

B.Sc. BOTANY

2023-2024

(Syllabus from the Academic Year 2023- 2024)



**THANTHAI PERIYAR GOVERNMENT ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)
Re -Accredited with 'A' Grade by NAAC (Affiliated to Bharathidasan University)
Tiruchirappalli -620 023**

THANTHAI PERIYAR GOVERNMENT ARTS AND SCIENCE COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI-23.										
GENERAL COURSE PATTERN FOR UG - SCIENCE - 2023-2024 ONWARDS										
SL. NO.	PART	COURSE		Sub-Code	COURSE TITLE	Hrs.	Credits	CIA	Semester Exam	Total
I SEMESTER										
1	P - I	TAMIL	I	LT- I	LT-I : Tamil Paper - I	6	3	25	75	100
2	P - II	ENGLISH	I	LE- I	LE-I : English Paper - I	6	3	25	75	100
3	P - III	CORE	I	C- I	Algae and Bryophytes	6	5	25	75	100
		CORE	II*-P	C -II	Core Practical Paper - I	2	-	-	-	-
4		First Alli.	I	GE - I	Allied - I Zoology	4	4	25	75	100
		First Alli.	II*-P	GE - II	Allied Zoology Practical	2	-	-	-	-
5	P - IV	SBE	I	PCSEC	Mushroom Cultivation	2	2	25	75	100
6		VE		VE	Value Education	2	2	25	75	100
TOTAL						30	19	150	450	600
II SEMESTER										
7	P - I	TAMIL	II	LT -II	LT-II :Tamil Paper -II	6	3	25	75	100
8	P - II	ENGLISH	II	LE - II	LE-II : English Paper - II	4	3	25	75	100
9	P - III	CORE	II-P	C - II	C-II : Core Practical Paper - I	4	4	40	60	100
10		CORE	III	C - III	C-III : Fungi, Lichen and Plant Pathology	5	5	25	75	100
11		First Alli.	II-P	GE - II	Allied Zoology Practical	3	3	40	60	100
12		First Alli.	III	GE - III	Allied Zoology - III	4	4	25	75	100
13	P - IV	ES		ES	Environmental Studies:	2	2	25	75	100
14		NMSDC*	I	AECC - I	NMSDC-I :	2	2	25	75	100
TOTAL						30	26	230	570	800
III SEMESTER										
15	P - I	TAMIL	III	LT-III :	LT-III : Tamil Paper - III	6	3	25	75	100
16	P - II	ENGLISH	III	LE-III :	LE-III : English Paper - III	6	3	25	75	100
17	P - III	CORE	IV	C-IV :	Pteridophytes , Gymnosperms and Paleobotany	4	4	25	75	100
		CORE	V*-P	C-V :	Core Practical - II	2	-	-	-	-
18		ME	I	C-VI	Microbiology	4	4	25	75	100
19		Sec. Alli.	I	GE - IV	Allied Chemistry- I	4	4	25	75	100
		Sec. Alli.	II*-P	DSE-I	Allied Chemistry Practical	2	-	-	-	-
20	P - IV	NME	I	NME - I	Medicinal Botany	2	2	25	75	100
TOTAL						30	20	150	450	600

IV SEMESTER										
21	P - I	TAMIL	IV	LT-IV :	LT-IV : Tamil Paper IV	6	3	25	75	100
22	P - II	ENGLISH	IV	LE-IV :	LE-IV : English Paper IV	6	3	25	75	100
23	P - III	CORE	V-P	C-V :	Core Practical - II	4	4	40	60	100
24		CORE	VII	C-VII :	Anatomy and Embryology	5	5	25	75	100
25		Sec. Alli.	II-P	DSE-I	Allied Chemistry Practical	3	3	40	60	100
26		Sec. Alli.	III	DSE-II	Allied Chemistry - III	4	3	25	75	100
27	P - IV	NMSDC*	II	AECC - II	NMSDC-II :	2	2	25	75	100
TOTAL						30	23	205	495	700
V SEMESTER										
28	P - III	CORE	VIII	C-VIII :	Taxonomy of Angiosperms	5	5	25	75	100
29		CORE	iX	C-IX :	Horticulture and Plant Breeding	5	5	25	75	100
30		CORE	X	C-X :	Cell Biology, Genetics and Evolution	6	5	25	75	100
31		CORE	XI-P	C-XI :	Core Practical - III	5	5	40	60	100
32		ME	II	DSE-III	Morphology & Economic Botany	5	3	25	75	100
33	P - IV	NME	II	NME	Horticulture	2	2	25	75	100
34		SSD		AECC - III	SSD : Soft Skill Development	2	2	25	75	100
35	P - V	EA		EA	Garden maintenance	-	1	25	75	100
TOTAL						30	28	215	585	800
VI SEMESTER										
36	P - III	CORE	XII	C-XII :	Biophysics, Biochemistry and Biostatistics	6	6	25	75	100
37		CORE	XIII	C-XIII :	Plant physiology	6	5	25	75	100
38		CORE	XIIV	C-XIV :	Plant Ecology and Phytogeography	5	5	25	75	100
39		CORE	XV-P	C-XV :	Core Practical - IV	6	5	40	60	100
40		ME	III	DSE-IV	Plant Biotechnology (or)	5	3	25	75	100
41		NMSDC*	III	AECC - IV	NMSDC-III :	2	2	25	75	100
TOTAL						30	26	165	435	600
GRAND TOTAL						180	142	1115	2985	4200
		*Optional			Extra/Additional :					

SEMESTER – I
CORE PAPER - I
ALGAE AND BRYOPHYTES

Hours : 6
Credits : 5
Code :

Learning Objectives	Course Outcome
To provide a comprehensive knowledge on the biology of algae.	Relate to the structural organization, reproduction and significance of algae.
To provide a basis for better understanding of the evolution of algae.	Demonstrate knowledge in understanding the various life cycle patterns in algae
To provide a comprehensive knowledge on the biology of bryophytes.	Recognize the salient features and Classification of Bryophytes
To understand the morphological diversity and Life cycle of Bryophytes.	Compare and contrast the thallus organization and modes of reproduction in Bryophytes.
To understand importance of algae and Bryophytes to animals and humans.	Determine the emerging areas of Algae and Bryophytes with their uses.

Unit I

Algae : General characters of Algae, Classification – Fritsch (1935-1945), Ecology and Distribution of Algae. Thallus organization and Life cycle of *Oscillatoria*, *Chlorella*, *Volvox*, *Oedogonium* and *Caulerpa*

Unit II

Thallus organization and Life cycle of *Chara*, *Ulva*, Diatoms, *Sargassum* and *Gracilaria*

Unit III

Bryophytes : General characters of Bryophytes, Classification of Bryophytes – Rothmaler (1951). Salient features of Hepaticopsida, Anthocerotopsida and Bryopsida. Ecology and Distribution of Bryophytes. Evolution of Bryophytes.

Unit IV

Structure, reproduction and life cycle of the following genera: *Marchantia*; *Anthoceros* and *Funaria*

Unit V

Economic Importance of Algae and Bryophytes: Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite. Resource potential of algae: Application of algae as fuel, agriculture and pharmaceutical. Phycoremediation. Role of algae in CO₂ sequestration, Algae as indicator of water pollution, algal bioinoculants. Bioluminescence.

Economic importance of Bryophytes – Ecological importance - Pollution indicators and monitoring, Medicinal uses, horticulture, industrial uses and absorbent bandages.

Recommended Texts:

1. Dehradun. Edwardlee,R.2018. Phycology,5thEd.,CambridgeUniversityPress, London.
2. Kumar,H.D.1999. Introductory Phycology. Affiliated East-West Press, Delhi

3. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
4. Vashishta, P.C. 2014. S.Chand & Company Ltd, New Delhi
5. Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd. London
6. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
7. Alam, A. 2020. Contemporary Research on Bryophytes Book Series: Recent Advances in Botanical Science. 10.2174/97898114337881200101.
8. Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition, Cambridge University Press.
9. Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India.
10. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.

Reference Books :

1. Chapman, V.J and Chapman, D.J. 1960. The Algae, ELBS & MacMillan, London.
2. Lee, R.D. 2008. Phycology 4th Edition, Cambridge University Press, New York
3. Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill, Chennai
4. Watson, E.V. 1963. The structure and Life of Bryophytes. Hutchinson & Co, UK.
5. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.

Web Resources :

1. [https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-\(PDF-21P\).html](https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-(PDF-21P).html)
2. <https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/3>.
3. https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&redir_esc=y
4. <http://www.bryoecol.mtu.edu/>
5. <https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoorten-ebook/dp/B007NFWQK>
6. <http://scitec.uwichill.edu.bb/bcs/b114apl/bryo1.htm>

SEMESTER – I & II
CORE PAPER - II
CORE PRACTICAL PAPER – I

Hours : 2 + 4

Credits : 4

Code :

Practical Covering

Core Paper I

- Algae
- Bryophytes

Core Paper III

- Fungi
- Lichens
- Plant Pathology

SEMESTER – I
GENERIC ELECTIVE PAPER - I
ALLIED BOTANY – I

Hours : 4
Credits : 4
Code :

Learning Objectives	Course Outcome
To study morphological and anatomical adaptations of algae of various habitats.	Increase the awareness and appreciation of human friendly algae and their economic importance.
To study the structure and life cycle of fungi, bacteria and virus	Develop an understanding of microbes and fungi and appreciate their adaptive strategies
To study the structure and life cycle of <i>Funaria</i> , <i>Lycopodium</i> and <i>Cycas</i>	Develop critical understanding on morphology and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
To study the structure and function of cell and cellular organelles	Compare the structure and function of cells and explain the development of cells.
To understand the genetics and basic tissue culture techniques.	Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.

Unit I

Algae: General characters and classification of algae (Fritsch, 1935) - Structure, reproduction and life cycle of the following genera – *Chlorella* and *Sargassum* -Economic importance of algae.

Unit II

Fungi, Bacteria and Virus: General characters and classification of fungi (Alexopoulos and Mims). Structure, reproduction and life cycle of the following genera – *Penicillium* and *Agaricus*. Economic importance of fungi. Bacteria - general characters, structure and reproduction of *Escherichia coli*. Economic importance of bacteria. Virus - general characters, structure of TMV, Structure of bacteriophage.

Unit III

Bryophytes, Pteridophytes and Gymnosperms: General characters of Bryophytes, Structure and life cycle of *Funaria*. General characters of Pteridophytes, Structure and life cycle of *Lycopodium*. General characters of Gymnosperms, Structure and life cycle of *Cycas*.

Unit IV

Cell Biology: Ultrastructure of Prokaryotic (Bacteria) and Eukaryotic cell (Plant cell) . Ultra structure and function of Chloroplast, Mitochondria, ER and Nucleus. Cell division - Mitosis and Meiosis.

Unit V

Genetics and Plant Biotechnology: Mendelism - Law of dominance, Law of segregation, Law of independent assortment and Incomplete dominance. Monohybrid and Dihybrid cross - Test cross - Back cross. Plant tissue culture –Sterilization and Media Preparation, Micropropagation technique. Plant tissue culture and its application in biotechnology

Recommended Texts :

1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
5. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany, S. Viswanathan Pvt. Ltd., Madras

Reference Books:

1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi.
2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.
3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.
4. Coulter, M. John, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
5. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
6. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi.
7. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I &II, S.Chand and Co. New Delhi.

Web Resources:

1. <https://www.kobo.com/us/en/ebook/the-algae-world>
2. [http://www.freebookcentre.net/biology-books-download/Fungi-\(PDF-15P\).html](http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html)
3. <http://scitec.uwichill.edu.bb/bcs/b114apl/bryo1.htm>
4. <https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/>
5. <https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf>
6. <https://www.us.elsevierhealth.com/medicine/cell-biology>
7. <https://www.us.elsevierhealth.com/medicine/genetics>
8. <https://www.kobo.com/us/en/ebook/plant-biotechnology-1>

Hours : 2
Credits : 2
Code :

SEMESTER – I
PROFESSIONAL COMPETENCY SKILL ELECTIVE COURSE- I
MUSHROOM CULTIVATION

Learning Objectives	Course Outcome
To learn and develop skills in mushroom cultivation.	Recall various types and categories of mushroom.
To understand and appreciate the role of mushrooms in Nutrition, Medicine and health.	Explain about various types of food technologies associated with mushroom industry.
To cultivate mushroom cultivation in small scale industry.	Apply techniques studied for cultivation of various types of mushroom.
To learn about diseases and post-harvest technology.	Analyze and decipher the environmental factors and economic value associated with mushroom cultivation
To study new methods and strategies in mushroom production.	Develop new methods and strategies followed in large scale production

Unit I

Introduction: History and scope of edible mushroom, Morphology, Types of Mushroom, Identification of edible and poisonous mushroom, Nutritive and Medicinal value of Mushroom.

Unit II

Mushroom cultivation, Spawn preparation - Isolation of pure culture; Nutrient media for pure culture; Sterilization; preparation of mother spawn and multiplication.

Unit III

Structure and life cycle of *Agaricus*, *Pleurotus* and *Calocybe*. Cultivation of following types of mushroom – *Agaricus bisporous* (Button mushroom); *Pleurotus sajor-caju* (Oyster mushroom).

Unit IV

Mushroom- bed preparation, harvesting and preservation methods. Mushroom marketing in India and abroad.

Unit V

Diseases of mushrooms- Insect, pests, nematodes, mites, virus, fungal competitors. Preparation of various dishes from mushroom (Soup, Samosa, Biryani and Pickle).

Recommended Texts :

1. Handbook of Mushroom Cultivation. 1999. TNAU publication.
2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
4. Singh. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun.
5. Verma,2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.

Reference Books :

1. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi.
2. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.

Web resources:

1. <https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X>
2. <http://nrcmushroom.org/book-cultivation-merged.pdf>
3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf
4. <http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/>
5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

SEMESTER – II
CORE PAPER - III
FUNGI, LICHEN AND PLANT PATHOLOGY

Hours : 5
Credits : 5
Code :

Learning Objectives	Course Outcome
To describe the common characteristics and classification of fungi	Relate to the structural organization, reproduction and significance of Fungi.
To understand the biology of fungi and to discuss the importance of fungi in various ecological roles	Demonstrate knowledge in understanding the various life cycle patterns and the fundamental concepts in Fungi
To understand the different uses of Fungi	Determine the economic importance of fungi and lichens
To understand structure, function, and the use of lichens. Lichens as bioindicator species.	Identify the common plant diseases, according to geographical locations and device control measures.
To identify the main groups of plant pathogens, their symptoms and the various types of plant diseases.	Identify the common plant diseases, according to geographical locations and device control measures.

Unit I

Fungi : Classification of fungi - (Alexopoulos and Mims, 1979), Characteristic features, thallus organization and mode of nutrition. Structure and life cycle of *Mucor*, *Puccinia* and *Cercospora*.

Unit II

Structure and life cycle of *Saccharomyces*, *Aspergillus*, *Neurospora* and *Penicillium*.

Unit III

Economic Importance of Fungi : Fungi as food, biofertilizers, bio-pesticides, Production of industrially important products from Fungi- Alcohol (Ethanol), Organic acids (Citric acid), enzymes (Protease), Vitamins (Vitamin B-complex and Vitamin B-12).

Unit IV

Lichen : Classification (Hale, 1969). Habitat, Structure - Mycobionts and Phycobionts, Forms of lichens (Crustose, Foliose and Fruticose), Structure and reproduction of *Usnea*.
Economic importance of Lichens.

Unit V

Plant Pathology : General symptoms of plant diseases; Symptoms, causative agent and control measures of the following diseases; Tobacco Mosaic and Bunchy top of Banana (Viral Diseases), Bacterial wilt of Banana and Citrus canker (Bacterial Diseases), Blast disease in Rice and Tikka disease of Ground nut (Fungal Diseases)

Recommended Texts :

1. Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology.
2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi.
3. Satyanarayana ,T and Johri, B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.
4. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.
5. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India.
6. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.

Reference Books :

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore.
2. Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge.
3. Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill companies, New Delhi.
4. Burnett, J.H. 1971. The fundamentals of Mycology. ELBS Publication, London.
5. Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi.
6. Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi.
7. Pandey, P.B. 2014. College Botany- 1:. Chand Publishing, New Delhi.
8. Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH.

Web Resources :

1. <https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE>
2. <http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html>
3. <http://www.freebookcentre.net/Biology/Mycology-Books.html>
4. <https://www.kobo.com/us/en/ebook/introduction-to-fungi>
5. <http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html>
6. [http://www.freebookcentre.net/biology-books-download/Fungi-\(PDF-15P\).html](http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html)

SEMESTER – I
GENERIC ELECTIVE PAPER –II
ALLIED BOTANY – III

Hours: 4
Credits : 4
Code:

Learning Objectives	Course Outcome
To be familiar with the morphology of flowering plants	Understand the various parts of the plant
To be familiar with the basic concepts and principles of plant systematics	Classification of plants and recognize the importance of herbarium.
Learn the importance of plant anatomy in plant production systems	Understand the fundamental concepts of plant anatomy
Understand the mechanism underlying the shift from vegetative to reproductive phase.	Understand the fundamental concepts of embryology
To learn about the physiological processes that underlie plant metabolism.	Understand water relation of plants with respect to various physiological processes.

Unit I

Morphology of Flowering Plants: Plant and its parts. Structure and function of root and stem. Leaf and its parts. Leaf types- simple and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose, Mixed and Special types. Terminology with reference to flower description.

Unit II

Taxonomy: Bentham and Hooker's system of classification. Study about the following families and economic importance of plants included in the families: Annonaceae, Rutaceae, Rubiaceae, Euphorbiaceae and Poaceae.

Unit III

Anatomy: Tissues, Simple and complex tissues. Anatomy of monocot and dicot roots - Anatomy of monocot and dicot stems - Anatomy of dicot and monocot leaves.

Unit IV

Embryology: Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination -double fertilization, structure of dicotyledonous and monocotyledonous embryo

Unit V

Plant Physiology : Absorption of water, photosynthesis - light reaction - Calvin cycle; respiration - Glycolysis - Krebs cycle - electron transport system. Growth hormones - auxins and cytokinins and their applications.

Recommended Texts :

1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.
2. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
4. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
5. Ting, I.P. 1982. Plant Physiology. Addison Wesley Press. Philippines

Reference Books :

1. Lawrence.G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad.
2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Pandey, B.P. 2012. Plant Anatomy. S Chand Publishing.
4. Jain, VK. 2006. Fundamentals of Plant Physiology, S. Chand and Company Ltd.
5. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.
6. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi.
7. Verma, S.K. 2006. A Textbook of Plant Physiology, S.K.Chand& Co., New Delhi

Web Resources :

1. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y
2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFuUC&redir_esc=y
3. <https://archive.org/EXPERIMENTS/plantanatomy031773mbp>
4. <https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG>
5. <https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692>

SEMESTER – I
GENERIC ELECTIVE PAPER –II
ALLIED BOTANY PRACTICAL – II

Hours : 2 + 3
Credits : 3
Code :

Practical Covering

Allied Botany Paper I

- Algae
- Fungi
- Bacteria
- Virus
- Bryophytes
- Pteridophytes
- Gymnosperms
- Cell Biology
- Genetics
- Plant Biotechnology

Allied Botany Paper III

- Morphology
- Taxonomy
- Anatomy
- Embryology
- Plant Physiology

SEMESTER – III

Hours : 4
Credits : 4
Code :

CORE PAPER - IV

PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

Learning Objectives	Course Outcome
To enable the students to have an overview of Vascular cryptogams.	Recognize the morphological variations of Pteridophytes.
To understand the morphological diversity of Pteridophytes.	Explain the anatomy and reproduction of Pteridophytes.
To understand the classification and general characters of Gymnosperms	Relate to the general characteristics of Gymnosperms.
To understand the internal and the reproductive structures of Gymnosperms.	Explain about the morphology and anatomy of Gymnosperms.
To acquaint students with evidences of the past history of plant groups and significance of the fossilization.	Determine the various fossilization methods and their significance in paleobotany.

Unit I

Pteridophytes: General characters of Pteridophytes-Classification (Reimer,1954), Apogamy, Apospory and Heterospory and seed habit, Stelar Evolution. Economic importance of Pteridophytes

Unit II

Morphology ,anatomy and reproduction of the taxa belonging to each of the following classes: Psilotopsida (*Psilotum*), Lycopsidea (*Lycopodium*), Sphenopsida (*Equisetum*), Pteropsida(*Marsilea*)

Unit III

Gymnosperms: Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics and Economic importance of Gymnosperms.

Unit IV

Gymnosperms: Morphology, anatomy and reproduction of the genus belonging to each of the following orders: Cycadales (*Cycas*), Coniferales (*Pinus*). Gnetales (*Gnetum*).

Unit V

Paleobotany: Geological time scale. Types of fossils, Radiocarbon dating. Study of the following fossils: *Rhynia*, *Lepidocarpon*, and *Williamsonia*.

Recommended Texts:

1. Eames, A. 1963. Morphology of lower vascular plant, McGraw Hill, Chennai.

2. Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pteridophyta, Central book depot, Allahabad.
3. Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill, Chennai
4. Sporne, K.L. 1976. Morphology of Pteridophytes, 4th edition, B.I. Publication. Chennai.
5. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
6. Gupta, M.N. 1972. The Gymnosperms (2nd Edition) Shiva Lal Agarwala & Co., Agra.
7. Vashista, P.C. 1976. Gymnosperms, S.Chand & Co. New Delhi.
8. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
9. Anil Kumar. 2006. Gymnosperms. S. Chand & Company Pvt. Ltd. New Delhi.
10. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.

Reference Books :

1. Vashista.P.C. 1971. Botany for Degree students: Pteridophyta. S.Chand & Co. New Delhi.
2. Sporne, K.R.1991. The Morphology of Gymnosperme. B.I. Publications, New Delhi.
3. Stewart, W.N and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.
4. Raup, D.M and Steven, M. Stanley. 2004. Principles of paleontology. San Francisco: W.H. Freeman, 1971.

Web Resources :

1. http://www.bsienviis.nic.in/Database/Pteridophytes-in-India_23432.aspx
2. <https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC>
3. <https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf>
4. <https://www.palaeontologyonline.com/>

SEMESTER – III & IV
CORE PAPER - V

Hours : 2 + 4 Credits : 4 Code :

CORE PRACTICAL PAPER – II

Practical Covering

Core Paper IV

- Pteridophytes
- Gymnosperms
- Paleobotany

Core Paper VI

- Microbiology

Core paper VII

- Anatomy
- Embryology

SEMESTER – III
CORE PAPER - VI

Hours: 4
Credits: 4
Code:

MICROBIOLOGY

Learning Objectives	Course Outcome
Impart knowledge on the working of different types of Microscopes and staining techniques	Be familiar with the history and development of Microbiology with the broad perspective of the scope of Microbiology
Understand the concept of asepsis and modes of sterilization	Be acquainted with different methods of sterilization and preservation of cultures
Learn about the different characteristics of microorganisms and outline of bacteria	Identify the different types of medium and techniques used for the growth and cultivation of microorganisms
Understand the general characteristics of Viruses.	Familiar with the structure and life cycle of selected viruses.
Gain insights on how the subject is implemented in different areas.	Appreciate the role of microbes in human welfare.

Unit I

History and Scope of Microbiology – Haeckel’s three kingdom, Whittaker’s five kingdom concepts.
Introduction to Microscopes – Light (Compound) and EM. (SEM & TEM)

Unit II

Sterilization and disinfection – principles – methods of sterilization – physical methods – dry heat – moist heat – radiation– filtration (membrane and HEPA)– chemical sterilization – chemical agents – mode of action. Preservation and maintenance of culture. Types of staining – simple, differential (Gram’s Staining).

Unit III

Classification for bacteria as per the Bergey’s Manual. Structural organization of bacteria – Size, shape and arrangement of bacterial cells - Ultrastructure of a bacterial cell - cell wall, cell membrane, capsule, flagella, fimbriae, Mesosomes .Spores and cysts. Culture and media preparation – solid and liquid. Types of media –semi synthetic, synthetic, enriched, selective and differential media.

Unit IV

VIRUSES : General characteristics and Classification of Viruses. Structure and Life cycle of TMV, CaMV and Cucumber Mosaic Virus.

Unit V

Agricultural Microbiology- Bio Fertilizer, Bio Pesticide, Bio control agents. Mass production and application of *Rhizobium*, *Azotobacter*, *Azospirillum*. Mycorrhiza - types and application- Role of Frankia and AM in soil fertility.

Recommended Texts :

1. Willey J.M., Sherwood L.M. and Woolverton C.J. (2013) Prescott’s Microbiology, 9th Edn. McGraw-Hill Higher Education.

2. Pelczar MJ, Chan ECS and Kreig NR. Microbiology, fifth edition. McGraw-Hill. Book Co. Singapore. 2009.
3. Ananthanarayanan R and CK JayaramPanicker, (2017). Textbook of microbiology, 10thEd. Orient Longman.
4. Dubey, R.C. & D.K. Maheshwari, (2010). A text Book of Microbiology. S. Chand & Co.

Reference Books :

1. Black JG. Microbiology-principles and explorations, 6th edition. John Wiley and Sons, Inc. New York. 2005.
2. Kanika Sharma. Textbook of Microbiology – Tools and Techniques. 1st edition, Ane Books Pvt. Ltd., New Delhi. 2011.
3. Madigan MT, Martinko JM, and Parker J. Biology of Microorganisms, 12th Edition, MacMillan Press, England. 2009.
4. MoselioSchaechter and Joshua Leaderberg. The Desk encyclopedia of Microbiology. Elsevier Academic press, California. 2004.
5. Madigan M.T., Bender K.S., Buckley D.H., Sattley W.M. and Stahl D.A. (2017) Brock Biology of Microorganisms, 15th Edn. (Global Edn.) Pearson Education.
6. Schlegel HG. General Microbiology, Cambridge University Press, U.K. 2008.
7. Tortora GJ, Funke BR and Case CL. Microbiology: An Introduction. 9th Edition, Pearson Education, Singapore. 2009.
8. Rajan S and Selvi Christy R. Essentials of Microbiology, Anjanaa Book House, Chennai, 2015.

Web Resources :

1. <http://www.microbelibrary.org/>
2. <https://eol.org/>
3. <https://Microbewiki.kenyon.ed>
4. <https://microbeworld.org>
5. <https://microbiol.org>

SEMESTER – IV
CORE PAPER - VII

Hours: 5
Credits: 5
Code:

ANATOMY AND EMBRYOLOGY

Learning Objectives	Course Outcome
To know fundamental concepts of plant anatomy and embryology	Relate to the fundamental concepts of plant anatomy and embryology
To understand the internal tissue organization of various plant organs	Describe the internal tissue organization of various plant organs
To differentiate normal and abnormal secondary growth	Elucidate the stages of normal and abnormal secondary growth
To comprehend the structural organization of flower with relevance to the process of pollination and fertilization	Compare the structural organization of flower in relation to the process of pollination and fertilization
To know embryology of plants.	Access the various anatomical adaptations in plants

Unit I

Meristem: definition, structure, function and classification. Apical organization and theories: Apical cell theory, Histogen theory and Tunica-Corpus theory. Root apex: Histogen theory and Korper-Kappe theory. Tissues - Definition, types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem.

Unit II

Epidermal tissue system: epidermis, cuticle, trichome, bulliform cells, periderm and silica cells. Ground tissue systems: cortex, endodermis, pericycle, pith and pith rays. Vascular tissue systems: different types of vascular bundles and their arrangement in root and stem. Primary structure of root and stem (Dicot and monocot) Nodal anatomy: leaf trace, leaf gap, branch trace and branch gap-types

Unit III

Secondary thickening in monocots and dicots Root and Stem. Anomalous secondary growth of stem- *Boerhaavia*, *Nyctanthes* and *Dracaena*. Leaf - anatomy of dicot and monocot leaf. Stomatal structure and types.

Unit IV

Structure and development of anther - development of male gametophyte. Ovule: Structure of mature ovule, types of ovules; female gametophyte- megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (*Polygonum* type); Organization and ultra structure of mature embryo sac.

Unit V

Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria. Polyembryony - types, apomixis, parthenogenesis and parthenocarpy. Seed structure and its importance.

Recommended Texts :

1. Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas.

2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
4. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
5. Vimla Singh and AlokAbhishek. 2019. Plant Embryology and Experimental Biology. Educational Publishers and Distributors. New Delhi.
6. Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi.
7. Bhatnagar,S.P., Dantu, P.K, Bhojwani, S.S. 2014. The Embryology of Angiosperms 6th edition Vikas Publishing House. Delhi.
8. Waisel, Y., Eshel, A and Kafkaki, U. 1996. Plant Roots: The Hidden Hall (2nd edition). Marcel Dekker, New York.

Reference Books :

1. Esau, K. 1985. Anatomy of Seed Plants –John Willey.
2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co..
3. Maheswari, P.1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd.,
4. Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd.
5. Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA.
6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA.
7. Mauseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publisher, USA.
8. Evert, R.F. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc. Any local/state/regional flora published by BSI or any other agency.
9. Swamy, B.G.L and Krishnamurthy,K.V.1980. From flower to fruit .Tata McGraw Hill Co. Pvt. Ltd, New Delhi

Web Resources :

1. https://www.amazon.in/PLANT-ANATOMY-EMBRYOLOGY-BIOTECHNOLOGY-ebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/?tag=googleshopdes-2
2. <https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy>
3. <https://archive.org/EXPERIMENTS/plantanatomy031773mbp>
4. <https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG>
5. <https://www.worldcat.org/title/embryology-of-angiosperms/oclc/742342811>.https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&redir_esc=y

**SEMESTER – V
CORE COURSE – VIII
TAXONOMY OF ANGIOSPERMS**

Hours : 5 Credits : 5 Code :

Learning Objectives	Course Outcome
Learn about the classification of Angiosperms	Familiarize with classification of Angiosperms
To know the basics of biosystematics and role of ICBN.	Familiarize with the numerical taxonomy, and ICBN
Develop comprehensive skills in field identification, collection of specimens, writing technical description, botanical drawings and herbaria preparation and key preparation.	Apply techniques in Herbarium preparation and Key preparation
Know the characteristics features of the the plant specimen by analyzing and dissecting the vegetative and floral characters.	Recognise the floral characters of plant specimen and its identification.
Validate the plant specimen by analyzing and dissecting the vegetative and floral characters.	Identify the plant specimen based on floral characters.

Unit – I

Historical account of the classification of the angiosperms, familiarization of the classification of Linnaeus, Engler and Prantl. Detailed account of the classification of Bentham & Hooker. Outline of Takhtajan classification.

Unit – II

Biosystematics, Chemotaxonomy, Numerical taxonomy. ICBN, Typification, Principles of priority and their limitation, effective and valid publication, citation, rejection and retention of names.

Unit – III

A general account on keys, Monographs, and Flora; BSI, Botanical gardens, Herbarium.

Unit – IV

A detailed study of the following families with their economic importance: Annonaceae, Nymphaeaceae, Capparidaceae, Tiliaceae, Rutaceae, Leguminosae and Asteraceae..

Unit – V

A detailed study of the following families with their economic importance: Cucurbitaceae, Rubiaceae, Asclepiadaceae, Solanaceae, Verbenaceae, Amaranthaceae, Euphorbiaceae, Orchidaceae and Poaceae.

Recommended Texts

1. Taxonomy of Angiosperms. BP Pandey
2. Systematic Botany – RK Gupta
3. Taxonomy of Angiosperms – V. Singh & DK Jain
4. Plant Taxonomy – OP Sharma

Reference Books

1. Taxonomy of Angiosperms. AVSS, Sambamurthy.
2. Taxonomy of Vascular Plants. Lawrence

SEMESTER – V
CORE PAPER - IX

HORTICULTURE AND PLANT BREEDING

Hours : 5 Credits : 5 Code :

Learning Objectives	Course Outcome
To gain an understanding of the fundamentals of horticulture and techniques needed to grow and maintain plants.	Enumerate the concepts in horticulture and nursery management
To develop skills in students to work as gardeners, therapists, designers, growers and technical advisors in the food and non-food sectors of horticulture	Demonstrate a working knowledge on biology of soil, compost making, designing and planning of garden, pest, diseases and nutrient management practices
To know about hydroponic culture.	Appraise the importance of floriculture and evaluate the contribution of spices and condiments on economy
Study the sexual and vegetative propagation methods including propagation through specialized vegetative structures	Decipher the stages of plant evolution and their transition to land habitat
Develop conceptual understanding of plant genetic resources, plant breeding, gene bank and gene pool	Develop their competency on pre and post-harvest technology in horticultural crops.

Unit I

Importance and scope of horticulture. Classification of horticultural crops –fruits and vegetables. Essentials of nursery Management - Soil management: Garden soil, Physical and chemical properties of soil, Organic matter, Compost, Cultural practices; Water management: Water quality, Irrigation, Mulching. Nursery structures: Protected cultivation (greenhouses), environment controls.

Unit II

Hydroponic culture-types of container. Use of manures and fertilizers in Horticultural crop production. Principles of organic farming. Environmental factors influencing vegetable and fruit production.

Unit III

Horticultural crop protection; physical control - pruning. Chemical control- pesticides, fungicides. Plant propagation - Cutting, Layering, Grafting and Budding. Types of gardens: formal, informal, kitchen and Terrace. Indoor gardening-bottle garden. Floriculture, ornamental gardening.

Unit IV

Principles involved in plant breeding. Plant introduction and acclimatization. Methods of crop improvement: selection (mass, pure line and clonal), hybridization techniques. Heterosis – Interspecific and intergeneric, causes and effects

Unit V

Mutation in plant breeding, polyploidy in plant breeding and its applications. Breeding for crop improvement for paddy and sugarcane. Biotechnology in crop improvement: Transgenics – scope and limitations; Bt-Cotton.

Recommended Texts :

1. Hartmann, H.T and D.E. Kester. 1989. Plant propagation – principles and practices. Half of India. New Delhi.
2. Bose, T.K and Mitra and Sadhu. 1991. Propagation of tropical and subtropical horticultural crops. Naya Prakash.
3. Singh, S.P. 1989. Mist propagation Metropolitan book Co., New Delhi.
4. Chadha, K.L. 1986. Ornamental horticulture in India ICAR, Krishi Bhavan, New Delhi.
5. Bose, T.K and Mukharjee, D. 1977. Gardening in India. Oxford & IBH Pub., Co., Calcutta.
6. GopalswamyIyyangar. 1970. Complete gardening in India, Kalyan Printers, Bangalore.
7. Rangaswami, G and Mahadevan, A. 1999. Diseases of Crop Plants in India (4th edition). Prentice Hall of India Pvt. Ltd., New Delhi Chahal,
8. G.S and Gosal, S.S. 2018. Principles and Procedures of Plant Breeding Biotechnological and Conventional Approaches, Narosa Publishing House, New Delhi.
9. Singh, B.D. 2013. Plant Breeding: Principles and Methods, Kalyani Publishers, New Delhi
10. Singh, P. 2017. Fundamentals of Plant Breeding, Kalyani Publishers.
11. Chaudhary, R.C. 2017. Introductory principles of plant breeding, Oxford IBH Publishers, New Delhi.

Reference Books :

1. Arditti, A. 1977. Orchid biology, Gornell Univ., Press. Ithaca.
2. Bailey, S. 1971. Perpetual flowering carnation, Fabner and Fabner, London.
3. Laurie, A., Kiplinger, D.D and Nelson, K.S. 1968. Commercial flower forcing. Mc Graw-Hill Book, London.
4. Cumming, R.W. 1964. The chrysanthemum Book. D.Van., Nostrand Inc.
5. Biswas, T.D. 1984. Rose growing – Principles and Practices – Assoc., Pub., Co., New Delhi.
6. Hartman, H.T and Kester, D.E. 1989. Plant propagation. Printice Hall Ltd., New Delhi.
7. Abraham, A and Vatsala, P. 1981. Introduction to Orchids. Trop. Bot. Garden, Trivandrum.
8. Bose, T.K and Yadav, L.P. 1989. Commercial flowers. Naya Prakash, Calcutta. Mc Daniel, G.L. 1982. Ornamental horticulture. Reston Publ., London.
9. Helleyer, A. 1976. The Collingridge Encyclopedia of gardening Chartwell Book, Inc., New Jersey.

Web Resources :

1. <https://www.kopykitab.com/Precision-Horticulture-by-Archarya-SK>
2. <https://www.ebooks.com/en-us/subjects/science-horticulture-ebooks/423/>
3. <http://www.agrimoon.com/horticulture-icar-ecourse-pdf-books/>
4. <https://www.worldcat.org/title/handbook-of-horticulture/oclc/688653648>
5. <https://cbseportal.com/ebook/vocational-books-horticulture>
6. <http://www.digitalbookindex.org/search/search010agriculhortigardena.asp>

SEMESTER – V
CORE PAPER - X

Hours : 5 Credits : 5 Code :

CELL BIOLOGY, GENETICS AND EVOLUTION

Learning Objectives	Course Outcome
To enable students to gain insights into cell wall organization and its functions.	Enumerate the structure and functions of cells, cellular structures and organelles
To familiarize with various cell organelles and their functions.	Explain about cell cycle, cell division
To gain knowledge in classical genetics	Elucidate concepts of laws of inheritance with suitable examples sex determination and sex linked inheritance
To know about sex linked inheritance	Analyze the importance of genes interactions at population and evolutionary levels
To know the basic evolutionary concepts and its theories.	Familiarize with the origin of life and its evolutionary concepts.

Unit I

Introduction- scope- cell organisation- Ultra structure of Prokaryotic cell and Eukaryotic cell. Plant cell structure and function. Cell boundaries- cell wall- gross layer i.e. middle lamella, primary wall, secondary wall- Structure, chemistry and functions of cell wall, pits- (simple and bordered), Plasmodesmata. Plasma membrane- occurrence, structure (fluid mosaic model) chemistry, function and origin. Properties of Cytoplasm Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

Unit II

Occurrence, structure, function and origin of Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Mitochondria, Chloroplast and Micro bodies. Semi genetic autonomy of Mitochondria and Chloroplast. Ultrastructure and functions of Nucleus, nuclear envelope, nuclear pore complex, nucleolus, chromosomes structure molecular organization of chromatin, Euchromatin, heterochromatin, Polytene and Lampbrush chromosomes-, Centromere: types. cell inclusion. Cell cycle, Cell division, Mitosis and Meiosis- their significance.

Unit III

Mendelian genetics–monohybrid, dihybrid crosses. Laws of Mendel, Reciprocal cross - Back cross and Test cross. Incomplete dominance - *Mirabilis jalapa*. Interaction of factors–Complementary genes, Supplementary genes, inhibitory genes, epistasis (dominant and recessive), duplicate genes and multiple alleles. Multiple alleles. ABO Blood grouping in Human. Chromosome theory of linkage, crossing over, recombinations and mapping of genes on chromosomes. Sex determination in plants.

Unit IV

Sex linked inheritance–Haemophilia and colour blindness. Polyploidy origin, types and significance. Mutation-types and significance. Chromosomal aberration–addition, deletion, inversion, duplication and translocation . Extra nuclear inheritance and its significance-Male sterility incorn, Maternal inheritance–Plastid Inheritance in *Mirabilis jalapa*. Population genetics–Hardy–Weinberg principle.

Unit V

An elementary account on origin of life, evolutionary concepts in explaining the diversity of life forms. Theories of Lamarck, Charles Darwin, Hugo de Vries and Modern synthetic theories.

Recommended Texts :

1. Verma, P.S and V.K. Agarwal. 2002. Cytology. S. Chand & Co. Ltd., New Delhi-55.
2. Sinnott, E.W., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi.
3. Cohn.N.S.1979, Elements of Cytology, Freeman Book Co.
4. Singh, R. J. 2016. Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA.
5. Singh, R.J. 2017. Practical Manual on Plant Cytogenetics. CRC Press, Boca Raton, Florida, USA.

Reference Books :

1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York.
3. Hackett, P.B., Fuchs, J.A and Messing, J.W. 1988. An Introduction to Recombinant. DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/Cummings Publishing Co. Inc., Menlo Park, California.
4. Cooper, G.M and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C. Sinauer Associates, MA.
5. Becker, W.M., Kleinsmith, L.J., Hardin. J and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
6. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.
7. Lewin. 2007. Gene IX. Jones and Barlett Pub. ISBN. O 7637 52223.
8. Strickberger, M.W. 1999.Genetics.Prentice Hall of India Pvt Ltd, New Delhi.

Web Resources :

1. <http://www.freebookcentre.net/Biology/Cell-Biology-Books.html>
2. <https://www.us.elsevierhealth.com/medicine/cell-biology>
3. <https://www.amazon.in/Cell-Biology-Thomas-D-Pollard-ebook/dp/B01M7YAL2A>
4. http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html
5. <https://www.us.elsevierhealth.com/medicine/genetics>
6. <https://libguides.uthsc.edu/genetics/ebooks>
7. <https://www.kobo.com/us/en/ebook/principles-of-plant-genetics-and-breeding>
8. <http://sharebooks.com/content/plant-breeding-ebooks-raoul-robinson>

SEMESTER – V
CORE PAPER - XI
CORE PRACTICAL PAPER – III

Hours : 5

Credits : 5

Code :

Practical Covering

Core Paper VIII

- Taxonomy

Core Paper IX

- Horticulture
- Plant Breeding

Core Paper X

- Cell Biology
- Genetics
- Evolution

Discipline Specific Elective III

- Morphology
- Economic Botany

SEMESTER – V
DISCIPLINE SPECIFIC ELECTIVE - III
MORPHOLOGY AND ECONOMIC BOTANY

Hours : 5
Credits : 3
Code :

Learning Objectives	Course Outcome
Students will have extensive knowledge of the morphology of flowering plants.	Familiarize the concepts in angiospermic habitat and its morphology
Students will know about the vegetative structures	Elucidate the structure of vegetative parts and their modifications.
To know the characteristic features of the floral parts.	Familiarize with the reproductive morphology of angiosperms.
Understand major evolutionary trends of floral characters in Angiosperms	Analyze the floral parts and construct the floral diagram.
To know the economic importance of selected plants	Describe the core concepts of economic Botany and relate its applications in human life

Unit I

Introduction; Habit-Types; Life span; Habitat; Vegetative morphology –Root system – Characteristic features, Regions of root; Types of roots, Functions, Modification of roots- Tap root (Conical, Napiform, Fusiform); Fibrous root (tuberous, Nodulose, Moniliform, fasciculated and annulated); Adventitious root (Prop root, Stilt root, Aerial root, Climbing root, Respiratory root, Parasitic root, Assimilatory root, Foliar root, Floating root and Root buttress).

Unit II

Shoot system - Characteristic features, Buds - Terminal, Axillary and Adventitious buds-modifications; Stem modifications –aerial (Phylloclade, cladode, tendril, thorn, hook), sub aerial (runner, sucker, offset, stolon), underground (rhizome, corm, bulb, tuber); Leaf –Parts, Venation, Types of leaves -simple and compound. Modification of leaf (tendrils, spines, hooks, scales, storage leaf, insectivorous leaf, foliar leaf), Phyllotaxy

Unit III

Reproductive Morphology - Inflorescence, Types - Racemose, Cymose, Mixed and Special types; Flower- Monoecious, Dioecious, Polygamous, floral symmetry; Calyx, Corolla, Perianth; aestivation.

Unit IV

Androecium –Structure and Types (Adelphy, Epipetalous, Syngenesious, Gynostegium, Pollinia, Didynamous, Tetradynamous); Gynoecium –Parts –Syncarpous and Apocarpous, Gynobasic style; Androphore, Gynophore and Gynandrophore, Placentation. Fruit –Definition and types. Construction of floral diagram and floral formula- *Crotolaria*, *Catharanthus*, *Phyllanthus* and *Oryza*.

Unit V

Origin, morphology, Processing & Uses of Cereals –Rice; Millets –Ragi; Legumes –Cowpea; Sugars & Starches –Sugarcane and Sago; Spices –Cardamom, Clove and Pepper. Origin, morphology, processing & uses of Beverages - Tea and Coffee; Essential Oils - Lemon grass; Oil – Groundnut and Sesame; Rubber (*Hevea*) - tapping, processing and uses. Timber plants - Teak and Mahogany. Fibers - Cotton and Jute.

Recommended Texts :

1. Lawrence, G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad.
2. Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi
3. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. The MacMillan Co-collier-MacMillan Ltd., London.
4. Solbrig, O.T and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-WesleyPublishing Co. Ind USA.
5. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
6. Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey.
7. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.
8. Pandey, B. P. (1989). Taxonomy of Angiosperms (Systematic Botany). S. Chand & Co. Ltd.,
9. Ram Nagar, New Delhi.
10. Vashista, P.C. (1997). Taxonomy of Angiosperms. S. Chand & Co., New Delhi.
11. Palaniappan, S. (2000). AngiospermgalinVagaippadu (in Tamil), V.K Publishing House,
12. Chennai. 6.
13. Palaniappan, S. (2002). ThavaraPuraamaippial (in Tamil), V.K Publishing House, Chennai.

Reference Books :

1. Hutchinson, J. 1973. The Families of Flowering plants , Oxford University press, London.
2. Gamble, J.S., Fisher, L.E.F.1967. The Flora of The presidency of Madras (Vol-III) BSI,
3. Calcutta
4. Davis, P.H and Heywood, V.M. 1965. Principles of Angiosperm Taxonomy, Oliver and
5. Boyd Edinburgh.
6. Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York.
7. Harborne, J.B and Turner, B.L. 1984. Plant Chemosystematics, Acad. Press, London.
8. Lawrence, G.H. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA.
9. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-Hill Book Co.,New York.

Web Resources :

1. https://books.google.co.in/books/about/Plant_Taxonomy_2E.html?id=_px_WAwHiZIC&redir_esc=y
2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnuC&redir_esc=y
3. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y

4. https://books.google.co.in/books/about/Economic_Botany.html?id=2ahsDQAAQBAJ&redir_esc=y
5. https://books.google.co.in/books/about/Textbook_Of_Economic_Botany.html?id=XmZFJO_JHv8C&redir_esc=y

SEMESTER – VI
CORE-XII
BIOPHYSICS, BIOCHEMISTRY & BIostatISTICS

Hours : 6
Credits : 6
Code :

Learning Objectives	Course Outcome
To learn about the basics of biophysics	Understand the laws of thermodynamics & basics of bioenergetics
To understand the essential instrumentation	Gain knowledge about bioanalytical techniques
To comprehend plant metabolites	Be familiar with the primary and secondary plant metabolites
To understand the structure of proteins and enzymes	Understand the structure and function of nucleic acids, proteins & enzymes
To apply biostatistics for data analysis	Be familiar the fundamentals of Biostatistics

Unit I

BASICS OF BIOPHYSICS : Biophysics – laws of thermodynamics – enthalpy, entropy and free energy. Bioenergetics (ATP) dual nature of light (wave and particulate) – Energy status of atoms - ground, excited, singlet and triplet. De-excitation, heat and light phosphorescence, fluorescence. Biological effects of ionizing radiations.

Unit II

INSTRUMENTATION : pH and its determination - Buffers – Chromatography – principles, uses and types – TLC and HPLC. Basic principles of Colorimetry and Centrifugation. Electrophoresis – AGE and PAGE.

Unit III

PRIMARY & SECONDARY PLANT PRODUCTS : Chemical bonds – primary & secondary, Primary plant products – Carbohydrates: classification, structure and properties of glucose, sucrose and cellulose. Lipids - Fatty acids - classification, saturated and unsaturated fatty acids. Secondary plant products: Alkaloids, Terpenoids, Phenolics and Flavonoids.

Unit IV

NUCLEIC ACIDS, PROTEINS & ENZYMES : Nucleic acids –DNA, RNA (Types and functions). Double helical model of DNA. Satellite DNA. Amino acids – structure, classification and properties. Proteins –classification and structure (primary, secondary, tertiary). Enzyme – properties – classification – nomenclature of enzymes – mode of enzyme action – factors influencing enzyme action.

Unit V

BIOSTATISTICS : Measures of central tendencies – Mean, Median, Mode and Measures of Dispersion - Standard Deviation, Standard Error, Testing of Hypothesis – Simple Definition of Null Hypothesis, t Test, Chi square test.

Recommended Texts :

1. Srivastava, H.S. 1990. Elements of Biochemistry. Rastogi Publications, Meerut, India
2. Narayanan, P. 2000. Essentials of Biophysics. New Age International Publishers(P)ltd., New Delhi, Bangalore, Calcutta, Chennai, Guwahati, Hyderabad, Lucknow, Mumbai
3. Annie & Arumugam, N. 2000. Biochemistry & Biophysics. Saras Publications, Nagercoil, Tamilnadu.
4. Jain J.L. 1979. Fundamentals of Biochemistry. S. Chand & Co., Ltd.
5. Khan & Khanum. Fundamentals of Biostatistics. 1994. Ukaaz publications, India.

Reference Books :

1. Lehninger, A.L. (1984): Biochemistry (2nd Edition). Kalyani Publishers, Ludhiana, New Delhi
2. Stryer, L. (1989) : Biochemistry. W.H. Freeman & Co., New York, San Francisco
3. Casey, E.J. (1969): Biophysics-Concepts and Mechanisms. Van Nostrand Reinhold Co., & Affiliated East West Press (P) Ltd., New Delhi.
4. Plummer, D. (1989) : Biochemistry –the Chemistry of life. McGraw Hill Book Co., London, N.Y. New Delhi, Paris, Singapore, Tokyo
5. Upadhyay A. et al. (2000). Biophysical Chemistry – principles & Techniques.
7. Himalaya publishing house, Delhi.

Web Resources :

1. <https://www.biophysics.org/education-resources>
2. <https://blanco.biomol.uci.edu/WWWResources.html>
3. <https://www.chemweb.com/>
4. <https://chem.libretexts.org/>
5. <https://online.stanford.edu/lagunita-learning-platform>

SEMESTER – VI
CORE PAPER XIII
PLANT PHYSIOLOGY

Hours : 6 Credits : 5 Code :

Learning Objectives	Course Outcome
To relate to water relation of plants with respect to various physiological phenomenon.	Relate to water relation of plants with respect to various physiological phenomenon
To know about the mineral nutrition and its absorption mechanism.	Elucidate properties of nutrients and their deficiency symptoms in plants.
To know the pathways of photosynthesis	Familiarize the process of photosynthesis.
To familiarize with respiration and nitrogen metabolism.	Explain the process and significance of respiration.
To know about plant growth regulators.	Decipher the phenomenon of growth regulators, seed dormancy and germination in plants.

Unit I

WATER RELATIONS: Properties of water—imbibition, diffusion, osmosis and plasmolysis-Ascent of sap- Cohesion and root pressure theories, Mechanism of water absorption – active and passive, apoplast and symplast pathway. Transpiration – types and factors affecting transpiration and significance. Opening and closing of stomata- mechanisms and theories of transpiration. Guttation.

Unit II

Mineral nutrition –role of major & minor elements, mineral deficiency symptoms, Hydroponics, Foliar nutrition, Absorption of mineral salts, Active & Passive Absorption, Translocation of organic solutes, Mass Flow.

Unit III

PHOTOSYNTHESIS: Radiant energy and its role in photosynthesis, Photosynthetic unit, photosynthetic pigments and their role, Emerson Enhancement effect, PS I and PS II, - Light reaction, electron transport system in the chloroplast (Z-Scheme). Dark reaction - C3 cycle, C4 cycle, CAM pathway, Photorespiration (C2)

Unit IV

RESPIRATION : Respiration - respiratory substrates, Aerobic-Glycolysis, Krebs Cycle, Electron Transport System, oxidative phosphorylation, respiratory quotient, Anaerobic- fermentation - Cyanide resistant respiration as alternate pathway its mechanism, significance. Biological Nitrogen fixation and Nitrogen Cycle

Unit V

Growth and Stress Physiology : Plant growth regulatory substances –Auxins, Cytokinins, Gibberellins and ABA. Phytochrome, Photoperiodism. Seed dormancy. Vernalization. Senescence. Plant movements –Geotropism, Phototropism, Thigmotropism. Stress physiology –water stress, temperature stress, salt stress, Plant responses to biotic (pathogen) and abiotic water deficit, salinity, metal toxicity and heat stress.

Recommended Texts :

1. Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Hall, New Delhi.
2. Pandey, SN and Sinha, BK. 1989. Plant Physiology, Vikas Publishing House Ltd., New Delhi.
3. Robert M. Devlin. 1970. Plant Physiology, East West Press, New Delhi.
4. Westhoff, P. 1998. Molecular Plant Development from Gene to Plant. Oxford University Press, Oxford, UK. Jain, JL. 1979. Fundamentals of Biochemistry, Chand & Co. Ltd., New Delhi.
5. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi.
6. Verma, V. 2008. Textbook of plant Physiology, Ane's student edition, New Delhi.
7. Conn, E and Stumpf, PK. 1979. Outline of Biochemistry NileyEasdtern Ltd., New Delhi.
8. Metz, E.T. 1960. Elements of Biochemistry. V.F & S (P) Ltd., Bombay.

Reference Books :

1. Buchanan, B.B., Gruissem, W and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.
2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D and Layzell, D.B. (Eds) 1997. Plant Metabolism (second edition). Longman Essex, England.
3. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.
4. Hooykaas, P.J.J., Hall M.A and Libbenga, K.R. (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands.
5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
6. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York, USA.
7. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA.
8. Salisbury, F.B and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA.
9. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D and Govindjee. 1999. Concepts in Photobiology: Photosynthesis and Photo morphogenesis. Narosa Publishing House, New Delhi.
10. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
11. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego. USA.

Web Resources :

1. [https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-biology-of-](https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-biology-of)
2. <https://www.amazon.in/Plant-Biochemistry-Hans-Walter-Heldt-ebook/dp/B004FV4RS6>
3. <https://www.kobo.com/us/en/ebook/plant-biochemistry>
4. <https://www.kobo.com/us/en/ebook/a-textbook-of-plant-physiology-1>
5. <https://www.amazon.in/Advances-Plant-Physiology-P-Trivedi-ebook/dp/B01JP5L0YA>
6. <https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692>
7. [https://www.amazon.com/Introduction-Plant-Physiology-William-Hopkins-ebook/dp/B006R6I850.](https://www.amazon.com/Introduction-Plant-Physiology-William-Hopkins-ebook/dp/B006R6I850)

SEMESTER – VI
CORE-XIV
PLANT ECOLOGY AND PHYTOGEOGRAPHY

Hours : 5
Credits : 5
Code :

Learning Objectives	Course Outcome
To relate to the significance of the biotic and abiotic components of the ecosystems.	Relate to the significance of the biotic and abiotic components of the ecosystems and energy flow.
To understand the energy flow in ecosystem.	To familiarize with the energy flow and biogeochemical cycles
Understand the importance of biodiversity and conservation.	Analyze the implications of biodiversity and conservation
Develop mitigations for the effective control of pollution and disaster management	To know implication of pollution on the environment and its control measures.
Summarize the phytogeographical division of India.	To familiarize with the phytogeography.

Unit I

Biotic and abiotic factors and their influence on vegetation – a brief account of microbes, plants, animals, soil, wind, light, temperature, rainfall, and fire. Autecology and Synecology – Vegetation – Units of Vegetation – Formation, Association, Consociation, Society – development of vegetation. Migration – ecesis, colonization, 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 II

Structure, trophic organization; food chains and food web, energy flow in an ecosystem. Types of ecosystems: pond, forest and grassland. Ecological pyramids and Biogeochemical cycles of carbon and nitrogen and phosphorus.

Unit III

Biodiversity: Ecosystem, community, species and genetic diversity. Endemism and hotspots, Natural resources and its conservation (*In situ* and *ex situ*).

Unit IV

Pollution: Types of pollution: Primary and secondary and their impacts: Air - Green house effect, global warming, ozone depletion, acid rain, Water, soil-causes and consequences. Remedial measures – Green building. Disaster management.

Unit V

Phytogeography: Introduction, continuous and discontinuous distribution, Phytogeography of India, Vegetational regions of India. Plant indicators. Diversification of land plants. Speciation Changing Earth. Island Biogeography. Plant Biodiversity and its importance. Definition, levels of biodiversity-genetic, species and ecosystem. Biodiversity hotspots- Criteria, Biodiversity hotspots of India. Loss of biodiversity – causes and conservation (*In situ* and *ex situ* methods). Seed banks - conservation of genetic resources and their importance. Consequences of deforestation and exploitation of targeted species; Forest conservation, Social forestry and Participatory Management of Forest. Concept of degeneration and regeneration of plants.

Recommended Texts :

1. Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
2. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India.8th edition.
3. Krishna Iyer.V.R. 1992. Environmental protection and legal defence. Sterling Publishers Pvt. Ltd.,
4. Shukla, R.S and Chandel,PS.1990. Plant Ecology, S.Chand & Co. Pvt. Ltd.,
5. Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity - Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications.

Reference Books :

1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
3. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd.,
4. Smith,W.H. 1981. Air pollution and forest : Interactions between air contaminants and forest ecosystems.
5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons.
6. Melchias, G., 2001. Biodiversity and Conservation, Science Publishers Inc. USA.
7. Asthana, D.K and Meera Asthana. 2006. A text book of Environmental studies. S.Chand and Company Ltd. New Delhi.
8. Brian Groombridge. 1992. Global Biodiversity, Chapman and Hall, UK.
9. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland.
10. Ambasht, R.S. 2017. A textbook of plant ecology 15ed (pb 2019). CBS Publishers Distributors.

Web Resources :

1. . <https://www.kobo.com/us/en/ebook/plant-ecology-3>.
2. <https://www.worldcat.org/title/plant-ecology/oclc/613206385>
3. https://books.google.co.in/books/about/Plant_Ecology.html?
4. https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP_5.
<http://www.freebookcentre.net/Biology/Ecology-Books.html>
5. <https://www.amazon.in/Plant-Ecology-Ernst-Detlef-Schulze/dp/354020833X>

6. <https://www.tandfonline.com/toc/tped20/current> (Plant Ecology and Diversity)
7. <https://link.springer.com/journal/11258> (Plant Ecology)

SEMESTER – VI
CORE PAPER - XV
CORE PRACTICAL PAPER – IV

Hours : 6

Credits : 5

Code :

Practical Covering

Core Paper XII

- Biophysics
- Biochemistry
- Biostatistics

Core Paper XIII

- Plant Physiology

Core Paper XIV

- Plant Ecology
- Phytogeography

Discipline Specific Elective IV

- Plant Biotechnology

SEMESTER – VI
DISCIPLINE SPECIFIC ELECTIVE- IV
PLANT BIOTECHNOLOGY

Hours : 5
Credits : 3
Code :

Learning Objectives	Course Outcome
To know various aspects of biotechnology and basic techniques.	Recognize the fundamentals concepts of plant biotechnology and genetic engineering.
To familiarize with the gene transfer techniques.	Explain various techniques in gene cloning.
To know the concept and techniques of gene transfer in detail.	Elucidate gene cloning and evaluate different methods of gene transfer.
To know the concept, techniques and applications of plant tissue culture.	Analyze the major concerns and applications of transgenic technology.
To familiarize with the conservation of genetic resources and applications of biotechnology in various fields.	Develop their competency on different types of plant tissue culture.

Unit I

Biotechnology – definition, history and scope. Gene cloning : Enzymes involved in Gene cloning, Nucleases- Exonucleases and endonucleases, modifying enzymes and ligases. Vectors-Plasmid vectors – pBR322, pUC18; Cosmid, BAC .

Unit II

Cloning vectors, shuttle vectors and expression vectors – plant expression vectors. Promoters, Selection Markers, Reporter genes. Genetic engineering in plants: Methods of transformation -. Direct DNA transfer - Particle bombardment, electroporation and micro injection.

Unit III

Indirect method - Agrobacterium and crown gall tumours. Ti-plasmid vectors for plant transformation – Mechanisms of T DNA transfer to plants. *Agrobacterium* mediated transformation.

Unit IV

Plant tissue culture - introduction, scope and importance, concept of totipotency, aseptic techniques in plant tissue culture. Composition of media, types of media, sterilization, explant preparation and inoculation. Callus induction and micropropagation. Application of plant tissue culture in agriculture, horticulture and forestry. Synthetic seed technology.

Unit V

Conservation of plant genetic resources – Gene banks – Cryopreservation – Germplasm Conservation –Application of Genetically Modified Organisms (Fruits, Vegetables, Crops and

Cereals) –Application of plant biotechnology in various fields. Agriculture, Medicine – Antibiotics ,Recombinant vaccines, Environment – Bioremediation and Biofuel. Industry – ethanol production (yeast). Transgenicplants - Pros and cons of GM food.

Recommended Texts :

1. Brown. T.A, Gene Cloning And DNA Analysis: An Introduction, 8th Edition , 2020, Wiley Blackwell Publications
2. Bhojwani, S and Razdan, 1984. Plant tissue culture. Theory and practice.
3. Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford & IBH Publishing, New Delhi.
4. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd.
5. Purohit, S.S. 2010. Plant tissue culture, Student edition, Jodhpur.
6. Bajaj, Y.P.S. 1987. Biotechnology in agriculture and forestry. Springer – Verlag

Reference Books :

1. Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology-principles and applications of recombinant DNA, (2nd Edition), ASM Press, Washington, D.C.
2. Jogdand, SN. 1997. Gene biotechnology, Himalaya Publishing House, New Delhi.
3. Ernst L. Winnaccker. 2002. From Genes to Clones-introduction to gene technology, VCR Pub., Weintein.
4. James, D Watson et al., 1992. Recombinant DNA (2nd Edition), WH Freeman and Co., New York.
5. Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol.I, II & III, Coldspring Harbor Laboratory Press, New York.
6. Old, RW and Primrose, SB. 2001. Principles of Gene Manipulation-an introduction to genetic engineering, Black Well Science Ltd., New York.
7. Halder, T and Gadgil, V.N.1981. Plant cell culture in crop improvement. Plenum, New York.
8. Neuman, K.H., Barz, W and E. Reinhard. 1985. Primary and secondary metabolism of plant cell cultures – Springer – Verlag, Berlin.
9. Barz, W., Reinhard, E and Zenk, M.H. 1977. Plant tissue culture and its biotechnology application – Springer – Verlag, Berlin.
10. Hu, C.Y and P.J.Wang. 1984. Handbook of plant cell culture Vol.1. Mac million, New York.
11. Hammond, J.C. McGarvey and V. Yusibov. 2009. Plant Biotechnology, Springer Verlag. New York.

Web Resources :

1. <http://www.freebookcentre.net/Biology/BioTechnology-Books.html>
2. https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.html?id=RgQLISN8zT8C
3. <https://www.kobo.com/us/en/ebook/plant-biotechnology-1>
4. <https://www.kobo.com/us/en/ebook/plant-biotechnology-1>
5. <https://www.worldcat.org/title/molecular-biology/oclc/1062496183>
6. <http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html>
7. <https://www.amazon.in/Molecular-Biology-Multicolour-Verma-Agarwal-ebook/dp/B06XKVVWT3>

SEMESTER – VI
NON MAJOR ELECTIVE – I
PRINCIPLES OF GARDENING

Hours : 2 Credits : 1 Code :

Learning Objectives	Course Outcome
To know about the fundamental concepts of gardening and landscaping.	Recognize fundamental concepts of gardening and landscaping
To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.	Explain about significance of garden adornments and propagation structures.
To illustrate the significance of garden adornments and propagation structures.	Apply techniques of landscaping for aesthetic purposes and gardening for recreation.
To inculcate entrepreneurial skills in students for creative landscaping design using CAD software.	Distinguish between formal, informal and free style gardens and their applications
To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.	Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.

Unit I

Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden, etc. Special types of gardens, their walk-paths, bridges, constructed features. Greenhouse. Special types of gardens, trees, their design, values in landscaping, propagation, planting shrubs and herbaceous perennials. Importance, design values, propagation, plating, climbers and creepers, palms, ferns, grasses and cacti succulents.

Unit II

Flower arrangement: importance, production experiments and cultural operations, constraints, postharvest practices. Bioaesthetic planning, definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds.

Unit III

Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parks and public gardens. Landscape designs, Styles of garden, formal, informal and free style gardens, types of gardens, Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, damsites, IT parks, corporate.

Unit IV

Establishment and maintenance, special types of gardens, Bio-aesthetic planning, ecotourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.

Unit V

Computer Aided Designing (CAD) for outdoor and indoorscaping Exposure to CAD (Computer Aided Designing).

Recommended Texts :

1. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd.
2. Rao Manibhushan K. 1991. Textbook of horticulture. MaC Millan India Ltd.
3. Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, New Central Book Agency
4. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.
5. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.

Reference Books :

1. Berry, F. and Kress, J. 1991. Heliconia: An Identification Guide . Smithsonian Books.
2. Butts, E. and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd.
3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides).
4. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd.
5. EdmentSenn Andrews. 1994. Fundamentals of Horticulture.Tata. McGraw Hill Publishing Co., Ltd., Delhi.

Web Resources :

1. https://www.amazon.in/Gardening-Landscape-Design-and-Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Garden
2. <https://www.overdrive.com/subjects/gardening>
3. [https://www.scribd.com/book/530538456/Opportunities-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Career s.](https://www.scribd.com/book/530538456/Opportunities-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Career-s)
4. <https://www.scribd.com/book/305542619/Botanic-Gardenshttps://www.overdrive.com/subjects/gardening>

SEMESTER – III
NON MAJOR ELECTIVE – I
MEDICINAL BOTANY

Hours : 2
Credits : 2
Code :

Learning Objectives	Course Outcome
To understand the nuances of medicinal plants and their phytoconstituents of commercial value	Define and describe the principle of cultivation of herbal products.
To design and develop medicinal garden.	Explain about the phytochemistry of economically important medicinal herbs
To apply the knowledge to cultivate medical plants.	Apply techniques for evaluation of drug adulteration through biological testing.
To know the pharmacological importance of medicinal plants.	Formulate the value added processing / storage / quality control for the better use of herbal medicine.
To enlist phytochemicals and secondary metabolites of market and commercial value.	Develop the skills for cultivation of plants and their value added processing/storage/quality control.

Unit – I

Traditional systems of medicine – Siddha, Unani and Ayurveda - Scope and Applications of Herbal Medicine.

Unit – II

Identification ,Collection and storage of medicinal plants - Cultivation of medicinal plants in small scale(pots, garden),in large scale (farms),Cultivation of medicinal plants ex-situ (in Hills, Plains) and *in-situ*.

Unit – III

Botanical description of Medicinal plants containing Glycosides – (*Aloe vera*), Tannins (Amla), Lipids (Olive Oil), Terpenoids (Eucalyptus Oil),Protein (Lectins) and Alkaloids (*Vinca*).

Unit – IV

Herbal medicinal formulations, Medicinal plants of export values; TRIP, Adultration and detection.

Unit – V

Herbal Cosmetics for skin care, hair care and oral care.

Recommended Texts :

1. Jain S.K. (1989) Methods and approaches in Ethnobotany, Society of Ethnobotanists, Luknow.
2. Pal D.C. and Jain S.K. (1998) Tribal Medicine. Naya Prakash Publishers, Calcutta.
3. Shukla RS (2000) Forestry for Tribal Development. AH Wheeler & Co., Ltd., India.

Reference Books :

1. Sharol Tilgner N.D. (1999). Herbal Medicine – From the heart to the Earth. Printed in the USA, by Malloy Lithographing Inc.
2. Kumar N.C. (1993) Introduction to Medical Botany and Pharmacognosy. Emkay Publications, Delhi.

Web Resources :

1. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu
2. <https://www.springer.com/gp/book/9783540791157>
3. <https://www.gpatonline.com/gpat/book-reference-pharmacognosy>
4. https://www.researchgate.net/publication/334670695_Book_review-Herbal_Drug_Technology
5. <http://www.eurekaselect.com/node/173492/herbal-medicine-back-to-the-future>

SEMESTER – V
NON MAJOR ELECTIVE - II
PRINCIPLES OF GARDENING

Hours : 2 Credits : 1 Code :

Learning Objectives	Course Outcome
To know about the fundamental concepts of gardening and landscaping.	Recognize fundamental concepts of gardening and landscaping.
To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning	Distinguish between formal, informal and free style gardens and their applications
To illustrate the significance of garden adornments and propagation structures	Explain about significance of garden adornments and propagation structures
To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping	Apply techniques of landscaping for aesthetic purposes and gardening for recreation
To understand the techniques involved in Bonsai cultivation and its management.	Appraise the importance of Bonsai cultivation.

Unit I

Importance, scope and classification of Horticulture, Garden Implements, Growth regulators used in Horticulture, Cultivation practices of horticultural crops – Banana and Guava.

Unit II

Importance and types of garden – Formal and Informal. Lawn – Grasses used, Establishment and maintenance, Topiary.

Unit III

Plant propagation methods – Cutting - Stem, Layering - simple, Grafting - wedge and Budding - chip.

Unit IV

Gardening and landscaping – preparation of soil, manuring, irrigation, pest control

Unit V

Bonsai – introduction, Types, containers, training, pruning, watering, manuring. Managing pests and diseases.

Recommended Texts :

1. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd.
2. Manibhushan Rao K. 1991. Textbook of horticulture. MaC Millan India Ltd.
3. Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, New Central Book Agency
4. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.

5. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.
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