DR. AMBEDKAR GOVERNMENT ARTS COLLEGE (AUTONOMOUS)

Vyasarpadi, Chennai – 600 039.

(Accredited by NAAC at level "B")

SYLLABUS FRAMED BASED ON

Learning Outcomes Based Curriculum Framework (LOCF) with Choice Based Credit System (CBCS)

B.Sc. - Plant Biology and Plant Biotechnology
Allied Botany for B.Sc. Advanced Zoology and Biotechnology
Non – Major Electives and Environmental Studies

(With effect from the academic year 2022-2023)

DEPARTMENT OF PLANT BIOLOGY AND PLANT BIOTECHNOLOGY
Dr. Ambedkar Government Arts College (Autonomous)
Vyasarpadi, Chennai – 600 039

Based on UGC – Learning Outcomes-Based Curriculum Framework
Course Structure under Choice Based Credit System

(For the candidates admitted from the academic year 2022-2023 onwards)

Sem No	Part No.	Course	Subject code	Course Title	Ins. Hrs/ Week	Credit	Exam Hrs	Marks		Total
								Int	Ext	
I	I	LC - I	22UAFTA1	General Tamil - I	6	3	3	25	75	100
	II	ELC - I	22UACEN1	Communicative English - I	4	3	3	50	50	100
	III	CC - I	22UAPBC1	Algology	6	4	3	25	75	100
	III	CCP*	Even Sem.	**Major Practical - I**	3	-	3	40	60	100
	III	AC - I	22UAAZA1	Allied Zoology- I	4	3	3	25	75	100
	III	ACP *	Even Sem.	**Practical - Allied Zoology**	3	-	3	40	60	100
	IV	NME - I	@	One from Non Major Elective Subjects	2	2	3	25	75	100
	IV	SBE - I	22UAPLS1	Professional English for Life Sciences - I	2	3	3	50	50	100
				Total	**30**	**18**				
II	I	LC - II	22UBFTA2	General Tamil - II	6	3	3	25	75	100
	II	ELC - II	22UBCEN2	Communicative English - II	4	3	3	50	50	100
	III	CC - II	22UBPBC1	Mycology & Lichenology	6	4	3	25	75	100
	III	CCP - III	22UBPBC2	**Major Practical - I**	3	4	3	40	60	100
	III	AC - II	22UBAZA2	Allied Zoology- II	4	3	3	25	75	100
	III	ACP - III	22UBAZA3	**Practical - Allied Zoology**	3	4	3	40	60	100
	IV	NME - II	@@	One from Non Major Elective Subjects	2	2	3	25	75	100
	IV	SBE - II	22UBPLS2	Professional English for Life Sciences - II	2	3	3	50	50	100
				Total	**30**	**26**				
III	I	LC - III	22UCFTA3	General Tamil - III	6	3	3	25	75	100
	II	ELC - III	22UCLTS1	Language Through Literature-I	4	3	3	50	50	100
	III	CC - IV	22UCPBC1	Bryophytes & Pteridophytes	6	4	3	25	75	100
	III	CCP**	Even Sem.	**Major Practical - II**	3	-	-	40	60	100
	III	AC - IV	22UCCHA1	Allied Chemistry - I	4	3	3	25	75	100
	III	ACP**	Even Sem.	**Practical - Allied Chemistry**	3	-	-	40	60	100
	IV	EVS	22UCEVS1	Environmental Studies	2	2	3	25	75	100
	IV	SBE - III	22UCSBE3	SS III – Personality Enrichment	2	3	3	40	60	100
				Total	**30**	**18**				
IV	I	LC - IV	22UDFTA4	General Tamil - IV	6	3	3	25	75	100
	II	ELC - IV	22UDLTS2	Language Through Literature II	4	3	3	50	50	100
	III	CC - V	22UDPBC1	Gymnosperms & Palaeobotany	6	4	3	25	75	100
	III	CCP - VI	22UDPBC2	**Major Practical - II**	3	4	3	40	60	100
	III	AC - V	22UDCHA2	Allied Chemistry - II	4	3	3	25	75	100
	III	ACP - VI	22UDCHA3	**Practical - Allied Chemistry**	3	4	3	40	60	100
	IV	VBE	22UDVBE1	Value Based Education	2	2	3	25	75	100
	IV	SBE - IV	22UDSBE4	Computer Basics & Office Automation	2	3	3	40	60	100
	V	Extension	22UDEXT1	Extension Activities	-	1	-	-	-	-
				Total	**30**	**27**				

V	III	CC - VII	22UEPBC1	Anatomy and Embryology	5	4	3	25	75	100
	III	CC - VIII	22UEPBC2	Genetics, Evolution & Plant breeding	5	4	3	25	75	100
	III	CC - IX	22UEPBC3	Morphology, Taxonomy of Angiosperms & Economic Botany	5	4	3	25	75	100
	III	CC - X	22UEPBC4	Cell and Molecular Biology	5	4	3	25	75	100
	III	CCP***	Even Sem.	Major Practical - III	3	-	-	40	60	100
	III	CCP***	Even Sem.	Major Practical - IV	3	-	-	40	60	100
	III	CEC - I	#	One from the Elective-I Subjects	4	5	3	25	75	100
				Total	**30**	**21**				
VI	III	CC - XI	22UFPBC1	Plant Biotechnology & Bioinformatics	5	4	3	25	75	100
	III	CC - XII	22UFPBC2	Ecology, Phytogeography & Biostatistics	4	4	3	25	75	100
	III	CC - XIII	22UFPBC3	Plant Biochemistry & Plant Physiology	5	4	3	25	75	100
	III	CC - XIV	22UFPBC4	Major Practical - III	3	4	3	40	60	100
	III	CC - XV	22UFPBC5	Major Practical - IV	3	4	3	40	60	100
	III	CEC - II	##	One from the Elective-II Subjects	5	5	3	25	75	100
	III	CEC - III	###	One from the Elective-III Subjects	5	5	3	25	75	100
				Total	**30**	**30**				
				Total Credits	**180**	**140**				

***- Practical Exam at the end of second semester. **- Practical Exam at the end of fourth semester.**

CORE ELECTIVE COURSES:

Any one subject of the following Core Elective chosen by the candidate					
Elective-I		**Elective-II**		**Elective-III**	
***Sub. Code**	**Core Elective Courses**	****Sub. Code**	**Core Elective Courses**	****Sub. Code**	**Core Elective Courses**
22UEPBE1A	Microbiology	22UFPBE2A	Mushroom Technology	22UFPBE3A	Water management
22UEPBE1B	Fermentation Technology	22UFPBE2B	Herbal Botany	22UFPBE3B	Plant Pharmacogncy
22UEPBE1C	Plant Protection	22UFPBE2C	Forest Technology	22UFPBE3C	Horticulture

NON MAJOR ELECTIVE COURSE:

(Any one subject of the following Non Major Elective chosen by the candidate			
I Semester		**II Semester**	
Sub. Code	**Non Major Elective**	**Sub. Code**	**Non Major Elective**
22UAPBN1A	Applied Botany	22UBPBN2A	Bioresource Management & Utilization
22UAPBN1B	Technique in Biology	22UBPBN2B	Economic Botany

Allied Botany Courses

I Semester		**II Semester**	
Sub. Code	**Name of the Subject**	**Sub. Code**	**Name of the Subject**
22UAPBA1	Allied Botany - I	22UBPBA2	Allied Botany - II
		22UBPBA3	Allied Botany Practical

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DEPARTMENT OF PLANT BIOLOGY AND PLANT BIOTECHNOLOGY

Class: I B.Sc. Plant Biology & Plant Biotechnology Time 3 hrs

Model Question paper

(For those students in June 2022 onwards)

Subject Code : 20PBC417 Subject Name PHYCOLOGY Max: 75 marks

CO level	K level	Q.No.	Section – A (10 x 2 = 20 marks) Answer ALL Questions.
CO1	K3	1	Determine the characteristic features of Stoneworts
CO1	K2	2	Comment on Sea Weeds
CO1	K2	3	Define Colonial forms
CO1	K2	4	Distinguish between filamentaous and siphanous forms
CO2	K2	5	Compare red algae with brown algae
CO2	K4	6	Exhibit the features of SCP
CO5	K3	7	Explain about the isolation of Iodine from Alagae
CO2	K3	8	Demonstrate the role of Carpogonium on reproduction of Algae
CO5	K3	9	Explain the Chlorellin
CO3	K4	10	Differentiate the Haplontic life cycle with diplontic life cycle
			Section – B (5 x 5 = 25 marks) **Answer ALL Questions choosing either (a) or (b)**
CO1	K1	11.a	Describe the occurrence of Algae. (or)
		11.b	Outline the and distribution of Algae
CO3	K3	12.a	Demonstrate salient features of Cyanophyta (or)
		12.b	Illustrate in details about the reproduction of Nostoc
CO4	K1	13.a	Describe the occurrence and structure of Anabena (or)
		13.b	Explain the salient features of Volvox
CO3	K1	14.a	Outline economic and environmental importance of Diatom (or)
		14.b	Describe the life cycle of Caulerpa with neat diagram
CO5	K3	15.a	Demonstrate the applications of Agar - Agar (or)
		15.b	Illustrate the economic importance Algae as source of feed
			Section – C (3 x 10 = 30 marks) **Answer Any THREE Questions**
CO1	K2	16	Illustrate the Classification of Algae proposed by F.E. Fritch
CO1	K3	17	Demonstrate general characters of Phaeophyta and Rhodophyta
CO3	K4	18	Deduce the structure and reproduction in *Oedogonium*
CO1	K2	19	Describe the structure and life cycle of *Sargassum.*
CO5	K3	20	Demonstrate the Economic importance of Algae.

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Assessment Summary for Model Question Paper

BLUE PRINT

Department: Plant biology and Plant biotechnology Class: I B.Sc. Plant Biology & Plant Biotech

Tile of the Question paper: PHYCOLOGY Subject Code : 22UAPBC1

CO		K1	K2	K3	K4	K5	K6	TOTAL
CO1	Q. No.	11	2,3,4,16, 19	1,17				
	Marks	5	2,2,2,10,10	2,10				43
CO2	Q. No.		5	8	6			
	Marks		2	2	2			6
CO3	Q. No.	14		12	10,18			
	Marks	5		5	2,10			22
CO4	Q. No.	13						
	Marks	5						5
CO5	Q. No.			7, 9,15,20				
	Marks			2,2,5,10				19
Total		15	28	38	14			95

Note: Marks allotted in the question paper for each K – Level corresponding to a Particular CO must be entered in the cells of this assessment Summary

ANALASIS:

CO1 Level 43 Marks (45 %) CO2 Level 6 (7 %)

CO3 Level 22 Marks (23 %) CO4 Level 5 (5 %)

CO5 Level 19 Marks (20 %)

B.Sc. Degree Programme in Plant Biology and Plant Biotechnology

FIRST SEMESTER B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UAPBC1**		
Name of the course		**ALGOLOGY**		
Course No	Course Category Core / Elective /	No of Credits	No of hrs /week	Total marks (Internal + External)
CC- I	**Core**	**4**	**6**	**25 + 75=100**

Course objectives:

The main objectives of this course are to provide knowledge on the fundamentals of Phycology and to help students understand and recognize the types of major group of algae and its important features of Classification, Structure Reproduction and Economic importance of Algae

UNIT I: Algal Classification 6 hrs

General Classification - Classification by Silva PC (1982) ; General characters of Algae; Occurrence and Distribution

UNIT II: Features of Algae 12 hrs

General account of thallus structure, pigmentation, reserve food materials, general reproduction and life cycle of Cyanophyta, Chlorophyta, Phaeophyta & Rhodophyta

UNIT III: Life Cycle of Algae – I 18 hrs

Detailed study of life cycles (excluding developmental studies) of : Unicellular - *Chlamydomonas*, Diatoms, Colonial - *Volvox*, Filamentous - *Anabaena*, *Oedogonium*,

UNIT IV: Life Cycle of Algae – II 18 hrs

Detailed study of life cycles (excluding developmental studies) of : Siphonous - *Caulerpa*, parenchymatous - *Sargassum, Gracilaria*

UNIT V: Economic importance of algae 6 hrs

Economic importance of algae: Algae as food and feed; Nutraceuticals, Algal fertilizer, Algae used in Industry Agar-agar, Alginic acid and Carrageenan; Diatomite

Text Books :

1. B.R.Vashishta, Dr.A.K.Sinha, and Dr. V. P. Singh' 2019. Botany for Degree Students – Algae. S Chand & Co Ltd

2. Singh,V., Pandey, P.C. and Jain, D.K., 1998. A Text Book of Botany for undergraduate students, Rastogi Publications.

3. O P Sharma, 2020. Textbook of Algae, India Higher Education, Meerut

4. Vashista B.R. 1982, Botany for Degree Students, S.Chand & Co New Delhi.

5. Pandey, B. P. 2009. College Botany, Vol II. S. Chand & Company New Delhi.

Reference Books:

1. Chapman, V.J. & Chapman, D.J., 1980, The Algae, Macmillan.

2. Fritsch, F.E. 1945, Structure and Reproduction of Algae. Vol. I & II, Cambridge University Press.

3. Smith, G.M. 1955, Cryptogamic Botany, Vol. I. McGraw Hill

4. South, G.R. & Whitlick 1989.Introduction to Phycology Black Well Scientific Publications.

5. Fritsch, F.E. 1935 Structure and Reproduction of Algae, Vol. I, Cambridge University Press, Cambridge.

Web Resources

1. https://cals.arizona.edu/azaqua/algaeclass/algaeweb.html
2. https://www.psaalgae.org/educational-materials
3. https://www.cliffsnotes.com/study-guides/biology/microbiology/the-unicellular-algae/general-characteristics-of-algae

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignments, Field-based learning

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Would have deeper understanding of Algae at structural and functional level.	**K1 and K2**
CO2	Would have broad knowledge on the pigments pattern in Algae	**K3**
CO3	Would demonstrate a clear understanding of the vegetative structure, reproduction and life cycle of Algae	**K4**
CO4	Would develop skill on working principles of microscopy and identification of Algal types.	**K5**
CO5	Would gain the knowledge of economic importance of different algal groups	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

Second Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UBPBC1**		
Name of the course		**Mycology & Lichenology**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CC - II	**Core - Theory**	**4**	**6**	**25 + 75 = 100**

Course objectives:

The main objectives of this course are to provide knowledge on the fundamentals of Phycology and to help students understand and recognize the types of major group of algae and its important features of Classification, Structure Reproduction and Economic importance of Fungi and Lichens.

UNIT I: General Characters of Fungi

Classification of fungi proposed by Alexopoulos, 1962 - General Characters, occurrence and mode of nutrition of Fungi

UNIT II: Detailed study of structure, reproduction and life cycles of the following:

a) Oomycetes - *Albugo, Phytopthora*

b) Ascomycetes - *Saccharomyces, Penicillium*

UNIT III: Detailed study of structure, reproduction and life cycles of the following:

a) Basidiomycetes - *Agaricus,*

b) Deuteromycetes - *Fusarium,*

Plant Pathology- Tikka disease and Citrus Canker

UNIT IV: Study of the General characteristics of Lichens

Structure & Reproduction of Crustose, Foliose and Fruticose Lichens (excluding developmental studies) Detailed study of *Usnea.*

UNIT V: Economic importance

Economic importance of Fungi: Medicine, food, biopesticides, biofertilizers and industrial uses such as Production of ethyl alcohol, citric acids and lipase enzyme.

Text Books :

1. Pandey, B.P., "College Botany", Vol. I, Twentieth Edition, S. Chand & Co., New Delhi, 2019.
2. Vashista, B.R., Sinha, A.K. and Singh, V.P., "Botany for Degree Students", Thirty Fourth Edition, S. Chand & Co., New Delhi, 2019.
3. Dube, H.C. 2008 An Introduction to Fungi. Vikas Publishing House Pvt. Ltd.
4. Chopra G.L., A Text book of Fungi, S.Nagin & Co. Meerut, India
5. Vashista B.R. 1982, Botany for Degree Students, S.Chand & Co New Delhi.

Reference Books:

1. Alexopoulos, C & Mims C.V 1988. Introductory Mycology, John Willey & Sons, New York
2. Sharma, P.D."Fungi and Allied Organisms" Alpha Science Int. Ltd. New Delhi, 2005.
3. Vernon Ahmadjian & Mason Hale, 1973, The Lichens, Cambridge University press, London
4. Thomas H. Nash III, 2008, Lichen Biology, Cambridge University press, London
5. Raven PH Evert RF and Eichhorn SE 2013. Biology of plants. W.H. Freeman Publishers

Web Resources

1. www.richard-seaman.com/Fungus/links.html
2. www.myfg.org.uk/links.htm
3. simple.wikipedia.org/wiki/Fungus
4. www.fungibank.csiro.au/topic_7_3.htm
5. www.accessexcellence.org/RC/botany.php -- explore lichenland

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignments, Field-based learning

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	State general characters of fungi and their ecological significance.	**K1 and K2**
CO2	Explicate the basis of classification of fungi and their life cycles.	**K3**
CO3	Categorize the causal organisms according to the diseases caused by fungi	**K4**
CO4	Deduct and relate the life cycle of lichens	**K5**
CO5	Compile the economic importance of fungi and lichens	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	2	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	2.8	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	14	8	9	7	6

Second Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UBPBC2**		
Name of the course		**Major Practical - I**		
Course No	Course Category Core / Elective Theory / Practical	No of hrs /week	No of Credits	Total marks (Internal + External)
CCP - III	**Core - Practical**	**3**	**4**	**40 + 60 = 100**

Course objectives:

This course aimed to the students gain the hands on experience on classification, diversification and identification of the present land plant lower group of plants like algae, fungi and lichens

1. Observation of the following microscopic and macroscopic specimens:

ALGAE:

Unicellular - *Chlamydomonas*, Diatoms,
Colonial - *Volvox*,
Filamentous - *Anabaena, Oedogonium,*
Siphonous - *Caulerpa,*
Parenchymatous - *Sargassum, Gracilaria*

FUNGI:

Oomycetes - *Albugo*
Ascomycetes - *Saccharomyces, Penicillium*
Basidiomycetes - *Agaricus*
Deuteromycetes – *Fusarium*
Cercospora – Tikka disease
Xanthomonas – Citrus canker

LICHENS:

Crustose Forms, Foliose forms, Fruticose forms- *Usnea*

ECONOMIC IMPORTANCE: Agar-Agar, Alginic acid, Carrageenan

2. Micro preparation and observations of the following specimens:

ALGAE: *Caulerpa, Sargassum, Gracilaria*
FUNGI: *Albugo*

3. Observations of permanent slides:

ALGAE: *Chlamydomonas, Volvox, Anabaena, Oedogonium, Caulerpa, Sargassum* and *Gracilaria*

FUNGI: *Albugo, Saccharomyces, Penicillium*,

4. Observations of Spotters:

ALGAE : *Caulerpa, Sargassum and Gracilaria*

FUNGI : *Agaricus, Cercospora* – Tikka disease; *Xanthomonas* –Citrus canker

LICHENS: Crustose Forms (*Graphis*); Foliose forms (*Parmelia*), Fruticose forms- *Usnea*

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Field-based learning, Hands on training

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Demonstrate algae and fungi based on their morphological structure	**K1 and K2**
CO2	Experiment with the algal, fungal and lichens at generic level based on anatomical variations	**K3**
CO3	Examine the morphological and internal structural pattern found in the lichens	**K4**
CO4	Equipped with micro preparation of algal and fungal species from various samples	**K5**
CO5	Formulate the hands on training on s identification of lower life forms through specimens	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	2
CO2	3	3	2	1	1	
CO3	3	2		2	2	2
CO4	3	3	3	3		1
CO5	3	2	2		1	
Average of CO – PSO mapping	3	2.6	1.4	1.8	1.4	1.0
Total of CO – PSO mapping	15	13	7	9	7	5

Third Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UCPBC1**		
Name of the course		**Bryophytes & Pteridophytes**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CC - IV	**Core - Theory**	**4**	**6**	**25 + 75 = 100**

Course Objectives

This course provides the evolution, classification and diversifies of the Bryophytes and Pteridophytes. The students gain the endow with knowledge on the comparative studies of steles, sporangia and gametangial of Pteridophytes also impart knowledge on morphology, anatomy and reproduction of selected Bryophytes and Pteridophytes

UNIT I: Introduction to Bryophytes

Occurrence and distribution; General characters - Classification of Bryophytes - Watson.

UNIT II: Life Cycle of Bryophytes

Study of thallus structure, reproduction and life cycle of the follow genera (excluding developmental studies): Hepaticopsida (*Marchantia*); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Funaria*).

UNIT III: Introduction to Pteridophytes

Occurrence and distribution; General characters, Classification of Pteridophytes – Reimer.

UNIT IV: Life Cycle of Pteridophytes

Study of structure, reproduction and life cycle of the follow genera (excluding developmental studies) of Pteridophytes: *Lycopodium, Selaginella, Equisetum* and A*diantum.*

UNIT V: Ecology and Evolution

Ecology and Economic importance of Bryophytes; Stelar evolution in Pteridophytes - Heterospory and Seed Habits. Economic importance of Pteridophytes:

Text Books :

1. Kumaresan & Annie Ragland, 2011 Pteridophytes, Gymnosperms & Paleobotany. Saras Publication
2. Pandey, B.P., "College Botany", Vol. I, Twentieth Edition, S. Chand & Co., New Delhi, 2019.
3. Sambamurty AVSS 2005 A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. IK International Publishing House Pvt.Ltd.
4. Sharma OP, 2017 Pteridophyta. McGraw Hill Education (India) Pvt Ltd
5. Vashishta PC, Sinha AK, Anil Kumar. 2010 Botany for Degree students Pteridophyta. S.Chand and Company Ltd. New Delhi.

Reference Books:

1. Parihar, N.S. 1967. An introduction to Embryophyta Vol. I & II. General Book Dept.
2. Prempuri, 1973, Bryophytes – A Broad Perspective, Atmaram & Sons.
3. Rashid A. 1999. An Introduction to Pteridophyta. South Asia Books.
4. Saxena, P and Pathik, C.A Text Book of Pteridophyta, Wisdom Press, New Delhi, 2012
5. Smith, G.M. 1955, Cryptogamic Botany for Degree students, S. Chand & Co.

Web resources:

1. http://www.bryophytes.biz
2. bryophytes.plant.siu.edu/
3. www.mobot.org/MOBOT/tropicos/most/bryolist.shtml --bryophytes name list
4. www2.una.edu/pdavis/bryophytes. (images)
5. www.cavehill.uwi.edu/FPAS/bcs/bl14apl/pter1.htm
6. www.anbg.gov.au/fern/taxa/classification.html
7. www.cpbr.gov.au/fern/index.html - resources for ferns and allies

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Field-based learning, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Illustrate the characteristics of algae and bryophytes, their habitats, and classification	**K1 and K2**
CO2	Organize and illustrate the morphological and internal structural characteristics selected forms of bryophytes and pteridophytes	**K2 and K3**
CO3	Compare and contrast the asexual and sexual reproduction in the bryophytes and pteridophytes.	**K4**
CO4	Interpret and summarize the nature of evolution pattern in the origin and development of stele in pteridophytes	**K5**
CO5	Compile the various economic importance of bryophytes and pteridophytes	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	1	2	2	2
CO2	3	3	2		1	
CO3	3	2		3	2	2
CO4	3	2	2	2		1
CO5	2	2	3	1	2	1
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	13	8	9	7	6

Third Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UDPBC1**		
Name of the course		**Gymnosperms & Palaeobotany**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CC - V	**Core - Theory**	**4**	**6**	**25 + 75 = 100**

Course objectives:

The aim of the course is providing fundamental information on the general morphological characteristics, anatomical structures and the reproductive pattern of Gymnosperms. It provides the detail on the evolution of the diverse groups of plants and their salient features and their interrelationships. The course offering the basic of Paleobotany related to evolution and extinction of the fossil plants of the Pteridophytes and Gymnosperms.

UNIT I: Gymnosperms – General

Distribution of Gymnosperms – General characters – Economic importance – classification of Gymnosperms- K.R. Sporne 1962. Origin of seed habit.

UNITII: Life cycle of Gymnosperms

Distribution, structure, reproduction and life cycles of (Excluding developmental stages) 1. Cycadales : *Cycas* 2. Coniferales : *Pinus.*

UNIT III: Paleobotany – General

Geological time scale; Introduction to fossils; Types of fossils; Contribution of Birbal Sahni

UNIT IV: Fossilization

Fossilization processes - compression, casts, molds, petrification, impressions and coal balls; radio carbon dating. Significance of Paleobotany with special reference to fossil fuels

UNIT V: Fossil plants

Brief study of the following fossils

Fossil Pteridophytes : *Lepidendron* and *Calamites*
Fossil Gymnosperms : *Williamsonia sewardiana* and *Lyginopteris*

Text Books :

1. Pandey, B.P., "College Botany", Vol. II, English Edition, S. Chand & Co., New Delhi, 2011.
2. Bhatnagar, S.P. and Moitra, A., "Gymnosperms", Fifth Edition, New Age International Pvt. Ltd., New Delhi, 2013.
3. Vashista, P.C., Sinha, A.K. and Kumar, A., "Gymnosperms", Fifth Edition, S. Chand & Co., New Delhi, 2013.
4. Sundrara Rajan, S.2003. Practical Manual of Plant Morphology: Algae Fungi Bryophyta Pteridophyta Gymnosperms and Angios. Anmol Publications Pvt Ltd.
5. Shukla A and Mishra S.P. 1982, Essentials of Paleobotany, Vikas Publishing House Pvt. Ltd.

Reference Books

1. Chamberlain C.L. 2009.Gymnosperms, structure and evolution. CBS publishers
2. Sporne K.R.1965. The Morphology of Gymnosperms, B.I. Publications.
3. Vashista P.C. 1976. Gymnosperms, S.Chand & Co.
4. Arnold C.A. 1947. Introduction to Paleobotany, McGraw Hill
5. Muller,W,H. (1979). Botany: A functional approach, Collier Mac Millan

Web Resources

1. www.gymnosperms.org/
2. hcs.osu.edu/hcs300/gymno.htm
3. www.geocities.com/heartland/plains/6761/ecycads.htm
4. www.life.umd.edu/classroom/BSCI124/lec19.html
5. www.conifers.org/ -
6. www.mineralogie.uni-wuerzburg.de/palbot1.html

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Field-based learning, Hands on training

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	summarize the general features of both morphological and anatomical features of Gymnosperms	**K1 and K2**
CO2	assess the reproductive structure and life cycle of Gymnosperms	**K3**
CO3	evaluate the economic importance of Gymnosperms	**K4**
CO4	analyze the fossils and its process and methods of fossilization	**K5**
CO5	gather geological time table and compile the features of fossil plants	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

Fourth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UDPBC2**		
Name of the course		**Major Practical - II**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CCP - VI	**Core - Practical**	**4**	**3**	**40 + 60 = 100**

Course objectives:

To equip the students with the basic principles of plant diversity and plant anatomical sections and observe the structure microscopically.

1. Observation of the following microscopic and macroscopic specimens:

Bryophytes : *Marchantia, Anthoceros, Funaria*

pteridophytes : *Lycopodium, Selaginella, Equisetum, Adiantum*

Gymnosperms : *Cycas, Pinus*

Paleobotany : *Lepidendron, Calamites, Williamsonia*

2. Micro preparation and observations of the following specimens:

Bryophytes : Thallus CS of *Marchantia, Anthoceros* and *Funaria*

Pteridophytes : Stem CS of *Lycopodium, Selaginella, Equisetum*

Gymnosperms : TS of *Cycas* Leaf lets and Microsporophyll, *Pinus* Needle

3. Observations of permanent slides:

Bryophytes : *Marchantia* - CS of Thallus, VS of Gemma cup, Sproprophyte, Antheridiophore and Archegoniophone

: *Anthoceros* - CS of Thallus, VS of Sproprophyte, Antheridiophore and Archegoniophone

: *Funaria* - CS of Stem

Pteridophytes : *Lycopodium* – CS of Stem, VS of Strobililus

Selaginella – CS of Stem

Equisetum - CS of Stem VS of Strobililus

Gymnosperms : *Cycas* – Leaf let T.S., Microsporophyll T.S.

Pinus – Needle T.S.

Paleobotany : *Lepidendron* , *Calamites*

4. Observations of Spotters:

Bryophytes : *Marchantia* – Habit; *Anthoceros* – Habit; *Funaria* – Habit

Pteridophytes : *Lycopodium* – Habit; *Selaginella* – Habit; *Equisetum* -Habit and Cone

Adiantum - Habit

Gymnosperms : *Cycas* - Male cone, Female cone , Megasporophyll

Pinus - Female cone

5. Observations of permanent slides:

Bryophytes : *Marchantia* – Thallus c.s. Gemma cup V.S., Sproprophyte V.S., Antheridiophore and Archegoniophone

Anthoceros – Thallus c.s. Sproprophyte V.S., Antheridiophore and Archegoniophone

Funaria – Stem c.

Pteridophytes : *Lycopodium* – Stem c.s. Strobililus V.S.

Selaginella – Stem c.s.

Equisetum - Stem c.s. Strobililus V.S.

Gymnosperms : *Cycas* – Leaf let T.S., Microsporophyll T.S.

Pinus – Needle T.S.

Paleobotany : *Lepidendron, Calamites*

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Field-based learning, Hands on training

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Enumerate the extensive study on the lower cryptogams and phanerogams.	**K1 and K2**
CO2	Practice the morphology, anatomy and reproductive structures from algae to gymnosperms	**K3**
CO3	Experiment to identify, differentiate and observe the morphological, anatomical features of lower plant groups	**K4**
CO4	Persuade and analyze the reproductive features of the cryptogams and phanerogams.	**K5**
CO5	Invent to identify and appreciate the different fossils forms and their course of formation	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

Fifth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UEPBC1**		
Name of the course		**Anatomy and Embryology**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CC - VII	**Core - Theory**	**4**	**5**	**25 + 75 = 100**

Course objectives:

This course gains the knowledge the students into the inner structure and organization of flowering plants. Students will be skilled to recognize the types of tissue and organ system. The embryology of Angiosperm which give rise to the development of reproductive organs, gametes and seed will be educated to the students to understand the fundamentals of reproduction.

UNIT I: Tissues and its organization

Tissues - meristematic, simple, complex tissues. Meristematic tissues: structure, function and classification; Apical organization - Theories of Shoot and root apex (apical cell, histogen, tunica corpus Korper-Kappe). Structure, function and classification of Permanent tissues –Simple and complex.

UNIT II: Anatomical features of plants

Tissue systems: Epidermal tissue system: Ground tissue systems; Vascular tissue systems (Brief account), Nodal anatomy, Primary structure of stem and root of dicot and monocot. Internal structure of Dicot and monocot leaf.

UNIT III: Secondary Growth

Secondary structure of stem of dicotyledons. Anomalous secondary growth in stem – Boerhaevia, Secondary growth in monocot stem-Dracaena. Periderm structure and development; Phellam, phellogen, phelloderm, rytidome and lenticel.

UNIT IV: Development of Gametophytes

Structure of anther. Development of male gametophyte. Structure and types of ovule. Structure of female gametophyte.

UNIT V: Fertilization and development of Embryo

Fertilization – double fertilization syngamy, triple fusion – endosperm – types (nuclear, cellular, helobial) ruminate endosperm, Haustoria – function of endosperm, structure and development of mature dicot embryo (Capsella). Structure and development of monocot embryo (Najas)

Text Books:

1. Bhojwani, S. S. and Bhatnagar, S. P., 2009. The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd., New Delhi.
2. Singh, V., Pande, P. C. and Jain, D. K., 2018. Embryology of Angiosperms, Rastogi Publications, Meerut.
3. Pandey, B.P (2009). Plant Anatomy. S. Chand & Company Ltd., New Delhi.
4. Vashista P. C. (1997). Plant Anatomy. Pradeep Publication, Meerut.
5. Raghavan V. 1986. Embryogenesis in angiosperms. Cambridge University Press

Reference Books

1. Swamy B.G.L and Krishnamoorthy K.V (1990): From flower to Fruits, Tata-McGraw Hill Publishing Co Ltd.
2. Maheswari P. (1991): An Introduction to Embryology of Angiosperms. Tata-McGraw Hill Publishing Co. Ltd.
3. Esau, K. (2006): Anatomy of Seed Plants-John Willey Eastern Pvt. Ltd. New Delhi.
4. Cutter E.G. (1989): Plant Anatomy-Part 1 -Addison-Wesley Publishing Co
5. Fahn, A, (1992). Plant Anatomy. Pergamon Press.

Web Resources

1. www.stumbleupon.com/tag/plant-anatomy/ -- links to plant anatomy websites
2. www.mnstate.edu/weibust/internetresbiostu.htm(general website all topics in botany)

3. https://www.biology-pages.info/P/PlantTissues.html

4. https://academic.oup.com/plcell/article/16/suppl_1/S46/6010562

5. http://mgcub.ac.in/pdf/material/20200501064652545422c4ae.pdf

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignments, Field-based learning

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Demonstrate the different types of plant tissues through their structural organization and functions	**K1 and K2**
CO2	Construct the organization and complexity of tissue types	**K3**
CO3	Categorize the features of normal and anomalous secondary growth	**K4**
CO4	Criticize the structure of reproductive organs; appreciate the development of pollen and embryo sac.	**K5**
CO5	Elaborate the agents of pollination; examine development of embryo and endosperm in a seed.	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2		1	
CO3	3	3		2	2	2
CO4	3	3	3	3		1
CO5	3	3	2		2	1
Average of CO – PSO mapping	3.0	3.0	1.4	1.6	1.6	1.4
Total of CO – PSO mapping	15	15	7	8	8	7

Fifth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UEPBC2**		
Name of the course		**Genetics, Evolution and Plant breeding**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CC - VIII	**Core - Theory**	**4**	**5**	**25 + 75 = 100**

Course Objectives:

The course establishes the fundamentals of genetics dealing with inheritance of characters, about principles pertaining to plant breeding, crop improvement and evolution. Students should be able to comprehend the science of inheritance of genes and basis behind the variations.

UNIT I: Mendalian Genetics

Mendalian Genetics- Mendel's Laws, monohybrid and Dihybrid Cross; Test and Back cross. Deviation from Mendalian ratio – incomplete dominance, Codominance; multiple alleles – ABO blood group; Non allelic interactions – dominant epitasis, Recessive epitasis, Complementary gene

UNIT II: Chromosomal inheritance

Linkage: Types and significance; Crossing over - mechanism and its significance; Sex determination in plant - Melandrium. Extra chromosomal inheritance: Cytoplasmic male sterility in maize

UNIT III: Bacterial genetics

Bacterial genetic recombination: Transformation, conjugation, transduction.

UNIT IV: Evolution

Origin of life, chemosynthetic theory– Evolutionary theory of Lamarck, Darwin and de Vries, Concept of species- Allopatric and Sympatric ; Isolating mechanisms.

UNIT V: Plant Breeding

Methods of crop improvement; Introduction, acclimatization, selection – mass, pure line and clonal. Hybridization – Hybrid vigour. Breeding for crop improvement -Paddy.

Text Books:

1. Verma, P. S. and Agarwal, V., "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology", S. Chand & Co. Ltd., New Delhi, 2012.
2. Gupta, P.K. 2000. Principles of Genetics. Rastogi publications. Meerut.
3. Verma, P.S and Agarwal. V.K. 2007. Genetics. S. Chand & Co. New Delhi
4. Singh, B.D. (2014). Plant Breeding- Principles and methods. Kalyani Publishers.
5. Verma P.S. and Agarwal V.K. 2004. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology, S. Chand & Co. New Delhi

Reference Books

1. Chahal,G.C and Gosal,S.S (2002) Principles and procedures of Plant breeding. Narosa Publi. House.
2. Gardner, E.J., Simmons, M.J. and Snustad, D.P., "Principles of Genetics", Eighth Edition, John Wiley and Sons, New York, 2005.
3. Lewin, B., "Genes IX", Ninth Edition, Jones and Barrlett Publishers, London, 2008.
4. Allard, R.W. 1960. Principles of plant breeding. John Wiley, New York.
5. Charles Darwin, 2021, The Origin of Species, Prakash Books India Pvt. Ltd

Web Resources

1. http://depts.washington.edu/genetics/courses/genet371b-aut99/overheads/pdfs/all_lect.pdf
2. https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/lecture-notes/
3. https://www.wur.nl/en/show/online-course-plant-breeding.htm

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Field-based learning, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	demonstrate Mendel's law of inheritance and Gene to gene interactions	**K1 and K2**
CO2	Illustrate the extra-chromosomal inheritance and sex determination in plants	**K3**
CO3	Analyze in details about the Bacterial genetics and its applications	**K4**
CO4	evaluate the process of evolution using the evidences and theories	**K5**
CO5	Elaborate objectives, different methods and importance of plant breeding.	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

Fifth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UEPBC3**		
Name of the course		**Morphology, Taxonomy Angiosperms and Economic Botany**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CC - IX	**Core - Theory**	**4**	**5**	**25 + 75 = 100**

Course Objectives:

This course is planned to provide preamble on plant taxonomy to the students. It also further the on hand study of locally existing flora can provide them the fundamental knowledge and conservation of plants. After the successful completion of the course, the student will be able to understand and explain the principles of taxonomy, distinctive features of selected below listed families, remember the economic value of the plants.

UNIT I: Morphology of Angiosperm

A brief account of morphology of Leaf: Phyllotaxy, simple, compound and its modifications; inflorescence-types; Flower: description of floral parts; Fruits-types.

UNIT II: Systems of Classification and Principles of plant taxonomy

Systems of classification – outline classification of Linnaeus; Bentham & Hooker. Binomial nomenclature- IUCN- citation of authors; herbarium technique. Botanical survey of India (BSI)

UNIT III: Flora of Polypetalae and Gamopetale

Detailed study of the range of characters and plants of economic importance of the following families.

Polypetalae - Annonaceae, Caesalpinaceae, Rutaceae

Gamopetale – Rubiaceae, Asteraceae, Asclipiadaceae Solanaceae

UNIT IV: Flora of Monochlamydae and Monocot

Detailed study of the range of characters and plants of economic importance of the following families.

Monochlamydae – Euphorbiaceae, Amaranthaceae

Monocotyledons - Lilliaceae and Poaceae

UNIT V: Economic Botany

Study of binomial, family and morphology useful parts and uses of the following - Cereals – paddy; Pulses – Red gram; Oil seeds – Groundnut; Fibers – Cotton; Timbers – Teak.

Text Books:

1. Sharma, O.P., "Plant Taxonomy", Second Edition, Tata McGraw-Hill Education, Publishing Co. Pvt. Ltd., New Delhi, 2012.
2. Pandey, S. N. and Misra, S. P., 2008. Taxonomy of angiosperms. Ane books India, New Delhi.
3. Singh, G., 2012. Plant systematics, Third edition. Oxibh publishers, New Delhi.

Reference Books

1. Gamble, J.S and Fischer, C.E.C., 1957. Flora of the presidency of madras, I – III, W. C. Adlard and son limited, London
2. Lawrence, G.H.M. 1967, Taxonomy of Vascular Plants, Oxford 7 IBH Publishing company.
3. Vashista, P.C. 1974. Taxonomy of Angiosperms S. Chand & Co.
4. Hill A.W. 1951. Economic Botany. MC Graw Hill
5. Rao K.N.R. Krishnamurthi, K.V. 1980. Text book of Angiosperms, S.Viswanathan Pvt. Ltd.
6. Sambamurty, A. V. S. S., 2005. Taxonomy of angiosperms. I. K. International private limited, New Delhi.

Web Resources

1. www.cartage.org.lb/en/themes/sciences/botanicalsciences/aboutbotany/PlantTaxonomy/mainpage
2. www.colby.edu/info.tech/BI211/Bio211.html
3. 101science.com/Taxonomy.htm

4. www.flickr.com/groups/taxonomy/
5. www.csdl.tamu.edu/FLORA/201Manhart/Homepage(lecture notes)

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Field-based learning, Hands on training

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Illustrate the reproductive morphology of Angiosperm plants	**K1 and K2**
CO2	Utilize the system of classification, recognize and infer the characteristic features of flowering plants	**K3**
CO3	Examine techniques of herbarium preparation and analyze the role of ICN in plant nomenclature	**K4**
CO4	evaluate the distinguishing floral features of angiosperm families and assess their economic importance	**K5**
CO5	build the floral diagram, compile the floral formula of given families	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

Fifth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UEPBC4**		
Name of the course		**Cell and Molecular Biology**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CC - X	**Core - Theory**	**4**	**5**	**25 + 75 = 100**

Course objectives:

Provide the fundamental knowledge on structure and function of cells, cellular organelles and chromosome organization to the students.

UNIT I: Fundamentals of cell and its organelles

Introduction – prokaryotic and eukaryotic cell. Occurrence, structure and function of Plasma membrane, endoplasmic reticulum, golgi bodies, lysosomes, ribosomes, mitochondria, chloroplast and nucleus.

UNIT II: Chromosomes and Cell division

Chromosomes – structure, number and types; Euchromatin and Heterochromatin; Giant chromosomes– polytene and lamp brush chromosomes; Brief account of cell cycle; cell division - mitosis and meiosis.

UNIT III: Nucleic acid

Nucleic acid – DNA - structure and types (A, B, C & Z). Watson and Crick model of DNA. DNA as genetic material, DNA synthesis and replication (prokaryote). RNA – types and its function

UNIT IV: Gene Expression

Gene Expression - Transcription in Prokaryotes - Initiation, elongation, termination, Genetic code - Wobble hypothesis, Translation in prokaryotes.

UNIT V: Gene Regulation

General principles of Gene Regulation, Gene Regulation in prokaryotes, Operon concept - lac Operon

Text Books:

1. Gupta, P.K., "Cell Biology", First Edition, Rastogi Publications, Meerut, 2017.

2. Kumar, N., "Plant Cell Biology", First Edition, ALP Books, New Delhi, 2010.

3. Verma, P. S. and Agarwal, V., "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology", S. Chand & Co. Ltd., New Delhi, 2012.

4. Veer Bala Rastogi, Introductory cytology. Kedar Nath Ram Nath. Meerut

5. Verma, P.S. and V.K. Agarwal, 1 995. Cell and Molecular Biology, 8 th Edition, S.Chand & co., New Delhi

Reference Books

1. Brown W.V and Bertke E.M 1974, A Textbook of Cytology, C.V. Moshy Co, St.Louis.

2. Cohn N.S 1979, Elements of Cytology, Freeman Book Co.

3. De Robertis, E.D.P. and De Robertis, E.M.F.," Cell and Molecular Biology", Eighth Edition, Lee and Fabiger International Publications, Philadelphia, 2011.

4. Gardner, E.J., Simmons, M.J. and Snustad, D.P., "Principles of Genetics", Eighth Edition, John Wiley and Sons, New York, 2005.

5. Lewin, B., "Genes IX", Ninth Edition, Jones and Barrlett Publishers, London, 2008.

Web Resources

1. www.biology.arizona.edu/CELL_BIO/cell_bio.html -
2. www.cellbio.com/ (online cell and molecular biology)
3. https://nptel.ac.in/content/storage2/courses/102103012/pdf/mod3.pdf
4. https://courses.lumenlearning.com/wm-biology1/chapter/reading-endomembrane-system
5. http://depts.washington.edu/genetics/courses/genet371b-aut99/overheads/pdfs/all_lect.pdf
6. https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/lecture-notes/

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment,

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Outline the ultra structure and functions of cell organelles and nucleus	**K1 and K2**
CO2	Organize the structure and function of chromosomes	**K3**
CO3	Categorize the cell division processes within the cell and Differentiate between the particulars of the mitotic and meiotic divisions.	**K4**
CO4	Perceive the structural details of nucleic acids and elucidate the pattern of gene expression.	**K5**
CO5	Elaborate a model for the Operon concept for gene expression	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

Sixth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UFPBC1**		
Name of the course		**Plant Biotechnology and Bioinformatics**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CC - XI	**Core - Theory**	**4**	**5**	**25 + 75 = 100**

Course objectives:

This course will help to students learn the fundamental techniques applied in plant Biotechnology. Students will learn the basic principles of plant tissue culture for propagation and techniques of genetically modified plants

UNIT I: Basics of Biotechnology

Basics of Biotechnology and its applications; techniques in rDNA Technology - Restriction endonucleases - Ligase, Adapters and Linkers, Cloning Vectors: Plasmids- pBR 322 and Ti plasmids.

UNIT II: Molecular and Gene transfer techniques

Electrophoresis – AGE, Blotting techniques: Procedure and applications of Southern, Western and Northern blotting. Principles and applications of PCR; Physical methods of gene transfer: Gene gun, Electroporation and microinjection; Chemical method: liposomes and PEG stimulated

UNIT III: Introduction to Plant tissue culture

Plant tissue culture – Totipotency, nutrient medium – MS medium. Sterilization, Root and shoot culture; Anther culture, Protoplast isolation and fusion – somatic hybrid; Somatic embryogenesis Synthetic seeds.

UNIT IV: Application of Plant Tissue Culture

Application of Plant Tissue Culture - Transgenic plants – methods- Pest resistant plants – BT cotton; Golden rice; flavr savr tomato, edible vaccines.

UNIT V: Introduction to Bioinformatics

Introduction to Bioinformatics – NCBI- EMBL- DDBJ; Biological database – Genbank-PDB; literature database -Pubmed; Sequence alignment – global – local ; gap - gap penalty: Pair wise and Multiple sequence alignment Sequence similarity search – BLAST

Text Books:

1. Dubey, R.C., 2006. Textbook of Biotechnology, S.Chand & Company, New Delhi.
2. Razdan, M.K., 2003. Introduction to Plant Tissue Culture. IBH publishing, New Delhi
3. Ignacimuthu, S., 2012. Biotechnology – An Introduction. Narosa Publish House Ltd
4. Chiranjib Chakraborty. 2010. Bioinformatics: Approaches & Applications, Daya Publi,
5. Kumar H.O. 1993. A text book of Biotechnology, East West Affiliated Press

Reference Books

1. Rashid, A. 2009. Molecular Physiology and Biotechnology of Flowering plants. Narosa Publishing House Pvt. Ltd., New Delhi.

2. Treven M.D.S. Buffery, R.G. Goulding and F.Standary 1987. 3. Biotechnology-The Biological Principles. Tata Mc.Graw Hill.

4. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P., 2008. The Molecular Biology of the cell.5th edition. Garland Science Taylor and Francis Group.

5. Mount, D.W. 2006. Bioinformatics: Sequence and Genome Analysis, University of Arizona,

Web Resources

1. www.molecular-plant-biotechnology.info/resources-for-molecular-plant-biotechnology.htm
2. www.studentsguide.in (online dictionary)
3. http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=3
4. http://www.bio-nica.info/biblioteca/OksmanCaldentey2002PlantBiotechnology.pdf
5. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470686522

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment , Power point presentation

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Illustrate and demonstrate the principle of rDNA technology for genetically modified plants	**K1 and K2**
CO2	Make use of the process of PCR, ACE, Blotting techniques with its applications for GMO.	**K3**
CO3	Analyze the importance of plant tissue culture and molecular techniques in crop improvement programme.	**K4**
CO4	Assess to address environmental, Biosafety and socio-ethical issues on transgenic plants.	**K5**
CO5	Elaborate the bioinformatics tools in retrieval and handling biological data from genomic and proteomic databases.	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	2	1	3	2	2
CO4	3	3	3	3		1
CO5	3	2	3		2	
Average of CO – PSO mapping	3	2.6	1.8	1.8	1.4	1.2
Total of CO – PSO mapping	15	13	9	9	7	6

Sixth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UFPBC2**		
Name of the course		**Ecology, Phytogeography & Biostatistics**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal +External)
CC - XII	**Core - Theory**	**4**	**4**	**25 + 75 = 100**

Course objectives:

This course gives information regarding basic principles and applications of ecology, Phytogeography and Biostatistics. The course is aimed at openhanded to provide ample knowledge on plants interacted with other organism and its surrounding. After the completion of this course the student will be able to comprehend and understand the conventional information and natural resources around the world.

UNIT I: Introduction of Ecological factors

Biotic and abiotic factors and their influence on vegetation; a brief account of microbes, plants, animals, soil, wind, light, temperature, rainfall and fire; Biogeochemical cycles - Nitrogen and Carbon cycle.

UNIT II: Ecosystem

Ecosystem - concept, processes and components. Food chain, food web, energy flow, pyramids. Nutrient cycling. Types of ecosystems - marine and grassland.

UNIT III: Ecological Succession

Autecology and Synecology - Methods of study of vegetation (Quadrat and transect) Plant succession - Hydrosere and Xerosere. Ecological classification of plants: Morphological and anatomical features of plants and their correlation to the habitat factors

UNIT IV: Phytogeography

Phytogeographical regions of India. Endemism – Indian flora – Age and area hypothesis and continental drift – Endangered species; Hot spots.

UNIT V: Biostatistics

Classification of data, mean, median and mode. Standard deviation, standard error, variance, chi square test.

Text Books:

1. Khan, I.D. and Khanum, A. 2004. Fundamentals of Biostatistics, Ukazsz Public, Hyderabad,
2. Odum, E.P., "Fundamentals of Ecology", Saunders International Ltd,USA 2005
3. Sharma, P.D., "Ecology and Environment", Rastogi Publications, Meerut, 2009.
4. Subramanyam, N.S. & A.V.S.S. Sambamurthy. 2000. Ecology, Narosa Publish House, New Delhi.
5. Verma, P.S. and V.K. Agarwal. 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S.Chand & Company Ltd., New Delhi.

Reference Books

1. Kumar H.D. 1990. Modern concepts of Ecology. Vikas publishing.
2. Shukla R. and Chandel P 1990. Plant Ecology. S.Chand & Co. Pvt. Ltd.
3. Rangaswami, R.A. 1995. A. Textbook of Agricultural statistics. New Age Publi, Chennai.
4. Khan, I.D. and Khanum, A. 2004. Fundamentals of Biostatistics, Ukazsz Publications,
5. Zar, J.K. 2011. Bio statistical Analysis, 4th Edition, Prantice-Hall International, New Jersey, USA.

Web Resources

1. https://www.vedamsbooks.com/no10662.htm
2. https://www.bdu.ac.in/cde/SLM/SLM_FULL/M.Sc%20BOTANY%20BOOK/Botany%20I%20Year/Angiosperm%20Taxonomy%20,%20Ecology,Phytogeography/chapter5.pdf
3. https://www.conserve-energy-future.com/list-10-natural-resources.php 2.
4. http://egov.uok.edu.in/elearningug/tutorials/7314_2_2016_161121115114.pdf
5. http://www.physicalgeography.net/fundamentals/9i.html

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Field-based learning, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Interpret the components in a different ecosystem	**K1 and K2**
CO2	Identify the interaction among the biotic and abiotic factors in the ecosystem	**K3**
CO3	Recognize the pattern of plant succession and Illustrate interactions among the living organisms	**K4**
CO4	Categorize the different vegetation pattern in the Phytogeographical regions of India	**K5**
CO5	expertise in the areas of biostatistics and its applications in modern topics of Life Sciences	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	2
CO2	3	3	2			
CO3	3	2	1	3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	2.8	1.8	1.8	1.4	1.0
Total of CO – PSO mapping	15	14	9	9	7	5

Sixth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UFPBC3**		
Name of the course		**Plant Biochemistry & Plant Physiology**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CC - XIII	**Core - Theory**	**4**	**5**	**25 + 75 = 100**

Course objectives:

The course thus provides an insight into the plant physiological and biochemical nature and the functional metabolism aspects of plants. It deals that aims to comprehend processes in plants, such as photosynthesis, mineral nutrition, respiration, transportation, and ultimate plant growth and development.

UNIT I: Fundamentals of Biochemistry

Carbohydrates: Classification- Mono, di, tri and polysaccharides, Lipids – Classification - Triglycerides – saturated and unsaturated fatty acids, General classification of amino acids and proteins, protein structure - Primary, secondary, tertiary and quaternary; Nucleic acids – Types of nucleic acids – components

UNIT II: Enzymology

Enzymes – Properties, nomenclature and classification as per IUBC (enzyme commission of the International Union of Biochemistry) cofactors, coenzymes and mode of action. Factors affecting activity of enzyme.

UNIT III: Transport in Plants

Water relations – diffusion, permeability, osmosis, absorption of water – Apoplast and symplast. Mechanism – passive and active. Translocation of water – Ascent of sap – Transpiration – types and significance, factors. Stomatal mechanisms.

UNIT IV: Photosynthesis and Respiration

Photosynthesis – Photo system I and II, cyclic and Non cyclic electron transport – C3 cycle, factors affecting photosynthesis. Respiration – Aerobic – anaerobic – Glycolysis – Kreb's cycle – electron transport system – oxidative phosphorylation – factors affecting respiration.

UNIT V: Nitrogen metabolism and Plant Growth and Development

Nitrogen Fixation – Biological nitrogen fixation – nitrogen fixing organisms, legume – Rhizobium symbiosis; Nitrogen assimilation.

Plant Growth regulators - Chemical properties and Physiological activity - Auxins, Gibberellins, Cytokines, Abscisic acid and Ethylene. Photoperiodism - Phytochromes – Florigen concept. Seed Dormancy - Seed viability and germination.

Text Books:

1. Jain, J.L. 2007. Text book of Biochemistry. S. Chand & Co. Ltd., New Delhi.
2. Jain, V.K. 2018. Text Book of Plant Physiology, S. Chand & Company Ltd., New Delhi.
3. Rama Rao A.V.S.S 1988, Text Book of Biochemistry, L.K & S Publishers.
4. Taiz and Zeiger, Plant Physiology, IV edition, 2006, Sinauer Associates, Inc Pub Sunderland,
5. Verma S K and Mohit Verma 1995. A Textbook Of Plant Physiology, Biochemistry And Biotechnology, S Chand

Reference Books

1. Ross and Salisbury. (2009). Plant Physiology. Cengage Learning New Delhi
2. Bidwell R.G.S 1974, Plant Physiology. Macmillan Publication Co, New York.
3. Conn E.E, P.K. Stumpf, G.Brueming and R.H.Doi 1987, Outlines of Biochemistry, John
4. Devlin, O.P. 1983. Plant Physiology, Affiliated East West Press Pvt. Ltd. New Delhi.
5. Noggle, G.R. & Fritz, G. 1976. Introductory Plant Physiology, Prentice – Hall, India.

Wiley & Co, New York. USA

Web Resources

1. http://www.botany.com
2. http://glossary.gardenweb.com/glossary
3. http://www.esalq.usp.br/lepse/imgs/conteudo/Plant-Physiology-by-Vince-Ordog.pdf
4. http://dallas.tamu.edu/weeds/anat.html

5. http://employees.csbsju.edu/ssaupe/biol327/Lecture/mineral_nutrition.htm
6. http://atlasveg.ib.usp.br/English/focara.html

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Field-based learning, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Demonstrate the diverse physiological processes in plants and biochemical constituents of plants.	**K1 & K2**
CO2	Apply the structure & function of the Biomolecules and its physiological mechanism on plant metabolism	**K3**
CO3	Analyze mechanics and structures for water and mineral uptake and its transport translocation of food and sap.	**K4**
CO4	Criticize the basic aspects of photo biology and its relevance to photosynthetic function and plant respiratory metabolism and its significance	**K5**
CO5	Elaborate the different nature of physiological activity of plant growth substances, flowering, fruit ripening photoperiodism, dormancy and germination in plants	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

Sixth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UFPBC4**		
Name of the course		**Major Practical – III**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CCP - XIV	**Core - Practical**	**4**	**3**	**40 + 60 = 100**

Taxonomy, Anatomy, Genetics, Embryology, Cell Biology, Evolution, Plant breeding

Course objectives:

This major lab course aimed to gain the basic fundamental knowledge on taxonomy includes Identification, Nomenclature, and Classification of plants. Also students gains the knowledge in the field of cell biology, solve the genetics problems and identification of spotters in the field of evolution and plant breeding

1. Observation of the following microscopic and macroscopic specimens:

I : Taxonomy

A. Study of examples of the following families

Annonaceae	*Caesalpiniaceae*	*Rutaceae*
Rubiaceae	*Solanaceae*	*Asteraceae*
Asclepiadaceae	*Euphorbiaceae*	*Amaranthaceae*
Liliaceae	*Poaceae*	

B. Collection, identification, preparation and submission of at least 10 herbaria

II: Anatomy

A. Micro preparation and observations of permanent slides of following specimens

T.S of dicot stem T.S of dicot root

T.S of monocot stem T.S of monocot root

T.S. of Anomalous secondary Growth of Boerhaavia stem

T.S. of Anomalous secondary thickening of Dracaena stem

III: Genetics

Solving problems in Genetics: Mendalian monohybrid and dihybrid cross

IV : Cell Biology:

Observation of micrographs of cell organelles – Mitochondria, Nucleus, Chloroplast, Golgi apparatus, DNA , Polytene chromosome, Lamp brush chromosome

V: Embryology:

A. Observation of micrographs of Anatropous Ovlue, Anther and Pollinium

B. Dissection of Pollinium from *Calotropis* flower

VI: Evolution:

Concepts of Darwin, Lamarck and De Vries

VII: Plant Breeding:

Emasculation technique

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Field-based learning, Hands on training

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	enrich the students' knowledge on writing the description to identify the plants and economic importance of plants	**K1 and K2**
CO2	Build a practical skill for plant identification through botanical keys and preparation of Herbarium	**K3**
CO3	Examine slide for identification of various stages of cells and its organelles and other spotters in evolution;	**K4**
CO4	compare the anatomy of the various parts of a plant like stem, root and leaves	**K5**
CO5	Compile and summarize the reproductive structures in plants and the development of embryo	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	2
CO2	3	3	2	1		
CO3	3	3	1	2	2	2
CO4	3	2	3	3	1	1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	2.8	1.8	1.8	1.6	1.0
Total of CO – PSO mapping	15	14	9	9	8	5

Sixth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UFPBC5**		
Name of the course		**Major Practical – IV**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CCP - XV	**Core - Practical**	**4**	**3**	**40 + 60 = 100**

Plant Physiology and Plant Biochemistry, Biotechnology and Bioinformatics, Ecology, Phytogeography

Course objectives:

This course explores the knowledge on functional processes of plants in the way of study the physiology, biochemical aspects and ecology. Students are trained to water transport, transpiration, ecological distribution, Phytogeography and the uptake of nutrients of plants.

A. PLANT PHYSIOLOGY (Individual experiments)

1. To separate the plant pigments using paper chromatography
2. To determine the effect of Photosynthesis using Wilmatt's Air bubbler
3. To determine the respiration rate of two different plant materials using Ganong's respiroscope
4. To prove the phenomenon of "OSMOSIS" through Potato osmoscope
5. To determine the effect of temperature on plant cell permeability
6. To determine the effect of Chemical on Plant cell permeability
7. To determine the turger pressure of plant cell by Plasmolysis

B. Plant Biochemistry (Experimental set- up)

To determine the effect of catalase

C. Plant Biotechnology (Spotters)

- Agrobacterium mediated gene transfer

- Preparation of M.S. medium
- Plant tissue culture - Micro propagation
- Synthetic seeds
- pH meter

D. Ecology and Phytogeography (Spotters)

- Phytogeographical regions of India
- Hydrophytes- *Eichornia*
- Xerophytes-*Opuntia*
- Epiphytes-*Vanda*
- Mangrove -*Rhizopora*

E. Microbiology (Spotters)

Bacterial Food Poisoning - Botulism

Fungal Food Poisoning - *Aspergillus*

F. Mushroom Technology (Spotters)

Cultivation of Mushrooms

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Field-based learning, Hands on training

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Illustrate the interaction between soil – plant – air continuum by the way of transpiration	**K1 and K2**
CO2	Determine the structure and function of plant organs in plant growth	**K3**
CO3	Analyze the basic principles of Mendelian genetics and methods of cultivation of mushroom	**K4**
CO4	Criticize the anabolism, catabolism and growth regulators in plant growth and development.	**K5**
CO5	Formulate the distribution of angiosperm plants in the earth and effect of ecology on their growth	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

CORE ELECTIVES

Fifth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UEPBE1A**		
Name of the course		**Microbiology**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CEC - I	**Core – Elective**	**4**	**5**	**25 + 75 = 100**

Course Objectives:

The aim of this course is to introduce micro-organisms, its diversity, characteristics, and classification and their use in industry and human wealth. Students will be able to understand the life and processes of prokaryotic organisms and able gain the knowledge of different types of media, reproduction, measurements of bacterial growth. This course gives the essential knowledge on industrial microbiology with the production of organic acids and fermented products.

UNIT I: Fundamentals of Microbiology

The scope of microbiology – history of microbiology – classification of microorganisms – Whittaker's Five kingdom concept.

UNIT II: Bacteriology

Bacteria – classification, (Bergy's classification), General Characters of bacteria, structure – Reproduction, Nutrition – Photosynthetic, Chemosynthetic, Mycoplasma, PPLO.

UNIT III: Virology

Structure of TMV and bacteriophage; bacteriophage replication – lytic and lysogenic cycle.

UNIT IV: Food Microbiology

Microbiology of food – food spoilage, types of microbes associated with food spoilage, food preservation. Food poisoning – Botulism.

UNIT V: Industrial Microbiology

Industrial Microbiology - Production of organic acid and alcoholic beverage.

Text books :

1. Dubey, R C and Maheswari,D.K .(2013) A Textbook of Microbiology, S.Chand & Comp
2. Pelczar, H.J. E.C.S. Chan and N.R. Kreig. (1993). Microbiology concepts and applications. Tata McGraw Hill Inc.
3. Power & Daginawala 2007 General microbiology Vol. I & II Himalaya Publishing House.
4. Sharma, P.D., "Microbiology & Plant Pathology", 3rd Edition, Rastogi Publications, Meerut, 2017.

Reference Books:

1. Prescott, L.M., Harley J.P., Klein D. A. (2008). Microbiology. McGraw Hill, India
2. Atlas R.M. Microbiology – Fundamentals and applicants. Mc. Millan Publishing Company, New York.
3. Anantharayan, R. and C.K.J. Paniker 2000 Text book of Microbiology, 6th Ed. Orient Longman.

Web Resources

1. http://www.grsmu.by/files/file/university/cafedry/micr5obiologii-virysologiiimmunologii/files /essential_microbiology.pdf
2. https://www.slideshare.net/AndreaJosFuentesBisbal/21-microbiological-laboratorytechniques
3. http://www.wales.nhs.uk/sitesplus/documents/888/Microbiology%20Presentation11.pdf
4. https://microbiologynote.com/whittakers-five-kingdom-classification/
5. https://microbenotes.com/five-kingdom-system-of-classification-features-and-limitations/
6. https://www.lamission.edu/lifesciences/lecturenote/mic20/Chap06Growth.pdf

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Illustrate the microbial diversity with the kingdom and domain concept.	**K1 and K2**
CO2	Organize the characteristics and classification of Microbes	**K3**
CO3	Examine the morphology, physiology, genetics and reproduction of bacteria.	**K4**
CO4	Assess knowledge on the nutritional requirements, media types for microbial growth, its measurement and maintenance.	**K5**
CO5	Develop the industrial microbial fermentation of various products.	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	2	2
CO2	3	3	2	1		
CO3	3	2	1	2	2	2
CO4	3	3	2	3		1
CO5	3	2	3		1	
Average of CO – PSO mapping	3	2.6	1.6	1.8	1.0	1.0
Total of CO – PSO mapping	15	13	8	9	5	5

Fifth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UEPBE1B**		
Name of the course		**Fermentation Technology**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CEC - I	**Core – Elective**	**4**	**5**	**25 + 75 = 100**

Course Objectives

This course contains the development of bioprocesses in an interdisciplinary perspective. Basic technological knowledge applied in biological processes for production of product for human wealth. This course dealt with Principles of bioreactors, bioreactor systems, basic bioreactor design, bioprocess scale multiplication, and bioprocess controlling.

UNIT I: Fundamentals of Bioprocess Engineering

Bioprocess Engineering - upstream and downstream processing, Fermentation technology – Bioreactor – aerators, agitators (impellers and spargers) Types - CSTR, Airlift reactor, fluidized bed reactor.

UNITII: Microbial Growth

Microbes for reactor, media formulation, microbial growth medium for bioreactor – fermentation enzymes, Types of Culture - Batch culture, Fed Batch and continuous culture.

UNIT III: Processes for Food and Beverages

Single cell proteins (SCP) - SCP as food and feed mass cultivation of *Spirulina; A*lcoholic beverage production – wine and beer.

UNIT IV: Processes for industrial products

Microbial enzymes - Production and application of amylase, protease, Microbes used for amino acid production: production of L- Glutamic acids - Organic acids: production of citric acid and acetic acid

UNIT V: Processes for Pharmaceutical products

General account on vitamins - Production of cynocobalamine, Antibiotics- sources and types - Production of Penicillin and Streptomycin

Text Books:

1. Crueger F and Anneliese Crueger, 2000. Biotechnology: Industrial Microbiology Panima publishing Corporation, New Delhi.
2. Dubey RC 2015. A text Book of Biotechnology, S. Chand Publishers, New Delhi
3. Kumar H.D 1993, A Text Book of Biotechnology, East West Affiliated Press Ltd.
4. Purohit,S.S. 2003. Microbiology – Fundamentals and Application. Sixth edition.

Reference Books:

1. Alexander N. Glazer and Hiroshi Nikaido, 1994. Microbial Biotechnology: Fundamentals of Applied microbiology. W.H. Freeman and Co., New York.
2. Stanbury, P. F., Whittaker, A. and Hall, S.J., 1995. Principles of Fermentation technology First edn, Pergamon Press, UK.
3. Ramawat, K.G. 2007. Biotechnology: Secondary metabolites – Plant and Microbes, Science Publisher, India.
4. Satyanarayana U. 2010. Introduction to Biotechnology, Books and Allied (P) Ltd. Kolkata.

Web resources:

1. https://www.biotechnologynotes.com/antibiotics/penicillin/penicillin-biosynthesis-structurefermentation-process-and-uses/138431.
2. https://www.biotechnologynotes.com/food-biotechnology/cheese/how-to-manufacture-cheesewith-steps-fermentation-biotechnology/14147
3. https://www.slideshare.net/MominulIslam34/presentation-on-hepatitis-b-recombinant-vaccine
4. https://www.slideshare.net/puppalamuthenna/microbial-products
5. https://www.onlinebiologynotes.com/human-insulin-production-by-genetic-engineering/

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Demonstrate the basics of upstream and downstream processing of Bioprocess engineering	**K1 and K2**
CO2	Utilize knowledge of microbial growth and conditions required for growth, culture media on operation of Bioreactor	**K3**
CO3	Analyze processes involved in the area of food and beverage industry.	**K4**
CO4	Evaluate formulation of products and processes related to microbes in pharmaceutical industries.	**K5**
CO5	Formulate knowledge on process & products of amino acids, organic acids,	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	2
CO2	3	3	2			
CO3	3	2		2	2	2
CO4	3	3	2	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	2.8	1.4	1.6	1.4	1.0
Total of CO – PSO mapping	15	14	7	8	7	5

Fifth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UEPBE1C**		
Name of the course		**Plant protection**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CEC - I	**Core – Elective**	**4**	**5**	**25 + 75 = 100**

Course Objectives

As an outcome of this course student will understand and identify, diagnose and manage the common disease of important crops. This course also deals with the concept of pathogenesis and host response, and gain the knowledge of conventional and modern methods of disease management

UNIT I: Fundamentals of Plant pathology

A general account of Plant pathology ; types of plant diseases and its causative agents.

UNIT II: Plant disease

Study of symptoms, etiology and control measures of the under mentioned diseases:- Damping off of seedlings, Black rust of wheat, Smut of maize, Blast of paddy, Wilt of cotton, Bhendi mosaic and Bunchy top of banana.

UNIT III: Plant protection techniques

Principles of plant protection

1. Exclusion and eradication (quarantine)
2. Cultural practices,
3. Chemical – protectant fungicides and systemic fungicides.

Definition and mode of action of sulphur fungicides, copper fungicides (Bordeaux), Organic fungicides (Thiocarbamates, Captan) Systemic fungicide (Benzimidazole)

4. Biological control methods.

UNIT IV: Epiphytotics

Epiphytotics : Definition. Types, factors affecting epiphytotics.

UNIT V : Plant protection appliances

Plant protection appliances – sprayers – dusters – soil injectors – seed dressing drum.

Text Books:

1. Bap Reddy – 1968. Plant Protection in India. Allied Publishers.
2. Chattopadhyay, S.B. 2012. Principles and Procedures of Plant Protection.
3. Chaudhury & Majid, S. 1954. Hand Book of Plant Protection, Dept of Agriculture, Assam.
4. Rangasami, G. 1994. Disease of Crop Plants. Printice Hall of India Ltd.

Reference Books:

1. Mukundan, T.K. 2003. Plant Protection, Principle and Practice, Asia Publishing House.
2.. Walker, J.C. 1969. Plant Pathology. Tata MC Graw – Hill Publishing Co. Ltd.

Web resources:

1. https://www.ipm.iastate.edu/files/curriculum/05%20Introduction%20to%20Plant%20Pathology_0.pdf
2. https://www.rvskvv.net/images/I-Year-II-Sem_Principles_Plant-Pathology_ANGRAU_20.04.2020.pdf
3. http://www.jnkvv.org/PDF/11042020102651plant_pathology.pdf
4. http://assets.vmou.ac.in/MBO09.pdf

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Illustrate the concepts of plant pathology and Rephrase the fundamentals plant pathology techniques	**K1 and K2**
CO2	Identify the symptomatology to diagnose fungal, bacterial and viral disease	**K3**
CO3	Analyze the epidemiology nature and forecast disease	**K4**
CO4	Assess the delineating host pathogen interactions.	**K5**
CO5	Develop suitable disease management strategies and suitable control measures	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	3			
CO3	3	3	1	3	2	2
CO4	3	3	3	3		1
CO5	3	3	3	1	2	
Average of CO – PSO mapping	3	3	2.0	2.0	1.4	1.2
Total of CO – PSO mapping	15	15	10	10	7	6

Sixth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UFPBE2A**		
Name of the course		**Mushroom technology**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CEC - II	**Core – Elective**	**4**	**5**	**25 + 75 = 100**

Course Objectives

This course is designed to motivate students to learn the science of cultivating mushrooms. It is an introductory level course and designed to help the students to grow mushrooms in simple and cheap substrates like hay and organic debris and other locally available substratum. At the end of the course the students will develop skills in commercial cultivation, harvest and marketing. This course is also designed to carter to the need of young entrepreneurs who would like to start a food based industry.

UNIT I: Introduction

Morphology of Mushroom; mushroom classification, Naming of mushroom ; Popular mushroom – Edible and poisonous mushroom, Nutritive value of mushrooms. Economic value of various mushrooms – Food and Dietary Component – Medicinal value – Mushroom recipes.

UNIT II: Life cycle

Morphological characters and Life cycle of *Pleurotus, Agaricus* and *Volvariella.*

UNIT III: Mushroom cultivation - I

History of mushroom cultivation; Scenario of Mushroom cultivation, prospects and scope of mushroom cultivation in small scale industry; Institutes cultivating mushroom – Varieties available in Tamilnadu

UNIT IV: Mushroom cultivation - II

Cultivation – conditions for tropical and temperate countries, Tray method for large cultivation – Packet method for small scale cultivation, isolation, spawn production, growth media, spawn running and harvesting of mushrooms.

UNIT V: Post Harvest technology

Diseases: insect pests, nematodes, mites, viruses, fungal competitors and other important diseases on Mushroom. Post harvest technology: Harvesting, Freezing, dry freezing, drying, packaging, Marketing

Text Books:

1. Handbook of Mushroom cultivation, 1999, TNAU publication
2. Nita Bahl, 2002, Handbook on Mushroom 4th edition Vijay 73 Primlani for oxford & IBH publishing co. Pvt. Ltd.
3. Suman, 2005, Mushroom Cultivation Processing and Uses, M/s. IBD publishers and Distributors, New Delhi.
4. Sing, 2005 Modern Mushroom Cultivation, International Book Distributors, Dehradun.
5. Manibushan Rao, K., Text Book of Horticulture, Mac Millan India Ltd.

Reference Books

1. Bahl N., Handbook on Mushroom, Oxford and IBM, New Delhi.
2. Dey, S.C. Mushroom growing, Agrobios (India), Jodhpur.
3. Handbook of Edible Mushroom Today and Tomorrows printers and Publishers.
4. Kapoor J.N. Mushroom cultivation, KrishiBhavan, New Delhi.
5. Parthiban, Malathi and BalaMohan, Mushroom culture (Tamil).
6. Sharma V.P. 2006, Diseases and Pests of Mushrooms, M/S. IBD Publishers and Distributors, New Delhi.

Web resources

1. www.krishiworld.com/html/mushroom.html
2. www.nrcmushroom.org/mushroom_cultivation_technology
3. icargoa.res.in/oyster_mushroom.htm (cultivation technique for oyster mushroom)

4. mofpi.nic.in/.../EDII_AHMD/01%20Fruit%20&%20Vegetable/20%20Mushroom%20Cultivation%20&%20Proc.pdf

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	List different varieties of mushroom, distinguish between edible and non edible, and classify them.	**K1 and K2**
CO2	Characterize, compare the cultivating mushroom and trace the lifecycle.	**K3**
CO3	Experiment the cultivation procedure, design new culture technique and analyze the pest and factors affecting growth of mushroom.	**K4**
CO4	Develop technologies for harvesting, packaging and acquire knowledge to avail loan from banks	**K5**
CO5	Summarize uses of mushroom and create new recipes for marketing.	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	2	1	3	2	2
CO4	3	3	3	3		2
CO5	3	2	3	1	3	
Average of CO – PSO mapping	3	2.6	1.8	2.0	1.6	1.4
Total of CO – PSO mapping	15	13	9	10	8	7

Sixth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UFPBEC**		
Name of the course		**Herbal Botany**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CEC - II	**Core – Elective**	**4**	**5**	**25 + 75 = 100**

Course Objectives

This course aimed to help the students gain the knowledge in the field of proper documentation and presentation of traditional knowledge about plants. Also this course used to important plants by the tribal communities

UNIT – I : Fundamentals of Herbal Botany:

History and role of the herbs in day-to-day life

UNIT – II: Herbal Food

Beneficial aspects of herbal plants as food -common greens .vegetables and edible oils (general account only)

UNIT-III : Medicinal Plants

Study of some common plants which are used as medicine.

Calotropis gigantea .Centella asiatica, Cissus quadrangularis, Rosa centifolia, Piper betel, Ocimum sanctum, Azadirachta indica, Curcuma longa, Zingiber officinalis Lawsonia inermis.

UNIT – IV: Herbal remedies

Herbal remedies - herbal first aid, home remedies-for common cold, fever, headaches, migraines, digestive and respirator) disorders, ear, eyes, mouth and throat infections.

UNIT - V: Skin Care

Skin care – herbal products for skin care.

Text Books:

1. Ambasta, S.P. (ed) 1988. *The useful plants of India.* CSIR, New Delhi
2. Bhattacharjee, S.K. 2004. *Handbook of MedicinalPlants*(4th ed.). Pointer Publishers, Jaipur
3. Chadha, K.L. and Gupta, R. 1995. *Advance in Horticulture*: Vol. II: *Medicinal and Aromatic Plants*. Malhotra Pub. House, New Delhi
4. CSIR. 1971. *The Wealth of India*. Vol. A-Z. Council for Industrial and Scientific Research, New Delhi
5. Farooqui, A.A., Khan, M.M. and Sreeramu, B.S. 1997. *Cultivation of Medicinal and Aromatic Crops in India*. NayaPrakash, Kolkatta

Reference Books:

1. Hurtmann, H.T., Kester, D.E., Davies, F.T. and Geneva, R.L. 2004. Plant Propagation: Principle and Practice. Prentice-Hall of India, New Delhi
2. ICAR. 2003. *Handbook of Agriculture*. Indian Council Agricultural Research, New Delhi
3. Nair, C.K.N. and Mohanan, N. *Medicinal Plants of India*. Nag Publishers, Delhi
4. Nehra, S. 2005. *Plant Diseases: Biocontrol and Management*. Aavishkar Publishers and Distributors, Jaipur
5. Pearce, D. and Moran, D. 1994. *The economic value of biodiversity*. Earthscan Pub., London
6. Prajapati, N.S., Purohit, S.S., Sharma, A.K. and Kumar,T. 2003. *A Handbook of Medicinal Plants*. Agrobios-India.

Web resources

1. www.enpab.it/images/2018/James_A._Duke_-_Handbook_of_Medicinal_Herbs.pdf
2. https://www.bgci.org/files/Worldwide/Publications/PDFs/medicinal.pdf
3. www.biologicaldiversity.org/publications/papers/Medicinal_Plants_042008_lores.pdf
4. https://www.iucn.org/downloads/medicinal_plant_11_book.pdf

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Interpret the historical development of ethno botany and its uses	**K1 and K2**
CO2	Recognize and identify important local native plant species.	**K3**
CO3	Categorize medicinally used local plants and their native habitats and consumed practice	**K4**
CO4	Evaluate the various plant parts utilize in Ethanobotany and its applications on human wealth	**K5**
CO5	Formulate the techniques for solve human problem of clinically well in health care and life support system	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

Sixth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UFPBE2C**		
Name of the course		**Forest technology**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CEC - II	**Core – Elective**	**4**	**5**	**25 + 75 = 100**

Course Objectives:

This course provide the outstanding scientific knowledge, practical field and technical skills, strong stewardship ethic needed to sustainably manage forest for wood products, biological diversity, water, and other ecosystem services.

UNIT I: Fundamentals of Forestry

Forestry – Definition, Classification, Scope of forestry utilization, major and minor forest products, commercial Timber Yielding plants of South India. Forest types of India, Social forestry, Village forestry, farm forest, avenues.

UNIT II: Forest management

Principle and scope of forest management. Concept of sustainable utilization and conservation strategies, sustainable development. Major wild life in South India – Endangered species – causes for destruction and need for protection.

UNIT III: Silviculture

Elements of silviculture – Silviculture of the following species – a. *Tectona grandis* b. *Casuarina equisetifolia*. Silvicultural systems – clear felling, simple coppice and selective felling.

UNIT IV: Wood Technology

Wood Structure, Physical, chemical and mechanical properties of wood. Wood preservation, wood seasoning and wood preservatives.

UNIT V: Tree improvement

Tree improvement methods – species introduction, hybridization, individual tree selection, vegetative propagation, grafting, and biotechnology for forestry.

Text Books:

1. Singh, J.S., Singh, S.P. and Gupta, S. (2006) Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi.
2. Sharma, P.D. (2010) Ecology and Environment, (8th Ed.) Rastogi Publications, Meerut.
3. Balasubramaniyan, P and Palaniappan,S.P.(2001). Principles and Practices of Agronomy. Agro Bios (India) Ltd., Jodhpur
4. Nair, P.K.R. (1993). An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
5. Khanna, L.S. (1989). Principles and Practice of Silviculture. Tilak Marg, Dehra Dun

Reference Books:

1. De,G.C.(1989). Fundamentals of Agronomy. Oxford & IBH Publishing Co.,New Delhi
2. Westoby, J. (1991). Introduction to World Forestry.
3. Mather, A.S. (1990). Global forest resources. Belhaven, London. Khanna, L.S. (1989). Principles and Practice of Silviculture. Khanna Bandhu, New Delhi,
4. Tewari D.N. Tropical Forestry in India, International Book Distributors, Dehradun.
5. Ward H.M. 2001, Trees A Handbook of Forest Botany, International Book Distributor, Dehradun.

Web resources:

1. https://www.nrs.fs.fed.us/fmg/nfmg/docs/fm101.pdf
2. https://efi.int/sites/default/files/files/publication-bank/2018/ir_06.pdf
3. https://www.eolss.net/sample-chapters/c10/E5-01A-02.pdf
4. https://www.esa.org/seeds/toolkits/forests/introduction-to-forestry/

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Demonstrate knowledge of principles of forestry and silviculture	**K1 and K2**
CO2	Develop skills in Forest management for utilization and conservation of Endangered species	**K3**
CO3	Analyze the different Silviculture practice of locally available forest trees for human wealth	**K4**
CO4	Assess knowledge of properties of wood and Wood preservation technologies and wood seasoning methods	**K5**
CO5	Build the Tree improvement methods such as vegetative propagation biotechnology methods for improvement of forest tree breeding program	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	1	2	3	3
CO2	3	3	2			
CO3	3	2		3	2	2
CO4	3	3	2	2		1
CO5	2	2	3	1	2	
Average of CO – PSO mapping	2.8	2.6	1.6	1.6	1.4	1.2
Total of CO – PSO mapping	14	13	8	8	7	6

Sixth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UFPBE3A**		
Name of the course		**Water Management**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CEC - III	**Core - Elective**	**4**	**5**	**25 + 75 = 100**

Course Objectives

The Introduction to Water management course is intended to provide students with the knowledge of Water Quality, Water pollution, Sewage and effluent treatment, and Water management practice

UNIT I: Properties of water

Water – General properties: Physical and chemical properties, and biological importance.

UNIT II: Water Quality

Potable water, Water quality index - Measurement of water quality, BOD, COD, evaluation of drinking water quality.

UNIT III: Pollution

Water pollution, industrial, agricultural and heavy metal pollution on water. Water quality in and around industrial sites.

UNIT IV: Treatment of water

Sewage and effluent treatment - Primary , Secondary and Tertiary, Drinking water treatment

UNIT V: Water management

Water management, recreational aspects of water - quality of swimming pool water. Water quality monitoring. Environmental impact assessment.

Text Books:

1. Cech Thomas V., 2003. Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York.

2. Mollinga .P. etal2006 " Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications,

3. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. 2002. Global water partnership, Stockholm, Sweden.

Reference Books:

1. Technical Advisory Committee, Effective Water Governance". 2003. Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden,

2. M. Thangarajan., 2006. Ground water management. Jain book Publishers

3. A.KChaterjee.2010., Water supply waste disposal & Environmental Engineering. Jain books publishers.

Web resources:

1. https://repositorio.cepal.org/bitstream/handle/11362/39542/1/FOCUSIssue4Oct-Dec2015.pdf
2. https://www.indiawaterportal.org/sites/default/files/iwp2/Water_Management_Space___Time_India_University_of_Bonn_2010.pdf
3. https://www.twdb.texas.gov/publications/state_water_plan/2012/07.pdf
4. https://www.gwp.org/contentassets/f998a402e3ab49ea891fa49e77fba953/iwrmp-training-manual-and-operational-guide.pdf
5. http://www.agrilearner.com/integrated-water-management-pdf-notes-download/

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Working knowledge of water quality characteristics of water sources	**K1 and K2**
CO2	Ability to describe the purpose and operational steps of key water treatment processes used to improve water quality	**K3**
CO3	Working knowledge of drinking water regulations and standards required to protect public health	**K4**
CO4	Identify and Recognize a various types water resources for conservation of water	**K5**
CO5	Working knowledge of Sewage and effluent treatment to control the Water pollution	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

Sixth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UFPBE3B**		
Name of the course		**Plant Pharmacognosy**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CEC - III	**Core – Elective**	**4**	**5**	**25 + 75 = 100**

Course Objectives

At the end of the course student should be able to know exhaustive list of plants having active constituents effective against advanced diseases. Also student learn the Phytochemistry of the drugs and discuss phyto-pharmacology and pharmaceutical adjuvant of plant origin.

UNIT I: Introduction to Pharmacognosy

Introduction, Traditional systems of Medicine – Siddha and Ayurveda. Present and future Status of Pharmacognosy. Classification. Classification of Organized Crude drugs. Drugs isolated from

a). Roots - *Hemidesmus* b). Stem- *Tinospora*

c). Underground stem - Zingiber d.) Wood-*Santalum*

e). Barks-*Terminalia arjuna*

UNIT II: Plant Drugs - I

Drugs isolated from

a). Leaves - *Ocimum* b). Flowers - *Cloves*

c). Fruits - *Myriobalan* d). Seeds - *Mucuna*

e). Whole plants- *Phyllanthus amarus*

UNIT III: Plant Drugs -II

Unorganized drugs –Excretory and Secretary Products.

a). Oleoresin – Turpentine b). Hard Resin- Damars

c). Gum Resins – Asafoetida d). Volatile Oil – Lemon grass oil

e). Non-volatile Oil- Castor Oil f). Fungi - *Penicillium*

UNIT IV: Phytochemistry

Phytochemistry of medicinal plants: Alkaloids, Glycosides, Tannins, Saponins. Preliminary Phytochemical tests.

UNIT V: Drugs Quality control

Drug adulteration and detection. Poisonous plants. Importance of Herbal garden.

Text Books

1. Kirtikar & Basu 2006, Indian Medicinal Plants, Bishen Singh Mahendra Pal Singh, Dehra Dun.

2. Mohamed Ali, 2008 Pharmacognosy & Phytochemistry – Vol. I and II CBS Publishers & Distributors

3. The Wealth of India – A dictionary of Indian Raw Materials & Industrial products 2005 National Instt. Of Sc. N & Comm. Information Resources CSIR

4. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.

5. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.

Reference Books

1. AshutoshKan 2009, Pharmacognosy & Pharmaco biotechnology, New Age Pvt. Ltd. Publications.

2. Somasundaram. S 1997. Maruthuva Thavaraviyal, Elangovan Publications. Palayankottai.

3.Nadkarni K.M. 1976 Indian Material Medica Vol. I Popular Prakashan, Bombay.

4. Murudesa Mudaliar 1998. Siddha Materia Medica (Gunapadam – Mooligai). Directorate of Indian Medicine and Homeophathy, Chennai.

5. Pal, D.C. & Jain, S.K.1998. Tribal Medicine. NayaPrakash Publishers, Calcutta.

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Outline the identify drug from natural origin and their supply, cultivation, collection, storage	**K1 and K2**
CO2	Apply the methods for the quality control and conformity of drugs from natural origin.	**K3**
CO3	Distinguish the appropriate methods according to the source of the natural product material.	**K4**
CO4	Criteria adopted for methods for quality control for drugs	**K5**
CO5	Estimate the phytochmical products such as carbohydrates, gums, musilages, enzymes and protein contain drugs.	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	2
CO2	3	3	2			
CO3	3	3	1	3	1	2
CO4	3	3	2	3	1	2
CO5	3	3	2		3	
Average of CO – PSO mapping	3	3	1.4	1.8	1.6	1.2
Total of CO – PSO mapping	15	15	7	9	8	6

Sixth Semester: B.Sc., Plant Biology and Plant Biotechnology				
Course code		**22UFPBE3C**		
Name of the course		**Horticulture**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
CEC - III	**Core – Elective**	**4**	**5**	**25 + 75 = 100**

Course Objectives

At the end of the course student should be able to gain the awareness of horticultural skills and knowledge in their career and also identify and prescribe sustainable options in horticulture which benefit the environment while maintaining productivity and economic viability.

UNIT I: Fundamentals of Horticulture

Importance of horticulture, divisions, garden tools and appliances, components of garden, planning the garden, types of garden.

UNIT II: Growth Pattern

Fumigation, sterilization, irrigation, soil types, use of organic manures and fertilizers to improve the fertility of the soil.

UNIT III: Plants of Garden

Lawn - types, maintenance, grass types, soil preparation, irrigation and weeding., Herbs, shrubs, trees, path, edges, hedges, borders, climbers, carpet beds, rockery. Water garden, topiary, Pot culture with special reference to Bonsai & green house.

UNIT IV: Methods of propagation

A brief study of the methods of propagation of plants from seeds, raising of plants from cuttings, layering, budding and grafting.

UNIT V: Pest control measures

Soilless Plants and hydroponics. Green house - types, aeration, soil fertilizers, types of plants & Pest control - disease, infection & prevention. Specific pathogen -free plant production.

Text Books

1. Sheela V. L. 2011. Horticulture. MJP Publishers.
2. Chadha KL & Pareek OP. 1996.Advances in Horticulture. Vols. II-IV. Malhotra Publ.
3. Nakasone HY & Paul RE. 1998. Tropical Fruits. CABI.Peter KV. 2008. (Ed.). Basics of Horticulture. New India Publ. Agency.
4. George Acquaah, 2002. Horticulture Principles and Practices.2nd Edition. Pearson Education (Singapore) Pvt.Ltd.,
5. Randhawa, G.S. and Amitabh Mukhopadhyay, 1986. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.

Reference Books

1. Pradeepkumar T, Suma B, Jyothi bhaskar & Satheesan KN. 2008.Management of Horticultural Crops. Parts I, II. New India Publ. Agency.
2. Radha T & Mathew L. 2007. Fruit Crops. New India Publ. Agency.
3. Singh HP, Negi JP & Samuel JC.2002. Approaches for Sustainable Development of Horticulture. National Horticultural Board.
4. Bose TK, Mitra SK &Rathore DS.1988. Temperate Fruits -Horticulture. Allied Publ.
5. Percy Lancaster (1979) – Gardening in India. Mohan Makhijani and Rekha Printers, New Delhi

Web resources

1. www.dpi.nsw.gov.au/agriculture/resources/soils/biology/basics
2. https://ncert.nic.in/textbook/pdf/ievs101.pdf
3. https://niti.gov.in/planningcommission.gov.in/docs/aboutus/committee/wrkgrp/horticulture.pdf
4. https://www.agrimoon.com/wp-content/uploads/Fundamentals-of-Horticulture.pdf
5. https://agritech.tnau.ac.in/pdf/HORTICULTURE.pdf

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	scope and importance of horticulture, classification of horticultural plants, brief note on some families of horticultural importance.	**K1 and K2**
CO2	Deals with soil science and fertility management for horticultural crops.	**K3**
CO3	Complete knowledge about Scope and importance of commercial floriculture in India	**K4**
CO4	aware with the mechanism of Pest and Disease Management of Horticultural Crops	**K5**
CO5	awareness of basics of ornamental and landscape gardening and study of Plant Propagation and Nursery Management.	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	2
CO2	3	3	2			
CO3	3	2	1	2	1	1
CO4	3	3	2	3	1	1
CO5	3	2	3		2	1
Average of CO – PSO mapping	3	2.6	1.6	1.6	1.4	1.0
Total of CO – PSO mapping	15	13	8	8	7	5

First Semester: B.Sc., Advanced Zoology and Biotechnology				
Course code		**22UAPBA1**		
Name of the course		**ALLIED BOTANY - I**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
AC - I	**Core – Theory**	**4**	**4**	**25 + 75 = 100**

Course Objectives

This course aimed students gained the basic and fundamental knowledge in the various field of Botany such as Taxonomy, anatomy, Microbiology, Horticulture and Economic Botany

UNIT I: **Classification of Angiosperm**

General outline of Bentham and Hooker's System of classification. Study of the range of characters and economic importance of Verbenaceae.

UNIT II: Taxonomy

Study of the range of characters and economic importance of Apocynaceae, Euphorbiaceae, Rubiaceae, Solanaceae and Poaceae

UNIT III: Anatomy of flowering plants

Types of tissues - simple and permanent tissues. Primary structure of Dicot stem, root and leaf .Structure of mature Anther and Ovule and its types, Fertilization, Development of Dicot Embryo (CAPSELLA).

UNIT IV: Microbiology

Elementary knowledge of bacteria - Shape, Size and Flagellation - Classification. Ultra-structure of *E.coli*. Economic importance of Bacteria. General account of Plant Viruses (T.M.V).

UNIT V: Horticulture and Economic Botany:

Horticulture: Scope and importance. Propagation methods (Cuttage, Layering and Air layering), Grafting techniques. Bonsai techniques.

Economic Botany: Economic importance of the following: Cereals - Paddy; Pulses - Red gram; Oilseeds - Groundnut; Fibers - Cotton

Text Books:

1. Rao, K. N., Krishnamurthy, K.V. and Rao, G. (1979) Ancillary Botany, Viswanathan Private Ltd.
2. Priti Shukla and Shital P Misra (1979) An Introduction to Taxonomy of Angiosperms. Vikas Publishing House Pvt Ltd, New Delhi.
3. Jayaraman, P. (2000) Allied Botany I & II.V.K. Publishing House, Chennai -5
4. Pandey, S.N., Misra, S.P. and Trivedi, P.S.(2006) A Textbook of Botany: Vol I & II. VIKAS Publishing house Pvt Ltd.
5. Sharma, O.P., "Plant Taxonomy", Second Edition, Tata McGraw-Hill Education, Publishing Co. Pvt. Ltd., New Delhi, 2012.

Reference Books:

1. Ganguly, A.K. (1971) General Botany: Vol. I. The New Book Stall, Calcutta.
2. Dubey & Maheshwari (1999) A Textbook of Microbiology. Chand & Company
3. Singh,V., Pande, P.C. and Jain, D.K.(2010). A Text book of Botany Rastogi Publ.
4. Manihhushan Rao, K. (1991) Textbook of Horticulture.MacMillan India Limited.
5. Maheswari P. (1991): An Introduction to Embryology of Angiosperms. Tata-McGraw Hill Publishing Co. Ltd.

Web resources:

1. https://www.biology-pages.info/P/PlantTissues.html
2. www.cartage.org.lb/en/themes/sciences/botanicalsciences/aboutbotany/PlantTaxonomy/mainpage
3. www.flickr.com/groups/taxonomy/
4. https://www.biology-pages.info/P/PlantTissues.html
5. www.stumbleupon.com/tag/plant-anatomy/ -- links to plant anatomy websites

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignments, Field-based learning

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Describe the distinguishing floral features of angiosperm families and assess their economic importance	**K1 and K2**
CO2	apply the system of classification, recognize and infer the characteristic features of flowering plants	**K3**
CO3	categorize the agents of pollination; examine development of embryo and endosperm in a seed.	**K4**
CO4	assess the different types of plant tissues through their structural organization and functions	**K5**
CO5	Compose the microbiological composition of different resources and horticultural aspects of specific plants	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3	2	2	2	2
CO4	3	2	2	3	1	1
CO5	3	3	3	1	2	
Average of CO – PSO mapping	3	2.8	1.8	1.8	1.6	1.2
Total of CO – PSO mapping	15	14	9	9	8	6

Second Semester: B.Sc., Advanced Zoology and Biotechnology				
Course code		**Allied Botany - II**		
Name of the course		**22UBPBA3**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
NME 1	**Core – Theory**	**4**	**5**	**25 + 75 = 100**

Course Objectives

At the end of the course, the student will be able to learn the basic aspects of life cycle of lower plants like algae fungi etc. Also students understand the plant metabolism and gene transfer mechanism

UNIT I: Plant Diversity - I 12 Hrs

Structure and Reproduction of Algae; *Oscillatoria Chlamydomonas, Ectocarpus* and *Polysiphonia.*

UNIT II: Plant Diversity – II 12Hrs

Structure and Reproduction of Fungi -Albugo, Yeast and Polyporus

UNIT III: **Plant Diversity – III** 12Hrs

Structure and Reproduction of the following

Bryophyta - Funaria;

Pteridophyta - Lycopodium

Gymnosperms - Cycas.

UNIT IV: Plant Physiology 12Hrs

Absorption of Water; Photosynthesis -Light Reaction and Dark Reaction; Respiration - Glycolysis - Kreb's Cycle, Electron Transport System.

UNIT V: Plant Biotechnology 12Hrs

Biotechnology -Principles and Applications; rDNA technology; Plant tissue Culture - Totipotency - MS medium, Sterilization methods, Shoot and Anther culture; Application of Plant tissue culture

Text Books:

1. Pandey, S.N., Misra, S.P. and Trivedi, P.S.(2006). A text book of Botany: Vol I & II. VIKAS Publishing House Pvt Ltd.
2. Singh, V., Pande, P.C.and Jain, D.K. (2010). A Text book of Botany (IV Edition). Rastogi Publications.
3. Jayaraman, P. (2000.) Allied Botany -Vol. I & II.V.K. Publishing House, Chennai -5
4. Kumaresan, V. (2009). Biotechnology. Saras Publication, Nagercoil.
5. Pandey, B.P., "College Botany", Vol. II, English Edition, S. Chand & Co., New Delhi, 2011.

Reference Books:

1. Alexopholus, C.J. and Mims, C.W. (1979). Introductory Mycology (III Edition), Wiley Eastern Ltd, New Delhi.
2. Noggle, G.R. and George, J.F. (1992). Introductory Plant Physiology.(II Edition), Prentice-Hall of India Pvt Ltd, New Delhi.
3. Dubey: R.C. (1993). A Text Book of Biotechnology, S.Chand & Co Ltd, New Delhi.
4. lgnacimuthu, S.(1996). Basic Biotechnology, Tata McGraw Hill Publishing Co Ltd
5. Gardner, E.J., Simmons, M.J. and Snustad, D.P., "Principles of Genetics", Eighth Edition, John Wiley and Sons, New York, 2005.

Web resources:

1. www.mobot.org/MOBOT/tropicos/most/bryolist.shtml --bryophytes name list
2. www.geocities.com/heartland/plains/6761/ecycads.htm
3. http://www.esalq.usp.br/lepse/imgs/conteudo/Plant-Physiology-by-Vince-Ordog.pdfhttp://depts.washington.edu/genetics/courses/genet371b-aut99/overheads/pdfs/all_lect.pdf
4. http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=3
5. www.molecular-plant-biotechnology.info/resources-for-molecular-plant-biotechnology.htm

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment, Power point presentation

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	Illustrate and demonstrate the principle of rDNA technology for genetically modified plants	**K1 and K2**
CO2	Demonstrate the diverse physiological processes in plants and biochemical constituents of plants.	**K3**
CO3	summarize the general features of both morphological and anatomical features of Gymnosperms	**K4**
CO4	Organize and illustrate the morphological and internal structural characteristics selected forms of bryophytes and pteridophytes	**K5**
CO5	Formulate the hands on training on s identification of lower life forms through specimens	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

First Semester: B.Sc., Advanced Zoology and Biotechnology				
Course code		**22UBPBA3**		
Name of the course		**Allied Botany Practical**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
NME 1	**Core – Theory**	**4**	**5**	**25 + 75 = 100**

Course Objectives

I. To describe plants in technical terms &to identify the family by observed morphological characters of vegetative and floral parts.

2. To dissect flower and to construct the floral diagram.

3. To make suitable micro preparations of algae, fungi, bryophytes, pteridophytes, gymnosperms and to describe and identify the same.

4. To make suitable micro preparation of the stem, root of dicot and identify the same giving reasons.

5. To identify the habitat of the given plant by observing morphological features.

6. To critically comment simple experimental set-ups in plant physiology section of the syllabus.

7.To identify the horticultural implements/tools .

1		**Families**
	A	**Apocynaceae** - *Catharanthus roseus, Nerium oleander, Tabernaemontana divaricata* and *Thevetia peruviana*
		Solanaceae - *Datura metal, Solanum trilobatum, Solanum melongena*
		Euphorbiaceae - *Ricinus communis, Croton sparsiflorus, Euphorbia hirta*
		Rubiaceae – *Ixora coccinea, Oldenlandia corymbosa, Mussa endaluteola*
		Verbenaceae - *Lantana camara*
		Poaceae - *Chloris barbata*
2	**B**	**Dissect flower and to construct the floral diagram** - Any Flower
3	**C**	**Micro-preparation** - Dicot stem and Dicot Root

4	**D**	**Micro-preparation** - *Funaria* Stem, *Lycopodium* Stem and *Cycus* leaflet
5	**E to J**	**identify and giving reasons:**
	E	Chylamydomonas, Ectocarpus, Oscillatoria, Polysiphonia
	F	Albugo, Yeast , Polyporus
	G	Sclerenchymatous fibre, Sclerenchyma T.S., Xyem thickening (spiral), Phloem maceration, Parenchyma, Collenchyma, Anatrpous ovule.
	H	*Funaria*, *Cycas*- male cone ,*Cycas*-Megasporophyll, *Lycopodium* habit
	I	*Eichornia* (Hydrophyte), *Opuntia* (Xerophyte), *Vanda* (Epiphyte)
	J	Trowel, Digging hoes, Sprayer, Secateurs
6	**K**	Comment on experimental set-ups: Plant-Tissue culture/ Plant Physiology / Mushroom cultivation

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	identify the diverseness of various plant forms in their surrounding	**K1 and K2**
CO2	Analyze the advancement of plant tissue culture and plant biotechnology for human wealth	**K3**
CO3	distinguish between different types of cells and tissues,	**K4**
CO4	identify the different parts of reproductive and internal structure	**K5**
CO5	able to carry out basic microscope techniques for visualization internal organs	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	2
CO2	3	3	2			
CO3	3	3		2	2	2
CO4	3	2	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	2.8	1.6	1.6	1.4	1.0
Total of CO – PSO mapping	15	15	8	8	7	5

NON MAJOR ELECTIVE COURSES

First Semester: Common to All UG students				
Course code		**22UAPBN1A**		
Name of the course		**Applied Botany**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
NME - I	**Core – ELECTIVE**	**4**	**5**	**25 + 75 = 100**

Course Objectives

This course aimed students gained the essential and basic knowledge in the various field of Botany to applied the day today life such as herbal medicine, plant pathology, application fungi on plant growth, role of biofertilizer on yield

UNIT I: Herbal Botany

Medicinal Plants - Uses and their importance

a. *Azhadirachta indica* b. *Moringa oleifera* c.*Rauvolfia serpentina*

d. *Centella asiatica* e. *Zingiber officinale*.

UNIT II: Plant Pathology

Plant protection -General account of insecticides and pesticides. Common diseases of Citrus (Canker disease), Groundnut (Tikka disease)

UNIT III: Mycorrhiza

Mycorrhiza- Types of Mycorrhiza and their uses. Lichens –its types (Crustose, Foliose and Fruticose) and their economic importance.

UNIT IV: Biofertilizers

Biofertilizers- Mass cultivation of cyanobacteria, mass cultivation of Azolla.

UNIT V: Mushroom Technology

Mushroom Cultivation -Nutritive value and importance of Mushroom. Cultivation of Oyster mushroom. Spawn preparation. Preservation of mushrooms. Recipes made from mushrooms.

Text Books:

1. Handbook of Mushroom cultivation, 1999, TNAU publication
2. Pathak, V.N., Khatri, N.K. and Pathak, M. (1996) Fundamentals of Plant Pathology. Agro Botanical Publishers (India).
3. Suman, 2005, Mushroom Cultivation Processing and Uses, M/s. IBD publishers and Distributors, New Delhi.
4. Vaidyaratnam P and S.,Varier (1996) Indian Medicinal Plants- a compendium of 500 species. Vol.1-5, Orient Longman Ltd.

Reference Books:

1. Alexopholus, C.J. and Mims, C.W. (1979) Introductory Mycology.III Edition, Wiley Eastern Limited, New Delhi
2. Chandrasekaran, P.(2002) Modern Mycology, T.K.Publication, Pudukkottai. (Tamil version).
3. Kumaresan, V. (2009) Biotechnology. Saras Publication, Nagercoil.

Web resources:

1. www.krishiworld.com/html/mushroom.html
2. www.nrcmushroom.org/mushroom_cultivation_technology
3. https://www.enpab.it/images/2018/James_A._Duke_-_Handbook_of_ Medicinal_Herbs.pdf
4. https://www.bgci.org/files/Worldwide/Publications/PDFs/medicinal.pdf

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	describe the basic and fundamental aspects plant science in applied various filed	**K1 and K2**
CO2	articulate the concept of relevance on herbal medicine and control the plant disease on human welfare	**K3**
CO3	categorize the application of Mycorrhiza and Biofertilizers on increase the yield of crops	**K4**
CO4	assess the applications of Mushroom Technology by the way of cultivation, nutrition value and products of mushroom	**K5**
CO5	develop the development of techniques adopted for improvement of application of plant science for human wealth	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	2
CO2	3	3	2			
CO3	3	2		3	2	2
CO4	3	2	3	2		1
CO5	2	3	3		2	
Average of CO – PSO mapping	2.8	2.6	1.6	1.6	1.4	1.0
Total of CO – PSO mapping	14	13	8	8	7	5

First Semester: Common to All UG students				
Course code		**22UAPBN1B**		
Name of the course		**Technique in Biology**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
NME- I	**Core – Theory**	**4**	**5**	**25 + 75 = 100**

Course Objectives

This course aimed students gained the basic and fundamental information related the various techniques adopted for study the structure and function of organism through techniques in Microscope, use of radio isotopes, spectroscopic method etc.,

Unit – I : Microscopic techniques

Visualization of cells and sub cellular components by light microscopy, resolving powers of microscopes, microscopy of living cells, scanning and transmission microscopes

Unit – II : Radio labeling techniques:

Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues, Application of Radiolabeling techniques in Biology

Unit – III: Biophysical Method:

Principles and Instrumentation and Application of UV/Visible, fluorescence and NMR Spectroscopy

Unit – IV: Molecular Biology

Isolation and purification of RNA, DNA (genomic DNA) ; Analysis of RNA, DNA and proteins by Electrophoresis; Polymerase Chain Reaction and its applications

Unit – V: Immunotechniques and Electrophysiological methods

Detection of molecules using ELISA, in situ localization by techniques such as FISH ; Electrocardiogram (ECG), Brain activity recording, CAT, MRI.

Text Books:

1. Khandpur, R. S Biomedical Instrumentation Technology and Applications, McGraw-Hill Professional, 2004
2. Plummer, D.T., "An Introduction to Practical Biochemistry", Third Edition, Tata McGraw Hill Co. Ltd., New Delhi, 2008
3. Raja Rao, C, Guha, S.K, Principles of Medical Electronics and Biomedical Instrumentation, Orient Longman Publishers (2000)
4. Shaw, C.H., "Plant Molecular Biology- A Practical Approach", First Edition, Oxford University Press, Oxford, 1998

Reference Books:

1. De Robertis, E.D.P. and De Robertis, E.M.F. "Cell and Molecular Biology", First Edition, Lee and Fabiger, Philadelphia, 2007.
2. Gardner, E.J., Simmons, M.J. and Snustad, D.P., "Principles of Genetics", Eighth Edition, John Wiley, New York, 2008.
3. Leslie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd Edition, PHI, 2003.

Web resources:

1. https://cw.fel.cvut.cz/b172/_media/courses/a6m33zsl/microscopic_techniques.pdf
2. https://www.imperial.ac.uk/media/imperial-college/medicine/facilities/film/Basics-website.pdf
3. https://www.photometrics.com/wp-content/uploads/2019/10/Electrophysiology-AppNote.pdf
4. https://www.vyssotski.ch/BasicsOfInstrumentation/Introduction+to+Electrophysiological+Methods+and+Instrumentation.pdf

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	understand and recall the principle of various techniques in plant science	**K1 and K2**
CO2	determine and evaluate the products of plants by spectroscopy	**K3**
CO3	analyze the molecules related to human health by Immunotechniques and electrophysiology	**K4**
CO4	appraise the principles of radioactive isotopes on crop improvement and human wealth	**K5**
CO5	adapt the importance of spectroscopy, microscopy, molecular biology techniques in crop improvement programme.	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	2	2
CO2	3	3	3			
CO3	3	2	1	3	2	2
CO4	2	2	3	2	1	1
CO5	3	3	1		2	
Average of CO – PSO mapping	2.8	2.6	1.6	1.6	1.4	1.0
Total of CO – PSO mapping	14	13	8	8	7	5

Second Semester: Common to All UG students				
Course code		**22UBPBN2A**		
Name of the course		**Bioresource Management and Utilization**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
NME - II	**Core – Theory**	**4**	**5**	**25 + 75 = 100**

Course Objectives

This course provides an general idea about the Bioresource available in India and its pattern of utilization in Society. The course brings in students to diverse biodiversity life forms in the world and techniques adopted for conservation.

UNIT I: Fundamentals of Biodiversity

Biodiversity – Definition- Types of Biodiversity – Protected areas – Biosphere reserves – National Parks and wildlife sanctuaries.

UNIT II: Biodiversity Assessment

Biodiversity assessment and inventory programs – Morphological and Molecular characterization of biodiversity – Methods for species identification and classification

UNIT III: Conservation of biodiversity

Conservation of biodiversity – National and International initiatives – IUCN categories- Endangered, Threatened, Vulnerable and extinct species.

UNIT IV: Biodiversity informatics

Biodiversity informatics – Documenting biodiversity – Biodiversity databases – Red Book – Blue book and Green book – Biodiversity registers.

UNIT V: Biodiversity Data Management

Global biodiversity information system – Species 2000 and Tree of life – Overview of the UNEP/GEP biodiversity data management project (BDM) and bioethics.

Text Books:

1. Sharma, P. D., 2015. Ecology and environment. Rastogi publications, New Delhi.
2. Bawa, K.S., Primack, R.B. and Oommen, M.A., 2012. Conservation biology. Universities press, New Delhi.
3. Sharma, P. D., 2013. Environmental biology and toxicology. Rastogi publications,
4. Krishnamurthy, K.V. 2003. An Advanced Textbook on Biodiversity, Principles and Practice. Oxford and IBH Publishing CO. Pvt. Ltd., New Delhi.

Reference Books:

1. Kumar 2005, Biodiversity Principles and Conservation, Internation Book Distributors,.
2. Rana, S.V.S., 2012. Environmental studies. Rastogi publications, New Delhi.
3. . Kevin, J. Canton and John I Spicer, An introduction of Biodiversity
4. 3. Global biodiversity, 1992, Status of the Earth Living Resources, Water conservation and monitoring center, Chapman hall, London.
5. Forey, P.L. Humphries C.J. and Vane R.I. Wright (Eds. 1994, Systematics and Conservation Evolution.

Web resources:

1. https://dducollegedu.ac.in/Datafiles/cms/ecourse%20content/PK%20(AECC-EVS)%20Chapter%20-%204%20Biodiversity.pdf
2. http://www.gcekjr.ac.in/pdf/lectures/2020/6415ALL_3rd%20Semester_Civil%20Engineering.pdf
3. tezu.ernet.in/denvsc/IDC/biodiversity.pdf
4. http://www.tezu.ernet.in/denvsc/IDC/biodiversity.pdf
5. https://www.ndvsu.org/images/StudyMaterials/VPH/topic-2-biodiversity.pdf

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	classify biodiversity using geographical nature and analyze the current status of biodiversity resources of our country	**K1 and K2**
CO2	compute the biological wealth of our country as a prospective resource and integrate its use with the need for conservation	**K3**
CO3	analyze strategy for conservation, policies specific to Indian scenario and effectively manage the resources.	**K4**
CO4	assess and understand biodiversity as a main resource of our wealth	**K5**
CO5	assess the biodiversity data and registers Indian subcontinent for conservation of Indian wealth	**K5**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	2	2
CO2	3	3	2			
CO3	3	2		2	2	2
CO4	3	3	2	3	1	1
CO5	3	2	3		1	
Average of CO – PSO mapping	3	2.6	1.4	1.6	1.2	1.0
Total of CO – PSO mapping	15	13	7	8	6	5

Second Semester: Common to All UG students				
Course code		**22UBPBN2B**		
Name of the course		**Economic Botany**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
NME 1	**Core – Theory**	**4**	**5**	**25 + 75 = 100**

Course Objectives

This course provides an overview of the economic importance aspects of plant life forms to the students. The course introduces students to various economically important aspects like herbal plants, mushroom cultivation, in day today life of them.

UNIT I: Vermitechnology

Vermitechnology - Definition, Vermicomposting methods, importance in agriculture. Application of vermicompost in agricultural and horticultural practices

UNIT II: UNIT II: Herbal Botany

Beneficial aspects of herbal plants as food -common greens .vegetables and edible oils (general account only)

UNIT III: Mushroom Technology

Introduction about the Mushroom; Nutritive value of mushrooms; Edible and poisonous mushroom; Medicinal value; Mushroom recipes; mushroom cultivation; Post harvest technology: Harvesting, packaging, marketing.

UNIT IV: Biodiesel

Biodiesel -Definition –Production –*Jatropha* sps. - Application of Biodiesel

UNIT V: Wood technology

Types of Wood - Economic importance of Woody plants – *Dalbergia latifolia – Tectona grandis - Hevea brnsiliensis - Cocos nucifera*

Text Books:

1. Farooqui, A.A., Khan, M.M. and Sreeramu, B.S. 1997. Cultivation of Medicinal and Aromatic Crops in India. Naya Prakash, Kolkatta
2. Nita Bahl, 2002, Handbook on Mushroom 4th edition Oxford & IBH publishing co. Pvt. Ltd.
3. Renganathan, L.S. (2006) Vermicomposting technology- from soil health to human health, AgroBios (India), Agrohouse, Chopasani Road, Jodhpur- 342 002.

Reference Books:

1. Ambasta, S.P. (ed) 1988. The useful plants of India. CSIR, New Delhi
2. Bhatnagar & R.K.Palta (1999) Earthworm (Vermiculture and Vermicomposting). Kalyani Publishers, New Delhi
3. Bhattacharjee, S.K. 2004. Handbook of Medicinal Plants(4^{th} ed). Pointer Publishers,
4. Kameswara Rao, C.2000. Database of medicinal plants. KSCST, Bangalore
5. Pearce, D. and Moran, D. 1994. The economic value of biodiversity. Earthscan Pub., London

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	describe the essential and elemental aspects plant science in applied various filed of crop improvement	**K1 and K2**
CO2	categorize the application of Vermitechnology on yield of crops	**K3**
CO3	Understand the Mushroom Technology by the way of cultivation, nutrition value and products of mushroom	**K4**
CO4	development of techniques adopted for improvement of application of plant science for human wealth	**K5**
CO5	apply the system of classification, recognize and infer the characteristic features of woody plants	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		3	3	3
CO2	3	3	2			
CO3	3	3		3	2	2
CO4	3	3	3	3		1
CO5	3	3	3		2	
Average of CO – PSO mapping	3	3	1.6	1.8	1.4	1.2
Total of CO – PSO mapping	15	15	8	9	7	6

Second Semester: Common to All UG students				
Course code		**22UCEVS1**		
Name of the course		**Environmental Studies**		
Course No	Course Category Core / Elective Theory / Practical	No of Credits	No of hrs /week	Total marks (Internal + External)
EVS	**Theory**	**2**	**2**	**25 + 75 = 100**

Course Objectives

Students gain knowledge on the fundamental concepts, mechanism and importance of environment and ecosystem. This course provides the consciousness and awareness about the significance of our environment, to save and protect the nature.

Unit I: Scope and importance of Environmental Science :

Definition, Multidisciplinary nature of environmental science, scope and importance; global environmental problems.

Unit II: Ecosystems:

Concept of an ecosystem. Structure and function of an ecosystem. producers, consumers and decomposers. Energy flow in the ecosystem. Food chains, food webs and ecological pyramids.

Unit III: Biodiversity and its conservation :

Introduction - Definition : Value of biodiversity: consumptive use, productive use. India as a mega-diversity nation, Hot-spots of biodiversity. Brief account on biodiversity conservation.

Unit 4: Environmental Pollution:

Definition- Cause, effects and control measures of:- a)Air pollution, b) Water pollution Solid waste Management : Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.

Unit 5: Social Issues and the Environment:

Water conservation, rain water harvesting. Climate change, global warning, acid rain, ozone layer depletion, nuclear accidents. Waste land reclamation. ·

Text Books:

1. Arindam Ghosh, 2022, Environmental Studies, Generic publications
2. Chauhan, B.S., 2015. Environmental studies, Second edition. Laxmi publications
3. Erach Bharucha, 2021, Textbook of Environmental Studies for Undergraduate Courses, Orient Blackswan Pvt Ltd
4. Rajagopalan, R. 2015., Environmental Studies, Oxford University Press
5. Sharma, PD., 2017. Ecology and Environment, Rastogi Publications

Reference Books:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publications Ltd. Bikaner.
2. Bharucha Brach, 2017, The Biodiversity of India, Mapin Publishing Pvt. Ltd
3. Cunningham, W. P., Cunningham, M.A. and Saigo, B. W., 2006. Environmental sciences, Nineth edition. Mcgraw-hill higher education,
4. Odum, E.P., 1971. Fundamentals of ecology, Third edition. W.B. Saunders company, Philadelphia
5. Subramanyam, N.S. and Sambamurthy, A.V., 2000. Ecology. Narosa publishing house,

Web resources:

1. 1.https://www.sbsc.in/pdf/resources/1588750812_Unit_1_Introduction_to_environmental_studies.pdf
2. https://nitsri.ac.in/Department/CHEMISTRY/EVS_MATERIAL_2.pdf
3. 3.https://www.tripurauniv.ac.in/Content/pdf/StudyMaterialsDetail/BA%203rd%20Semester/BA-3RD(FNDC)-Environmental%20Studies.pdf
4. https://aissmschmct.in/wp-content/uploads/2020/08/BSC-HS-Sem-III-Environment-Science-I-HS-307-Chapter-1.pdf

METHODOLOGY OF TEACHING

Class lectures, Group Discussion, Assignment

Course Outcomes (COs):

Upon completion of this course, the students

CO code	Course Outcomes	K-levels
CO1	describe the structure, functions and energy flow in the ecosystem	**K1 and K2**
CO2	determine the interactions among the physical, chemical and biological components	**K3**
CO3	categorize the types, distribution of Biodiversity in India and its benefits on society and methods adopted for biodiversity conservation	**K4**
CO4	criticize the sources, effects and control measures of various types of Pollution	**K5**
CO5	Compile the environment legislations in India for sustainable development.	**K6**

CO- PSO Mapping (Course Articulation Matrix)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3		2	1	2
CO2	3	2		1		2
CO3	3	3		2	1	3
CO4	3	2	3	3	2	3
CO5	3	2	2	3	2	3
Average of CO – PO mapping	3	2.4	1.0	2.2	1.2	2.6
Total of CO – PO mapping	15	12	5	11	6	13