



DEPARTMENT OF BOTANY
SYLLABUS FOR B.Sc BOTANY
UNDER CHOICE BASED CREDIT SYSTEM (CBCS)
FOR CANDIDATES ADMITTED FOR
THE ACADEMIC YEAR OF
2019 -2020



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.

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 hands on experience in fundamental botany, advanced biotechnological methods, *in vitro* studies to promote new variants in crop plants and for environmental improvement.
- 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 new plant varieties, 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- 2019 ARTICULATION MATRIX

COURSE TITLE	COURSE CODE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
Angiosperm Morphology and Taxonomy	U16BY101	H	H	L	L	M	L	-	L	L	H	H	M	H
Major Practical - I	U16BY1P1	M	H	L	L	M	L	L	L	L	H	H	L	M
Plant Anatomy and Embryology	U16BY202	M	M	H	L	L	L	L	L	-	H	H	L	L
Major Practical - II	U16BY2P2	M	M	H	L	L	L	L	L	L	H	H	L	L
Plant Diversity - I (Thallophytes and Bryophytes)	U16BY303	H	H	M	L	L	L	M	-	-	H	H	L	L
Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)	U16BY404	H	H	H	H	H	M	M	L	L	H	H	M	H
Major Practical - III	U19BY4P3	H	H	L	L	H	H	M	M	M	H	H	M	L
Major Practical - IV	U16BY4P4	H	H	L	-	L	-	M	-	-	H	M	L	L
Plant Physiology, Biochemistry and Biophysics	U16BY505	H	M	M	H	H	H	H	L	L	H	H	L	L
Cell Biology, Genetics and Evolution	U16BY506	M	M	H	H	H	H	M	L	L	H	H	L	M
Major Practical - V	U16BY5P5	M	M	M	M	M	M	M	M	L	H	H	L	L
Biostatistics, Computer Applications and Bioinformatics	U16BY5:1	M	M	L	L	L	L	M	L	L	H	H	L	L
Mushroom and Nursery Technology	U16BYPS1	M	L	L	L	L	L	-	-	-	M	M	-	L
General Geology, Ecology and Phytogeography	U16BY607	H	H	L	L	L	L	L	L	-	H	H	L	L

General Microbiology	U16BY608	M	M	M	H	H	H	L	M	M	H	H	H	H
Major Practical - VI	U16BY6P6	H	M	L	H	L	M	L	-	-	H	H	L	L
Plant Breeding, Pathology, Protection and Organic Farming	U16BY6:1	M	M	M	M	-	-	M	H	H	M	H	M	M
Molecular biology and Plant Biotechnology	U16BY6:2	M	L	M	H	H	H	H	H	H	H	H	M	M
Molecular and Plant Tissue culture Techniques	U16BYPS2	M	L	H	H	H	H	H	H	H	M	M	H	H
Plant Wealth for Human Life	U16BYPS3	L	L	-	-	-	-	-	-	-	L	-	-	-

	III	Core III	Plant Diversity - I (Thallophytes and Bryophytes)	U16BY 303	6	6	25	75	100	
		Allied III	Allied Chemistry – I	U19CH Y33	4	4	25	75	100	
		Allied Prac. II	Volumetric and Organic Analysis	U19CH YP2	3	--	--	--	--	
IV	I V	NMEC I	Nursery Technology	U16BY PE1	2	2	40	60	100	
		I	Tamil IV /*	செய்யுள்(மேற்கணக்கு,கீழ்கணக்கு), இலக்கிய வரலாறு , நாடகம், மொழிப்பயிற்சி	U18TM 4L4	5	3	25	75	100
		II	English IV	English through Literature	U16EG PL4	5	3	25	75	100
IV	III	Core IV	Plant Diversity - II (Pteridophytes, Gymnosperms and Palaeobotany)	U16BY 404	6	5	25	75	100	
		Core Prac. III	Major Practical III (Covid 19)	U19BY 4P3	3	2	40	60	100	
		Core Prac. IV	Major Practical – IV	U16BY 4P4	3	2	40	60	100	
		Allied IV	Chemistry for Life Sciences	U19CH Y44	4	4	25	75	100	
		Allied Prac. II	Volumetric and Organic Analysis	U19CH YP2	3	3	40	60	100	
		I V	NMEC II	Mushroom Cultivation	U16BY PE2	2	2	40	60	100
Soft Skills	Life Skills		U16LF S41	2	1	-	-	100		
IV	V	Extension Activities	NSS, NCC, Rotaract, Leo Club, Etc.	U16ET A41	-	1	-	-	-	
		V	III	Core V	Plant Physiology, Biochemistry and Biophysics	U16BY 505	7	6	25	75
Core VI	Cell Biology, Genetics and Evolution			U16BY 506	7	6	25	75	100	
Core Prac. V	Major Practical V			U16BY 5P5	3	2	40	60	100	
Core Project	Project			U16BY 5PJ	5	5	25	75	100	
Elective I	Biostatistics, Computer Applications and Bioinformatics			U16BY 5:1	6	5	25	75	100	
VI	III	IV	SBEC I	Mushroom and Nursery Technology	U16BY PS1	2	2	40	60	100
		III	Core VII	General Geology, Ecology and Phytogeography	U16BY 607	6	6	25	75	100
			Core VIII	General Microbiology	U16BY 608	6	5	25	75	100
			Core Prac. VI	Major Practical VI	U16BY 6P6	3	2	40	60	100
			Elective II	Plant Breeding, Pathology, Protection and Organic Farming	U16BY 6:1	5	5	25	75	100
			Elective III	Molecular biology and Plant Biotechnology	U16BY 6:2	5	5	25	75	100
IV	SBEC II	Molecular and Plant Tissue culture Techniques	U16BY PS2	2	2	40	60	100		

Semester I: U18HD1L1 U17SK1L1 U18FR1L1 Semester III : U18HD3L3 U17SK3L3 U18FR3L3

		SBEC III	Plant Wealth for Human Life	U16BY PS3	2	2	40	60	10 0
	V	Gender Studies	Gender Studies	U16GS T61	-	1	-	-	10 0
Semester II: U18HD2L2 U17SK2L2 U18FR2L2 Semester IV : U18HD4L4 U17SK4L4 U18FR4L4									
Part I : 4 Core Theory : 8 Core Project : 1 Allied Theory : 4 NMEC : 2 Env. Studies : 1									Total : 42
Part II : 4 Core Prac. : 6 Allied Prac.: 2 Elective : 3 SBEC : 3 Value Education : 1									
Soft Skills : 1 Extension Activities : 1 Gender Studies : 1									

NMEC offered by the Department: 1. Nursery Technology - U16BYPE1
2. Mushroom Cultivation- U16BYPE2

ANGIOSPERM MORPHOLOGY AND TAXONOMY

Semester : I
Credits : 6

Course Code : **U16BY101**
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

SYLLABUS:

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 Aestivation, Floral diagram and floral formula

2.4 Gynoecium – types- Placentation

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**(18 Hours)**

3.0 Importance of Taxonomy

3.1 Binomial nomenclature

3.2 Bentham and Hooker’s classification, merits and demerits,

3.3 Hutchinson’s classification – Merits and demerits.

3.3 Herbarium - importance and techniques.

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

4.0 A detailed study of Angiosperm families with their economic importance.

4.1 **Polypetalae**

i) Annonaceae, ii) Capparidaceae, iii) Sterculiaceae, iv) Rutaceae, v) Fabaceae, vi) Caesalpineaceae, vii) Mimosaceae, viii) Cucurbitaceae, ix) Apiaceae.

Unit V:**(6 Hours)**

5.0 Gamopetalae - i) Rubiaceae, ii) Asteraceae, iii) Apocynaceae iv) Asclepiadaceae, v) Solanaceae, vi) Lamiaceae, vii) Verbinaceae

5.1 **Monochlamideae**- i) Euphorbiaceae, ii) Amaranthaceae,

5.2 **Monocotyledon** - i) Orchidaceae, ii) Liliaceae iii) Poaceae.

Topics for self-study:

Self-study topics	References
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General morphological characters of leaf	https://naldc.nal.usda.gov/download/CAT78702502/PDF https://www.sciencedirect.com/topics/earth-and-planetary-sciences/leaf-morphology
Plant Reproductive biology/ Pollination	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.&text=Later%2C%20The%20Origin%20of%20Species,relationship%20between%20flowers%20and%20pollinators.
Digital herbaria	http://dhcrop.bsmrau.net/
Kew botanical garden	https://www.kew.org/
Plant Databases	http://www.plantgdb.org/ http://www.plantphysiol.org/content/by/section/BIOINFORMATICS-PLANT%20DATABASES
National botanical garden, Tamil nadu	https://nilgiris.nic.in/tourist-place/botanical-garden/

TEXT BOOKS:

Taxonomy

- Pandey, B.P. 1997. *Taxonomy of Angiosperms*. S. Chand & Co., (P) Ltd., New Delhi.
- Sharma, O.P. 2000. *Plant Taxonomy*. Tata McGraw Hill Publishing Co., New Delhi.
- Pandey, S.N and Misra, S.P. 2008. *Taxonomy of Angiosperms*. Ane Books India, New Delhi.
- Sharma, O. P, 1993. *Plant Taxonomy*. Tata Mc Graw Hill Publishing Co Ltd., New Delhi.

REFERENCE BOOKS:

- Lawrence GHM, 1951. *Taxonomy of Vascular Plants*, Oxford & IBH, New Delhi.
- 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
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			LEVEL OF TRANSACTION
I	Plant Morphology		
1.1	Plant Habits	<ul style="list-style-type: none"> Recall the Plant Habits Compare the various habitats of Plants List out the systematic characteristics of angiosperm plants 	K1 K2 K4
1.2	Root, Stem and its modification	<ul style="list-style-type: none"> Classify the different morphological variation of the plant parts Explain the root, stem and its modification 	K2 K2
000000 000000 00001. 3	Phyllotaxy	<ul style="list-style-type: none"> Distinguish the leaf types 	K4
1.3.1	Leaf structure- simple, compound venation and its modifications	<ul style="list-style-type: none"> Explain the leaf structure its modifications Interpret the adaptations occurred in plant 	K2 K2
1.4	Inflorescence and types - Racemose and Cymose and special types	<ul style="list-style-type: none"> Classify the Inflorescence types 	K2
1.4.1	Racemose : simple, spike, spadix, catkin, corymb, umbel and head	<ul style="list-style-type: none"> Distinguish between Racemose inflorescence 	K4
1.4.2	Cymose: simple, monochasial – helicoids, scorpoid; Dichasial and Polychasial	<ul style="list-style-type: none"> Compare Cymose inflorescence 	K4
1.4.3	Special types of Inflorescence: cyathium, verticillaster and Hypanthodium	<ul style="list-style-type: none"> Explain the special types of Inflorescence 	K2
II	Floral Morphology		
2.1.1	Flower as a modified shoot, structure of flower	<ul style="list-style-type: none"> Explain the modified shoot Classify structure of flower 	K2 K2

2.1.2	Types of flowers	<ul style="list-style-type: none"> List out Types of flowers 	K1
2.2	Types of anthers and arrangement	<ul style="list-style-type: none"> Classify the types of anthers and arrangement 	K2
2.3	Gynoecium – types Placentation	<ul style="list-style-type: none"> Distinguish the Gynoecium and types of placentation 	K4
2.4	Aestivation Floral diagram and floral formula	<ul style="list-style-type: none"> List out the arrangement of petals and sepals in a flower bud. Apply the floral formula is a system of representing the structure of a flower using specific letters, numbers and symbols 	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"> Classify to fruit and types of fruits 	K2
III	Importance of Taxonomy		
3.0	Importance of Taxonomy	<ul style="list-style-type: none"> List out the Importance of Taxonomy 	K1
3.1.1	Systems of Classification, Binomial nomenclature	<ul style="list-style-type: none"> Apply the importance of Botanical nomenclature 	K3
3.1.2	Bentham and Hooker’s classification, merits and demerits	<ul style="list-style-type: none"> Explain the classification of Bentham and Hooker and others 	K4
3.1.3	Hutchinson’s classification – Merits and demerits.	<ul style="list-style-type: none"> Outline the classification of Hutchinson’s classification – Merits and demerits 	K2
IV	Polypetalae		

4.1	Polypetalae: i) Annonaceae, ii) Capparidaceae, iii) Sterculiaceae, iv) Rutaceae, v) Fabaceae, vi) Caesalpineaceae, vii) Mimosaceae, viii) Cucurbitaceae, ix) Apiaceae.	<ul style="list-style-type: none"> • Illustrate the salient features of plants belonging to the families Annonaceae to Apiaceae • Identify the characters of various plant families. 	K2 K3
V	Gamopetalae		
5.1	Gamopetalae: i) Rubiaceae, ii) Asteraceae, iii) Apocynaceae, iv) Asclepiadaceae, v) Solanaceae, vi) Lamiaceae, vii) Verbinaceae	<ul style="list-style-type: none"> • Distinguish the plants belonging to Gamopetalae and apply the knowledge gained by studying families under Rubiaceae to Verbinaceae 	K4
5.2	Monochlamideae : i) Euphorbiaceae, ii) Amaranthaceae	<ul style="list-style-type: none"> • Distinguish the plants belonging to the families 	K4
5.3	Monocotyledon : i) Orchidaceae, ii) Liliaceae, iii) Poaceae	<ul style="list-style-type: none"> • Distinguish the plants belonging to the families • Apply the knowledge gained by studying the plants belonging to Monocotyledon 	K4 K3

Mapping Scheme for the Course Code: U16BY101

U16BY 101	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 - I

Semester : I

Credits : 2

Course Code : U16BY1P1

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 morphological variations and modifications of the plant	K3	I
CO 2	Analyse plant modifications based on ecological adaptation	K4	I
CO 3	Make use of the knowledge in identifying the plants belonging to the Polypetalae family.	K3	II
CO 4	Distinguish the floral characters of different families belonging to the Gamopetalae	K4	II
CO 5	Identify Monocotyledon plants by their characters	K3	II
CO 6	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 (Bougainvillea), 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), Monochasialscorpioid (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	https://www.merriam-webster.com/dictionary/placentation
Plant Reproductive biology/ Pollination	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.&text=Later%2C%20The%20Origin%20of%20Species,relationship%20between%20flowers%20and%20pollinators.
Digital herbaria	http://dhcrop.bsmrau.net/
Kew botanical garden	https://www.kew.org/

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/ SECTI ON	CONTENT	LEARNING OUTCOME	HIGHEST BLOOM TAXONO MIC LEVEL OF TRANSA CTION
I	Morphological studies in Plants		

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)	<ul style="list-style-type: none"> • Define the root modifications by observing the parts. • Explain the useful plant parts 	K2 K2
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)	<ul style="list-style-type: none"> • Explain the use for stem modifications and the parts adaptation • Examine the ecological adaptation of plant modification 	K2 K4
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	<ul style="list-style-type: none"> • Define the leaf modifications in plants • Explain the taxonomic principles for plant identification 	K2 K2

	(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 (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 (Leucas), Hypanthodium (Fig).	<ul style="list-style-type: none"> • Make use of the flower types for plant identification • Tell the various types of flowers • Analyze the flower modification that favour pollination 	K3 K1 K4
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).	<ul style="list-style-type: none"> • Examine the various fruit modifications • Analyze the seed dehiscence mechanisms • Define the fruit types 	K4 K4 K2
II	Taxonomy		
	Taxonomy Study of various angiosperm families mentioned in the syllabus by using MLS of flower and study of floral whorls	<ul style="list-style-type: none"> • Analyze the plant groups on various groups • Identify the plant category • Make use of the scientific classification of plants 	K4 K3

	with floral formula and floral diagram.		K3
III	Economic Importance in Plants		
	Binomials and Morphology of the useful parts of the Economic products belonging to the families studied.	<ul style="list-style-type: none"> Explain the economic importance of selected plant parts. 	K2

Mapping Scheme for the Course Code: U16BY1P1

U16BY 1P1	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

ALLIED BOTANY - I

Semester : I

Credits : 3

Course Outcomes:

Course Code : U16BYY11

Hours/Week : 4

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

No	COURSE OUTCOMES (CO)	Level	Unit
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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	Explain the different plant species	K 5	III
CO 5	Examine the internal structure of Dicot and Monocot leaf, stem and root	K4	IV
CO 6	Determine the various components of male and female gametophyte and mechanism of fertilization	K5	V

SYLLABUS:

Unit I: Plant Diversity

(12 Hours)

1.1 Structure, reproduction and life cycle of

- (a) Algae - *Chlamydomonos*
- (b) Fungi - *Penicillium*
- (c) Bryophytes - *Riccia*
- (d) Pteridophytes - *Lycopodium*
- (e) Gymnosperms - *Cycas*

Unit 2: Morphology of Angiosperms

(12 Hours)

2.1 Leaf shape and Phyllotaxy

2.2 Inflorescence

- (a) Racemose, (b) Cymose (c) Special types

2.3 Terminologies in flower description.

Unit 3: Plant Taxonomy:

(12 Hours)

3.1 Bentham and Hooker Systems of Classification

3.2 Study of following Plant families

- (a) Annonaceae, (b) Cucurbitaceae, (c) Lamiaceae, (d) Euphorbiaceae (e) Poaceae.

Unit 4: Anatomy

(12 Hours)

4.1 Meristematic - Definition, Types (Apical, Lateral and Intercalary) and Functions

4.2 Permanent Tissue - Parenchyma, Collenchyma, Chlorenchyma and Sclerenchyma

Complex tissue – Xylem and Phloem

4.3 Primary and Secondary structure of Dicot and Monocot - (a) Leaf (b) Stem (d) Root.

Unit 5: Embryology**(12 Hours)**

5.1 Structure of Flower

5.1 Structure of male gametophyte (Anther- Internal Structure and Functions)

5.2 Structure of Female gametophyte (Ovules – Definition and Types of ovules Orthotropous, Anatropous, Campylotropous, Hemianatropous and Amphitropous)

5.3 Fertilization and Dicot Embryo (Polygonum)

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 6th 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	https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/hill-reaction
2.	Ecological adaptations of xerophytes	https://www.biologydiscussion.com/plants/xerophytes/xerophyte-meaning-and-characteristics-plants-botany/75464

3.	Torus	https://www.easybiologyclass.com/pits-ultra-structure-classification-functions-simple-bordered-pits-similarities-differences/
4.	secondary wall thickening	https://www.biologydiscussion.com/plants/cell-wall/thickening-of-cell-wall-in-plants-with-diagram-botany/68837

SPECIFIC LEARNING OUTCOME (SLO):

Unit/ Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
I	Plant Diversity		
1.1	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"> Explain the habit and habitat of Cryptograms and phanerograms Tell life cycle of plant groups 	K2 K2
II	Morphology of Angiosperms		
	2.1 Leaf shape and Phyllotaxy 2.2 Inflorescence (a) Racemose, (b) Cymose (c) Special types 2.3 Terminologies in flower description.	<ul style="list-style-type: none"> Explain the structure of leaf and its arrangements Make use of defining the plant families 	K2 K3
III	Taxonomy		
	Bentham and Hooker Systems of Classification 3.2 Study of following Plant families (a) Annonaceae, (b) Cucurbitaceae, (c) Lamiaceae, (d) Euphorbiaceae (e) Poaceae.	<ul style="list-style-type: none"> Identify the plant species Explain the phylogeny of plant species 	K3 K5

IV	Anatomy		
4.1	Meristematic - Definition, Types (Apical, Lateral and Intercalary) and Functions	<ul style="list-style-type: none"> Explain tissue in leaf, stem and root 	K2
4.2	Permanent Tissue - Parenchyma, Collenchyma, Chlorenchyma and Sclerenchyma, Complex tissue -Xylem and phloem	<ul style="list-style-type: none"> Examine the order of arrangement of tissues in plants Explain the structure of tissues 	K4 K2
4.3	Primary and Secondary structure of Dicot and Monocot - (a) Leaf (b) Stem (d) Root.	<ul style="list-style-type: none"> Compare the internal structure of leaf, stem and root Analyze the arrangement of tissues in leaf, stem and root 	K2 K4
V	Embryology		
5.1	Structure of Flower	<ul style="list-style-type: none"> Illustrate the arrangements of various parts in flowers 	K2
5.2	Structure of male gametophyte (Anther- External and Internal Structure and Functions)	<ul style="list-style-type: none"> Explain the importance of anther and pollen and internal structure of anther 	K5
5.3	Structure of Female gametophyte (Ovules – Definition and Types of ovules Orthotropous, Anatropous, Campylotropous, Hemianatropous and Amphitropous)	<ul style="list-style-type: none"> Recognize main difference between male and female gametophyte Explain the structure of Ovule 	K2 K5
5.4	Fertilization and Dicot Embryo (Polygonum)	<ul style="list-style-type: none"> Illustrate mechanism of fertilization 	K2

Mapping Scheme Course Code: U16BYY11

U16BYY 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

Course Code : U16BYY22

Credits : 4

Hours/Week : 2

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.	K3	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	IV
CO 6	Appraise the adaptations of plants in various habitat and their ecological and economic importance	K5	IV, V

SYLLABUS:

Unit I: Plant Propagation

(12 Hours)

1.1 Asexual methods: (a) Cutting (b) Air layering (c) Grafting (d) Budding.

1.2 Micropropagation - Medium, Explants, Techniques and Application

Unit-2: Plant Pathology

2.1 Detailed study of following plant diseases, symptoms, causal agents, and control

(a) White rust disease (b) Citrus canker (c) TMV

2.2 Plant protection methods

Natural methods: (a) Prevention (b) control (C) Eradication (d) Plant quarantine

Biological Control and methods of application

(a) Pesticide (b) Fungicide

Unit III: Ecology

(12 Hours)

3.1 climatic factors- (a) Edaphic (b) Biotic

3.2 Plant adaptations (a) Xerophytic (b) Hydrophytes (c) Halophytes

3.3 Vegetational types of Tamil Nadu.

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. 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 Cossec2 (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 Nagargoil, 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	https://www.coursera.org/learn/plant-biology
Modifications of plants	http://kea.kar.nic.in/vikasana/bridge/biology/chap_05_ppt.pdf
Gootee	https://www.merriam-webster.com/dictionary/gootee

SPECIFIC LEARNING OUTCOME (SLO):

Unit/Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
I	Plant Propagation		
	1.1 Asexual methods: (a) Cutting (b) Air layering (c) Grafting (d) Budding. 1.2 Micropropagation - Medium, Explants, Techniques and Application	<ul style="list-style-type: none"> • Define the morphology, structure and arrangement of leaves, scales, or bracts with flowers along the plant stem. 	K2

II	Plant Pathology		
2.1	.1 Detailed study of following plant diseases, symptoms, causal agents, and control (a) White rust disease (b) Citrus canker (c) TMV 2.2 Plant protection methods Natural methods: (a) Prevention (b) control (C) Eradication (d) Plant quarantine Biological Control and methods of application (a) Pesticide (b) Fungicide	<ul style="list-style-type: none"> • Illustrate the Plant disease infections Plant families. • Identify the plant diseases based on their morphological characters. 	K2 K3
III	Ecology		
3.1	3.1 climatic factors- (a) Edaphic (b) Biotic 3.2 Plant adaptations (a) Xerophytic (b) Hydrophytes (c) Halophytes 3.3 Vegetational types of Tamil Nadu.	<ul style="list-style-type: none"> • Explain the ecological adaptations of plants • Analyse the morphological adaptations plants observe in their habitat 	K2 K4
IV	Plant Physiology		
4.1	Absorption of water and salts	<ul style="list-style-type: none"> • Identify the mode of absorption • Illustrate and analyze the mechanism of water and salt Absorption 	K3 K2
4.2	Role of mineral elements (Micro minerals and Macro minerals)	<ul style="list-style-type: none"> • Interpret role of minerals in plant growth 	K5
4.3	Nitrogen cycle, Transpiration	<ul style="list-style-type: none"> • Explain the significance of stomatal transpiration • Analyze the mechanism significance of transpiration 	K2 K4
V	Photosynthesis		
5.1	Light and Dark Reactions	<ul style="list-style-type: none"> • Illustrate the mechanism of photosynthesis • Explain the importance of photosynthesis 	K2 K4

5.2	Respiration – (a) Aerobic (b) Anaerobic	<ul style="list-style-type: none"> • Compare the Aerobic and Anaerobic • Explain the difference between respiration 	K2 K4
5.5	Krebs cycle and oxidative phosphorylation	<ul style="list-style-type: none"> • Explain how the plants respire. • Apply the mechanism of respiration 	K5 K3

Mapping of Course Code: U16BYY22

U16BYY 22	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	M	-	-	M	-	M	-	-	H	L	-	H
CO 2	H	H	M	H	L	-	L	M	M	H	H	-	H
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

Semester: I & II
Credits: 3

Course Code: U16BYYP1
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.	K 4	I, II
CO 2	Understand and illustrate the structure and arrangement of tissue and morphology of plants.	K 3	III
CO 3	Compare the internal structure of leaf, stem and root of dicot and monocot plants and the gametophyte development.	K 4	IV
CO 4	Distinguish the economic importance of plants	K 4	V
CO 5	Analyse propagation, protection methods for the plants.	K 4	VI, VII
CO 6	Explain the vital plant functions and disease resistance in plants	K 5	VIII, IX

Unit-1: Plant Diversity

(6 Hours)

- (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: Taxonomy

(6 Hours)

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

Unit-3: Anatomy

(6 Hours)

- (a) T.S of dicot Stem, Leaf and Root (Hand work)
- (b) T.S of monocot Stem, Leaf and Root (Hand work)

Unit-4: 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-5: Economic Botany- (Images) (6 Hours)

- (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-6: Plant propagation - (Hand work) (6 Hours)

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

Unit-7: Plant Protection (3 Hours)

- (a) Knapsac sprayer (B) Cyanomag foot pump duster

Unit -8: Plant Pathology

- (a) White rust disease (b) Citrus canker (c) TMV

Unit-9: 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.

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 6th 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	https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/hill-reaction
secondary wall thickening	https://www.biologydiscussion.com/plants/cell-wall/thickening-of-cell-wall-in-plants-with-diagram-botany/68837
Vegetative propagation	https://www.toppr.com/en-in/content/concept/vegetative-propagation-201517/

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) Algae - <i>Chlamydomonas</i> (b) Fungi- <i>Penicillium</i> (c) Bryophyte - <i>Riccia</i> - Habit, Thallus Sporophyte (d) Pteridophyte-<i>Lycopodium</i> – Habit, Stem (e) Gymnosperm-<i>Cycas</i> – Habit, Corolloid root, Rachis, Leaflets, Microsporophyll And Megasporophyll</p>	<ul style="list-style-type: none"> • Distinguish the structure of cryptogamae and phanerogamae via., permanent slides and fresh Specimen • List the external characteristic of plant group • Illustrate the various external and internal structure of Lower plants 	<p>K4 K1 K2</p>
II	Taxonomy		
	<p>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></p>	<ul style="list-style-type: none"> • Examine the morphological feature of flowering plants • Illustrate the external characteristic features of plant • Analyse the floral diagram and formula for each species 	<p>K4 K2 K4</p>
III	Anatomy		
	<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"> • Explain the structure of meristems and tissues • Examine the structure of permanent tissue though slides • Compare and contrast feature between dicot and monocot • Identify and illustrate the tissues arrangement in leaf stem and root 	<p>K2 K2 K3</p>
IV	Embryology		
	<p>(a) T.S of mature anther (b) Ovule - ovules: anatropous, orthotropous, circinotropous, amphitropous and campylotropous (c) Fertilization (d) Embryo- (i) Cordata (ii) Globular</p>	<ul style="list-style-type: none"> • Analyse the various development pattern of the reproductive structures of plants. • Compare the seed development in various plants. 	<p>K4 K2</p>

V	Economic Botany		
	(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"> List out the economic importance of Plants Categorize the plant species based on various characters. Compare the importance of plant products 	K1 K4 K2
VI	Plant Propagation		
	(a) Air layering (b) Wedge grafting (c) Cleft grafting	<ul style="list-style-type: none"> Compare the various kinds of vegetative propagation methods in plants 	K4
VII	Plant Protection		
	(b) Knapsac sprayer (c) Cyanomag foot pump duster	<ul style="list-style-type: none"> Analyse the use of plant protection methods 	K4
VIII	Plant Pathology		
	(a) White rust disease (b) Citrus canker (c) TMV	<ul style="list-style-type: none"> Explain the plant disease spreads 	K5
IX	Plant Physiology		
	(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	<ul style="list-style-type: none"> Demonstrate the various physiological process Analyse the various physiological process Explain the important feature of experiments 	K2 K4 K5

Mapping Scheme Course Code: U16BYYP1

U16BYY P1	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**

ALLIED I: ENVIRONMENTAL BOTANY

Semester I

Credits: 3

Code: U17ESBY1

Hours/Week: 3

THEORY

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	1
CO 2	Describe the concept of Plant morphology and its Modifications	K2	II

CO 3	Appraise the knowledge about the various aspects of inflorescence and plant taxonomy	K4	II
CO 4	Discuss the basic concepts of plant Anatomy and plant Embryology	K6	III
CO 5	Explain the various concepts of Plant physiology	K5	IV
CO6	Describe the various plant diseases and also plant as ecological indicator.	K4	V

Syllabus:

Unit I Plant Diversity (12 Hours.)

Structure, reproduction and life cycle of Algae - Chlamydomonos, Fungi - Penicillium, Bryophyte -Riccia, Pteridophyte – Lycopodium and Gymnosperm -Cycas.

Unit II Morphology (12 Hours.)

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 (12 Hours.)

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 Plant Physiology (12 Hours.)

Absorption of water and salts. Role of mineral elements; Transpiration. Photosynthesis, Light and Dark Reactions – C3 Cycle, Respiration – aerobic, anaerobic, Krebs cycle.

Unit V Plant as an ecological indicator (12 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. Muneeswaran, A., 2004. *Allied Botany*, Titan Books, Madurai, India.
3. Rao, K.N. Krishnamoorthy, K. and Rao. G.S. 1979. *Ancillary Botany*, Rajalakshmi Publication, Nagercoil.

REFERENCES BOOKS:

1.S K Verma and Mohit Verma. 1995. *A Textbook of Plant Physiology, Biochemistry and Biotechnology*. S Chand Publications.

Web Link:

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

TOPICS FOR SELF-STUDY

Topics for Self-Study	Reference Link
Adaptations of plants	https://www.mbgnet.net/bioplants/adapt.html
secondary wall thickening	https://www.biologydiscussion.com/plants/cell-wall/thickening-of-cell-wall-in-plants-with-diagram-botany/68837
Vegetative propagation	https://www.toppr.com/en-in/content/concept/vegetative-propagation-201517/

SPECIFIC LEARNING OUTCOMES (SLO)

Unit	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> .	Explain lower group of plant kingdom and their reproduction systems.	K2
II	Morphology		
2.0	Root, shoot system and its modification.	Recognize the importance and study morphological features of plants	K2

2.1	Inflorescence – Simple and compound and Special types – one example). Flower description.	Develop the interest in study of inflorescence.	K3
2.2	Taxonomy: 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> .	Demonstrate the various taxonomical information of plants.	K4
III	Anatomy		
3.0	Tissue (Meristematic and Permanent), primary structures of Dicot and Monocot Stem and Root.	Demonstrate understanding of fundamental concepts of plant anatomy	K2
3.1	Embryology: Structure of Anther and Ovule; Types of Pollination, Fertilization and development of Dicot Embryo.	Explain the simple concepts of embryology	K2
IV	Plant physiology		
4.0	Absorption of water and salts. Role of mineral elements; Transpiration. Photosynthesis, Light and Dark Reactions – C3 Cycle, Respiration – aerobic, anaerobic, Krebs cycle.	Demonstrate fundamental of plant physiology in plants.	K4
V	Plant as an ecological indicator		
5.0	characteristics, type and physiological changes.	Discuss about the different Plants as an ecological indicator	K6
5.1	Plant pathology: 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.	Demonstrate the various plant diseases in india.	K2 and K4

Mapping Scheme for the Course Code: U17ESBY1

U17ESBY1	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

Code: U18ESBP1

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	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

CO 4	Examine the different types of Plant Physiology (Demo only),	K4	IV
CO 5	Analyse the plant physiological functions	K4	IV
CO 6	Importance of Plant pathology (<i>White rust, Citrus canker</i> and <i>Tobacco</i>) Plant specimens for the ecological indicators	K 2	V

SYLLABUS:

Unit I (12 Hours)

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

Unit II (12 Hours)

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

Unit III (12 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 (12 Hours)

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

Unit V (12 Hours)

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

TEXT BOOKS:

1. Mathawat, G.S.P., Sharma, D. and R.K. Sahni. 1996. *A text book of Botany*, Ramesh Book depot, Jaipur.
2. Muneeswaran, A. 2004. *Allied Botany*, Titan Nooks, Madurai, India.
3. Rao, K.N. Krishnamoorthy, K. and G.S. Rao. 1979. *Ancillary Botany*, Rajalakshmi Publication, Nagerkoil.

REFERENCE BOOKS:

1. Chattopadhyaya, S.B., 1991. *Principles and Procedures of Plant protection*, (3rd Ed.), Oxford and IBH Publishing Cossec2 (P) Ltd., New Delhi.
2. Fuller, H.J. and Tippo, O. 1967. *College Botany*, Henry Holt and Co., New York.
3. Gangully, A.K., 1971. *General Botany*, The New Book Stall Calcutta, Vol I and II. Rajalakshmi Publication., Nagerkoil.

WEB LINKS:

https://onlinecourses.nptel.ac.in/noc19_ag04/preview

TOPICS FOR SELF STUDY:

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

SPECIFIC LEARNING OUTCOMES (SLO):

Unit/ Section	Course Content	Learning Outcomes	Highest Blooms Taxonomic level of transaction
1	<p>Plant diversity: 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></p>	<ul style="list-style-type: none"> Explain the habit and habitat of Cryptograms and phanerograms Distinguish life cycle of plant groups 	<p>K2</p> <p>K 4</p>

	(e) Gymnosperms- <i>Cycas</i>		
2	Plant Taxonomy: Annonaceae – <i>Polyalthia longifolia</i> ; Apocyanacea – <i>Vinca rosea</i> ; Lamiaceae – <i>Leucas aspera</i> ; Euphorbiaceae – <i>Euphorbia hirta</i> : Poaceae – <i>Chloris barbata</i>	<ul style="list-style-type: none"> Examine the morphological feature of flowering plants Illustrate the external characteristic features of plant Analyse the floral diagram and formula for each species 	K4 K2 K4
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"> Compare the internal structure of leaf, stem and root Determine the arrangement of tissues in leaf, stem and root Illustrate the arrangements of various parts in flowers Explain the importance of anther and pollen and internal structure of anther 	K2 K4 K2 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"> Demonstrate the various physiological process 	K2
5	Plant specimens for the ecological indicators; Plant pathology: <i>White rust</i> , <i>Citrus canker</i> and <i>Tobacco</i>	Demonstrate the various infected plants	K 2

Mapping Scheme for the Course Code: U18ESBP1

U18ESBP1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO 1	H	M	H	L	L	-	L	M	M	H	M	M	L
CO 2	M	L	M	L	M	-	-	L	M	H	M	M	L
CO 3	M	L	M	L	L	-	-	L	M	H	M	L	L
CO 4	H	L	H	L	-	-	L	-	M	H	L	L	L
CO 5	M	M	H	L	L	-	-	L	M	H	L	L	L
CO 6	M	M	H	L	M	-	-	M	M	H	M	L	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 II : PLANT ANATOMY AND EMRYOLOGY OF ANGIOSPERM

Semester: II
Credits : 6

Course Code: U16BY202
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 it 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- PRIMARY AND SECONDARY GROWTH, ANOMALOUS SECONDARY GROWTH (15 Hours)

3.1. Primary Growth - Definition

3.1.1. Structure of Monocot and Dicot Root, Stem and leaf

3.2. Secondary Growth - Definition

3.2.1. Secondary growth in dicotyledonous stem and root

3.2.2 Annual Rings

3.2.3 Heart Wood and Sap Wood

3.3 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, APOMIXIS AND POLYEMBRYONY (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	https://www.nature.com/scitable/topic/cell-cycle-and-cell-division-14122649/ https://www.genome.gov/genetics-glossary/Cell-Cycle

Abscission and healing of wounds	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2634118/ https://nph.onlinelibrary.wiley.com/doi/pdf/10.1111/j.1469-8137.1986.tb00606.x
Ecological Anatomy	https://www.researchgate.net/publication/279432765_Ecological_anatomy https://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-29452018000400201
Systemic Plant Anatomy	https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/plant-anatomy https://pubmed.ncbi.nlm.nih.gov/21245193/
Palynology	https://www.floridamuseum.ufl.edu/paleobotany/palynology/#:~:text=Palynology%20is%20the%20study%20of,both%20living%20and%20fossil%20form. https://sfb.univie.ac.at/en/research/palynology/
Embryology in relation to Taxonomy	https://link.springer.com/chapter/10.1007/978-3-642-69302-1_14 https://www.jstor.org/stable/2481545?seq=1
Experimental Embryology	https://www.ncbi.nlm.nih.gov/books/NBK10002/ https://www.nature.com/articles/080451a0

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
I	Scope of Plant Anatomy & Meristematic Tissue System		
1.1	Scope of Plant Anatomy -Application in Systematics, forensics and Pharmacognosy	<ul style="list-style-type: none"> List out the Scope of Plant Anatomy Discuss the scope of Plant anatomy in connection with Systematics, Forensics and Pharmacognosy fields. 	K1 K2
1.2	Plant Tissues Tissues – Definition Characteristics & Classification	<ul style="list-style-type: none"> Define – Tissue Classify the kinds of Plant tissue 	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	<ul style="list-style-type: none"> Explain the Structure of Simple Permanent tissues List out the functions of Simple Permanent tissues. Discuss the Components of Complex tissues. 	K2 K4

	Pits and Plasmodesmata		K2
1.4	<p>Meristematic Tissue</p> <p>Characteristics, Classification of meristem- based on stage of development</p> <p>Organisation – Shoot Apex- Apical Cell theory, Histogen theory, Tunica Corpus theory, Types of Vascular Bundles, Primary Structure of Dicot and Monocot stem</p> <p>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.</p>	<ul style="list-style-type: none"> • Classify the meristem and its type. • Elaborate the theories related with the shoot apical meristem. • Distinguish Primary Structure of monocot stem from Dicot stem. • Discuss the theories related with the Root Apical Meristem • Compare the Primary Structure of Dicot and Monocot Root. 	<p>K4</p> <p>K2</p> <p>K4</p> <p>K6</p> <p>K4</p>
1.5	<p>Secretory Tissue</p> <p>Laticiferous tissues – I) Non-articulate Latex Ducts/Latex cells II) Articulate Latex Ducts/Latex Vessels</p> <p>Glandular tissues – I) Hydathodes II) Lithocytes III) Cavities</p>	<ul style="list-style-type: none"> • Categorize the kind of Secretory tissue system. • Explain the Glandular tissues and its type. 	<p>K4</p> <p>K5</p>
II	EPIDERMAL AND VASCULAR TISSUE SYSTEM, NODAL ANATOMY		
2.1	<p>Epidermal Tissue System</p> <p>Cuticle, epicuticular waxes, trichomes (Uni and Multicellular, Glandular and Non-glandular – Two examples each), Stomata and its type.</p>	<ul style="list-style-type: none"> • Elaborate the types of Epidermal Tissue System. • Classify the Stomatal types with examples. 	K6

			K4
2.2	Vascular Cambium Structure and Function, Secondary growth in Root and Stem	<ul style="list-style-type: none"> • Explain the structure and function of Vascular Cambium. • Discuss the Secondary growth pattern in Root & Stem. 	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"> • Distinguish the anatomical structure of Monocot and dicot leaf. • Define -Leaf Trace, Leaf Gap • Explain the types of nodes 	K4 K1 K2
III	PRIMARY AND SECONDARY GROWTH, ANOMALOUS SECONDARY GROWTH		
3.1	Secondary growth in dicotyledonous stem and root	<ul style="list-style-type: none"> • Compare the anatomy of axillary and radially oriented elements of Cambium. 	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"> • Discuss about the various kinds of wood 	K6
3.3.1	Anomalous Secondary Growth Anomalous secondary growth of Genus <i>Aristolochia</i> and <i>Dracaena</i>	<ul style="list-style-type: none"> • Criticize the anomalous nature of <i>Aristolochia</i>. • Justify the Anomalous secondary growth in <i>Dracaena</i>. 	K5 K5
IV	EMBRYOLOGY OF ANGIOSPERMS		
4.1	Flower and its parts	<ul style="list-style-type: none"> • Analyse the flower and its parts 	K4

4.2	Stamen and Androecium (microsporangium) -Structure of anther - Microsporangium-development of anther	<ul style="list-style-type: none"> Distinguish the anther wall and sporogenous tissue 	K4
4.3	Microgametogenesis - Development of male gametophyte - Pollen development and structure	<ul style="list-style-type: none"> Explain the development of male gametophyte Examine the pollen development and structure 	K2 K4
4.4	Carpel and Gynoecium (Megasporangium) - Megasporangium – Structure and development -Types of ovules - Orthotropous, Anatropous, Campylotropous, Hemianatropous and Amphitropous	<ul style="list-style-type: none"> Analyse the Structure and development of megasporangium Interpret the types of ovules 	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"> Explain the development of female gametophyte Classify the types of embryo 	K2 K2
V	POLLINATION, FERTILIZATION, APOMIXIS AND POLYEMBRYONY		
5.1	Pollination - Definition	<ul style="list-style-type: none"> Compare the various types of pollination. 	K5

	<p>-Pollination mechanism</p> <p>-Types of Pollination – Self Pollination, Cross Pollination</p> <p>-Advantages and disadvantages of pollination.</p> <p>Pollen pistle interaction</p>		
5.2	<p>Double Fertilization</p> <p>- Syngamy - Triple fusion</p>	<ul style="list-style-type: none"> Analyse the double fertilization changes 	K4
5.3	<p>Post fertilization changes</p>	<ul style="list-style-type: none"> Understand the post fertilization changes 	K2
5.4	<p>Endosperm</p> <p>- Definition, Types – Nuclear, Cellular and Helobial, function of endosperm- Ruminant endosperm</p> <p>- Endosperm haustoria</p>	<ul style="list-style-type: none"> Categorize the types of endosperm 	K4
5.5	<p>Embryo development</p> <p>-Development and structure of Embryo in Dicots and monocots</p>	<ul style="list-style-type: none"> Describe the plant embryo development and structure 	K3
5.6	<p>Seed structure</p> <p>-Structure of monocot and Dicot seed</p> <p>-Importance and reserve food materials of seed</p>	<ul style="list-style-type: none"> Differentiate the monocot and dicot seed structure Manipulate the importance of the seed 	K4
5.7	<p>Apomixis</p> <p>- Definition and types</p> <p>- Parthenocarpy and its application</p>	<ul style="list-style-type: none"> Compare the apomixes and parthenocarpy 	K4
5.8	<p>-Polyembryony and its application</p>	<ul style="list-style-type: none"> Predict and illustrate the poly embryony 	K4

Mapping Scheme for the Course Code: U16BY202

U16BY202	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	1	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 II – PLANT ANATOMY AND EMBRYOLOGY

[CORE PRACTICAL – II]

Course code: U16BY2P2

Credits: 2

Course Outcomes:

Semester : II

Hours/Week: 3

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 observing various tissue system.	K4	I

CO 2	Distinguish various kind of tracheary elements by performing Maceration technique.	K4	II
CO 3	Dissect the plant specimen of Stem, root and Leaf of Dicot and Monocot Plants and compare its anatomical features.	K4	III
CO 4	Dissect out and mount the Pollinium and Dicot Embryo.	K4	IV
CO 5	Analyze the structure of anther and Embryo sac.	K4	V
CO 6	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

(6Hours)

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

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. Pollen Morphology. (n.d.). Pollen Terminology, 15–25. doi:10.1007/978-3-211-79894-2_4
2. <https://bio.biologists.org/content/7/5/bio031237>

3.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	<p>Study the Structure of shoot apex using hand section and preparation of temporary mounts-<i>Hydrilla</i> twigs with 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"> • Dissect out the Shoot Apical Meristem. • Identify the simple tissues and Complex tissues • Distinguish between Articulated Latex vessels & Non-articulated latex ducts 	<p>K4</p> <p>K3</p> <p>K4</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.</p> <p>Study of Nodal anatomy: (i) Unilacunar Node (ii) Trilacunar Node (iii) Multilacunar Node.</p>	<ul style="list-style-type: none"> • Examine the Tracheary elements. • Outline the types of stomata • Identify the kinds of Nodal anatomy. 	<p>K4</p> <p>K2</p> <p>K3</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:</p>	<ul style="list-style-type: none"> • Compare the anatomical features Primary Structure of stem, root and leaves of Dicot and Monocot Plant specimens. 	<p>K5</p> <p>K5</p>

	Dicot Root – <i>Tridax</i> sp.; Dicot Stem – <i>Pongamia</i> . Study of anomalous secondary thickening and preparation of T.S – (i) <i>Dracaena</i> (ii) <i>Aristolochia</i> .	<ul style="list-style-type: none"> Compare the anatomical anomalies of Secondary thickenings of <i>Dracaena</i> and <i>Aristolochia</i> 	
4	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.	<ul style="list-style-type: none"> Examine the floral parts of bisexual and unisexual flowers. Dissect out and mount the Dicot Embryo Dissect out and mount the Pollinium 	K4 K4 K4
5	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</i> , <i>Hibiscus</i> , <i>Acacia</i> , <i>Grass</i>).	<ul style="list-style-type: none"> Identify and label the parts of anther. Distinguish the various kind of ovules and its arrangement. Analyze the Structure of an Embryo sac. Identify the Pollen Morphology. 	K3 K4 K4 K3

Mapping Scheme for Course Code: U16BY2P2

U16BY 2P2	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

Course-end survey

CORE PRACTICAL III - PLANT DIVERSITY- I
(THALLOPHYTES AND BRYOPHYTES)

Semester : III

Course Code : U16BY3P3

Credits : 2

Hours/Week : 3

Course Outcome

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

No	Course Outcome (CO)	Level	Unit
CO1	Name and identify the different algal Specimens	K3	I
CO2	Show the sections and understand the economic importance of algae	K1	I
CO3	Distinguish the fungal specimens and diseases caused by them	K4	II
CO4	Experiment the specimen by cross sectioning.	K3	II
CO5	Explain the morphological and general characteristics of lichens and describe the fruiting bodies of Lichen- Apothecium	K2	III
CO6	Summarise the morphology and general characters of Riccia	K2	IV

Algae

(15 Hours)

1. To analyse the general characteristics of the algal specimens and identification with reasons
Oscillatoria, Volvox, Navicula, Dictyotaand Gracillaria.

2. To understand taking section and giving structural features- Dictyota and Gracillaria.
3. To know the economic importance of Laminaria, Gracillaria, Chondrus and Spirullina

Fungi **(15 Hours)**

1. To study the fungal specimens in reference to plant disease and their spore structure Phytophthora, Cersospora and Mucor.
2. To disseminate knowledge on fruiting bodies of Peziza and Polyporus and to study the morphological features.
3. Taking cross section and structural features- Peziza and Polyporus

Lichens **(6 Hours)**

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

Bryophytes **(9 Hours)**

1. To study morphology of Riccia, Anthoceros and Funaria
2. To comprehend the development such as antheridia, archegonia in Riccia, Anthoceros and Funaria
3. To study the sporophyte of Riccia and capsule of Anthoceros, Polytrichum and Funaria

PRACTICAL MANUAL

ALGAE

1. Bhatia, K.N. 2000. *Algae*. Chand and Co. New Delhi.
2. Fritsch, F.E, 1965. *The Structure and Reproduction of Algae*: Cambridge University press, Cambridge, London.
3. Venkateswarlu, 1970. V. *A Text Book of Algae*. Maruthi Book Depot, Guntur, Hyderabad, India.

FUNGI

1. Alexopoulos, C.J. and Delavoryas, T, 1987. *Morphology of Plants and Fungi*. Harper and Row Publishers, New York.
2. Vashista, B.R. 2000. *Botany for Degree Students – Fungi*. S.Chand and Co., New Delh, India.
3. Mims, C.W. and Blackwell, M. 1996. *Introductory Mycology*. John Wiley and Sons, New York.
4. Srivastava, J.O. 1996. *Introduction to Fungi* (2ndEdn.,) S.Nagin and Co., Meerut India.
5. Sharma.O.P. 1992. *Test Book of Fungi*. Tata McGraw-Hill Publishing C., New Delhi.

BRYOPHYTES

1. Srivastava, N.N. 1996. *Bryophyta*. Pradeep Prakashan, Meerut, India.

2. Vashista, B.R. 2000. *Botany for Degree Students – Bryophytes*. S.Chand and Co., New Delhi, India.

Topics for self-learning

Algae thallus	https://www.plantscience4u.com/2014/11/range-of-thallus-structure-in-algae.html
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WEB LINKS:

<https://www.coursera.org/learn/algae-biotechnology>

SPECIFIC LEARNING OUTCOMES (SLO):

Unit	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
Unit I : Algae			
1.1	To analyse the general characteristics of the algal specimens and identification with reasons- <i>Oscillatoria, Volvox, Navicula, Dictyota</i> and <i>Gracillaria</i> .	<ul style="list-style-type: none"> Name and list the general characteristics of algae Identify the structural and functional differences between different algal specimens. 	K1,K4 K3
1.2	To understand taking section and giving structural features- <i>Dictyota</i> and <i>Gracillaria</i> .	<ul style="list-style-type: none"> Develop sections of the specimens 	K4
1.3	To know the economic importance of <i>Laminaria, Gracillaria, Chondrus</i> and <i>Spirullina</i>	<ul style="list-style-type: none"> Explain the economic importance of algal species 	K2
Unit II- Fungi			

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"> Relate the fungal specimen and diseased caused by them. 	K2
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"> Explain the mapping of genes in a chromosome. 	K2
2.3	Taking cross section and structural features- <i>Peziza</i> and <i>Polyporus</i>	<ul style="list-style-type: none"> Develop sections of the specimens 	K4
Unit III Lichens			
3.1	To study the morphological and general characteristics of lichens	<ul style="list-style-type: none"> Explain the morphological and general characters of lichens 	K2
3.2	To describe the fruiting bodies of Lichen- Apothecium	<ul style="list-style-type: none"> explain the fruiting bodies of Lichen- Apothecium 	K2
Unit –IV Bryophytes			
4.1	To study morphology of <i>Riccia, Anthoceros</i> and <i>Funaria</i>	<ul style="list-style-type: none"> Explain the morphology of Bryophytes 	K2
4.2	To comprehend the development such as antheridia, archegonia in <i>Riccia, Anthoceros</i> and <i>Funaria</i>	<ul style="list-style-type: none"> Decide and identify the development of <i>Riccia, Anthoceros</i> and <i>Funaria</i> 	K3
4.3	To study the sporophyte of <i>Riccia</i> and capsule of <i>Anthoceros, Polytrichum</i> and <i>Funaria</i>	<ul style="list-style-type: none"> Study and explain the sporophyte of <i>Riccia</i> and capsule of <i>Anthoceros, Polytrichum</i> and <i>Funaria</i> 	K2

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Mapping Scheme for the Course Code: U16BY3P3

U16BY3P3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	M	L	-	L	-	M	L	M	H	L
CO2	H	H	L	M	L	-	L	-	L	L	M	H	L
CO3	H	H	L	M	L	-	-	-	L	L	M	H	L
CO4	H	H	L	M	L	-	-	-	M	L	M	H	L
CO5	H	H	L	M	L	-	-	-	-	L	M	H	L
CO6	H	H	L	M	L	-	-	-	-	L	M	H	L

CORE- III- PLANT DIVERSITY- II

(PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY)

Course code: U16BY404

Credits: 5

Semester: IV

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 pteridophytes, explain their characteristics, Differentiate the stelar types	K5	I
CO 2	Identify characters, and reproduction in pteridophytes	K4	II
CO 3	Assess the living Gymnosperms and their morpho-anatomical adaptations for development.	K4	III
CO 4	Appraise the structure and reproduction of selected gymnosperms	K5	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 : Pteridophytes

(18 Hours)

Specific objective: To understand the general characters, classification and stele types of Pteridophytes

1.1 General characters

1.2 Sporne's Classification

1.3 Stelar Types

1.3.1. Haplostele and Actinosteale

1.3.2. Plectosteale and mixed stele

1.3.3. Siphnostele

(a) Ectophloic siphnostele (b) Ambphiphloic siphnostele

1.3.4. Solenosteale

(a) Ectophloic solenosteale (b) Ambphiphloic solenosteale

1.3.5. Distele and Polysteale

1.4 Apospory

1.5 Apogamy

1.6 Heterospory

1.7 Seed habit

Unit II- Pteridophytes- Type study

(18 Hours)

Specific Objective:

To study the structure and reproduction of selected pteridophytes species

2.1 Habit and habitat,

2.2 External and internal morphology Structure,

2.3 Asexual and sexual reproduction

2.4 life cycles (Development not required)

(a) *Psiltoum* (b) *Lycopodium* (c) *Equisetum* (d) *Adiantum*

Unit III: Gymnosperms

(18 hours)

Specific Objective

To understand the general characters, classification and economic importance of Gymnosperms

3.1 General characters

3.1.1. Comparison of Ferns and Gymnosperms

3.1.2. Comparison of Angiosperms and Gymnosperms

3.2 Sporne's Classification

3.3 Economic Importance

(a) Food (b) Medicine (c) Timber

Unit IV- Gymnosperms – Type study

(18 Hours)

4.1 Habit and habitat

4.2 External and internal structure,

4.3 Reproduction - asexual and sexual

4.4 Life Cycles (Development not required).

(a) *Cycas* (b) *Pinus* (c) *Gnetum*

Unit V: Paleobotany

(18 Hours)

5.1 Fossils - Definition

5.2 Methods of fossilization

5.2.1. Petrifications

5.2.2. Compressions

5.2.3. Impressions

5.3 Geological time scale

5.4 Radio carbon dating

5.5 A study on fossil forms

(a) *Rhynia* (b) *Lepidodendron* (c) *Lepidocarpon* (d) *Calamites* (e) 5.4.5. *Willamsonia*

Topics for Self-Study:

Topics	References/Web links
Phyllopodium	http://www.theplantlist.org/browse/A/Scrophulariaceae/Phyllopodium/

Adaptations in Gymnosperms	https://prezi.com/k5fbjtt91vzz/gymnosperms-adaptation/ http://cortland.edu/waldbauer-trail/12-plant-evolution-III.html
Types of indusium	https://www.researchgate.net/figure/A-Types-of-receptacle-and-indusium-sketches-only-which-were-not-based-on-any-particular_fig4_280831494
living fossils - <i>Gingko biloba</i>	https://palaeobotany.org/index.php/living-fossils/ https://motherearthworks.com/healthy-living-learning-center/healthy-living-center-articles/gingko-biloba-a-living-fossil/

TEXT BOOKS:

Pteridophytes

1. Parihar, N.S. 1965. *An introduction to Embryophyta Vol. 1 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 (2nd 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

1.4	Apospory	<ul style="list-style-type: none"> • Explain about the apospory and apogamy 	K2	
1.5	Apogamy			
1.6	Heterospory	<ul style="list-style-type: none"> • Examine each theories related to evolution. 	K2	
1.7	Seed habit			
II	Pteridophytes- Type study			
2.1	Habit and habitat,	<ul style="list-style-type: none"> • Explain the habit and habitat of Pteridophytes • Discuss the morpho-anatomical structure of Pteridophytes 	K2	
2.2	External and internal morphology Structure,		K5	
2.3	Asexual and sexual reproduction	<ul style="list-style-type: none"> • Explain the habit and habitat of Pteridophytes. • Relate the morphology of Pteridophytes. • Compare the similarities and dissimilarities with lower and higher forms 	K2	
2.4	Life cycles (Development not required) <i>(a) Psiltoum (b) Lycopodium (c) Equisetum (d) Adiantum</i>		K4	
III	Gymnosperms			
3.1	3.1 General characters 3.1.1. Comparison of Ferns and Gymnosperms 3.1.2. Comparison of Angiosperms and Gymnosperms	<ul style="list-style-type: none"> • Compare the various habitats of Gymnosperms • List out the systematic characteristics of gymnosperms • Compare ferns with gymnosperms • Compare Angiosperms with Gymnosperms 	K2 K2 K2 K2	
3.2	Sporne's Classification		<ul style="list-style-type: none"> • Classify gymnosperms using the unique characters. 	K2
3.3	Economic Importance <i>(a) Food (b) Medicine (c) Timber</i>		<ul style="list-style-type: none"> • List out the uses of gymnosperms 	K2
IV	Gymnosperms – Type study			

4.1	Habit and habitat	<ul style="list-style-type: none"> Recall the habit, habitat and their characters. 	K1
4.2	External and internal structure,	<ul style="list-style-type: none"> Explain the anatomical and evolutionary aspects of Gymnosperms. 	K5
4.3	Reproduction - asexual and sexual	<ul style="list-style-type: none"> Experiment with various types of reproduction in the selected gymnosperms 	K4
4.4	Life Cycles (Development not required). (a) <i>Cycas</i> (b) <i>Pinus</i> (c) <i>Gnetum</i>	<ul style="list-style-type: none"> Illustrate the life cycle of gymnosperms 	K2
4.4	Economic importance	<ul style="list-style-type: none"> Recognize the importance of gymnosperms Enumerate the economic importance of Gymnosperms. 	K2 K5
V	Paleobotany		
5.1	Fossils - Definition	<ul style="list-style-type: none"> Define fossils Compare the various fossil formation process 	K1 K2
5.2	Methods of fossilization Petrifactions Compressions Impressions	<ul style="list-style-type: none"> Discuss the methods of fossilization 	K6
5.3	Geological time scale	<ul style="list-style-type: none"> Explain geological time scale and the process of carbon dating on dating 	K2
5.4	Radio carbon dating	<ul style="list-style-type: none"> Explain and utilizing the radio carbon dating 	K5
5.5	A study on fossil forms (a) <i>Rhynia</i> (b) <i>Lepidodendron</i> (c) <i>Lepidocarpon</i> (d) <i>Calamites</i> (e) <i>Willamsonia</i>	<ul style="list-style-type: none"> Summarize the fossilization using the examples 	K2

Mapping Scheme for the Course Code: U16BY404

U16BY404	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	-	H	L	H	H	H	L	M	M	L	H	-
CO2	H	L	M	-	-	L	L	-	L	H	M	H	-
CO3	H	M	-	-	M	-	-	-	M	H	L	M	L
CO4	H	L	L	-	L	-	-	-	M	M	-	H	L
CO5	M	M	-	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 in Class** test, Group Discussion and Quiz.
- Assessment also done through Seminar Presentation, submission of Assignments and Model Making and Model exams.
- 3. End Semester Examination**

Indirect

- 1. Course-end survey**

CORE PRACTICAL III - PLANT DIVERSITY- II (PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY)

Semester : IV

Course Code : U16BY4P4

Credits : 2

Hours/Week : 3

Course Outcome

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

No	Course Outcome (CO)	Level	Unit
CO1	Interpret and Explain the morphology and anatomy of the Pteridophytes.	K2	I
CO2	Develop the crosssections of Pteridophyte specimens	K3	I
CO3	Interpret and Explain the morphology, vegetative and reproductive parts of Gymnosperms.	K2	II

CO4	Experiment the Gymnosperm specimens by taking cross sections.	K3	II
CO5	Summarise the different aspects of fossil form according to geological time scale	K2	III
CO6	Interpret plant remains, connections in plant evolution and conserve the linking plant forms from extinction through field visits and exposures.	K2	III

Syllabus:

PTERIDOPHYTES

(15 Hours)

1. A study of the morphology, anatomy and sori organization of the following genera- Psilotum, Lycopodium, Adiantum and Equisetum.
2. Cross section:- Lycopodium- stem, Psilotum, Adiantum- petiole and sporangia and Equisetum stem.

GYMNOSPERMS

(15 Hours)

1. A study of the morphology, vegetative and reproductive parts of the of the genera- Cycas, Pinus and Gnetum
2. To train the students to take section on Cycas- corollid root, leaf and rachis and microsporophyll, Pinus- needle and stem and Gnetum- stem.

PALEOBOTANY

(15 Hours)

1. Fossil forms- Rhynia, Lepidodendron , Lepidocarpon and Calamites.
2. Field Trip to National fossil park

Topics for self study:

Topics	References
Birbal Sahni	https://www.bsip.res.in/
Steles in ferns	https://www.britannica.com/plant/fern/Vascular-tissues

TEXT BOOKS:

1. Parihar, N.S. 1965. *An introduction to Embryophyta Vol. 1 Pteridophyta*. Central Book Depot. Allahabad, India..
2. Smith, 1956. G.M. *Cryptogamic Botany Vol. II. (2ndEdn.,). (Bryophytes &Pteridophytes)*. McGraw Hill Book Co., N.Y
3. Venkatachala, B. S., Shukla, M. and Sharma, M. 1992. *Plant Fossils – a Link with the past (A Birbal Sahni Birth Centenary Tribute)*. BirbalSahni Institute of Paleobotany, Lucknow, India

WEB LINKS:

<http://2020.botanyconference.org/engine/search/index.php?func=detail&aid=444>

SPECIFIC LEARNING OUTCOMES (SLO):

Unit	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
Unit I : Pteridophytes			
1.1	A study of the morphology, anatomy and sori organization of the following genera- <i>Psilotum</i> , <i>Lycopodium</i> , <i>Adiantum</i> and <i>Equisetum</i> .	<ul style="list-style-type: none"> Name and list the general characteristics of algae Identify the structural and functional differences between different algal specimens. 	K1,K4 K3
1.2	Cross section:- <i>Lycopodium</i> -stem, <i>Psilotum</i> , <i>Adiantum</i> -petiole and sporangia and <i>Equisetum</i> stem.	<ul style="list-style-type: none"> Develop sections of the specimens 	K4
Unit II- Gymnosperms			
2.1	A study of the morphology, vegetative and reproductive parts of the of the genera- <i>Cycas</i> , <i>Pinus</i> and <i>Gnetum</i>	<ul style="list-style-type: none"> Name and list the general characteristics of species Identify the structure of vegetative and reproductive parts of gymnosperm species. 	K1,K4 K3
2.2	To train the students to take section on <i>Cycas</i> - corollid root, leaf and rachis and microsporophyll, <i>Pinus</i> -needle and stem and <i>Gnetum</i> - stem.	<ul style="list-style-type: none"> Develop sections of the specimens 	K4

Unit III Paleobotany			
3.1	Fossil forms- <i>Rhynia</i> , <i>Lepidodendron</i> , <i>Lepidocarpon</i> and <i>Calamites</i> .	<ul style="list-style-type: none"> Explain the different fossil forms and the eras in the geological time scale 	K2
3.2	Field Trip to National fossil park.	<ul style="list-style-type: none"> Decide and identify the development of Riccia, Anthoceros and Funaria 	K3

Mapping Scheme for the Course Code: U16BY4P4

U16BY4P4	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	H	L	M	L	-	L	-	M	L	M	H	L
CO2	H	H	L	M	L	-	L	-	L	L	M	H	L
CO3	H	H	L	M	L	-	-	-	L	L	M	H	L
CO4	H	H	L	M	L	-	-	-	M	L	M	H	L
CO5	L	H	-	-	-	-	H	L	-	-	-	-	-
CO6	L	H	-	-	-	-	H	L	M	-	-	-	-

Course Assessment Methods:

Direct

1. **Continuous Assessment in** Class test, Group Discussion.
2. Assessment also done through Seminar , Record
3. **End Semester Examination**

Indirect

1. Course-end survey

NMEC I - NURSERY TECHNOLOGY

Course Code: U16BYPE1

Credits: 2

Semester III**Hours/Week: 3**

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

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

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

SPECIFIC LEARNING OUTCOME (SLO):

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

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

Mapping Scheme for Course Code: U20BYPE1

U20BY PE1	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:

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

NMEC II -MUSHROOM CULTIVATION

Semester IV

Credits 2

Course Code: U16BYPE2

Hours/Week: 3

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://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"> List out the edible mushrooms Identify the edible mushrooms 	K1 K3
II	Scenario of Mushroom cultivation –Prospects and Scope of Mushroom Cultivation.	<ul style="list-style-type: none"> Tell the scope of mushroom cultivation Explain the challenges in it. 	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"> Apply various medium to grow mushroom Compare the growth of mushrooms in different medium. 	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"> Analyze the growth in different substratum Compare the cropping, harvesting and marketing of mushroom products 	K4 K2
Unit V	Protection and Management Disease & Pests of Mushroom and their control measures	<ul style="list-style-type: none"> Identify the best practice for disease and pest control. List some of the measures. 	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"> Experiment with the cultivation of mushrooms. Illustrate different methods and mode of cultivation. 	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 BIOCHEMISTRY AND BIOPHYSICS

Course Code: U16BY505

Credits : 6

Semester : V

Hours/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⁺) – K⁺ 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 BIOPHYSICS

(18 Hours)

5.1.0 pH and its determination

5.1.1. pH-Definition, Measurement, Hydrogen ion Concentration and Importance

5.2.0 Buffers

5.2.1. Definition, Examples, Mechanism of Buffer action, Bicarbonate Buffer system

5.3.0 Chromatography

5.3.1. Principle, Types- Paper, TLC, Column, Affinity, Gas and HPLC and applications

5.4.0 Centrifugation

5.4.1. Principle, Types- Clinical, Ultra, Refrigerated and High speed

5.5.0 Carbohydrates

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

5.6.0 Lipids

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

5.7.0 Proteins

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

5.8.0 Elementary account on Secondary Metabolites

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

Topics for Self-Study:

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

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.swayam2.ac.in/cec19_bt09/preview

SPECIFIC LEARNING OUTCOMES (SLO):

Unit	Content	Learning Outcome	Highest Bloom taxonomic level of transaction
I	Importance of Water and Minerals		
1.1	<p>Water – properties & role</p> <p>Structure, Physical and chemical properties.</p> <p>Importance of Water</p>	<ul style="list-style-type: none"> • List the Physico-chemical properties of water • Summarize the importance of water 	<p>K4</p> <p>K2</p>
1.2	<p>Osmotic & non-osmotic uptake of water</p> <p>Diffusion – Role in Plants</p> <p>Kinds of Solution – Hypotonic, Hypertonic and Isotonic</p> <p>Osmosis – role in plants, Diffusion Pressure Deficit, Turgor Pressure, Osmotic Pressure and Significance.</p>	<ul style="list-style-type: none"> • Define – Diffusion, Osmosis and Plasmolysis • Compare the types of water absorption • Distinguish the 	<p>K1</p> <p>K4</p> <p>K4</p>

	<p>Plasmolysis – definition, Incipient, De-plasmolysis, Advantages</p> <p>Imbibition</p> <p>Water potential & Osmotic relations of plant cells – Water potential, Osmotic Potential and Pressure Potential</p> <p>Mechanism of Absorption of water</p> <p>Types – Active – Osmotic and Non-Osmotic absorption, Passive, Symplastic and Apoplastic absorption.</p> <p>Factors affecting absorption of water.</p> <p>Ascent of sap –Mechanism – Vital force theory, Root pressure theory, Physical force theory, Transpiration pull and Cohesion of water theory</p>	<p>Osmotic and Non-osmotic active absorption</p> <ul style="list-style-type: none"> • Interpret the various theories related with Ascent of Sap 	K6
1.3	<p>Transpiration</p> <p>Definition, Kinds</p>	<ul style="list-style-type: none"> • Recall the Kinds of Transpiration 	K1
1.4	<p>Stomatal Transpiration</p> <p>Structure and Mechanism of Stomatal Transpiration</p> <p>(i) Opening & Closing of Stomata</p> <p>(a) Starch-Sugar Interconversion theory (b) Synthesis of sugars or organic acids in guard cells</p> <p>(c) ATP-driven Proton(H⁺) – K⁺ Exchange pump Mechanism in Guard cells</p> <p>1.4.3. Advantages, factors affecting stomatal movements</p>	<ul style="list-style-type: none"> • Elaborate the Mechanism of Stomatal Movements. 	K2

1.5	Translocation of organic solutes & assimilates Mechanism of Translocation through Phloem- Munch's mass flow hypothesis	<ul style="list-style-type: none"> Prove the translocation of Organic solutes and assimilates in the Phloem Column. 	K5
1.6	Mineral nutrition of plants Essential and Non-essential elements, Types- Essential – Major and Minor Elements function and its deficiency symptoms	<ul style="list-style-type: none"> Determine and Evaluate the Deficiency symptoms and role of Major and Minor elements. 	K5
1.7	Mineral salt absorption Types – Passive and Active	<ul style="list-style-type: none"> Distinguish the Types of Mineral salt absorption 	K4
1.8	Determination of essentiality of mineral elements Solution Culture, Hydroponics and Aeroponics	<ul style="list-style-type: none"> Determine the essentiality of Mineral elements 	K5
II	Photosynthesis		
2.1	Radiant energy & its role in photosynthesis Photosynthesis – definition, significance, Photosynthetic Apparatus Photosynthetic Pigments, Location, Absorption and utilisation of light energy	<ul style="list-style-type: none"> Summarize the Photosynthetic apparatus and its role in the capturing of light energy 	K2
2.2	Absorption Spectrum Absorption Spectra of Chlorophylls, Carotenoids and Phycobilins	<ul style="list-style-type: none"> Interpret the Absorption spectra of Photosynthetic Pigments. 	K5
2.3	Red drop & Emerson's Enhancement effect	<ul style="list-style-type: none"> Evaluate the Red drop and Emerson's enhancement effect in relation with the rate of Photosynthesis. 	K5

2.4	Photosystems Types – Photosystem I, Photosystem II	<ul style="list-style-type: none"> Distinguish the kinds of Photosystem 	K4
2.5	Mechanism of Photosynthesis 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"> Elaborate the Mechanism of Light reaction Discuss the Light Independent Phase of Photosynthesis. 	K6 K6
2.6	Hatch and Slack Pathway C4 –Dicarboxylic Acid Pathway and its Significance	<ul style="list-style-type: none"> Justify a plant can photosynthesize even in presence of very low concentration of CO₂. 	K5
2.7	CAM pathway Crassulacean Acid Metabolism (CAM)	<ul style="list-style-type: none"> Criticize the role of CAM pathway in Crassulaceae members. 	K5
2.8	Photorespiration Glycolate Pathway, Factors affecting photorespiration and Significance	<ul style="list-style-type: none"> Discuss the inter-organelle relationships of Chloroplast, Peroxisome and Mitochondria 	K6
III	Respiration and Nitrogen Metabolism		
3.1	Definition, Organelle involved, kinds – Aerobic and Anaerobic	<ul style="list-style-type: none"> Compare the aerobic and anaerobic respiration 	K2
3.2	Glycolysis - Glycolysis / EMP Pathway	<ul style="list-style-type: none"> Analyse the glycolysis pathway 	K4
3.3	Krebs cycle Krebs / TCA Cycle – pathway	<ul style="list-style-type: none"> Assume the Krebs / TCA Cycle – pathway 	K4

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

4.9	Phytochrome - Definition, Types- Red light absorbing form(PR), Far-red light absorbing Form(PFR)	<ul style="list-style-type: none"> Assume the Phytochrome 	K4
4.10	Vernalization Definition, Perception of the cold stimulus and other conditions	<ul style="list-style-type: none"> Inspect the Vernalization 	K4
4.11	Seed dormancy Definition, factors causing dormancy, Artificial methods of breaking the dormancy of seeds	<ul style="list-style-type: none"> Identify the Seed dormancy Artificial methods of breaking the dormancy of seeds 	K3
4.12	Seed Viability Definition, kinds- Microbiotic, Mesobiotic and Macrobiotic, Viability test	<ul style="list-style-type: none"> Explain the Seed Viability, Definition, kinds- Microbiotic, Mesobiotic and Macrobiotic, Viability test 	K2
4.13	Seed germinability Physiology, Physiological condition of quiescent seed, of seed germination	<ul style="list-style-type: none"> Make use of Seed germinability, Physiology, Physiological condition of quiescent seed, of seed germination 	K3
V	BIOCHEMISTRY AND BIOPHYSICS		
5.1	pH and its determination - pH-Definition, Measurement, Hydrogen ion Concentration and Importance	<ul style="list-style-type: none"> Describe the uses of pH in experiments Explain the importance of H⁺ ions 	K5 K2
5.2	Buffer -Definition, Examples, Mechanism of Buffer action, Bicarbonate Buffer system	<ul style="list-style-type: none"> Explain the buffer actions 	K2
5.3	Carbohydrates	<ul style="list-style-type: none"> Compare the Structure, Monosaccharides, 	K5

	Definition, Structure, Types – Monosaccharides, Oligosaccharides and Polysaccharides, Function.	Oligosaccharides and Polysaccharides, Function.	
5.4	Lipids - Definition, Structure, Types – Simple, compound and derived, functions.	<ul style="list-style-type: none"> Estimate the Structure, Types – Simple, compound and derived, functions 	K5
5.5	Proteins Definition, Structure, Types – Simple, Conjugated and derived, functions	<ul style="list-style-type: none"> Determine the Structure, Types Simple, Conjugated and derived, functions 	K5
5.6	Enzymes Definition, Nature, Structure & properties Mechanism of Enzyme action – Lock & Key theory & Induced Fit theory	<ul style="list-style-type: none"> Explain the properties Mechanism of Enzyme action – Lock & Key theory & Induced Fit theory 	K5
5.7	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"> Analyze Elementary account on Secondary Metabolites 	K4

Mapping Scheme for the Course Code: U16BY505

U16BY505	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: CELL BIOLOGY, GENETICS AND EVOLUTION

Semester : V

Credits :6

Course Code: U16BY506

Hours/Week: 7

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 cell structure	K6	I
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- CELL AND ITS INCLUSIONS

(18 Hours)

- 1.1 Cell- Definition and types- Prokaryotic cell and Eukaryotic cells
- 1.2 Cell theory and its significance
- 1.3 Cell Wall- Bacterial (a) Gram positive and (b) Gram negative cell wall
- 1.4 Plant cell wall – Ultra structure and functions
- 1.5 Cytoplasm- physical, chemical and biological properties
- 1.6 Plasma membrane – Ultrastructure, Models (Sandwich and Fluid mosaic model) functions
- 1.7 Endoplasmic Reticulum – Ultrastructure, types and functions
- 1.8 Mitochondria- ultrastructure and functions
- 1.9 Plastids- Types and functions
- 2.0 Chloroplasts – distribution, Ultrastructure and functions
- 2.1 Golgi Apparatus – Ultrastructure and functions
- 2.2 Ribosomes- Ultrastructure and functions- (a) Prokaryotic Ribosomes (70S)(b) Eukaryotic Ribosomes (80S)

UNIT II- NUCLEUS

(18 Hours)

- 2:1 Nucleus – Ultrastructure and functions
- 2.2 Chromosomes- types - Euchromatin and Heterochromatin (a) Facultative and (b) Constitutive heterochromatin
- 2.3 Special types of Chromosomes- (a) Lampbrush chromosomes (b) Polytene chromosomes
- 2.4 Components and Organization of Nucleic acid– DNA structure and Watson and crick's double helical DNA model and types- DNA -A, B and Z form of DNA
- 2.5. Ribonucleic acid -mRNA,rRNA,tRNA – Clover leaf model
- 2.6 Chromosomes
- 2.7 Cell division- Amitosis, Mitosis and Meiosis- Occurrence, Processes and Significances.

UNIT-III -MENDELISM AND GENIC INTERACTION

(18 Hours)

- 3:1 Definition of Genetics, Scope and importance of genetics
- 3:2 Mendel's Laws of inheritance.- Law of segregation, Law of dominance and Law of independent assortment

- 3:3 Monohybrid cross, dihybrid cross, Back cross and Test cross
- 3:4 Variation in Dominance- Incomplete dominance, Co-dominance, Lethal factor in plants.
- 3:5 Gene Interaction- Complementary gene 9:7, Supplementary genes, Duplicate genes.
- 3:6 Epistasis-Definition and types- Dominant Epistasis (12:3:1), Recessive Epistasis (9:3:4)
- 3:7 Multiple alleles- Polygenic inheritance- Definition, Kernel Colour in wheat, Skin colour in human
- 3:8 Blood Group in human, Rh factor.

Unit IV- LINKAGE AND CROSSING OVER

(18 Hours)

- 4:1 Linkage - Definition and types- complete and incomplete linkage and its Significance of linkage
- 4:2 Crossing over - Definition, Types –Single, double and Multiple crossing over and its significance
- 4:3 Crossing over - Theories about the mechanisms of crossing over- Stern's experiment, Tetrad analysis and Crighton and McClintocks experiment
- 4:4 Linkage Mapping
- 4:5 Cytoplasmic inheritance– Kappa particle (*Paramaceium*) and Plastid inheritance in *Mirabilis*.
- 4:6 Sex linkage – Definition and *Drosophilla* (Bar eye) and human (colour blindness)
- 4:7 Sex determination -Definition and *Drosophilla* and human
- 4:8 *Neurospora* Genetics

UNIT-V- EVOLUTION

(18 Hours)

- 5.1 Definition of Evolution - Inorganic, Organic Evolution
- 5.2 Theories of Evolution of organic forms- Theory of Eternity, Theory of Special creation, Cosmozoic theory, Catastrophism and Modern theory
- 5.3 Theories of Evolution- inheritance of acquired characters (Lamarckism) and natural selection (Darwinism)
- 5.4 Modern Synthetic Theory
- 5.5 Isolation - Types of Isolation and Role.

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

TOPICS FOR SELF-STUDY:

S. No	Topic	Web links
1	Chromosomal rearrangement	https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/chromosomal-rearrangement
2	Karyotype	https://www.genome.gov/genetics-glossary/Karyotype#:~:text=A%20karyotype%20is%20an%20in%20individual's,numbers%20or%20structures%20of%20chromosomes
3	convergent evolution	https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/convergent-evolution
4	genetic drift	https://www.sciencedirect.com/topics/neuroscience/genetic-drift
5	instant speciation	http://www.chemistrylearning.com/instantaneous-speciation/
6	Genetic Variability	https://www.sciencedirect.com/topics/medicine-and-dentistry/genetic-variability
7	Pedigree Method,	https://www.slideshare.net/ShekhAlisha/pedigree-method-of-plant-breeding
8	Bulk Method,	https://www.slideshare.net/pawannagar8/bulk-method-pedigree-method-ampline-breeding
9	Plant Uniformity and Stability	https://link.springer.com/article/10.1007/s001220100710

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. Mann Rosanna. 2017. *Human Genetics and Genomics*, Callisto publish.
6. Singh, M.P. and Sunil Kumar. 2016. *Genetics and Plant Breeding*, Vol. I & II New Delhi, APH Publishing Corporation.
7. Verma, P.S, V.K. Agarwal. 2014. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*, S. Chand, New Delhi.
8. 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.

Web Links:

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

https://onlinecourses.swayam2.ac.in/cec20_bt03/preview

SPECIFIC LEARNING OUTCOMES (SLO):

Unit	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
1	CELL BIOLOGY		
1.1	Cell- Definition and types- Prokaryotic cell and Eukaryotic cells	<ul style="list-style-type: none"> • Explain the structure and functions of cells • Analyse the functions of each cell organelles 	K2 K4
1.2	Cell theory and its significance	<ul style="list-style-type: none"> • Define the theories of cell division 	K2

1.3	Cell Wall- Bacterial (a) Gram positive and (b) Gram negative cell wall	<ul style="list-style-type: none"> • Discuss the cell wall differences 	K6
1.4	Plant cell wall – Ultra structure and functions	<ul style="list-style-type: none"> • Discuss the ultra structure of plant cellwall 	K6
1.5	Cytoplasm- physical, chemical and biological properties	<ul style="list-style-type: none"> • Explain the cytoplasmic compositions 	K5
1.6	Plasma membrane – Ultrastructure, Models (Sand wich and Fluid mosaic model) functions	<ul style="list-style-type: none"> • Define the theories related to membranes 	K2
1.7	Endoplasmic Reticulum – Ultrastructure, types and functions	<ul style="list-style-type: none"> • Imagine the functions of ER 	K4
1.8	Mitochondria- ultrastructure and functions	<ul style="list-style-type: none"> • Analyse the structure 	K4
1.9	Plastids- Types and functions	<ul style="list-style-type: none"> • Explain the function and structure 	K5
1.10	Chloroplasts – distribution, Ultrastructure and functionS	<ul style="list-style-type: none"> • Analyse the structure of chloroplasts 	K4
1.11	Golgi Apparatus – Ultrastructure and functions	<ul style="list-style-type: none"> • Explain the structure 	K5
1.12	Ribosomes- Ultrastrurcture and functions- (a)	<ul style="list-style-type: none"> • Differentiate their role in protein synthesis 	K4

	Prokaryotic Ribosomes (70S)(b)80 S		
II	NUCLEUS		
2.0	Nucleus – Ultrastructure and functions	<ul style="list-style-type: none"> • Explain the structure of Nucleus 	K2
2.1	Chromosomes- types - Euchromatin and Heterochromatin (a) Facultative and (b) Constitutive heterochromatin.	<ul style="list-style-type: none"> • Analyse the chromosome types 	K4
2.2	Special types of Chromosomes- (a) Lampbrush chromosomes (b) Polytene chromosomes	<ul style="list-style-type: none"> • Define the structure of special type of chromosomes 	K2
2.3	Components and Organization of Nucleic acid– DNA structure and Watson and crick’s double helical DNA model and types- DNA -A, B and Z form of DNA	<ul style="list-style-type: none"> • Differentiate the structure and function of genetic materials 	K4
2.4	Ribonucleic acid - mRNA,rRNA,tRNA – Clover leaf model	<ul style="list-style-type: none"> • Explain the structure of RNAs 	K5
2.5	Chromosomes	<ul style="list-style-type: none"> • Tell the chromosome structure 	K1

2.6	Cell division- Amitosis, Mitosis and Meiosis- Occurrence, Processes and Significances.	<ul style="list-style-type: none"> • Discuss the cell divisions 	K6
III	GENETICS		
3.1	Definition of Genetics, Scope and importance of genetics	<ul style="list-style-type: none"> • Recall the concepts of genetics • Classify the scope and importance genetics 	K4
3.2	Mendel's Laws of inheritance.- Law of segregation, Law of dominance and Law of independent assortment	<ul style="list-style-type: none"> • Prove the Mendel's Law. • Distinguish between law of dominance and Law of independent assortment 	K5
3.3	Monohybrid cross, dihybrid cross, Back cross and Test cross	<ul style="list-style-type: none"> • Explain monohybrid and dihybrid cross. • Make up the back cross and test cross 	K6
3.4	Variation in Dominance- Incomplete dominance, Co-dominance, Lethal factor in plants	<ul style="list-style-type: none"> • Determine the incomplete and codominance • Explain lethal factor 	K5
3.5	Gene Interaction- Complementary gene 9:7, Supplementary genes, Duplicate genes.	<ul style="list-style-type: none"> • Make use of the gene interaction with a allelic and non allelic gene interaction. 	K3
3.6	Epistasis-Definition and types- Dominant Epistasis	<ul style="list-style-type: none"> • Define Epistasis • Interpret dominant and recessive epistasis and its significance 	K5

	(12:3:1), Recessive Epistasis (9:3:4)		
3.7	Multiple alleles- Polygenic inheritance- Definition, Kernel Colour in wheat, Skin colour in human	<ul style="list-style-type: none"> Recall the multiple allele. Prove kernel colour in wheat and skin colour in human 	K5
3.8	Blood Group in human and Rh factor.	<ul style="list-style-type: none"> List out the types of blood groups Illustrate the blood groups in human and Rh factor 	K2
Unit IV- LINKAGE AND CROSSING OVER			
4.1	Linkage - Definition and types- complete and incomplete linkage and its Significance of linkage	<ul style="list-style-type: none"> Define Linkage Explain the characteristic of linkage. Importance of complete and incomplete linkage 	K5
4.2	Crossing over - Definition, Types –Single, double and Multiple crossing over and its significance	<ul style="list-style-type: none"> What is crossing over Explain they types of crossing over and its significance 	K5
4.3	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"> Prove crossing over theories and its mechanisms 	K6
4.4	Linkage Mapping	<ul style="list-style-type: none"> Construct the Linkage mapping. 	K3

		<ul style="list-style-type: none"> Solve the sum of gene mapping 	K6
4.5	Cytoplasmic inheritance– Kappa particle (<i>Paramaceium</i>) and Plastid inheritance in <i>Mirabilis</i> .	<ul style="list-style-type: none"> Define Plasmagene. Support the kappa particle and plastid inheritance in <i>Mirabilis</i>. 	K5
4.6	Sex linkage – Definition and <i>Drosophilla</i> (Bar eye) and human (colour blindness)	<ul style="list-style-type: none"> Make use of sex linkage in <i>Drosophila</i> and human, Solve the colour blindness and haemophilia through sex linkage 	K3 K6
4.7	Sex determination - Definition and <i>Drosophilla</i> and human	<ul style="list-style-type: none"> Classify the sex determination and <i>Drosophila</i> and Human. 	K4
4.8	<i>Neurospora</i> Genetics	<ul style="list-style-type: none"> Explain <i>Neurospora</i> in genetics 	K4
UNIT- V - EVOLUTION			
5.1	Definition of Evolution - Inorganic, Organic Evolution	<ul style="list-style-type: none"> Define Evolution Categorize the evolution 	K1 K4
5.2	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"> Theories of evolution Classify the evolution of organic forms 	K6 K2

5.3	Theories of Evolution-inheritance of acquired characters (Lamarckism) and natural selection (Darwinism)	<ul style="list-style-type: none"> Discuss Lamarckism and Darwinism 	K6
5.4	Modern Synthetic Theory	<ul style="list-style-type: none"> Explain modern synthetic theory 	K5
5.5	Isolation - Types of Isolation and Role	<ul style="list-style-type: none"> List out the types of Isolation and its role 	K4
5.6	Speciation–Definition, Gradual Speciation - Allopatric Speciation and Sympatric Speciation.	<ul style="list-style-type: none"> Illustrate speciation and its types 	K2

Mapping Scheme for the Course Code: U16BY506

U16BY506	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, BIOCHEMISTRY,
BIOPHYSICS, CELL BIOLOGY, GENETICS & EVOLUTION**

Semester : V
Credits : 2

Course Code : U16BY5P5
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 (21 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 CO₂ concentrations.
10. Measurement of O₂ 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

(18 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

CYTOLOGY-

(6 Hours)

Study on cell structures
Study on mitosis

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.
3. Chaudhari, H.K. 1984. *Elementary Principles of Plant Breeding*. Oxford – IBH. 2nd edition.
3. Acquaah, G. 2007. *Principles of Plant Genetics & Breeding*. Blackwell Publishing.

Web link:

https://onlinecourses.swayam2.ac.in/cec20_bt03/preview

SPECIFIC LEARNING OUTCOMES (SLO):

Unit	Content	Learning Outcome	Highest Bloom taxonomic level of transaction
I	Plant Physiology		
I	1. Estimation of sugars (Colorimetric).	<ul style="list-style-type: none"> • Estimate the Concentration of Sugar in the given Plant 	K5

		tissue	
	2.Estimation of lipids (Gravimetric).	<ul style="list-style-type: none"> Estimate the Concentration of Lipid present in the Plant tissue 	K5
	3.Demonstration of Osmosis by Potato Osmoscope Method.	<ul style="list-style-type: none"> Experiment with Potato Osmoscope. 	K3
	4.Determination of stomatal frequency and index.	<ul style="list-style-type: none"> Estimate the stomatal frequency and index 	K5
	5.Determination of the ratio between the stomatal and cuticular transpiration by Cobalt Chloride Method.	<ul style="list-style-type: none"> Determine the rate of Stomatal and cuticular transpiration 	K5
	6.Determination of absorption and transpiration ratio in plants.	<ul style="list-style-type: none"> Estimate the transpiration and absorption rate by using TA Balance apparatus 	K5
	7.Separation of plant pigments by paper chromatography.	<ul style="list-style-type: none"> Estimate the Rf value of Plant Pigments 	K5
	8.Determination of photosynthetic rate in water plants under different CO ₂ concentrations.	<ul style="list-style-type: none"> Estimate the Photosynthetic rate under different CO₂ concentrations 	K5
	9.Measurement of O ₂ evolution under different color lights using Wilmott's bubbler.	<ul style="list-style-type: none"> Measure the Photosynthetic rate by using Wilmott's bubbler. 	K5
	10.Qualitative test for phytochemicals – Starch, sugar, protein, Amino acid, Phenols, Alkaloids, flavonoids, Saponins and tannins.	<ul style="list-style-type: none"> Identify the Phytochemical compound in the given Plant extracts. 	K3

II	Genetics		
	1.Problems based on Mendel’s Laws of inheritance	<ul style="list-style-type: none"> Solve the Problems related with Monohybrid cross and Dihybrid Cross 	K6
	2.Problems based on Interaction of Genes-Allelic and Non-Allelic	<ul style="list-style-type: none"> Solve the Problems related with gene interaction 	K6
	3.Problems based on Gene Mapping	<ul style="list-style-type: none"> Solve the Linkage Mapping 	K6
	4.Life Cycle of <i>Drosophila</i> (Culture Studies) - Demonstration	<ul style="list-style-type: none"> Demonstrate the Life Cycle of <i>Drosophila</i> 	K2
	5.Construction and Analysis of Family Pedigree Charts	<ul style="list-style-type: none"> Solve Family Pedigree problems 	K6
III	CELL BIOLOGY		
1	Study of plant cells	<ul style="list-style-type: none"> Explain the structure of plant cells in detail 	K2

Mapping Scheme for the Course Code: U16BY5P5

U16BY5P5	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: U16BY5:1
Semester: V

Hours/Week: 6
Credits: 5

Course Outcomes:

On completion of the course, the student 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 various concepts of chromatography techniques	K5	IV
CO 6	Describe the concept of Spectrophotometry, Tracer techniques	K2	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 INFERENCE 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)

- .1. Computer application in biology
 - 3.1.1. Introduction, Advantages, Evolution and Generations of Computer
- 3.2. Organization of a computer
 - 3.2.1. Input devices- (a) Keyboard (b) Mouse
 - 3.2.2. Output devices - (a) Monitors (b) Printers
- 3.3. Computer Memory - RAM and ROM
- 3.4. Storage devices – Floppy, Compact and Hard Disc
- 3.5. Central Processing Unit

3.6. Software

3.7. Hardware

Unit IV: COMPUTER APPLICATIONS

(15 Hours)

4.1. Computer Network - LAN and WAN

4.2. Data – Representation

4.3. Number Systems- Binary and Arithmetic

4.4. Operating System -Windows

4.5. Word Processing Software - (a) MS Office (b) Word (c) Excel (d) Power point

Unit V: BIOINFORMATICS

(15 Hours)

5.1.0. Bioinformatics

5.1.1. Definition and scope.

5.1.2. Role of Internet in Bioinformatics

5.2.0. Biological database

5.2.1. Nucleotide sequence database

(a) European Molecular Biology Laboratory (EMBL)

(b) National Centre for Biotechnology Information (NCBI)

5.2.2. Protein sequence database - (a) Protein Information resources (PIR) (b) Swiss-Prot

5.3.0. Role of Bioinformatics - Human genome project and *Arabidopsis thaliana*

TOPICS FOR SELF-STUDY:

Biostatistical study in Health management	https://www.publichealthcareeredu.org/biostatistics-and-informatics
Epidemiology	https://www.bmj.com/about-bmj/resources-readers/publications/epidemiology-uninitiated/1-what-epidemiology
MEGA Softwares.	https://www.megasoftware.net/
Software for security operations	https://respond-software.com/automate-your-soc/

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/EnrollmentOpenforSWAYAMNP TELCoursesJulytoDecember2020.pdf>

SPECIFIC LEARNING OUTCOMES (SLO):

Unit	Content	Learning Outcome	Highest Blooms Taxonomic level of transaction.
I	BIOSTATISTICS		
1.1	Biostatistics - Definition – Scope	<ul style="list-style-type: none"> • Define the subject by own 	K1
1.2	Data- Definition -Types- (a) Primary(b) Secondary - Collection of data	<ul style="list-style-type: none"> • Recall the concept of data 	K1
1.3	Population - Definition -Types of population - (a) Finite population (b) Infinite population	<ul style="list-style-type: none"> • Summarize the population statistics 	K2

1.4	Samples -Definition - Sampling techniques - Random sampling techniques	<ul style="list-style-type: none"> Define sample 	K1
1.5	Frequency distribution - Definition - Discrete method & Continuous method- Frequency graphs	<ul style="list-style-type: none"> Select sampling techniques Compare the various methods in frequency distribution 	K1
1.6	Statistical table - Rules, Organization and types of table	<ul style="list-style-type: none"> Make use of statistical tables 	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"> Interpret the graphical representation on data Distinguish among various graphical methods of data presentation 	K2 K4
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"> Explain the use of mean, median and mode value in statistics. 	K5
II	Measure of dispersion		
2.1	Definition - Types of dispersion (a) Absolute measure of dispersion (b) Relative measure of dispersion	<ul style="list-style-type: none"> Recall the use of dispersion Compare the different dispersion methods 	K2 K4
2.2	Probability - Probability scale, Definition, Types and application of biological problems	<ul style="list-style-type: none"> Define probability Make use of the concept of probability in future studies 	K1 K3

2.3	Binomial distribution - Introduction, Definition and Properties of binomial distribution	<ul style="list-style-type: none"> • Interpret Binomial distribution 	K2
2.4	Poisson Distribution - Introduction, Definition and Properties of Poisson distribution	<ul style="list-style-type: none"> • Utilize poisson distribution for further studies 	K3
2.5	Normal distribution - Introduction, Definition and Properties	<ul style="list-style-type: none"> • Explain the concept of normal distribution 	K2
2.6	Test of Significance - Introduction, Definition, Procedure and application of chi-square test	<ul style="list-style-type: none"> • Make use of the test of significant functions in statistical survey 	K3
III	Introduction to computers		
3.1	Computer- Introduction- generations of computer, Applications of computer, Classification of computers.	<ul style="list-style-type: none"> • Define what computer is and the uses of computer • Explain the classification of computer in various generation 	K1 K2
3.2	Components of computer system.	<ul style="list-style-type: none"> • Identify the input and output devices in computer 	K2
3.3	Storage devices – Floppy, Compact and Hard Disc	<ul style="list-style-type: none"> • Interpret the number systems used in computer 	K2
3.4	Central Processing Unit	<ul style="list-style-type: none"> • Apply the basics in learning the software • Make use of the MS software 	K3 K3

3.5	Software Hardware	<ul style="list-style-type: none"> Analyse the physical needs of networking Explain the various network connections used 	K4 K2
IV	COMPUTER APPLICATIONS		
4.1	Computer Network - LAN and WAN	<ul style="list-style-type: none"> Tell the definition of Bioinformatics 	K1
4.2	Data representations	<ul style="list-style-type: none"> Interpret the databases 	K2
4.3	Number Systems- Binary and Arithmetic	<ul style="list-style-type: none"> Evaluate the number systems 	K4
4.4	Operating System -Windows	<ul style="list-style-type: none"> Examine the feasible process of data extraction Criticize the data management 	K4 K5
4.5	Word Processing Software - (a) MS Office (b) Word (c) Excel (d) Power point	<ul style="list-style-type: none"> Analyse the importance of computer in recent studies 	K4
V	BIOINFORMATICS AND ITS APPLICATION		
5.1	5.1.0. Bioinformatics 5.1.1. Definition and scope. 5.1.2. Role of Internet in Bioinformatics	<ul style="list-style-type: none"> Define the concept bioinformatics and various aspects of it. Interpret the techniques for future studies 	K1 K4
5.2	5.2.0. Biological database 5.2.1. Nucleotide sequence database	<ul style="list-style-type: none"> Identify the scope in Biomics using Bioinformatics. Explain the basics of metabolomics 	K3

	(a) European Molecular Biology Laboratory (EMBL) (b) National Centre for Biotechnology Information (NCBI) 5.2.2. Protein sequence database - (a) Protein Information resources (PIR) (b) Swiss-Prot.	and chemo informatics.	K2
5.3	Role of Bioinformatics - Human genome project and <i>Arabidopsis thaliana</i>	<ul style="list-style-type: none"> Apply the metagenomics methods in genomic studies. 	K3
5.4	Concept of metabolome and metabolomics, its applications- Chemoinformatics: Cheminformatics tools for drug discovery.	<ul style="list-style-type: none"> Define the basics of advent branches of Bioinformatics. Construct phylogenetic trees, modify the available nucleotide data using the tools available 	K5 K6

Mapping Scheme for the Course Code: U16BY5:1

U16BY5:1	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

SBEC I – MUSHROOM AND NURSERY TECHNOLOGY

Semester : V

Credits : 2

Course Code : U16BYPS1

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

CO 6	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)

5.1 Nursery 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. 4th 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, New Delhi.
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

SPECIFIC LEARNING OUTCOMES (SLO):

Unit/ Section	Content	Learning Outcome	Highest Bloom taxonomic level of transaction
1	INTRODUCTION TO MUSHROOMS		

1.1	Introduction and Systematic position	<ul style="list-style-type: none"> ● Categorize scientific classification of mushroom 	K4
1.2	Structure of mushroom	<ul style="list-style-type: none"> ● Discuss and elaborates about various forms of mushroom 	K2
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"> ● Compile and understand the different types of mushroom ● Analyze mushroom cultivation techniques ● Examine and recognize the poisonous mushroom 	K3 K4 K4
1.4	Identification of edible and poisonous Mushrooms - Physical and Chemical method	<ul style="list-style-type: none"> ● Analyse methods for identifying poisonous mushroom 	K4
1.5	Nutrient values of edible mushroom	<ul style="list-style-type: none"> ● Inspect the importance of nutritional values of mushroom 	K4
1.6	Life cycle	<ul style="list-style-type: none"> ● Interpret the life cycle of mushroom 	K5
1.7	Economic values	<ul style="list-style-type: none"> ● Apply the economic importance of mushroom 	K3
II	CULTIVATION OF MUSHROOMS		
2.0	Mushroom cultivation - Compost beds, Spawn types, Production and management of Spawn, Spawn running	<ul style="list-style-type: none"> ● Develop a concept about a method for mushroom cultivation 	K6
2.1	Disease and pest management – Insects, Nematodes, Mites, Virus, Bacteria and Fungi	<ul style="list-style-type: none"> ● Discuss and know the disease and pest management during mushroom cultivation 	K6
2.2	Harvesting methods	<ul style="list-style-type: none"> ● Evaluate of harvesting techniques 	K5

III	MUSHROOMS –POST HARVEST AND PROCESSING		
3.1	Post harvesting technology – Cleaning, Freezing, Freeze drying, Packing and Marketing	<ul style="list-style-type: none"> Analyze post-harvesting technology 	K4
3.2	Mushroom recipes preparation – Pickle, Soup, Gravy and Biryani	<ul style="list-style-type: none"> Make up various recipes using mushroom 	K3
IV	BASIC CONCEPTS AND TECHNIQUES OF NURSERY TECHNOLOGY		
4.1	Nursery technology – Introduction, Definition	<ul style="list-style-type: none"> Assess new methods in nursery technology 	K5
4.2	Methods of Propagation	<ul style="list-style-type: none"> Analyze various propagation techniques 	K4
4.2	Sexual Propagation	<ul style="list-style-type: none"> Interpret the importance of sexual propagation 	K5
4.2	Vegetative Propagation –(a) Cuttings, (b) Stem cuttings– <i>Hibiscus</i> ,(c) Root cuttings – Rose	<ul style="list-style-type: none"> Make use of plants using numerous vegetative propagation 	K3
4.2	Layering -(a) Simple layering, (b) Air layering – <i>Ixora</i>	<ul style="list-style-type: none"> Explain layering methods 	K5
4.2	Grafting-(a) Inarching – Guava (b)Wedge grafting - Mango	<ul style="list-style-type: none"> Explain grafting method for planting 	K5
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"> Recommends tools for gardening 	K5
V	COMPONENTS AND PREPARATION OF NURSERY BED		

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"> ● Compose and construct a nursery ● Explain the various composting techniques. 	K6
5.2	Green houses for tropical countries - Management, Pot mixture, Pot culture, Maintenance and Marketing of Nursery Stock	<ul style="list-style-type: none"> ● Elaborates greenhouse technology in various countries 	K6

Mapping Scheme Course Code: U16BYPS1

U16BYPS 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	-	-	M	-	H	H	H	-	-	-	-	-	M
CO2	-	-	M	-	M	H	L	-	-	-	-	-	L
CO3	L	-	M	-	-	-	-	-	-	-	-	-	L
CO4	-	-	M	-	L	-	M	-	-	-	-	-	L
CO5	L	-	-	-	-	-	M	-	-	-	-	-	L
CO6	-	-	-	L	-	L	L	--	-	-	-	-	L

Course assessment:

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

CORE VII- GENERAL GEOLOGY, ECOLOGY AND PHYTOGEOGRAPHY

Semester : VI

Course Code: U16BY607

Credits : 6

Hours/Week :6

Course Outcomes:

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

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

Syllabus:

GEOLOGY

(18 Hours)

- 1.1. Scope, subdivisions and importance of Geology
- 1.2. Solar system, origin and age of earth
- 1.3. Land distribution (Continental drift)
- 1.4. Interior of the earth
- 1.5. Soil
- 1.5.1. Soil erosion and soil types of India.
- 1.6. Elementary knowledge of ground water
- 1.6.1. Surface water systems.

Unit II: ECOLOGY

(18 Hours)

- 2.1. Scope and importance of studying ecology.
- 2.2. Approaches to the study of ecology
 - 2.2.1. Autecology
 - 2.2.2. Synecology
- 2.3. Plants and Environmental factors
 - 2.3.1 Plants and Climate
 - 2.3.2. Plants and Edaphic factors
 - 2.3.3. Plants and Biotic factors

2.3.4. Topographic factors.

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 RESPONSE (18 Hours)

- 1.1. Ecological classification of plants, Hydrophytes, Mesophytes Xerophytes,
- 1.2. 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:

Sl. No.	Topics	Reference Book/Web Links
1.	Geographic Deltas of India	https://www.geographynotes.com/landforms/classification-of-deltas-6-types-landforms-geography/2470 https://www.nationalgeographic.org/encyclopedia/delta/
2.	Climate in India	https://www.toppr.com/guides/geography/climate/climate-of-india/ https://www.newworldencyclopedia.org/entry/Climate_of_India
3.	The Kharif and Rabi Crops in India	https://www.javatpoint.com/kharif-crops-vs-rabi-crops#:~:text=Major%20Kharif%20crops%20are%20rice,for%20the%20growth%20of%20crops.

		https://www.drishtiiias.com/to-the-points/paper3/cropping-patterns-and-major-crops-of-india-part-one
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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.swayam2.ac.in/cec19_bt03/preview

SPECIFIC LEARNING OUTCOMES (SLO):

Unit/Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
I	GEOLOGY		
1.1	Scope, subdivisions and importance of Geology	<ul style="list-style-type: none"> List out the scope and importance of geology 	K1
1.2	Solar system, origin and age of earth	<ul style="list-style-type: none"> Illustrate the various theories of origin of solar system Analyse the age of age 	K2 K4
1.3	Land distribution (Continental drift)	<ul style="list-style-type: none"> classify the various components of Soil. 	K2

1.4	Interior of the earth	<ul style="list-style-type: none"> Classify the different layers of earth. 	K4
1.5	Soil- Soil erosion and soil types of India.	<ul style="list-style-type: none"> Define the soil formation and its characteristics. Explain various zones of soil profile Classify the various types of soils 	K1 K2 K2
1.6	Elementary knowledge of ground water and Surface water systems	<ul style="list-style-type: none"> recall and explain the different forms of water in earth apply the knowledge on ground water systems for proper use. 	K2 K3
II	ECOLOGY		
2.1	Scope and importance of studying ecology.	<ul style="list-style-type: none"> explain the importance of Ecology make use of the various scopes in Ecology 	K2 K3
2.2	Approaches to the study of ecology, Autecology Synecology	<ul style="list-style-type: none"> relate the different studies in ecology. 	K2
2.3	Plants and Environmental factors Climate, Topographic factors, Edaphic factors, Plants and Biotic factors	<ul style="list-style-type: none"> compare the distribution of plants in relation with their environmental factors explain the various interaction of with its biotic factors 	K4 K2
2.4	Ecosystem -Types of Ecosystem, Ecological Pyramid, energy flow, Food web - Niche	<ul style="list-style-type: none"> illustrate the structure and function of different ecosystem 	K2
2.5.	Community ecology and Population Dynamics.	<ul style="list-style-type: none"> Analyze the natality, mortality, productivity of a population. 	K4
III	EVOLUTION OF PLANT COMMUNITY		
3.1	Development of vegetation, Migration, Ecesis and colonization.	<ul style="list-style-type: none"> demonstrate the development of vegetation 	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"> • apply different methods of vegetation studies in Field • interpret the data obtained from vegetation studies. 	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"> • summarize the various concepts of plant succession • Distinguish the different stage of plant succession 	K2 K4
IV	PLANT RESPONSE		
4.1	Ecological classification of plants, Hydrophytes, Xerophytes, Epiphytes, Halophytes	<ul style="list-style-type: none"> • classify the plants based on their habitats 	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"> • explain the adaptation of plants in relation with their habitat. • examine morphological and anatomical modification of plants in different environmental condition. 	K2 K5
4.3	Plant as ecological Indicator	<ul style="list-style-type: none"> • Define the importance of plants as the ecological indicator. 	K5
V	PHYTOGEOGRAPHY		
5.1	Phytogeography Definition and importance, Types of distribution of plants (continuous and discontinuous)	<ul style="list-style-type: none"> • categorize the different Phytogeographic regions. • explain the distribution of plants 	K4 K2

5.2	Climate of India and climatic zones. Phytogeographic regions of India	<ul style="list-style-type: none"> Summarize the phytogeographic regions of India 	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"> Classify the vegetation types based on the component of the forests 	K4
5.4	Conservation of vegetation and its importance	<ul style="list-style-type: none"> choose appropriate conservation strategies for the conservation of vegetation 	K5

Mapping Scheme for the Course Code: U16BY607

U16BY607	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

CORE VIII – GENERAL MICROBIOLOGY

Semester : VI

Course Code : U16BY608

Credits : 5

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	V
CO 5	Identify the causal agent of microbes and control the mechanisms of pathogens and diseases.	K3	IV
CO 6	Examine the evidences of management and host resistance of diseases.	K4	IV

Unit I : CLASSIFICATION OF MICROORGANISMS

(18 hours)

1.1. 0 Microbiology

1.1. 1 Define Microbes

1.2.1 History of Microbiology.

1.3.1 Concepts of microbiology

1.4.1 Scope of microbiology

1.5.1 Classification of Microorganisms

1.6.0 Bacteria

1.6.1 Morphology

1.6.2 Cell Structure,

1.6.3 Growth,

1.6.4 Nutrition,

1.6.5.0 Reproduction 1.6.5.1- Asexual methods 1.6.5.2-Sexual Method

1.6.6 Economic Importance of Bacteria,

1.7.0 Virus

1.7.1 Morphology,

1.7.2 Cell Structure

1.7.3 Nutrition,

1.7.4 Reproduction 1.7.4.1 –Lytic cycle 1.7.4.2- Lysogenic cycle

1.8.0 Yeast

1.8.1 Morphology

1.8.2 Cell Structure,

1.8.3 Nutrition,

1.8.4.0 Reproduction 1.8.4.1- Vegetative 1.8.4.2.- Asexual 1.8.4.3 Sexual

1.8.5 Economic importance of Yeast.

1.9.0 Cyanobacteria

1.9.1 Morphology

1.9.2 Cell Structure

1.9.3 Nutrition

1.9.4.0 Reproduction 1.9. 4.1- Vegetative 1.9. 4.2 Asexual

1.9.5 Economic Importance of cyanobacteria.

Unit II : METHODS IN MICROBIOLOGY

(18 hours)

2.1.0 Microscope

2.1.1 Basic Principles of microscopy

2.2.0 Light Microscopes

2.2.1 Simple microscope- Principle,

2.2.2 Structure

2.2.3 Applications

2.2.4.1 Compound Microscope- Principle

2.2.4.2 Structure

2.2.4.3 Applications

2.3.1 Fluorescence microscopes- Principle,

2.3.2 Structure

2.3.3 Applications

2.4.1 TEM - Principle,

2.4.2 Structure

2.4.3 Applications

2.5.1 SEM- Principle,

2.5.2 Structure

2.5.3 Applications

2.6.0 Micrometer

2.6.1 Define Micrometry-

2.6.2 Ocular meter

2.6.3 Stage meter

2.7.0 Staining

2.7.1 Define staining,

2.7.2 Staining- Procedure,

2.7.3.0 Types of staining

2.7.3.1 Simple staining, 2.7.3.2 Gram staining, 2.7.3.3 Negative staining 2.7.3.4 Acid fast staining.

2.8.0 Sterilization

2.8.1 Define Sterilization and methods

2.8.2 Heat sterilization,

2.8.3 Chemical sterilization,

2.8.4 Filtration,

2.8.5 UV radiations,

2.8.6 Aldehydes

2.8.7 Gases

2.9.0 Culture media

2.9.1 Define Culture media

2.9.2 Types of culture media

2.9.3 Broth culture

2.9.4 Agar plate culture

2.10.0 Pure culture

2.10.1 Define Pure culture

2.10.2.0 Methods of purer culture

2.10.2.1 Serial dilution technique, 2.10.2.2 Streak plate cultures, 2.10.2.3 Pour plate culture, 2.10.2.4 Spread plate technique, 2.10.2.5 Enrichment culture, 2.10.2.6 Selective medium culture, 2.10.2.7 Differential medium culture 2.10.2.8 Single isolation culture

Unit III : FOOD AND DAIRY MICROBIOLOGY

(18 hours)

3.1.0 Milk

3.1.1 Microorganisms in milk,

3.2.1 Preservation of milk

3.2.2 Pasteurization,

3.2.3 Sterilization

3.2.4 Dehydration.

3.3.1 Bacteriological standard

3.3.2 Grading of milk

3.3.3 Methylene Blue reduction test

3.4.1 Define Dairy Products

3.4.2 Fermented milk,

3.4.3 Curd,

3.4.4 Butter

3.4.5 Ghee

3.4.6 Cheese.

3.5.1 Define Food spoilage

3.5.2 Causes of food spoilage

3.5.3 Biochemical changes of food spoilage

3.6.1 Define Food poisoning

3.6.2 Types of food poisoning

3.7.1 Methods of Food preservation.

Unit IV : MEDICAL MICROBIOLOGY

(18 hours)

4.1 Disease, Disease causing organism, symptoms and Prevention and control measure- Typhoid, Cholera, Hepatitis -B, Common cold, Mycosis –superficial, Amoebiasis and Malaria

Unit V : ENVIRONMENTAL MICROBIOLOGY

(18 hours)

5.1.0 Biogeochemical cycle

5.1.1 Define Biogeochemical cycle

5.1.2 Role of microorganisms in biogeochemical cycle

5.2.1 Nitrogen cycle

5.3.1 Carbon cycle

5.4.0 Biofertilizers

5.4.0 Importance of Biofertilizers

5.5.0 *Rhizobium*,

5.5.1 identification

5.5.2 Isolation

5.5.3 Mass culture

5.5.4 Commercial production

5.6.0 *Azospirillum*

5.6.1 identification

5.6.2 Isolation

5.6.3 Mass culture

5.6.4 Commercial production

5.7.0 *Mycorrhiza*,

5.7.1 identification

5.7.2 Isolation

5.7.3 Mass culture

5.7.4 Commercial production

5.8.0 Biodegradation

- 5.8.1 Define biodegradation
- 5.8.2. Biodegrading agents
- 5.8.3 Degradation of Xenobiotics
- 5.8.4 Degradation of hydrocarbons
- 5.8.5 Degradation of Polychlorinated Biphenyl compounds
- 5.8.6 Bioremediation
- 5.8.7 Advantages of biodegradation
- 5.9.0 Bioleaching.
- 5.9.1 Define bioleaching
- 5.9.2 Types of bioleaching
- 5.9.3 Direct bioleaching
- 5.9.4 Indirect bioleaching
- 5.9.5 Advantages of bioleaching

TOPICS FOR SELF-STUDY:

TOPICS	REFERENCES
Kingdom concepts of classification	<ol style="list-style-type: none"> 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	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7180381/ https://www.sciencedirect.com/topics/medicine-and-dentistry/arbovirus https://www.microbiologyresearch.org/content/arboviruses-and-their-vectors
Dualistic activity of <i>Enterococcus</i> in food	https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/enterococcus https://cmr.asm.org/content/32/2/e00058-18
Listeriosis	https://www.cdc.gov/listeria/index.html

Vermicomposting	https://www.sciencedirect.com/topics/earth-and-planetary-sciences/vermicomposting
Environmental reclamation	http://www.fao.org/3/x5872e/x5872e0c.htm
Innate mechanisms in plants	https://pubmed.ncbi.nlm.nih.gov/23660678/ https://www.nature.com/subjects/plant-immunology
Crown Oomycetes	https://link.springer.com/article/10.1007/s13225-011-0128-7 https://bsppjournals.onlinelibrary.wiley.com/doi/full/10.1111/mpp.12190?scrollTo=references

TEXT BOOKS:

1. Arumugam. N, A. Mani, A. M. Selvaraj and Narayanan. L. M. 2014. *Microbiology*, Saras publication, Nagarcoil, Kanyakumari district.
2. Dubey, R. C. and D.K. Maheshwari, 2004. *A Text book of Microbiology*. Published by S.Chand & Company Ltd, 7361, Ram nagar, New Delhi.

REFERENCES BOOKS-

Microbiology

1. Michael.J.Pelczar,J.R.,E.C.S.Chanand N&RKrieg. 2013. *Microbiology*,McGrewHillEducation Private Limited, New Delhi, India.
2. Lansing M. Prescott, John P. Harley, Donald A. Klein. 2005. *Microbiology* 6th 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* 9th Edition. Orient Publication.
5. Kathleen P.Talaro and Berry Chess. 2017. *Foundations in Microbiology*. McGraw-Hill.

Web Link:

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

SPECIFIC LEARNING OUTCOMES (SLO):

Unit	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
I	Unit I : CLASSIFICATION OF MICROORGANISMS		
1.1.0	Microbiology	<ul style="list-style-type: none"> • Illustrate the general characteristic feature of micro-organisms • Compare the various period of microbiology • apply the scope of microbiology 	K2
1.1.1	Define Microbes		K3
1.2.1	History of Microbiology.		
1.3.1	Concepts of microbiology		
1.4.1	Scope of microbiology		
		K2	
1.5.1	Classification of Microorganisms	<ul style="list-style-type: none"> • Classify and explain the Whittaker's five kingdom concept 	K2
1.6.0	Bacteria	<ul style="list-style-type: none"> • Explain the morphology and structure of bacteria • Interpret the various types of reproduction. • Apply the various use of bacteria 	K2
1.6.1	Morphology		
1.6.2	Cell Structure,		
1.6.3	Growth,		K3
1.6.4	Nutrition,		
1.6.5	Reproduction- Asexual methods and Sexual Method		
1.6.6	Economic Importance of Bacteria,		
1.7.0	Virus	<ul style="list-style-type: none"> • Illustrate the structure and 	K2

1.7.1	Morphology,	<ul style="list-style-type: none"> characteristic of virus Examine the various types of reproduction in virus. 	K4
1.7.2	Cell Structure		
1.7.3	Nutrition,		
1.7.4	Reproduction–Lytic cycle-and Lysogenic cycle		
1.8.0	Yeast	<ul style="list-style-type: none"> List out characteristic of yeast. Classify the structure of yeast. Explain the types of reproduction in yeast. Utilize the importance of yeast. 	K1
1.8.1	Morphology		K2
1.8.2	Cell Structure,		
1.8.3	Nutrition,		
1.8.4	Reproduction – Vegetative, Asexual and Sexual		K3
1.8.5	Economic importance of Yeast.		
1.9.0	Cyanobacteria	<ul style="list-style-type: none"> Label the structure of cyanobacteria. Demonstrate the reproduction and application of blue green algae. 	K2
1.9.1	Morphology		
1.9.2	Cell Structure		K4
1.9.3	Nutrition		
1.9.4	Reproduction – Vegetative, Asexual		
1.9.5	Economic Importance of cyanobacteria.		
II	METHODS IN MICROBIOLOGY		
2.1.0	Microscope	<ul style="list-style-type: none"> Label the various parts of light microscopes. 	K2
2.1.1	Basic Principles of microscopy		
2.2.0	Light Microscopes	<ul style="list-style-type: none"> Explain the structure and application of microscopes. Compare and contrast of Simple and compound microscope. 	K2
2.2.1	Simple microscope- Principle,		
2.2.2	Structure		
2.2.3	Applications	K4	
2.2.4.1	Compound Microscope- Principle		

2.2.4.2	Structure		
2.2.4.3	Applications		
2.3.1	Fluorescence microscopes-	<ul style="list-style-type: none"> Label the various parts of fluorescence and electron microscopes. Explain the structure and application of electron microscopes. Compare and contrast of SEM and TEM microscope. Discuss the micrometry 	K2
	Principle,		
2.3.2	Structure		
2.3.3	Applications		K2
2.4.1	TEM - Principle,		
2.4.2	Structure		K4
2.4.3.	Application		
2.5.1	SEM- Principle,		
2.5.2	Structure		
2.5.3	Applications		
2.6.0	Micrometer		
2.6.1	Define Micrometry-		
2.6.2	Ocular meter		
2.6.3	Stage meter		
2.7.0	Staining	<ul style="list-style-type: none"> List out the various types of staining methods. Explain the types of staining methods. Apply the use of bacterial based staining. 	K2
2.7.1	Define staining,		K2
2.7.2	Staining- Procedure,		
2.7.3	Types of staining Simple staining, Gram staining, Negative staining and Acid fast staining.		K3
2.8.1	Define Sterilization and method	<ul style="list-style-type: none"> Compare and contrast of physical and chemicals methods of sterilization. Relate and apply the types of sterilization techniques. 	
2.8.2	Heat sterilization,		K2
2.8.3	Chemical sterilization,		
2.8.4	Filtration,		
2.8.5	UV radiations,		K1
2.8.6	Aldehydes		

2.8.7	Gases	<ul style="list-style-type: none"> Apply various types physical sterilization. 	K3
2.9.0	Culture media	<ul style="list-style-type: none"> Define and classify the types of culture media. Explain the types of culture media for pure culture isolation. Interpret various form of pure culture and apply in isolation microbes. 	K2
2.9.1	Define Culture media		K2
2.9.2	Types of culture media		K2
2.9.3	Broth culture		
2.9.4	Agar plate plate culture		
2.10.0	Pure culture		
2.10.1	Define Pure culture		K2
2.10.2	Methods of purer culture		
2.10.2.1	Serial dilution technique,	<ul style="list-style-type: none"> Discuss the types of culture media for pure culture isolation. Interpret various form of pure culture and apply in isolation microbes. 	K6
2.10.2.2	Streak plate cultures,		
2.10.2.3	Pour plate culture,		
2.10.2.4	Spread plate technique,		
2.10.2.5	Enrichment culture,		
2.10.2.6	Selective medium culture,		K2
2.10.2.7	Differential medium culture		
2.10.2.8	Single isolation culture		
III	FOOD AND DAIRY MICROBIOLOGY		
3.1.0	Milk	<ul style="list-style-type: none"> List out the microorganisms present in milk 	K1
3.1.1	Microorganisms in milk,		
3.2.1	Preservation of milk	<ul style="list-style-type: none"> Discuss the various methods of preservation of milk 	K6
3.2.2	Pasteurization,		
3.2.3	Sterilization		
3.2.4	Dehydration.		
3.3.1	Bacteriological standard	<ul style="list-style-type: none"> Explain the bacterial standard of 	K4

3.3.2	Grading of milk	<ul style="list-style-type: none"> pasteurized milk. Assess milk with the help of MBR test. 	K5
3.3.3	Methylene Blue reduction test		
3.4.1	Define Dairy Products	<ul style="list-style-type: none"> Elaborate in details about the source of contamination of milk. Identify briefly the preparation of butter and cheese 	K6
3.4.2	Fermented milk,		
3.4.3	Curd,		K3
3.4.4	Butter		
3.4.5	Ghee		
3.4.6	Cheese.		
3.5.1	Define Food spoilage	<ul style="list-style-type: none"> List out the toxin responsible for Staphylococcus food poisoning Compare between food spoilage and food poisoning. Explain the principle involved in food preservation 	K4
3.5.2	Causes of food spoilage		
3.5.3	Biochemical changes of food spoilage		
3.6.1	Define Food poisoning		K5
3.6.2	Types of food poisoning		
3.7.1	Methods of Food preservation.		
IV	MEDICAL MICROBIOLOGY		
4.1.0.	Typhoid	<ul style="list-style-type: none"> Name a few important modes of transmission of disease. Compare the symptoms, diagnosis and treatment of typhoid and cholera. 	K1
4.1.1	Causal organisms		
4.1.2	Symptoms		K6
4.1.3	Prevention and control measure		
4.2.0	Cholera		
4.2.1	Causal organisms		
4.2.2	Symptoms		
4.2.3	Prevention and Control measures		
4.3.0	Hepatitis B	<ul style="list-style-type: none"> Discuss the few viral diseases of man and its control measure. 	K6
4.3.1	Causal organisms		

4.3.2	Symptoms	<ul style="list-style-type: none"> • What are reservoirs of viral infections? 	
4.3.3	Prevention and Control measures		
4.4.0	Common cold		
4.4.1	Causal organisms		
4.4.2	Symptoms		
4.4.3	Prevention and Control measures		
4.5.0	Mycosis -superficial	<ul style="list-style-type: none"> • Define mycosis • Explain the few fungal diseases of man and their control measures. 	K1
4.5.1	Causal organisms		K5
4.5.2	Symptoms		
4.5.3	Prevention and Control measures		
4.6.0	Amoebiasis	<ul style="list-style-type: none"> • Define Epidemiology. • List of major protozoa disease • Discuss the protozoa diseases of man and their control measures. • Identify the host parasitic relationship. 	K1
4.6.1	Causal organisms		
4.6.2	Symptoms		
4.6.3	Prevention and Control measures		K6
4.7.0	Malaria		
4.7.1	Causal organisms		
4.7.2	Symptoms		K3
4.7.3	Prevention and Control measures		
V	ENVIRONMENTAL MICROBIOLOGY		
5.1.0	Biogeochemical cycle	<ul style="list-style-type: none"> • List out the types of biogeochemical cycle • Explain the role of microbes in biogeochemical cycle. • Outline the types of Nitrogen cycle and carbon cycle • Interpret relationship between nitrogen 	K4
5.1.1	Define Biogeochemical cycle		K2
5.1.2	Role of microorganisms in biogeochemical cycle		K2
5.2.1	Nitrogen cycle		
5.3.1	Carbon cycle		K2

		and carbon cycle.	
5.4.0	Biofertilizers	<ul style="list-style-type: none"> Define Biofertilizer 	K2
5.4.1	Importance of Biofertilizers	<ul style="list-style-type: none"> Classify and explain of biofertilizer 	K2
5.5.0	<i>Rhizobium</i> ,	<ul style="list-style-type: none"> Illustrate the mass cultivation 	K2
5.5.1	identification		
5.5.2	Isolation	<ul style="list-style-type: none"> Summarize the relationship between mass and commercial production 	K2
5.5.3	Mass culture		
5.5.4	Commercial production		
5.6.0	<i>Azospirillum</i>	<ul style="list-style-type: none"> Estimation of various production of cultivation process. 	K5
5.6.1	identification		
5.6.2	Isolation		
5.6.3	Mass culture		
5.6.4	Commercial production		
5.7.0	<i>Mycorrhiza</i>		
5.7.1	identification		
5.7.2	Isolation		
5.7.3	Mass culture		
5.7.4	Commercial production		
5.8.0	Biodegradation	<ul style="list-style-type: none"> Comment on Biodegradation 	K5
5.8.1	Define biodegradation	<ul style="list-style-type: none"> Explain Xenobiotics 	
5.8.2	Biodegrading agents		
5.8.3	Degradation of Xenobiotics		
5.8.4	Degradation of hydrocarbons		
5.8.5	Degradation of Polychlorinated Biphenyl compounds		
5.8.6	Bioremediation	<ul style="list-style-type: none"> List out types of bioremediation. 	K4
5.8.7	Advantages of biodegradation	<ul style="list-style-type: none"> Explain the advantage of 	K5

		bioremediation.	
5.9.0	Bioleaching.	<ul style="list-style-type: none"> Discover the various types of bioleaching methods Make use of the advantage of bioleaching. Explain bioleaching 	K4
5.9.1	Define bioleaching		K3
5.9.2	Types of bioleaching		
5.9.3	Direct bioleaching		
5.9.4	Indirect bioleaching		
5.9.5	Heaps or dumos method		
5.9.6	Insitu bioleaching		
5.9.7	Bioreactor		
5.9.8	Advantages of bioleaching		

Mapping Scheme for the Course Code: U16BY508

U16BY 508	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 –VI – MAJOR PRACTICAL VI

Hours/Week: 3
Course Code: U16BY6P6

Credits: 2
Semester: VI

Course Outcomes:

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

No	COURSE OUTCOMES (CO)	Level	Unit
CO 1	Analyse the importance of food web and organisms in each level	K4	I
CO 2	Identify the process of ecological succession	K3	I
CO 3	Determine the importance of microbes	K5	II
CO 4	Identify the plant breeding method utilized	K3	III
CO 5	Explain the plant diseases	K2	IV
CO 6	Define the plant protection techniques	K2	V

SYLLABUS

ECOLOGY

(18 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.

MICROBIOLOGY

(18 Hours)

1. Basic requirements of a microbiology laboratory
2. Preparation of temporary cotton plugs
3. Preparation of culture media- Nutrient broth medium and PDA medium
4. Methods of sterilization
5. Fungal spore identification and germination

6. Isolation of Microorganism from soil, air, water, food, vegetables and plants
7. Techniques for pure culture of microorganisms
8. Serial Dilution -Agar plate method
9. Methods of culture, preservation and maintenance
10. Measurement of Microorganisms using micrometer.
11. Methylene blue reductase test.
12. Measurement of fungal growth by colony diameter method.
13. Completed Test for coliform bacteria

Plant Breeding:

(3 Hours)

1. Selection methods- Explanation through charts
 - a. Mass selection
 - b. Pureline selection
 - c. Clonal selection
2. Hybridization and Emasculation- Class work

Plant Pathology

(3 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

Plant Protection- Spotters

(3 Hours)

TOPICS FOR SELF-STUDY:

Sl. No.	Topics for Self-Study	Reference Link
1	Law of ten percent	https://en.wikipedia.org/wiki/Ecological_efficiency
2	BOD, COD	https://www.usgs.gov/special-topic/water-science-school/science/biological-oxygen-demand-bod-and-water
3	Staining techniques	https://courses.lumenlearning.com/microbiology/chapter/staining-microscopic-specimens/

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.

WEB LINK:

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

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

SPECIFIC LEARNING OUTCOME (SLO):

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

II	MICROBIOLOGY		
1	Basic requirements of a microbiology laboratory	<ul style="list-style-type: none"> • Explain the different microbes having economic importance • Compare the media for microbial growth 	K2
2	Preparation of temporary cotton plugs		K5
3	Preparation of culture media- Nutrient broth medium and PDA medium		
4	Methods of sterilization		
	Fungal spore identification and germination		
5	Isolation of Microorganism from soil, air, water, food, vegetables and plants		
6	Techniques for pure culture of microorganisms		
7	Serial Dilution -Agar plate method		
8	Methods of culture, preservation and maintenance		
9	Measurement of Microorganisms using micrometer. Methylene blue reductase test. Measurement of fungal growth by colony diameter method. Completed Test for coliform bacteria.		
III	PLANT BREEDING		
	Selection methods- Explanation through charts	<ul style="list-style-type: none"> • Apply the useful method for plant propagation 	K3

	a. Mass selection b. Pureline selection c. Clonal selection		
IV	PLANT PATHOLOGY		
	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	<ul style="list-style-type: none"> Explain the diseases caused by microbes in plants 	K2
V	PLANT PROTECTION		
	1. Knapsac Sprayer 2. Duster	<ul style="list-style-type: none"> Explain the methods for prevention of plants from diseases 	K2

Mapping Scheme for the Course Code: U16BY6P6

U16BY6P6	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	H	M	-	L	M	H	H	-	-	M
CO2	H	-	M	-	M	H	L	-	-	H	-	M	L
CO3	L	-	-	M	-	-	-	-	-	-	-	-	L
CO4	L	-	M	-	L	-	M	-	-	-	-	-	L
CO5	H	L	-	-	-	-	M	-	-	H	-	H	L
CO6	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 -PLANT BREEDING, PATHOLOGY, PROTECTION

AND ORGANIC FARMING

Course code : U16BY6:1

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	Make use of the knowledge on means of exploiting plants through varies breeding programs	K3	I
CO 2	Explain the necessity of breeding programs, hybrid vigor	K5	I
CO 3	Interpret how humans flourished by breeding and domestication of plants.	K4	II
CO 4	Explain the causal agent of microbes, evidence of management of plant diseases.	K6	III
CO 5	Elaborate the knowledge of crop protection, soil and crop management for sustainable organic agricultural production and development.	K6	IV
CO6	Improve the soil production with the application of compost and organic residues for the substitution of chemical and mineral fertilizers	K6	V

Syllabus:

Unit I: PLANT BREEDING

Introduction to Plant breeding

(15 Hours)

1.2.3. Importance-Plant Domestication

Concepts of Domestication

Center of Origin of Species- N. Vavilov

Basic principles of selection methods

Mass Selection

Pure line Selection

Clonal selection

Hybridization

Objectives

Hybridization procedure

Choice of parents(b) Emasculation(c) Bagging and Labelling

(d) Harvesting and Raising F1 generation

Heterosis

Definition

Genetic causes of heterosis

Dominance theory (b) Over dominance theory

Physiological causes of heterosis

Effects of heterosis

Unit II- BREEDING METHODS

(15 Hours)

Mutation Breeding

Definition – Mutation and Mutagenesis

Types of mutation

Spontaneous(b) Induction -Physical and Chemical

Application and limitation

Achievements

Polyploidy in breeding

Types of Polyploidy

Aneuploidy(b) Euploidy(c) Autopolyploidy(d) Allopolyploidy

Application

Achievements

Breeding for disease resistance

Disease escape

Disease resistance - Vertical and Horizontal

Mechanisms of Disease resistance

Mechanical(b) Hypersensitivity(c) Antibiosis(d) Nutritional

Achievements

Breeding for drought tolerance

Mechanisms of Drought Resistance

Drought escape(b) Drought avoidance(c) Drought tolerance (d) Drought resistance

Achievements in Drought tolerance

Plant breeding achievements in India with reference to Rice, Wheat, Sugarcane

Unit III: PLANT PATHOLOGY

(15 Hours)

Plant pathology

Classification of Plant diseases

Study of the following diseases with reference to casual agents, symptoms, and preventions and control methods.

Little leaf of Brinjal

Tobacco Mosaic virus

Citrus Canker

Red rot of Sugarcane

Unit IV: PLANT PROTECTION

(15 Hours)

Principles of Plant Protection

Methods of plant protection

Prevention

Control

Eradication

Methods of control

Cultural practices

Quarantine methods

Methods of application of fungicides and pesticides

Sprayers

Dusters

Integrated Pest Management

Concepts and Principles

Approaches

4.5.3. Advantages

Seed treatment

Methods of Seed treatment

Hot water, (b) Dry heat, (c) Aerated heat and (d) Radiation

Chemical and Biological treatment

Soil treatment

Sterilization

Heating and (b) Fumigation

Unit V: ORGANIC FARMING

(15 Hours)

Organic farming

Concepts and Importance

Land and seed preparation

Crop maintenance

Crop rotation

Biofertilizers

Role and Benefits of Biofertilizers

Different types of Biofertilizers

Rhizobium(b) Azotobacter(c)Azospirillum(d) Cyanobacteria (e) Azolla(f) Mycorrhiza

5.2.3 Culture preparation and Methods of application

Green manure

Compost and Vermicompost

Principles and Methods

Benefits
 Bio-pesticides
 Types of Biopesticides
 Bacteria, (b)Fungi and (c) Virus
 Benefits
 Integrated farming
 Definition
 Scope and concepts
 Importance

TOPICS FOR SELF-STUDY:

S. no	Topics for Self-Study	References
1	Drought resistance by Engineering Plant – Tissue specific response	https://www.frontiersin.org/articles/10.3389/fpls.2019.01676/full
2	Plant adaptation to drought stress	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4937719/
3	Host resistance	https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/host-resistance
4	Recent trends in Agriculture: Vertical Farming and Organic Farming	https://medcraveonline.com/APAR/recent-trends-in-agriculture-vertical-farming-and-organic-farming.html
5	Integrated Pest Management in Practice	https://www.sciencedirect.com/science/article/abs/pii/S0261219499000988

6	Impact of Pesticides use in Agriculture	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2984095/
7	Pesticide productivity and food security	https://link.springer.com/article/10.1007/s13593-012-0105-x

TEXT BOOKS:

Plant Breeding:

1. Chaudhary, R. C. *Introduction to Plant Breeding*. Oxford IBH Publishing Co., (P) Ltd., New Delhi, 1991.
2. Ghahal, G. S. and Gosal, S. S. *Principles and procedures of Plant Breeding*. Narosa Publishing House, 2002.
3. Singh, B. D. 1996. *Plant Breeding: Principles and methods*. Kalyani Publications , 1996.
4. Singh, B. D. *Plant Breeding: Principles and Methods*, Kalyani Publishers, 2006.

Plant Pathology:

1. Mehrotra R.S., and Askok Agarwall. 2008. *Plant pathology*, Tata McGrew Hill Education Pvt., Ltd., New Delhi, India.

Plant Protection:

1. 1. Bugdol, M. and Jedynek, P. 2015. *Integrated Management Systems*. Springer International Publishing, Switzerland.
2. 4. Lee, T.H., Shiba, S. and Wood, R. C. 1999. *Integrated Management Systems: A Practical Approach to Transforming Organizations*. John Wiley & Sons, Inc., India.
3. Maheshwari, D.K. 2014. *Composting for Sustainable Agriculture*. Springer International Publishing, Switzerland.

Reference Books:

Plant Breeding:

1. Acquaah, G. *Principles of Plant Genetics and Breeding*. Blackwell Publishing, USA, 2007.
2. Agarwal, R. I. *Fundamentals of Plant Breeding and Hybrid Seed Production*. Oxford IBH Publications, New Delhi, 1998.

3. Allard, R. W. *Principles of Plant breeding*. John Wiley Publications, N.Y, 1999.
4. Baudai, M. M. *Practical Plant Breeding*. Oxford IBH Publication, New Delhi, 1974.
5. Chopra, V. I. *Plant breeding – Theory and Practice*, (2nd Edn.) Oxford IBH Publishing Co., (P) Ltd., New Delhi, 1998.
6. Sharma, J. R. *Principles and practices of Plant Breeding*. Tata McGraw-Hill Publishers Company Ltd, 1994.

Organic Farming:

1. Palaniappan, S.P. and Annadurai, K. 2012. *Organic Farming – Theory and Practice*. Scientific Publishers, India.

HORTICULTURE

1. Edmond Musser and Andres. *Fundamentals of Horticulture*. McGraw Hill Book Co., New York. 1974.
2. Randhawa. *Ornamental Horticulture in India*. Today and Tomorrow Publishers. New Delhi, India. 1978.
3. Naik. *South Indian Fruits and their culture*. Varadhachary and Co., Madras, Tamil Nadu, India. 1963.

PLANT PROTECTION

1. Chatterjee, P.B. *Plant Protection Techniques*. BharathiBhawan, Patna, India, 1997.
2. Chattopadhyaya, S.B. *Principles and Procedures of Plant Protection (3rd Ed.,)*. Oxford and IBII Publishing Co. (P) Ltd., New Delhi, India. 1989.
3. Joshi, N.C. *Plant Protection in India*. Allied Publishers Ltd., New Delhi, India, 1992.

Web links:

<https://www.wur.nl/en/show/Online-course-Plant-Breeding.htm>

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

<http://ecoursesonline.iasri.res.in/course/view.php?id=134>

SPECIFIC LEARNING OUTCOME(SLO):

Unit	Content	Learning Outcome	Highest Bloom taxonomic level of transaction
I	Plant Breeding		
1.1	Introduction to Plant Breeding - History, Objective, Importance	Recall the history of Genetics	K1
1.2	Plant Domestication Concepts of Domestication, Center of Origin of Species – N. Vavilov	List the Centre of Origin of Species	K1
1.3	Basic principles of Selection Methods Mass selection, Pure line selection, Clonal Selection	Classify the kinds of Selection methods Compare the principles of selection methods.	K4 K4
1.4	Hybridization Objectives, Hybridization Procedure – (a) Choice of Parents (b) Emasculation (c) Bagging and Labelling (d) Harvesting and Raising F1 generation	Illustrate Multiple Alleles in Human traits.	K2
1.5	Heterosis Definition, Genetic causes of heterosis (a) Dominance theory (b) Over dominance theory, Physiological causes of heterosis, Effects of heterosis.	Classify the genetic causes of Heterosis. Discuss the Physiological causes of Heterosis.	K4 K6
II	BREEDING METHODS		
	Mutation Breeding Definition -Mutation and Mutagenesis, Types of Mutation – (a) Spontaneous (b) Induction –	Classify the types of Mutation	K4

2.1	Physical and Chemical, Application and Limitation, Achievements.	Distinguish the Spontaneous and Induced Mutation	K4
2.2	Polyploidy in breeding Types of Polyploidy (a) Aneuploidy (b) Euploidy (c) Autopolyploidy (d) Allopolyploidy, Application, Achievements	Recall the kinds of Polyploidy	K1
2.3	Breeding for disease resistance Disease escape, Disease resistance – Vertical and Horizontal, Mechanism of Disease resistance – (a) Mechanical (b) Hypersensitivity (c) Antibiosis (d) Nutritional, Achievements	Examine the mechanism of disease resistance	K4
2.4	Breeding for Drought tolerance Mechanisms of Drought resistance (a) Drought escape (b) Drought avoidance (c) Drought tolerance (d) Drought resistance, Achievements in Drought tolerance	Explain the mechanism of drought resistance	K5
2.5	Plant breeding achievements in India Plant breeding achievement in India with reference to Rice, Wheat, Sugarcane	Justify the Plant breeding achievement in India with reference to Economically important crops.	K5
III	PLANT PATHOLOGY		
3.1	Plant Pathology- Definition	Recall the definition of Plant Pathology	K1

3.2	Classification of Plant diseases	Classify the Kinds of Plant diseases with suitable illustration	K4
3.3	Study of the following diseases with reference to causal agents, symptoms, preventions and control methods Little Leaf of Brinjal, Tobacco Mosaic Virus Citrus canker Red rot of Sugarcane	Outline the Causal agent, Symptom, preventive and control methods of Plant diseases	K2
IV	PLANT PROTECTION		
4.1.	Principles of Plant Protection	Explain the principle of Plant protection	K2
4.2.	Methods of Plant Protection- Prevention, Control, Eradication	<ul style="list-style-type: none"> • Explain the methods of Plant protection 	K2
4.3.	Methods of Control Cultural Practices, Quarantine methods,	Distinguish the varies methods of cultural practices Evaluate the Plant Quarantine methods	K4 K5
4.4.	Methods of application of Fungicides and Pesticides Sprayers, Dusters	Distinguish between Sprayer and Duster Demonstrate the working mechanism of Sprayer	K4 K2
4.5.	Integrated Pest Management Definition, Concepts and Principles, Approaches, Advantages	Explain the concepts and Principles of IPM	K5

		List out the advantages of IPM	K1
4.6	Seed Treatment Methods of seed treatment (a) Hot water (b) Dry heat (c) Aerated heat (d) Radiation, Chemical and Biological treatment	Classify the methods of seed treatment Examine the chemical and biological method of seed treatment	K4 K4
4.7	Soil Treatment Soil treatment, Sterilization (a) Heating, (b) Fumigation	Compare the Heating and Fumigation method	K2
V	ORGANIC FARMING		
5.1	Organic Farming Concepts and Importance, Land and seed preparation, Crop Importance, Crop rotation,	Examine the importance of crop rotation	K2
5.2.	Biofertilizers Role and Benefits of Biofertilizers, Different types of Biofertilizers (a) Rhizobium (b) Azotobacter (c) Azospirillum (d) Cyanobacteria (e) Azolla (f) Mycorrhiza, Culture preparation and methods of application	Classify the various kinds of Microbial biofertilizers Determine the culture preparation and methods of application of Microbial fertilizers	K2 K5
5.3.	Green Manure Compost and Vermicompost, Principles and Methods, Benefits	Defend that vermicompost enhances the soil fertility	K3
5.4.	Bio-pesticides Types of Biopesticides (a) Bacteria, (b) Fungi and (c) Virus, Benefits	Explain different types of Biopesticides	K5

5.5.	Integrated Farming Definition, Scope and concepts, Importance	Discuss the importance of Integrated Farming	K6
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Mapping Scheme for Course Code: U16BY6:1

U16BY6:1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1	H	-	L	L	-	-	H	H	H	L	-	L	-
CO2	H	-	M	L	H	L	L	H	H	L	-	-	-
CO3	H	-	M	H	L	L	L	H	H	H	-	L	-
CO4	H	L	M	M	H	L	L	M	M	H	L	-	-
CO5	H	M	H	M	H	M	L	H	H	H	L	L	L
CO6	H	L	H	H	M	L	H	H	H	H	L	L	L

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.

Elective III: MOLECULAR BIOLOGY AND PLANT BIOTECHNOLOGY

Semester: VI

Course Code: U16BY6:2

Credits: 5

Hours/Week:5

Course Outcomes:

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

No	COURSE OUTCOME (CO)	Level	Unit
CO 1	Analyze the applications of plant biotechnology	K4	I

CO 2	Determine various aspects of tissue culture and their applications	K5	II
CO 3	Explain plant biotechnological applications viz., Algal and transgenic crops	K5	III
CO 4	Apply the concepts of Biotechnology in Environmental Management.	K3	IV
CO 5	Analyze the reasons for pollution and choose the method of pollution management.	K5	IV
CO 6	Discuss Ethical Issues, intellectual property management and handling of GMOs.	K6	V

Syllabus:

Unit I: BASIC CONCEPT OF MOLECULAR BIOLOGY

(15 Hours)

- 1.1. Denaturation and Renaturation
- 1.2. DNA replication
 - 1.2.1. Basic requirements
 - 1.2.2. Semi-conservative method- Proof for semi-conservative - Meselson and Stahl's Experiment
 - 1.2.3. Rolling circle mechanism
 - 1.2.4. Theta replication
- 1.3. Semi-discontinuous replications
 - 1.3.1. Unwinding of double helix, RNA primer formation
 - 1.3.2. DNA polymerase in prokaryotes and eukaryotes DNA polymerase I,II,III, Topoisomerase, SSB Protein
 - 1.3.4. Leading strand synthesis, Lagging strand synthesis, Okazaki fragments
 - 1.3.5. Origin of replication - Replicon and replication fork

Unit: II- GENE EXPRESSION

(15 Hours)

- 2.0. Central dogma of molecular biology
 - 2.1. Prokaryotic transcription
 - 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 of transcription
 - 2.2. Eukaryotic transcription
 - 2.2.1. Eukaryotic RNA Polymerases - RNA Polymerase I,II and III
 - 2.2.2. Transcription factors and Promoters, Post Transcription modifications
 - 2.2.3. RNA capping, Poly A tailing, Intron splicing
 - 2.3. Translation in Prokaryotes - Initiation, Elongation, Termination
 - 2.4. Translation in Eukaryotes – Initiation, Elongation, Termination
 - 2.4.1. Post Translation modifications - Protein folding, Biochemical modification

UNIT III: METHODS OF GENETIC ENGINEERING

(15 Hours)

- 3.0. Restriction endonucleases, Prokaryotic and eukaryotic cloning vectors, Genomic and c-DNA libraries
- 3.1. Gene cloning strategies - Screening of recombinants, Expression of cloned genes
- 3.2. Methods of Gene transfer - Agrobacterium mediated, Direct DNA transfer (I) Micro injection (II) Electroporation (III) Biolistics

Unit IV: APPLICATIONS OF MOLECULAR BIOLOGY

(15 Hours)

- 4.0. Nucleic acid hybridization 4.1 Blotting techniques - Southern,Northern, Western blotting
 4.2 PCR – Principle, Techniques and Applications.
 4.3 RFLP - Principle, Techniques, Applications, Advantages and Disadvantages
 4.4 RAPD – Principle, Techniques, Applications, Advantages and Disadvantages
 4.5 DNA Finger Printing

Unit V: PLANT TISSUE CULTURE

(15 Hours)

- 5.0 Laboratory requirements of plant tissue culture
 5.1 Preparation of Culture media –(a) Natural medium - Coconut milk (b) Synthetic medium - White medium and MS medium
 5.2 Sterilization– Techniques.
 5.3 Plant tissue culture techniques- Direct and Indirect.
 5.4 Somatic embryogenesis
 5.5 Production of synthetic seeds
 5.6 Somoclonal variations
 5.7 Protoplast isolation – Mechanical, Enzymatic
 5.8 Protoplast fusion – Physical, Chemical and Advantages
 5.9. GM foods - Varieties of GM foods, Advantages, Disadvantage

Topics for Self-Study:

Sl. No.	Topics	Reference Book/Web Links
1.	GURT	https://onlinelibrary.wiley.com/doi/full/10.1111/pbi.12084
2.	Bt-GM crops	https://ejbpc.springeropen.com/articles/10.1186/s41938-018-0051-2 Chopra, V. L. and Nasim, A. 1990. <i>Genetic engineering and Biotechnology. Concepts, Methods and Application.</i> (4th Ed.). Oxford and IBH Publication.
3.	Microbes as a tool in biowar	https://www.sciencedirect.com/topics/medicine-and-dentistry/biological-warfare https://www.britannica.com/technology/biological-weapon
4.	Impact of terminator seeds on Agriculture	https://cban.ca/gmos/issues/terminator-technology/ https://www.sites.ext.vt.edu/newsletter-archive/csces/1999-02/1999-02-03.html

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.

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

SPECIFIC LEARNING OUTCOMES (SLO):

Unit/ Section	CONTENT	LEARNING OUTCOME	Highest Bloom taxonomic level of transaction
I-	BASIC CONCEPT OF MOLECULAR BIOLOGY		
1.1	1.1. Denaturation and Renaturation	<ul style="list-style-type: none"> Recognize the importance and scope Appraise the application of plant biotechnology Develop interest in micropropagating plants 	K2 K4 K3
1.2	1.2. DNA replication	<ul style="list-style-type: none"> Identify suitable explants and medium for <i>In vitro</i> Propagation 	K3
1.3	1.2.1. Basic requirements	<ul style="list-style-type: none"> Plan the protocol for micropropagation Plan Micropropagation experiments 	K3
1.4	1.2.2. Semi-conservative method- Proof for semi-conservative - Meselson and Stahl's Experiment	<ul style="list-style-type: none"> Define biotechnological techniques involved in breeding plants 	K1
	1.2.3. Rolling circle mechanism	<ul style="list-style-type: none"> Explain the mechanisms 	K5

	1.2.4. Theta replication	<ul style="list-style-type: none"> Analyse the methods 	K4
	1.3. Semi-discontinuous replications	<ul style="list-style-type: none"> Define the multiplications 	K2
	1.3.1. Unwinding of double helix, RNA primer formation	<ul style="list-style-type: none"> Explain the DNA replication 	K2
	1.3.2. DNA polymerase in prokaryotes and eukaryotes DNA polymerase I,II,III, Topoisomerase, SSB Protein	<ul style="list-style-type: none"> Explain the enzymes 	K2
	1.3.4. Leading strand synthesis, Lagging strand synthesis, Okazaki fragments	<ul style="list-style-type: none"> Analyse the multiplication process 	K4
II	GENETIC ENGINEERING		
2.1	2.0. Central dogma of molecular biology	<ul style="list-style-type: none"> Summarize the application techniques in Genetic Engineering 	K2
2.2	2.1. Prokaryotic transcription 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 of transcription	<ul style="list-style-type: none"> Apply the knowledge gained from Genetic Engineering in Crop plants 	K3
2.3	2.2. Eukaryotic transcription	<ul style="list-style-type: none"> Identify the suitable vectors for expression of genes 	K3
2.4	2.2.1. Eukaryotic RNA Polymerases - RNA Polymerase I,II and III	<ul style="list-style-type: none"> Determine biotechnological techniques involved in breeding plants 	K5
III	METHODS OF GENETIC ENGINEERING		
3.1	3.0. Restriction endonucleases, Prokaryotic and eukaryotic cloning vectors, Genomic and c-DNA libraries	<ul style="list-style-type: none"> Demonstrate understanding of fundamental concepts of natural resource 	K2
3.2	3.1. Gene cloning strategies - Screening of recombinants, Expression of cloned genes	<ul style="list-style-type: none"> Explain the role of Renewable and non renewable energy resources and types of biomass. 	K5

3.3	3.2. Methods of Gene transfer - Agrobacterium mediated, Direct DNA transfer (I) Micro injection (II) Electroporation (III) Biolistics	<ul style="list-style-type: none"> Identify Bioremediation and Restoration of Environment 	K3
3.4	3.0. Restriction endonucleases, Prokaryotic and eukaryotic cloning vectors, Genomic and c-DNA libraries	<ul style="list-style-type: none"> Explain the various bioremediation process 	K2
3.5	3.1. Gene cloning strategies - Screening of recombinants, Expression of cloned genes	<ul style="list-style-type: none"> Explain the various concept of Bioremediation 	K2
IV	BIOMEDICAL APPLICATIONS OF BIOTECHNOLOGY		
4.1	Biotechnological applications in health care, (1) Molecular diagnosis – monoclonal antibodies, DNA probes, Microarrays, DNA finger printing, Gene therapy, Antisense Technology	<ul style="list-style-type: none"> Analyze the use of Biotechnological aspects in clinical field. 	K5
V	BIOTECHNOLOGY AND BIOSAFETY		
5.1	Biotechnology Act- regulatory agencies -	<ul style="list-style-type: none"> Discuss the Social and ethical issues of bio safety 	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"> Discuss the ethical issues of synthetic biology 	K6
5.3	Intellectual property rights (IPR), patenting (Process and Product)	<ul style="list-style-type: none"> Explain the importance of IPR and Patenting 	K2

Mapping Scheme for Course Code: U16BY6:2

U16BY6:2	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

**Continuous Assessment in assignments, record submission.
Class tests, Model Exams.
End Semester Examination**

Indirect

1. Course-end survey

SBEC II – MOLECULAR AND PLANT TISSUE CULTURE TECHNIQUES

Course Code: U16BYPS2

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
CO 3	Elaborating sterilization techniques, hands-on media preparation and monitoring the cultures	K6	IV

CO 4	Interpreting, analyzing, and validation of the bio-molecules (DNA and Protein) using the methods and protocols	K5	II
CO 5	Evaluating the direct and indirect methods for performing different micro propagation techniques	K5	III
CO 6	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. Rajini 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://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	INTRODUCTION AND LABORATORY ORGANIZATION		
1.1	Molecular Biology- Definition and importance	<ul style="list-style-type: none">• Define the basic concepts and principles	K6

		<ul style="list-style-type: none"> • Discuss the importance of plant culturing. 	
1.2	Laboratory Design and Requirements	<ul style="list-style-type: none"> • Develop core knowledge about laboratory setup • Determine the ethics of safety measures 	K6
II	PLANT DNA EXTRACTION AND QUANTIFICATION		
2.1	DNA Extraction and Separation by Agarose Gel Electrophoresis	<ul style="list-style-type: none"> • Make use of suitable technique in the separation of DNA • Explain the quality and quantity of DNA 	K3 K5
2.2	Protein Extraction and Separation by SDS-PAGE	<ul style="list-style-type: none"> • Make use of suitable technique in the separation of Protein • Asses the quality and quantity of Protein 	K3 K4
III	GENETIC TRANSFORMATION TECHNIQUES – PHOTOGRAPHS AND VIDEO PRESENTATION		
3.1	DNA transformation by indirect methods (Ti Plasmid and <i>Agrobacterium</i> -mediated transformation)	<ul style="list-style-type: none"> • Distinguish between DNA transformation indirect methods • Model of genetic elements present on the Ti plasmid • Relate the concepts of <i>Agrobacterium</i> mode of gene transfer in transformation 	K4
3.2	DNA transformation by direct methods (Biolistics, Microinjection and Electroporation)	<ul style="list-style-type: none"> • Compare and contrast the process of DNA transformation using direct methods • Distinguish between the principles of microinjection, electroporation and biolistic gun in DNA transformation 	K4

IV	PLANT TISSUE CULTURE AND STERILIZATION TECHNIQUES		
4.1	Sterilization and Media Preparation	<ul style="list-style-type: none"> • Choose suitable sterilization methods glassware and media • Influence of micro-, macro-nutrients and plant growth regulators • Discuss about key components of media 	K6
4.2	Explants preparation	<ul style="list-style-type: none"> • Assess the knowledge of choosing and using specific explants 	K5
4.3	Culture room set-up and Laminar Air Flow maintenance	<ul style="list-style-type: none"> • Determine fumigation methods • Make use of skills in working in Laminar Air Flow 	K5
V	MICROPROPAGATION		
5.1	Micropropagation of explants by direct and indirect methods	<ul style="list-style-type: none"> • Outline the procedure of <i>in-vitro</i> culturing the explants • Assess the suitable methods for propagating plants • Interpret, troubleshoot and standardize the protocols 	K5
5.2	Embryogenesis	<ul style="list-style-type: none"> • Examine the stages of embryo development 	K4
5.3	Synthetic seed	<ul style="list-style-type: none"> • Develop procedures for synthetic seeds • Select suitable methods for production of synthetic seeds 	K3
5.4	Hardening	<ul style="list-style-type: none"> • Outline the procedure of <i>in-vivo</i> conditions 	K2

		for growing the explants	
5.5	Field Visit	<ul style="list-style-type: none"> • Perceive novel ideas of gardens. • Planning and designing of lab • Relate with commercial aspects of micro propagation 	K5

Mapping Scheme for Course Code: U16BYPS2

U16BYPS2	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 – PLANT WEALTH FOR HUMAN WELFARE

Semester : VI

Course Code : U16BYPS3

Credits : 2

Hours/Week : 2

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
- 4.2. Preparation of Decoctions - Syrups
- 4.3. Herbal Remedies – Ointments, Pain balms

No	COURSE OUTCOME (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

- 4.4. 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 Phyt jewellery (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)

REFERENCES

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
I	Flowers		
1.1	Bouquet	<ul style="list-style-type: none"> • Develop the skills of making bouquet 	K6
1.2	Garlands and Strings	<ul style="list-style-type: none"> • Compile various hands on techniques to make the Garlands and floral strings 	K6
1.3	Regular and festival decorations	<ul style="list-style-type: none"> • Create decorative products 	K6
1.4	Hair designs	<ul style="list-style-type: none"> • Make up various hair designs by using plant products 	K6
II	Vegetables and Fruits		
2.1	Pickle (Lime/Mango/Ginger)	<ul style="list-style-type: none"> • Demonstrate the pickle preparation 	K2
2.2	Juice (Lemon/Sweet Lime) / Squash (Grape/Orange)	<ul style="list-style-type: none"> • Adapt a suitable preservation method in the preparation of squash/juice 	K6
2.3	Drying (Directed & Treated)	<ul style="list-style-type: none"> • List the drying methods 	K1
2.4	Vegetable, pith and grain carving	<ul style="list-style-type: none"> • Examine the carving techniques 	K4
III	Fibers		
3.1	Baskets and Pans	<ul style="list-style-type: none"> • Outline the procedure in the preparation of Baskets 	K2

		and Pans	
3.2	Ropes and Chords	<ul style="list-style-type: none"> Modify the process of Rope and Chord making. 	K6
3.3	Brushes and Brooms	<ul style="list-style-type: none"> Compare the techniques of making Brushes and Brooms 	K4
3.4	Mats and Carpets	<ul style="list-style-type: none"> Demonstrate the Mat and Carpet making 	K2
IV	Cosmetics and Medicines		
4.1	Medicinal oils / Application – Hair Oil	<ul style="list-style-type: none"> Make use of suitable technique in the preparation of Medicinal Oil. 	K3
4.2	Preparation of Decoctions- Syrups	<ul style="list-style-type: none"> formulate the Medicinal Plants in the preparation of Decoction 	K6
4.3	Herbal Remedies – Ointments, Pain balms	<ul style="list-style-type: none"> Analyse the formulations in the preparation of Ointments and Pain balms 	K4
4.4	Cosmetics, Face Packs & Skin Care	<ul style="list-style-type: none"> Make use of the Plant resources in the preparation of Cosmetics and Face Packs 	K3
V	Phyto-wastes to wealth		
5.1	Shells and rinds (Useful and Ornamental articles)	<ul style="list-style-type: none"> Make use of the Phyto wastes such as Shells and rinds for the production of commercial products. 	K3
5.2	Waste/used papers and wood (recycling)	<ul style="list-style-type: none"> Demonstrate the Process of making Paper cups. 	K2
5.3	Leaves (Cups and Plates)	<ul style="list-style-type: none"> Construct leaf cups and Palm plates by using Phyto-wastes 	K6
5.4	Phyto jewellery (ear drops, studs, bangles/necklace)	<ul style="list-style-type: none"> Make use of the Phyto waste in the making of Phyto Jewels preparation. 	K3

Mapping Scheme for the Course Code: U16BYPS3

U16BYP S3	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	-	-	-	H	L	L	-	-	-	-
CO2	M	M	L	-	-	-	H	L	L	-	-	-	-

CO3	L	M	L	-	-	-	H	L	L	-	-	-	-
CO4	H	M	H	-	L	L	H	L	M	-	H	-	-
CO5	M	M	H	-	-	-	H	L	L	-	-	-	-
CO6	H	M	L	-	-	L	H	L	L	-	-	-	-

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

