomes	Highest Blooms Taxonomic level of transaction
1	<b>Plant diversity:</b> Structure, reproduction and life cycle of (a) Algae - <i>Chlamydomonos</i> (b) Fungi - <i>Penicillium</i> (c) Bryophytes - <i>Riccia</i> (d) Pteridophytes - <i>Lycopodium</i>	<ul style="list-style-type: none"> <li>• Explain the habit and habitat of Cryptogams and phanerogams</li> <li>• Distinguish life cycle of plant groups</li> </ul>	K2    K 4

	(e) Gymnosperms- <i>Cycas</i>		
2	Plant Taxonomy: <b>Annonaceae</b> – <i>Polyalthia longifolia</i> ; <b>Apocyanacea</b> – <i>Vinca rosea</i> ; <b>Lamiaceae</b> – <i>Leucas aspera</i> ; <b>Euphorbiaceae</b> – <i>Euphorbia hirta</i> : <b>Poaceae</b> – <i>Chloris barbata</i>	<ul style="list-style-type: none"> <li>Examine the morphological feature of flowering plants</li> <li>Illustrate the external characteristic features of plant</li> </ul>	K4  K2
3	Plant Anatomy: Primary and Secondary structure of Dicot and Monocot - (a) Leaf (b) Stem (d) Root.  Structure of Flower Embryology: T. S of mature anther - Ovule L. S – Fertilization - Globular – embryo - Cordate embryo	<ul style="list-style-type: none"> <li>Compare the internal structure of leaf, stem and root</li> <li>Determine the arrangement of tissues in leaf, stem and root</li> <li>Illustrate the arrangements of various parts in flowers</li> <li>Explain the importance of anther and pollen and internal structure of anther</li> <li>Explain the structure of Ovule</li> </ul>	K2  K5  K2  K5  K2
4	Plant physiology (Demo only): (a) Bell Jar, (b) Thistle funnel, (c) TA balance, (d) Test tube funnel, (e) Ganong light screen and (f) respiroscope	<ul style="list-style-type: none"> <li>Demonstrate the various physiological process</li> </ul> Analyze the importance of plant functions.	K2 K4
5	Plant specimens for the ecological indicators; Plant pathology: <i>White rust, Citrus canker</i> and <i>Tobacco</i>	Demonstrate the various infected plants	K 2

### Mapping Scheme for the Course Code: U20ESBP1

U20ES BP1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	M	H	-	-	M	-	L	L	H	-	M	L
CO2	M	M	H	-	L	L	-	-	M	H	L	M	H
CO3	L	L	H	-	-	L	-	L	L	H	M	M	L
CO4	M	L	L	-	-	-	-	-	L	H	L	M	L
CO5	L	M	M	-	-	-	-	-	L	H	L	L	-
CO6	L	L	-	-	-	-	-	-	M	H	L	M	-

L-Low (1) M-Medium (2) H-High (3)

## COURSE ASSESSMENT METHODS:

### Direct

Continuous Assessment in Practical works, sectioning, record submission.  
Practical tests, Records etc. (as applicable), Class tests, Model Exams.  
End Semester Examination

### Indirect

#### 1. Course-end survey

## ALLIED BOTANY - I

Semester : I

Credits : 3

Course Outcomes:

Course Code : U20BYY11

Hours/Week : 4

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Classify the character feature and classification of plant diversity (Cryptograms and Phaneograms) and use that to identify species in plant kingdom	K2	I
CO 2	Explain the structure and lifecycle of Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms with examples from each group	K 2	I
CO 3	Distinguish the structure and functions of various tissues.	K 4	II
CO 4	Examine the internal structure of Dicot and Monocot leaf, stem and root	K 4	II
CO 5	Determine the various components of male and female gametophyte and mechanism of fertilization	K5	III
CO 6	Determine the mechanism of absorption, transpiration, respiration and mechanism of photosynthesis in plants	K5	IV and V

## SYLLABUS:

### Unit I: Plant Diversity

(12 Hours)

1.1 Introduction to diversity of Plants

1.2 General characteristic features and Classification of Algae (F.E. Fritsch's Classification- 1945), Fungi (Ainsworth's – 1973), Bryophytes (Rothmaler's-1951), Pteridophytes (Sporne's- 1975 )and Gymnosperms (Sporne's- 1965)

1.3 Structure, reproduction and life cycle of

- (a) Algae - *Chlamydomonos*
- (b) Fungi - *Penicillium*
- (c) Bryophytes - *Riccia*

- (d) Pteridophytes - *Lycopodium*  
(e) Gymnosperms - *Cycas*

**Unit II: Anatomy (12 Hours)**

- 2.1 Meristematic - Definition, Types (Apical, Lateral and Intercalary) and Functions  
2.2 Permanent Tissue - Parenchyma, Collenchyma, Chlorenchyma and Sclerenchyma  
Complex tissue – Xylem and Phloem  
2.3 Primary and Secondary structure of Dicot and Monocot - (a) Leaf (b) Stem (d) Root.

**Unit III: Embryology (12 Hours)**

- 3.1 Structure of Flower  
3.1 Structure of male gametophyte (Anther- Internal Structure and Functions)  
3.2 Structure of Female gametophyte (Ovules – Definition and Types of ovules  
Orthotropous, Anatropous, Campylotropous, Hemianatropous and Amphitropous)  
3.3 Fertilization and Dicot Embryo (Polygonum)

**Unit IV: Plant physiology (12 Hours)**

- 4.1 Absorption of water and salts.  
4.2 Role of mineral elements (Micro minerals and Macro minerals).  
4.3 Nitrogen cycle.  
4.4 Transpiration.

**Unit V: Photosynthesis (12 Hours)**

- 5.1 Light and Dark Reactions  
5.3 Respiration – (a) Aerobic (b) Anaerobic  
5.3 Krebs cycle and oxidative phosphorylation.

**TEXT BOOKS:**

1. Sharma. O. P. 2011. *Algae*, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
2. Sha rma. O. P. 2006. *Text book of Fungi*, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
3. Sharma. O. P. 2014. *Bryophytes*, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
4. Sharma. O. P. 2012. *Pteridophytes*. Tata McGraw Hill Education Pvt. Ltd., New Delhi.
5. Bhatnagar, S.P. and Alok Moitra. 2004. *Gymnosperms*, New age international Pvt. Ltd. Publishers, India.
6. Pandey. B.P. 2011. *Plant Anatomy*, Chand Pvt. Ltd.
7. Bhojwani, S.S., Bhatnagar, S. P. and Dantu, P. K. 2015. *The Embryology of Angiosperms 6<sup>th</sup> Edition*. Vikas Publishing House Pvt. LTD.
8. Verma, S. K and Mohit Verma, 2007. *A text book of Plant Physiology, Biochemistry and Biotechnology*. S. Chand and Company Ltd. New Delhi.

**REFERENCES BOOKS:**

1. S K Verma and Mohit Verma. 1995. *A Textbook of Plant Physiology, Biochemistry and Biotechnology*. S Chand Publications.
2. Vinod Kumar Jain. 2009. *Laboratory Manual of Plant Pathology*. Oxford Book Company.

**WEB LINK:**

<https://nptel.ac.in/content/storage2/courses/122103039/pdf/mod1.pdf>

**TOPICS FOR SELF-STUDY:**

Sl. No.	Topics for Self-Study	Reference Link
1.	Hill reactions	<a href="https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/hill-reaction">https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/hill-reaction</a>
2.	Ecological adaptations of xerophytes	<a href="https://www.biologydiscussion.com/plants/xerophytes/xerophyte-meaning-and-characteristics-plants-botany/75464">https://www.biologydiscussion.com/plants/xerophytes/xerophyte-meaning-and-characteristics-plants-botany/75464</a>
3.	Torus	<a href="https://www.easybiologyclass.com/pits-ultra-structure-classification-functions-simple-bordered-pits-similarities-differences/">https://www.easybiologyclass.com/pits-ultra-structure-classification-functions-simple-bordered-pits-similarities-differences/</a>
4.	secondary wall thickening	<a href="https://www.biologydiscussion.com/plants/cell-wall/thickening-of-cell-wall-in-plants-with-diagram-botany/68837">https://www.biologydiscussion.com/plants/cell-wall/thickening-of-cell-wall-in-plants-with-diagram-botany/68837</a>

### SPECIFIC LEARNING OUTCOME (SLO):

Unit/Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>I:</b>	<b>Plant Diversity</b>		
1.1	Introduction to diversity of Plants	<ul style="list-style-type: none"> <li>Classify and describe the major plant kingdom based on flowering and non-flowering</li> </ul>	K 2
1.2	General characteristic features and Classification of Algae (F.E. Fritsch's Classification- 1945), Fungi (Ainsworth's – 1973 ), Bryophytes (Rothmaler's-1951), Pteridophytes (Sporne's- 1975) and Gymnosperms (Sporne's- 1965)	<ul style="list-style-type: none"> <li>Tell the morphology characters</li> </ul>	K 1
1.3	Structure, reproduction and life cycle of (a) Algae - <i>Chlamydomonos</i> (b) Fungi - <i>Penicillium</i> (c) Bryophytes - <i>Riccia</i> (d) Pteridophytes - <i>Lycopodium</i> (e) Gymnosperms- <i>Cycas</i>	<ul style="list-style-type: none"> <li>Explain the habit and habitat of Cryptograms and phanerograms</li> <li>Tell life cycle of plant groups</li> </ul>	K2  K2
<b>II</b>	<b>Anatomy</b>		

2.1	Meristematic - Definition, Types (Apical, Lateral and Intercalary) and Functions	<ul style="list-style-type: none"> <li>Explain tissue in leaf, stem and root</li> </ul>	K2
2.2	Permanent Tissue - Parenchyma, Collenchyma, Chlorenchyma and Sclerenchyma, Complex tissue - Xylem and phloem	<ul style="list-style-type: none"> <li>Examine the order of arrangement of tissues in plants</li> <li>Explain the structure of tissues</li> </ul>	K4 K2
2.3	Primary and Secondary structure of Dicot and Monocot - (a) Leaf (b) Stem (d) Root.	<ul style="list-style-type: none"> <li>Compare the internal structure of leaf, stem and root</li> <li>Analyze the arrangement of tissues in leaf, stem and root</li> </ul>	K2 K4
<b>III</b>	<b>Embryology</b>		
3.1	Structure of Flower	<ul style="list-style-type: none"> <li>Illustrate the arrangements of various parts in flowers</li> </ul>	K2
3.2	Structure of male gametophyte (Anther- External and Internal Structure and Functions)	<ul style="list-style-type: none"> <li>Explain the importance of anther and pollen and internal structure of anther</li> </ul>	K5
3.3	Structure of Female gametophyte (Ovules – Definition and Types of ovules Orthotropous, Anatropous, Campylotropous, Hemianatropous and Amphitropous)	<ul style="list-style-type: none"> <li>Recognize main difference between male and female gametophyte</li> <li>Explain the structure of Ovule</li> </ul>	K2 K5
3.4	Fertilization and Dicot Embryo (Polygonum)	<ul style="list-style-type: none"> <li>Illustrate mechanism of fertilization</li> </ul>	K2
<b>IV</b>	<b>Plant physiology</b>		
4.1	Absorption of water and salts	<ul style="list-style-type: none"> <li>Identify the mode of absorption</li> <li>Illustrate and analyze the mechanism of water and salt Absorption</li> </ul>	K3 K2
4.2	Role of mineral elements (Micro minerals and Macro minerals )	<ul style="list-style-type: none"> <li>Interpret role of minerals in plant growth</li> </ul>	K5
4.3	Nitrogen cycle	<ul style="list-style-type: none"> <li>Explain the significance of nitrogen</li> <li>Illustrate the process of nitrogen fixation</li> </ul>	K4 K2
4.4	Transpiration	<ul style="list-style-type: none"> <li>Explain the significance of stomatal transpiration</li> <li>Analyze the mechanism significance of transpiration</li> </ul>	K2 K4
<b>V</b>	<b>Photosynthesis</b>		

5.1	Light and Dark Reactions	<ul style="list-style-type: none"> <li>• Illustrate the mechanism of photosynthesis</li> <li>• Explain the importance of photosynthesis</li> </ul>	K2 K4
5.2	Respiration – (a) Aerobic (b) Anaerobic	<ul style="list-style-type: none"> <li>• Compare the Aerobic and Anaerobic</li> <li>• Explain the difference between respiration</li> </ul>	K2 K4
5.3	Krebs cycle and oxidative phosphorylation	<ul style="list-style-type: none"> <li>• Illustrate how the plants respire.</li> <li>• Apply the mechanism of respiration</li> </ul>	K2 K3

### Mapping Scheme Course Code: U20BYY11

U20BYY 11	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PS O 1	PS O 2	PS O 3	PS O 4
CO1	L	H	L	-	-	-	L	-	L	H	M	M	H
CO2	L	H	L	L	-	-	-	-	L	M	L	H	M
CO3	L	H	L	L	-	-	-	-	-	-	-	H	-
CO4	L	H	L	-	-	-	-	-	-	-	-	H	-
CO5	M	H	M	M	-	-	-	-	-	-	-	L	-
CO6	M	H	M	H	-	M	L	-	L	-	M	M	M

**L-Low**

**M-Moderate**

**H- High**

### COURSE ASSESSMENT METHODS:

#### Direct

**Continuous Assessment in class works, assignments, seminars.**

**Class tests, Model Exams.**

**End Semester Examination**

#### Indirect

#### 1. Course-end survey

### Allied Botany II

**Semester : II**

**Credits : 4**

**Course Code : U20BYY22**

**Hours/Week : 4**

#### Course Outcomes:

On completion of this course, the students will be able to



No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Understand the plant morphology terminologies and identify morphological peculiarities	K2	I
CO 2	Define members of the major angiosperm families by their features and economic importance.	K2	II
CO 3	Evaluate the economic importance of selected angiosperms.	K4	III
CO 4	Make use of the vegetative propagation methods in plants	K3	IV
CO 5	Interpret plant remains, connections in plant evolution and conserve the linking plant forms from extinction.	K2	V
CO 6	Appraise the adaptations of plants in various habitat and their ecological and economic importance	K5	I - V

## SYLLABUS:

### Unit I: Morphology of Angiosperms

(12 Hours)

- 1.1 Leaf shape and Phyllotaxy
- 1.2 Inflorescence
  - (a) Racemose, (b) Cymose (c) Special types
- 1.3 Terminologies in flower description.
- 1.4 Bentham and Hooker Systems of Classification

### Unit II: Plant Taxonomy:

(12 Hours)

- 2.1 Study of following Plant families
  - (a) Annonaceae, (b) Cucurbitaceae, (c) Lamiaceae, (d) Euphorbiaceae (e) Poaceae.

### Unit III: Economic Botany

(12 Hours)

A brief study of the following economically important plants:- history, botanical name, family, uses(nutritional aspects, active compounds and importance)

- (a)Cereals : *Oryza sativa* and *Triticum aestivum*
- (b) Spices : *Cinnamomum verum* and *Syzygium aromaticum*
- (c) Essential oils : Sandal wood oil, Eucalyptus oil and Lemon grass oil
- (d)Medicinal Plants : *Catharanthus roseus* (cardiotonic), *Withania somnifera* (Drugs acting on nervous system), and *Centella asiatica* (Memory booster).

### Unit IV: Plant Propagation

(12 Hours)

- 4.1 Asexual methods: (a) Cutting (b) Air layering (c) Grafting (d) Budding.
- 4.2 Micropropagation - Medium, Explants, Techniques and Application

**Unit V: Distribution & Dispersal of Plants & animals****(12 Hours)**

- 5.1 Vegetation types of India
- 5.2 Vegetation and its effect on animal distribution
- 5.3 Pollination & seed dispersal
- 5.4 Shelter & Nesting by animals
- 5.5 Key stone species- Fig

**TEXT BOOKS:**

- 1. Fuller, H.J. and Tippo, O, 1967. *College Botany*. Henry Holt and Co.
- 2. Gangully, A.K, 1971. *General Botany*. The New Book Stall Calcutta. Vol I and II.
- 3. Muneeswaran, 2004. A. *Allied Botany*. Titan Nooks, Madurai, India.

**REFERENCE BOOKS:**

- 1. Chattopadhyaya, S.B. 1991. *Principles and Procedures of Plant protection (3rdE.d.,)* Oxford and IBH Publishing Cosec2 (P) Ltd., New Delhi.
- 2. Edmond Musser and Andres. 1957. *Fundamentals of Horticulture*. McGraw Hill Book Co
- 3. Kumar N, 1997. *Introduction to Horticulture*. Rajalakshmi Publications Nagarcovil, India.
- 4. Mathawat, G.S.P., D. Sharma and R.k. Sahni. 1996. *A text book of Botany*, Ramesh Book depot, Jaipur.
- 5. Pandey, B.P. 1999. *Economic Botany*. S. Chand and Co. New Delhi.
- 6. Verma, V. 1980. *A text book of Economic Botany*. Emkay Publications, New Delhi.

**WEB LINK:**

<https://www.iht.edu.in/>

<https://www.coursera.org/courses?query=botany&page=1>

**TOPICS FOR SELF-STUDY:**

Topics for Self-Study	Reference Link
Identification of common plants	<a href="https://www.coursera.org/learn/plant-biology">https://www.coursera.org/learn/plant-biology</a>
Modifications of plants	<a href="http://kea.kar.nic.in/vikasana/bridge/biology/chap_05_ppt.pdf">http://kea.kar.nic.in/vikasana/bridge/biology/chap_05_ppt.pdf</a>
Gootee	<a href="https://www.merriam-webster.com/dictionary/gootee">https://www.merriam-webster.com/dictionary/gootee</a>

**SPECIFIC LEARNING OUTCOME (SLO):**

Unit/ Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>I</b>	<b>Morphology of Angiosperms</b>		
1.1	Leaf shape and Phyllotaxy	<ul style="list-style-type: none"> <li>Define the morphology, structure and arrangement of leaves, scales, or bracts with flowers along the plant stem.</li> </ul>	K2
1.2	Inflorescence – (a) Racemose (b) Cymose (c) Special types	<ul style="list-style-type: none"> <li>Explain inflorescence.</li> <li>Identify the parts of an inflorescence</li> <li>Distinguish inflorescence from simple flower</li> </ul>	K2 K3 K4
1.3	Terminologies in flower	<ul style="list-style-type: none"> <li>List out the terminologies in flower</li> </ul>	K1
1.4	Bentham and Hooker systems of classification	<ul style="list-style-type: none"> <li>Outline the Bentham and hooker systems of classification</li> </ul>	K2
<b>II</b>	<b>Plant Taxonomy</b>		
2.1	Study of following plant families (a) Annonaceae (b) Cucurbitaceae (c) Lamiaceae (d) Euphobiaceae (e) Poaceae	<ul style="list-style-type: none"> <li>Illustrate the structure and characteristic of selected Plant families.</li> <li>Identify the plant families based on their morphological characters.</li> <li>Examine the plant characters</li> </ul>	K2 K3 K5
<b>III</b>	<b>Economic Botany</b>		
3.1	A brief study of the following economically important plants: history, botanical name, Family uses (nutritional aspects, active compounds and importance) <b>(a)Cereals:</b> <i>Oryza sativa and Triticum aestivum</i> <b>(b) Spices:</b> <i>Cinnamomum verum</i>	<ul style="list-style-type: none"> <li>Explain commercial products derived from plants that provide us with consumable products such as cereals, Spices, essential oils and medicinal plants.</li> </ul>	K2

	and <i>Syzygium aromaticum</i> (c) <b>Essential oils</b> : Sandal wood oil, Eucalyptus oil and Lemon grass oil (d) <b>Medicinal Plants:</b> <i>Catharanthus roseus</i> (cardiotonic), <i>Withania somnifera</i> (drugs acting on nervous system), and <i>Centella asiatica</i> (memory booster).		
<b>IV</b>	<b>Plant Propagation</b>		
4.1	Asexual methods: (a) Cutting (b) Air layering (c) Grafting (d) Budding.	<ul style="list-style-type: none"> <li>Analyze the propagation of different types of plants from cuttings, Air layering, grafting, budding using different propagation methods.</li> </ul>	K4
4.2	Micropropagation - (1)Medium,(2)Explants, Techniques and Application	<ul style="list-style-type: none"> <li>Apply plant tissue culture techniques.</li> </ul>	K3
<b>V</b>	<b>Distribution &amp; Dispersal of Plants &amp; animals</b>		
5.1	Vegetational types of India	<ul style="list-style-type: none"> <li>Compare the various type of Indian forest.</li> </ul>	K2
5.2	Vegetation and its effect on animal distribution	<ul style="list-style-type: none"> <li>Define sdifferent means of dispersal in different organisms</li> </ul>	K2
5.3	Pollination & seed dispersal	<ul style="list-style-type: none"> <li>Explain the concept of dispersal and how it helps in the process of colonization of a population</li> </ul>	K2
5.4	Shelter & Nesting by animals	<ul style="list-style-type: none"> <li>Evaluate the different shelter and nesting by animals</li> </ul>	K4
5.5	Key stone species- Fig	<ul style="list-style-type: none"> <li>Explain key stone species – fig</li> </ul>	K4

### Mapping of Course Code: U20BYY22

<b>U20BYY22</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>	<b>PSO 4</b>
<b>CO 1</b>	<b>H</b>	<b>M</b>	<b>-</b>	<b>-</b>	<b>M</b>	<b>-</b>	<b>M</b>	<b>-</b>	<b>-</b>	<b>H</b>	<b>L</b>	<b>-</b>	<b>H</b>
<b>CO 2</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>H</b>	<b>L</b>	<b>-</b>	<b>L</b>	<b>M</b>	<b>M</b>	<b>H</b>	<b>H</b>	<b>-</b>	<b>H</b>

CO 3	M	H	M	L	-	-	M	L	M	H	M	-	H
CO 4	M	-	M	H	H	M	L	H	H	H	H	M	M
CO 5	M	H	M	L	M	-	H	L	M	H	L	M	H
CO 6	M	L	L	L	M	L	M	L	L	H	M	L	M

**COURSE ASSESSMENT METHODS:**

**Direct**

**Continuous Assessment in Class tests, Model Exams.**

**End Semester Examination**

**Indirect**

**1. Course-end survey**

**ALLIED BOTANY PRACTICAL - I**

**Semester: I & II**  
**Credits: 3**

**Course Code: U20BYYP1**  
**Hours/Week: 3**

**Course Outcomes:**

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Distinguish the external, internal, reproductive structure of cryptogamae and phanerogamae	K4	I
CO 2	Understand and illustrate the structure and arrangement of tissue and morphology of plants	K 3	II
CO 3	Compare the internal structure of leaf, stem and root of dicot and monocot plants	K 4	III
CO 4	Analyse the structure of male and female gametophyte	K 4	IV
CO 5	Formulate taxonomic formula and explain a variety of physiological process	K6	V
CO 6	Explain the methods of vegetative propagation and preparation of rooting and potting medium	K5	VI, VII, VIII

**Unit-1: Plant Diversity**  
**Hours)**

**(6**

- (a) Algae - *Chlamydomonos* (Slide)
- (b) Fungi - *Penicillium* (Slide)
- (c) Bryophyte - *Riccia* - Habit, Thallus (Hand work), Sporophyte (Slide)
- (d) Pteridophyte - *Lycopodium* – Habit, Stem (Hand work),
- (e) Gymnosperm - *Cycas* – Corolloid root, Rachis, Leaflets,

Microsporophyll (Hand work), Habit (Images/ Life specimen) and Megasporophyll (Spotters )

**Unit- 2: Anatomy** (6 Hours)

- (a) Meristems (slides)
- (b) Tissues - Parenchyma, Collenchyma and Sclerenchyma, Xylem and Phloem (slides)
  - (a) T.S of dicot Stem, Leaf and Root (Hand work)
  - (b) T.S of monocot Stem, Leaf and Root (Hand work)

**Unit-3: Embryology** (6 Hours)

- (a) T.S of mature anther (Hand work),
- (b) Ovule - ovules: anatropous, orthotropous, circinotropous, amphitropous and campylotropous (Slides)
- (c) Fertilization (Slides)
- (d) Embryo (i) Cordata (ii) Globular- (Slide/images)

**Unit-4: Plant Physiology (Demonstration)** (6 Hours)

- (a) Osmosis -Thistle Funnel
- (b) Bell jar
- (c) Ganong's Photometer
- (d) Test Tube and Funnel
- (e) Ganong's light screen
- (f) Ganong's Respiroscope
- (g) Kuhne's Experiment.

**Unit-5: Taxonomy- (Hand work)** (6 Hours)

- (a) Annonaceae – *Polyalthia longifolia*
- (b) Cucurbitaceae – *Coccinia indica*
- (c) Lamiaceae – *Leucas aspera*
- (d) Euphorbiaceae – *Euphorbia heterophylla*
- (e) Poaceae – *Chloris barbata*

**Unit-6: Economic botany- (Images)** (6Hours)

- (a)Cereals : *Oryza sativa and Triticum aestivum*
- (b) Spices : *Cinnamomum verum and Syzygium aromaticum*
- (c) Essential oils : Sandal wood oil, Eucalyptus oil and Lemon grass oil
- (d) Medicinal Plants : *Catharanthus roseus, Withania somnifera, Centella asiatica*

**Unit-7: Plant propagation - (Hand work)** (6 Hours)

- (a) Air layering
- (b) Wedge grafting
- (c) Cleft grafting

**Unit-8: Plant – animal interactions and Dispersal-** (3 Hours)

- (a)Pollen and seed dispersal (Photograph)
- (b) Vegetation types in India –Map

**Text Books:**

1. Sharma. O. P. 2011. *Algae*, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
2. Sharma. O. P. 2006. *Text book of Fungi*, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
3. Sharma. O. P. 2014. *Bryophytes*, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
4. Sharma. O. P. 2012. *Pteridophytes*. Tata McGraw Hill Education Pvt. Ltd., New Delhi.
5. Bhatnagar, S.P. and Alok Moitra. 2004. *Gymnosperms*, New age international Pvt. Ltd. Publishers, India.
6. Pandey. B.P. 2011. *Plant Anatomy*, Chand Pvt. Ltd.

7. Bhojwani, S.S., Bhatnagar, S. P. and Dantu, P. K. 2015. *The Embryology of Angiosperms 6<sup>th</sup> Edition*. Vikas Publishing House Pvt. LTD.
8. Verma, S. K. and Mohit Verma, 2007. *A text book of Plant Physiology, Biochemistry and Biotechnology*. S. Chand and Company Ltd. New Delhi.

**REFERENCES BOOKS:**

1. S K Verma and Mohit Verma. 1995. *A Textbook of Plant Physiology, Biochemistry and Biotechnology*. S Chand Publications.
2. Vinod Kumar Jain. 2009. *Laboratory Manual of Plant Pathology*. Oxford Book Company.

**TOPICS FOR SELF-STUDY**

Topics for Self-Study	Reference Link
Hill reactions	<a href="https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/hill-reaction">https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/hill-reaction</a>
secondary wall thickening	<a href="https://www.biologydiscussion.com/plants/cell-wall/thickening-of-cell-wall-in-plants-with-diagram-botany/68837">https://www.biologydiscussion.com/plants/cell-wall/thickening-of-cell-wall-in-plants-with-diagram-botany/68837</a>
Vegetative propagation	<a href="https://www.toppr.com/en-in/content/concept/vegetative-propagation-201517/">https://www.toppr.com/en-in/content/concept/vegetative-propagation-201517/</a>

**WEB LINK:**

<https://nptel.ac.in/content/storage2/courses/122103039/pdf/mod1.pdf>

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit/Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
1-	Plant Diversity		

	<p>(a) <b>Algae</b> - <i>Chlamydomonas</i></p> <p>(b) <b>Fungi</b>- <i>Penicillium</i></p> <p>(c) <b>Bryophyte</b> - <i>Riccia</i> - Habit, Thallus Sporophyte</p> <p>(d) <b>Pteridophyte</b>-<i>Lycopodium</i> – Habit, Stem</p> <p>(e) <b>Gymnosperm</b>-<i>Cycas</i> – Habit, Corolloid root, Rachis, Leaflets, Microsporophyll And Megasporophyll</p>	<ul style="list-style-type: none"> <li>• Distinguish the structure of cryptogamae and phanerogamae via., permanent slides and fresh Specimen</li> <li>• List the external characteristic of plant group</li> <li>• Illustrate the various external and internal structure of Lower plants</li> </ul>	<p>K4</p> <p>K1</p> <p>K2</p>
<b>II</b>	<b>Anatomy</b>		
	<p>(a) Meristems (b) Tissues - Parenchyma, Collenchyma Chlorenchyma and Sclerenchyma, Xylem and Phloem (a) T.s of dicot Stem, Leaf and Root (b) T.s of monocot Stem, Leaf and Root</p>	<ul style="list-style-type: none"> <li>• Explain the structure of meristems and tissues</li> <li>• Examine the structure of permanent tissue through slides</li> <li>• Compare and contrast feature between dicot and monocot</li> <li>• Identify and illustrate the tissues arrangement in leaf stem and root</li> </ul>	<p>K2</p> <p>K2</p> <p>K3</p>
<b>III</b>	<b>Embryology</b>		
	<p>(a) T.S of mature anther</p> <p>(b) Ovule - ovules: anatropous, orthotropous, circinotropous, amphitropous and campylotropous</p> <p>(c) Fertilization</p> <p>(d) Embryo- (i) Cordata (ii) Globular</p>	<ul style="list-style-type: none"> <li>• Analyse the various development pattern of the reproductive structures of plants.</li> <li>• Compare the seed development in various plants.</li> </ul>	<p>K4</p> <p>K2</p>
<b>IV</b>	<b>Plant Physiology</b>		
	<p>(a) Osmosis -Thistle Funnel</p> <p>(b) Bell jar</p> <p>(c) Ganong's Photometer</p> <p>(d) Test Tube and Funnel</p> <p>(e) Ganong's light screen</p> <p>(f) Ganong's Respiroscope</p> <p>(g) Kuhne's Experiment</p>	<ul style="list-style-type: none"> <li>• Demonstrate the various physiological process</li> <li>• Analyse the various physiological process</li> <li>• Explain the important feature of experiments</li> </ul>	<p>K2</p> <p>K4</p> <p>K2</p>
<b>V</b>	<b>Taxonomy</b>		



	a) Annonaceae – <i>Polyalthia longifolia</i> (b) Cucurbitaceae – <i>Coccinia indica</i> (c) Lamiaceae – <i>Leucas aspera</i> (d) Euphorbiaceae – <i>Euphorbia heterophylla</i> (e) Poaceae – <i>Chloris barbata</i>	<ul style="list-style-type: none"> <li>Examine the morphological feature of flowering plants</li> <li>Illustrate the external characteristic features of plant</li> <li>Construct the floral diagram and formula for each species</li> </ul>	K4 K2 K6
<b>VI</b>	<b>Economic Botany</b>		
	(a) Cereals: <i>Oryza sativa</i> and <i>Triticum aestivum</i> (b) Spices: <i>Cinnamomum verum</i> and <i>Syzygium aromaticum</i> (c) Essential oils: Sandal wood oil, Eucalyptus oil and Lemon grass oil (d) Medicinal Plants: <i>Catharanthus roseus</i> , <i>Withania somnifera</i> , <i>Centella asiatica</i>	<ul style="list-style-type: none"> <li>List out the economic importance of Plants</li> <li>Categorize the plant species based on various characters.</li> <li>Compare the importance of plant products</li> </ul>	K1 K4 K5
<b>VII</b>	<b>Plant Propagation</b>		
	(a) Air layering (b) Wedge grafting (c) Cleft grafting	<ul style="list-style-type: none"> <li>Explain the various kinds of vegetative propagation methods in plants</li> </ul>	K5
<b>VIII</b>	<b>Plant – animal interactions and Dispersal</b>		
	a) Pollen and seed dispersal b) Vegetation types in India	<ul style="list-style-type: none"> <li>Tell the Relationship between pollination agents and seeds dispersal agents</li> <li>Explain the vegetation type in India</li> </ul>	K2 K5

### Mapping Scheme Course Code: U20BYYP1

U20BYYP1	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	-	H	-	-	L	-	-	-	L	H	L	L	M
CO 2	-	H	-	-	-	-	-	-	-	H	-	M	H
CO 3	-	M	-	-	-	-	-	H	M	-	-	M	-
CO 4	-	L	-	H	-	-	-	H	M	-	-	M	-
CO 5	-	M	-	H	M	-	M	-	-	M	-	H	M
CO 6	-	H	M	H	M	-	L	L	H	M	L	H	M

L-Low (1) M-Medium (2) H-High (3)

**COURSE ASSESSMENT METHODS:**

**Direct**

**Continuous Assessment in Practical works, sectioning, record submission.**

**Practical tests, Records etc. (as applicable), Class tests, Model Exams.**

**End Semester Examination**

**Indirect**

**1. Course-end survey**

**CORE – III- PLANT SYSTEMATICS AND ECONOMIC BOTANY**

**Semester : III**

**Course Code : U20BY303**

**Credits : 6**

**Hours/Week: 6**

**Course Outcomes:**

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Distinguish and apply the morphological variation and modifications of the plant parts	K4	I
CO 2	Analyse the floral taxonomy of angiosperms	K4	II
CO 3	Apply the knowledge on identification of plants, its botanical nomenclature, herbariums and its importance	K3	III
CO 4	Apply the knowledge gained in studying the plants belonging to the Polypetalae, Gamopetalae, Monocot families with their economic importance	K3	IV
CO 5	Distinguish different families on their economic importance.	K4	V
CO 6	Identify the general characteristics, morphological variations and modifications of the plant	K3	I - V

**Unit I: Vegetative Morphology**

**(18 Hours)**

1.0. Plant Morphology

1.1. Plant Habits

1.2. Root, Stem and its modification

1.3. Leaf structure- simple, compound; Phyllotaxy, venation and its modifications.

1.4. Inflorescence and types - Racemose and Cymose and special types- Racemose: simple, spike, spadix, catkin, corymb, umbel and head- Cymose: simple, monochasial –helicoids, scorpioid; Dichasial and Polychasium- Special types of Inflorescence: cyathium, verticillaster and Hypanthodium

**Unit II: Floral Morphology**

**(18 Hours)**

2.1 Floral morphology- Flower as a modified shoot, structure of flower.

2.2 Anthers- Types and arrangement

- 2.3 Gynoecium – types- Placentation  
 2.4 Aestivation, Floral diagram and floral formula  
 2.5 Classification of fruits- Simple: Fleshy – drupe, berry, Hesperidium-Fruits: Dry – Dehiscent – legume, capsule; Indehiscent -Caryopsis, Cypsella- Schizocarpic – lomentum, carcerulus, regma, cremocarp with examples- Aggregate. Multiple: sorosis, syconus.

**Unit III: Taxonomy (21 Hours)**

- 3.0 Importance of Taxonomy  
 3.1 Systems in Plant Classification (Outline only)- its merits and demerits:  
 3.1.1 Artificial Systems - Linnaeus Binomial System of classification  
 3.1.2 Natural system - Bentham and Hooker System of Classification  
 3.1.3 Phylogenetic systems - Hutchinsons system of Classification  
 3.1.4 Molecular systems- APG Systems with special reference to APG IV.  
 3.2. Cytotaxonomy- its applications  
 3.3. Numerical Taxonomy- its applications.  
 3.3 Chemotaxonomy- its applications  
 3.4 Herbarium - importance and techniques.  
 3.5 Two important National Herbaria.

**Unit IV: Angiosperm Families (30 Hours)**

- 4.0 A detailed study of Angiosperm families with their economic importance.  
 4.1 **Polypetalae:** i) Annonaceae, ii) Sterculiaceae, iii) Rutaceae, iv) Fabaceae, v) Caesalpineaceae, vi) Mimosaceae, vii) Cucurbitaceae, viii) Apiaceae.  
 4.2 **Gamopetalae:** i) Rubiaceae, ii) Asteraceae, iii) Apocynaceae iv) Asclepiadaceae, v) Solanaceae, vi) Lamiaceae, vii) Verbinaceae  
 4.3 **Monochlamideae :** i) Euphorbiaceae, ii) Amaranthaceae,  
 4.4 **Monocotyledonae:** i) Orchidaceae, ii) Liliaceae iii) Poaceae.

**Unit V: Economic Botany (3 Hours)**

Study of the following medicinal plants with special reference to their systematic position, morphology of useful parts and uses: *Adhatoda*, *Aloe*, *Bacopa*, *Catharanthus*, *Eclipta*, *Neem*, *Ocimum*, *Phyllanthus niruri*, *Rauwolfia* and *Sida*

**Topics for self-study:**

Self-study topics	References
General morphological characters of leaf	<a href="https://naldc.nal.usda.gov/download/CAT78702502/PDF">https://naldc.nal.usda.gov/download/CAT78702502/PDF</a> <a href="https://www.sciencedirect.com/topics/earth-and-planetary-sciences/leaf-morphology">https://www.sciencedirect.com/topics/earth-and-planetary-sciences/leaf-morphology</a>
Plant Reproductive biology/ Pollination	<a href="https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1438-8677.2010.00414.x#:~:text=He%20concluded%20from%20his%20observations,to%20attract%20insects%20for%20pollination.&amp;text=Late%20r%20C%20The%20Origin%20of%20Species,relationship%20between%20flowers%20and%20pollinators.">https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1438-8677.2010.00414.x#:~:text=He%20concluded%20from%20his%20observations,to%20attract%20insects%20for%20pollination.&amp;text=Late%20r%20C%20The%20Origin%20of%20Species,relationship%20between%20flowers%20and%20pollinators.</a>
Digital herbaria	<a href="http://dhcrop.bsmrau.net/">http://dhcrop.bsmrau.net/</a>
Kew botanical garden	<a href="https://www.kew.org/">https://www.kew.org/</a>
Plant Databases	<a href="http://www.plantgdb.org/">http://www.plantgdb.org/</a> <a href="http://www.plantphysiol.org/content/by/section/BIOINFORMATICS-PLANT%20DATABASES">http://www.plantphysiol.org/content/by/section/BIOINFORMATICS-PLANT%20DATABASES</a>
National botanical garden, Tamil nadu	<a href="https://nilgiris.nic.in/tourist-place/botanical-garden/">https://nilgiris.nic.in/tourist-place/botanical-garden/</a>

**TEXT BOOKS:****Taxonomy**

1. Lawrence, G.I.M. 1953. *Taxonomy of Vascular Plants*. Oxford & IBH Publishers, New Delhi.
2. Narayanaswamy, R.V. and Rao, K.N. 1976. *Outlines of Botany*. S. Viswanathan Printers & Publishers, Chennai.
3. Pandey, B.P. 1997. *Taxonomy of Angiosperms*. S. Chand & Co., (P) Ltd., New Delhi.
4. Sharma, O.P. 2000. *Plant Taxonomy*. Tata McGraw Hill Publishing Co., New Delhi.
5. Vashista, P.C. 1997. *Taxonomy of Angiosperms*. S. Chand & Co., New Delhi.
6. Eames, A.J, 1969. *Morphology of Angiosperms*. McGraw Hill Publishing Co, New York.
7. Naik, V.N, 1984. *Taxonomy of Angiosperms*. Tata McGraw Hill Publishing Co, New Delhi.
8. Pandey, S.N and Misra, S.P. 2008. *Taxonomy of Angiosperms*. Ane Books India, New Delhi.
9. Sharma, O. P, 1993. *Plant Taxonomy*. Tata Mc Graw Hill Publishing Co Ltd., New Delhi.
10. Lawrence GHM, 1951. *Taxonomy of Vascular Plants*, Oxford &IBH, New Delhi.
11. Singh, G. 1999. *Plant Systematics: Theory and Practice*, Oxford & IBH, New Delhi.

**WEB LINKS:**

<https://nptel.ac.in/content/storage2/courses/122103039/pdf/mod1.pdf>

**SPECIFIC LEARNING OUTCOMES (SLO):**

UNIT/ SECTI ON	CONTENT	LEARNING OUTCOME	HIGHEST BLOOM TAXONO MIC LEVEL OF TRANSA CTION
<b>I</b>	<b>Plant Morphology</b>		
1.1	Plant Habits	<ul style="list-style-type: none"> <li>• Recall the Plant Habits</li> <li>• Compare the various habitats of Plants</li> <li>• List out the systematic characteristics of angiosperm plants</li> </ul>	K1 K2 K4
1.2	Root, Stem and its modification	<ul style="list-style-type: none"> <li>• Classify the different morphological variation of the plant parts</li> </ul>	K2

		<ul style="list-style-type: none"> <li>• Explain the root, stem and its modification</li> </ul>	K2
1.3	Phyllotaxy	<ul style="list-style-type: none"> <li>• Distinguish the leaf types</li> </ul>	K4
1.3.1	Leaf structure- simple, compound venation and its modifications	<ul style="list-style-type: none"> <li>• Explain the leaf structure its modifications</li> <li>• Interpret the adaptations occurred in plant</li> </ul>	K2 K2
1.4	Inflorescence and types - Racemose and Cymose and special types	<ul style="list-style-type: none"> <li>• Classify the Inflorescence types</li> </ul>	K2
1.4.1	Racemose : simple, spike, spadix, catkin, corymb, umbel and head	<ul style="list-style-type: none"> <li>• Distinguish between Racemose inflorescence</li> </ul>	K4
1.4.2	Cymose: simple, monochasial – helicoids, scorpid; Dichasial and Polychasial	<ul style="list-style-type: none"> <li>• Compare Cymose inflorescence</li> </ul>	K4
1.4.3	Special types of Inflorescence: cyathium, verticillaster and Hypanthodium	<ul style="list-style-type: none"> <li>• Explain the special types of Inflorescence</li> </ul>	K2
<b>II</b>	<b>Floral Morphology</b>		
2.1.1	Flower as a modified shoot, structure of flower	<ul style="list-style-type: none"> <li>• Explain the modified shoot</li> <li>• Classify structure of flower</li> </ul>	K2 K2
2.1.2	Types of flowers	<ul style="list-style-type: none"> <li>• List out Types of flowers</li> </ul>	K1
2.2	Types of anthers and arrangement	<ul style="list-style-type: none"> <li>• Classify the types of anthers and arrangement</li> </ul>	K2
2.3	Gynoecium – types Placentation	<ul style="list-style-type: none"> <li>• Distinguish the Gynoecium and types of placentation</li> </ul>	K4
2.4	Aestivation Floral diagram and floral formula	<ul style="list-style-type: none"> <li>• List out the arrangement of petals and sepals in a flower bud.</li> <li>• Apply the floral formula is a system of representing the structure of a flower using specific letters, numbers and symbols</li> </ul>	K1 K3

2.5	Classification of fruits Fruits: outline of the classification; Simple: Fleshy – drupe, berry, hesperidium, Dry – Dehiscent – legume, capsule; Indehiscent -Caryopsis, Cypsella, Schizocarpic – lomentum, carcerulus, regma, cremocarp, Aggregate. Multiple: sorosis, syconus	<ul style="list-style-type: none"> <li>Classify to fruit and types of fruits</li> </ul>	K2
<b>III</b>	<b>Importance of Taxonomy</b>		
3.0	Importance of Taxonomy	<ul style="list-style-type: none"> <li>List out the Importance of Taxonomy</li> </ul>	K1
3.1.1	Systems of Classification, Binomial nomenclature	<ul style="list-style-type: none"> <li>Apply the importance of Botanical nomenclature</li> </ul>	K3
3.1.2	Bentham and Hooker's classification, merits and demerits	<ul style="list-style-type: none"> <li>Explain the classification of Bentham and Hooker and others</li> </ul>	K4
3.1.3	Hutchinson's classification – Merits and demerits.	<ul style="list-style-type: none"> <li>Outline the classification of Hutchinson's classification – Merits and demerits</li> </ul>	K2
3.1.4	Molecular systems- APG Systems with special reference to APG IV.	<ul style="list-style-type: none"> <li>Explain the modern system of classification</li> </ul>	K2
3.2	Cytotaxonomy	<ul style="list-style-type: none"> <li>Explain the chromosomes studies</li> </ul>	K2
3.3	Numerical Taxonomy	<ul style="list-style-type: none"> <li>Analyze the importance of Phenetics in phylogenetic study.</li> </ul>	K4
3.4	Chemotaxonomy	<ul style="list-style-type: none"> <li>Identify originally plants according to confirmable in their biochemical compositions.</li> </ul>	K3
3.6	Herbarium - importance and techniques	<ul style="list-style-type: none"> <li>List out the importance of herbariums</li> </ul>	K1
3.6.1	Two important national herbaria	<ul style="list-style-type: none"> <li>List out the national herbaria</li> </ul>	K1
<b>IV</b>	<b>Polypetalae</b>		

4.1	<b>Polypetalae:</b> i) Annonaceae, ii) Capparidaceae, iii) Sterculiaceae, iv) Rutaceae, v) Fabaceae, vi) Caesalpineaceae, vii) Mimosaceae, viii) Cucurbitaceae, ix) Apiaceae.	<ul style="list-style-type: none"> <li>Illustrate the salient features of plants belonging to the families Annonaceae to Apiaceae</li> <li>Identify the characters of various plant families.</li> </ul>	K2  K3
4.2	<b>Gamopetalae:</b> i) Rubiaceae, ii) Asteraceae, iii) Apocynaceae, iv) Asclepiadaceae, v) Solanaceae, vi) Lamiaceae, vii) Verbinaceae	<ul style="list-style-type: none"> <li>Distinguish the plants belonging to Gamopetalae and apply the knowledge gained by studying families under Rubiaceae to Verbinaceae</li> </ul>	K4
4.3	<b>Monochlamideae :</b> i) Euphorbiaceae, ii) Amaranthaceae	<ul style="list-style-type: none"> <li>Distinguish the plants belonging to the families</li> </ul>	K4
4.4	<b>Monocotyledon :</b> i) Orchidaceae, ii) Liliaceae, iii) Poaceae	<ul style="list-style-type: none"> <li>Distinguish the plants belonging to the families</li> <li>Apply the knowledge gained by studying the plants belonging to Monocotyledon</li> </ul>	K4  K3
<b>V</b>	<b>Economic Botany</b>		
5.0	Study of the following medicinal plants with special reference to their systematic position, morphology of useful parts and uses: <i>Adhatoda, Aloe, Bacopa, Catharanthus, Eclipta, Neem, Ocimum, Phyllanthus niruri, Rauwolfia and Sida</i>	<ul style="list-style-type: none"> <li>Explain the importance of plants</li> <li>Make use of these plants in future</li> </ul>	K2  K3

### Mapping Scheme for the Course Code: U20BY303.

U20BY 303	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	M	-	-	-	-	-	L	L	H	L	L
CO2	H	H	-	-	-	-	-	-	M	L	H	M	L
CO3	H	H	-	L	-	-	L	--	-	L	H	M	M
CO4	H	H	-	M	-	-	-	-	-	L	H	L	M
CO5	H	H	-	-	-	L	L	-	M	L	H	L	M
CO6	H	H	L	-	-	L	-	-	L	L	H	L	M

**L-Low M-Medium H-High**

**COURSE ASSESSMENT METHODS:****Direct****Continuous Assessment in Practical works, sectioning, record submission.****Practical tests, Records etc. (as applicable), Class tests, Model Exams.****Herbarium, field book****End Semester Examination****Indirect****1. Course-end survey****MAJOR PRACTICAL III – PLANT SYSTEMATICS AND ECONOMIC BOTANY****Semester : III****Credits : 2****Course Code : U20BY3P3****Hours/week. : 3****Course Outcomes:**

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

<b>No</b>	<b>COURSE OUTCOMES (CO)</b>	<b>Level</b>	<b>Unit</b>
<b>CO 1</b>	Identify the morphological variations and modifications of the plant	K3	I
<b>CO 2</b>	Analyse plant modifications based on ecological adaptation	K4	I
<b>CO 3</b>	Make use of the knowledge in identifying the plants belonging to the Polypetalae family.	K3	II
<b>CO 4</b>	Distinguish the floral characters of different families belonging to the Gamopetalae	K4	II
<b>CO 5</b>	Identify Monocotyledon plants by their characters	K3	II
<b>CO 6</b>	Explain the economic importance of plant and plant parts.	K2	III

**Syllabus:****UNIT I- Morphological studies in Plants****(15 Hours)**



1.1 Study of Root and its Modifications a) Tap root (*Acalypha*) b) Adventitious root (Grass) c) Storage roots – Conical (*Daucas*), Fusiform (*Raphanus*), Napiform (Beta) d) Stilt root (Maize/Pandanus) e) Aerial root (Pothos) f) Respiratory root (*Avicennia*)

1.2. Study of Stem and its Modifications a) Underground stem –Corm (*Amorphophallus*), Tuber (Potato), Bulb (Onion), Rhizome (Ginger) b) Sub aerial stem- Runner (Grass), Offset (*Eichhornia*). c) Aerial stem – Phylloclade (*Opuntia*), Cladode (*Asparagus*), Thorn (*Bougainvilla*), Stem tendril (*Passiflora*)

1.3. Study of Leaf and its diversity a) Types of leaf (Simple (Mango), Compound-Paripinnate (*Tamarindus*), Imparipinnate (*Neem/Rose/Clitoria*) b) Shape – Linear (Grass), Lanceolate (*Nerium*), Ovate (*Hibiscus*), Obcordate (*Bauhinia*), Elliptical (Guava) c) Venation – i) Reticulate- Unicostate (*Ficus*), Multicostate (*Cucurbita*) ii) Parallel- i) Unicostate/Pinnate (*Canna*), ii) Multicostate convergent (*Bamboo/Grass*) d) Phyllotaxy – i) Spiral (*Hibiscus*), ii) Opposite Decussate (*Calotropis/Ixora*), Opposite superimposed (Guava) iii) Ternate (*Nerium*) iv) Whorled (*Alamanda*) v) Radical (*Aloe*) vi) Leaf Mosaic (*Acalypha*) e) Modifications- i) Succulent leaf (*Bryophyllum*), ii) Reproductive leaf (*Kalanchoe*).

1.4. Study of Flower / Inflorescence a) Typical flower (*Hibiscus / Datura*), Inflorescence-i) Simple Receme (*Tephrosia*), Spike (*Achyranthes*), Corymb (*Caesalpinia*), Head/Capitulum (*Tridax*), ii) Cymose – Simple cyme (*Jasmine*), Monochasial Helicoid (*Haemelia*), Monochasialscorpoid (*Heliotropium*), Dichasial cyme (*Ixora*), Polychasial cyme (*Nerium*), iii) Special-Cyathium (*Euphorbia*), Thyrsus (*Ocimum*), Verticillaster (*Leucas*), Hypanthodium (*Fig*).

1.5. Study of Fruits & its Type a) Simple: i) Dry Dehiscent – Legume (*Tephrosia*), Follicle (*Calotropis*), Capsule (*Ladies finger*) ii) Dry Indehiscent – Cypsella (*Tridax*), iii) Splitting/Schizocarpic- Carcerulus (*Ocimum*) iii) Succulent – Pome (Apple), Berry (Brinjal), Hesperidium (Orange), Drupe (Mango) b) Aggregate (*Polyalthia*) c) Composite fruit- Sorosis (Jack fruit).

**UNIT II. Taxonomy (12 Hours)**

Taxonomy Study of various angiosperm families mentioned in the syllabus by using MLS of flower and study of floral whorls with floral formula and floral diagram.

**UNIT III. Economic Importance in Plants (3 Hours)**

Binomials and Morphology of the useful parts of the Economic products belonging to the families studied.

Submission Field visit & report, preparation and submission of 20 bonafide Herbarium sheets with Field Note Book and Record should be submitted during the end semester practical examination.

**Topics for self-study:**

Self-study topics	References
Placentation	<a href="https://www.merriam-webster.com/dictionary/placentation">https://www.merriam-webster.com/dictionary/placentation</a>
Plant Reproductive	<a href="https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1438-">https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1438-</a>

biology/ Pollination	<a href="https://www.researchgate.net/publication/312111111/figure/fig1/figure-pdf?input=1&amp;context=1">8677.2010.00414.x#:~:text=He%20concluded%20from%20his%20observations,to%20attract%20insects%20for%20pollination.&amp;text=Later%2C%20The%20Origin%20of%20Species,relation%20between%20flowers%20and%20pollinators.</a>
Digital herbaria	<a href="http://dncrop.bsmrau.net/">http://dncrop.bsmrau.net/</a>
Kew botanical garden	<a href="https://www.kew.org/">https://www.kew.org/</a>

### TEXT BOOKS:

1. Sharma, O.P, 2000.*Plant Taxonomy*. Tata McGraw Hill Publishing Co., New Delhi.
2. Ashok Bendre and Ashok Kumar, 1999. *Economic Botany*. Rastogi Publications, Meerut, India.

### REFERENCE BOOK:

1. Dr. R. Satish Kumar, *Plant Taxonomy & Embryology (With Practical Manual)*. KNRN publications.
2. John C. Semple, 2016. Flowering Plants Laboratory Manual, Aster Graphics Publisher, ISBN: 978-0-9736087-2-4

### Web Links:

<https://www.acs.edu.au/courses/plant-taxonomy-833.aspx>

### SPECIFIC LEARNING OUTCOMES (SLO):

UNIT/ SECTION	CONTENT	LEARNING OUTCOME	HIGHEST BLOOM TAXONOMIC LEVEL OF TRANSACTION
<b>I</b>	<b>Morphological studies in Plants</b>		
<b>1.1</b>	Study of Root and its Modifications a) Tap root (Acalypha) b) Adventitious root (Grass) c) Storage roots – Conical (Daucas), Fusiform (Raphanus), Napiform (Beta) d) Stilt root (Maize/Pandanus) e) Aerial root (Pothos) f) Respiratory root (Avicennia)	<ul style="list-style-type: none"> <li>• Define the root modifications by observing the parts.</li> <li>• Explain the useful plant parts</li> </ul>	<b>K2</b>  <b>K2</b>
<b>1.2</b>	Study of Stem and its Modifications a) Underground stem –Corm (Amorphophallus), Tuber (Potato), Bulb (Onion), Rhizome (Ginger) b) Sub aerial	<ul style="list-style-type: none"> <li>• Explain the use for stem modifications and the parts adaptation</li> <li>• Examine the ecological adaptation of plant</li> </ul>	<b>K2</b>  <b>K4</b>

	stem- Runner (Grass), Offset (Eichhornia). c) Aerial stem – Phylloclade (Opuntia), Cladode (Asparagus), Thorn (Bougainvillea), Stem tendril (Passiflora)	modification	
<b>1.3</b>	Study of Leaf and its diversity a) Types of leaf (Simple (Mango), Compound-Paripinnate (Tamarindus), Imparipinnate (Neem/Rose/Clitoria) b) Shape – Linear (Grass), Lanceolate (Nerium), Ovate (Hibiscus), Obcordate (Bauhinia), Elliptical (Guava) c) Venation – i) Reticulate- Unicostate (Ficus), Multicostate (Cucurbita) ii) Parallel- i) Unicostate/Pinnate (Canna), ii) Multicostate convergent (Bamboo/Grass) d) Phyllotaxy – i) Spiral (Hibiscus), ii) Opposite Decussate (Calotropis/Ixora), Opposite superimposed (Guava) iii) Ternate (Nerium) iv) Whorled (Alamanda) v) Radical (Aloe) vi) Leaf Mosaic (Acalypha) e) Modifications- i) Succulent leaf (Bryophyllum), ii) Reproductive leaf (Kalanchoe).	<ul style="list-style-type: none"> <li>Define the leaf modifications in plants</li> <li>Explain the taxonomic principles for plant identification</li> </ul>	<b>K2</b>  <b>K2</b>
<b>1.4</b>	Study of Flower / Inflorescence a) Typical flower (Hibiscus / Datura), Inflorescence-i) Simple Receme (Tehprosia), Spike (Achyranthes), Corymb (Caesalpinia), Head/Capitulum (Tridax), ii) Cymose – Simple cyme (Jasmine), Monochasial Helicoid (Haemelia), Monochasialscorpoid (Heliotropium), Dichasial cyme (Ixora), Polychasial cyme (Nerium), iii) Special-Cyathium (Euphorbia), Thyrsus (Ocimum), Verticillaster	<ul style="list-style-type: none"> <li>Make use of the flower types for plant identification</li> <li>Tell the various types of flowers</li> <li>Analyze the flower modification that favour pollination</li> </ul>	<b>K3</b>  <b>K1</b>  <b>K4</b>

	(Leucas), Hypanthodium (Fig).		
<b>1.5</b>	Study of Fruits & its Type a) Simple: i) Dry Dehiscent – Legume (Tephrosia), Follicle (Calotropis), Capsule (Ladies finger) ii) Dry Indehiscent – Cypsella (Tridax), iii) Splitting/Schizocarpic- Carcerulus (Ocimum) iii) Succulent – Pome (Apple), Berry (Brinjal), Hesperidium (Orange), Drupe (Mango) b) Aggregate (Polyalthia) c) Composite fruit- Sorosis (Jack fruit).	<ul style="list-style-type: none"> <li>Examine the various fruit modifications</li> <li>Analyze the seed dehiscence mechanisms</li> <li>Define the fruit types</li> </ul>	<b>K4</b> <b>K4</b> <b>K2</b>
<b>II</b>	<b>Taxonomy</b>		
	Taxonomy Study of various angiosperm families mentioned in the syllabus by using MLS of flower and study of floral whorls with floral formula and floral diagram.	<ul style="list-style-type: none"> <li>Analyze the plant groups on various groups</li> <li>Identify the plant category</li> <li>Make use of the scientific classification of plants</li> </ul>	<b>K4</b> <b>K3</b> <b>K3</b>
<b>III</b>	<b>Economic Importance in Plants</b>		
	Binomials and Morphology of the useful parts of the Economic products belonging to the families studied.	<ul style="list-style-type: none"> <li>Explain the economic importance of selected plant parts.</li> </ul>	<b>K2</b>

### Mapping Scheme for the Course Code: U20BY3P3

<b>U20BY 3P3</b>	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	M	M	-	-	-	-	-	L	L	H	L	L
CO2	H	H	-	-	-	-	-	-	M	L	M	M	L
CO3	H	H	M	L	L	L	L	M	-	L	H	M	M
CO4	M	H	L	M	-	-	-	-	-	L	H	L	M
CO5	H	H	-	-	-	L	L	-	M	L	H	L	M
CO6	H	H	L	-	-	L	-	-	L	L	H	L	M

**L-Low M-Medium H-High**

### COURSE ASSESSMENT METHODS:

**Direct**

**Continuous Assessment in Practical works, record submission.**

**Class tests, Model Exams.**

**Herbarium, field book**

**End Semester Examination**

**Indirect**

**1. Course-end survey**

### **NMEC I - NURSERY TECHNOLOGY**

**Course Code: U20BYPE1**

**Credits: 2**

**Semester III**

**Hours/Week: 2**

On completion of this course, the student will be able to:

<b>No</b>	<b>COURSE OUTCOMES (CO)</b>	<b>Level</b>	<b>Unit</b>
<b>CO 1</b>	Summarize the basic concepts of Nursery Management.	<b>K2</b>	<b>I</b>
<b>CO 2</b>	Explain with the process of vegetative propagations	<b>K5</b>	<b>I</b>
<b>CO 3</b>	Make use of the <i>in vitro</i> cultivation methods.	<b>K3</b>	<b>II</b>
<b>CO 4</b>	Identify plant multiplication methods and nursery structures.	<b>K3</b>	<b>III</b>
<b>CO 5</b>	Distinguish greenhouse farming, net farming, pot culturing.	<b>K4</b>	<b>IV</b>
<b>CO 6</b>	Identify the methods of harvesting, storage in various plants	<b>K3</b>	<b>V</b>

#### **SYLLABUS:**

##### **Unit I: Introduction**

**(6 Hours)**

Methods of Propagation-Sexual Propagation, Vegetative Propagation, Cuttings, Layering, Grafting, Budding.

##### **UNIT II : Tissue culture**

**(6 Hours)**

Methods of Plant multiplication *in vitro*. Basic parameters for propagation *in vitro*.

##### **UNIT III : Nursery Structures**

**(6 Hours)**

Store House, Potting and Packing Shed, Nursery Bed, Mist Chamber, Manures, compost, vermicompost.

##### **UNIT IV:**

**(6 Hours)**

Green houses for tropical countries – Management, Pot culture, Pot mixture

##### **UNIT V :**

**(6 Hours)**

Harvesting, Packing, Storage and Marketing of Nursery Stock

#### **TEXT BOOKS:**

1. Kumar. N. 1997. *Introduction to Horticulture*. Rajalakshmi Publications Nagercoil, India.
2. Manibhushan Rao, K. 1991. *Text Book of Horticulture*. Macmillon India Ltd.

**REFERENCES:**

1. Edmond Musser and Andres. 1957. *Fundamentals of Horticulture*. McGraw Hill Book Co.
2. Gardener. 1996. *Basic Horticulture*. Mac Millan N.Y.
3. Lex Lauries and Victor H, Rice. 1979. *Floriculture – fundamentals and practices*. Mc. Graw Hill publishers N.Y.
4. Mukherjee. D. 1977. *Gardening in India*. Oxford IBH Publishing Co., New Delhi.
5. Randhawa. 1997. *Ornamental Horticulture in India*. Today and Tomorrow Publishers New Delhi.
6. Sandhu. M.K. 1989. *Plant Propagation*. Wiley Easter Ltd., New Delhi.
7. Sundararajan, J.S., Muthuswamy, J., Shanmugavelu, K.G. and Balakrishnan. R. 1995. *A Guide to Horticulture*. Thiruvenskadam Printers, Coimbatore. 60
8. Trevor Thorpe, Indra Hary. 1997. *Application of tissue culture to Horticulture*. International Society for Horticulture and Science. 447. Page 39-48.

**Web link:**

[https://onlinecourses.nptel.ac.in/noc20\\_ce11/preview](https://onlinecourses.nptel.ac.in/noc20_ce11/preview)

**SPECIFIC LEARNING OUTCOME (SLO):**

Unit	Content	Learning Outcome	Highest Bloom taxonomic level of transaction
I	Introduction	<ul style="list-style-type: none"> <li>Define the basic concepts in plant propagation.</li> </ul>	<b>K1</b>
	Methods of Propagation- Sexual Vegetative.	<ul style="list-style-type: none"> <li>List out the major plant propagative methods.</li> <li>Explain the importance of plant propagative methods.</li> </ul>	<b>K2</b> <b>K5</b>
II	Tissue culture – Methods of Plant multiplication <i>in vitro</i> .	<ul style="list-style-type: none"> <li>Define various <i>in vitro</i> and <i>in vivo</i> methods used in plant propagation.</li> <li>Make use of new techniques in the <i>in vitro</i> technology.</li> </ul>	<b>K2</b> <b>K3</b>
	Basic parameters for propagation <i>in vitro</i> .	<ul style="list-style-type: none"> <li>Name various parameters influencing the successful</li> </ul>	<b>K1</b>

		<ul style="list-style-type: none"> <li>plant <i>in vitro</i> propagation.</li> <li>Select the best planting protocol for various plants.</li> <li>Relate <i>in vitro</i> propagative methods in industrial scale..</li> </ul>	<b>K2</b>
<b>III</b>	Nursery Structures – Store House, Potting and Packing Shed, Nursery Bed, Mist Chamber, Manures, compost, vermicompost	<ul style="list-style-type: none"> <li>Define the parts of Nursery Structure.</li> <li>Develop new formulations for different plants in growth chamber.</li> </ul>	<b>K1</b> <b>K3</b>
<b>IV</b>	Green houses for tropical countries – Management, Pot culture, Pot mixture	<ul style="list-style-type: none"> <li>Summarize the green house management systems.</li> <li>Analyze best suited practice.</li> </ul>	<b>K2</b> <b>K4</b>
<b>V</b>	Harvesting, Packing, Storage and Marketing of Nursery Stock	<ul style="list-style-type: none"> <li>List out stages in Nursery techniques.</li> <li>Identify the best practice based on utility.</li> </ul>	<b>K2</b> <b>K3</b>

#### Mapping Scheme for Course Code: U20BYPE1

<b>U20BY PE1</b>	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	-	L	H	L	-	L	L	M	L	L	M	-
CO2	L	-	L	-	-	L	L	-	L	-	M	M	-
CO3	M	L	-	H	L	-	-	-	M	L	L	L	L
CO4	L	L	L	-	M	-	-	-	M	M	-	H	L
CO5	M	L	-	M	-	L	M	L	-	M	H	-	L
CO6	M	-	-	L	L	M	L	L	M	-	-	L	-

L-Low (1) M-Medium (2) H-High (3)

#### Course assessment:

1. Continuous assessment by seminars, assignments, records.
2. Model exam and End semester exam

#### Core IV: PLANT ANATOMY AND DEVELOPMENTAL BOTANY

Semester: IV  
Credits : 5

Course Code: U20BY404  
Hours/Week : 6

### Course Outcomes:

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Classify the major types of tissue system and its functions.	K4	I
CO 2	Discuss the theories related with Shoot & Root Apical Meristem.	K6	I
CO 3	Elaborate the developmental process of secondary growth pattern of shoot & Root.	K6	II
CO 4	Discuss the anatomical structure of Anomalies of Monocot and Dicot.	K6	III
CO 5	Compare the structure and development of Micro gametogenesis and Mega gametogenesis.	K4	IV
CO 6	Evaluate the Process of Development of an Embryo, seed structure and apomixes	K5	V

### SYLLABUS:

#### Unit I : Scope of Plant Anatomy & Meristematic Tissue System (15 Hours)

**1.1 Scope of Plant Anatomy-** Application in Systematics, forensics and pharmacognosy

#### 1.2 Plant Tissues

1.2 Tissue – definition, characteristics and classification

**1.3 Simple and Complex tissues (no phylogeny)-** Simple Tissues – Structure and Function of Parenchyma, Collenchyma and Sclerenchyma- Complex Tissues – Xylem, Phloem and its component - Pits and Plasmodesmata

**1.4 Meristematic Tissue-** Meristem -Characteristics, Classification of meristem based on stage of development- Organization – Shoot Apex – Apical cell theory, Histogen theory, Tunica Corpus theory. Types of Vascular Bundles, Primary structure of Dicot and Monocot stem.- Organisation- Root Apex – Apical cell theory, Histogen theory, Korper-Kappe theory, Quiescent centre, Primary structure of Dicot and Monocot root.

**1.5 Secretory Tissue-** Laticiferous tissues - (i) Non-articulate Latex Ducts / Latex Cell (ii) Articulate Latex Ducts/ Latex Vessels- Glandular Tissues – (i) Hydathodes, (ii) Lithocysts (iii) Cavities

#### Unit II: Adaptive and Protective Systems & Vascular Cambium (15 Hours)

**2.1 Epidermal Tissue System-** Cuticle, epicuticular waxes, trichomes (uni and Multicellular, Glandular and Non-glandular – two examples of each), - Stomata and its types

#### 2.2 Vascular Cambium

Structure and function - Secondary growth in root and stem

#### 2.3 Nodal Anatomy



Anatomical Structure of Monocot & Dicot Leaf- Definition, Leaf Trace, Leaf gap- Types of Nodes – Unilacunar, Trilacunar and Multilacunar

**Unit III- Wood and Anomalous secondary growth (15 Hours)**

**3.1. Cambium-** Axillary and radially oriented elements

**3.2 Nature of Wood** -Sapwood and Heartwood, Ring and diffuse porous wood & Early and late wood

**3.3 Tylosis**

**3.4 Dendrochronology**

**3.5 Periderm-** Periderm development

**3.6 Anomalous Secondary growth-** Anomalous secondary structure of Genus *Aristalochia* and *Dracaena*

**UNIT IV- DEVELOPEMENTAL EMBRYOLOGY IN ANGIOSPERMS (15 Hours)**

**4.1. Flower and it parts**

**4.2. Stamen and Androecium (microsporangium)-** Structure of anther - Microsporangium-development of anther - Microsporogenesis

**4.3 Microgametogenesis-** Development of male gametophyte - Pollen development and structure

**4.4 Carpel and Gynoecium (Megasporangium)**

Megasporangium – Structure - Types of ovules - Orthotropous, Anatropous, Campylotropous, Hemianatropous and Amphitropous

**4.5 Megagametogenesis**

Development of female gametophyte - Types of Embryosac – Monosporic (*Polygonum*), Bisporic(*Allium*) and Tetrasporic (*Peperomia*)-Development of Embryosac.

**UNIT V: POLLINATION AND FERTILIZATION (15 Hours)**

**5.1 Pollination** – Definition - Pollination mechanism - Types of Pollination – Self Pollination, Cross Pollination - Advantages and disadvantages of pollination, Pollen pistle interaction

**5.2 Double Fertilization-** Syngamy - Triple fusion

**5.3 Post fertilization changes**

**5.4 Endosperm**

Definition, Types – Nuclear, Cellular and Helobial, function of endosperm- Ruminante endosperm

**5.5 Embryo development**

Development of Embryo in Dicots and monocots

**5.6. Seed structure** - Structure of monocot and Dicot seed - Importance and reserve food materials of seed

5.7. Apomixis- (a) Definition (b) Parthenocarpy and its application

5.8 Polyembryony and its application

**Topics for Self-Study:**

Self-Study topics	References
The Cell, Cell Cycle & Cell Division	<a href="https://www.nature.com/scitable/topic/cell-cycle-and-cell-division-14122649/">https://www.nature.com/scitable/topic/cell-cycle-and-cell-division-14122649/</a> <a href="https://www.genome.gov/genetics-glossary/Cell-Cycle">https://www.genome.gov/genetics-glossary/Cell-Cycle</a>
Abcission and	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2634118/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2634118/</a>

healing of wounds	<a href="https://nph.onlinelibrary.wiley.com/doi/pdf/10.1111/j.1469-8137.1986.tb00606.x">https://nph.onlinelibrary.wiley.com/doi/pdf/10.1111/j.1469-8137.1986.tb00606.x</a>
Ecological Anatomy	<a href="https://www.researchgate.net/publication/279432765_Ecological_anatomy">https://www.researchgate.net/publication/279432765_Ecological_anatomy</a> <a href="https://www.scielo.br/scielo.php?script=sci_arttext&amp;pid=S0100-29452018000400201">https://www.scielo.br/scielo.php?script=sci_arttext&amp;pid=S0100-29452018000400201</a>
Systemic Plant Anatomy	<a href="https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/plant-anatomy">https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/plant-anatomy</a> <a href="https://pubmed.ncbi.nlm.nih.gov/21245193/">https://pubmed.ncbi.nlm.nih.gov/21245193/</a>
Palynology	<a href="https://www.floridamuseum.ufl.edu/paleobotany/palynology/#:~:text=Palynology%20is%20the%20study%20of,both%20living%20and%20fossil%20form.">https://www.floridamuseum.ufl.edu/paleobotany/palynology/#:~:text=Palynology%20is%20the%20study%20of,both%20living%20and%20fossil%20form.</a> <a href="https://sfb.univie.ac.at/en/research/palynology/">https://sfb.univie.ac.at/en/research/palynology/</a>
Embryology in relation to Taxonomy	<a href="https://link.springer.com/chapter/10.1007/978-3-642-69302-1_14">https://link.springer.com/chapter/10.1007/978-3-642-69302-1_14</a> <a href="https://www.jstor.org/stable/2481545?seq=1">https://www.jstor.org/stable/2481545?seq=1</a>
Experimental Embryology	<a href="https://www.ncbi.nlm.nih.gov/books/NBK10002/">https://www.ncbi.nlm.nih.gov/books/NBK10002/</a> <a href="https://www.nature.com/articles/080451a0">https://www.nature.com/articles/080451a0</a>

#### TEXT BOOKS:

1. Pandey B.P. 1990. *Plant Anatomy*, S. Chand & Co., New Delhi.
2. Vashista.P.C. 1998. *A Text Book of Plant Anatomy*. S Nagin & co
3. Bhojwani, S.S. and Bhatnagar, S.P. 2011. *Embryology of Angiosperms*. Vikas Publication House Pvt. Ltd. New Delhi.
4. S.N. Pandey and A. Chadha. 1997. *Plant Anatomy and Embryology*. Sangam Books Ltd.

#### REFERENCE BOOKS:

1. Mauseth, J.D. 1988. *Plant Anatomy*. The Benjamin/Cummings Publisher, USA.
2. Esau, K. 1985. *Anatomy of seed plants* -John Willey Publication.
3. Cutter.E.G. 1989. *Plant Anatomy –Part I*, Addison –Wesley Publishing Co.
4. Maheswari. P. 1991: *An Introduction to Embryology of Angiosperms*. Tata- McGraw hill Publishing Co. Ltd.
5. Swamy B.G.L and Krishnamurthy K.V. 1990. *From flower to fruits*, Tata – McGraw hill publishing Co. Ltd
6. Erdtman, G. 1954. *An introduction to pollen analysis*. Chronica Botanica, Waltham, Mass. USA.

#### WEB LINKS:

<https://study.com/academy/topic/introduction-to-plant-anatomy.html>

#### SPECIFIC LEARNING OUTCOMES (SLO):

Unit	Content	Learning Outcome	Highest Bloom taxonomic level of

			transaction
<b>I</b>	<b>Scope of Plant Anatomy &amp; Meristematic Tissue System</b>		
1.1	Scope of Plant Anatomy  -Application in Systematics, forensics and Pharmacognosy	<ul style="list-style-type: none"> <li>List out the Scope of Plant Anatomy</li> <li>Discuss the scope of Plant anatomy in connection with Systematics, Forensics and Pharmacognosy fields.</li> </ul>	K1  K2
1.2	Plant Tissues Tissues – Definition Characteristics & Classification	<ul style="list-style-type: none"> <li>Define – Tissue</li> <li>Classify the kinds of Plant tissue</li> </ul>	K1  K2
1.3	Simple & Complex tissues (Phylogeny is not included) Simple Tissues – Structure and Function of Parenchyma, Collenchyma & Sclerenchyma Complex Tissues – Xylem, Phloem and its component Pits and Plasmodesmata	<ul style="list-style-type: none"> <li>Explain the Structure of Simple Permanent tissues</li> <li>List out the functions of Simple Permanent tissues.</li> <li>Discuss the Components of Complex tissues.</li> </ul>	K2  K4  K2
1.4	Meristematic Tissue Characteristics, Classification of meristem- based on stage of development Organisation – Shoot Apex- Apical Cell theory, Histogen theory, Tunica Corpus theory, Types of Vascular Bundles, Primary Structure of Dicot and Monocot stem Organisation – Root Apex – Apical cell theory, Histogen theory, Korper-Kappe theory, Quiescent centre, Root cap, Endodermis, Origin of lateral root, Primary Structure of Dicot and Monocot Root.	<ul style="list-style-type: none"> <li>Classify the meristem and its type.</li> <li>Elaborate the theories related with the shoot apical meristem.</li> <li>Distinguish Primary Structure of monocot stem from Dicot stem.</li> <li>Discuss the theories related with the Root Apical Meristem</li> <li>Compare the Primary Structure of Dicot and Monocot Root.</li> </ul>	K4  K2  K4  K6  K4
1.5	Secretory Tissue Laticiferous tissues – I) Non-articulate Latex Ducts/Latex cells II) Articulate Latex Ducts/Latex Vessels Glandular tissues – I) Hydathodes II) Lithocytes III) Cavities	<ul style="list-style-type: none"> <li>Categorize the kind of Secretory tissue system.</li> <li>Explain the Glandular tissues and its type.</li> </ul>	K4  K5

<b>II</b>			
<b>Adaptive and Protective Systems &amp; Vascular Cambium</b>			
2.1	Epidermal Tissue System Cuticle, epicuticular waxes, trichomes (Uni and Multicellular, Glandular and Non-glandular – Two examples each), Stomata and its type.	<ul style="list-style-type: none"> <li>Elaborate the types of Epidermal Tissue System.</li> <li>Classify the Stomatal types with examples.</li> </ul>	K6  K4
2.2	Vascular Cambium Structure and Function, Secondary growth in Root and Stem	<ul style="list-style-type: none"> <li>Explain the structure and function of Vascular Cambium.</li> <li>Discuss the Secondary growth pattern in Root &amp; Stem.</li> </ul>	K2  K6
2.3	Nodal Anatomy Anatomical Structure of Monocot and Dicot Leaf, Definition – Leaf Trace, Leaf gap, Types of Nodes – Unilacunar, Trilacunar and Multilacunar	<ul style="list-style-type: none"> <li>Distinguish the anatomical structure of Monocot and dicot leaf.</li> <li>Define -Leaf Trace, Leaf Gap</li> <li>Explain the types of nodes</li> </ul>	K4  K1 K2
<b>III</b>			
<b>Wood and Anomalous Secondary growth</b>			
3.1	Cambium Axillary and radially oriented elements	<ul style="list-style-type: none"> <li>Compare the anatomy of axillary and radially oriented elements of Cambium.</li> </ul>	K4
3.2	Nature of Wood Sap wood and Heartwood, Ring and diffuse porous wood and Early and Late Wood	<ul style="list-style-type: none"> <li>Discuss about the various kinds of wood</li> </ul>	K6
3.3	Tylosis	<ul style="list-style-type: none"> <li>Where the tyloses are formed?</li> </ul>	K1
3.4	Dendrochronology	<ul style="list-style-type: none"> <li>What Dendrochronology deals with?</li> </ul>	K1
3.5	Periderm Periderm development	<ul style="list-style-type: none"> <li>Elaborate the development of Periderm.</li> </ul>	K6
3.6	Anomalous Secondary Growth Anomalous secondary growth of Genus <i>Aristolochia</i> and <i>Dracaena</i>	<ul style="list-style-type: none"> <li>Criticize the anomalous nature of <i>Aristolochia</i>.</li> <li>Justify the Anomalous secondary growth in <i>Dracaena</i>.</li> </ul>	K5  K5
<b>IV</b>			
<b>Developmental Embryology in Angiosperms</b>			
4.1	Flower and its parts	<ul style="list-style-type: none"> <li>Analyse the flower and its parts</li> </ul>	K4
4.2	Stamen and Androecium (microsporangium)	<ul style="list-style-type: none"> <li>Distinguish the anther wall and sporogenous</li> </ul>	K4

	-Structure of anther - Microsporangium- development of anther	tissue	
4.3	Microgametogenesis - Development of male gametophyte - Pollen development and structure	<ul style="list-style-type: none"> <li>• Explain the development of male gametophyte</li> <li>• Examine the pollen development and structure</li> </ul>	K2  K4
4.4	Carpel and Gynoecium (Megasporangium) - Megasporangium – Structure and development -Types of ovules - Orthotropous, Anotropous, Campylotropous, Hemianotropous and Amphitropous	<ul style="list-style-type: none"> <li>• Analyse the Structure and development of megasporangium</li> <li>• Interpret the types of ovules</li> </ul>	K4  K4
4.5	Megagametogenesis - Development of female gametophyte -Development and structure of Embryosac. -Types of Embryosac – Monosporic ( <i>Polygonum</i> ), Bisporic ( <i>Allium</i> ) and Tetrasporic ( <i>Peperomia</i> )	<ul style="list-style-type: none"> <li>• Explain the development of female gametophyte</li> <li>• Classify the types of embryo</li> </ul>	K2  K2
<b>V</b>	<b>Mega gametogenesis</b>		
5.1	Pollination - Definition -Pollination mechanism -Types of Pollination – Self Pollination, Cross Pollination -Advantages and disadvantages of pollination. Pollen pistle interaction	<ul style="list-style-type: none"> <li>• Compare the various types of pollination.</li> </ul>	K5
5.2	Double Fertilization - Syngamy - Triple fusion	<ul style="list-style-type: none"> <li>• Analyse the double fertilization changes</li> </ul>	K4
5.3	Post fertilization changes	<ul style="list-style-type: none"> <li>• Understand the post fertilization changes</li> </ul>	K2
5.4	Endosperm - Definition, Types – Nuclear, Cellular and Helobial, function of endosperm- Ruminant endosperm - Endosperm haustoria	<ul style="list-style-type: none"> <li>• Categorize the types of endosperm</li> </ul>	K4
5.5	Embryo development -Development and structure of Embryo in Dicots and monocots	<ul style="list-style-type: none"> <li>• Describe the plant embryo development and structure</li> </ul>	K3

5.6	Seed structure -Structure of monocot and Dicot seed -Importance and reserve food materials of seed	<ul style="list-style-type: none"> <li>Differentiate the monocot and dicot seed structure</li> <li>Manipulate the importance of the seed</li> </ul>	K4
5.7	Apomixis - Definition and types - Parthenocarpy and its application	<ul style="list-style-type: none"> <li>Compare the apomixes and parthenocarpy</li> </ul>	K4
5.8	-Polyembryony and its application	<ul style="list-style-type: none"> <li>Predict and illustrate the poly embryony</li> </ul>	K4

### Mapping Scheme for the Course Code: U20BY404

U20BY404	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	-	-	-	-	H	H	L	H	H	-	H
CO2	M	M	H	-	-	-	H	M	-	-	-	-	H
CO3	H	-	-	-	M	M	H	-	-	M	M	-	H
CO4	H	-	M	-	L	M	H	-	-	L	L	-	H
CO5	M	L	-	-	M	H	M	L	M	M	M	-	H
CO6	H	L	H	L	L	M	H	M	M	H	H	-	H

L – Low (1) M-Medium (2) H-High (3)

#### Assessment/Evaluation:

- 1.Continuous Assessment by conducting Class test, Group Discussion and Quiz.
2. Assessment also done through Seminar Presentation, submission of Assignments and Model Making and Model exams.
3. End Semester Examination.

### MAJOR PRACTICAL IV – PLANT ANATOMY AND DEVELOPMENTAL BOTANY

#### [CORE PRACTICAL – IV]

Course code: U20BY4P4  
Credits: 2

Semester : IV  
Hours/Week: 3

#### Course Outcomes:

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Take part in hand dissection in Plant Anatomy and	K4	I

	observing various tissue system.		
<b>CO 2</b>	Distinguish various kind of tracheary elements by performing Maceration technique.	K4	II
<b>CO 3</b>	Dissect the plant specimen of Stem, root and Leaf of Dicot and Monocot Plants and compare its anatomical features.	K4	III
<b>CO 4</b>	Dissect out and mount the Pollinium and Dicot Embryo.	K4	IV
<b>CO 5</b>	Analyze the structure of anther and Embryo sac.	K4	V
<b>CO 6</b>	Explain the process of pollination and its mechanisms.	K2	V

## **SYLLABUS:**

### **Unit-1-**

**(6 Hours)**

Study the Structure of shoot apex using hand section and preparation of temporary mounts-*Hydrilla* twigs with shoot tips. Study of the distribution and function of permanent tissues. (i) Parenchyma (ii) Sclerenchyma and (iii) Collenchyma (iv) Xylem (v) Phloem. To study secretory tissue system through permanent slides: (i) Articulated Latex vessels (ii) Non-Articulated Latex Ducts.

### **Unit-2**

**(6 Hours)**

Study of Tracheary elements by maceration technique: (1) *Cycas* rachis (2) *Cucurbita* Stem. Study of Stomata from epidermal peels: (i) Actinocytic (ii) Diacytic (iii) Paracytic (iv) Anamocytic (v) Anisocytic (vi) Gramineous. Study of Nodal anatomy: (i) Unilacunar Node (ii) Trilacunar Node (iii) Multilacunar Node.

### **Unit-3**

**(6 Hours)**

Study of internal structure and preparation of T.S of Primary structure of Dicot and Monocot: Root - *Cicer*, *Canna*; Stem – *Tridax*, *Sorghum*, Leaf – *Tridax*, Grass. Secondary structure: Dicot Root – *Tridax* sp.; Dicot Stem – *Pongamia*. Study of anomalous secondary thickening and preparation of T.S – (i) *Dracaena* (ii) *Aristolochia*.

### **Unit -4**

**(6 Hours)**

Study of floral parts using bisexual and unisexual flowers. Isolation and mounting of embryo - (i) Globular embryo (ii) Cordate embryo - *Tridax* flower. Pollinium dissection – *Calotropis* flower.

### **Unit -5**

**(6 Hours)**

Structure of anther and microsporogenesis using permanent slides. Study of ovule & its types – (i) Anatropous (ii) Orthotropous (iii) Circinotropous (iv) Amphitropous (v) Campylotropous using permanent slides and photographs. Study of Embryo sac & Fertilization using photographs. Structure of pollen grains using whole mounts (*Catharanthus*, *Hibiscus*, *Acacia*, *Grass*).

## **TOPICS FOR SELF STUDY:**

Topics	References
Maceration	<a href="https://www.ableweb.org/biologylabs/wp-content/uploads/volumes/vol-19/9-yeung.pdf">https://www.ableweb.org/biologylabs/wp-content/uploads/volumes/vol-19/9-yeung.pdf</a>
Anomalous secondary growth	<a href="http://virtualplant.ru.ac.za/Main/ANATOMY/prac5.htm">http://virtualplant.ru.ac.za/Main/ANATOMY/prac5.htm</a>
Pollen grain Morphology	<a href="https://link.springer.com/chapter/10.1007%2F978-3-211-79894-2_4">https://link.springer.com/chapter/10.1007%2F978-3-211-79894-2_4</a>

### REFERENCE BOOKS:

#### Plant Anatomy

1. Pandey, B. P. 1984. *Plant Anatomy*. S. Chand and Company Ltd, New Delhi.
3. Esau, K. 1953. *Plant Anatomy*. John Wiley and Sons, INC, New York, London.
4. Cutter, E. G. 1978. *Anatomy part I* – The English Language Book Society and Edward Arnolds Ltd. London.
5. Eames, A. J. and Mac Daniels, I. H. 1947. *An introduction to plant Anatomy*. MC Graw and Hill Book Company, INC., New York, London.

#### Developmental Botany

1. Bhojwani, S. S. and Bhatnagar, S. P. 1978. *The Embryology of Angiosperms*. Vikas Publishing House Pvt. Ltd,
2. Maheswari, P. 1950. *An introduction to the Embryology of Angiosperms*. Vikas Publishing House Pvt. Ltd.
3. Agarwal, S. B. 1972. *Embryology of angiosperms*. Sahitya Bhavan, Agra.
4. Agrawal, R.L. 1982. *Seed technology*. Oxford and IBH Publishing CO.

### WEB LINKS:

1. <https://bio.biologists.org/content/7/5/bio031237>
2. [https://biocyclopedia.com/index/introduction\\_to\\_botany/simple\\_tissues\\_and\\_complex\\_tissues.php](https://biocyclopedia.com/index/introduction_to_botany/simple_tissues_and_complex_tissues.php)

### SPECIFIC LEARNING OUTCOMES (SLO):

Unit/Section	Course Content	Learning Outcomes	Highest Blooms Taxonomic level of transaction
1	Study the Structure of shoot apex using hand section and preparation of temporary mounts- <i>Hydrilla</i> twigs with	<ul style="list-style-type: none"> <li>Dissect out the Shoot Apical Meristem.</li> </ul>	K4



	<p>shoot tips.</p> <p>Study of the distribution and function of permanent tissues. (i) Parenchyma (ii) Sclerenchyma and (iii) Collenchyma (iv) Xylem (v) Phloem</p> <p>To study secretory tissue system through permanent slides: (i) Articulated Latex vessels (ii) Non-Articulated Latex Ducts</p>	<ul style="list-style-type: none"> <li>Identify the simple tissues and Complex tissues</li> <li>Distinguish between Articulated Latex vessels &amp; Non-articulated latex ducts</li> </ul>	<p><b>K3</b></p> <p><b>K4</b></p>
2	<p>Study of Tracheary elements by maceration technique: (1) <i>Cycas</i> rachis (2) <i>Cucurbita</i> Stem. Study of Stomata from epidermal peels: (i) Actinocytic (ii) Diacytic (iii) Paracytic (iv) Anamocytic (v) Anisocytic (vi) Gramineous. Study of Nodal anatomy: (i) Unilacunar Node (ii) Trilacunar Node (iii) Multilacunar Node.</p>	<ul style="list-style-type: none"> <li>Examine the Tracheary elements.</li> <li>Outline the types of stomata</li> <li>Identify the kinds of Nodal anatomy.</li> </ul>	<p><b>K4</b></p> <p><b>K2</b></p> <p><b>K3</b></p>
3	<p>Study of internal structure and preparation of T.S of Primary structure of Dicot and Monocot: Root - <i>Cicer</i>, <i>Canna</i>; Stem - <i>Tridax</i>, <i>Sorghum</i>, Leaf - <i>Tridax</i>, Grass. Secondary structure: Dicot Root - <i>Tridax</i> sp.; Dicot Stem - <i>Pongamia</i>.</p> <p>Study of anomalous secondary thickening and preparation of T.S - (i) <i>Dracaena</i> (ii) <i>Aristolochia</i>.</p>	<ul style="list-style-type: none"> <li>Compare the anatomical features Primary Structure of stem, root and leaves of Dicot and Monocot Plant specimens.</li> <li>Compare the anatomical anomalies of Secondary thickenings of <i>Dracaena</i> and <i>Aristolochia</i></li> </ul>	<p><b>K5</b></p> <p><b>K5</b></p>
4	<p>Study of floral parts using bisexual and unisexual flowers. Isolation and mounting of embryo - (i) Globular embryo (ii) Cordate embryo - <i>Tridax</i> flower. Pollinium dissection - <i>Calotropis</i> flower.</p>	<ul style="list-style-type: none"> <li>Examine the floral parts of bisexual and unisexual flowers.</li> <li>Dissect out and mount the Dicot Embryo</li> <li>Dissect out and mount the Pollinium</li> </ul>	<p><b>K4</b></p> <p><b>K4</b></p> <p><b>K4</b></p>

<b>5</b>	Structure of anther and microsporogenesis using permanent slides. Study of ovule & its types – (i) Anatropous (ii) Orthotropous (iii) Circinotropous (iv) Amphitropous (v) Campylotropous using permanent slides and photographs. Study of Embryo sac & Fertilization using photographs. Structure of pollen grains using whole mounts ( <i>Catharanthus, Hibiscus, Acacia, Grass</i> ).	<ul style="list-style-type: none"> <li>Identify and label the parts of anther.</li> <li>Distinguish the various kind of ovules and its arrangement.</li> <li>Analyze the Structure of an Embryo sac.</li> <li>Identify the Pollen Morphology.</li> </ul>	<b>K3</b>  <b>K4</b>  <b>K4</b>  <b>K3</b>
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### Mapping Scheme for the Course Code: U20BY4P4

U20BY4P4	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	-	-	-	L	-	M	-	-	L	-	L	H
CO2	H	-	-	-	-	-	M	-	-	-	-	H	H
CO3	M	L	-	-	L	-	M	-	M	L	-	H	H
CO4	M	L	L	-	L	-	M	-	M	L	-	-	M
CO5	L	-	L	-	-	-	L	-	L	H	-	-	L
CO6	L	L	L	L	L	L	L	M	H	H	L	M	-

L-Low (1) M-Medium (2) H-High (3)

#### COURSE ASSESSMENT METHODS:

##### Direct

Continuous Assessment in Practical works, sectioning, record submission.

Practical tests, Records etc. (as applicable), Class tests, Model Exams.

End Semester Examination

##### Indirect

1. Course-end survey

### NMEC II -MUSHROOM CULTIVATION

Semester IV  
Credits 2

Course Code: U20BYPE2  
Hours/Week: 2

On completion of this course, the student will be able to:

No	COURSE OUTCOME (CO)	Level	Unit
CO 1	Identify the types of mushrooms-edible and poisonous	K3	I
CO 2	Explain the scope of mushroom cultivation	K2	II
CO 3	Experiment with various cultivation methods	K3	III
CO 4	Distinguish various methods of mushroom cultivation.	K4	IV
CO 5	Select the methods of harvesting, pest management in mushrooms	K3	V
CO 6	Experiment with the process of mushroom cultivation	K3	Practical

### SYLLABUS:

#### Unit I Introduction (6 Hours)

Types of Mushroom-Identification of edible and poisonous Mushroom. Nutritive values life cycle of common edible mushroom.

#### Unit II (6 Hours)

Scenario of Mushroom cultivation – Prospects and Scope of Mushroom Cultivation.

#### Unit III - Cultivation methods for different types of Edible mushroom (6 Hours)

Paddy straw mushroom (*Volvariella* Sp.) Button mushroom (*Agaricus* Sp.) Oyster mushroom (*Pleurotus* Sp.)

#### Unit IV (6 Hours)

Cultivation, Pure Culture Preparation of Spawn and Compost and Spawn Running Cropping and its maintenance Harvesting and Marketing

#### Unit V (6 Hours)

Protection and Management Disease & Pests of Mushroom and their control measures

### TEXT BOOKS:

1. Gardner, 1996. *Basic Horticulture* Mac Milan N Y.
2. Tavis Lynch, 2018. *Mushroom Cultivation: An Illustrated Guide to Growing Your Own Mushrooms at Home*. Quarry Books; Ill edition. ISBN-13: 978-1631594045

### REFERENCES

1. Manibhushan Rao, K. 1999. *Text Book of Horticulture*. Macmillon India Ltd.
2. Sharma, O. P. 1982. *Test Book of Fungi*. Tata McGraw-Hill Publishing C., New Delhi.

### WEB LINK:

[https://onlinecourses.swayam2.ac.in/nos20\\_ge07/preview](https://onlinecourses.swayam2.ac.in/nos20_ge07/preview)

<https://nios.ac.in/departmentsunits/vocational-education/stand-alone-courses/oyster-mushroom-production-technology.aspx>

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
I	Introduction-Types of Mushroom -Identification of edible and poisonous Mushroom. Nutritive values life cycle of common edible mushroom.	<ul style="list-style-type: none"> <li>List out the edible mushrooms</li> <li>Identify the edible mushrooms</li> </ul>	K1 K3
II	Scenario of Mushroom cultivation –Prospects and Scope of Mushroom Cultivation.	<ul style="list-style-type: none"> <li>Tell the scope of mushroom cultivation</li> <li>Explain the challenges in it.</li> </ul>	K1 K2
III	Cultivation methods for different types of Edible mushroom Paddy straw mushroom ( <i>Volvariella</i> Sp.) Button mushroom ( <i>Agaricus</i> Sp.) Oyster mushroom ( <i>Pleurotus</i> Sp.)	<ul style="list-style-type: none"> <li>Apply various medium to grow mushroom</li> <li>Compare the growth of mushrooms in different medium.</li> </ul>	K3 K2
IV	Cultivation, Pure Culture Preparation of Spawn and Compost and Spawn Running Cropping and its maintenance Harvesting and Marketing	<ul style="list-style-type: none"> <li>Analyze the growth in different substratum</li> <li>Compare the cropping, harvesting and marketing of mushroom products</li> </ul>	K4 K2
Unit V	Protection and Management Disease & Pests of Mushroom and their control measures	<ul style="list-style-type: none"> <li>Identify the best practice for disease and pest control.</li> <li>List some of the measures.</li> </ul>	K3 K1
PRACTICAL	1. Setting up of Cultivation room 2. Preparation of Spawn, Spawning & Spawn running 3. Preparation of Compost 4. Harvest and Packing methods	<ul style="list-style-type: none"> <li>Experiment with the cultivation of mushrooms.</li> <li>Illustrate different methods and mode of cultivation.</li> </ul>	K3 K2

**Mapping Scheme for Course Code: U20BYPE2**

U20BYPE2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	L	-	H	-	-	-	L	L	-	L	L	L	-
CO2	M	-	M	-	-	L	L	-	L	-	L	M	-
CO3	L	L	-	-	L	-	-	-	M	H	L	H	L
CO4	-	-	L	L	M	-	-	-	M	M	-	H	L

CO5	-	L	-	-	-	L	M	L	-	M	-	-	L
CO6	M	-	-	L	-	-	L	L	M	-	-	L	-

L-Low (1) M-Medium (2) H-High (3)

### COURSE ASSESSMENT METHODS:

#### Direct

1. Continuous Assessment in Practical works, sectioning, record submission.
2. Practical tests, Records etc. (as applicable), Class tests, Model Exams.
3. End Semester Examination

#### Indirect

1. Course-end survey

### Core V: PLANT PHYSIOLOGY AND PLANT METABOLISM

Course Code: U20BY505

Credits : 6

Semester : V

Hour/Week : 7

#### Course Outcomes:

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Develop an insight to the various plant water relations.	K6	I
CO 2	Discuss the mechanism of Photosynthesis.	K6	II
CO 3	Analyze the mechanism of Respiration and Nitrogen Metabolism	K4	III
CO 4	Evaluate the various growth and development processes in plants	K5	IV
CO 5	Compare the properties, structure and function of Primary and Secondary Metabolites.	K5	V
CO 6	Analyze the mechanism of photosynthesis, respiration, nitrogen metabolism and secondary metabolites	K4	II - V

### SYLLABUS:

#### UNIT 1 : IMPORTANCE OF WATER & MINERALS

(18 Hours)

##### 1.1 Water – properties & role

1.1.1. Structure, Physical and chemical properties

1.1.2. Importance of Water

##### 1.2 Osmotic & non-osmotic uptake of water

1.2.1. Diffusion – Role in Plants

- 1.2.2. Kinds of Solution – Hypotonic, Hypertonic and Isotonic
- 1.2.3. Osmosis – role in plants, Diffusion Pressure Deficit, Turgor Pressure, Osmotic Pressure and Significance.
- 1.2.6. Plasmolysis – definition, Incipient, Deplasmolysis, Advantages
- 1.2.7. Imbibition
- 1.2.8. Water potential & Osmotic relations of plant cells – Water potential, Osmotic Potential and Pressure Potential
- 1.2.9. Mechanism of Absorption of water
  - (i) Types – Active – Osmotic and Non-Osmotic absorption, Passive, Symplastic and Apoplastic absorption.
- 1.2.10. Factors affecting absorption of water.
- 1.2.11. Ascent of sap - Mechanism – Vital force theory, Root pressure theory, Physical force theory, Transpiration pull and Cohesion of water theory

### **1.3. Transpiration**

- 1.3.1. Definition, Kinds

### **1.4. Stomatal transpiration**

- 1.4.1. Structure and Mechanism of Stomatal Transpiration
  - (i) Opening & Closing of Stomata
    - (a) Starch-Sugar Interconversion theory (b) Synthesis of sugars or organic acids in guard cells
    - (c) ATP-driven Proton(H<sup>+</sup>) – K<sup>+</sup> Exchange pump Mechanism in Guard cells
- 1.4.3. Advantages, factors affecting stomatal movements
- 1.4.4 Transpiration as a Necessary evil

### **1.5. Translocation of organic solutes & assimilates**

- 1.5.1. Mechanism of Translocation through Phloem- Munch's mass flow hypothesis

### **1.6 Mineral nutrition of plants**

- 1.6.1. Essential and Non-essential elements, Types- Essential – Major and Minor Elements function and its deficiency symptoms

### **1.7 Mineral salt absorption**

- 1.7.1. Types – Passive and Active

### **1.8 Determination of essentiality of mineral elements**

- 1.8.1. Solution Culture, Hydroponics and Aeroponics

## **UNIT II: PHOTOSYNTHESIS**

**(18 Hours)**

### **2.1.0 Radiant energy & its role in photosynthesis**

- 2.1.1. Photosynthesis – definition, significance, Photosynthetic Apparatus
- 2.1.2. Photosynthetic Pigments, Location, Absorption and utilisation of light energy

### **2.2.0 Absorption Spectrum**

- 2.2.1. Absorption Spectra of Chlorophylls, Carotenoids and Phycobilins

### **2.3.0 Red drop & Emerson's Enhancement effect**

### **2.4.0 Photosystems**

- 2.4.1. Types – Photosystem I, Photosystem II

### **2.5.0 Mechanism of Photosynthesis**

- 2.5.1. Parts – Light / Hill's Reaction, Dark Reaction / Blackman's reaction
- 2.5.2. Light Reaction
- 2.5.3. Photophosphorylation Types – Non-cyclic Photophosphorylation, Cyclic Photophosphorylation
- 2.5.5. Dark Reaction - Pathway of C3 Cycle

### **2.6.0 Hatch and Slack Pathway**

2.6.1 C4 –Dicarboxylic Acid Pathway and its Significance

**2.7.0 CAM pathway**

2.7.1 Crassulacean Acid Metabolism (CAM)

**2.8.0 Photorespiration**

2.8.1 Glycolate Pathway, Factors affecting photorespiration and Significance

**UNIT III: RESPIRATION AND NITROGEN METABOLISM (18 Hours)**

**3.1.0 Respiration**

3.1.1. Definition, Organelle involved, kinds – Aerobic and Anaerobic

**3.2.0 Glycolysis**

3.2.1. Glycolysis / EMP Pathway

**3.3.0 Krebs cycle**

3.3.1. Krebs / TCA Cycle – pathway

**3.4.0 Electron Transport System & Oxidative Phosphorylation**

**3.5.0 Nitrogen Metabolism**

3.5.5 Nitrogen Cycle – **Biological, Industrial and Physical Nitrogen fixation** Steps – Proteolysis, Ammonification, Nitrification and Denitrification,

**UNIT IV: PLANT GROWTH (18 Hours)**

**4.1.0 Plant Growth**

4.1.1. Growth-Definition, Growth curve

**4.2.0 Auxins** – Discovery and Physiological effects

**4.3.0 Gibberellins** – Discovery and Physiological effects

**4.4.0 Kinetin** – Discovery and Physiological effects

**4.5.0 Role of Hormones and Florigen in Flowering**

**4.6.0 Senescence in Plants**

4.6.1. Definition and its Types – Overall, Top, Deciduous and Progressive

**4.7.0 Abscission of leaves** - Definition and Mechanism

**4.8.0 Photoperiodism**

4.8.1. Definition, Duration of Photoperiod – Short Day, Long Day, Day Neutral, Long Short Day, Short-Long Day Plants.

4.8.4. Importance of Photoperiodism

**4.9.0 Phytochrome**

4.9.1. Definition, Types- Red light absorbing form (PR), Far-red light absorbing Form (PFR)

**4.10.0 Vernalization**

4.10.1. Definition, Perception of the cold stimulus and other conditions.

**4.11.0 Seed dormancy**

4.11.1. Definition, factors causing dormancy

4.11.2. Artificial methods of breaking the dormancy of seeds

**4.12.0 Seed Viability**

4.12.1. Definition, kinds- Microbiotic, Mesobiotic and Macrobiotic, Viability test

**4.13.0 Seed germinability**

4.13.1. Physiology, Physiological condition of quiescent seed, of seed germination

**UNIT V: BIOCHEMISTRY AND SECONDARY METABOLITES (18 Hours)**

**5.1.0 Carbohydrates**

5.1.1. Definition, Structure, Types – Monosaccharides, Oligosaccharides and Polysaccharides, Function.

**5.2.0 Lipids**

5.2.1. Definition, Structure, Types – Simple, compound and derived, functions.

### 5.3.0 Proteins

5.3.1. Definition, Structure, Types – Simple, Conjugated and derived, functions

### 5.4.0 Enzymes

5.4.1. Definition, Nature, Structure & properties

5.4.2 Mechanism of Enzyme action – Lock & Key theory & Induced Fit theory

### 5.5.0 Elementary account on Secondary Metabolites

5.5.1. Definition, Structure, Occurrence and properties of the following secondary Metabolites – Flavonoids, Terpenoids, Alkaloids & Phenolics

#### TOPICS FOR SELF-STUDY:

Self-Study topics	References
The Cell	<a href="https://www.nature.com/scitable/topicpage/what-is-a-cell-14023083/">https://www.nature.com/scitable/topicpage/what-is-a-cell-14023083/</a> <a href="https://www.britannica.com/science/cell-biology">https://www.britannica.com/science/cell-biology</a>
The Oxidative Enzymes	<a href="https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/oxidative-enzyme">https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/oxidative-enzyme</a> <a href="https://link.springer.com/chapter/10.1007/978-3-642-66279-9_22">https://link.springer.com/chapter/10.1007/978-3-642-66279-9_22</a>
Role of Nucleic Acids in Protein synthesis	<a href="https://www.ncbi.nlm.nih.gov/books/NBK21634/#:~:text=In%20the%20process%20of%20transcription,amino%20acids%20during%20protein%20synthesis.">https://www.ncbi.nlm.nih.gov/books/NBK21634/#:~:text=In%20the%20process%20of%20transcription,amino%20acids%20during%20protein%20synthesis.</a> <a href="https://link.springer.com/chapter/10.1007/978-1-4684-0294-0_10">https://link.springer.com/chapter/10.1007/978-1-4684-0294-0_10</a>
The fate of Light energy	<a href="https://link.springer.com/article/10.1023/B%3APRES.0000040446.87305.f4">https://link.springer.com/article/10.1023/B%3APRES.0000040446.87305.f4</a> <a href="http://www.plantphysiol.org/content/176/2/1171">http://www.plantphysiol.org/content/176/2/1171</a>
Electro-Osmosis	<a href="https://link.springer.com/referenceworkentry/10.1007%2F978-3-642-40872-4_2079-2#:~:text=Electro%2Dosmosis%20is%20the%20movement,%2C%20microchannel%2C%20or%20porous%20material.">https://link.springer.com/referenceworkentry/10.1007%2F978-3-642-40872-4_2079-2#:~:text=Electro%2Dosmosis%20is%20the%20movement,%2C%20microchannel%2C%20or%20porous%20material.</a> <a href="https://www.sciencedirect.com/topics/chemical-engineering/electroosmosis">https://www.sciencedirect.com/topics/chemical-engineering/electroosmosis</a>

#### TEXT BOOKS:

1. Jain, V.K. 1997. *Fundamentals of Plant Physiology*. S. Chand and Co., New Delhi.
2. Pandey, S.N. 2005. *Plant Physiology*. Vikas publishing House (P) Ltd., New Delhi.
3. Srivastava, H.N. 1998. *Plant Physiology*. Pradeep Publications, Jalandhar, India.
4. Verma, S.K. 1995. *A text book of Plant Physiology*. S. Chand and Co., New Delhi.
5. Srivastava, H.N. 1999. *Elements of Biochemistry*. Rastogi Publications, Meerut, India.
6. Trehan, K. 1987. *Biochemistry*. Wiley Eastern Ltd., New Delhi.
7. Arumugam, N. 1993. *Biochemistry*. Saras publications, Nagercoil, Tamilnadu.

#### REFERENCE BOOKS:

1. Lincoln Taiz and Eduardo Zeiger. 2010. *Plant Physiology* 5th Edition. Sunderland, Massachusetts, USA.
2. Devlin, R.M. 1969. *Plant Physiology*. Holt, Rinechart & Winston & Affiliated East. West press (p) Ltd. New Delhi.
3. Noggle, R. and Fritz. 1986. *Introductory Plant Physiology*. Prentice Hall of India. New Delhi.
4. Harborne, J.B. 1997. *Plant Biochemistry*. Harcourt Asia (P) Ltd., India and Academic Press – Singapore.
5. Jayaraman, J. 1981. *Laboratory Manual of Biochemistry*. Wiley Eastern Ltd., New Delhi.



Web links:

<https://www.classcentral.com/course/swayam-plant-physiology-and-plant-tissue-culture-14238>

[https://onlinecourses.swyam2.ac.in/cec19\\_bt09/preview](https://onlinecourses.swyam2.ac.in/cec19_bt09/preview)

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit	Content	Learning Outcome	Highest Bloom taxonomic level of transaction
<b>I</b>	<b>Importance of Water and Minerals</b>		
1.1	<b>Water – properties &amp; role</b> Structure, Physical and chemical properties. Importance of Water	<ul style="list-style-type: none"> <li>List the Physico-chemical properties of water</li> <li>Summarize the importance of water</li> </ul>	K4 K2
1.2	<b>Osmotic &amp; non-osmotic uptake of water</b> Diffusion – Role in Plants Kinds of Solution – Hypotonic, Hypertonic and Isotonic Osmosis – role in plants, Diffusion Pressure Deficit, Turgor Pressure, Osmotic Pressure and Significance. Plasmolysis – definition, Incipient, De-plasmolysis, Advantages Imbibition Water potential & Osmotic relations of plant cells – Water potential, Osmotic Potential and Pressure Potential Mechanism of Absorption of water Types – Active – Osmotic and Non-Osmotic absorption, Passive, Symplastic and Apoplastic absorption. Factors affecting absorption of water. Ascent of sap –Mechanism – Vital force theory, Root pressure theory, Physical force theory, Transpiration pull and Cohesion of water theory	<ul style="list-style-type: none"> <li>Define – Diffusion, Osmosis and Plasmolysis</li> <li>Compare the types of water absorption</li> <li>Distinguish the Osmotic and Non-osmotic active absorption</li> <li>Interpret the various theories related with Ascent of Sap</li> </ul>	K1 K4 K4 K6
1.3	<b>Transpiration</b>	<ul style="list-style-type: none"> <li>Recall the</li> </ul>	K1

	Definition, Kinds	Kinds of Transpiration	
1.4	<b>Stomatal Transpiration</b> Structure and Mechanism of Stomatal Transpiration (i) Opening & Closing of Stomata (a) Starch-Sugar Interconversion theory (b) Synthesis of sugars or organic acids in guard cells (c) ATP-driven Proton(H <sup>+</sup> ) – K <sup>+</sup> Exchange pump Mechanism in Guard cells 1.4.3. Advantages, factors affecting stomatal movements	<ul style="list-style-type: none"> <li>Elaborate the Mechanism of Stomatal Movements.</li> </ul>	K2
1.5	<b>Translocation of organic solutes &amp; assimilates</b> Mechanism of Translocation through Phloem- Munch's mass flow hypothesis	<ul style="list-style-type: none"> <li>Prove the translocation of Organic solutes and assimilates in the Phloem Column.</li> </ul>	K5
1.6	<b>Mineral nutrition of plants</b> Essential and Non-essential elements, Types- Essential – Major and Minor Elements function and its deficiency symptoms	<ul style="list-style-type: none"> <li>Determine and Evaluate the Deficiency symptoms and role of Major and Minor elements.</li> </ul>	K5
1.7	<b>Mineral salt absorption</b> Types – Passive and Active	<ul style="list-style-type: none"> <li>Distinguish the Types of Mineral salt absorption</li> </ul>	K4
1.8	<b>Determination of essentiality of mineral elements</b> Solution Culture, Hydroponics and Aeroponics	<ul style="list-style-type: none"> <li>Determine the essentiality of Mineral elements</li> </ul>	K5
<b>II</b>	<b>Photosynthesis</b>		
2.1	<b>Radiant energy &amp; its role in photosynthesis</b> Photosynthesis – definition, significance, Photosynthetic Apparatus Photosynthetic Pigments, Location, Absorption and utilisation of light energy	<ul style="list-style-type: none"> <li>Summarize the Photosynthetic apparatus and its role in the capturing of light energy</li> </ul>	K2
2.2	<b>Absorption Spectrum</b> Absorption Spectra of Chlorophylls, Carotenoids and Phycobilins	<ul style="list-style-type: none"> <li>Interpret the Absorption spectra of Photosynthetic</li> </ul>	K5

		Pigments.	
2.3	<b>Red drop &amp; Emerson's Enhancement effect</b>	<ul style="list-style-type: none"> <li>Evaluate the Red drop and Emerson's enhancement effect in relation with the rate of Photosynthesis.</li> </ul>	K5
2.4	<b>Photosystems</b> Types – Photosystem I, Photosystem II	<ul style="list-style-type: none"> <li>Distinguish the kinds of Photosystem</li> </ul>	K4
2.5	<b>Mechanism of Photosynthesis</b> Parts – Light / Hill's Reaction, Dark Reaction / Blackman's reaction Light Reaction PhotophosphorylationTypes – Non-cyclic Photophosphorylation, Cyclic Photophosphorylation Dark Reaction - Pathway of C3 Cycle	<ul style="list-style-type: none"> <li>Elaborate the Mechanism of Light reaction</li> <li>Discuss the Light Independent Phase of Photosynthesis.</li> </ul>	K6 K6
2.6	<b>Hatch and Slack Pathway</b> C4 –Dicarboxylic Acid Pathway and its Significance	<ul style="list-style-type: none"> <li>Justify a plant can photosynthesize even in presence of very low concentration of CO<sub>2</sub>.</li> </ul>	K5
2.7	<b>CAM pathway</b> Crassulacean Acid Metabolism (CAM)	<ul style="list-style-type: none"> <li>Criticize the role of CAM pathway in Crassulaceae members.</li> </ul>	K5
2.8	<b>Photorespiration</b> Glycolate Pathway, Factors affecting photorespiration and Significance	<ul style="list-style-type: none"> <li>Discuss the inter-organelle relationships of Chloroplast, Peroxisome and Mitochondria</li> </ul>	K6
<b>III</b>	<b>Respiration and Nitrogen Metabolism</b>		
3.1	Definition, Organelle involved, kinds – Aerobic and Anaerobic	<ul style="list-style-type: none"> <li>Compare the aerobic and anaerobic respiration</li> </ul>	K2
3.2	<b>Glycolysis -</b> Glycolysis / EMP Pathway	<ul style="list-style-type: none"> <li>Analyse the glycolysis pathway</li> </ul>	K4
3.3	<b>Krebs cycle</b>	<ul style="list-style-type: none"> <li>Assume the</li> </ul>	K4

	Krebs / TCA Cycle – pathway	Krebs / TCA Cycle – pathway	
3.4	Electron Transport System & Oxidative Phosphorylation	<ul style="list-style-type: none"> <li>Analyze the Electron Transport System &amp; Oxidative Phosphorylation</li> </ul>	K4
3.5	Nitrogen Metabolism Nitrogen Cycle– Biological, Industrial and Physical Nitrogen fixation Steps – Proteolysis, Ammonification, Nitrification and Denitrification,	<ul style="list-style-type: none"> <li>Discuss the Nitrogen Metabolism and Nitrogen Cycle</li> </ul>	K2
<b>IV</b>	<b>Plant Growth</b>		
4.1	<b>Plant Growth</b> Growth-Definition, Growth curve	<ul style="list-style-type: none"> <li>Analyse the plant growth curve</li> </ul>	K4
4.2	<b>Auxins</b> – Discovery and Physiological effects	<ul style="list-style-type: none"> <li>Examine the Discovery and Physiological effects of auxins</li> </ul>	K4
4.3	<b>Gibberellins</b> – Discovery and Physiological effects	<ul style="list-style-type: none"> <li>List the Physiological effects of gibberellins</li> </ul>	K4
4.4	<b>Kinetin</b> – Discovery and Physiological effects	<ul style="list-style-type: none"> <li>Identify the physiological role of kinetin</li> </ul>	K3
4.5	Role of Hormones and Florigen in Flowering	<ul style="list-style-type: none"> <li>Determine the role of Hormones and Florigen in Flowering</li> </ul>	K5
4.6	Senescence in Plants Definition and its Types – Overall, Top, Deciduous and Progressive	<ul style="list-style-type: none"> <li>Illustrate the Senescence in Plants</li> </ul>	K2
4.7	<b>Abscission of leaves</b> - Definition and Mechanism	<ul style="list-style-type: none"> <li>Identify the Abscission of leaves</li> </ul>	K3
4.8	<b>Photoperiodism</b> 4.8.1. Definition, Duration of Photoperiod – Short Day, Long Day, Day Neutral, Long Short L Day, Short-Long Day Plants.	<ul style="list-style-type: none"> <li>Analyze the Photoperiod – Short Day, Long Day, Day Neutral, Long</li> </ul>	K4

		Short L Day, Short-Long Day Plants.	
4.9	<b>Phytochrome</b> - Definition, Types- Red light absorbing form(PR), Far-red light absorbing Form(PFR)	<ul style="list-style-type: none"> <li>Assume the Phytochrome</li> </ul>	K4
4.10	<b>Vernalization</b> Definition, Perception of the cold stimulus and other conditions	<ul style="list-style-type: none"> <li>Inspect the Vernalization</li> </ul>	K4
4.11	<b>Seed dormancy</b> Definition, factors causing dormancy, Artificial methods of breaking the dormancy of seeds	<ul style="list-style-type: none"> <li>Identify the Seed dormancy Artificial methods of breaking the dormancy of seeds</li> </ul>	K3
4.12	<b>Seed Viability</b> Definition, kinds- Microbiotic, Mesobiotic and Macrobiotic, Viability test	<ul style="list-style-type: none"> <li>Explain the Seed Viability, Definition, kinds- Microbiotic, Mesobiotic and Macrobiotic, Viability test</li> </ul>	K2
4.13	<b>Seed germinability</b> Physiology, Physiological condition of quiescent seed, of seed germination	<ul style="list-style-type: none"> <li>Make use of Seed germinability, Physiology, Physiological condition of quiescent seed, of seed germination</li> </ul>	K3
<b>V</b>	<b>BIOCHEMISTRY AND SECONDARY METABOLITES</b>		
5.1	<b>Carbohydrates</b> Definition, Structure, Types – Monosaccharides, Oligosaccharides and Polysaccharides, Function.	<ul style="list-style-type: none"> <li>Compare the Structure, Monosaccharides, Oligosaccharides and Polysaccharides, Function.</li> </ul>	K5
5.2	<b>Lipids</b> - Definition, Structure, Types – Simple, compound and derived, functions.	<ul style="list-style-type: none"> <li>Estimate the Structure, Types – Simple, compound and derived,</li> </ul>	K5

		functions	
5.3	<b>Proteins</b> Definition, Structure, Types – Simple, Conjugated and derived, functions	<ul style="list-style-type: none"> <li>Determine the Structure, Types Simple, Conjugated and derived, functions</li> </ul>	K5
5.4	<b>Enzymes</b> Definition, Nature, Structure & properties Mechanism of Enzyme action – Lock & Key theory & Induced Fit theory	<ul style="list-style-type: none"> <li>Explain the properties Mechanism of Enzyme action – Lock &amp; Key theory &amp; Induced Fit theory</li> </ul>	K5
5.5	Elementary account on Secondary Metabolites Definition, Structure, Occurrence and properties of the following secondary Metabolites – Flavonoids, Terpenoids, Alkaloids & Phenolics	<ul style="list-style-type: none"> <li>Analyze Elementary account on Secondary Metabolites</li> </ul>	K4

#### Mapping Scheme for the Course Code: U20BY505

U20BY505	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	M	-	-	L	L	-	-	-	L	-	H	M
CO2	M	M	-	-	L	L	-	-	-	M	-	H	M
CO3	M	L	L	-	H	L	-	-	-	M	-	H	M
CO4	M	L	L	-	M	L	-	L	-	M	-	H	M
CO5	M	L	L	-	-	L	-	-	-	M	-	H	H
CO6	M	-	-	-	M	L	-	-	-	M	-	H	M

L – Low (1) M-Medium (2) H-High (3)

#### Course Assessment Methods:

1. Continuous Assessment by conducting Class test, Group Discussion and Quiz.
2. Assessment also done through Seminar Presentation, submission of Assignments and Model Making and Model exams.
3. End Semester Examination

#### CORE VI: GENETICS, EVOLUTION AND PLANT BREEDING

Semester : V  
Credits : 6

Course Code: U20BY506  
Hours/Week: 6

## Course Outcome

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

No	COURSE OUTCOME (CO)	Level	Unit
CO 1	Evaluate the basic principles of inheritance in plants, allelic and non-allelic gene, linked gene and recombination gene	K5	I
CO 2	Discuss the inheritance of X and Y linked inheritance gene	K6	I and II
CO 3	Construct and modify personal and family pedigree charts.	K6	I and II
CO 4	Analyze crops to express hybrid vigour, Describe the necessity of breeding programs, Imparting knowledge on means of exploiting plants through breeding	K4	III, IV
CO 5	Estimate the necessity of Plant genetic resources, IPR protecting farmers and breeders	K5	V
CO 6	Appraise how humans have flourished due to breeding and domestication of plants	K5	III, IV, V

## SYLLABUS:

### UNIT-I -MENDELISM AND GENIC INTERACTION (18 Hours)

1:1 Definition of Genetics, Scope and importance of genetics

1:2 Mendel's Laws of inheritance.- Law of segregation, Law of dominance and Law of independent assortment

1:3 Monohybrid cross, dihybrid cross, Back cross and Test cross

1:4 Variation in Dominance- Incomplete dominance, Co-dominance, Lethal factor in plants.

1:5 Gene Interaction- Complementary gene 9:7, Supplementary genes, Duplicate genes.

1:6 Epistasis-Definition and types- Dominant Epistasis (12:3:1), Recessive Epistasis (9:3:4)

1:7 Multiple alleles- Polygenic inheritance- Definition, Kernel Colour in wheat, Skin colour in human

1:8 Blood Group in human, Rh factor.

### Unit II- LINKAGE AND CROSSING OVER (18 Hours)

2:1 Linkage - Definition and types- complete and incomplete linkage and its Significance of linkage

2:2 Crossing over - Definition, Types –Single, double and Multiple crossing over and its significance

2:3 Crossing over - Theories about the mechanisms of crossing over- Stern's experiment, Tetrad analysis and Crighton and McClintocks experiment

2:4 Linkage Mapping

2:5 Cytoplasmic inheritance– Kappa particle (*Paramaceium*) and Plastid inheritance in *Mirabilis*.

2:6 Sex linkage – Definition and *Drosophilla* (Bar eye) and human (colour blindness)

2:7 Sex determination -Definition and *Drosophilla* and human

2:8 *Neurospora* Genetics

### **UNIT-III- EVOLUTION**

**(18 Hours)**

3.1 Definition of Evolution - Inorganic, Organic Evolution

3.2 Theories of Evolution of organic forms- Theory of Eternity, Theory of Special creation, Cosmozoic theory, Catastrophism and Modern theory

3.3 Theories of Evolution- inheritance of acquired characters (Lamarckism) and natural selection (Darwinism)

3.4 Modern Synthetic Theory

3.5 Isolation - Types of Isolation and Role.

3.6 Speciation–Definition, Gradual Speciation - Allopatric Speciation and Sympatric Speciation.

### **UNIT- IV- PLANT BREEDING**

**(18 Hours)**

4.1 **Introduction to Plant breeding** - History (Pre and post-Mendelian era), Objectives Scope and Importance and future prospect.

4.2 Plant Domestication- Concepts of Domestication Acclimatization and plant introduction, Role of plant introduction in plant breeding

4.3 Genetics in relation to plant breeding, modes of reproduction, apomixes, self-incompatibility- Heteromorphic and Homomorphic- Gametophytic and Sporophytic and male sterile

4.4 Centre of Origin of Species (N. Vavilov)

4.5 Basic principles of selection methods- Mass Selection, Pureline Selection and Clonal selection

### **UNIT- V- BREEDING METHODS**

**(18 Hours)**

5.1 Hybridization- Objectives, Hybridization procedure - (a) Choice of parents(b) Emasculation(c) Bagging and Labelling (d) Harvesting and Raising F1 generation



5.2 Heterosis – Definition, Genetic causes of heterosis- (a) Dominance theory (b) Over dominance theory, Physiological causes of heterosis and Effects of heterosis.

5.3 Mutation Breeding- Definition – Mutation and Mutagenesis, Types of mutation - Spontaneous and Induction -Physical and Chemical, Application and limitation and Achievements.

5.4 Polyploidy in breeding- Types of Polyploidy- (a) Aneuploidy (b) Euploidy (c) Autopolyploidy (d) Allopolyploidy, Application and Achievements

5.5 Breeding for disease resistance- Nature of Disease resistance- Vertical and Horizontal, Mechanisms of Disease resistance - (a) Mechanical(b) Hypersensitivity(c) Antibiosis(d) Nutritional and Achievements.

5.6 Seed certification- Purpose and necessity of seed certification; seed act 1996.

5.7 IPRs in plant breeding: UPOV, Plant Breeders Rights (PBRs), Protection of plant varieties and farmers rights act (PPV & FRA) 2001.

**TOPICS FOR SELF-STUDY:**

Topic	Web links
Chromosomal rearrangement	<a href="https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/chromosomal-rearrangement">https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/chromosomal-rearrangement</a>
Karyotype	<a href="https://www.genome.gov/genetics-glossary/Karyotype#:~:text=A%20karyotype%20is%20an%20individual's,numbers%20or%20structures%20of%20chromosomes">https://www.genome.gov/genetics-glossary/Karyotype#:~:text=A%20karyotype%20is%20an%20individual's,numbers%20or%20structures%20of%20chromosomes</a>
convergent evolution	<a href="https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/convergent-evolution">https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/convergent-evolution</a>
genetic drift	<a href="https://www.sciencedirect.com/topics/neuroscience/genetic-drift">https://www.sciencedirect.com/topics/neuroscience/genetic-drift</a>
instant speciation	<a href="http://www.chemistrylearning.com/instantaneous-speciation/">http://www.chemistrylearning.com/instantaneous-speciation/</a>
Genetic Variability	<a href="https://www.sciencedirect.com/topics/medicine-and-dentistry/genetic-variability">https://www.sciencedirect.com/topics/medicine-and-dentistry/genetic-variability</a>
Pedigree Method,	<a href="https://www.slideshare.net/ShekhAlisha/pedigree-method-of-plant-breeding">https://www.slideshare.net/ShekhAlisha/pedigree-method-of-plant-breeding</a>
Bulk Method,	<a href="https://www.slideshare.net/pawannagar8/bulk-method-pedigree-method-ampline-breeding">https://www.slideshare.net/pawannagar8/bulk-method-pedigree-method-ampline-breeding</a>
Plant Uniformity and Stability	<a href="https://link.springer.com/article/10.1007/s001220100710">https://link.springer.com/article/10.1007/s001220100710</a>
Inbreeding Depression,	<a href="https://en.wikipedia.org/wiki/Inbreeding_depression#:~:text=Inbreeding%20depression%20is%20the%20reduced,result%20of%20a%20population%20bottleneck">https://en.wikipedia.org/wiki/Inbreeding_depression#:~:text=Inbreeding%20depression%20is%20the%20reduced,result%20of%20a%20population%20bottleneck</a>

Reciprocal hybrid	<a href="https://en.wikipedia.org/wiki/Reciprocal_cross">https://en.wikipedia.org/wiki/Reciprocal_cross</a>
disease endurance,	<a href="https://en.wikipedia.org/wiki/Endurance">https://en.wikipedia.org/wiki/Endurance</a>
Heterosis in crop Plants	<a href="https://link.springer.com/chapter/10.1007/978-94-007-1040-5_19">https://link.springer.com/chapter/10.1007/978-94-007-1040-5_19</a>
Male sterility	<a href="https://link.springer.com/chapter/10.1007/978-94-011-1524-7_15">https://link.springer.com/chapter/10.1007/978-94-011-1524-7_15</a>
Pedigree analysis for genetic disease,	<a href="https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/pedigree-analysis">https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/pedigree-analysis</a>
challenges to overcome self-sterility in crop plants	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7098457/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7098457/</a>

### TEXT BOOKS:

1. Veer Bala Rastogi, 2019. *Genetics IV Edition*, Scientific International Pvt Ltd, New Delhi
2. Chahal, G.S. and Gosal, S.S. 2015. *Principles and Procedures of Plant Breeding, - Biological and Conventional Approaches*. New Delhi: Narosa Publishing House Pvt. Ltd.
4. Daniel L Harti. 2014. *Essential Genetics*. Jones and Bartlett, Unites States of America.
5. Kumar Sushil. 2016. *Plant Breeding and Genetics*, Book Enclave, Jaipur.
6. Kumaresan, V. 2009. *Plant Breeding*. Saras Publications Nagercoil.
7. Mann Rosanna. 2017. *Human Genetics and Genomics*, Callisto publish.
8. Singh, M.P. and Sunil Kumar. 2016. *Genetics and Plant Breeding*, Vol. I & II New Delhi, APH Publishing Corporation.
9. Verma, P.S, V.K. Agarwal. 2014. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*, S. Chand, New Delhi.
10. Benjamin, L. 2014. *Genes IX*. Lewin Oxford University Press, Oxford, New York.

### REFERENCE BOOKS:

1. Meyyan, R.P. 2010. *Fundamental of Genetics*, Saras Publication, Nagarcoil.
2. Chopra, V.I. 1998. *Plant breeding – Theory and Practices (2ndEdn.)* Oxford IBH Publishing Co., (P) Ltd., New Delhi, India.

### Web Links:

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

**SPECIFIC LEARNING OUTCOMES (SLO):**

<b>Unit</b>	<b>CONTENT</b>	<b>LEARNING OUTCOME</b>	<b>Highest Bloom taxonomic level of transaction</b>
<b>UNIT-I -MENDELISM AND GENIC INTERACTION</b>			
1.1	Definition of Genetics, Scope and importance of genetics	<ul style="list-style-type: none"> <li>Recall the concepts of genetics</li> <li>Classify the scope and importance genetics</li> </ul>	K4
1.2	Mendel’s Laws of inheritance.- Law of segregation, Law of dominance and Law of independent assortment	<ul style="list-style-type: none"> <li>Prove the Mendel’s Law.</li> <li>Distinguish between law of dominance and Law of independent assortment</li> </ul>	K5
1.3	Monohybrid cross, dihybrid cross, Back cross and Test cross	<ul style="list-style-type: none"> <li>Explain monohybrid and dihybrid cross.</li> <li>Make up the back cross and test cross</li> </ul>	K6
1.4	Variation in Dominance- Incomplete dominance, Co-dominance, Lethal factor in plants	<ul style="list-style-type: none"> <li>Determine the incomplete and codominance</li> <li>Explain lethal factor</li> </ul>	K5
1.5	Gene Interaction- Complementary gene 9:7, Supplementary genes, Duplicate genes.	<ul style="list-style-type: none"> <li>Make use of the gene interaction with a allelic and non allelic gene interaction.</li> </ul>	K3
1.6	Epistasis-Definition and types- Dominant Epistasis (12:3:1), Recessive Epistasis (9:3:4)	<ul style="list-style-type: none"> <li>Define Epistasis</li> <li>Interpret dominant and recessive epistasis and its significance</li> </ul>	K5

1.7	Multiple alleles- Polygenic inheritance- Definition, Kernel Colour in wheat, Skin colour in human	<ul style="list-style-type: none"> <li>Recall the multiple allele.</li> <li>Prove kernel colour in wheat and skin colour in human</li> </ul>	K5
1.8	Blood Group in human and Rh factor.	<ul style="list-style-type: none"> <li>List out the types of blood groups</li> <li>Illustrate the blood groups in human and Rh factor</li> </ul>	K2
<b>Unit II- LINKAGE AND CROSSING OVER</b>			
2.1	Linkage - Definition and types- complete and incomplete linkage and its Significance of linkage	<ul style="list-style-type: none"> <li>Define Linkage</li> <li>Explain the characteristic of linkage.</li> <li>Importance of complete and incomplete linkage</li> </ul>	K5
2.2	Crossing over - Definition, Types – Single, double and Multiple crossing over and its significance	<ul style="list-style-type: none"> <li>What is crossing over</li> <li>Explain they types of crossing over and its significance</li> </ul>	K5
2.3	Crossing over - Theories about the mechanisms of crossing over- Stern's experiment, Tetrad analysis and Creighton and McClintocks experiment	<ul style="list-style-type: none"> <li>Prove crossing over theories and its mechanisms</li> </ul>	K6
2.4	Linkage Mapping	<ul style="list-style-type: none"> <li>Construct the Linkage mapping.</li> <li>Solve the sum of gene</li> </ul>	K3 K6

		mapping	
2.5	Cytoplasmic inheritance– Kappa particle ( <i>Paramaceium</i> ) and Plastid inheritance in <i>Mirabilis</i> .	<ul style="list-style-type: none"> <li>• Define Plasmagene.</li> <li>• Support the kappa particle and plastid inheritance in <i>Mirabilis</i>.</li> </ul>	K5
2.6	Sex linkage – Definition and <i>Drosophilla</i> (Bar eye) and human (colour blindness)	<ul style="list-style-type: none"> <li>• Make use of sex linkage in <i>Drosophila</i> and human,</li> <li>• Solve the colour blindness and haemophilia through sex linkage</li> </ul>	K3 K6
2.7	Sex determination - Definition and <i>Drosophilla</i> and human	<ul style="list-style-type: none"> <li>• Classify the sex determination and <i>Drosophila</i> and Human.</li> </ul>	K4
2.8	<i>Neurospora</i> Genetics	<ul style="list-style-type: none"> <li>• Explain <i>Neurospora</i> in genetics</li> </ul>	K4
<b>UNIT-III- EVOLUTION</b>			
3.1	Definition of Evolution - Inorganic, Organic Evolution	<ul style="list-style-type: none"> <li>• Define Evolution</li> <li>• Categorize the evolution</li> </ul>	K1 K4
3.2	Theories of Evolution of organic forms-Theory of Eternity, Theory of Special creation, Cosmozoic theory, Catastrophism and Modern theory	<ul style="list-style-type: none"> <li>• Theories of evolution</li> <li>• Classify the evolution of organic forms</li> </ul>	K6 K2
3.3	Theories of Evolution-inheritance of acquired characters (Lamarckism) and natural selection (Darwinism)	<ul style="list-style-type: none"> <li>• Discuss Lamarckism and Darwinism</li> </ul>	K6
3.4	Modern Synthetic Theory	<ul style="list-style-type: none"> <li>• Explain modern synthetic theory</li> </ul>	K5
3.5	Isolation - Types of Isolation and Role	<ul style="list-style-type: none"> <li>• List out the types of Isolation and its role</li> </ul>	K4

3.6	Speciation–Definition, Gradual Speciation - Allopatric Speciation and Sympatric Speciation.	<ul style="list-style-type: none"> <li>• Illustrate speciation and its types</li> </ul>	K2
<b>UNIT- IV- PLANT BREEDING</b>			
4.1	<b>Introduction to Plant breeding</b> - History (Pre and post-Mendelian era), Objectives Scope and Importance and future prospect	<ul style="list-style-type: none"> <li>• Explain the importance of plant breeding to increase the food production</li> </ul>	K2
4.2	Plant Domestication- Concepts of Domestication Acclimatization and plant introduction, Role of plant introduction in plant breeding	<ul style="list-style-type: none"> <li>• Explain the necessity of Plant Domestication</li> <li>• Identify desirable variability in wild plants</li> </ul>	K2 K3
4.3	Genetics in relation to plant breeding, modes of reproduction, apomixes, self-incompatibility- Heteromorphic and Homomorphic- Gametophytic and Sporophytic and male sterile	<ul style="list-style-type: none"> <li>• Examine the mode of reproduction and pollination control in crop plants</li> </ul>	K4
4.4	Centre of Origin of Species (N. Vavilov)	<ul style="list-style-type: none"> <li>• Outline the origin of cultivated plants in the world</li> <li>• Utilize the crops to maximize the agricultural productivity</li> </ul>	K2 K3
4.5	Basic principles of selection methods- Mass Selection, Pureline Selection and Clonal selection	<ul style="list-style-type: none"> <li>• Distinguish the various methods of plant selection</li> <li>• Evaluate the crop plants to observe quality and quantity character</li> </ul>	K4 K5
<b>UNIT- V- BREEDING METHODS</b>			

5.1	4.1. Hybridization- Objectives, Hybridization procedure - (a) Choice of parents(b) Emasculation(c) Bagging and Labelling (d) Harvesting and Raising F1 generation	<ul style="list-style-type: none"> <li>• Demonstrate controlled pollination in plant to create genetic variability</li> <li>• Determine the crossing ability of one or more characters into a single plant</li> <li>•</li> </ul>	K2 K5
5.2	Heterosis – Definition, Genetic causes of heterosis- (a) Dominance theory (b) Over dominance theory, Physiological causes of heterosis and Effects of heterosis	<ul style="list-style-type: none"> <li>• Estimate the vigour and causes of heterosis in F1 generation</li> </ul>	K5
5.3	Mutation Breeding- Definition – Mutation and Mutagenesis, Types of mutation - Spontaneous and Induction -Physical and Chemical, Application and limitation and Achievements	<ul style="list-style-type: none"> <li>• Explain the importance of Mutation breeding</li> <li>• Determine and evaluate genetic variation in mutant variety</li> </ul>	K2 K5
5.4	Polyploidy in breeding- Types of Polyploidy- (a) Aneuploidy (b) Euploidy (c) Autopolyploidy (d) Allopolyploidy, Application and Achievements	<ul style="list-style-type: none"> <li>• Explain the production of improved varieties through Ploidy breeding</li> <li>• Examine crops by manipulating the chromosomes numbers</li> </ul>	K2 K4
5.5	Breeding for disease resistance- Nature of Disease resistance- Vertical and Horizontal, Mechanisms of Disease resistance - (a) Mechanical(b) Hypersensitivity(c) Antibiosis(d)	<ul style="list-style-type: none"> <li>• Identify the plant mode of disease resistance in plants</li> <li>• Determine the plant varieties capable of resisting pathogens</li> </ul>	K3 K5

	Nutritional and Achievements		
5.6	Seed certification- Purpose and necessity of seed certification; seed act 1996	<ul style="list-style-type: none"> <li>Discuss the role and necessity Seed certification in crop production</li> </ul>	K6
5.7	IPRs in plant breeding: UPOV, plant breeders rights (PBRs), Protection of plant varieties and farmers rights act (PPV & FRA) 2001	<ul style="list-style-type: none"> <li>Prioritize the protection of breeders and farmers right</li> </ul>	K5

#### Mapping Scheme for Course Code: U20BY506

U20BY506	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	M	L	-	-	H	L	-	L	H	M	H	-
CO2	H	M	-	-	M	-	-	-	M	H	L	H	L
CO3	H	L	L	-	M	-	-	-	M	M	-	H	L
CO4	M	L	-	M	-	L	M	L	-	M	H	-	L
CO5	H	-	-	-	-	-	L	M	M	H	M	-	M
CO6	H	M	-	-	M	-	-	H	H	H	H	L	H

L-Low M- Medium H-High

#### COURSE ASSESSMENT METHODS:

##### Direct

Continuous Assessment in Practical works, sectioning, record submission.  
Practical tests, Records etc. (as applicable), Class tests, Model Exams.  
End Semester Examination

##### Indirect

1. Course-end survey

#### MAJOR PRACTICAL: V – PLANT PHYSIOLOGY & PLANT METABOLISM, GENETICS, EVOLUTION & PLANT BREEDING

Semester : V  
Credits : 2

Course Code : U20BY5P5  
Hours/Week : 3



**Course Outcome:**

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

No	COURSE OUTCOME (CO)	Level	Unit
CO 1	Experiment with plant cells in relation to water.	K3	I
CO 2	Estimate the amount of sugar & lipid concentration in a given plant tissue.	K5	I
CO 3	Estimate the rate of photosynthesis under various environmental conditions.	K5	I
CO 4	Solve the practical problems in Mendelian Genetics, Gene Interaction & Gene Mapping.	K6	II
CO 5	Demonstrate the life cycle of <i>Drosophila</i>	K2	II
CO 6	Experiment with Hybridization & Emasculation techniques, Evaluate the Pollen viability & germinability	K5	III

**SYLLABUS:****PHYSIOLOGY EXPERIMENTS TO BE PERFORMED BY EACH STUDENT****(15 Hours)**

1. Estimation of sugars (Colorimetric).
2. Estimation of lipids (Gravimetric).
3. Demonstration of Osmosis by Potato Osmoscope Method.
4. Determination of stomatal frequency and index.
5. Determination of the ratio between the stomatal and cuticular transpiration by Cobalt Chloride Method.
6. Comparison of stomatal and cuticular transpiration.
7. Determination of absorption and transpiration ratio in plants.
8. Separation of plant pigments by paper chromatography.
9. Determination of photosynthetic rate in water plants under different CO<sub>2</sub> concentrations.
10. Measurement of O<sub>2</sub> evolution under different colour lights using Wilmott's bubbler.
11. Qualitative test for phytochemicals – Starch, sugar, protein, Amino acid, Phenols, Alkaloids, flavonoids, Saponins and tannins.

**GENETICS****(15 Hours)**

- a. Problems based on Mendel's Laws of inheritance
- b. Problems based on Interaction of Genes-Allelic and Non-Allelic
- c. Problems based on Gene Mapping
- d. Life Cycle of *Drosophila* (Culture Studies) - Demonstration
- e. Construction and Analysis of Family Pedigree Charts

**PLANT BREEDING****(15 Hours)**

Selection methods- Explanation through charts

- a. Mass selection
- b. Pureline selection
- c. Clonal selection
- d. Floral biology in self and cross pollinated species
- e. Center of Origin of Species
- f. Hybridization and Emasculation
- g. Pollen viability and pollen germination

**TEXT BOOKS:**

1. Taiz, L., Zeiger, E., 2010. *Plant Physiology*. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P. 2009. *Introduction to Plant Physiology*. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D. 1999. *Experiments in Plant Physiology- A Laboratory Manual*. Narosa Publishing House, New Delhi.
4. Gardner EJ, Simmons MJ, Snustad DP. 2008. *Principles of Genetics*. 8th Ed. Wiley India.
5. Snustad, D.P. and Simmons, M.J. 2010. *Principles of Genetics*, John Wiley & Sons Inc., India. 5th edition.
6. Klug WS, Cummings MR, Spencer, C, Palladino, M. 2011. *Concepts of Genetics*, 10th Ed., Benjamin Cummings
7. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. 2010. *Introduction to Genetic Analysis*. W. H. Freeman and Co., U.S.A. 10th edition.

**REFERENCE BOOKS:**

1. Pierce BA. 2011. *Genetics: A Conceptual Approach*, 4th Ed., Macmillan Higher Education Learning 6.
2. Singh, B.D. 2005. *Plant Breeding: Principles and Methods*. Kalyani Publishers. 7th edition.
2. Chaudhari, H.K. 1984. *Elementary Principles of Plant Breeding*. Oxford – IBH. 2nd edition.
10. Acquah, G. 2007. *Principles of Plant Genetics & Breeding*. Blackwell Publishing.

**Web link:**

[https://onlinecourses.swayam2.ac.in/cec20\\_bt03/preview](https://onlinecourses.swayam2.ac.in/cec20_bt03/preview)

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit	Content	Learning Outcome	Highest Bloom taxonomic level of transaction
<b>I</b>	<b>Plant Physiology</b>		
<b>I</b>	1. Estimation of sugars (Colorimetric).	<ul style="list-style-type: none"> <li>Estimate the Concentration of Sugar in the given Plant tissue</li> </ul>	K5
	2. Estimation of lipids (Gravimetric).	<ul style="list-style-type: none"> <li>Estimate the Concentration of Lipid present in the Plant tissue</li> </ul>	K5
	3. Demonstration of Osmosis by Potato Osmoscope Method.	<ul style="list-style-type: none"> <li>Experiment with Potato Osmoscope.</li> </ul>	K3
	4. Determination of stomatal frequency and index.	<ul style="list-style-type: none"> <li>Estimate the stomatal frequency and index</li> </ul>	K5
	5. Determination of the ratio between the	<ul style="list-style-type: none"> <li>Determine the rate</li> </ul>	K5

	stomatal and cuticular transpiration by Cobalt Chloride Method.	of Stomatal and cuticular transpiration	
	6.Determination of absorption and transpiration ratio in plants.	<ul style="list-style-type: none"> <li>Estimate the transpiration and absorption rate by using TA Balance apparatus</li> </ul>	K5
	7.Separation of plant pigments by paper chromatography.	<ul style="list-style-type: none"> <li>Estimate the Rf value of Plant Pigments</li> </ul>	K5
	8.Determination of photosynthetic rate in water plants under different CO <sub>2</sub> concentrations.	<ul style="list-style-type: none"> <li>Estimate the Photosynthetic rate under different CO<sub>2</sub> concentrations</li> </ul>	K5
	9.Measurement of O <sub>2</sub> evolution under different color lights using Wilmott's bubbler.	<ul style="list-style-type: none"> <li>Measure the Photosynthetic rate by using Wilmott's bubbler.</li> </ul>	K5
	10.Qualitative test for phytochemicals – Starch, sugar, protein, Amino acid, Phenols, Alkaloids, flavonoids, Saponins and tannins.	<ul style="list-style-type: none"> <li>Identify the Phytochemical compound in the given Plant extracts.</li> </ul>	K3
<b>II</b>	<b>Genetics</b>		
	1.Problems based on Mendel's Laws of inheritance	<ul style="list-style-type: none"> <li>Solve the Problems related with Monohybrid cross and Dihybrid Cross</li> </ul>	K6
	2.Problems based on Interaction of Genes- Allelic and Non-Allelic	<ul style="list-style-type: none"> <li>Solve the Problems related with gene interaction</li> </ul>	K6
	3.Problems based on Gene Mapping	<ul style="list-style-type: none"> <li>Solve the Linkage Mapping</li> </ul>	K6
	4.Life Cycle of <i>Drosophila</i> (Culture Studies) - Demonstration	<ul style="list-style-type: none"> <li>Demonstrate the Life Cycle of <i>Drosophila</i></li> </ul>	K2
	5.Construction and Analysis of Family Pedigree Charts	<ul style="list-style-type: none"> <li>Solve Family Pedigree problems</li> </ul>	K6
<b>III</b>	<b>Plant Breeding</b>		
	1. Mass selection	<ul style="list-style-type: none"> <li>Outline the Protocol of Mass Selection</li> </ul>	K2
	2.Pure line selection	<ul style="list-style-type: none"> <li>Outline the Protocol of Pure line selection</li> </ul>	K2
	3.Clonal selection	<ul style="list-style-type: none"> <li>Outline the Protocol of Clonal</li> </ul>	K2

		selection	
	4. Floral biology in self- and cross-pollinated species	<ul style="list-style-type: none"> <li>Examine the self- and Cross-pollinated flowers</li> </ul>	K4
	5. Center of Origin of Species	<ul style="list-style-type: none"> <li>List the Centre of Origin of Species</li> </ul>	K4
	6. Hybridization and Emasculation	<ul style="list-style-type: none"> <li>Experiment on emasculation, bagging &amp; tagging for controlled pollination.</li> </ul>	K5
	7. Pollen viability and pollen germination	<ul style="list-style-type: none"> <li>To measure the Pollen Viability and Germination rate of Pollen grains</li> </ul>	K5

#### Mapping Scheme for the Course Code: U20BY5P5

U20BY5P5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	-	-	-	-	-	L	-	-	-	-	H	L
CO2	H	-	-	-	-	-	L	-	-	-	-	H	H
CO3	M	-	-	-	L	-	L	-	-	-	-	H	L
CO4	M	-	-	-	-	M	-	-	-	-	-	-	-
CO5	L	-	-	-	-	-	-	-	-	-	-	-	-
CO6	M	-	-	L	-	M	-	-	-	-	-	L	-

L-Low (1) M-Medium (2) H-High (3)

#### Assessment / Evaluation:

1. Continuous Assessment by conducting Model Exams, Demonstration Experiments, Written test on Protocols.
2. Assessment also done through solving Genetics problems, Hands on Techniques, Lab Attendance and Practical Record work.
3. End Semester Practical Examination

#### Elective-I: BIOSTATISTICS, COMPUTER APPLICATION AND BIOINFORMATICS

Course code: U22BY5:A

Hours/Week:5

Semester: V

Credits: 5

**Course Outcomes:**

**On completion of the course the students will be able to:**

No	COURSE OUTCOMES (CO)	level	Unit
CO 1	Make use of the statistical data in scientific studies	K3	I
CO 2	Distinguish the importance of advanced statistical operations	K4	II
CO 3	Apply the basics of computer in further studies	K3	III
CO 4	Explain the databases and tools of bioinformatics	K5	IV
CO 5	Analyse the use of bioinformatics in solving evolution	K4	V
CO 6	Compare the applications of bioinformatics in modern studies	K5	V

**Syllabus:**

**Unit I: BASIC CONCEPT OF BIOSTATISTICS**

**(15 Hours)**

- 1.1. Biostatistics - Definition - Scope
- 1.2. Data - Definition -Types- (a) Primary(b) Secondary, Collection of data
- 1.3. Population - Definition - Types of population - (a) Finite population (b) Infinite population
- 1.4. Samples -Definition - Sampling techniques -Random sampling techniques
- 1.5. Frequency distribution - Definition - Discrete method & Continuous method-Frequency graphs
- 1.6. Statistical table - Rules, Organization and types of table
- 1.7. Graphical Representation of Data - Importance and general guidelines - Types of graphs - (a) Bar (b) Simple(c) Multiple(d) Percentage (e) Subdivided (f) Pie diagram (g) Pictogram (h) Cartogram
- 1.8. Central Tendency -Mean (a) Definition (b) Merits and demerits (c) Problems - Median (a) Definition (b) Merits and demerits (c) Problems - Mode (a) Definition (b) Merits and demerits (c) Problems

**Unit II: DESCRIPTIVE AND INFERENTIAL STATISTICS**

**(15 Hours)**

- 2.1. Measure of dispersion - Definition - Types of dispersion (a) Absolute measure of dispersion (b) Relative measure of dispersion
- 2.2. Probability - Probability scale, Definition, Types and application of biological problems
- 2.3. Binomial distribution - Introduction, Definition and Properties of binomial distribution
- 2.4. Poisson Distribution - Introduction, Definition and Properties of Poisson distribution
- 2.5. Normal distribution - Introduction, Definition and Properties
- 2.6. Test of Significance - Introduction, Definition, Procedure and application of chi-square test

**UNIT- III- INTRODUCTION TO COMPUTERS**

**(15 Hours)**

- 3.1- Computer- Characteristics of computer- Applications of computer, generations of computer, Classification of computers
- 3.2- Components of computer system. Input/Output Units: Keyboard, Mouse, Trackball, Joystick, Digitizing tablet, Scanners, Digital Camera, MICR, OCR, OMR, Bar-code Reader, Voice Recognition, Light pen, Touch Screen, CRT, LCD, LED Monitors.
- 3.3- Number systems -Binary, Octal, Decimal, Hexadecimal
- 3.4- Introduction to Operating Systems- Introduction of MS-Office, Different elements of word processing (MS-WORD), Spreadsheets (MS EXCEL), Data storage (MS ACCESS) and PowerPoint presentation (MS POWERPOINT).
- 3.5- Computer Networking and security - Networking gadgets (Router, Switch, etc), Communication Links (Wire pairs, Coaxial cables, Fiber optics, Microwave, Satellite, etc) - Local Area Network (LAN), Wide Area Network (WAN), Metropolitan Area Network (MAN) - Network Security: Firewall, Packet filtering, Honeypots

**UNIT-IV- INTRODUCTION TO BIOINFORMATICS (15 hours)**

- 4.1- Bioinformatics and its importance.
- 4.2.-Examples of related tools (FASTA, BLAST, RASMOL)- Databases (GENBANK)
- 4.3- General Introduction of Biological Databases- Nucleic acid databases (NCBI, DDBJ, and EMBL)- Protein databases (Primary, Composite, and Secondary)- Specialized Genome databases: (SGD, TIGR, and ACeDB)- Structure databases (CATH, SCOP, and PDB sum).
- 4.4- Data generation, Data storage and retrieval- Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction and microarray)- (Detailed study not required)
- 4.5- Applications of Bioinformatics.

**UNIT-V- BIOINFORMATICS AND ITS APPLICATION (15 Hours)**

- 5.1- Genomics-Concept, Evolution of Genomics-Structural and Functional Genomics-Comparative Genomics- Microarray: technique, Design, Analysis.
- 5.2- Systems biology: Introduction to Associated disciplines- Interactomics (PPI)- Fluxomics.
- 5.3- Metagenomics: Introduction to metagenomics- Tool's in metagenomics, MEGAN, MG- RAST, and SEED- Application (Gene survey, Environmental genomes, Microbial diversity).
- 5.4- Concept of metabolome and metabolomics, its applications- Chemoinformatics: Cheminformatics tools for drug discovery.

**TOPICS FOR SELF-STUDY:**

Biostatistical study in Health management	<a href="https://www.publichealthcareeredu.org/biostatistics-and-informatics">https://www.publichealthcareeredu.org/biostatistics-and-informatics</a>
Epidemiology	<a href="https://www.bmj.com/about-bmj/resources-readers/publications/epidemiology-uninitiated/1-what-epidemiology">https://www.bmj.com/about-bmj/resources-readers/publications/epidemiology-uninitiated/1-what-epidemiology</a>
MEGA Softwares.	<a href="https://www.megasoftware.net/">https://www.megasoftware.net/</a>

Software for security operations	<a href="https://respond-software.com/automate-your-soc/">https://respond-software.com/automate-your-soc/</a>
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**TEXTBOOKS:**

1. Gurumani. N, 2015. *An introduction to biostatistics*. 2nd Edition, MJP Publishers, Chennai, India.
2. Pranab kumar Banerjee, 2014. *Introduction to Biostatistics*. S. Chand And Company pvt ltd. New Delhi, India.
3. Rastogi, V.B. *Fundamentals of biostatistics*. 2nd Edition, Anne Books Pvt Ltd, New Delhi, India,
4. David W. Mound, 2001. *Bioinformatics: Sequence and Genome analysis*. Gold Spring Harbour Laboratory Press, New York.
5. Sundararajan.S. & R. Balaji. 2002. *Introduction to Bioinformatics*, Mumbai, Himalaya.
6. Ramakrishnan, P, 2001. *Biostatistics*. Saras Publication, Nagarcoil, Tamil Nadu, 2001.

**REFERENCE BOOK:**

1. Bryant, T.N. and J. W. T. 1989. *Computers in Microbiology. Practical Approach Series*. (Published in the Practical Approach Series. Editors, D. Rickwood and B.D. Hames.) Oxford University Press. Oxford, New York.
2. Walid A. Houry, 2016. *The Molecular Chaperones Interaction Networks in Protein Folding and Degradation: 1 (Interactomics and Systems Biology)*, Springer.

**Web Links:**

- <https://www.mooc-list.com/tags/plant-bioinformatics>
- <http://www.srtmun.ac.in/images/Data2020/SchoolCirculars/EnrollmentOpenforSWAYAMNPTELCoursesJulytoDecember2020.pdf>

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit	Content	Learning Outcome	Highest Blooms Taxonomic level of transaction.
<b>I</b>	<b>Biostatistics</b>		
1.1	Biostatistics - Definition – Scope	<ul style="list-style-type: none"> <li>• Define the subject by own</li> </ul>	K1
1.2	Data- Definition -Types- (a) Primary(b) Secondary - Collection of data	<ul style="list-style-type: none"> <li>• Recall the concept of data</li> </ul>	K1
1.3	Population - Definition -Types of population - (a) Finite population (b) Infinite population	<ul style="list-style-type: none"> <li>• Summarize the population statistics</li> </ul>	K2
1.4	Samples -Definition - Sampling techniques - Random sampling techniques	<ul style="list-style-type: none"> <li>• Define sample</li> </ul>	K1
1.5	Frequency distribution - Definition - Discrete method & Continuous method- Frequency graphs	<ul style="list-style-type: none"> <li>• Select sampling techniques</li> <li>• Compare the various methods in</li> </ul>	K1

		frequency distribution	
1.6	Statistical table - Rules, Organization and types of table	<ul style="list-style-type: none"> <li>• Make use of statistical tables</li> </ul>	K3
1.7	Graphical Representation of Data - Importance and general guidelines - Types of graphs - (a) Bar (b) Simple(c) Multiple(d) Percentage (e) Subdivided (f) Pie diagram (g) Pictogram (h) Cartogram	<ul style="list-style-type: none"> <li>• Interpret the graphical representation on data</li> <li>• Distinguish among various graphical methods of data presentation</li> </ul>	K2 K2
1.8	Central Tendency -Mean (a) Definition (b) Merits and demerits (c) Problems - Median (a) Definition (b) Merits and demerits (c) Problems - Mode (a) Definition (b) Merits and demerits (c) Problems	<ul style="list-style-type: none"> <li>• Explain the use of mean, median and mode value in statistics.</li> </ul>	K2
<b>II</b>	<b>Measure of dispersion</b>		
2.1	Definition - Types of dispersion (a) Absolute measure of dispersion (b) Relative measure of dispersion	<ul style="list-style-type: none"> <li>• Recall the use of dispersion</li> <li>• Compare the different dispersion methods</li> </ul>	K2 K4
2.2	Probability - Probability scale, Definition, Types and application of biological problems	<ul style="list-style-type: none"> <li>• Define probability</li> <li>• Make use of the concept of probability in future studies</li> </ul>	K1 K3
2.3	Binomial distribution - Introduction, Definition and Properties of binomial distribution	<ul style="list-style-type: none"> <li>• Interpret Binomial distribution</li> </ul>	K2
2.4	Poisson Distribution - Introduction, Definition and Properties of Poisson distribution	<ul style="list-style-type: none"> <li>• Utilize poisson distribution for further studies</li> </ul>	K3
2.5	Normal distribution - Introduction, Definition and Properties	<ul style="list-style-type: none"> <li>• Explain the concept of normal distribution</li> </ul>	K2
2.6	Test of Significance - Introduction, Definition, Procedure and application of chi-square test	<ul style="list-style-type: none"> <li>• Make use of the test of significant functions in statistical survey</li> </ul>	K3
<b>III</b>	<b>Introduction to computers</b>		
3.1	Computer- Introduction- generations of computer, Applications of computer, Classification of computers.	<ul style="list-style-type: none"> <li>• Define what computer is and the uses of computer</li> <li>• Explain the classification of</li> </ul>	K1 K2



		computer in various generation	
3.2	Components of computer system. Input/Output Units: Keyboard, Mouse, Trackball, Joystick, Digitizing tablet, Scanners, Digital Camera, MICR, OCR, OMR, Bar-code Reader, Voice Recognition, Light pen, Touch Screen, CRT, LCD, LED Monitors.	<ul style="list-style-type: none"> <li>Identify the input and output devices in computer</li> </ul>	K2
3.3	Number systems-Binary, Octal, Decimal, Hexadecimal	<ul style="list-style-type: none"> <li>Interpret the number systems used in computer</li> </ul>	K2
3.4	Introduction to Operating Systems- Introduction of MS-Office, Different elements of word processing (MS-WORD), Spreadsheets (MS EXCEL), Data storage (MS ACCESS) and PowerPoint presentation (MS POWERPOINT).	<ul style="list-style-type: none"> <li>Apply the basics in learning the software</li> <li>Make use of the MS software</li> </ul>	K3 K3
3.5	Computer Networking and security - Networking gadgets (Router, Switch, etc), Communication Links (Wire pairs, Coaxial cables, Fiber optics, Microwave, Satellite, etc) - Local Area Network (LAN), Wide Area Network (WAN), Metropolitan Area Network (MAN) - Network Security: Firewall, Packet filtering, Honeypots	<ul style="list-style-type: none"> <li>Define the physical needs of networking</li> <li>Define the network issues and network security settings</li> <li>Explain the various network connections used</li> </ul>	K2 K2
<b>IV</b>	<b>Introduction To Bioinformatics</b>		
4.1	Bioinformatics and its importance	<ul style="list-style-type: none"> <li>Tell the definition of Bioinformatics</li> </ul>	K1
4.2	Examples of related tools (FASTA, BLAST, RASMOL)- Databases (GENBANK)	<ul style="list-style-type: none"> <li>Interpret the databases used in Bioinformatics</li> <li>Make use of the tools used in Bioinformatics</li> </ul>	K2 K3
4.3	General Introduction of Biological Databases- Nucleic acid databases (NCBI, DDBJ, and EMBL)- Protein databases (Primary, Composite, and Secondary)- Specialized Genome databases: (SGD, TIGR, and ACeDB)- Structure databases (CATH, SCOP, and PDB sum).	<ul style="list-style-type: none"> <li>Distinguish the molecular and protein databases</li> <li>List out the specialized databases.</li> <li>Evaluate the databases based on skeleton of nucleotide representation</li> </ul>	K4 K4 K5
4.4	Data generation, Data storage and retrieval-		

	Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray.	<ul style="list-style-type: none"> <li>• Examine the feasible process of data extraction</li> <li>• Criticize the data management and storing in the field of Bioinformatics.</li> <li>• Deduct the data analysis using the search methods</li> </ul>	K4 K5 K5
4.5	Applications of Bioinformatics.	<ul style="list-style-type: none"> <li>• Analyse the importance of bioinformatics in recent studies</li> </ul>	K4
<b>V</b>	<b>Bioinformatics And Its Application</b>		
5.1	Genomics-Concept, Evolution of Genomics-Structural and Functional Genomics-Comparative Genomics- Microarray: technique, Design, Analysis	<ul style="list-style-type: none"> <li>• Define the concept of genomics and various aspects of it.</li> <li>• Compare the population studies and genomic variation studies related to speciation.</li> <li>• Interpret the microarray technique for future studies</li> </ul>	K1 K2 K4
5.2	Systems Biology: Introduction to Associated disciplines- Interactomics (PPI)- Fluxomics.	<ul style="list-style-type: none"> <li>• Identify the scope in Biomics using Bioinformatics.</li> <li>• Explain the basics of metabolomics and chemo informatics.</li> </ul>	K3 K2
5.3	Metagenomics: Introduction to metagenomics-Tool's in metagenomics, MEGAN, MG- RAST, and SEED- Application (Gene survey, Environmental genomes, Microbial diversity)	<ul style="list-style-type: none"> <li>• Define the procedural study on Metagenomics</li> <li>• Construct phylogenetic trees, modify the available nucleotide data using the tools available</li> <li>• Apply the metagenomics methods in genomic studies.</li> </ul>	K2 K6 K3

5.4	Concept of metabolome and metabolomics, its applications- Chemoinformatics: Cheminformatics tools for drug discovery.	<ul style="list-style-type: none"> <li>Define the basics of advent branches of Bioinformatics.</li> </ul>	K5
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### Mapping Scheme for the Course Code: U22BY5:A

U22BY5:A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	-	-	M	M	M	H	-	L	H	-	L	L
CO2	M	-	-	L	L	-	H	L	-	L	-	L	L
CO3	L	L	-	L	-	-	L	-	L	-	-	L	L
CO4	L	L	L	L	-	-	H	M	-	-	L	L	L
CO5	-	-	-	-	-	L	H	L	-	L	-	M	-
CO6	L	-	-	-	-	-	H	L	-	-	-	-	L

L-Low (1) M-Medium (2) H-High (3)

### COURSE ASSESSMENT METHODS:

#### Direct

Continuous Assessment in Practical works, record submission.  
Class tests, Model Exams.  
End Semester Examination

#### Indirect

##### 1. Course-end survey

#### Elective I: BIO -INSTRUMENTATION

Semester: V  
Credits: 5

Course Code : U22BY5:B  
Hours/Week : 5

#### Course Outcomes:

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

No	COURSE OUTCOME (CO)	Level	Unit
CO 1	Apply the process safety and describe the benefits of process safety to an General Lab safety and to society	K2	I
CO 2	Explain Instrumentation, separation and identification of compounds by electrophoresis technique	K5	II
CO 3	Explain Instrumentation, Working mechanism and Application of PCR.	K4	II
CO 4	Apply the knowledge about the various aspects of Centrifugation and Microscopy for identification, and characterization of compounds	K3	III
CO 5	Explain the varies concepts of chromatography techniques	K5	IV
CO 6	Describe the concept of Spectrophotometry, Tracer techniques	K2	V

## SYLLABUS:

### Unit – I: Laboratory Safety Management (15 Hours)

**General Lab safety** - Basic Safety Rules, Laboratory Specific Safety Rules (Tissue culture, Microbiology, Biochemistry). **Personal protective Equipment (PPE)** – introduction,

Hazard Assessment – survey, sources, Eye and face protection, Head protection, Hand protection. **Administrative Control** – orientation and training, standard operation procedures(SOPs) , safety signs, Personal Hygiene. **Biological**– Biosafety levels, Risk Assessment, Safety data sheets for infected substances. **Chemical Safety** –Safety data sheet, safe work practice – general rules and regulations **Waste management** – Biological and Chemical waste disposal. General waste management procedure and waste determination processes,

Laboratory waste classification. **Emergency procedure** – Spill, First Aid, Emergency kits

### Unit II – Electrophoresis (15 Hours)

Electrophoresis- Principles and types- Agrose gel Electrophoresis, Pulsed Field Gel Electrophoresis (PFGE), Polyacrylamide Gel Electrophoresis (PAGE). Blotting Technology- Southern, Northern and Western blot. PCR: Working mechanism and Application

### Unit – III: Analytical Techniques (15 Hours)

Centrifugation - Types of Centrifuge & Centrifugation (definition, principle, uses), Microscopy – Fluorescence, Flow cytometry, confocal and Electron Microscope (SEM and TEM).

### UNIT – IV- Chromatography (15 Hours)

**Chromatography** - Basic principles, types – Paper, Column, TLC, HPTLC, GC-MS, HPLC, Ion exchange, Size exclusion, Hydrophobic interaction, Gel filtration and Affinity chromatography.

### UNIT – V: Spectrophotometry (15 Hours )

Spectrophotometry - Principle and Instrumentation, UV-Visible, FTIR, NMR, X-ray Crystallography, MALDI-TOF.

Tracer techniques - Nature of radio activity- GM Counter, Scintillation Counter, Auto radiography and applications of isotopes.

## TOPICS FOR SELF-STUDY:

Self-Study topics	Reference Links
Metabolomics	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4850886/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4850886/</a>
Confocal microscopy	<a href="https://www.olympus-lifescience.com/en/microscope-resource/primer/techniques/confocal/confocalintro/">https://www.olympus-lifescience.com/en/microscope-resource/primer/techniques/confocal/confocalintro/</a>
Protein-3-D softwares	<a href="https://www.princeton.edu/news/2020/11/03/software-determining-3d-structure-proteins">https://www.princeton.edu/news/2020/11/03/software-determining-3d-structure-proteins</a>

## TEXT BOOK:

- Jayaraman, J. 2006. *Laboratory manual in Biochemistry*, New Delhi, India, New Age International Ltd.

## REFERENCE BOOKS:

- Palanivelu, P. 2000. *Laboratory manual for Analytical Biochemistry and Separation techniques*, Madurai, India.
- Plummer, D.T. 1999. *An introduction to practical Biochemistry*, New Delhi, McGraw Hills Publishing Company.

**WEB LINKS:**

<https://www.sathyabama.ac.in/course-materials/virtual-bioinstrumentation>

[https://onlinecourses.nptel.ac.in/noc20\\_bt21/preview](https://onlinecourses.nptel.ac.in/noc20_bt21/preview)

**SPECIFIC LEARNING OUTCOME (SLO):**

Unit/ Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>I</b>	<b>Laboratory Safety Management</b>		
1.1	General Lab safety - Basic Safety Rules, Laboratory Specific Safety Rules (Tissue culture, Microbiology, Biochemistry)	<ul style="list-style-type: none"> <li>• Recall general lab safety in laboratory.</li> </ul>	K2
1.2	Personal protective Equipment (PPE) – introduction. 1.2.1 Hazard Assessment – survey, sources, 1.2.2 Eye and face protection, 1.2.3 Head protection, 1.2.4 Hand protection,	<ul style="list-style-type: none"> <li>• Demonstrate understanding of fundamental concepts of Personal protective Equipments.</li> </ul>	K2
1.3	Administrative Control – orientation and training, standard operation procedures(SOPs) , safety signs, Personal Hygiene,	<ul style="list-style-type: none"> <li>• Explain the various administrative control in the lab.</li> </ul>	K2
1.4	Biological– Biosafety levels, Risk Assessment, Safety data sheets for infected substances. Chemical Safety –Safety data sheet, safe work practice – general rules and regulations	<ul style="list-style-type: none"> <li>• Demonstrate the biological safety level and chemical safety level.</li> </ul>	K2
1.5	Waste management – Biological and Chemical waste disposal 5.5.1 General waste management procedure and waste determination processes, Laboratory waste classification	<ul style="list-style-type: none"> <li>• Explain Waste management both biological and chemical waste in the laboratory.</li> </ul>	K2
1.6	Emergency procedure – Spill, First Aid, Emergency kits	<ul style="list-style-type: none"> <li>• Discuss the Emergency procedure in laboratory.</li> </ul>	K2
<b>II</b>	<b>Electrophoresis</b>		

2.1	Electrophoresis- Principles and types- Agrose gel Electrophoresis, Pulsed Field Gel Electrophoresis (PFGE), Polyacrylamide Gel Electrophoresis (PAGE).	<ul style="list-style-type: none"> <li>Appraise the application of Electrophoresis</li> </ul>	K4
2.2	Blotting Technology- Southern, Northern and Western blot.	<ul style="list-style-type: none"> <li>Examine the different blotting technology in biotechnological field</li> </ul>	K5
2.3	PCR: Working mechanism and Application	<ul style="list-style-type: none"> <li>Explain the varies application of PCR in the Biotechnological industry</li> </ul>	K2
<b>III</b>	<b>Analytical Techniques</b>		
3.1	Centrifugation - Types of Centrifuge & Centrifugation (definition, principle, uses)	<ul style="list-style-type: none"> <li>Develop interest in principles of Centrifugation</li> </ul>	K3
3.2	Microscopy – Fluorescence, Flow cytometry, confocal and Electron Microscope (SEM and TEM).	<ul style="list-style-type: none"> <li>Recall the importance and scope of Microscopes</li> </ul>	K2
<b>IV</b>	<b>Chromatography</b>		
<b>4.1</b>	<b>Chromatography</b> - Basic principles, types – Paper, Column, TLC, HPTLC, GC-MS, HPLC, Ion exchange, Size exclusion, Hydrophobic interaction, Gel filtration and Affinity chromatography.	<ul style="list-style-type: none"> <li>Determine Chromatography techniques involved in biotechnological field.</li> <li>Explain the basic bio-interaction techniques.</li> </ul>	K5 K2
<b>V</b>	<b>Spectrophotometry</b>		
5.1	Spectrophotometry - Principle and Instrumentation, UV-Visible, FTIR, NMR, X-ray Crystallography, MALDI-TOF.	<ul style="list-style-type: none"> <li>Explain the various Spectrophotometry instruments</li> </ul>	K2
5.2	Tracer techniques - Nature of radio activity- GM Counter, Scintillation Counter, Auto radiography and applications of isotopes.	<ul style="list-style-type: none"> <li>Demonstrate understanding of fundamental concepts of Tracer techniques</li> </ul>	K2

### Mapping Scheme for Course Code: U22BY5:B

U22BY5:B	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	L	-	-	L	M	H	L	-	M	H	M	L
CO2	H	M	H	H	M	L	L	-	L	L	-	-	H
CO3	H	M	H	H	H	L	L	-	L	-	M	-	L
CO4	M	M	M	M	L	-	M	-	L	M	L	-	-
CO5	H	M	L	-	-	L	H	L	-	M	-	-	M

CO6	M	L	-	L	L	-	M	H	M	-	L	L	M
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**L-Low (1) M-Medium (2) H-High (3)**

### Assessment / Evaluation:

1. Continuous Assessment by conducting Model Exams, Demonstration Experiments, Written test on Protocols.
2. End Semester Practical Examination

### Elective I - BIOFERTILIZERS AND BIOPESTICIDES

Semester : V  
Credits : 5

Course Code : U22BY5:C  
Hours/Week : 6

### Course Outcomes:

On completion of the course students will be able to:

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Outline the fundamentals of Biofertilizers, classification, recent advancements, challenges and advantages of biofertilizers	K2	I
CO 2	Explain about the organic farming, sources and significances of organic farming practices	K5	II
CO 3	Elaborate the mycorrhizae, role and significances of mycorrhizae in crop improvement	K6	III
CO 4	Functions of biofertilizers in modern agriculture in respect to mass cultivation of biofertilizers and their management	K4	IV
CO 5	Improve biopesticides as a protecting tool of farming crops and its yield aspects	K6	V
CO 6	Summarize the role of biofertilizer and biopesticides as a tool of conservation, integrated farming management.	K6	I,II,III,IV,V

### SYLLABUS

#### Unit - I: Biofertilizers and its kinds

##### 1.1. Biofertilizers

1.1.1. Definition, kinds, Microbes as biofertilizers.

##### 1.2. Recent trends and future outlook, Types, applications and advantages

1.2.1. Current challenges for sustainable agricultural production.

### 1.3. Symbiotic association

#### 1.3.1. *Rhizobium* inoculants

#### 1.3.2. Classification, Physiology, Host – *Rhizobium* interactions and mass cultivation.

#### 1.3.3. Rhizoplane, R/S ratio

## **Unit - II: Organic farming**

### 2.1. Organic farming

#### 2.1.1. Carrier materials of organic farming

### 2.2. General outline of microbes as fertilizers

#### 2.2. 1. Rhizosphere effect - microbial products influencing plant growth.

#### 2.2.2. Environmental Benefits of Organic Agriculture.

## **Unit - III: Mycorrhizae**

### 3.1. Mycorrhizae

#### 3.1.1. VAM association, occurrence, types, Collection, isolation, inoculum production and mass cultivation

### 3.2. Mycorrhizae and Water Relations

#### 3.2.1. Mycorrhizal roots on water absorption, AMF in Agriculture.

## **Unit - IV: Mass production of biofertilizers**

### 4.1. Frankia, Actinorhizae and Host plants - characteristics, identification, Impact of Root Exudates.

### 4.2. Culture method and maintenance biofertilizers

#### 4.2.1. Anabaena, Azospirillum, Azotobacter

#### 4.2.2. Azolla.

## **Unit - V: Biopesticides**

### 5.1. Biopesticides - Definition, Bacterial, Viral and Fungal Pesticides.

### 5.2. Biological control of weeds

#### 5.2.1. Mycoherbicides

#### 5.2.2. Insect as bio control agents - *Egg parasitoid*, *Trichogramma*

### 5.3. Biological control of plant pathogens.

### 5.4. Role of phytopesticides in sustainable agriculture.

### 5.5. Management of Soil Biota and Their Processes.



### Topics for Self Study:

S. no	Self Study	References
1	Vermicompost	- <a href="https://www.planetnatural.com/composting-101/indoor-composting/vermicomposting/">https://www.planetnatural.com/composting-101/indoor-composting/vermicomposting/</a>
2	Compost	<a href="https://www.nrdc.org/stories/composting-101">https://www.nrdc.org/stories/composting-101</a>
3	Green Manure	<a href="https://agritech.tnau.ac.in/org_farm/orgfarm_green%20manure.html">https://agritech.tnau.ac.in/org_farm/orgfarm_green%20manure.html</a>
4	Neem cake fertilizer	<a href="https://www.agrifarming.in/neem-cake-fertilizer-uses-application-benefits">https://www.agrifarming.in/neem-cake-fertilizer-uses-application-benefits</a>

### Text Books:

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.

### Reference Books

1. Bikas R. Pati and Santi M. Mandal 2016. Recent trends in Biofertilizers, I K International Publishing House, New Delhi.
2. B. D. Kaushik, Deepak Kumar, Md. Shamim, 2020. Biofertilizers and Biopesticides in Sustainable Agriculture, 1st Edition, Apple Academic Press.

### SPECIFIC LEARNING OUTCOMES (SLO):

Unit	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>Unit I - Biofertilizers and its kinds</b>			

Unit-I. 1.1 1.1.1.	Biofertilizers Definition, kinds, Microbes as biofertilizers.	<ul style="list-style-type: none"> <li>• Explain biofertilizer as a conservation tool of farming land</li> </ul>	K5
1.2	Recent trends and future outlook, Types, applications and advantages of biofertilizers	<ul style="list-style-type: none"> <li>• Relationship between modern day agriculture and traditional agriculture</li> <li>• List out the applications of biofertilizers</li> </ul>	K4 K4
1.2.1	Current challenges for sustainable agricultural production	<ul style="list-style-type: none"> <li>• Discuss the challenges for sustainable agricultural production</li> </ul>	K6
1.3. 1.3.1. 1.3.2. 1.3.3.	Symbiotic association <i>Rhizobium</i> inoculants Classification, Physiology, Host – <i>Rhizobium</i> interactions and mass cultivation. Rhizoplane, R/S ratio	<ul style="list-style-type: none"> <li>• Effectiveness of symbiotic association with plant and their growth</li> <li>• Explain rhizoplane with R/S ration</li> </ul>	K2 K2
<b>Unit II - Organic farming</b>			
Unit II 2.1 2.1.1.	Organic farming Carrier materials of organic farming	<ul style="list-style-type: none"> <li>• Why organic farming is mandatory in modern day agriculture?</li> </ul>	K1
2.2. 2.2. 1. 2.2.2.	General outline of microbes as fertilizers Rhizosphere effect - microbial products influencing plant growth. Environmental Benefits of Organic Agriculture.	<ul style="list-style-type: none"> <li>• Justify the role of as biofertilizer with examples and their environmental benefits</li> </ul>	K5
<b>Unit III- Mycorrhizae</b>			

Unit III			
3.1.	Mycorrhizae		
3.1.1.	VAM association, occurrence, types, Collection, isolation, inoculum production and mass cultivation	<ul style="list-style-type: none"> <li>Interpret the mycorrhizal association with their importance.</li> <li>Explain VAM in along with their role in agriculture</li> </ul>	K5
3.2.	Mycorrhizae and Water Relations		
3.2.1.	Mycorrhizal roots on water absorption, AMF in Agriculture.	<ul style="list-style-type: none"> <li>Justify the significances of Mycorrhizal roots on water absorption and AMF in Agriculture</li> </ul>	K5
<b>Unit IV- Mass production of biofertilizers</b>			
Unit IV			
4.1	Frankia, Actinorhizae and Host plants - characteristics, identification, Impact of Root Exudates.	<ul style="list-style-type: none"> <li>Discuss the production ob biofertilizers and their role</li> </ul>	K6
4.2.	Culture method and maintenance biofertilizers		
4.2.1.	Anabaena, Azospirillum, Azotobacter	<ul style="list-style-type: none"> <li>Elaborate the mass production of and maintenance of biofertilizers with their nutritional impact in soil</li> </ul>	K6
4.2.2.	Azolla.		
<b>Unit V- Biopesticides</b>			
Unit V			
5.1	Biopesticides - Definition, Bacterial, Viral and Fungal Pesticides.	<ul style="list-style-type: none"> <li>Importance of biopesticides as a tool for the protection of farming crops</li> </ul>	K5
5.2	Biological control of weeds		
5.2.1.	Mycoherbicides	<ul style="list-style-type: none"> <li>List out the biological pest control agents</li> <li>Explain the role of insects as a bio control agents</li> </ul>	K4
5.2.2.	Insect as bio control agents - <i>Egg parasitoid, Trichogramma</i>		K2

5.3	Biological control of plant pathogens.	<ul style="list-style-type: none"> <li>Importance of biopiracy and IPR in ethnobotany</li> <li>Rate the role of biopiracy and IPR in traditional knowledge</li> </ul>	K5 K5
5.4.	Role of phytopesticides in sustainable agriculture.	<ul style="list-style-type: none"> <li>List out the role of phytopesticides in sustainable agriculture</li> </ul>	K4
5.5.	Management of Soil Biota and Their Processes.	<ul style="list-style-type: none"> <li>Explain about the Management of Soil Biota and Their Processes</li> </ul>	K2

### Mapping Scheme for the Course Code: U22BY5:C

U22BY5:C	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	L	L	-	H	L	L	M	M	M	L	L	L
CO2	M	H	L	-	L	-	L	-	-	M	L	L	M
CO3	M	H	M	-	L	M	M	M	L	L	H	L	L
CO4	M	M	H	M	L	M	H	M	M	H	H	L	M
CO5	M	L	M	-	-	L	L	L	M	L	L	M	M
CO6	H	H	M	M	M	M	M	M	M	H	H	H	M

**L-Low (1) M-Medium (2) H-High (3)**

### COURSE ASSESSMENT METHODS:

#### Direct

1. Continuous Assessment by conducting Class test, Group Discussion and Quiz.
2. Assessment also done through Seminar Presentation, submission of Assignments and Model Making and Model exams.
3. End Semester Examination.

#### Indirect

1. Course-end survey

## ELECTIVE (CAC) : COMPETITIVE BOTANY

Semester : V

Course Code: U20CAC5:1

Credits :2

Hours/Week: 3

### Course Outcome

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

No	COURSE OUTCOME (CO)	Level	Unit
CO 1	Develop the skill to crack competitive exams in Listening, reading, learning, problem solving and thinking out of Box.	K6	I - V
CO 2	Choose an appropriate sampling scheme and/or experimental design for a given biological question.	K5	I, - V
CO 3	Apply an appropriate analytical methods to work out the given biological data.	K3	I, - V
CO 4	Demonstrate the necessary skills for biological data management, analysis and graphical presentation.	K2	I - V,
CO 5	Discover their ability to reason both inductively and deductively with experimental information and data.	K4	I - V
CO 6	Summarize and interpret the primary literature in botany.	K2	I - V

### SYLLABUS:

#### Unit 1: Aptitude & Mental Ability Tests, Microbiology and Plant Pathology- 6 Hours

1.1 Conversion of information to data--Collection, Compilation and presentation of data Tables, graphs, diagrams-Analytical interpretation of data.

1.2 Simplification-Percentage-Highest Common Factor (HCF)-Lowest Common Multiple (LCM)-1.3 Ratio and Proportion-Simple interest-Compound interest-Area-Volume-Time and Work

1.4 Decision making and problem solving-Logical Reasoning-Puzzles-Dice-Visual

1.5 Reasoning -Alpha numeric Reasoning- Number Series- Logical Number/ Alphabetical/ Diagrammatic Sequences

1.6 Structure and reproduction/multiplication of viruses, viroids, bacteria, fungi, and mycoplasma;

1.7 Applications of microbiology in agriculture, industry, medicine and in control of soil and water pollution; Prion and Prion hypothesis.

- 1.8 Important crop diseases caused by viruses, bacteria, mycoplasma, fungi, and nematodes; Modes of infection and dissemination;
- 1.9 Molecular basis of infection and disease resistance/ defense; Physiology of parasitism and control measures; Fungal toxins; Modelling and disease forecasting; Plant quarantine.

**Unit II: Cryptogamae, Phanerogamae, Morphogenesis, Plant Resource Development-6 Hours**

2. 1 Algae, fungi, lichens, bryophytes, pteridophytes – structure and reproduction from the evolutionary viewpoint; Distribution of Cryptogams in India and their ecological and economic important.
- 2.2 Gymnosperms: Concept of Progymnosperms; Classification and distribution of gymnosperms; Salient features of Cycadales, Ginkgoales, Coniferales and Gnetales, their structure, and reproduction;
- 2.3 A General account of Cycadofilicales, Bennettitales and Cordaitales; Geological time scale; Type of fossils and their study techniques.
- 2.4 Angiosperms: Systematics, anatomy, embryology, palynology, and phylogeny.
- 2.5 Taxonomic hierarchy; International Code of Botanical Nomenclature; Numerical taxonomy and chemotaxonomy; Evidence from anatomy, embryology, and palynology. Origin and evolution of angiosperms;
- 2.6 Comparative account of various systems of classification of angiosperms; Study of angiospermic families – Magnoliaceae, Ranunculaceae, Brassicaceae, Rosaceae, Fabaceae, Euphorbiaceae, Malvaceae, Dipterocarpaceae, Apiaceae, Asclepiadaceae, Verbenaceae, Solanaceae, Rubiaceae, Cucurbitaceae, Asteraceae, Poaceae, Arecaceae, Liliaceae, Musaceae and Orchidaceae.
- 2.7 Stomata and their types; Glandular and non-glandular trichomes; Unusual secondary growth; Anatomy of C3 and C4 plants; Xylem and phloem differentiation; Wood anatomy.
- 2.8 Development of male and female gametophytes, pollination, fertilization; Endosperm – its development and function; Patterns of embryo development;
- 2.9 Polyembryony and apomixes; Applications of palynology; Experimental embryology including pollen storage and test-tube fertilization.
- 2.10 Domestication and introduction of plants;
- 2.11 Origin of cultivated plants; Vavilov's centres of origin; Plants as sources for food, fodder, fibre, spices, beverages, edible oils, drugs, narcotics, insecticides, timber, gums, resins and dyes, latex, cellulose, starch and its products; Perfumery;
- 2.12 Importance of Ethnobotany in Indian context; Energy plantations; Botanical Gardens and Herbaria.
- 2.13 Totipotency, polarity, symmetry, and differentiation; Cell, tissue, organ and protoplast culture; Somatic hybrids and Cybrids;
- 2.14 Micropropagation; Somaclonal variation and its applications; Pollen haploids, embryo rescue methods and their applications.

**Unit III: Cell Biology, Genetics, Evolution and Plant Breeding, Biotechnology and Biostatistics (6 Hours)**

3. 1 Techniques of cell biology; Prokaryotic and eukaryotic cells – structural and ultra-structural details; Structure and function of extracellular matrix (cell wall), membranes-cell adhesion, membrane transport and vesicular transport;
- 3.2 Structure and function of cell organelles (chloroplasts, mitochondria, ER, dictyosomes, ribosomes, endosomes, lysosomes, peroxisomes); Cytoskeleton and microtubules; Nucleus, nucleolus, nuclear pore complex; Chromatin and nucleosome;
3. 3 Cell signalling and cell receptors; Signal transduction; Mitosis and meiosis;

3.4 Molecular basis of cell cycle; Numerical and structural variations in chromosomes and their significance; Chromatin organization and packaging of genome; Polytene chromosomes; B-chromosomes – structure, behaviour and significance.

3.5 Development of genetics; Gene versus allele concepts (Pseudoalleles); Quantitative genetics and multiple factors; Incomplete dominance, polygenic inheritance, multiple alleles;

3.6 Linkage and crossing over; Methods of gene mapping, including molecular maps (idea of mapping function);

3.7 Sex chromosomes and sex-linked inheritance, sex determination and molecular basis of sex differentiation; Mutations (biochemical and molecular basis);

3.8 Cytoplasmic inheritance and cytoplasmic genes (including genetics of male sterility).

3.9 Structure and synthesis of nucleic acids and proteins; Genetic code and regulation of gene expression; Gene silencing;

3.10 Multigene families; Organic evolution – evidence mechanism, and theories. Role of RNA in origin and evolution.

3.11 Methods of plant breeding – introduction, selection and hybridization (pedigree, backcross, mass selection, bulk method);

3.12 Mutation, polyploidy, male sterility and heterosis breeding; Use of apomixes in plant breeding; DNA sequencing;

3.13 Genetic engineering – methods of transfer of genes; Transgenic crops and biosafety aspects; Development and use of molecular markers in plant breeding; Tools and techniques – probe, southern blotting, DNA fingerprinting, PCR and FISH.

3.14 Standard deviation and coefficient of variation (CV); Tests of significance (Z-test, t-test and chi-square test); Probability and distributions (normal, binomial and Poisson); Correlation and regression.

#### **Unit IV: Physiology and Biochemistry (6 Hours)**

4.1 Water relations, mineral nutrition and ion transport, mineral deficiencies;

4.2 Photosynthesis – photochemical reactions; photo-phosphorylation and carbon fixation pathways; C<sub>3</sub>, C<sub>4</sub> and CAM pathways;

4.3 Mechanism of phloem transport; Respiration (anaerobic and aerobic, including fermentation) – electron transport chain and oxidative phosphorylation; Photorespiration; Chemiosmotic theory and ATP synthesis;

4.4 Lipid metabolism; Nitrogen fixation and nitrogen metabolism; Enzymes, coenzymes; Energy transfer and energy conservation;

4.5 Importance of secondary metabolites; Pigments as photoreceptors (plastidial pigments and phytochrome); Plant movements; Photoperiodism and flowering, vernalization, senescence;

4.6 Growth substances – their chemical nature, role and applications in agri-horticulture; Growth indices, growth movements; Stress physiology (heat, water, salinity, metal); Fruit and seed physiology; Dormancy, storage and germination of seed; Fruit ripening – its molecular basis and manipulation.

#### **Unit V: Ecology and Plant Geography (6 Hours)**

5.1 Concept of ecosystem; Ecological factors; Concepts and dynamics of community; Plant succession;

5.2 Concept of biosphere; Ecosystems; Conservation; Pollution and its control (including phytoremediation); Plant indicators; Environment (Protection) Act.

5.3 Forest types of India – Ecological and economic importance of forests, afforestation, deforestation and social forestry; Endangered plants, endemism, IUCN categories, Red

Data Books; Biodiversity and its conservation; Protected Area Network; Convention on Biological Diversity;

5.4 Farmers' Rights and Intellectual Property Rights; Concept of Sustainable Development; Biogeochemical cycles; Global warming and climatic change; Invasive species; Environmental Impact Assessment; Phytogeo-graphical regions of India.

**TOPICS FOR SELF STUDY:**

Topic	Web links
Mean, Median and mode	<a href="https://en.wikipedia.org/wiki/Mean">https://en.wikipedia.org/wiki/Mean</a> <a href="https://www.khanacademy.org/math/statistics-probability/summarizing-quantitative-data/mean-median-basics/a/mean-median-and-mode-review">https://www.khanacademy.org/math/statistics-probability/summarizing-quantitative-data/mean-median-basics/a/mean-median-and-mode-review</a>
Correlation and deviation	<a href="https://www.statisticshowto.com/probability-and-statistics/correlation-coefficient-formula/">https://www.statisticshowto.com/probability-and-statistics/correlation-coefficient-formula/</a>
population genetics,	<a href="https://en.wikipedia.org/wiki/Population_genetics">https://en.wikipedia.org/wiki/Population_genetics</a>
Lod score,	<a href="https://www.genome.gov/genetics-glossary/LOD-Score">https://www.genome.gov/genetics-glossary/LOD-Score</a>
Mortality and Natality,	<a href="https://en.wikipedia.org/wiki/Natality_in_population_ecology#:~:text=Natality%20in%20population%20ecology%20is,staying%20the%20same%20in%20size.">https://en.wikipedia.org/wiki/Natality_in_population_ecology#:~:text=Natality%20in%20population%20ecology%20is,staying%20the%20same%20in%20size.</a>
SCP	<a href="https://en.wikipedia.org/wiki/Single-cell_protein#:~:text=Single%2Dcell%20proteins%20(SCP),consumption%20or%20as%20animal%20feeds.">https://en.wikipedia.org/wiki/Single-cell_protein#:~:text=Single%2Dcell%20proteins%20(SCP),consumption%20or%20as%20animal%20feeds.</a>
Algal bloom,	<a href="https://en.wikipedia.org/wiki/Algal_bloom">https://en.wikipedia.org/wiki/Algal_bloom</a>
genomics,	<a href="https://en.wikipedia.org/wiki/Genomics">https://en.wikipedia.org/wiki/Genomics</a>
proteomics,	<a href="https://en.wikipedia.org/wiki/Proteomics#:~:text=Proteomics%20is%20the%20large%2Dscale,ever%20increasing%20numbers%20of%20protein.">https://en.wikipedia.org/wiki/Proteomics#:~:text=Proteomics%20is%20the%20large%2Dscale,ever%20increasing%20numbers%20of%20protein.</a>
COVID-19,	<a href="https://en.wikipedia.org/wiki/Coronavirus_disease_2019">https://en.wikipedia.org/wiki/Coronavirus_disease_2019</a>
Swine flu,	<a href="https://en.wikipedia.org/wiki/Swine_influenza">https://en.wikipedia.org/wiki/Swine_influenza</a>
Dengue,	<a href="https://www.cdc.gov/dengue/symptoms/index.html">https://www.cdc.gov/dengue/symptoms/index.html</a>
MAB,	<a href="https://en.wikipedia.org/wiki/Man_and_the_Biosphere_Programme">https://en.wikipedia.org/wiki/Man_and_the_Biosphere_Programme</a>
<i>In situ</i> and <i>ex situ</i> conservation,	<a href="https://www.yourarticlelibrary.com/biodiversity/conservations-of-biodiversity-in-situ-conservation-and-ex-situ-conservation/30144">https://www.yourarticlelibrary.com/biodiversity/conservations-of-biodiversity-in-situ-conservation-and-ex-situ-conservation/30144</a>



Hotspot	<a href="https://en.wikipedia.org/wiki/Biodiversity_hotspot">https://en.wikipedia.org/wiki/Biodiversity_hotspot</a>
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**TEXT BOOK:**

1. Saxena, N. P. 2011. *Objective Botany*, Prakashan Media (P) Ltd, Meerut, U.P, India.
2. Pandey, B. P. 2015. *College Botany Volume –I, II and III*, S. Chand Pvt. Ltd. New Delhi.
3. Kumar and Malik. 2019. *Objective Botany for AIPMET and All other medical examination*, Prakash Publication, Meerut.

**REFERENCE BOOK**

1. Patil, D. A., 2020. *Objective Botany MCQ’s*, Scientific publishers, ISBN: 9789389832761.
2. Hemant Roy, 2016. *Comprehensive MCQ in Biology for competitive Examinations*, Laxmi publication.
3. Gangwar, H.O., 2019. *Objective Biology for NEET, AIIMS and other competitive examinations*. Dinesh Publication Pvt, Ltd. New Delhi.
4. Aggarwal, R.S. 2016. *A modern Approach to verbal and Non-verbal reasoning*. S. Chand Publication, New Delhi.
5. Sijwali and Indu Sijwali. 2018. *A new approach to reasoning verbal, non-verbal and analytical*. Arihant Publishers, New Delhi.
6. Arumugam, N., and Senthil Kumar, P., 2018. *Bio- Botany I mark solved questions*. Saras Publication, Nagar Coil.
7. Pandey, B. P., 2015. *College Botany Volume –I, II and III*, S. Chand Pvt. Ltd. New Delhi.
8. Pandey, S.N, Misra. S.P, Trivedi. P.S. 2002. *A Text Book of Botany*, Vikas Publishing House Pvt. Ltd. New Delhi.

**Web Links:**

- <https://www.classcentral.com/report/swayam-moocs-course-list/>
- <https://www.swayamprabha.gov.in/index.php/program/archive/9>
- <https://swayam.gov.in/NPTEL>

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit/ Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
I	<b>Aptitude &amp; Mental Ability Tests, Microbiology and Plant Pathology</b>		
1.1	Conversion of information to data--Collection, Compilation and presentation of data Tables, graphs, diagrams-Analytical interpretation of data.	<ul style="list-style-type: none"> <li>• Interpret various types of data, graphs, diagram and tables</li> <li>• Find the values rational and irrational</li> </ul>	K5

		numbers	
1.2	Simplification-Percentage-Highest Common Factor (HCF)-Lowest Common Multiple (LCM)	<ul style="list-style-type: none"> <li>• Determine the percentage, HCF and LCM.</li> <li>• Find gain or loss percentage</li> </ul>	K5
1.3	Ratio and Proportion-Simple interest-Compound interest-Area-Volume-Time and Work	<ul style="list-style-type: none"> <li>• Estimate the ratio, volume, time and work</li> <li>• Find the simple and compound interest</li> </ul>	K6
1.4	Decision making and problem solving-Logical Reasoning-Puzzles-Dice-Visual	<ul style="list-style-type: none"> <li>• Compare and contrast between logical and reasoning puzzles</li> <li>• Solve verbal and non verbal reasoning</li> <li>• Identify the statement and conclusion</li> <li>• Which is the following correct position</li> </ul>	K6
1.5	Reasoning -Alpha numeric Reasoning- Number Series- Logical Number/ Alphabetical/ Diagrammatic Sequences	<ul style="list-style-type: none"> <li>• Formulate the alphabetical and logical sequences</li> <li>• Distinguish between local value and face value</li> </ul>	K6
1.6	Structure and reproduction/ multiplication of Viruses, Viroids, Bacteria, Fungi, and Mycoplasma;	<ul style="list-style-type: none"> <li>• Explain various types of reproduction in viruses, bacteria, fungi and mycoplasma.</li> <li>• Consider the statement regarding reproduction in fungi</li> <li>• Identify and label the structure of microbes</li> </ul>	K5

1.7	Applications of microbiology in agriculture, industry, medicine and in control of soil and water pollution; Prion and Prion hypothesis.	<ul style="list-style-type: none"> <li>Utilize the application of microorganisms in agriculture, industry, medicine and environment</li> </ul>	K3
1.8	Important crop diseases caused by viruses, bacteria, mycoplasma, fungi, and nematodes; Modes of infection and dissemination;	<ul style="list-style-type: none"> <li>List out the types of diseases and mode of entry</li> </ul>	K4
1.9	Molecular basis of infection and disease resistance/ defence; Physiology of parasitism and control measures; Fungal toxins; Modelling and disease forecasting; Plant quarantine.	<ul style="list-style-type: none"> <li>Explain the types of infections and control measure</li> </ul>	K5
<b>II Cryptogamae, Phanerogamae, Morphogenesis and Plant Resource Development</b>			
2.1	Algae, Fungi, Lichens, Bryophytes, Pteridophytes – structure and reproduction from the evolutionary viewpoint; Distribution of Cryptogams in India and their ecological and economic important.	<ul style="list-style-type: none"> <li>Discuss the various types structure, reproduction, ecological, phylogenetic and economic importance of Cryptogames.</li> <li>Match the different types fern.</li> <li>Select the incorrect area of distribution of Cryptogames</li> </ul>	K6
2.2	Gymnosperms: Concept of Progymnosperms; Classification and distribution of gymnosperms; Salient features of Cycadales, Ginkgoales, Coniferales and Gnetales, their structure, and reproduction;	<ul style="list-style-type: none"> <li>Explain the anatomical and evolutionary aspects of Gymnosperms.</li> <li>List out the salient feature of Cycas, Ginkgo and Pinus</li> <li>Assess the similarities and dissimilarities with lower and higher forms</li> </ul>	K5
2.3	A General account of Cycadofilicales, Bennettitales and Cordaitales; Geological time	<ul style="list-style-type: none"> <li>Determine the types of fossils, geological time</li> </ul>	K5

	scale; Type of fossils and their study techniques	scale and their study techniques.	
2.4	Angiosperms: Systematics, anatomy, embryology, palynology, and phylogeny.	<ul style="list-style-type: none"> <li>• Explain the types of classification, morphological and phylogenetic variations of angiosperms</li> </ul>	K5
2.5	Taxonomic hierarchy; International Code of Botanical Nomenclature; Numerical taxonomy and chemotaxonomy; Evidence from anatomy, embryology, and palynology. Origin and evolution of angiosperms;	<ul style="list-style-type: none"> <li>• Discuss in details about ICBN and various evidences of taxonomy of flowering plants</li> </ul>	K6
2.6	Comparative account of various systems of classification of angiosperms; Study of angiospermic families – Magnoliaceae, Ranunculaceae, Brassicaceae, Rosaceae, Fabaceae, Euphorbiaceae, Malvaceae, Dipterocarpaceae, Apiaceae, Asclepiadaceae, Verbenaceae, Solanaceae, Rubiaceae, Cucurbitaceae, Asteraceae, Poaceae, Arecaceae, Liliaceae, Musaceae and Orchidaceae.	<ul style="list-style-type: none"> <li>• Compare and contrast between various types of family and genus</li> </ul>	K2
2.7	Stomata and their types; Glandular and non-glandular trichomes; Unusual secondary growth; Anatomy of C3 and C4 plants; Xylem and phloem differentiation; Wood anatomy.	<ul style="list-style-type: none"> <li>• Compare the types of stomata, C3 and C4 plants.</li> <li>• Comment on stomata.</li> <li>• Explain wood anatomy</li> </ul>	K2
2.8	Development of male and female gametophytes, pollination, fertilization; Endosperm – its development and function; Patterns of embryo development	<ul style="list-style-type: none"> <li>• Outline the structure, development, fertilization of male and female gametes.</li> </ul>	K2

2.9	Polyembryony and apomixes; Applications of palynology; Experimental embryology including pollen storage and test-tube fertilization.	<ul style="list-style-type: none"> <li>Utilize the importance of polyembryony and apomixes</li> </ul>	K3
2.10	Domestication and introduction of plants	<ul style="list-style-type: none"> <li>Recall the centre of domestication of plants</li> </ul>	K1
2.11	Origin of cultivated plants; Vavilov's centres of origin; Plants as sources for food, fodder, fibre, spices, beverages, edible oils, drugs, narcotics, insecticides, timber, gums, resins and dyes, latex, cellulose, starch and its products; Perfumery	<ul style="list-style-type: none"> <li>List out the application of plants as source for food</li> </ul>	K4
2.12	Importance of Ethnobotany in Indian context; Energy plantations; Botanical Gardens and Herbaria.	<ul style="list-style-type: none"> <li>List out the application of ethnobotany and botanical Garden</li> </ul>	K4
2.13	Totipotency, polarity, symmetry, and differentiation; Cell, tissue, organ and protoplast culture; Somatic hybrids and Cybrids;	<ul style="list-style-type: none"> <li>Explain the various types of <i>invitro</i> culture methods.</li> </ul>	K4
2.14	Micropropagation; Somaclonal variation and its applications; Pollen haploids, embryo rescue methods and their applications.	<ul style="list-style-type: none"> <li>Recommend the types of micropropagation methods and its uses</li> </ul>	K5
<b>Unit III Cell Biology, Genetics and Evolution and Plant Breeding, Biotechnology and Biostatistics</b>			
3.1	Techniques of cell biology; Prokaryotic and eukaryotic cells – structural and ultra-structural details; Structure and function of extracellular matrix (cell wall), membranes-cell adhesion, membrane transport and vesicular transport;	<ul style="list-style-type: none"> <li>Elaborate the structure and function of prokaryotic and eukaryotic</li> </ul>	K6
3.2	Structure and function of cell organelles (chloroplasts, mitochondria, ER, dictyosomes ribosomes, endosomes, lysosomes, peroxisomes); Cytoskelaton and microtubules; Nucleus, nucleolus, nuclear pore complex; Chromatin and nucleosome;	<ul style="list-style-type: none"> <li>Classify the various and structure and function of cell organelles</li> </ul>	K4

3.3	Cell signalling and cell receptors; Signal transduction; Mitosis and meiosis	<ul style="list-style-type: none"> <li>• Compare the division and signaling of mitosis and meiosis</li> </ul>	K5
3.4	Molecular basis of cell cycle; Numerical and structural variations in chromosomes and their significance; Chromatin organization and packaging of genome; Polytene chromosomes; B-chromosomes – structure, behaviour and significance.	<ul style="list-style-type: none"> <li>• Interpret the various types of chromosomes and its significance</li> </ul>	K5
3.5	Development of genetics; Gene versus allele concepts (Pseudoalleles); Quantitative genetics and multiple factors; Incomplete dominance, polygenic inheritance, multiple alleles;	<ul style="list-style-type: none"> <li>• Compare the inheritance, Allelic and non allelic interaction</li> </ul>	K2
3.6	Linkage and crossing over; Methods of gene mapping, including molecular maps (idea of mapping function);	<ul style="list-style-type: none"> <li>• Summarize the character, types and function of linkage and crossing over</li> </ul>	K2
3.7	Sex chromosomes and sex-linked inheritance, sex determination and molecular basis of sex differentiation; Mutations (biochemical and molecular basis)	<ul style="list-style-type: none"> <li>• Demonstrate the molecular and biochemical basis of sex determination and sex linkage</li> </ul>	K2
3.8	Cytoplasmic inheritance and cytoplasmic genes (including genetics of male sterility).	<ul style="list-style-type: none"> <li>• Prove the extra chromosomal inheritance and male sterility</li> </ul>	K5
3.9	Structure and synthesis of nucleic acids and proteins; Genetic code and regulation of gene expression; Gene silencing;	<ul style="list-style-type: none"> <li>• Explain the genetic code and its regulation of gene expression.</li> </ul>	K5
3.10	Multigene families; Organic evolution – evidence mechanism, and theories. Role of RNA in origin and evolution.	<ul style="list-style-type: none"> <li>• Prove the organic theories of evolution and RNA.</li> </ul>	K5
3.11	Methods of plant breeding – introduction, selection and hybridization (pedigree, backcross, mass selection, bulk method);	<ul style="list-style-type: none"> <li>• Discuss various types traditional and conventional methods of breeding</li> </ul>	K6

3.11	Mutation, polyploidy, male sterility and heterosis breeding; Use of apomixes in plant breeding; DNA sequencing	<ul style="list-style-type: none"> <li>Differentiate between mutation and heterosis</li> </ul>	K4
3.12	Genetic engineering – methods of transfer of genes; Transgenic crops and biosafety aspects; Development and use of molecular markers in plant breeding; Tools and techniques – probe, southern blotting, DNA fingerprinting, PCR and FISH.	<ul style="list-style-type: none"> <li>Explain the various types of gene transfer methods and biosafety</li> </ul>	K4
3.13	Standard deviation and coefficient of variation (CV); Tests of significance (Z-test, t-test and chi-square test); Probability and distributions (normal, binomial and Poisson); Correlation and regression.	<ul style="list-style-type: none"> <li>Estimate the standard deviation, coefficient and probability</li> </ul>	K6

#### **IV Physiology and Biochemistry**

4.1	Water relations, mineral nutrition and ion transport, mineral deficiencies;	<ul style="list-style-type: none"> <li>List out the major and minor nutrients and their application and deficiencies</li> </ul>	K1
4.2	Photosynthesis – photochemical reactions; photo-phosphorylation and carbon fixation pathways; C3, C4 and CAM pathways	<ul style="list-style-type: none"> <li>Demonstrate photosynthesis and C3, C4 and CAM pathways</li> </ul>	K2
4.3	Mechanism of phloem transport; Respiration (anaerobic and aerobic, including fermentation) – electron transport chain and oxidative phosphorylation; Photorespiration; Chemiosmotic theory and ATP synthesis;	<ul style="list-style-type: none"> <li>Elaborate the process of, respiration, photorespiration and chemiosmotic theory</li> </ul>	K6
4.4	Lipid metabolism; Nitrogen fixation and nitrogen metabolism; Enzymes, coenzymes; Energy transfer and energy conservation;	<ul style="list-style-type: none"> <li>Importance of Lipid metabolism and Nitrogen fixation</li> </ul>	K5
4.5	Importance of secondary metabolites; Pigments as photoreceptors (plastidial pigments and phytochrome); Plant movements; Photoperiodism and	<ul style="list-style-type: none"> <li>Determine the importance of secondary metabolites</li> </ul>	K5

	flowering, vernalization, senescence	<p>and pigments.</p> <ul style="list-style-type: none"> <li>• Explain Plant movement, photoperiodism, vernalization and senescence</li> </ul>	
4.6	Growth substances – their chemical nature, role and applications in agri-horticulture; Growth indices, growth movements; Stress physiology (heat, water, salinity, metal); Fruit and seed physiology; Dormancy, storage and germination of seed; Fruit ripening – its molecular basis and manipulation.	<ul style="list-style-type: none"> <li>• Influence of growth substance their role and application.</li> <li>• Evaluated the seed physiology, dormancy and fruit ripening</li> </ul>	K5
<b>V Ecology and Plant Geography</b>			
5.1	Concept of ecosystem; Ecological factors; Concepts and dynamics of community; Plant succession;	<ul style="list-style-type: none"> <li>• Recall the concepts of ecosystem, dynamics of community and succession</li> </ul>	K1
5.2	Concept of biosphere; Ecosystems; Conservation; Pollution and its control (including phytoremediation); Plant indicators; Environment (Protection) Act.	<ul style="list-style-type: none"> <li>• Illustrate various types of biosphere, pollution and its control</li> </ul>	K2
5.3	Forest types of India – Ecological and economic importance of forests, afforestation, deforestation and social forestry; Endangered plants, endemism, IUCN categories, Red Data Books; Biodiversity and its conservation; Protected Area Network; Convention on Biological Diversity;	<ul style="list-style-type: none"> <li>• Explain the types of forest and their conservation network.</li> <li>• Discuss Importance of forest and social forest.</li> </ul>	K5 K2
5.4	Farmers' Rights and Intellectual Property Rights; Concept of Sustainable Development; Biogeochemical cycles; Global warming and climatic change; Invasive species; Environmental Impact Assessment; Phytogeo-	<ul style="list-style-type: none"> <li>• Discuss the role of IPR and their function.</li> <li>• Solve issues of global warming and climatic</li> </ul>	K6



	graphical regions of India.	changes	
		<ul style="list-style-type: none"> <li>Define phytogeographical region of India.</li> </ul>	

### Mapping Scheme for the Course Code: U20CAC5:1

U20CAC 5:1	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	-	H	L	M	H	L	L	M	M	L	H	-
CO2	H	M	L	-	-	L	L	-	L	H	M	H	-
CO3	H	L	-	M	L	-	M	-	M	H	L	H	H
CO4	H	L	L	-	M	-	-	-	M	M	-	H	H
CO5	M	L	-	M	-	L	M	L	-	M	H	-	L
CO6	M	-	-	L	L	M	L	L	M	-	-	L	-

L-Low (1) M-Medium (2) H-High (3)

#### Assessment / Evaluation:

1. Continuous Assessment by conducting Model Exams, Demonstration Experiments, Written test on Protocols.
2. End Semester Practical Examination

### SBEC I – MUSHROOM AND NURSERY TECHNOLOGY

Semester : V  
Credits : 2

Course Code : U20BYPS1  
Hours/Week : 2

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Explain the general information about mushrooms including edible and poisonous mushroom	K5	I
CO 2	Design and develop various technology for mushroom cultivation	K6	II
CO 3	Analyze post harvesting of mushroom and making up recipes using mushroom	K4	III
CO 4	Discuss concepts in nursery technology.	K5	IV
CO 5	Construction of nursery and greenhouse using various technology	K6	V

<b>CO 6</b>	Develop Entrepreneurship skill by understanding the cultivation and development technology for	K6	IV,V
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**SYLLABUS:**

**Unit I: INTRODUCTION TO MUSHROOMS (6 Hours)**

- 1.1 Introduction and Systematic position
- 1.2. Structure of mushroom
- 1.3. Types of mushrooms- Edible mushroom - (a)Definition(b) Cultivation of Edible of mushroom- Poisonous mushroom -(a) Introduction(b) Definition
- 1.4 Identification of edible and poisonous Mushrooms - Physical and Chemical method
- 1.5 Nutrient values of edible mushroom
- 1.6 Life cycle
- 1.7 Economic values

**Unit II: CULTIVATION OF MUSHROOMS (6 Hours)**

- 2..1 Mushroom cultivation - Compost beds, Spawn types, Production and management of Spawn, Spawn running
- 2.2 Disease and pest management – Insects, Nematodes, Mites, Virus, Bacteria and Fungi
- 2.3 Harvesting methods

**Unit III: MUSHROOMS –POST HARVEST AND PROCESSING (6 Hours)**

- 3.1 Post harvesting technology – Cleaning, Freezing, Freeze drying, Packing and Marketing
- 3.2 Mushroom recipes preparation – Pickle, Soup, Gravy and Biryani

**Unit IV: BASIC CONCEPTS AND TECHNIQUES OF NURSERY TECHNOLOGY – (6 Hours)**

- 4.1 Nursery technology – Introduction, Definition
- 4.2 Methods of Propagation- Sexual Propagation -Vegetative Propagation –(a) Cuttings- (i) Stem cuttings–Hibiscus (ii) Root cuttings – Rose- (b) Layering -(i) Simple layering, (ii) Air layering – Ixora - (c) Grafting-(i) Inarching – Guava (ii)Wedge grafting - Mango
- 4.3 Garden implements - Garden Hose, Pick Axe, Trenching Hoe, Knapsac sprayer, Mist Chamber, Trowel, Sprinkler, Rose Kittle, Crow Bar, Garden scissor, Grafting Knife, Rake, Sprayer, Pruning saw, Plant cutter

**UNIT V: COMPONENTS AND PREPARATION OF NURSERY BED (6 Hours)**

- 5.1Nursery Structures - Store House, Potting, Packing Shed, Nursery bed preparation, Mist chamber, Manures preparation, Compost preparation, Vermicompost preparation

5.2. Green houses for tropical countries - Management, Pot mixture, Pot culture, Maintenance and Marketing of Nursery Stock

**TEXT BOOKS:**

1. Bahl, N. 2002. *Hand book on mushrooms. 4<sup>th</sup> Edition.* Oxford and IBH publishing Co., Pvt. Ltd., New Delhi.
2. Dey, S.C. 2010. *Mushroom growing,* Agrobios (India), Jodhpur.
3. Edmond Musser and Andres. 1957. *Fundamentals of Horticulture.* McGraw Hill Book Co, New Delhi.
4. Gardener. 1996. *Basic Horticulture.* Mac Millan, New York.
5. Kapoor, J.N. 2001. *Mushroom cultivation,* Krishi Bhavan, NewDelhi.
6. Kumar N. 1997. *Introduction to Horticulture.* Rajalakshmi Publications, Nagercoil, India.
7. Lex Lauries and Victor H. Rice. 1979. *Floriculture – fundamentals and practices,* McGraw Hill publishers, New York. Mukherjee. D. 1977. *Gardening in India.* Oxford IBH Publishing Co., New Delhi.
9. Pathak, V.N., Yadav N. and Gaur M. 2010. *Mushroom production and processing Technology* Agrobios (India), Jodhpur.

**REFERENCE BOOKS:**

1. Sharma, V.P. 2006. *Diseases and Pests of Mushrooms,* MIS. IBD Publishers and Distributors, New Delhi.
2. Sharma, O.P. 2003. *Textbook of Fungi,* Tata McGraw Hill Publishing Co., New Delhi.
3. Singh. 2005. *Modern mushroom cultivation.* International book distributors, Dehradun.

**Web link:**

[https://onlinecourses.nptel.ac.in/noc20\\_ce11/preview](https://onlinecourses.nptel.ac.in/noc20_ce11/preview)

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit/ Section	Content	Learning Outcome	Highest Bloom taxonomic level of transaction
<b>1</b>	<b>Introduction to Mushrooms</b>		
1.1	Introduction and Systematic position	<ul style="list-style-type: none"> <li>● Categorize scientific classification of mushroom</li> </ul>	<b>K4</b>
1.2	Structure of mushroom	<ul style="list-style-type: none"> <li>● Discuss and elaborates about various forms of mushroom</li> </ul>	<b>K2</b>

1.3	Types of mushrooms Edible mushroom - (a) Definition(b) Cultivation of Edible of mushroom  Poisonous mushroom -(a) Introduction(b) Definition	<ul style="list-style-type: none"> <li>● Compile and understand the different types of mushroom</li> <li>● Analyze mushroom cultivation techniques</li> <li>● Examine and recognize the poisonous mushroom</li> </ul>	<b>K3</b> <b>K4</b> <b>K4</b>
1.4	Identification of edible and poisonous Mushrooms - Physical and Chemical method	<ul style="list-style-type: none"> <li>● Analyse methods for identifying poisonous mushroom</li> </ul>	<b>K4</b>
1.5	Nutrient values of edible mushroom	<ul style="list-style-type: none"> <li>● Inspect the importance of nutritional values of mushroom</li> </ul>	<b>K4</b>
1.6	Life cycle	<ul style="list-style-type: none"> <li>● Interpret the life cycle of mushroom</li> </ul>	<b>K5</b>
1.7	Economic values	<ul style="list-style-type: none"> <li>● Apply the economic importance of mushroom</li> </ul>	<b>K3</b>
<b>II</b>	<b>Cultivation of Mushrooms</b>		
2.0	Mushroom cultivation - Compost beds, Spawn types, Production and management of Spawn, Spawn running	<ul style="list-style-type: none"> <li>● Develop a concept about a method for mushroom cultivation</li> </ul>	<b>K6</b>
2.1	Disease and pest management – Insects, Nematodes, Mites, Virus, Bacteria and Fungi	<ul style="list-style-type: none"> <li>● Discuss and know the disease and pest management during mushroom cultivation</li> </ul>	<b>K6</b>
2.2	Harvesting methods	<ul style="list-style-type: none"> <li>● Evaluate of harvesting techniques</li> </ul>	<b>K5</b>
<b>III</b>	<b>Mushrooms –Post Harvest and Processing</b>		
3.1	Post harvesting technology – Cleaning, Freezing, Freeze drying, Packing and Marketing	<ul style="list-style-type: none"> <li>● Analyze post-harvesting technology</li> </ul>	<b>K4</b>
3.2	Mushroom recipes preparation – Pickle, Soup, Gravy and Biriyani	<ul style="list-style-type: none"> <li>● Make up various recipes using mushroom</li> </ul>	<b>K3</b>
<b>IV</b>	<b>Basic Concepts and Techniques of Nursery Technology</b>		
4.1	Nursery technology –	<ul style="list-style-type: none"> <li>● Assess new methods in</li> </ul>	<b>K5</b>

	Introduction, Definition	nursery technology	
4.2	Methods of Propagation	<ul style="list-style-type: none"> <li>Analyze various propagation techniques</li> </ul>	<b>K4</b>
4.2	Sexual Propagation	<ul style="list-style-type: none"> <li>Interpret the importance of sexual propagation</li> </ul>	<b>K5</b>
4.2	Vegetative Propagation –(a) Cuttings, (b) Stem cuttings– <i>Hibiscus</i> ,(c) Root cuttings – Rose	<ul style="list-style-type: none"> <li>Make use of plants using numerous vegetative propagation</li> </ul>	<b>K3</b>
4.2	Layering -(a) Simple layering, (b) Air layering – <i>Ixora</i>	<ul style="list-style-type: none"> <li>Explain layering methods</li> </ul>	<b>K5</b>
4.2	Grafting-(a) Inarching – Guava (b)Wedge grafting - Mango	<ul style="list-style-type: none"> <li>Explain grafting method for planting</li> </ul>	<b>K5</b>
4.3	Garden implements - Garden Hose, Pick Axe, Trenching Hoe, Knapsac sprayer, Mist Chamber, Trowel, Sprinkler, Rose Kittle, Crow Bar, Garden scissor, Grafting Knife, Rake, Sprayer, Pruning saw, Plant cutter	<ul style="list-style-type: none"> <li>Recommends tools for gardening</li> </ul>	<b>K5</b>
<b>V</b>	<b>Components and Preparation of Nursery Bed</b>		
5.1	Nursery Structures - Store House, Potting, Packing Shed, Nursery bed preparation, Mist chamber, Manures preparation, Compost preparation, Vermicompost preparation	<ul style="list-style-type: none"> <li>Compose and construct a nursery</li> <li>Explain the various composting techniques.</li> </ul>	<b>K6</b>
<b>5.2</b>	Green houses for tropical countries - Management, Pot mixture, Pot culture, Maintenance and Marketing of Nursery Stock	<ul style="list-style-type: none"> <li>Elaborates greenhouse technology in various countries</li> </ul>	<b>K6</b>

**Mapping Scheme for the Course Code: U20BYPS1**

<b>U20BYPS 1</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>	<b>PSO 4</b>
<b>CO1</b>	-	-	M	-	H	H	H	-	-	-	-	-	M
<b>CO2</b>	-	-	M	-	M	H	L	-	-	-	-	-	L
<b>CO3</b>	L	-	M	-	-	-	-	-	-	-	-	-	L
<b>CO4</b>	-	-	M	-	L	-	M	-	-	-	-	-	L
<b>CO5</b>	L	-	-	-	-	-	M	-	-	-	-	-	L
<b>CO6</b>	-	-	-	L	-	L	L	--	-	-	-	-	L

**Course assessment:**

1. Continuous assessment by seminars, assignments, records.
2. Model exam and End semester exam

**CORE VII- ECOLOGY AND PHYTOGEOGRAPHY**

**Semester : VI**

**Course Code: U20BY607**

**Credits : 6**

**Hours/Week : 6**

**Course Outcomes:**

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

<b>No</b>	<b>COURSE OUTCOME (CO)</b>	<b>Level</b>	<b>Unit</b>
<b>CO 1</b>	Identify the varying environmental factors and its influence on plants	<b>K3</b>	I
<b>CO 2</b>	Analyze Ecological structure of Plant communities in relation with the Abiotic and Biotic factors	<b>K4</b>	II
<b>CO 3</b>	Differentiate the vegetation types of plant communities	<b>K4</b>	III
<b>CO 4</b>	Apply different methods of vegetation studies to analyze the plant communities	<b>K3</b>	III
<b>CO 5</b>	Classify and correlate the Ecological adaptation of Plants	<b>K5</b>	IV
<b>CO 6</b>	Apply principles of biogeography to predict and explain general characteristics of a plant community	<b>K5</b>	V

**Syllabus:**

**Unit I : ENVIRONMENTAL FACTORS**

**(18 Hours)**

- 1.1. Soil, Origin of soil, Soil Profile, Component of Soils, Soil Minerals, Soil Air, Soil, Soil Water, Soil erosion and Soil types of India.
- 1.2. Water, Different Forms of Water, Fresh water and Marine water, Elementary knowledge on Ground and surface water systems
- 1.3. Air, Components of Air and Structure of Atmosphere

**Unit II : ECOLOGY**

**(18 Hours)**

- 2.1. Scope and importance of studying ecology.
- 2.2. Approaches to the study of ecology- Autecology and Synecology
- 2.3. Plants and Environmental factors – Climate, Edaphic, Biotic factors and Topographic factors.
- 2.4. Ecosystem -Types of Ecosystem, Ecological Pyramid, energy flow, Food web- Niche
- 2.5. Community ecology and Population Dynamics.

**Unit III – EVOLUTION OF PLANT COMMUNITY**

**(18 Hours)**

- 3.1. Development of vegetation, Migration, Ecesis and colonization.
- 3.2. Methods of studying vegetation, Physiognomic method, Phytosociological method - Quadrat, transect and Point method, Determination of Density, Frequency and Abundance, Verification of Raunkier’s Law
- 3.4. Plant succession, Hydrosere and Xerosere., Climax Concept
- 3.5. Biome

**Unit IV – PLANT ECOLOGICAL RESPONSE**

**(18 Hours)**

- 4.1. Ecological classification of plants, Hydrophytes, Mesophytes Xerophytes, Epiphytes and Halophytes
- 4.2. Ecological Adaptation of Plants, Morphological and anatomical features of plants and their correlation to their respective Habitats
- 4.3. Plant as Ecological Indicators

**Unit V: PHYTOGEOGRAPHY**

**(18 Hours)**

- 5.1 Definition and importance
- 5.2. Types of distribution of plants (continuous and discontinuous)
- 5.3. Climate of India and climatic zones.
- 5.4. Phytogeographic regions of India
- 5.3. Forest types of India, characterization and its management.
- 5.4. Vegetational types of Tamil Nadu – Evergreen, deciduous, scrub and mangrove.
- 5.5. Conservation of vegetation and its importance

**TOPICS FOR SELF-STUDY:**

Topics	Web Links
Geographic Deltas of India	<a href="https://www.geographynotes.com/landforms/classification-of-deltas-6-types-landforms-geography/2470">https://www.geographynotes.com/landforms/classification-of-deltas-6-types-landforms-geography/2470</a> <a href="https://www.nationalgeographic.org/encyclopedia/delta/">https://www.nationalgeographic.org/encyclopedia/delta/</a>
Climate in India	<a href="https://www.toppr.com/guides/geography/climate/climate-of-india/">https://www.toppr.com/guides/geography/climate/climate-of-india/</a>

	<a href="https://www.newworldencyclopedia.org/entry/Climate_of_India">https://www.newworldencyclopedia.org/entry/Climate_of_India</a>
The Kharif and Rabi Crops in India	<a href="https://www.javatpoint.com/kharif-crops-vs-rabi-crops#:~:text=Major%20Kharif%20crops%20are%20rice,for%20the%20growth%20of%20crops.">https://www.javatpoint.com/kharif-crops-vs-rabi-crops#:~:text=Major%20Kharif%20crops%20are%20rice,for%20the%20growth%20of%20crops.</a> <a href="https://www.drishtias.com/to-the-points/paper3/cropping-patterns-and-major-crops-of-india-part-one">https://www.drishtias.com/to-the-points/paper3/cropping-patterns-and-major-crops-of-india-part-one</a>

**TEXT BOOKS:**

1. Ambasht, R.S. 1974. *Text Book of Plant Ecology* (3rd Edition) Students & Friends Co., Varanasi.
2. Odum, E.P. 1975. *Ecology*, Holt, Rinert & Winston.
3. Kochhar, P.L *Plant Ecology* (9th Edition) S.Nagi& Co, Jullandhar.
4. Cain, S.A. 1944. *Foundations of Plant Geography*, Harper & Brothers N.Y.
5. Sharma, P.D. 1989. *Element of Ecology*. Rastogi Publications, U.K
6. Newman, E.I. 2000. *Applied Ecology*. Blackwell scientific Publishers U.K.

**REFERENCE BOOKS:**

1. Shukla, R.S. and P.S Chandel, 1975. *Plant Ecology & Soil Science*. S. Chand & Co., New Delhi.
2. Mani, M.S. 1974. *Ecology & Biogeography of India*. Dr. W. Junk Publishers, The Hague.
3. Good, R. 1977. *The Geography of the flowering plant* (2nd edition) Longmans Green & Co., Inc. London & Allied Science Publishers, New Delhi.

**WEB LINKS:**

- [https://onlinecourses.nptel.ac.in/noc19\\_ge23/preview](https://onlinecourses.nptel.ac.in/noc19_ge23/preview)  
[https://onlinecourses.swayam2.ac.in/cec19\\_bt03/preview](https://onlinecourses.swayam2.ac.in/cec19_bt03/preview)

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit/Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>I</b>	<b>ENVIRONMENTAL FACTORS</b>		
1.1	Soil Origin, Profile, Component, Soil erosion and management and Types of Soils in India.	<ul style="list-style-type: none"> <li>• Define the soil formation and its characteristics.</li> <li>• Explain various zones of soil profile</li> <li>• Classify the various types of soils</li> </ul>	K1 K2 K2
1.2	Water, Different Forms of Water, Fresh water and Marine water, Elementary knowledge on Ground and surface water systems	<ul style="list-style-type: none"> <li>• recall and explain the different forms of water in earth</li> <li>• apply the knowledge on ground water systems for proper use.</li> </ul>	K2 K3



1.3	Air and its Components Structure of Atmosphere	<ul style="list-style-type: none"> <li>• classify the various components of Air.</li> <li>• outline the structure of Atmosphere and its nature</li> </ul>	K2 K2
<b>II</b>	<b>ECOLOGY</b>		
2.1	Scope and importance of studying ecology.	<ul style="list-style-type: none"> <li>• explain the importance of Ecology</li> <li>• make use of the various scopes in Ecology</li> </ul>	K2 K3
2.2	Approaches to the study of ecology, Autecology Synecology	<ul style="list-style-type: none"> <li>• relate the different studies in ecology.</li> </ul>	K2
2.3	Plants and Environmental factors Climate, Topographic factors, Edaphic factors, Plants and Biotic factors	<ul style="list-style-type: none"> <li>• compare the distribution of plants in relation with their environmental factors</li> <li>• explain the various interaction of with its biotic factors</li> </ul>	K4 K2
2.4	Ecosystem -Types of Ecosystem, Ecological Pyramid, energy flow, Food web - Niche	<ul style="list-style-type: none"> <li>• illustrate the structure and function of different ecosystem</li> </ul>	K2
2.5.	Community ecology and Population Dynamics.	<ul style="list-style-type: none"> <li>• Analyze the natality, mortality, productivity of a population.</li> </ul>	K4
<b>III</b>	<b>EVOLUTION OF PLANT COMMUNITY</b>		
3.1	Development of vegetation, Migration, Ecesis and colonization.	<ul style="list-style-type: none"> <li>• demonstrate the development of vegetation</li> </ul>	K2
3.2	Methods of studying vegetation, Physiognomic method, Phytosociological method, Quadrat, transect and Point method, Determination of Density, Frequency and Abundance, Verification of Raunkier's Law	<ul style="list-style-type: none"> <li>• apply different methods of vegetation studies in Field</li> <li>• interpret the data obtained from vegetation studies.</li> </ul>	K3 K4

3.3	Plant succession, Hydrosere and Xerosere. Climax Concept, Biome  3.2. Methods of studying vegetation, Physiognomic method, Phytosociological method - Quadrat, transect and Point method, Determination of Density, Frequency and Abundance, Verification of Raunkier's Law 3.4. Plant succession, Hydrosere and Xerosere., Climax Concept 3.5. Biome	<ul style="list-style-type: none"> <li>summarize the various concepts of plant succession</li> <li>Distinguish the different stage of plant succession</li> </ul>	K2  K4
<b>IV</b>	<b>PLANT ECOLOGICAL RESPONSE</b>		
4.1	Ecological classification of plants, Hydrophytes, Xerophytes, Epiphytes, Halophytes	<ul style="list-style-type: none"> <li>classify the plants based on their habitats</li> </ul>	K2
4.2	Ecological Adaptation of Plants, Morphological and anatomical features of plants and their correlation to their respective Habitats	<ul style="list-style-type: none"> <li>explain the adaptation of plants in relation with their habitat.</li> <li>examine morphological and anatomical modification of plants in different environmental condition.</li> </ul>	K2  K5
4.3	Plant as ecological Indicator	<ul style="list-style-type: none"> <li>Define the importance of plants as the ecological indicator.</li> </ul>	K5
<b>V</b>	<b>PHYTOGEOGRAPHY</b>		
5.1	Phytogeography Definition and importance, Types of distribution of plants (continuous and discontinuous)	<ul style="list-style-type: none"> <li>categorize the different Phytogeographic regions.</li> <li>explain the distribution of plants</li> </ul>	K4  K2
5.2	Climate of India and climatic zones. Phytogeographic regions of India	<ul style="list-style-type: none"> <li>Summarize the phytogeographic regions of India</li> </ul>	K2
5.3	Forest types of India, characterization and its management, -Vegetational types of Tamil Nadu – Evergreen, deciduous, scrub and mangrove.	<ul style="list-style-type: none"> <li>Classify the vegetation types based on the component of the forests</li> </ul>	K4

5.4	Conservation of vegetation and its importance	<ul style="list-style-type: none"> <li>choose appropriate conservation strategies for the conservation of vegetation</li> </ul>	K5
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### Mapping Scheme for the Course Code: U20BY607

U20BY607	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	L	M	-	H	M	-	-	-	H	-	-	-
CO2	M	-	M	-	H	-	-	-	H	H	-	-	-
CO3	H	-	-	-	L	L	-	M	H	M	-	-	-
CO4	H	M	-	-	L	L	H	-	M	-	L	-	H
CO5	H	L	L	-	M	-	-	-	M	M	-	-	M
CO6	H	M	-	-	-	-	-	M	H	L	L	-	-

L-Low (1) M-Medium (2) H-High (3)

### COURSE ASSESSMENT METHODS:

#### Direct

**Continuous Assessment in Practical works, sectioning, record submission.  
Class tests, Model Exams.  
End Semester Examination**

#### Indirect

1. Course-end survey

## CYTOLOGY AND MOLECULAR BIOLOGY

Semester : VI  
Credits : 5

Course Code: U20BY608  
Hours/Week:6

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

No	COURSE OUTCOME (CO)	Level	Unit
CO 1	Determine the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles	K5	I
CO 2	Discuss the Nucleus, chromosomes and cell divisions	K6	II
CO 3	Explain the multiplication of DNA	K5	III
CO 4	Discuss the process of gene regulation	K6	IV
CO 5	Choose appropriate markers of gene cloning	K6	V
CO 6	Compare the gene modification and importance of wild varieties.	K5	V

## **SYLLABUS:**

### **UNIT I- CELL AND ITS INCLUSIONS**

**(18 Hours)**

- 1.1 History of cell biology cell as basic unit of life, cell theory, protoplasm theory and organismal theory
- 1.2 Cell- Definition and types- Prokaryotic cell and Eukaryotic cells and their similarities and differences
- 1.3 Cell Wall- Bacterial (a) Gram positive and (b) Gram negative cell wall- Plant cell wall – Ultra structure and functions
- 1.4 Cytoplasm- physical, chemical and biological properties
- 1.5 Plasma membrane – Ultra structure, Models (Sand wich and Fluid mosaic model) function - Cytoskeleton structure – microtubules, microfilaments, intermediate filament.
- 1.6 Mitochondria- ultra structure and functions
- 1.7 Plastids- Types and functions
- 1.8 Chloroplasts – distribution, Ultra structure and functions
- 1.9 Endoplasmic Reticulum – Ultrastructure, types and functions
- 1.10 Golgi Apparatus – Ultrastructure and functions
- 1.11 Ribosomes- Ultrastructure and function
- 1.12 Microbodies (peroxysomes and glyoxysomes), vacuoles

### **Unit – II- NUCLEUS AND CELL DIVISION**

**(18 Hours)**

- 2.1 Nucleus – Ultra structure and functions
- 2.2 Chromosomes- types - Euchromatin and Heterochromatin (a) Facultative and (b) Constitutive heterochromatin
- 2.3 Special types of Chromosomes- (a) Lamp-brush chromosomes (b) Polytene chromosomes
- 2.4 Ribonucleic acid - mRNA, rRNA, tRNA – Clover leaf model
- 2.5 Chromosomes- definition, types. Special type of Chromosomes.
- 2.6 Cell division- Amitosis, Mitosis and Meiosis- Occurrence, Processes and Significances.

### **Unit III- Introduction to Molecular Biology**

**(18 Hours)**

- 3.1-Discovery of DNA as genetic material- Griffith's experiment- Hershy and Chase warring blender experiment -Chargaff's rule,
- 3.2- Genetic molecules- (a) DNA- Structure (Watson and Crick Model)- Properties- Types (Nuclear, mitochondrial), Forms (A-DNA, B-DNA, c-DNA, Z-DNA). – (b) RNA- Structure, Types and Functions- (c) Proteins
- 3.3- Central dogma- One gene-one enzyme hypothesis

### **Unit VI- Gene regulation**

**(18 Hours)**

- 4.1-Basic mechanism of replication of DNA- replication fork, primer binding, initiation and elongation- Transcription- initiation, elongation and synthesis - translation in plant cells- Enzymes related to DNA synthesis - Reverse transcription.
- 4.2- Gene regulation in prokaryotes and eukaryotes - positive regulation, negative regulation, attenuation- gene regulation in lambda phage life cycle - RNA processing and post transcriptional regulation.
- 4.3- Plasmids-various forms (F-plasmid, R-plasmid, Ti-plasmid, virulence, col plasmids) - DNA Cloning and Gene therapy - Vectors for DNA cloning- Recombinant DNA Technology-its applications.

**Unit-V Transcriptional And Translational Regulation (18 Hours )**

- 5.1- Eukaryotic transcription factors, enhancers, silencers, insulators, chromatin structure and gene regulation,
- 5.2- Translational regulation in prokaryote and eukaryotes - Post translational modification and protein stability - PCR- definition, applications
- 5.3- Molecular markers- RAPD, AFLP, AFLP, Microsatellite - Gene silencing- Genetically modified crops- its benefits and drawbacks- GURT.

**TOPICS FOR SELF STUDY:**

Topics	Reference Book/Web Links
Cell Junction	<a href="https://www.ncbi.nlm.nih.gov/books/NBK26857/">https://www.ncbi.nlm.nih.gov/books/NBK26857/</a> <a href="https://courses.lumenlearning.com/boundless-ap/chapter/cell-junctions/">https://courses.lumenlearning.com/boundless-ap/chapter/cell-junctions/</a>
DNA damage	<a href="https://www.intechopen.com/books/new-research-directions-in-dna-repair/dna-damage-dna-repair-and-cancer#:~:text=DNA%20damage%20is%20a%20change,chains%20of%20the%20DNA%20strands.">https://www.intechopen.com/books/new-research-directions-in-dna-repair/dna-damage-dna-repair-and-cancer#:~:text=DNA%20damage%20is%20a%20change,chains%20of%20the%20DNA%20strands.</a>
Gap Junction	<a href="https://biologydictionary.net/gap-junction/">https://biologydictionary.net/gap-junction/</a> <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2742079/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2742079/</a>
Chemokines	<a href="https://biologydictionary.net/chemokines/">https://biologydictionary.net/chemokines/</a>
Cytolysis	<a href="https://biologydictionary.net/cytolysis/">https://biologydictionary.net/cytolysis/</a>
Anticodon	<a href="https://biologydictionary.net/anticodon/">https://biologydictionary.net/anticodon/</a>
Transferrin	<a href="https://www.ncbi.nlm.nih.gov/books/NBK532928/#:~:text=Transferrin%20is%20a%20blood%20Dplasma,liver%2C%20spleen%20and%20bone%20marrow">https://www.ncbi.nlm.nih.gov/books/NBK532928/#:~:text=Transferrin%20is%20a%20blood%20Dplasma,liver%2C%20spleen%20and%20bone%20marrow</a>

**TEXT BOOKS:**

1. Verma P.S. and Agarwal V.K. 2016. *Cell Biology (Cytology, Biomolecules, Molecular Biology)*, Paperback, S. Chand and Company Ltd.
2. Kumar P. and Mina U. 2018. *Life Sciences: Fundamentals and Practice, Part-I, 6th Edn.*, Pathfinder Publication. p.608.
3. Hardin. J. and Bertoni. G. 2017. *Becker’s World of the Cell. 9<sup>th</sup> Edn (Global Edition)*. Pearson Education Ltd., p. 923

**REFERENCE BOOKS:**

1. Karp. G, Iwasa J. and Masall W. 2015. *Karp's Cell and Molecular Biology – Concepts and Experiments*. 8<sup>th</sup> Edn. John Wiley and Sons. p.832.
2. Cooper G.M. 2019. *The Cell – A Molecular Approach, 8<sup>th</sup> Edn.*, Sinauer Associates Inc., Oxford University Press p.8
3. J.D.Watson .*Molecular biology of gene*, Pearson Publications, ISBN-10 : 0321507819,
4. Benjamin Lewin, *Gene VIII*, Pearson Publications, ISBN-13 : 978-0131439818
5. Friefelder David. 1983. *Applications to Biochemistry and Molecular Biology*, , W.H Freeman and Co Publishing Pvt. Ltd., ISBN-13 : 978-0716713159
6. Rasthogi. R.C. *Molecular Biology- a book review*, CBS Publishing, ISBN-13 : 978-8123913704

**Web Links:**<https://ocw.mit.edu/courses/biology/><https://online-learning.harvard.edu/course/cell-biology-mitochondria>[https://onlinecourses.swayam2.ac.in/cec19\\_bt02/preview](https://onlinecourses.swayam2.ac.in/cec19_bt02/preview)**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit/ Section	Content	Learning Outcome	Highest Blooms taxonomic level of transaction.
<b>I</b>	<b>CYTOLOGY</b>		
1.1	History of cell biology cell as basic unit of life, cell theory, protoplasm theory and organismal theory	<ul style="list-style-type: none"> <li>Recall the cell theory, protoplasm theory and organismal theory</li> </ul>	K2
1.2	Cell- Definition and types- Prokaryotic cell and Eukaryotic cells and their similarities and differences	<ul style="list-style-type: none"> <li>Compare the Prokaryotic cell and Eukaryotic cells and their similarities and differences</li> </ul>	K4
1.3	Plant cell wall – Ultra structure and functions	<ul style="list-style-type: none"> <li>Dissect the plant cell and its structure</li> </ul>	K4
1.4	Cytoplasm- physical, chemical and biological properties	<ul style="list-style-type: none"> <li>Examine the Cytoplasm- physical, chemical and biological properties</li> </ul>	K4
1.5	Plasma membrane – Ultra structure, Models (Sandwich and Fluid mosaic model) functions - Cytoskeleton structure – microtubules, microfilaments, intermediate filament.	<ul style="list-style-type: none"> <li>Discuss the Plasma membrane – Ultra structure, Models (Sandwich and Fluid mosaic model) functions</li> </ul>	K2
1.6	Mitochondria- ultra structure and functions	<ul style="list-style-type: none"> <li>Analyze Mitochondria, its ultra structure and functions</li> </ul>	K4
1.7	Plastids- Types and functions	<ul style="list-style-type: none"> <li>Interpret the types and functions of plastids</li> </ul>	K5
1.8	Chloroplasts– distribution, Ultra structure and functions	<ul style="list-style-type: none"> <li>Explain the distribution, Ultra structure and functions Chloroplasts</li> </ul>	K2
1.9	Endoplasmic Reticulum – Ultra structure,	<ul style="list-style-type: none"> <li>Illustrate the</li> </ul>	K2

	types and functions	Endoplasmic Reticulum Ultra structure, types and functions	
1.10	Golgi Apparatus – Ultra structure and functions Ribosomes- Ultra structure and function	<ul style="list-style-type: none"> <li>Infer the Golgi Apparatus – Ultra structure and functions, Ribosomes- Ultra structure and function</li> </ul>	K2
1.11	Microbodies (peroxysome glyoxysomes), vacuoles	<ul style="list-style-type: none"> <li>Compare the peroxisomes, glyoxysomes and vacuoles</li> </ul>	K5
<b>II</b>	<b>NUCLEUS AND CELL DIVISION</b>		
2.1	<b>Nucleus</b> – Ultra structure and functions	<ul style="list-style-type: none"> <li>Interpret the Ultra structure and functions</li> </ul>	K2
2.2	Chromosomes- types – Euchromatin and Heterochromatin (a) Facultative and (b) Constitutive heterochromatin	<ul style="list-style-type: none"> <li>Identify the chromosomes in a cell</li> </ul>	K3
2.3	Special types of Chromosomes- (a) Lampbrush chromosomes (b) Polytene chromosomes	<ul style="list-style-type: none"> <li>Distinguish the chromosome types</li> </ul>	K4
2.4	Ribonucleic acid- mRNA, rRNA, tRNA Clover leaf model Chromosomes	<ul style="list-style-type: none"> <li>Explain the RNA structure</li> </ul>	K5
2.5	Cell division- Amitosis, Mitosis and Meiosis- Occurrence, Processes and Significances.	<ul style="list-style-type: none"> <li>Compile the cell division and its significance</li> </ul>	K6
<b>III</b>	<b>INTRODUCTION TO MOLECULAR BIOLOGY</b>		
3.1	Discovery of DNA as genetic material - Griffith's experiment, Harshy-Chase experiment - Chargoff rule	<ul style="list-style-type: none"> <li>Summarise the experiments conducted on DNA</li> </ul>	K2
3.2	Genetic Molecules -DNA- Structure (Watson and Crick)- Properties- Types (Nuclear, mitochondrial), Forms (A-DNA, B-DNA, c-DNA, Z-DNA). - RNA- Structure, Types and Functions.	<ul style="list-style-type: none"> <li>Recall the DNA molecular structure</li> <li>Compare the different types of genetic material.</li> <li>Identify the RNA forms</li> </ul>	K2 K2 K3
3.3	DNA replication- mechanism- semi conservative method - Meselson and Stahl's Experiment, Rolling circle mechanism. - DNA polymerase I, II, III, Topoisomerase, SSB protein. - Origin of replication- replication fork,	<ul style="list-style-type: none"> <li>Interpret the enzymes related to DNA multiplication.</li> <li>Explain the mechanism of DNA multiplication</li> </ul>	K2 K5

	leading strands, lagging strands, Okasaki fragments	<ul style="list-style-type: none"> <li>List out the enzymes related to DNA multiplication</li> </ul>	K4
<b>IV</b>	<b>GENE REGULATIONS</b>		
4.0	Central dogma of molecular biology - Prokaryotic transcription	<ul style="list-style-type: none"> <li>Explain the process of gene regulation</li> </ul>	K2
4.1	(a) RNA polymerase in prokaryotes, (b) Transcription unit, (c) recognition of promoter region, (d) Initiation of polynucleotide chain (e) Elongation of RNA polynucleotide (f) Termination.	<ul style="list-style-type: none"> <li>Elaborate the various steps in eukaryotic and prokaryotic gene regulation</li> </ul>	K6
4.2	Eukaryotic Transcription –factors. - RNA Polymerase I, II, III- Role in transcription. -Gene regulation- Lac Operon, Tryptophan operon, attenuation, -RNA processing and post transcriptional regulation. -Translation process in Prokaryote and Eukaryote- Initiation, Elongation, Termination	<ul style="list-style-type: none"> <li>Discuss the process of gene regulation</li> <li>Examine the transcriptional and translational process</li> </ul>	K6 K5
<b>V</b>	<b>APPLICATIONS OF MOLECULAR BIOLOGY</b>		
5.1	Restriction enzymes, Ligase	<ul style="list-style-type: none"> <li>Interpret the enzymes related to gene multiplication</li> </ul>	K2
5.2	Vectors for DNA cloning, Genomic and c-DNA libraries	<ul style="list-style-type: none"> <li>Evaluate the vectors related to genetic cloning</li> </ul>	K5
5.3	Recombinant DNA Technology-its applications.	<ul style="list-style-type: none"> <li>Illustrate the genetic cloning and the application in various studies</li> </ul>	K2
5.4	Blotting Techniques- Southern, Northern, Western blotting	<ul style="list-style-type: none"> <li>Defend the techniques related to Genetic molecule identification</li> </ul>	K5
5.5	Molecular markers- PCR, RFLP, RAPD- Principles, Applications.	<ul style="list-style-type: none"> <li>Examine the genetic product after PCR and choose the primers related to the experiment.</li> </ul>	K5
5.6	DNA Fingerprinting.	<ul style="list-style-type: none"> <li>Analyze the importance of DNA studies in various fields of identification, forensic and molecular identity</li> </ul>	K4
5.7	Genetically modified crops- Benefits and	<ul style="list-style-type: none"> <li>Value the</li> </ul>	K5



	drawbacks.	application of gene manipulation and its significance.	
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**Mapping Scheme for the Course Code: U20BY608**

<b>U20BY608</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>	<b>PSO 4</b>
<b>CO1</b>	H	M	-	M	-	-	M	-	-	H	-	H	-
<b>CO2</b>	H	M	-	H	-	-	L	-	-	-	-	H	-
<b>CO3</b>	H	-	L	H	M	-	M	M	L	-	-	H	M
<b>CO4</b>	H	-	L	H	-	M	H	H	-	-	M	H	M
<b>CO5</b>	H	-	M	H	L	H	M	H	M	-	M	H	M
<b>CO6</b>	H	-	M	H	L	H	-	H	M	-	M	H	M

L – Low (1) M-Medium (2) H-High (3)

**Assessment / Evaluation:**

1. Continuous Assessment by conducting Model Exams, Demonstration Experiments, Written test on Protocols.
2. Hands on Techniques, Lab Attendance and Practical Record work.
3. End Semester Practical Examination

**Core Practical –VI- ECOLOGY & PHTOGEOGRAPHY, CYTOLOGY & MOLECULAR BIOLOGY**

**Hours/Week: 3**

**Credits: 2**

**Course Code: U20BY6P6**

**Semester: VI**

**Course Outcomes:**

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

<b>No</b>	<b>COURSE OUTCOMES (CO)</b>	<b>LEVEL</b>	<b>UNIT</b>
<b>CO 1.</b>	Explain the importance of food web and organisms in each level	<b>K2</b>	<b>I</b>
<b>CO 2</b>	Identify the process of ecological succession	<b>K3</b>	<b>I</b>
<b>CO 3</b>	Determine the importance of soil microbes and quality of soil structure	<b>K5</b>	<b>I</b>
<b>CO 4</b>	Explain the important phyto-geographic zones	<b>K2</b>	<b>II</b>
<b>CO 5</b>	Identify the cell inclusions and its functions	<b>K3</b>	<b>III</b>
<b>CO 6</b>	Explain the structure of cell organelle	<b>K2</b>	<b>III</b>

**SYLLABUS**

**ECOLOGY**

**(24 Hours)**

1. Construct an ecological niche from given set of data (Representation only required, drawing not necessary)- Draw Ecological Pyramids (number, biomass, energy) with given set of data.
2. Study of Morphological and anatomical characteristics of Plant groups:  
Hydrophytes, Xerophytes
3. Study of Plant Communities: Determination of density, abundance, frequency and dominance by quadrat method.
4. Study on edaphic factors: Determination of water and soil pH, Capillarity and Retentivity of soil.
5. Determination of dissolved Oxygen by Winkler's method.
6. Study of Ecosystems -Pond, Grassland, Agricultural land and Scrub vegetation.

### **PHYTOGEOGRAPHY**

**(3 Hours)**

Mark the Phytogeographic zones of India.

Forest management and conservation in Tiger reserve - a case study – Submission of field report.

### **CYTOLOGY**

**(18 Hours)**

1. Study the structure of plant cell through temporary mounts.
2. Study of the structure of cell organelles through photomicrographs.
3. Study of Mitosis- Acetocarmine squash preparation of Onion root tip.
4. Study on Meiosis using Acetocarmine - Submit any two stages for evaluation.

### **TEXT BOOKS:**

1. Shukla, R.S. and P.S Chandel, 1989. *Plant Ecology & Soil Science*. S. Chand & Co., New Delhi.
2. Sharma, P.D. *Element of Ecology*. 1989. Rastogi Publications, U.K.
3. Rekha Arya. 2014. *Unified Practical Botany*. Hindi Sahitya Sadan. ISBN: 81-88388-78

### **REFERENCE BOOKS:**

1. Newman, E.I. 2000. *Applied Ecology*. Blackwell scientific Publishers U.K.
2. P.K. Chhonkar, Bhadrarav. S, Patra. A.K. 2001. *Experiments In Soil Biology And Biochemistry*. Prestige Publishers. India.
3. Huihong Xu, Xiaohua Qian, He Wang, 2020. *Practical Cytopathology*, Springer Publications.

### **Web link:**

<https://www.coursera.org/courses?query=ecology>

<https://www.acsedu.com/courses/cell-biology-877.aspx>

### **TOPICS FOR SELF-STUDY:**

Topics for Self-Study	Reference Link
Law of ten percent	<a href="https://en.wikipedia.org/wiki/Ecological_efficiency">https://en.wikipedia.org/wiki/Ecological_efficiency</a>
BOD, COD	<a href="https://www.usgs.gov/special-topic/water-science-school/science/biological-oxygen-demand-bod-and-water">https://www.usgs.gov/special-topic/water-science-school/science/biological-oxygen-demand-bod-and-water</a>
Staining techniques	<a href="https://courses.lumenlearning.com/microbiology/chapter/staining-microscopic-specimens/">https://courses.lumenlearning.com/microbiology/chapter/staining-microscopic-specimens/</a>

**SPECIFIC LEARNING OUTCOME (SLO):**

Unit/Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>I</b>	<b>ECOLOGY</b>		
1	Food web, Ecological pyramid	<ul style="list-style-type: none"> <li>Explain the importance of levels of organization</li> <li>Relate the organisms</li> </ul>	<b>K2</b>
2	Morphological and anatomical study of plant groups	<ul style="list-style-type: none"> <li>Define the internal structure of plants in special habits</li> <li>Explain the adaptations of plants on specific groups</li> </ul>	<b>K1</b> <b>K2</b>
3	Study of plant communities	<ul style="list-style-type: none"> <li>Analyze the importance of plant community development</li> <li>Explain each communities in a succession</li> </ul>	<b>K4</b> <b>K2</b>
4	Study of edaphic factors	<ul style="list-style-type: none"> <li>Define the importance of soil components</li> <li>Compare the soil components.</li> </ul>	<b>K1</b> <b>K2</b>
5	Study of DO and ecosystems	<ul style="list-style-type: none"> <li>Explain the structure of various ecosytems</li> <li>Analyze the pollution content in an ecosysytem</li> </ul>	<b>K2</b> <b>K4</b>
<b>II</b>	<b>Phytogeography</b>		
1	Mark the phyto-geographic zone of India	<ul style="list-style-type: none"> <li>Explain the different zones</li> </ul>	<b>K2</b>

<b>III</b>	<b>CYTOLOGY</b>		
1	Study of plant cells	<ul style="list-style-type: none"> <li>Explain the structure of plant cells in detail</li> </ul>	<b>K2</b>
2	Study of Mitosis, Meiosis	<ul style="list-style-type: none"> <li>Identify the cell division</li> <li>Explain in detail about the chromosomes, cell multiplication</li> </ul>	<b>K3</b> <b>K2</b>

### Mapping Scheme for the Course Code: U20BY6P6

<b>U20BY6P6</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>	<b>PSO 4</b>
<b>CO1</b>	H	-	M	H	M	-	L	M	H	H	-	-	M
<b>CO2</b>	H	-	M	-	M	H	L	-	-	H	-	M	L
<b>CO3</b>	L	-	-	M	-	-	-	-	-	-	-	-	L
<b>CO4</b>	L	-	M	-	L	-	M	-	-	-	-	-	L
<b>CO5</b>	H	L	-	-	-	-	M	-	-	H	-	H	L
<b>CO6</b>	M	M	-	L	-	L	L	--	-	H	-	H	L

#### COURSE ASSESSMENT METHODS:

##### Direct

**Continuous Assessment in Practical works, sectioning, record submission.**

**Practical tests, Records etc. (as applicable), Class tests, Model Exams.**

**End Semester Examination**

##### Indirect

**1. Course-end survey**

**2. Field studies.**

## Elective-II ETHNOBOTANY

Course code: U22BY6:A

Credits : 5

Semester: VI

Hours/Week : 5

### Course Outcomes:

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

No	COURSE OUTCOME (CO)	Level	Unit
CO 1	Explain the fundamentals of Ethnobotany, life style of ethnic groups and plants used by them	K5	I
CO 2	Explain the methodologies of ethnobotanical studies	K5	II
CO 3	Elaborate the medico-ethnobotanical sources and significances of ethnobotanical practices in India	K6	III
CO 4	Functions of ethnobotany in modern medicines in respect to specific plants, ethnic groups in conservation and forest management	K4	IV
CO 5	Improve ethnobotany as a protecting tool of ethnic groups interest and its legal aspects	K6	V
CO 6	Summarize the role of ethnobotany as a tool of conservation, forest management, medicine, interest of ethnic groups and their legal issues	K6	II -, V

### SYLLABUS:

#### Unit I: Ethnobotany

(15 Hours)

- 1.1. Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science.
- 1.2. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India and their life styles.
- 1.3. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.
- 1.4. An Outline on Indigenous traditional health care systems in India - Ayurveda, Siddha, Unani, Yoga, Naturopathy and Homoeopathy.
- 1.5. Role of AYUSH.

#### Unit II: Methodology of Ethnobotanical studies

(15 Hours)

- 2.1. a) Field work
- 2.2. b) Herbarium
- 2.3. c) Ancient Literature
- 2.4. d) Archaeological findings
- 2.5. e) Temples and sacred places
- 2.6. f) Questionnaire for documentation.

#### Unit III: Role of ethnobotany in Medicine

(15 Hours)

- 3.1. Medico- ethnobotanical sources in India.
- 3.2. Significance of the following plants in ethno botanical practices (along with their habitat and morphology)

3.2 a) *Azadiractha indica* b) *Ocimum sanctum* c) *Vitex negundo* d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*, i) *Andrographis paniculata* j) *Erythrina variegata*.

**Unit IV: Role of ethnobotany in modern medicine and Role of ethnic groups (15 Hours)**

4.1. Role of ethnobotany in modern medicine with special example *Rauwolfia serpentina*, *Trichopus zeylanicus*, *Artemisia*, *Withania*.

4.2. Role of ethnic groups in conservation of plant genetic resources.

4.3. Endangered taxa and forest management (participatory forest management).

**Unit V: Ethnobotany and legal aspects (15 Hours)**

5.1. Ethnobotany as a tool to protect interests of ethnic groups.

5.2. Sharing of wealth concept with few examples from India.

5.3. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

**TOPICS FOR SELF-STUDY:**

Topics	Reference Book/Web Links
Anthropology	<a href="https://anthropology.ucdavis.edu/undergraduate/what-is-anthropology">https://anthropology.ucdavis.edu/undergraduate/what-is-anthropology</a> <a href="https://www.britannica.com/science/anthropology">https://www.britannica.com/science/anthropology</a>
Indigenous Biodiversity	<a href="https://www.nationalgeographic.com/environment/2018/11/can-indigenous-land-stewardship-protect-biodiversity-#:~:text=Comprising%20less%20than%205%25%20of,protect%2080%25%20of%20global%20biodiversity.&amp;text=The%20region%20is%20home%20to,watched%20over%20by%20indigenous%20people">https://www.nationalgeographic.com/environment/2018/11/can-indigenous-land-stewardship-protect-biodiversity-#:~:text=Comprising%20less%20than%205%25%20of,protect%2080%25%20of%20global%20biodiversity.&amp;text=The%20region%20is%20home%20to,watched%20over%20by%20indigenous%20people</a> .
Economic Botany	Verma, V. 1980. <i>A text book of Economic Botany</i> . Emkay Publications, New Delhi. Pandey, B.P. 1999. <i>Economic Botany</i> . S. Chand and Co. New Delhi.

**TEXT BOOK:**

1. Trivedi. P.C. and Niranjana Sharma, 2011. *Text Book of Ethnobotany* (ISBN 10: 8171326552 / ISBN 13: 9788171326556). Pointer Pub Publishers

**REFERENCE BOOKS**

- 1) Jain. S.K. 1995. *Manual of Ethnobotany*, Scientific Publishers, Jodhpur.
- 2) Jain. S.K. (ed.), 1981. *Glimpses of Indian Ethnobotany*, Oxford and I B H, New Delhi.
- 3) Lone *et al*, 1995. *Paleoethnobotany*, Asian Perspectives, Vol. 34, No. 1, pp. 125-127
- 4) Jain. S.K. (ed.) 1989. *Methods and approaches in ethnobotany*. Society of ethnobotanists, Lucknow, India.
- 5) Jain. S.K. 1990. *Contributions of Indian ethnobotany*. Scientific publishers, Jodhpur.
- 6) Colton C.M. 1997. *Ethnobotany – Principles and applications*. John Wiley and sons – Chichester
- 7) Rama Rao, N and Henry A.N. 1996. *The Ethnobotany of Eastern Ghats in Andhra Pradesh, India*. Botanical Survey of India. Howrah.

8) Rajiv K. Sinha. 1996. *Ethnobotany The Renaissance of Traditional Herbal Medicine* – INA –shree Publishers, Jaipur.

**WEB LINK:**

[https://onlinecourses.swayam2.ac.in/cec20\\_bt11/preview](https://onlinecourses.swayam2.ac.in/cec20_bt11/preview)

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>I</b>	<b>Ethnobotany</b>		
1.1	Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science.	<ul style="list-style-type: none"> <li>• Explain ethnobotany as an interdisciplinary science</li> </ul>	K5
1.2	The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles.	<ul style="list-style-type: none"> <li>• Relationship between ethnic groups and ethnobotany</li> <li>• List out the major and minor ethnic groups of India</li> </ul>	K4 K4
1.3	Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.	<ul style="list-style-type: none"> <li>• Categorize the plants used by tribals in India</li> </ul>	K4
1.4	An Outline on Indigenous traditional health care systems in India - Ayurveda, Siddha, Unani, Yoga, Naturopathy and Homoeopathy.	<ul style="list-style-type: none"> <li>• Explain the basics of various medicine systems</li> </ul>	K2
1.5	Role of AYUSH	<ul style="list-style-type: none"> <li>• Define the term</li> </ul>	K1
<b>II</b>	<b>Methodology of Ethnobotanical studies</b>		
2.1	a) Field work	<ul style="list-style-type: none"> <li>• Why field work is mandatory in Ethnobotany?</li> </ul>	K1
2.2.	b) Herbarium	<ul style="list-style-type: none"> <li>• Determine the role of herbarium in Ethnobotany</li> </ul>	K5
2.3.	c) Ancient Literature	<ul style="list-style-type: none"> <li>• Examine the Importance of ancient literature in ethnobotany</li> </ul>	K5
2.4.	d) Archaeological findings	<ul style="list-style-type: none"> <li>• Explain the role of archaeological findings in ethnobotany</li> </ul>	K2
2.5.	e) temples and sacred places	<ul style="list-style-type: none"> <li>• Discuss the role of sacred groves and temples in the conservation of plants</li> </ul>	K6
2.6.	f) Questionnaire for documentation.	<ul style="list-style-type: none"> <li>• Interviewing method for documentation in ethnobotany.</li> </ul>	K3

III		Role of ethnobotany in Medicine	
3.1.	Medico- ethnobotanical sources in India.	<ul style="list-style-type: none"> <li>Interpret the medico-ethnobotanical sources in India</li> </ul>	K5
3.2.	Significance of the following plants in ethno botanical practices (along with their habitat and morphology)	<ul style="list-style-type: none"> <li>Justify the significances of plants in ethnobotanical practices</li> </ul>	K5
3.2.1.	a) <i>Azadiractha indica</i> b) <i>Ocimum sanctum</i> c) <i>Vitex negundo</i> d) <i>Gloriosa superba</i> e) <i>Tribulus terrestris</i> f) <i>Pongamia pinnata</i> g) <i>Cassia auriculata</i> h) <i>Indigofera tinctoria</i> . <i>Andrographis paniculata</i> j) <i>Erythrina variegata</i> .	<ul style="list-style-type: none"> <li>Identify the ethnobotanical value of these plants.</li> <li>List out the medicinal uses of this plants</li> <li>Compare these plants with their habitat and morphology</li> </ul>	K3 K4 K4
IV		Role of ethnobotany in modern medicine and Role of ethnic groups	
4.1	Role of ethnobotany in modern medicine with special example <i>Rauwolfia serpentina</i> , <i>Trichopus zeylanicus</i> , <i>Artemisia</i> , <i>Withania</i> .	<ul style="list-style-type: none"> <li>Discuss the ethnobotanical role of these plants in modern medicine</li> </ul>	K6
4.2.	Role of ethnic groups in conservation of plant genetic resources.	<ul style="list-style-type: none"> <li>Elaborate the role of ethnic groups in conservation of plant genetic resources</li> </ul>	K6
4.3.	Endangered taxa and forest management (participatory forest management).	<ul style="list-style-type: none"> <li>Evaluate the role of forest management in endangered taxa</li> </ul>	K5
V		Ethnobotany and legal aspects	
5.1	Ethnobotany as a tool to protect interests of ethnic groups.	<ul style="list-style-type: none"> <li>Influence of ethnobotany as a tool to protect ethnic groups and their interest</li> </ul>	K5
5.2	Sharing of wealth concept with few examples from India.	<ul style="list-style-type: none"> <li>List the wealth of India in the means of biodiversity</li> </ul>	K4
5.3	Biopiracy, Intellectual Property Rights and Traditional Knowledge.	<ul style="list-style-type: none"> <li>Discuss the importance of biopiracy and IPR in ethnobotany</li> <li>Rate the role of biopiracy and IPR in traditional knowledge</li> </ul>	K6 K5

### Mapping Scheme for Course code: U22BY6:A

U22BY6:A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	M	L	L	-	H	L	L	M	M	M	L	L	L
CO2	M	H	L	-	L	-	L	-	-	M	L	L	M
CO3	M	H	M	-	L	M	M	M	L	L	H	L	L
CO4	M	M	H	M	L	M	H	M	M	H	H	L	M
CO5	M	L	M	-	-	L	L	L	M	L	L	M	M
CO6	H	H	M	M	M	M	M	M	M	H	H	H	M



**L-Low (1) M-Medium (2) H-High (3)**

**Assessment / Evaluation:**

1. Continuous Assessment by conducting Model Exams, Demonstration, Written test on Protocols.
2. End Semester Practical Examination

**Elective II: HORTICULTURE AND ORGANIC FARMING**

**Course code: U22BY6:B**  
**Credits : 5**

**Semester: VI**  
**Hours/Week :5**

**Course Outcomes:**

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

No	COURSE OUTCOME (CO)	Level	Unit
CO 1	Classify the scope, Climate, soil, water irrigation, propagation methods of horticulture and their implements	K4	I
CO 2	Discuss the principles, methods of indoor and outdoor gardening, Lawn and water garden	K6	II
CO 3	Explain gardening, Bonsai, Floriculture and Hydroponics	K2	III
CO 4	Elaborate organic farming, vermicompost and its advantages	K6	IV
CO 5	Illustrate the cultivation of organic vegetables, fruit crops and layout of kitchen garden	K2	V
CO 6	Importance of horticulture and their methods with organic farming practices	K5	I - V

**SYLLABUS:**

**Unit I**

**(15 Hours)**

- 1.1. Importance and scope of horticulture
- 1.2. Divisions of horticulture
- 1.3. Climate, soil and nutritional needs
- 1.4. Water irrigation
- 1.5. Plant propagation method – Cutting, layering, grafting, budding.
- 1.6. Stock – scion relationship and Glass houses and green houses

**Unit II**

**(15 Hours)**

- 2.1. Principles and methods of designing outdoor garden – hedges, edges, fences, trees, climbers, rockeries, arches, terrace garden

- 2.2. Lawn making and maintenance
- 2.3. Water garden – cultivation of water plants-common water plants.

**Unit III (15 Hours)**

- 3.1. Indoor gardening – Foliage plants, flowering plants, hanging basket
- 3.2. Bonsai plants – Training, watering and pruning.
- 3.3. Floriculture – Cultivation of commercial flower crops – Rose, Jasmine and Chrysanthemum,
- 3.4. Introduction to Hydroponics

**Unit IV (15 Hours)**

- 4.1. Organic Farming – Concept, Scope and importance of organic farming, Compost, Decomposition manure.
- 4.2. Vermicompost – Scope, importance, Types and uses. Vermi castings. Potentials and constraints for vermiculture in India.
- 4.3. Advantages of Organic farming.

**Unit V (15 Hours)**

- 5.1. Cultivation of some Organic vegetable – Tomato, potato, brinjal, onion, cabbage and snake guard.
- 5.2. Organic Fruit crops – Induction of flowering, flower thinning, fruit setting, fruit development.
- 5.3. Cultivation of some organic fruit crops - Mango, Grapes, Sapota and Guava.
- 5.4. Layout for a model kitchen garden

**TOPICS FOR SELF- STUDY:**

Topics	Reference Book/Web Links
Foundation Seed	<a href="https://vikaspedia.in/agriculture/agri-inputs/seeds/classes-of-seeds">https://vikaspedia.in/agriculture/agri-inputs/seeds/classes-of-seeds</a>
Landscape design,	<a href="http://www.indiaagronet.com/horticulture/CONTENTS/LANDSCAPE.htm">http://www.indiaagronet.com/horticulture/CONTENTS/LANDSCAPE.htm</a>
Market Gardening	<a href="https://douglas.extension.wisc.edu/files/2010/05/Market-Gardening-Getting-Started-ATTRA.pdf">https://douglas.extension.wisc.edu/files/2010/05/Market-Gardening-Getting-Started-ATTRA.pdf</a> <a href="https://marketbusinessnews.com/financial-glossary/market-garden/">https://marketbusinessnews.com/financial-glossary/market-garden/</a>
Slow-release fertilizer	<a href="https://www.ekompany.eu/en/slow-versus-controlled-release-fertilizers/">https://www.ekompany.eu/en/slow-versus-controlled-release-fertilizers/</a>

**TEXT BOOKS:**

1. Kumar, N. 1987. *Introduction to Horticulture*. Rajalakshmi Publishers, Nagercoil.
2. Manibushan Rao, K. 1991. *Textbook of Horticulture*. Macmillan Publishing Co., New York.
3. Rao, K.M. 2000. *Textbook of Horticulture*. Macmillan India Ltd., New Delhi.

**REFERENCE BOOKS:**

1. Arora, J.S. 1992. *Introductory Ornamental Horticulture*. Kalyani Publishers, New Delhi.
2. Edmond, J.B. *et al.* 1977. *Fundamentals of Horticulture*. Tata–McGraw Hill Publishers Co. Ltd., New Delhi.
3. George Acquaah. 2002. *Horticulture Principles and Practices (2nd ed.)*. Pearson Education, New Delhi.

No Practical for this paper

**WEB LINKS:**

[https://onlinecourses.nptel.ac.in/noc19\\_ag04/preview](https://onlinecourses.nptel.ac.in/noc19_ag04/preview)

[https://onlinecourses.swayam2.ac.in/nou19\\_ag08/preview](https://onlinecourses.swayam2.ac.in/nou19_ag08/preview)

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit/ Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>I</b>	<b>Introduction</b>		
1.1	Importance and scope of horticulture	<ul style="list-style-type: none"> <li>• Explain the scope of horticulture</li> </ul>	K2
1.2	Divisions of horticulture	<ul style="list-style-type: none"> <li>• Classify the divisions of horticulture</li> </ul>	K4
1.3	Climate, soil and nutritional needs	<ul style="list-style-type: none"> <li>• Influence of climate, soil and nutritional needs in horticulture</li> </ul>	K5
1.4	Water irrigation	<ul style="list-style-type: none"> <li>• Categorize the water irrigation</li> </ul>	K4
1.5	Plant propagation method – Cutting, layering, grafting, budding.	<ul style="list-style-type: none"> <li>• List out the propagation methods</li> </ul>	K4
1.6	Stock – scion relationship and Glass houses and green houses	<ul style="list-style-type: none"> <li>• Relationship between Stock and scion and the role of Glass and Green houses</li> </ul>	K4
<b>II</b>	<b>Principles and Methods of Horticulture</b>		
2.1.	Principles and methods of designing outdoor garden – hedges, edges, fences, trees, climbers, rockeries, arches, terrace garden	<ul style="list-style-type: none"> <li>• Outline the principles of outdoor garden.</li> <li>• Explain the methods and designing of outdoor garden</li> </ul>	K2 K2
2.2.	Lawn making and maintenance	<ul style="list-style-type: none"> <li>• Discuss about lawn and its maintenance</li> </ul>	K6

2.3.	Water garden – cultivation of water plants-common water plants.	<ul style="list-style-type: none"> <li>• Construct water garden</li> <li>• List out the common water plants</li> </ul>	K6 K4
<b>Unit III - Indoor gardening and Floriculture</b>			
3.1.	Indoor gardening – Foliage plants, flowering plants, hanging basket	<ul style="list-style-type: none"> <li>• Discuss the indoor gardening</li> <li>• Identify the foliage and flowering plants</li> </ul>	K2 K3
3.2.	Bonsai plants – Training, watering and pruning.	<ul style="list-style-type: none"> <li>• Explain Bonsai plants and its training</li> </ul>	K5
3.3.	Floriculture – Cultivation of commercial flower crops – Rose, Jasmine and Chrysanthemum	<ul style="list-style-type: none"> <li>• Explain floriculture</li> </ul>	K5
3.4.	Introduction to Hydroponics	<ul style="list-style-type: none"> <li>• Outline of hydroponics</li> </ul>	K2
<b>IV</b>	<b>Scope and Importance of Organic farming</b>		
4.1	Organic Farming – Concept, Scope and importance of organic farming, Compost, Decomposition manure.	<ul style="list-style-type: none"> <li>• Explain scope, importance of organic farming</li> <li>• Discuss the concept of organic farming</li> <li>• Distinguish compost and decompost manures</li> </ul>	K2 K6 K4
4.2.	Vermicompost – Scope, importance, Types and uses. Vermi castings. Potentials and constraints for vermiculture in India.	<ul style="list-style-type: none"> <li>• Elaborate vermicompost</li> <li>• List out the limitations for vermiculture in India</li> </ul>	K6 K4
4.3.	Advantages of Organic farming.	<ul style="list-style-type: none"> <li>• Importance of organic farming</li> </ul>	K5
<b>V</b>	<b>Olericulture and Pomology</b>		
5.1	Cultivation of some Organic vegetable – Tomato, potato, brinjal, onion, cabbage and snake guard.	<ul style="list-style-type: none"> <li>• Explain cultivation of organic vegetables</li> <li>• Choose the soil formulations for vegetables cultivation</li> <li>• Analyze cultivation practices for selected vegetables</li> </ul>	K2 K5 K4
5.2	Organic Fruit crops – Induction of flowering, flower thinning, fruit setting, fruit development.	<ul style="list-style-type: none"> <li>• explain organic fruit crops</li> </ul>	K5
5.3	Cultivation of some organic fruit crops - Mango, Grapes, Sapota and Guava.	<ul style="list-style-type: none"> <li>• Value cultivation of organic fruit production</li> <li>• Analyse the cultivation practices for selected fruit yielding trees and climbers</li> </ul>	K6 K4

5.4	Layout for a model kitchen garden	<ul style="list-style-type: none"> <li>Illustrate the layout of kitchen garden</li> </ul>	K2
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### Mapping Scheme for the Course code: U22BY6:B

U22BY6:B	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	L	-	-	L	-	L	M	-	M	-	-	L
CO2	H	L	-	-	-	-	L	M	-	L	-	-	L
CO3	H	L	L	-	-	-	L	L	-	L	-	-	L
CO4	H	L	L	-	-	-	L	L	-	L	-	-	L
CO5	H	L	L	-	-	-	L	L	-	L	-	-	L
CO6	H	L	M	-	L	L	M	M	-	M	-	-	M

L-Low (1) M-Medium (2) H-High (3)

#### Assessment / Evaluation:

1. Continuous Assessment by conducting Model Exams, Demonstration Experiments, Written test on Protocols.
2. Practical Record work.
3. End Semester Practical Examination

### Elective III - MICROSCOPY AND PLANT MICROTECHNIQUES

Semester : VI

Credits : 5

Course Code : U22BY6:C

Total Hours : 5

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

S. no	Course Outcomes	Level	Unit
CO 1	Outline the general features of Embedding techniques	K2	I
CO 2	Understand the microtome and types of staining techniques.	K2	II
CO 3	Distinguish between temporary and permanent slides preparation.	K3	II
CO 4	To acquire a basic background in histology and to understand the properties of cells.	K3	III
CO 5	Describe the basic components of an electron microscope and their role	K4	IV
CO 6	Discuss the application of microscopy and micro-technology for various kind of applications.	K5	V

## **SYLLABUS:**

### **UNIT - I**

- 1.1 Killing and Fixing - Dehydration - Infiltration
- 1.2 Embedding
  - 1.2.1 Paraffin Embedding
  - 1.2.2 Microwave Paraffin Embedding and
  - 1.2.3 Plastic Embedding techniques
  - 1.2.4 Reagents for embedding
  - 1.2.5 Fixatives - Post fixatives - Buffers - Resins used for different kinds of embedding.
  - 1.2.6 Advantages and disadvantages of embedding techniques

### **UNIT - II**

- 2.1 Sectioning Methods
  - 2.1.1 Freehand and Serial sectioning and Types
- 2.2 Microtomy
  - 2.2.1 Applications of microtomes
  - 2.2.2 Types
  - 2.2.3 Sledge Microtome, Rotary microtome, Sliding microtome and Cryomicrotome
- 2.3 Stains
  - 2.3.1 General stain and Specific stain
  - 2.3.2 Monochromatic stain and Metachromatic stain
  - 2.3.3 Acidic stain, Basic stain, and Neutral stain
  - 2.3.4 Staining Procedure - DoubleStaining - Mounting.

### **UNIT – III**

- 3.1 Slide preparations - Temporary, Semi-permanent and Permanent slide preparations
- 3.2 Smear - Squash - Clearing - Whole Mount - Peeling – Maceration techniques
- 3.3 Drawing microscopic images - Camera lucida - types (prism and mirror) and applications

### **UNIT - IV**

- 4.1 Histochemistry - Definition, staining methods, is staining theory
- 4.2 Scope of histochemistry and Cytochemistry in Biology
- 4.3 Gus staining methods
- 4.4 Histochemical Techniques - Identification and localization of structural and storage components in plants using specific dyes and
- 4.5 Fluorochoemes - Starch, protein, lipid, nucleic acids, cellulose, lignin, alkaloids, phenolics  
(tannin) and glycosoides

### **UNIT – V**

- 5.1 Microscopy - Principles, Parts, Functioning and
- 5.2 Applications of Bright Field, Dark Field
  - 5.2.1 Phase Contrast
  - 5.2.2 Polarized and Fluorescence microscopy
  - 5.2.3 Structure, Function and Application methods of TEM and SEM.
- 5.3 Photomicrography - Principles and uses of Photomicrography

### Text Books

1. Kothari, C.R. and Garg, G. 2014. Research Methodology: Methods and Techniques (3rd revised edition) New Age International publisher, New Delhi.
2. Sanderson, J. 1994. Biological Microtechnique. Garland Science, 1<sup>st</sup> edn: 1- 240.
3. Marimuthu, R. 2009. Microscopy and Microtechnique, MJP Publishers, 1-200.
4. Pradeep, T. 2012, A text book of nano science and nanotechnology, Tata McGraw Hill Publication, New Delhi.
5. Murthy, Shankar, Baldev Raj, Rath and Murday, J. 2013. A text book of nano science and nanotechnology, University Press India Ltd. Bangalore and Chennai.

### Reference Books

1. Parsons, C.J. 1973. Thesis and project work. A guide to research and writing, George Allen and Unwin Ltd London.
2. Antorson, Durston and Polle 1970. Thesis and assignment writing, Wiley eastern Ltd.
3. Krishnaswamy, K.N.Sivakumar, Appa Iyar and Mathirangen, M. 2006. Management of research methodology integration of principles, methods and techniques ( Pearson education New Delhi
4. Attwood, T.K and Smith, D.J. 1999. Introduction to Bioinformatics Addison Wesley Longman Limited, England.
5. Shanmugam, S. 2011. Nanotechnology - MJP Publication New Delhi.
6. Charles, P.P and Frank, J.O. 2006. Introduction to Nanotechnology, Wiley India Ed.

### Extra reading/Key Words:

Key Words	Link
CO2 analyser	<a href="https://cid-inc.com/plant-science-tools/photosynthesis-measurement/ci-340-handheld-photosynthesis-system/?gclid=Cj0KCQjwid SWBhDd ARIsAIoTVb38MF-UIyyr1Fluy3AkAXFSul_MHKdXUdM3EP2 mPtNws0 LUDYd34YMaAvX5EALw_wcB">https://cid-inc.com/plant-science-tools/photosynthesis-measurement/ci-340-handheld-photosynthesis-system/?gclid=Cj0KCQjwid SWBhDd ARIsAIoTVb38MF-UIyyr1Fluy3AkAXFSul_MHKdXUdM3EP2 mPtNws0 LUDYd34YMaAvX5EALw_wcB</a>
Plant canopy imager	<a href="https://cid-inc.com/plant-science-tools/leaf-area-measurement/ci-110-plant-canopy-imager/">https://cid-inc.com/plant-science-tools/leaf-area-measurement/ci-110-plant-canopy-imager/</a>
Handheld photosynthesis system	<a href="https://cid-inc.com/plant-science-tools/photosynthesis-measurement-plants/ci-340-handheld-photosynthesis-system/">https://cid-inc.com/plant-science-tools/photosynthesis-measurement-plants/ci-340-handheld-photosynthesis-system/</a>
SpectraVue leaf spectrometer	<a href="https://cid-inc.com/plant-science-tools/leaf-spectroscopy/ci-710-miniature-leaf-spectrometer/">https://cid-inc.com/plant-science-tools/leaf-spectroscopy/ci-710-miniature-leaf-spectrometer/</a>
Portable laser leaf area meter	<a href="https://cid-inc.com/plant-science-tools/leaf-area-measurement/ci-203-handheld-laser-leaf-area-meter/">https://cid-inc.com/plant-science-tools/leaf-area-measurement/ci-203-handheld-laser-leaf-area-meter/</a>

### LEARNING OUTCOME TABLE

Unit	Content	Learning Outcome	Highest Bloom taxonomic

			<b>level of transaction</b>
<b>Unit –I</b>	Killing and Fixing –	<ul style="list-style-type: none"> <li>• Explain infiltration</li> </ul>	K2
1.1	Dehydration - Infiltration	<ul style="list-style-type: none"> <li>• Discuss the killing and fixing</li> <li>• Explain briefly about Dehydration and Infiltration.</li> </ul>	K6  K4
1.2	Embedding	<ul style="list-style-type: none"> <li>• List the types of embedding techniques</li> </ul>	K1
1.2.1	Paraffin Embedding	<ul style="list-style-type: none"> <li>• Explain the procedure involved in paraffin embedding techniques.</li> </ul>	K4
1.2.2	Microwave Paraffin Embedding and Plastic Embedding techniques	<ul style="list-style-type: none"> <li>• Distinguish between paraffin and microwave embedding techniques</li> </ul>	K4
1.2.3	Reagents for embedding	<ul style="list-style-type: none"> <li>• Identify the reagents for embedding.</li> </ul>	K4
1.2.4		<ul style="list-style-type: none"> <li>• Describe the different steps involved in Paraffin Microtomy.</li> </ul>	K3
1.2.5	Fixatives - Post fixatives - Buffers - Resins used for different kinds of embedding.	<ul style="list-style-type: none"> <li>• Describe post fixatives techniques</li> <li>• Summarize resins used for different kinds of embedding.</li> </ul>	K2  K2
1.2.6	Advantages and disadvantages of embedding techniques	<ul style="list-style-type: none"> <li>• List out the advantages and disadvantages of Embedding Techniques</li> </ul>	K3
<b>Unit – II</b>			
2.1	Sectioning Methods	<ul style="list-style-type: none"> <li>• What are steps involved free hand and serial sectioning.</li> </ul>	K4
2.1.1	Freehand and Serial sectioning and Types		
2.2	Microtomy Applications of microtomes	<ul style="list-style-type: none"> <li>• Categorize the types of microtome with their application</li> </ul>	K3
2.2.1	Types: sledge Microtome Rotary microtome, Sliding microtome and Crymicrotome	<ul style="list-style-type: none"> <li>• Differentiate the sledge and rotary microtome</li> </ul>	K5
2.2.2		<ul style="list-style-type: none"> <li>• Distinguish sliding and crymicrotome</li> </ul>	



2.2.3			K2
2.3 2.3.1	Stains General stain and Specific stain	<ul style="list-style-type: none"> <li>• Specific stain – comment</li> </ul>	K
2.3.2 2.3.3	Monochromatic stain and Metachromatic stain Acidic stain, Basic stain, and Neutral stain	<ul style="list-style-type: none"> <li>• Examine the monochromatic and metachromatic stain</li> </ul>	K3 K4
2.3.4	Staining Procedure - Double Staining - Mounting.	<ul style="list-style-type: none"> <li>• Give an account on staining techniques</li> <li>• Write essay on Double staining methods</li> </ul>	K3 K4
<b>Unit – III</b> 3.1	Slide preparations Temporary, Semi-permanent and Permanent slide preparations	<ul style="list-style-type: none"> <li>• Write different methods of slide preparation</li> <li>• Give an account on Ocular and Stage micrometers</li> <li>• Summarize permanent slide preparation</li> </ul>	K4 K4 K3
3.2	Smear - Squash - Clearing - Whole Mount - Peeling – Maceration techniques	<ul style="list-style-type: none"> <li>• Distinguish between smear and squash in slide preparation</li> <li>• Write an essay about maceration techniques</li> </ul>	K4
3.3	Drawing microscopic images - Camera lucida - types (prism and mirror) and applications	<ul style="list-style-type: none"> <li>• Write a methods using camera lucida</li> </ul>	K2
<b>Unit 4</b> 4.1	Histochemistry - Definition, staining methods, is staining theory	Explain the histochemistry staining methods	K4
4.2.	Scope of histochemistry and Cytochemistry in Biology	<ul style="list-style-type: none"> <li>• Write the scope of histochemistry</li> </ul>	K2

4.3	Gus staining methods	<ul style="list-style-type: none"> <li>State the principles and procedure of Gus staining methods</li> </ul>	K4
4.4	Histochemical Techniques - Identification and localization of structural and storage components in plants using specific dyes.	<ul style="list-style-type: none"> <li>Write the methodology of identification of structural and storage components in plants</li> </ul>	K3
4.5	Fluorochomes - Starch, protein, lipid, nucleic acids, cellulose, lignin, alkaloids, phenolics (tannin) and glycosoides	<ul style="list-style-type: none"> <li>State the importance and scope of Histochemistry.</li> <li>Discuss the Fluorochomes</li> </ul>	K4 K3
<b>Unit 5</b>	Microscopy - Principles, Parts, Functioning and	<ul style="list-style-type: none"> <li>Explain the working principle of SEM and its sample preparation.</li> </ul>	K5
5.1		<ul style="list-style-type: none"> <li>Discuss the principles, working mechanisms and structure of Electron microscope</li> </ul>	K4
5.2	Applications of Bright Field, Dark Field	<ul style="list-style-type: none"> <li>Elaborate the applications of fluorescence microscopy</li> </ul>	K6
5.2.1	Phase Contrast	<ul style="list-style-type: none"> <li>Compare the bright field and dark field microscope.</li> </ul>	K4
5.2.2	Polarized and Fluorescence microscopy	<ul style="list-style-type: none"> <li>Elaborate the function and application methods of TEM and SEM</li> </ul>	K3
5.2.3	Structure, Function and Application methods of TEM and SEM.		
5.3	Photomicrography - Principles and uses of Photomicrography	<ul style="list-style-type: none"> <li>Write about the Principles and uses of Photomicrography</li> </ul>	K5

### Mapping Scheme for the Course Code: U22BY6:C

U22BY6:C	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	-	H	-	L	H	M	M	M	L	L	M	-
CO2	H	-	M	-	-	L	L	-	L	-	M	L	-
CO3	H	L	-	-	L	-	-	-	L	-	L	L	L
CO4	H	-	L	-	M	M	-	-	M	M	-	-	L

CO5	M	-	-	M	-	L	M	L	-	M	-	-	L
CO6	M	-	-	L	L	M	L	L	M	-	-	L	-

**L-Low (1) M-Medium (2) H-High (3)**

### **COURSE ASSESSMENT METHODS:**

#### **Direct**

1. Continuous Assessment by conducting Class test, Group Discussion and Quiz.
2. Assessment also done through Seminar Presentation, submission of Assignments and Model Making and Model exams.
3. End Semester Examination.

#### **Indirect**

1. Course-end survey

### **Elective III: BIOTECHNOLOGY**

**Semester: VI**

**Course Code: U22BY6:D**

**Credits: 5**

**Hours/Week: 5**

#### **Course Outcomes:**

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

<b>No</b>	<b>COURSE OUTCOME (CO)</b>	<b>Level</b>	<b>Unit</b>
<b>CO 1</b>	Analyze the applications of plant biotechnology	<b>K4</b>	I
<b>CO 2</b>	Determine various aspects of tissue culture and their applications	<b>K5</b>	II
<b>CO 3</b>	Explain plant biotechnological applications viz., Algal and transgenic crops	<b>K5</b>	III
<b>CO 4</b>	Apply the concepts of Biotechnology in Environmental Management.	<b>K3</b>	IV
<b>CO 5</b>	Analyze the reasons for pollution and choose the method of pollution management.	<b>K5</b>	IV
<b>CO 6</b>	Discuss Ethical Issues, intellectual property management and handling of GMOs.	<b>K6</b>	V

#### **Syllabus:**

#### **Unit I: Plant *in vitro* Technology**

**(15 Hours)**

1.1 Introduction – History, Scope, concepts, branches and applications of plant biotechnology

1.2 Plant Tissue culture: - Sterilization, Media and Plant Growth Hormones in *In vitro* cultures and Explants

- 1.3 Micro-propagation -direct and indirect morphogenesis, Callus Culture and anther and embryo culture
- 1.4 Somatic Hybridization: Protoplast Culture: Isolation of protoplast, somatic cell hybridization, selecting desired hybrids and regeneration into plants.

**Unit II: Genetic Engineering- rDNA technology (15 Hours)**

- 2.1 Introduction to Genetic Engineering
- 2.2. Techniques: Restriction endonucleases, Electrophoresis, PCR and Blotting
- 2.3 Cloning Vectors, Plasmid
- 2.4 Methods of Gene transfer - *Agrobacterium* mediated, Direct DNA transfer  
(I) Micro injection (II) Electroporation (III) Biolistics

**Unit III- ENVIRONMENTAL BIOTECHNOLOGY (15 Hours)**

- 3.1 Renewable and non- renewable energy resources, Fossil fuels as energy source and their impact on environment, Non-conventional source – biomass as source of bioenergy
- 3.2 Environmental Pollution: Pollution, (1) Types of pollution- Air, Water, land/Soil, Noise, Radioactive pollution, Impact of pollution- greenhouse gases and global warming.
- 3.3 Methods of Treating Pollution- Physical, Chemical, Biological methods- Algae, Fungi, Bacteria.
- 3.4 Bioremediation– concepts and types (*in-situ* and *ex-situ*);

**Unit IV- Biomedical applications of Biotechnology (15 Hours)**

- 4.1 Biotechnological applications in health care,**  
(1) Molecular diagnosis – monoclonal antibodies, DNA probes, Microarrays, DNA finger printing, Gene therapy, Antisense Technology.

**Unit- V- Biotechnology and Biosafety (15 Hours)**

- 5.1 Biotechnology Act- regulatory agencies - Biosafety for human health and environment.
- 5.2 Social and ethical issues of biosafety- Use of genetically modified organisms (BT cotton and BT brinjal) and their release into the environment. Ethical issues of Synthetic biology and nanobiotechnology.
- 5.3 Intellectual property right (IPR), Intellectual property protection (IPP)- Intellectual property rights (IPR), patenting (Process and Product

**TOPICS FOR SELF-STUDY:**

Topics	Reference Book/Web Links
GURT	<a href="https://onlinelibrary.wiley.com/doi/full/10.1111/pbi.12084">https://onlinelibrary.wiley.com/doi/full/10.1111/pbi.12084</a>
Bt-GM crops	<a href="https://ejbpc.springeropen.com/articles/10.1186/s41938-018-0051-2">https://ejbpc.springeropen.com/articles/10.1186/s41938-018-0051-2</a> Chopra, V. L. and Nasim, A. 1990. <i>Genetic engineering and Biotechnology. Concepts, Methods and Application.</i> (4th Ed.). Oxford and IBH Publication.
Microbes as a tool in biowar	<a href="https://www.sciencedirect.com/topics/medicine-and-dentistry/biological-warfare">https://www.sciencedirect.com/topics/medicine-and-dentistry/biological-warfare</a> <a href="https://www.britannica.com/technology/biological-weapon">https://www.britannica.com/technology/biological-weapon</a>
Impact of	<a href="https://cbn.ca/gmos/issues/terminator-technology/">https://cbn.ca/gmos/issues/terminator-technology/</a>

terminator seeds on Agriculture	<a href="https://www.sites.ext.vt.edu/newsletter-archive/cses/1999-02/1999-02-03.html">https://www.sites.ext.vt.edu/newsletter-archive/cses/1999-02/1999-02-03.html</a>
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**TEXT BOOKS:**

1. Chawla, H.S. 2002. *Introduction to plant biotechnology*, second edition, Oxford & IBH Publishing, Co,Pvt. Ltd., New Delhi.
2. Jwala Aggarwal and Shekhar K. Arora. 2014. *Experiments in Plant Tissue Culture*. Campus Book International, New Delhi.
3. Dubey. R.C. 2006. *A text book of Biotechnology*. S. Chand and Company ltd. Ramnagar New Delhi.
4. Rittmann, B.E. and McCarty, P.L. 2001. *Environmental Biotechnology: Principles and Applications*, McGraw-Hill.
5. Sharma. P.K. 2011. *An Introduction To Nanotechnology And Its Analysis*. Gaurav Book Centre Pvt Ltd.

**REFERENCE BOOKS:**

1. Razdan, M.K. 2003. *Introduction to Plant Tissue Culture*, Second edition. Oxford and IBH publishing, New Delhi.
2. Thara, K.M. 2009. *Practical Manual series-4. Biotechnology*, New India Publishing Agency, New Delhi.
3. Bhojwani, S. S. and Razdan. M. K. 1996. *Plant Tissue Culture: Theory and Practice*, a revised edition. Elsevier Science, Netherlands.

**WEB LINKS:**

- <https://www.classcentral.com/course/swayam-principles-of-biotechnology-17738>  
[https://onlinecourses.swayam2.ac.in/cec20\\_bt07/preview](https://onlinecourses.swayam2.ac.in/cec20_bt07/preview)

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit/ Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>I-</b>	<b>INTRODUCTION PLANT INVITRO TECHNOLOGY:</b>		
1.1	Introduction – History, Scope, concepts, branches and applications of plant biotechnology	<ul style="list-style-type: none"> <li>• Recognize the importance and scope</li> <li>• Appraise the application of plant biotechnology</li> <li>• Develop interest in micropropagating plants</li> </ul>	K2 K4 K3
1.2	<b>Plant Tissue culture:-</b> Sterilization, Media and Plant Growth Hormones in <i>In vitro</i> cultures and Explants	<ul style="list-style-type: none"> <li>• Identify suitable explants and medium for <i>In vitro</i> Propagation</li> </ul>	K3

1.3	Micropropagation -direct and indirect morphogenesis, Callus Culture and anther and embryo culture	<ul style="list-style-type: none"> <li>Plan the protocol for micropropagation</li> <li>Plan Micropropagation experiments</li> </ul>	K3
1.4	Somatic Hybridization : Protoplast Culture: Isolation of protoplast, somatic cell hybridization, selecting desired hybrids and regeneration into plants.	<ul style="list-style-type: none"> <li>Define biotechnological techniques involved in breeding plants</li> </ul>	K1
<b>II</b>	<b>GENETIC ENGINEERING</b>		
2.1	<b>rDNA technology:</b> Introduction to Genetic Engineering	<ul style="list-style-type: none"> <li>Summarize the application techniques in Genetic Engineering</li> </ul>	K2
2.2	Techniques: Restriction endonucleases, Electrophoresis, PCR and Blotting	<ul style="list-style-type: none"> <li>Apply the knowledge gained from Genetic Engineering in Crop plants</li> </ul>	K3
2.3	Cloning Vectors, Plasmid	<ul style="list-style-type: none"> <li>Identify the suitable vectors for expression of genes</li> </ul>	K3
2.4	Methods of Gene transfer - <i>Agrobacterium</i> mediated, Direct DNA transfer (I) Micro injection (II) Electroporation (III) Biolistics	<ul style="list-style-type: none"> <li>Determine biotechnological techniques involved in breeding plants</li> </ul>	K5
<b>III</b>	<b>ENVIRONMENTAL BIOTECHNOLOGY</b>		
<b>3.1</b>	4.1 Renewable and non- renewable energy resources, Fossil fuels as energy source and their impact on environment, Non-conventional source – biomass as source of bioenergy.	<ul style="list-style-type: none"> <li>Demonstrate understanding of fundamental concepts of natural resources</li> </ul>	K2
3.2	Types of biomass – plant, animal and microbial biomass.	<ul style="list-style-type: none"> <li>Explain the role of Renewable and non renewable energy resources and types of biomass.</li> </ul>	K5
3.3	<b>Environmental Pollution:</b> Pollution, (1) Types of pollution- Air, Water, land/Soil, Noise, Radioactive pollution, Impact of pollution- greenhouse gases and global warming.	<ul style="list-style-type: none"> <li>Identify Bioremediation and Restoration of Environment</li> </ul>	K3

3.4	Methods of Treating Pollution- Physical, Chemical, Biological methods- Algae, Fungi, Bacteria.	<ul style="list-style-type: none"> <li>Explain the various bioremediation process</li> </ul>	K2
3.5	Bioremediation– concepts and types ( <i>in-situ</i> and <i>ex-situ</i> );	<ul style="list-style-type: none"> <li>Explain the various concept of Bioremediation</li> </ul>	K2
IV	<b>BIOMEDICAL APPLICATIONS OF BIOTECHNOLOGY</b>		
4.1	<b>Biotechnological applications in health care,</b> (1) Molecular diagnosis – monoclonal antibodies, DNA probes, Microarrays, DNA finger printing, Gene therapy, Antisense Technology	<ul style="list-style-type: none"> <li>Analyze the use of Biotechnological aspects in clinical field.</li> </ul>	K5
V	<b>BIOTECHNOLOGY AND BIOSAFETY</b>		
5.1	Biotechnology Act- regulatory agencies -	<ul style="list-style-type: none"> <li>Discuss the Social and ethical issues of bio safety</li> </ul>	K6
5.2	Biosafety for human health and environment. Social and ethical issues of biosafety- Use of genetically modified organisms (BT cotton and BT brinjal) and their release into the environment. Ethical issues of Synthetic biology and nanobiotechnology	<ul style="list-style-type: none"> <li>Discuss the ethical issues of synthetic biology</li> </ul>	K6
5.3	<b>Intellectual property rights (IPR),</b> patenting (Process and Product)	<ul style="list-style-type: none"> <li>Explain the importance of IPR and Patenting</li> </ul>	K2

#### Mapping Scheme for the Course Code: U22BY6:D

U22BY6:D	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	L	M	L	M	L	-	-	-	H	M	-	L
CO2	M	-	-	M	H	H	-	H	H	H	H	L	M
CO3	L	M	H	M	H	M	-	H	H	H		L	M
CO4	H	M	H	-	L	H	-	M	L	H	M	-	-
CO5	H	H	L	-	-	M	L	L	M	M	L	L	-
CO6	H	M	L	-	L	M	L	H	H	L	M	-	-

L-Low (1) M-Medium (2) H-High (3)

#### COURSE ASSESSMENT METHODS:

Direct

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**Continuous Assessment in assignments, record submission.  
Class tests, Model Exams.  
End Semester Examination**

**Indirect**

**1. Course-end survey**

### **Elective III: NANOTECHNOLOGY**

**COURSE CODE: U22BY6:E**

**CREDITS: 5**

**HOUR/Week: 5 Hours**

**SEMESTER: VI**

**Course Outcomes:**

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

<b>No</b>	<b>COURSE OUTCOME (CO)</b>	<b>Level</b>	<b>Unit</b>
<b>CO 1</b>	Explain the scope of nanotechnology and its applications	K2	I
<b>CO 2</b>	Interpret the methods of nanoparticle synthesis	K2	II
<b>CO 3</b>	Apply the nanoparticle synthesis using potential green plants	K3	III
<b>CO 4</b>	Analyse the uses of nanoparticles in the biomedical field.	K4	IV
<b>CO 5</b>	Take part in the works and discussions related to the applications of nanoparticles in agriculture	K4	IV
<b>CO 6</b>	Test for the phytochemicals in biomedical field using the nanotechnology	K4	V

**Syllabus:**

#### **Unit I- Introduction to Nanotechnology**

**(15 Hours)**

- 1.1 Nanotechnology- Definition, scope and importance.
- 1.2 Nanomaterial and Nanocomposites. Origin and Types of Nanomaterials.
- 1.3 Classification of nanostructure- Top-down and bottom-up approaches.
- 1.4 Quantum dots -- Quantum wire – Quantum well and Carbon nanotubes

#### **Unit II – Nano particle synthesis**

**(15 Hours)**

- 2.1 Nanosynthesis – Definition.
- 2.2 Methods in Nanosynthesis Physical methods using Plasma and Laser, Chemical method using Sol-gel, Co-precipitation.
- 2.3 Advantages and Disadvantages of physical and chemical methods

#### **Unit III- Green Nano synthesis and Characterization**

**(15 Hours)**

- 3.1 Green Nanosynthesis using fungus and plant material.



3.2 Characterization of Nanoparticles – Principle, methodology and interpretation of the size, shape, structure, chemistry and crystallography of nanoparticles by the following techniques - UV Visible Spectroscopy, FTIR, Electron microscopy – TEM, SEM.

3.3 Merits of Green Nanosynthesis

**Unit IV – Applications of nanomaterials**

**(15 Hours)**

4.1 Applications of nanotechnology in Agriculture- nanoparticle based pesticides, Environment Remediation, Food packaging and monitoring .

**Unit V – Biomedical applications of Nanotechnology**

**(15 Hours)**

5.1 Applications of nanotechnology as Nanomedicine - cancer therapy.

5.2 Nanosensors - types and its applications.

5.3 Nanobiotechnology for Drug Discovery, Quantum Dots, Nanolasers, Lipid Nanoparticles as Drug Carriers and Nanocapsules.

**TOPICS FOR SELF-STUDY:**

<b>Topics</b>	<b>Reference Book/Web Links</b>
Biosensors	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4862100/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4862100/</a>
Bio-nanotechnology	<a href="https://www.news-medical.net/life-sciences/Bionanotechnology-Applications.aspx#:~:text=Bionanotechnology%20is%20a%20science%20that,biological%20problems%2C%20creating%20specialized%20applications.">https://www.news-medical.net/life-sciences/Bionanotechnology-Applications.aspx#:~:text=Bionanotechnology%20is%20a%20science%20that,biological%20problems%2C%20creating%20specialized%20applications.</a>
Methods of nanometal extraction from potential plants	<a href="http://www.issp.ac.ru/ebooks/books/open/The_Delivery_of_Nanoparticles.pdf">http://www.issp.ac.ru/ebooks/books/open/The_Delivery_of_Nanoparticles.pdf</a> Hashim, A. 2012. <i>The Delivery of Nanoparticles</i> , In Tech Publications, Janeza Trdine 9, 51000 Rijeka, Croatia.
Biophotonics and simulations in medical industry	<a href="https://onlinelibrary.wiley.com/doi/pdf/10.1002/9783527643981.bphot001">https://onlinelibrary.wiley.com/doi/pdf/10.1002/9783527643981.bphot001</a>

**TEXT BOOKS:**

1. Ratner, M. and Ratner, D. 2005. *Nanotechnology: A Gentle Introduction to the Next Big idea*. Pearson Education, Inc. NJ, USA.
2. Jain, K.K. 2006. *Nanobio-Technology in Molecular Diagnostics: Current Techniques and Applications*. Horizon Biosciences, India.
3. Cao. G. 2004. *Nanostructures and Nanomaterials*, Imperial College Press, London.
4. Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday J. 2013. *Textbook of Nanoscience and Nanotechnology*. Springer.244 Pages

**REFERENCE BOOKS:**

1. Rao. C. N. R, Müller. A, Cheetham. A. K. 2006. *The Chemistry of Nanomaterials :Synthesis, Properties and Applications*, Wiley-VCH.
2. Breachignac. C, Houdy. P, Lahmani. M. 2006. *Nanomaterials and Nanochemistry*, Springer, Publ.
3. Guozhong Cao. 2011. *Nanostructures and Nanomaterials: Synthesis, Properties, and Applications*, World Scientific Publishing Private, Ltd..
4. Zhong Lin Wang. 2004. *Characterization Of Nanophase Materials*, Springer Publ.

**Web Links:**

[https://onlinecourses.nptel.ac.in/noc19\\_bt28/preview](https://onlinecourses.nptel.ac.in/noc19_bt28/preview)

<http://www.biolim.org/programmes/online-courses/open/certificate-course-on-nanobiotechnology/>

[https://swayam.gov.in/nc\\_details/NPTEL](https://swayam.gov.in/nc_details/NPTEL)

**SPECIFIC LEARNING OUTCOMES (SLO):**

Unit/ Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
<b>I</b>	<b>NANOTECHNOLOGY</b>		
1.1	Nanotechnology- Definition, scope and importance.	<ul style="list-style-type: none"> <li>Define the scope of nanotechnology.</li> </ul>	K1 K2
1.2	Nanomaterial and	<ul style="list-style-type: none"> <li>Interpret the uses of nanomaterials.</li> <li>Explain the approaches for nanotechnology studies.</li> </ul>	K2
1.3	Nanocomposites. Origin and Types of Nanomaterials.		
1.4	Classification of nanostructure- Top-down and bottom-up approaches. Quantum dots -- Quantum wire – Quantum well and Carbon nanotubes.		
<b>II</b>	<b>NANOSYNTHESIS</b>		
2.1	Nanosynthesis – Definition.	<ul style="list-style-type: none"> <li>Summarise the methods in nanoparticle synthesis</li> <li>Compare the merits and demerits of the methods</li> </ul>	K2 K2
2.2	Methods in Nanosynthesis		
2.3	Physical methods using Plasma and Laser, Chemical method using Sol-gel, Co-precipitation.		
2.4	Advantages and Disadvantages of physical and chemical methods		
<b>III</b>	<b>GREEN NANOSYNTHESIS AND CHARACTERIZATION</b>		

3.1	Green Nanosynthesis using fungus and plant material,	<ul style="list-style-type: none"> <li>Choose different metals for bio-nanoparticle synthesis</li> <li>Interpret the colour changes in nanoparticles when the using metal varies</li> <li>Plan suitable metal by discussing the characteristics</li> <li>Apply the nanoparticle synthesis using plants.</li> </ul>	K3
3.2	Characterization of Nanoparticles – Principle, methodology and interpretation of the size, shape, structure, chemistry and crystallography of nanoparticles by the following techniques - UV Visible Spectroscopy, FTIR, Electron microscopy – TEM, SEM.		K2
3.3	Merits of Green Nanosynthesis		K3 K3
<b>IV</b>	<b>APPLICATIONS OF NANOMATERIALS</b>		
4.1	Applications of nanotechnology in Agriculture- nanoparticle based pesticides, Environment Remediation, Food packaging and monitoring	<ul style="list-style-type: none"> <li>Inspect the various uses of nanoparticles in the fields of agriculture, chemicals in pesticides, biomedical applications etc.</li> </ul>	K4
<b>V</b>	<b>BIOMEDICAL APPLICATIONS OF NANOTECHNOLOGY</b>		
5.1	Applications of nanotechnology as Nanomedicine - cancer therapy.	<ul style="list-style-type: none"> <li>Explain the uses of nanosensors and the area where it can be explored</li> <li>Conclude the usage of certain metals in nanoparticle synthesis</li> </ul>	K2
5.2	Nanosensors - types and its applications. Nanobiotechnology for Drug Discovery, Quantum Dots, Nanolasers, Lipid Nanoparticles as Drug Carriers and Nanocapsules.		K4

### Mapping Scheme for the Course Code: U22BY6:E

U22BY6:E	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	-	H	-	L	H	M	M	M	L	L	M	-
CO2	H	-	M	-	-	L	L	-	L	-	M	L	-
CO3	H	L	-	-	L	-	-	-	L	-	L	L	L
CO4	H	-	L	-	M	M	-	-	M	M	-	-	L
CO5	M	-	-	M	-	L	M	L	-	M	-	-	L

CO6	M	-	-	L	L	M	L	L	M	-	-	L	-
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**L-Low (1) M-Medium (2) H-High (3)**

**Evaluation:**

Continuous Assessment methods by class test, discussion, assignments  
Semester exams, Projects

**Elective – III NATURAL RESOURCE MANAGEMENT**

**Course code: U22BY6:F**

**Semester: VI**

**Credits: 5**

**Hours/Week: 5**

**Course Outcomes:**

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Interpret and explain the sustainable utilization - Concept, approaches (economic, ecological and socio-cultural).	K2	I
CO 2	Classify the Land and Water - Fresh water resources threats and management strategies.	K4	II
CO 3	Compare and contrast the Biodiversity with Management strategies	K4	III
CO 4	Apply the cover and its significance (with special reference to India) Major and minor Forest products; Depletion; Management.	K3	IV
CO 5	Analyze the Renewable and non-renewable sources of energy, Conservation strategies	K5	V
CO 6	Develop the Contemporary practices in resource management	K6	I - V

**Syllabus**

**Unit 1: Natural resources**

- 1.1 Definition and types.
- 1.2 Sustainable utilization - Concept, approaches (economic, ecological and socio-cultural).

**Unit 2: Land and Water**

- 2.1 Land - Utilization (agricultural, pastoral, horticultural, silvicultural)
- 2.2 Soil degradation and management
- 2.3 Water - Fresh water (rivers, lakes, groundwater, aquifers, watershed)

- 2.3.1 Marine; Estuarine; Wetlands
- 2.4 Threats and management strategies.

**Unit 3: Biological Resources**

- 3.1 Biodiversity-definition and types
  - 3.1.1 Significance; Threats;
- 3.2 Management strategies; Bio prospecting;
  - 3.2.1 IPR; CBD; National Biodiversity Action Plan).

**Unit 4: Forests**

- 4.1 Definition, Cover and its significance (with special reference to India)
- 4.2 Major and minor Forest products
- 4.3 Depletion; Management.

**Unit 5: Energy and Contemporary practices in resource management**

- 5.1 Renewable and non-renewable sources of energy
- 5.2 Conservation strategies
- 5.3 EIA, GIS, Participatory Resource Appraisal
- 5.4 Ecological Footprint with emphasis on carbon – footprint
- 5.5 Resource Accounting; Waste management.
- 5.6 National and international efforts in resource management and conservation

**Topics for Self - study:**

S. No.	Self Study	References
1	Global warming	<a href="https://www.toppr.com/guides/essays/essay-on-global-warming/">https://www.toppr.com/guides/essays/essay-on-global-warming/</a>
2	Ecosystem	<a href="https://www.toppr.com/guides/biology/ecosystem/components-of-ecosystem/">https://www.toppr.com/guides/biology/ecosystem/components-of-ecosystem/</a>
3	Green house gas effect	<a href="https://climate.nasa.gov/faq/19/what-is-the-greenhouse-effect/#:~:text=The%20greenhouse%20effect%20is%20the,it%20would%20be%20without%20them.">https://climate.nasa.gov/faq/19/what-is-the-greenhouse-effect/#:~:text=The%20greenhouse%20effect%20is%20the,it%20would%20be%20without%20them.</a>
4	Biofuel	<a href="https://www.britannica.com/technology/biofuel">https://www.britannica.com/technology/biofuel</a>
5	Deforestation	<a href="https://education.nationalgeographic.org/resource/deforestation">https://education.nationalgeographic.org/resource/deforestation</a>

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**TEXT BOOKS:**

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
4. Shukla, R.S. & Chandel, P.S. Plant Ecology, Latest Ed., S. Chandel and Co.
5. Kumar, H.D. Modern Concept of Ecology, Latest Ed. Vikas Publishing House

**REFERENCE BOOKS:**

1. Begon, M., Herper, J.L. and Townsend, C.R. Ecology- Individuals, Populations and Communities (3rd ed.), Oxford Blackwell Science
2. Verma, P.S. & Agarwal, U.K. Concept of Ecology, Latest Ed., S. Chand & Company
3. Odum, F.P. Fundamentals of Ecology, Latest Ed., Saunders
4. Sharma, P.D. Elements of Ecology, Latest Ed., Rastogi Publications

**WEB LINKS:**

1. [https://niti.gov.in/planningcommission.gov.in/docs/aboutus/committee/wrkgrp11/wg11\\_agrm.pdf](https://niti.gov.in/planningcommission.gov.in/docs/aboutus/committee/wrkgrp11/wg11_agrm.pdf)
2. <https://library.um.edu.mo/ebooks/b28112672.pdf>
3. [https://www.academia.edu/26716242/Community\\_Based\\_Natural\\_Resource\\_Management](https://www.academia.edu/26716242/Community_Based_Natural_Resource_Management)

**SPECIFIC LEARNING OUTCOMES (SLO):**

UNIT	CONTENT	LEARNING OUTCOME	Highest Bloom
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			<b>taxonomic level of transaction</b>
I 1.1	<b>Natural resources</b> Definition and types.	<ul style="list-style-type: none"> <li>Define natural resources</li> <li>Classify the types of natural resources</li> </ul>	K1 K3 K4
1.2	Sustainable utilization - Concept, approaches (economic, ecological and socio-cultural).	<ul style="list-style-type: none"> <li>Interpret the economic, ecological and socio-cultural</li> </ul>	K2
II 2.1	<b>Land and Water</b> Land - Utilization (agricultural, pastoral, horticultural, silvicultural); Soil degradation and management	<ul style="list-style-type: none"> <li>Explain the utilization of land</li> <li>Apply the Soil degradation and management</li> </ul>	K2 K3
2.2	Water - Fresh water (rivers, lakes, groundwater, aquifers, watershed); Marine; Estuarine; Wetlands; Threats and management strategies	<ul style="list-style-type: none"> <li>Classify the sources of water</li> <li>Apply the threats and management strategies.</li> </ul>	K3 K5
III 3.1	<b>Unit 3: Biological Resources</b> Biodiversity-definition and types; Significance; Threats	<ul style="list-style-type: none"> <li>Define biodiversity</li> <li>Explain the types of biodiversity</li> <li>Determine the significance and threats.</li> </ul>	K1 K3 K5
3.2	Management strategies Bio prospecting, IPR; CBD; National Biodiversity Action Plan).	<ul style="list-style-type: none"> <li>List out the Management strategies.</li> <li>Demonstrate the Bioprospecting; IPR; CBD</li> </ul>	K2 K4
IV 4.1	<b>Unit 4: Forests</b> Definition, Cover and its significance (with special reference to India)	<ul style="list-style-type: none"> <li>Define the Forest</li> <li>Explain the cover and significance.</li> </ul>	K1 K5

4.2	Major and minor Forest products; Depletion; Management.	<ul style="list-style-type: none"> <li>• List out the Major and minor Forest products</li> <li>• Explain the Depletion</li> <li>• Apply the Management</li> </ul>	K2 K2 K3
V 5.1	<b>Energy and Contemporary practices in resource management</b>  Renewable and non-renewable sources of energy	<ul style="list-style-type: none"> <li>• Relate and apply the Renewable and non-renewable sources of energy.</li> </ul>	K2 K3
5.2	Conservation strategies	<ul style="list-style-type: none"> <li>• Explain the various types of conservation.</li> <li>• Determine the various form of strategies.</li> </ul>	K2 K5
5.3	EIA, GIS, Participatory Resource Appraisal,	<ul style="list-style-type: none"> <li>• Summarize the EIA</li> <li>• Solve the problems in GIS</li> <li>• List out the resource appraisal.</li> </ul>	K2 K4 K3
5.4	Ecological Footprint with emphasis on carbon – footprint	<ul style="list-style-type: none"> <li>• Explain the Ecological Footprint with emphasis on carbon – footprint</li> <li>• Analyze the emphasis of carbon footprint</li> </ul>	K5 K6
5.5	Resource Accounting; Waste management.	<ul style="list-style-type: none"> <li>• Explain the resource accounting and waste management</li> </ul>	K5
5.6	National and international efforts in resource management and conservation	<ul style="list-style-type: none"> <li>• Make up and utilize the National and international efforts in resource management and conservation</li> </ul>	K6



**Mapping Scheme Course Code:U22BY6:F**

<b>U22BY 6:F</b>	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	-	H	L	M	H	L	L	M	M	L	H	-
CO2	H	M	L	-	-	L	L	-	L	H	M	H	-
CO3	H	L	-	-	L	-	-	-	M	H	L	H	H
CO4	H	L	L	-	M	-	-	-	M	M	-	H	H
CO5	M	L	-	M	-	L	M	L	-	M	H	-	L
CO6	M	-	-	L	L	M	L	L	M	-	-	L	-

L-Low (1) M-Medium (2) H-High (3)

**COURSE ASSESSMENT METHODS:****Direct**

1. Continuous Assessment by conducting Class test, Group Discussion and Quiz.
2. Assessment also done through Seminar Presentation, submission of Assignments and Model Making and Model exams.
3. End Semester Examination.

**Indirect**

1. Course-end survey

**SBEC II – MOLECULAR AND PLANT TISSUE CULTURE TECHNIQUES**

Course Code: U20BYPS2

Credits: 2

Semester: VI

Hours/Week: 2

**Course Outcome:**

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

No	COURSE OUTCOME (CO)	Level	Unit
CO 1	Build the concepts and criteria to design, organise, and maintenance of Plant Tissue Culture Laboratory	K6	I
CO 2	Comparing the gene transformation techniques using photographs and videos	K4	II

<b>CO 3</b>	Elaborating sterilization techniques, hands-on media preparation and monitoring the cultures	K6	IV
<b>CO 4</b>	Interpreting, analyzing, and validation of the bio-molecules (DNA and Protein) using the methods and protocols	K5	II
<b>CO 5</b>	Evaluating the direct and indirect methods for performing different micro propagation techniques	K5	III
<b>CO 6</b>	Propose a model of well equipped laboratory be able to develop Entrepreneurship skill with the prior knowledge of ethical values	K6	I, - V

### Syllabus:

#### **Unit I- Introduction and Molecular BioLaboratory organization (6 Hours)**

- 1.1 Molecular Biology- Definition and importance
- 1.2 Laboratory organization- Laboratory design- Laboratory requirements
- (a) Instruments (b) Glass wares (c) Chemicals - Laboratory safety- (a) Handling of Chemicals (b) Storage of Chemicals - Room Temperature - - Refrigerator - Deep Freezer (c) Personal safety (d) Disposal methods

#### **Unit –II- Plant DNA Extraction and Quantification (6 Hours)**

- 2.1 Plant DNA- Extraction- Separation - Agarose Gel Electrophoresis
- 2.2. Plant Protein- Extraction - Separation –SDS -PAGE

#### **Unit- III - Genetic transformation techniques – (6 Hours)**

- 3.1 Indirect DNA delivery- Ti plasmid - Agrobacterium-mediated transformation
- 3.2 Direct DNA delivery- Biolistics- Microinjection- Electroporation

#### **Unit –IV- Plant Tissue Culture and Sterilization Techniques (6 Hours)**

- 4.1 Sterilization techniques concepts and performance- Glass wares - Cleaning and sterilization, Medium-(a) Preparation - Murashige and Skoog (b) Maintenance of pH (c) Sterilization.
- 4.2 Explant- Washing- Sterilization
- 4.3 Culture room- Fumigation- Laminar air flow chamber -(a) Cleaning(b) UV exposure

#### **Unit-V- Micro propagation (6 Hours)**

- 5.1 Introduction to Plant tissue culture- Definition and importance- Micropropagation Techniques- Micropropagation- Direct - Indirect
- 5.2. Embryogenesis
- 5.3. Synthetic seed
- 5.4. Hardening
- 5.5. Field visit to Commercial Plant Tissue Culture Laboratory

#### **TEXT BOOKS:**

1. Rajni Sharma. 2000.*Plant Tissue Culture*, Campus books international, New Delhi,

2. Razdan, M.K. 2003. *Introduction to Plant Tissue Culture*, Second edition. Oxford and IBH publishing, New Delhi.
3. Thara, K.M. 2009. *Practical Manual series-4. Biotechnology*, New India Publishing Agency, New Delhi.
4. Bhojwani, S. S. and M. K. Razdan. 1996. *Plant Tissue Culture: Theory and Practice*, a revised edition. Elsevier Science, Netherlands.
5. Chawla, H.S. 2002. *Introduction to plant biotechnology*, second edition, Oxford & IBH Publishing, Co, Pvt. Ltd., New Delhi.

**REFERENCE BOOKS:**

1. Rajendra Reddy and Abhay Shankar, J.P. 2008. *Tissue Culture*. Commonwealth Publishers, NewDelhi.
2. Jwala Aggarwal and Shekhar K. Arora. 2014. *Experiments in Plant Tissue Culture*. Campus Book International, New Delhi.

**WEB LINKS:**

[https://onlinecourses.swayam2.ac.in/cec19\\_bt01/preview](https://onlinecourses.swayam2.ac.in/cec19_bt01/preview)

<https://adlonlinecourses.com/product/levels/professional-development/tissue-culture-100-hours-certificate-course/>

**SPECIFIC LEARNING OUTCOME (SLO):**

Unit/ Section	Content	Learning Outcome	Highest Bloom taxonomic level of transaction
1	<b>Introduction and Laboratory Organization</b>		
1.1	Molecular Biology- Definition and importance	<ul style="list-style-type: none"> <li>• Define the basic concepts and principles</li> <li>• Discuss the importance of plant culturing.</li> </ul>	<b>K6</b>

1.2	Laboratory Design and Requirements	<ul style="list-style-type: none"> <li>• Develop core knowledge about laboratory setup</li> <li>• Determine the ethics of safety measures</li> </ul>	<b>K6</b>
<b>II</b>	<b>Plant DNA Extraction and Quantification</b>		
2.1	DNA Extraction and Separation by Agarose Gel Electrophoresis	<ul style="list-style-type: none"> <li>• Make use of suitable technique in the separation of DNA</li> <li>• Explain the quality and quantity of DNA</li> </ul>	<b>K3</b> <b>K5</b>
2.2	Protein Extraction and Separation by SDS-PAGE	<ul style="list-style-type: none"> <li>• Make use of suitable technique in the separation of Protein</li> <li>• Asses the quality and quantity of Protein</li> </ul>	<b>K3</b> <b>K4</b>
<b>III</b>	<b>Genetic transformation techniques – Photographs and Video Presentation</b>		
3.1	DNA transformation by indirect methods (Ti Plasmid and <i>Agrobacterium</i> -mediated transformation)	<ul style="list-style-type: none"> <li>• Distinguish between DNA transformation indirect methods</li> <li>• Model of genetic elements present on the Ti plasmid</li> <li>• Relate the concepts of <i>Agrobacterium</i> mode of gene transfer in transformation</li> </ul>	<b>K4</b>
3.2	DNA transformation by direct methods (Biolistics, Microinjection and Electroporation)	<ul style="list-style-type: none"> <li>• Compare and contrast the process of DNA transformation using direct methods</li> <li>• Distinguish between the principles of microinjection, electroporation and biolistic gun in DNA transformation</li> </ul>	<b>K4</b>
<b>IV</b>	<b>Plant Tissue Culture and Sterilization Techniques</b>		
4.1	Sterilization and Media Preparation	<ul style="list-style-type: none"> <li>• Choose suitable sterilization methods glassware and media</li> <li>• Influence of micro-, macro-nutrients and plant growth regulators</li> <li>• Discuss about key components of media</li> </ul>	<b>K6</b>

4.2	Explants preparation	<ul style="list-style-type: none"> <li>Assess the knowledge of choosing and using specific explants</li> </ul>	<b>K5</b>
4.3	Culture room set-up and Laminar Air Flow maintenance	<ul style="list-style-type: none"> <li>Determine fumigation methods</li> <li>Make use of skills in working in Laminar Air Flow</li> </ul>	<b>K5</b>
<b>V</b>	<b>Micropropagation</b>		
5.1	Micropropagation of explants by direct and indirect methods	<ul style="list-style-type: none"> <li>Outline the procedure of <i>in-vitro</i> culturing the explants</li> <li>Assess the suitable methods for propagating plants</li> <li>Interpret, troubleshoot and standardize the protocols</li> </ul>	<b>K5</b>
5.2	Embryogenesis	<ul style="list-style-type: none"> <li>Examine the stages of embryo development</li> </ul>	<b>K4</b>
5.3	Synthetic seed	<ul style="list-style-type: none"> <li>Develop procedures for synthetic seeds</li> <li>Select suitable methods for production of synthetic seeds</li> </ul>	<b>K3</b>
5.4	Hardening	<ul style="list-style-type: none"> <li>Outline the procedure of <i>in-vivo</i> conditions for growing the explants</li> </ul>	<b>K2</b>
5.5	Field Visit	<ul style="list-style-type: none"> <li>Perceive novel ideas of gardens.</li> <li>Planning and designing of lab</li> <li>Relate with commercial aspects of micro propagation</li> </ul>	<b>K5</b>

#### Mapping Scheme for the Course Code: U20BYPS2

U20BYPS2	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	-	-	M	-	-	H	M	H	L	-	L	L
CO2	M	-	-	M	-	-	M	L	L	-	-	-	-
CO3	M	L	L	H	-	L	H	M	M	M	-	L	H
CO4	H	M	M	M	-	-	H	L	M	-	H	-	-
CO5	M	L	-	H	-	-	M	L	L	-	-	-	-
CO6	H	M	L	H	-	L	H	L	L	-	-	M	-

**Assessment/Evaluation:**

- 1. Class test, assignments
- 2. End semester exams.

**SBEC III – PLANTS AND HUMAN WELFARE**

**Semester : IV**

**Course Code : U20BYPS3**

**Credits : 2**

**Hours/Week : 2**

**Course Outcome**

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

**SYLLABUS:**

**Unit I : Flowers**

**(6 Hours)**

- 1.1. Bouquet
- 1.2. Garlands and Strings
- 1.3. Regular and festival decorations
- 1.4. Hair designs

**Unit II : Vegetables and Fruits**

**(6 Hours)**

- 2.1 Pickle (Lime / Mango / Ginger)
- 2.2. Juice (Lemon / Sweet lime)/ squash (Graph / Orange)
- 2.3. Drying (Direct & treated)
- 2.4. Vegetable, pith and grain carving

**Unit III: Fibers**

**(6 Hours)**

- 3.1 Baskets and pans
- 3.2. Ropes and chords
- 3.3. Brushes and brooms
- 3.4 . Mats and Carpets

**Unit IV: Cosmetics and Medicines**

**(6 Hours)**

- 4.1. Medicinal oils / Application – Hair oils

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Construct new patterns of designs in making Bouquets, garlands and hair designs.	K6	I
CO 2	Make use of techniques of Pickle and beverage preparation	K3	II
CO 3	Explain the protocols of making products by using plant fibers.	K2	III
CO 4	Evaluating the application of Medicinal plants in the preparation of Cosmetics, face packs and Herbal products.	K5	IV
CO 5	Create a wealthy product from the Phyto-wastes.	K6	V
CO 6	Develop Entrepreneurship skill by knowing the Aesthetic value, Medicinal value and Commercial value of Plant & its resources.	K6	I, - V

- 4.2. Preparation of Decoctions - Syrups

4.3. Herbal Remedies – Ointments, Pain balms

4.4. Cosmetics, Face packs & Skin care

**Unit V : Phytowastes to wealth**

**(6 Hours)**

5.1. Shells and rinds (Useful and ornamental articles)

5.2. Waste/used papers and wood (recycling)

5.3. Leaves (cups and plates)

5.4 Phytorejwellery (ear drops, studs, bangles / necklace)

(Details about the cultivation / procuring, processing uses and sales of these based on the availability will be dealt with the support of the field experts and field visits)

**REFERENCE BOOKS:**

1. Pandey, B.P. 2007. *Economic botany*. S. Chand and Co. New Delhi.

2. Samba Murty, A.V.S., Subramaniyan, N.S. 1989. *A Text book of economic botany*. Wiley Eastern Ltd. New Delhi,.

3. Siddappa, G.S. and Tandon, G.L. 1998. *Preservation of fruits and vegetables*. ICAR, New Delhi,

**WEB LINK:**

<https://www.theindianwire.com/education/swayam-post-graduate-college-students-complete-course-details-25307/>

**SPECIFIC LEARNING OUTCOME (SLO):**

Unit/ Section	Content	Learning Outcome	Highest Bloom taxonomic level of transaction
<b>I</b>	<b>Flowers</b>		
1.1	Bouquet	<ul style="list-style-type: none"><li>Develop the skills of making bouquet</li></ul>	K6
1.2	Garlands and Strings	<ul style="list-style-type: none"><li>Compile various hands on techniques to make the Garlands and floral strings</li></ul>	K6
1.3	Regular and festival decorations	<ul style="list-style-type: none"><li>Create decorative products</li></ul>	K6
1.4	Hair designs	<ul style="list-style-type: none"><li>Make up various hair designs by using plant products</li></ul>	K6
<b>II</b>	<b>Vegetables and Fruits</b>		
2.1	Pickle (Lime/Mango/Ginger)	<ul style="list-style-type: none"><li>Demonstrate the pickle preparation</li></ul>	K2
2.2	Juice (Lemon/Sweet Lime) / Squash (Grape/Orange)	<ul style="list-style-type: none"><li>Adapt a suitable preservation method in the preparation of squash/juice</li></ul>	K6
2.3	Drying (Directed & Treated)	<ul style="list-style-type: none"><li>List the drying methods</li></ul>	K1
2.4	Vegetable, pith and grain carving	<ul style="list-style-type: none"><li>Examine the carving techniques</li></ul>	K4

<b>III</b>		<b>Fibers</b>	
3.1	Baskets and Pans	<ul style="list-style-type: none"> <li>Outline the procedure in the preparation of Baskets and Pans</li> </ul>	K2
3.2	Ropes and Chords	<ul style="list-style-type: none"> <li>Modify the process of Rope and Chord making.</li> </ul>	K6
3.3	Brushes and Brooms	<ul style="list-style-type: none"> <li>Compare the techniques of making Brushes and Brooms</li> </ul>	K4
3.4	Mats and Carpets	<ul style="list-style-type: none"> <li>Demonstrate the Mat and Carpet making</li> </ul>	K2
<b>IV</b>		<b>Cosmetics and Medicines</b>	
4.1	Medicinal oils / Application – Hair Oil	<ul style="list-style-type: none"> <li>Make use of suitable technique in the preparation of Medicinal Oil.</li> </ul>	K3
4.2	Preparation of Decoctions- Syrups	<ul style="list-style-type: none"> <li>formulate the Medicinal Plants in the preparation of Decoction</li> </ul>	K6
4.3	Herbal Remedies – Ointments, Pain balms	<ul style="list-style-type: none"> <li>Analyse the formulations in the preparation of Ointments and Pain balms</li> </ul>	K4
4.4	Cosmetics, Face Packs & Skin Care	<ul style="list-style-type: none"> <li>Make use of the Plant resources in the preparation of Cosmetics and Face Packs</li> </ul>	K3
<b>V</b>		<b>Phyto-wastes to wealth</b>	
5.1	Shells and rinds (Useful and Ornamental articles)	<ul style="list-style-type: none"> <li>Make use of the Phyto wastes such as Shells and rinds for the production of commercial products.</li> </ul>	K3
5.2	Waste/used papers and wood (recycling)	<ul style="list-style-type: none"> <li>Demonstrate the Process of making Paper cups.</li> </ul>	K2
<b>5.3</b>	Leaves (Cups and Plates)	<ul style="list-style-type: none"> <li>Construct leaf cups and Palm plates by using Phyto-wastes</li> </ul>	K6
5.4	Phyto jewellery (ear drops, studs, bangles/necklace)	<ul style="list-style-type: none"> <li>Make use of the Phyto waste in the making of Phyto Jewels preparation.</li> </ul>	K3

### Mapping Scheme for the Course Code: U20BYPS3

<b>U20BYPS3</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PS O1</b>	<b>PS O2</b>	<b>PS O3</b>	<b>PS O4</b>
<b>CO1</b>	M	M	L	-	-	-	H	L	L	-	-	-	-
<b>CO2</b>	M	M	L	-	-	-	H	L	L	-	-	-	-
<b>CO3</b>	L	M	L	-	-	-	H	L	L	-	-	-	-
<b>CO4</b>	H	M	H	-	L	L	H	L	M	-	H	-	-
<b>CO5</b>	M	M	H	-	-	-	H	L	L	-	-	-	-



CO6	H	M	L	-	-	L	H	L	L	-	-	-	-
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**Assessment / Evaluation:**

1. Continuous Assessment by conducting Model Exams, Demonstration Experiment, Written test on Protocols.
2. Assessment also done through Lab Attendance and Practical Record work.
3. End Semester Practical Examination

