G. VENKATASWAMY NAIDU COLLEGE (AUTONOMOUS),

(Re-Accredited with 'A' grade by NAAC| DBT Star College Scheme)

(Affiliated to M.S.University, Tirunelveli)

KOVILPATTI – 628 502.

Department of BOTANY

MASTER OF SCIENCE

BOARD OF STUDIES

for the candidates admitted from the Academic Year 2023-2024 and onwards

Under CBCS PATTERN

Approved by the Board of Studies on _____

G. VENKATASWAMY NAIDU COLLEGE KOVILPATTI.

(Autonomous Institution)

(Re-Accredited by NAAC with 'A' Grade)

Department of Botany

(For those admitted from the academic year 2023-2024 and onwards)

Vision

Provision of knowledge to contribute towards the sustainable utilization of Plant Biosphere

Mission

- To foster an environment of excellence by providing a comprehensive set of courses in plant sciences that enhances the understanding, depth of knowledge and technical competency of the students.
- To provide the students competence for entry-level research and teaching positions in biological sciences.
- To inculcate the students with an environment that fosters the development of appropriate scientific vocabulary, reasoning skills, and effective oral and written communication abilities for students.
- To create a holistic understanding of the allied subjects through interdisciplinary

Programme Outcomes - (PO) (Aligned with Graduate Attributes)

At the completion of the Postgraduate Programme, the student will be able to accomplish the following outcomes:

GPO No.	Programme Outcomes
PO1	**Critical Thinking:** Ability to engage in independent and reflective thinking in order to understand logic connections between ideas.
PO2	**Effective Communication:** Development of communication skills for effectively transmitting and receiving information that focuses on acquiring knowledge, problem solving, improving on arguments and theories thereby paving the way for better employability and entrepreneurship.
PO3	**Social Consciousness:** Acquire awareness towards gender, environment, sustainability, human values and professional ethics and understand the difference between acting, responding and reacting to various social issues.
PO4	**Multidisciplinary Approach:** Combining various academic disciplines and professional specializations to cross borders and redefine problems in order to explore solutions based on the new understanding of complex situations.
PO5	**Subject Knowledge:** Acquiring knowledge at a higher level that would help develop the necessary skills, fuel the desire to learn and contribute to the field of expertise

	thereby providing valuable insights into learning and professional networking with the aim of catering to the local, national and global developmental needs.
PO6	**Lifelong Learning:** Understanding the necessity of being a lifelong learner for personal enrichment, professional advancement and effective participation in social and political life in a rapidly changing world.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The objectives of this Programme is to equip/prepare the students

GPO No.	Programme Educational Objective
PEO1	Graduates of the program will develop competent knowledge in basic Plant science required for continuous learning and research.
PEO2	Graduates will develop diversified basic professional skills through various Laboratory technical training, communication and presentation skills.
PEO3	Graduate will possess an ability to identify, formulate, and solve Plant problems to contribute to service efforts to community in both the professional and private realm.
PEO4	Gradates will integrate related topics from separate parts of the course such as levels of plant organization, cell biology, ecology, evolution, biochemistry, biotechnology, physiology, molecular biology, and taxonomy for successful career.
PEO5	Graduates will be proficient to assess the scope of plant science, appreciate the complexities of biological organization and address scientifically controversial issues in a rational way

PROGRAMME SPECIFIC OUTCOMES (PSO)

At the completion of the Undergraduate Programme, the student will be able to accomplish the following outcomes:

PSO No.	Intended Programme Specific Outcomes
PSO1	To prepare the students who will demonstrate respectful engagement with others' ideas, behaviours, beliefs and apply diverse frames of reference to decisions and actions.
PSO2	To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate start-ups and high potential organizations.
PSO3	Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.

GRADUATE ATTRIBUTES

1. Clear, comprehensive, Skill in practical work, experiments, use of biological tool and techniques and advanced mastery in the field of Botany.
2. Understand Proficiency in the use of recent advanced biological technologies, advanced areas of biological sciences with special reference to Botany and its applied branches.
3. Confidence to apply the acquired knowledge in practical life, ensure the implementation of a holistic pedagogical model in botany so as to make our country self-reliant.
4. To mould a responsible citizen who is aware of most basic domain-independent Knowledge, including critical thinking and communication.
5. To enable the graduate prepare for national as well as international competitive Examinations, especially UGC-CSIR NET and UPSC Civil Services Examination
6. The students would learn the use of the new technologies used in learning biology, digital platforms for fast transfer of information. Students will acquire digital skills and integrate the fundamental concepts with modern tools.
7. To demonstrate good working knowledge in the use of computers and able to upgrade skills by independent life long learning via e-learning resources.
8. The vast and deep knowledge of the subject, analytical and scientific reasoning, effective communication and problem solving task develop special qualities in a person to attract and influence the audience, which would be gained after the completion of this course. Students are expected to be familiar with decision making process and basic managerial skills to become a better leader.

DEPARTMENT OF BOTANY
Programme Structure for M.Sc(Botany)
(For those admitted from the academic year 2023-24 and onwards)

Course Type	Course code	Course Title	Contact Hrs.	Exam Hrs.	Marks			Credit
					CIA	ESE	Total	
Semester: I								
Core :1	P23BO101	Plant Diversity - I: Algae, Fungi, Lichens and Bryophytes	7	3	25	75	100	5
Core : 2	P23BO102	Plant Diversity - II: Pteridophytes, Gymnosperms and Paleobotany	7	3	25	75	100	5
Core -3 (Core Lab – 1)	P23BO1P1	Plant Diversity I & II	6	3	40	60	100	4
Elective - I	P23BO1E1A	Microbiology, immunology and Plant Pathology	5	3	25	75	100	3
	P23BO1E1B	Conservation of natural resources and policies						
	P23BO1E1C	Mushroom Cultivation						
	P23BO1E1D	Phytopharmacognosy						
Elective -II	P23BO1E2A	Algal Technology	5	3	25	75	100	3
	P23BO1E2B	Ethnobotany, naturopathy and Traditional Healthcare						
	P23BO1E2C	Horticulture						
	P23BO1E2D	Herbal Technology						
Comprehension – I (Online Exam)	P23BO1C1	Comprehension in Botany – I	-	-	-	50	50	1
Ability Enhancement	P23AE101	Cyber Security	-	-	-	50	50	2
NPTEL (Self Study Course – online – To be completed within 4 semester)								1
			30				**600**	**24**
Semester-II								
Core-4	P23BO204	Taxonomy of Angiosperms and Economic Botany	5	3	25	75	100	4
Core -5	P23BO205	Plant Anatomy and Embryology of Angiosperms	5	3	25	75	100	4
Core -6	P23BO206	Ecology, phytogeography,	5	3	25	75	100	3

		Conservation Biology and Intellectual property rights						
Core Lab - II	P23BO2P2	Core Practical Covering Core 4, 5 & 6	6	3	40	60	100	3
Elective- III	P23BO2E3A	Medicinal Botany	3	3	25	75	100	3
	P23BO2E3B	Photochemistry						
	P23BO2E3C	Research methodology, computer applications & bioinformatics						
	P23BO2E3D	Bio pesticide Technology						
Elective- IV	P23BO2E4A	Applied Bioinformatics	3	3	25	75	100	3
	P23BO2E4B	Biostatistics						
	P23BO2E4C	Intellectual Property Rights						
	P23BO2E4D	Nanobiotechnology						
Skill enhancement (SE1)	P23BO2SE1	Agriculture and Food Microbiology	3	3	25	75	100	2
Comprehension - 1(Self Study Course- Online Exam)	P23BO2C2	Comprehension in Botany - II	-	-	-	50	50	1
Ability Enhancement	P232AE202	Teaching Skill	-	-	50		50	1
Institutional Training	P23BO3IT	Institutional Training / Minor Project	-	-	-	-	-	-
			30				**800**	**24**

Core – I PLANT DIVERSITY – I: ALGAE, FUNGI, LICHENS AND BRYOPHYTES – P23BO101

Lecture Hours	**: 100**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 5**
Contact Hours per Semester: 105			
Contact hours per Week	**: 7**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.
- To gain knowledge about the ecological and economic importance of algae, fungi, lichens and bryophytes.
- To spark interest in the evolutionary roots of plant development.
- To study the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms.
- To expose the beneficial and harmful view point.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO 1: Relate to the structural organizations of algae, fungi, lichens and Bryophytes.

CO 2: Demonstrate both the theoretical and practical knowledge in understanding the diversity of basic life forms and their importance.

CO 3: Explain life cycle patterns in algae, fungi, lichens and Bryophytes.

CO 4: Compare and contrast the mode of reproduction in diverse groups of basic plant forms.

CO 5: Discuss and develop skills for effective conservation and utilization of lower plant forms.

Mapping with Programme Outcomes:

COs	Program Outcomes (Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	2	2	2
CO2	3	3	2	2	3	3	3	2	3
CO3	2	2	3	3	1	2	3	1	3
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	2	3	2	3	3	3	3
Total Contribution of COs to POs	14	14	12	14	11	11	14	11	14
Weighted Percentage of COs contribution to POs	93.33	93.33	80.00	93.33	73.33	73.33	93.33	73.33	93.33

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

COURSE CONTENTS

UNIT I – ALGAE (L 20 + T-1 Hours)

General account of algology, Contributions of Indian Phycologist (T.V.Desikachary, V.Krishnamurthy, M.O.P. Iyengar and V.S. Sundaralingam), Classification of algae by F.E. Fritsch (1935-45) & Silva (1982). Salient features of major classes: Cyanophyceae, Chlorophyceae, Xanthophyceae, Chrysophyceae, Cryptophyceae, Dinophyceae, Chloromonadineae, Euglenophyceae, Charophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Range of thallus organization, algae of diverse habitats, reproduction (vegetative, asexual and sexual) and life cycles. Phylogeny and inter-relationships of algae, origin and evolution of sex in algae.

Structure, reproduction and life histories of the following genera: *Oscillatoria*, *Scytonema, Ulva, Codium, Diatoms, Dictyota* and *Gelidium.*

UNIT II - FUNGI (L 20 + T-1 Hours)

General Characteristics, occurrence and distribution. Mode of nutrition in fungi. Contributions of Indian Mycologists (C.V.Subramanian), Classification of Fungi by Alexopoulos and Mims (1979) & Recent trends in the classification of fungi - Phylogeny and inter-relationships of major groups of fungi.

General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.

Heterothallism in fungi, sexuality in fungi, Para sexuality, sex hormones in fungi. Structure, reproduction and life histories of the following genera: *Plasmodiophora, Phytophthora, Rhizopus, Taphrina, Polyporus* and *Colletotrichum.*

UNIT – III LICHENS: **(L 20 + T-1 Hours)**

Introduction and Classification (Hale, 1969). Occurrence and inter-relationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basiodiolichens and Deuterolichens.

UNIT – IV BRYOPHYTES: (L 20 + T-1 Hours)

General characters and Classification of Bryophytes by Watson (1971). Distribution, Structural variations and evolution of gametophytes and sporophytes in Bryopsida, Anthoceropsida and Mosses. General characters of major groups - Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Reproduction - Vegetative and sexual, spore dispersal mechanisms in bryophytes, spore germination patterns in bryophytes.

Structure, reproduction and life histories of the following genera: *Targionia, Lunularia, Porella* and *Polytrichum.*

UNIT – V ECONOMIC IMPORTANCE: (L 20 + T-1 Hours)

Algae - Economic importance in Food and feed - Single cell protein, Industrial products (Agar-Agar, Carrageenan, Alginic acid, Iodine, biofertilizers, Vitamins and biofuel), Medicinal value and Diatomaceous earth. Fungi – Economic importance in food, industries and medicine. Culturing and cultivation of mushrooms Pleurotus. Lichen –economic importance and as indicator pollution. Bryophytes – Ecological and economic importance – industry, horticulture and medicine.

Recommended texts:

1. Kumar, H.D.1999. Introductory Phycology. Affiliated East-WestPress,Delhi.

2. Barsanti, L. and Guadtieri, P. 2014. Algae: Anatomy, Biochemistry and Biotechnology, 2nd Edition, CRC Press, ISBN: 1439867321.

3. Sharma, O.P. 2011. Fungi and Allied Microorganisms, Mc Graw Hill, ISBN:9780070700383, 0070700389

4. Kevin K. 2018. Fungi biology and Application, 3rd Edition, Wiley Blackwell.

5. Pandey, P.B. 2014. College Botany-1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.

6. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
7. Sharma, O.P. 2014. Bryophyta, Mcgraw Hill, ISBN: 9781259062872, 1259062872

Reference Books:

1. Sundaralingam, V. 1991. Marine algae. Bishen Singh and Mahendra Pal Singh Publishers, Dehradun.
2. Edward lee, R.E. 2018. Phycology, 5th Ed., Cambridge University Press, London.
3. Nash, T.H. 2008. Lichen Biology, Cambridge University press.
4. Johri, R.M., Lata, S. and Tyagi, K. 2012. A Textbook of Bryophyta. Dominant Publishers & Distributors Pvt., Ltd., New Delhi. ISBN: 9789384207335.
5. Alexopoulos, C.J. and Mims, M. 2007. Introductory Mycology. 4th Edition, Wiley Publishers,ISBN: 9780471522294

Web resources:

1. https://www.britannica.com/science/algae
2. https://en.wikipedia.org/wiki/Bryophyte
3. https://www.britannica.com/plant/bryophyte/Ecology-and-habits
4. https://www.livescience.com/53618-fungus.html.
5. http://www.uobabylon.edu.iq/eprints/paper_11_20160_754.pdf
6. https://www.youtube.com/watch?v=vcYPI6y-Udo
7. https://www.youtube.com/watch?v=XQ_ZY57MY64
8. http://www-plb.ucdavis.edu/courses/bis/1c/text/Chapter22nf.pdf

Core – II PLANT DIVERSITY – II (PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY) – P23BO102

Lecture Hours	**: 100**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 5**

Contact Hours per Semester: 105

Contact hours per Week : 7

Internal Marks : 25

External Marks : 75

Total Marks : 100

Objective of the Course

- To investigate the classification, distinctive traits,distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms.
- To identify and characterize diversity of lower vascular plants in order to comprehend the dynamics of diversity to realize the importance of diversity.
- To research the classification, phylogeny and economic importance of Pteridophytes and Gymnosperms.
- To study and understand the phylogeny and Paleontology of Pteridophytes and Gymnosperms.
- To learn about the concept of fossils and process of fossilization; distinctive characteristics of fossil records of Pteridophytes and Gymnosperms.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1: Recall on classification, recent trends in phylogenetic relationship, General characters of Pteridophytes and Gymnosperms.

CO2 : Learn the morphological/anatomical organization, life history of major types of Pteridophytes and Gymnosperms.

CO3 : Comprehend the economic importance of Pteridophytes, Gymnosperms, and fossils.

CO4 : Understanding the evolutionary relationship of Pteridophytes and Gymnosperms.

CO5 : Awareness on fossil types, fossilization and fossil records of Pteridophytes and Gymnosperms.

Mapping with Programme Outcomes:

COs	Program Outcomes (Pos)						Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	1	2	2	2
CO2	3	3	2	2	3	3	3	2	3
CO3	2	2	3	3	1	2	3	1	3
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	2	3	2	3	3	3	3
Total Contribution of COs to POs	14	14	13	14	14	12	12	14	12
Weighted Percentage of COs contribution to POs	93.33	93.33	86.67	93.33	93.33	80.00	80.00	93.33	80.00

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

COURSE CONTENTS

UNIT I

PTERIDOPHYTES: **(L 20 + T-1 Hours)**

General characteristics and classification (Reimer, 1954). Range of structure, reproduction and evolution of the gametophytes, Gametophyte types – sex organs. Apogamy and Apospory. Life cycles. Stelar evolution. Heterospory and seed habit, Telome theory, morphogenesis, Economic importance of Pteridophytes.

UNIT II

PTERIDOPHYTES: **(L 20 + T-1 Hours)**

Structure, anatomy, reproduction and life histories of the following genera: *Isoetes, Equisetum Angiopteris, Osmunda, Pteris* and *Azolla.*

UNIT – III

GYMNOSPERMS: **(L 20 + T-1 Hours)**

General characters - A general account of distribution of Gymnosperms. Morphology, anatomy, reproduction, phylogeny and classification (K.R.Sporne, 1965). Economic importance of Gymnosperms.

UNIT – IV

GYMNOSPERMS: **(L 20 + T-1 Hours)**

Structure (Exomorphic and endomorphic), anatomy, reproduction and life histories of the following genera: *Thuja, Cupressus, Araucaria, Podocarpus, Gnetum* and *Ephedra*.

UNIT – V

PALEOBOTANY: **(L 20 + T-1 Hours)**

Geological Scale; Radiocarbon dating; Contribution of Birbal Sahni to Paleobotany.Gondwana flora of India. Study of fossils in understanding evolution. Fossilization and fossil types. Economic importance of fossils – fossil fuels and industrial raw materials and uses. Study of organ genera: *Rhynia, Lyginopteris, Lepidocarpon, Calamites, and Cordaites*.

RecommendedText:

1. Vashishta, P.C. Sinha, A.K and Anil Kumar. 2016. Botany for Degree students. Gymnosperms. S. Chand and Company Ltd., New Delhi.
2. Singh,V.,Pande,P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
3. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
4. Sharma, O.P. 2017. Pteridophyta, McGraw Hill Education, New York.
5. Vashishta.P.C., A.K.Sinha and AnilKumar.2018.Botany for Degree students- Gymnosperms.S. Chand and Company Ltd., New Delhi.
6. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.

Reference books:

1. Parihar, N.S. 2019. An Introduction to Embryophyta Pteridophytes. 5th Edition, Surjeet Publication, Delhi.
2. Pandey, S.N and Trivedi, P.S. 2015. A Text Book of Botany Vol. II- 12 th edition (Paperback), Vikas Publishing.
3. Rashid, A. 2013. An introduction to Pteridophyta – Diversity, Development and differentiation (2nd edition), Vikas Publications.
4. Arnold A.C.2005.An Introduction to Paleobotany. Agrobios (India).Jodhpur.
5. Sporne, K.R. 2017. The morphology of Pteridophytes (The structure of Ferns and Allied Plants) (Paper back), Andesite Press.
6. Sporne, K.R. 1967. The Morphology of Gymnosperms. Hutchinson & Co., London.

7. Taylor, E, Taylor, T, Krings, M. 2008. Paleobotany: The Biology and Evolution of FossilPlants,2nd Edition, AcademicPress.

Web resources:

1. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
2. http://www.bsienvis.nic.in/Database/Pteridophytes-in-India_23432.aspx
3.https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y
4. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf
5. https://www.palaeontologyonline.com/
6. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAAIAAJ
https://trove.nla.gov.au/work/11471742?q&versionId=46695996

CORE - III LABORATORY COURSE-I - P23BO1P1

COVERING THEORY PAPERS I AND II

Lecture Hours	**: -**	**Tutorial Hours**	**: -**
Practical Hours	**: 90**	**No. of Credit**	**: 4**
Contact Hours per Semester: 90			
Contact hours per Week	**: 6**		
Internal Marks	**: 40**		
External Marks	**: 60**		
Total Marks	**: 100**		

Objective of the Course

- To learn how to employ the use of instruments, technologies and methodologies related tothallophytes and non-flowering plant groups.
- To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of algae, and fungi.
- To comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.
- To develop the technical abilities in staining, sectioning, sterilizing, and characterizing. thallophytes, and other varieties of non-flowering plants.
- To compare the structural diversity of fossil and extant plant species.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : Recall and applying the basic keys to distinguish at species level identification of important algae and fungi through its structural organizations.

CO2 : Demonstrate practical skills in thallophytes, Pteridophytes and Gymnosperms.

CO3 : Describe the structure of algae, fungi, lichens, Bryophytes, Pteridophytes and Gymnosperms.

CO4 : Determine the importance of structural diversity in the evolution of plant forms.

CO5 : Formulate techniques to isolate and culture of alga and fungi as well as to understand the diversity of plant forms.

Mapping with Programme Outcomes:

COs	Program Outcomes (Pos)						Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	3	3	2	3	3	3	3
CO2	3	3	2	3	3	3	3	1	3
CO3	3	3	3	3	1	3	3	2	3
CO4	3	3	2	1	3	2	2	1	3
CO5	3	3	3	3	2	3	2	3	2
Total Contribution of COs to POs	14	15	13	13	14	14	13	10	14
Weighted Percentage of COs contribution to POs	93.33	100.00	86.67	86.67	93.33	93.33	86.67	66.67	93.33

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

COURSE CONTENTS

Experiments

UNIT I

ALGAE **(P 20 Hours)**

Study of algae in the field and laboratory of the genera included in theory.

External morphology and internal anatomy of the vegetative and reproductive structures of the following living forms: *Oscillatoria, Scytonema, Ulva, Codium, Diatoms, Dictyota* and *Gelidium* (depending on availability of the specimen).

To record the local algal flora–Study of their morphology and structure.

Identification of algae to species level (at least One).

Preparation of culture media and culture of green algae and blue green algae in the laboratory (Demonstration).

UNIT II

FUNGI **(P 16 Hours)**

Study of morphological and reproductive structures of the following living forms: *Plasmodiophora, Phytophthora, Rhizopus, Taphrina, Polyporus* and *Colletotrichum* (depending on availability of the specimen).

Isolation and identification of fungi from soil, air, and Baiting method.

Preparation of culture media.

Cultivation of mushroom in the laboratory (Demonstration).

LICHENS

Study of morphological and reproductive structures of the genera *Parmelia*.

UNIT – III

BRYOPHYTES **(P15 Hours)**

External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Targionia, Lunularia, Porella and Polytrichum* (depending on availability of the specimen).

UNIT – IV

PTERIDOPHYTES **(P20 Hours)**

External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Isoetes, Equisetum Angiopteris, Osmunda, Pteris* and *Azolla* (depending on availability of the specimen).

Fossil slides observation: *Rhynia, Lepidocarpon, Calamites.*

UNIT – V

GYMNOSPERMS **(P 19 Hours)**

External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Thuja,Cupressus, Araucaria, Podocarpus, Gnetum* and *Ephedra* (depending on availability of the specimen).

Fossil slides observation: *Cordaites* and *Lyginopteris*

RecommendedText:

1. Kumar, H.D.1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Das, S and Saha, R.2020. Microbiology Practical Manual.CBS Publishers and Distributors(P) Ltd., New Delhi, India.
3. Sharma, O.P.2012. Pteridophyta, Tata Mc Graw-Hills Ltd, New Delhi.
4. Sharma O.P and S, Dixit.2002.Gymnosperms.PragatiPrakashan.

5. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.

Reference Books:

1. Chmielewski, J.G and Krayesky, D. 2013. General Botany laboratory Manual. Author House, Bloomington, USA.

2. Webster,J and Weber,R.2007. Introduction to Fungi,3rd Ed.Cambridge University Press, Cambridge.

3. Sharma,O.P.2017. Bryophyta, Mac Millan India Ltd, New Delhi.

4. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.

5. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.

Web resources:

1. https://www.frontiersin.org/articles/10.3389/fmicb.2017.00923/full
2. https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf
3. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
4. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4
5. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883

6.https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover

7. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721

ELECTIVE – I MICROBIOLOGY, IMMUNOLOGY AND PLANT PATHOLOGY - P23BO1E1A

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester: 75			
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- The goal of the course is to provide students with basic understanding of microbiology, immunology, plant pathology and the etiology of specific plant diseases.
- To provide comprehensive knowledge about microbes and its effect on man and environment.
- To provide comparative analysis of major groups of microbes.
- To study the principles of immune system, immunizing agents like antibodies and vaccines and gene therapy methods.
- To enhance the knowledge and skills needed for self-employment using the microbial derived products.
- To appreciate the role of immune system in conferring disease resistance.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : Recognize the general characteristics of microbes, plant defense and immune cells.

CO2 : Explain about the stages in disease development and various defense mechanisms in plants and humans.

CO3 : Elucidate concepts of microbial interactions with plant and humans.

CO4 : Analyze the importance of harmful and beneficial microbes and immune system

CO5 : Determine and interpret the detection of pathogens and appreciate their adaptive strategies.

Mapping with Programme Outcomes:

Cos	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	3	2
CO2	3	3	2	2	3	3	1	2	1
CO3	3	3	3	3	3	3	3	1	3
CO4	3	3	2	2	3	3	1	2	1
CO5	3	3	3	3	3	3	2	3	2
Total Contribution of COs to POs	15	15	13	13	15	15	9	11	9
Weighted Percentage of COs contribution to POs	100.00	100.00	86.67	86.67	100.00	100.00	60.00	73.33	60.00

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

COURSE CONTENTS

UNIT I

BACTERIA: **(L 14+ T-1 Hours)**

Types of microorganisms. General characteristic of bacteria – Outline classification of Bergey's manual of 9th edition. Classification of bacteria based on Morphological, cultural, physiological and molecular characteristics. Bacterial growth – batch culture and continuous culture. Growth Curve. Factors affecting growth. Determination of bacterial growth – Direct method: Haemocytometer, Viable plate count; Indirect method: Turbidity. Nutritional types.

Reproduction - Fission and sporulation. Genetic recombination- Transformation, Transduction and Conjugation. Isolation and cultivation of bacteria. Maintenance of bacterial culture.

UNIT II

VIRUSES: **(L 14+ T-1 Hours)**

General characters, Classification, Structure, Multiplication. Overview of Phycoviruses and Mycoviruses. Viruses of Eukaryotes – Animal & Plant viruses. Cultivation of viruses – in embryonated

egg and in plants. Control of viral infections. Bacteriophages- classification, replication of DNA and RNA phages -Lytic and Lysogenic cycle. Viroids and prions. Mycoplasma: Structure and classification.

UNIT – III

FOOD MICROBIOLOGY: (L 14 + T-1 Hours)

Beneficial role of microbes – yoghurt, Olives, Cheese, Bread, Wine, Tempeh, Miso & Fermented green tea. Spoilage of fruits, vegetables, meats, poultry, eggs, bakery products, dairy products and canned foods. Microbial toxins - Exotoxin, Endotoxin & Mycotoxin. Action of Enterotoxin, Cytotoxin& Neurotoxin. Food Preservation – temperature, drying, radiation and chemicals. Soil Microbiology: Importance of Microbial flora of soil and factors affecting the microbial community in soil. Interaction among soil microbes (positive and negative interactions) & with higher plants (rhizosphere &phyllosphere). Microorganisms in organic matter decomposition. Environmental Microbiology: Microbiology of water and air. Water borne diseases - diphtheria, chicken pox. Air borne diseases - Swine flu and Measles. Microbial degradation of chemical pesticides and hydrocarbon.

UNIT – IV

IMMUNOLOGY: (L 14+ T-1 Hours)

Introduction; Immune System; Types of Immunity - Innate and Acquired.Immune Cells - Hematopoiesis, B and T lymphocytes - Maturation, NK cells. Introduction to inflammation, Adaptive immune system, Innate Immune system. Antigen: Definition, Properties and types. Antibody – Structure, types and function. Generation of antibody diversity.Antigen - Antibody interactions: definition, types- Precipitation, Agglutination, Complement fixation. Immune Response – Humoral and Cell Mediated. Vaccines – history, types and recombinant vaccines. Immunodiagnosis –Blood Grouping, Widal test, Enzyme-Linked Immuno sorbent Assay (ELISA), Immunoelectrophoresis and Immuno diffusion.

UNIT – V

PLANT PATHOLOGY: **(L 14+ T-1 Hours)**

History and significance of plant pathology. Classification of plant diseases, Symptomology (important symptoms ofplant pathogens). Principles of plant infection –Inoculum, inoculum potential, Pathogenicity. Disease triangle. Host parasite interrelationship and interaction. Causal agents of plant diseases - biotic causes (fungi, bacteria virus, mycoplasma, nematodes, parasitic algae, angiospermic parasites - Abiotic causes (Physiological, deficiency of nutrients & minerals and pollution).Mechanism of penetration- Disease development of pathogen (colonization) and dissemination of pathogens. Role of enzymes and toxins in disease development. Defence mechanism of host – structural and biochemical

defences. Important diseases of crop plants in India - Sheath blight of rice, Late blight of potato, Little leaf of Brinjal and Red rust of tea.

Principles of disease management – Cultural practices, physical, chemical and biological methods, disease controlled by immunization. Biocontrol - merits and demerits;

Plant quarantine and legislation. Integrated Pest Management system. Diagnostic technique to detect pest/pathogen infection - Immunofluorescence (IF).

RecommendedText:

1. Singh, R.S. 2018. Introduction to Principles of Plant Pathology, 4th Edition.
2. Bilgrami, K.S and H.C. Dube. 2010 A text book of Modern Plant Pathology – Vikas Publishing House (P) Ltd., New Delhi
3. Mehrotra, R.S. and Aggarwal, A. 2017. Plant Pathology. McGraw Hill Publisher.
4. Dube, H.C. 2010. A text Book of Fungi, Bacteria and Viruses, 3rd Edition, Agrobios India, ISBN: 8188826383.
5. Vaman Rao, C. 2006. Immunology. 2nd Edition. Narosa Publisher.
6. Kenneth, M. 2017. Janeway's Immunobiology. 9th Edition. Garland Publisher.

Reference Books:

1. Agrios, A.G. 2007. Plant Pathology, Elsevier. ISBN: 9780120445653.
2. Jeffery, C., Pommerville. 2014. Alcamos Fundalmedals of Microbiology. 10th Edition. Johnsand Bartlett Learning.
3. Pelczar, M. J. 2007. Microbiology. 35th Edition, Tata-McGraw Hill Publications, New York,ISBN: 0074623260.
4. Ravi Chandra, N.G. 2013. Fundamentals of Plant Pathology, Phi Learning, ISBN:812034703X.
5. Willie, J. and Sherwood, L. 2016. Prescott's Microbiology McGraw-Hill Education; 10th Edition, ISBN: 978-1259281594
6. Chaube, H.S. and Singh, R. 2015. Introductory Plant Pathology CBS Publishers, ISBN: 978-8123926704.
7. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi.
8. Mishra, A., A. Bohra and A, Mishra. 2011. Plant Pathology-Disease and Management. Agro Bios, Jodhpur.

Web resources:

1. https://www.wileyindia.com/a-textbook-of-plant-pathology.html
2. https://www.britannica.com/science/plant-disease.
3. https://www.planetatural.com/pest-problem-solver/plant-disease/

4. https://www.elsevier.com/books/plant-pathology/agrios/978-0-08-047378-9
5. https://www.elsevier.com/life-sciences/immunology-and-microbiology/books

ELECTIVE-I CONSERVATION OF NATURAL RESOURCES AND POLICIES - P23BO1E1B

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester: 75			
Contact hours per Week	**: 6**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To create awareness of environmental problems and their consequences.
- Explain the term natural resources.
- Describe the reasons for degradation of natural resources and suggest measures to prevent these.
- List the various endangered species of animals and plants.
- State the various environmental laws passed to conserve the natural resources.
- Explain sustainable development and justify its need; and describe the various conventional as well as non-conventional sources of energy

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : Understand the concept of different natural resources and their utilization.

CO2 :Critically analyze the sustainable utilization land, water, forest and energy resources

CO3 :Evaluate the management strategies of different natural resources

CO4: Reflect upon the different national and international efforts in resource management and their conservation.

CO5 :State the various environmental policy passed to conserve the natural resources.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	2	3
CO2	3	3	3	3	2	2	3	1	3
CO3	3	3	3	2	2	2	3	1	3
CO4	3	3	3	2	2	2	3	1	3
CO5	3	3	3	2	2	2	3	1	3
Total Contribution of COs to POs	15	15	15	12	10	11	15	6	15
Weighted Percentage of Cos contribution to POs	100.00	100.00	100.00	80.00	66.67	73.33	100.00	40.00	100.00

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

COURSE CONTENTS

UNIT I

NATURAL RESOURCES: **(L 14+ T-1 Hours)**

Definition – Importance – Classification – Human physiological socio-economic and cultural development – Human Population Explosion – Natural Resource Degradation – Concept of conservation – Value system – Equitable resource use for sustainable life system.

UNIT II

FOREST RESOURCES: **(L 14+ T-1 Hours)**

Forest cover in India and the World – Importance – Desertification – Forest Wealth – Afforestation – Vanasamrakshna Samithi– Agroforestry – Social Forestry – Joint Forest Management Strategy for Forest Conservation. Wild Life: Resources – Importance – Benefits – Wild life Extinction – Causes for Extinction – List of Endanger species in India and in the World – Ecological approach in wild life management – Eco Tourism – Wild Life projects in India – Sanctuaries and National Parks In India – Man and Bio sphere Programme.

UNIT – III

LAND AND SOIL RESOURCES: **(L 14+ T-1 Hours)**

Soil, Complexity of soil nature, regional deposits, Land use and capability classification systems, Land use Planning models and their limitations. Impacts of natural and man-made activities on land characteristics and land use planning– Soil Erosion – Loss of Soil Nutrients – Restoration of Soil Fertility – Soil Conservation Methods and Strategies in India. Wet Land Conservation and Management – Ecological Importance of wet lands in India – Conservation Strategy and ecological Importance. Water Resources: Rivers and Lakes In India – Water Conservation and ground water level increase - Watershed Programme.

UNIT – IV

MINERAL RESOURCES: **(L 14+ T-1 Hours)**

Use and exploitation – Environmental effects of extracting and using mineral resources – Restoration of mining lands – Expansion of supplies by substitution and conservation. Food Resources: World Food Problems – Changes caused by agriculture – overgrazing effects of modern agriculture – Fertilizer-Pesticide problems – Water Logging – Salinity – Sustainable agriculture, life stock breeding and farming.

UNIT – V

ENVIRONMENTAL POLICY IN INDIA: **(L 14+ T-1 Hours)**

Need for policies- Public Policy – Economic policies – Relationship between economic development and environment – Implementing Environmental Public Policy Strategies in pollution control – Constitutional provisions in India regarding environment – Public Awareness and Participation in Environmental Management – National Land Use Policy 1988 – Industrial Policy 1991.

Recommended Text:

1. Trivedi R.K.1994. Environment and Natural Resources Conservation.
2. Murthy J.V.S.1994. Watershed Management in India.
3. Raymond, F Dasmann. 1984. Environmental Conservation, John Wiley.
4. Nalini, K.S. 1993. Environmental Resources and Management, Anmol Publishers, New Delhi.
5. Shyam Divan and Armin Rosencranz. 2001. Environmental Law and Policy in India, Oxford Uni.Press.

Reference Books:

1. Haue, R and Freed V.H. 1975. Environmental Dynamics of Pesticides, Menum Press, London
2. Singh, B. 1992. Social Forestry for Rural Development, Anmol Publishers, New Delhi.
3. Shafi. R. 1992. Forest Ecosystem of the World.
4. Stacy Keach. 2016. Natural Resources Management. Syrawood Publishing House.

5. Rathor B.S. 2013. Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.

Web resources:

1.https://www.amazon.in/conservation-natural-resources-Gifford-Pinchot-ebook/dp/B07HX76TVN

2.https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y

3. https://www.kobo.com/ww/en/ebook/natural-resources-conservation-law

4.https://www.scribd.com/book/552185119/Natural-Resources-Conservation-and-Advances-for-Sustainability

5. https://www.scribd.com/document/354699536/Conservation-of-Natural-Resources.

ELECTIVE-I MUSHROOM CULTIVATION - P23BO1E1C

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester:	**75**		
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To teach the identification of mushrooms.
- To differentiate the edible mushrooms with toxic and hallucinating fungi.
- To study the cultivation technique of mushrooms
- To learn the economic importance of mushroom in various fields.
- To study how to establish mushroom cultivation as business enterprise.
- To teach the identification of mushrooms.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : Knowledge on identification of edible and toxic mushrooms Belonging to Ascomycota and Basidiomycota.

CO2 : Outline the nutraceutical properties of edible mushrooms.

CO3 : Knowledge on cultivation techniques of edible and medicinal mushrooms

CO4: Understand the harvest and post-harvest techniques of mushroom crops.

CO5 : Knowledge on the production and marketing strategies for mushrooms.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	1	2	2	2
CO2	3	3	2	2	3	3	3	2	3
CO3	3	3	2	2	1	3	3	1	2
CO4	3	3	3	3	3	2	3	3	3
CO5	3	3	2	3	2	3	3	3	3
Total Contribution of COs to POs	15	15	10	13	11	12	14	11	13
Weighted Percentage of COs contribution to POs	100.00	100.00	66.67	86.67	73.33	80.00	93.33	73.33	86.67

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

COURSE CONTENTS

UNIT I

INTRODUCTION: **(L 14+ T-1 Hours)**

Mushroom, Edible Mushroom, commercial production, medicinal value of mushrooms, nutraceuticals and dietary supplements.

UNIT II **(L 14+ T-1 Hours)**

MORPHOLOGICAL AND MICROSCOPICAL IDENTIFICATION OF EDIBLE AND POISONOUS MUSHROOMS:

Keys for identification of edible mushrooms: Agaricusbisporus, Pleurotus sajorcaju, Volvariella volvcea and Calocy beindica. Key for identifying hallucinogenic mushroom (Psilocybesp.) Medicinal Mushroom – Cordyceps, Ganoderma lucidum and Lentinu sedodes.

UNIT – III

CULTIVATION: **(L 14+ T-1 Hours)**

Substrate sterilization, bed preparation, cropping room and maintenance, raising of pure culture and spawn preparation, factors effecting button mushroom production(Temp, pH, air and water management, competitor moulds and other disease).

UNIT – IV

POST-HARVESTMANAGEMENT: **(L 14+ T-1 Hours)**

Harvest, storage, quality assurance of mushrooms. Pest management.

UNIT – V **(L 14+ T-1 Hours)**

World production edible mushroom, Legal and regulatory issues of introducing the medicinal mushrooms in different countries. Developing small scale industry and Government schemes. Mushroom Research Centers –International and National levels.

RecommendedText:

1. Cheung, P.C.K.2008. Mushrooms as functional food. AJohn Wiley &Sons, Inc., Publication.
2. Dijksterhuis, J. and Samson, R.A. 2007. Food Mycology: A multifaceted approach in fungi and food. CRC press, New York.
3. Hall.,R.I.,Stepheson,S.L.,Buchanan,P.K.,Yun,W.andCole,A.L.J.2003.Edibleandpoisonousmushrooms of the world. Timber Press, Portland, Cambridge.
4. Ting,S.andMiles,P.G.2004.Mushrooms:Cultivation, nutritional value, medicinal effect and nutritional environmental impact. CRC press, New York.
5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.

Reference books:

1. Tiwari., SC., Pandey K. 2018.Mushroomcultivation.Mittalpublisher,NewDelhi.
2. Philips,G.,Miles,Chang,S-T. 2004.Mushrooms:Cultivation, nutritional value, medicinal effect and environmental effect. 2nded. CRC Press.
3. Diego,C.Z.,Pando-Gimenez,A.2017.EdibleandmedicinalmushroomsTechnologyandApplication.Wiley-Blackwell publishers.
4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.
5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.

Web resources:

1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X
2. http://nrcmushroom.org/book-cultivation-merged.pdf
3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf
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

ELECTIVE-I PHYTOPHARMACOGNOSY - P23BO1E1D

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester: 75			
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To learn the traditional knowledge on plant derived drugs and their conventional classification.
- To elucidate the biosynthetic pathway of major classes of secondary metabolites.
- Tostudythegeneralpharmacologicalmodeofactionofcrudedrugsoffewmedicinalplants.
- Toelucidatetheisolationandcharacterizationofplantderiveddrugsusingmodern biotechniques.
- Knowledge on pharmacological action of drugs.
- Tolearnthetraditionalknowledgeonplantderiveddrugsandtheirconventional classification.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1: Review on the traditional knowledge and classification of plant derived drugs.

CO2: Knowledge on biosynthetic pathway of different classes of plant metabolites.

CO3 : Knowledge on modern instrumentation on characterization of plant metabolites.

CO4: Discuss various aspets of Pharmacological action of herbal drugs.

CO5: Understanding medical and non-medical potential of plant derived in various sectors.

Mapping with Programme Outcomes:

COs	Program Outcomes (Pos)	Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	2	1
CO2	3	2	3	3	3	2	1	2	1
CO3	3	2	3	3	3	3	2	3	2
CO4	3	2	2	3	3	3	2	3	2
CO5	3	2	2	3	3	3	2	3	2
Total Contribution of COs to POs	15	11	13	15	15	14	8	13	8
Weighted Percentage of COs contribution to POs	100.00	73.33	86.67	100.00	100.00	93.33	53.33	86.67	53.33

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

COURSE CONTENTS

UNIT I **(L 14+ T-1 Hours)**

General introduction – History and scope of Pharmacognosy including indigenous system of medicine. Various systems of classification of drugs. Pharmacological action of plant drugs. Significance of Pharmacopoeial standards.

UNIT II **(L 14+ T-1 Hours)**

MORPHOLOGICAL AND MICROSCOPICAL Biosynthetic pathway of secondary metabolites: Acetate pathway (fatty acids and polyketides), mevalonate and deoxy-xylulose phosphate pathway (terpenoids and steroids), shikimate pathway (phenols, amino acids etc.).

UNIT – III **(L 14+ T-1 Hours)**

Characterization of Therapeutic drugs: Extraction, separation, isolation (Chromatographic techniques) and characterization of secondary metabolites (Spectroscopic techniques). Quality control of plant drugs: Classical and modern approaches of drugs. Significance of Pharmacopoeial standards.

UNIT – IV **(L 14+ T-1 Hours)**

Pharmacological action of Plant Drugs: Anti-cancer, Bitter tonic, Carminatives and G.I.regulators, Cardiotonics, CNS-Stimulatant, Expectorant, Laxatives, Puragatives. Outline ofpharmacogenomicsfunctions.

UNIT – V **(L 14+ T-1 Hours)**

Hallucinogenic, allergenic and other toxic plants, poisonous plants - biopesticides -biocides–biofungicides.

Recommended Text:

1. DewickP.M.,2002. Medicinal Natural Products: Abio synthetic approach, John Wiley& Sons Ltd.
2. EvansW.C.,2002,Trease and Evan's Pharmacognosy, W.B. Saunders.
3. Harborne,J.B.,1998.PhytochemicalMethods,ChapmanandHall.
4. Harborne,J.B.,1998.PhytochemicalMethods,ChapmanandHall.
5. Vickery M.L. and B.Vickery,1981.Secondary Plant Metabolism, The Mac Millan Press Ltd.

Reference books:

1. Bruneton, J.1999.Pharmacognosy,Phytochemistry, Medicinal Plants, Intercept Ltd., Paris.
2. Evans W.C.2002, Trease and Evan's Pharmacognosy, W.B. Saunders.
3. Harborne, J.B.1998. Phytochemical Methods,Chapman and Hall.
4. Vickery M.L and B.Vickery, 1981. Secondary Plant Metabolism, The Mac Millan Press Ltd.
5. Wagner H.,S. Bladt and E.M. Zgainski (Translated by A. Scott) 1984,Plant Drug Analysis, Springer-Verlag.

Web resources:

1. https://pharmabookbank.files.wordpress.com/2019/03/14.2.pharmacognosy-by-biren-shahavinash-seth-1.pdf
2. https://www.pdfdrive.com/pharmacognosy-books.html
3. https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H

ELECTIVE-II ALGAL TECHNOLOGY - P23BO1E2A

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester: 75			
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To provide a basic overview of algae cultivation techniques and resource potentials.
- To educate people about the widespread commercial uses of algae.
- To educate people about the therapeutic uses of algae.
- To enrich the current knowledge of how algae are used in basic research and technological applications.
- To spread awareness of the value of algae biotechnology and its applications in diverse industries.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : Understand the applied facet of botany and acquire a complete knowledge about the cultivation methods in algae

CO2 : Realization of the commercial potential of algal products.

CO3 : Analyze emerging areas of algal biotechnology for identifying therapeutic importance of algal products and their uses

CO4: Gain more information about algae genetics.

CO5 : Translate various algal technologies for the benefit of the ecosystem.

Mapping with Programme Outcomes:

COs	Program Outcomes (Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	3	1
CO2	3	3	3	2	3	3	2	3	2
CO3	3	2	3	2	2	3	1	1	1
CO4	3	3	3	3	3	3	2	3	2
CO5	3	2	3	3	3	3	1	3	1
Total Contribution of COs to POs	15	13	15	13	14	15	7	13	7
Weighted Percentage of COs contribution to POs	100.00	86.67	100.00	86.67	93.33	100.00	46.67	86.67	46.67

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

COURSE CONTENTS

UNIT I

SCOPE OF ALGAL TECHNOLOGY **(L 14+ T-1 Hours)**

Scope of algal technology – Commercial potential and utility of algae. Algae as sources for food, feed, pigments, Pharmaceuticals and neutraceuticals, fine chemicals, fuel, biofertilizers and hormones. Economic importance of algae in India.

UNIT II

ALGAL PRODUCTS **(L 14+ T-1 Hours)**

Industrial application of algae - fuel, algal lipids - transesterification to ester fuel - substitutes for petroleum derived fuel. Algal products - Spirulina mass cultivation and its applications. Mass cultivation of micro-algae as source of protein and as feed. Liquid seaweed fertilizers - method of preparation, applications and its advantages over inorganic fertilizers.

UNIT – III

ALGAL PRODUCTION AND UTILIZATION **(L 14+ T-1 Hours)**

Algal production systems; Strain selection; Algal growth curve; Culture media; cultivation methods – small scale and Large-scale cultivation of algae. Harvesting and packing. Therapeutic uses - antioxidant, anti-ulcerogenic, antifungal, antibiotics, antitumor and antiviral compounds. Production of pigments and their utilization

UNIT – IV

IMMOBILIZATION AND RDNA TECHNOLOGY IN ALGAE (L 14+ T-1 Hours)

Algal immobilization and its applications - culturing for metabolite production and natural compounds. Methods of immobilization - alginate beads-extraction of compounds. Recombinant DNA technology in algae - Transformation systems in algae. Isolation of protoplasts, regeneration of fusion of macro algae. Role of algae in nanobiotechnology..

UNIT – V

ROLE OF ALGAE IN ENVIRONMENT MANAGEMENT **(L 14+ T-1 Hours)**

Role of algae in environmental health - Sewage treatment, treating industrial effluent, Phyto remediation-heavy metal removal, algae as indicators in assessing water quality and pollution; Saprobic index; Monitoring, assessment, restoration and management of coastal and marine ecosystem environment. Algal culture collection centers in India and abroad and their importance.

Recommended Text:

1. Trivedi, P.C. 2001. Algal Biotechnology. Point publisher, Jaipur.India.
2. Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi.
3. Sahoo, D. 2000. Farming the ocean: seaweed cultivation and utilization. Aravali International, New Delhi.
4. Bast, F. 2014. An Illustrated Review on Cultivation and Life History of Agronomically Important Sea plants. In Seaweed: Mineral Composition, Nutritional and Antioxidant Benefits and Agricultural Uses, Eds. Vitor Hugo Pomin, 39-70. Nova Publishers, New York. ISBN: 978-1-63117-571-8.
5. Rapouso, M.F.J., Morais, R.M.S.C., Morais, A.M.M.B. 2013. Bioactivity and applications of sulphated polysaccharides from marine microalgae. Marine Drugs, 11, 233-252.
6. Bajpai, Rakesh, K., Prokop, Ales, Zappi,Mark,E.2014.Algal Biorefineries Volume1:

Reference Books:

1. Kumar H.D and H.N. Singh.1982. A text Book on Algae. Affiliated East- West Press Pvt. Ltd

2. Suganya, T and Renganathan, S. 2015. Biodiesel production using algal technology. Academic Press. ISBN: 0128009713.

3. Bajpai, Rakesh K., Prokop, Ales, Zappi, Mark E. 2014. Algal Biorefineries Volume 1: Cultivation of Cells and Products. Springer. ISBN: 9400774931.

4. Hojnacka, K., Wieczorek, P.P., Schroeder, G., Michalak, I. (Eds.). 2018. Algae Biomass: Characteristics and Applications. Developments in Applied Phycology.

5. Aziz, Farhad and Rasheed, Rezan. 2019. A Course Book of Algae. Publisher: University of Sulaimani. ISBN: 978-9922-20-391-1.

6. Dinabandhu, S and Kaushik. B.D. 2012. Algal Biotechnology and Environment. I.K. International, New Delhi.

7. Trivedi, P.C. 2001. Algal Biotechnology. Point publisher, Jaipur. India.

8. Becker. E.W. 1994. Micro algae Biotechnology and Microbiology. Cambridge University press.

9. Borowitzka, M.A. and borowizka, L.J. 1996. Microalgal Biotechnology. Cambridge University Press, Cambridge,

10. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. Resonance, 19(2) 1032-1043 ISSN: 0971-8044.

11. Faizal,B and Yusuf, C. 2016.Algalbiotechnology: Product sand processes. Springer.

12. Gouveia, L. 2011. Microalgae as a feedstock for biofuels. Springer Briefs in Microbiology, London.

Web resources:

1. https://www.springer.com/gp/book/9783319123332

2. https://www.researchgate.net/publication/318449035_Algae_Biotechnology

3. https://www.energy.gov/sites/prod/files/2015/04/f21/algae_marrone_132100.pdf

4. https://www.amazon.in/Prospects-Challenges-Algal-Biotechnology-Tripathi-ebook/dp/B0779BF366

5. https://www.degruyter.com/view/product/177050

6. https://www.amazon.in/Algal-Biotechnology-Mihir-Kumar-Das/dp/B0072I61LA

7. https://www.elsevier.com/books/algal-biotechnology/ahmad/978-0-323-90476-6

8. https://www.appleacademicpress.com/phycobiotechnology-biodiversity-and-biotechnology-of-algae-and-algal-products-for-food-feed-and-fuel/9781771888967

ELECTIVE-II ETHNOBOTANY, NATUROPATHY AND TRADITIONAL HEALTHCARE - P23BO1E2B

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester: 75			
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- Understand the concept of ethnobotany and the life style and traditional practices of plants by Indian tribals.
- Emphasize the importance of non-timber forest products for Indian tribal people livelihoods.
- Evaluate the various research techniques to gather tribal knowledge of ethnobotany.
- Use strategies to turn ethno botanical knowledge into goods with value additions.
- To save and document ethno botanicals in order to use plant resources sustainably.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : Recall or remember concept of ethnobotany.

CO2 : Understand the life style and traditional practices of plants by Indian tribals.

CO3 : Highlight the role of Non-Timber Forest products for livelihood of tribal people of India

CO4 : Assess the methods to transform ethnobotanical knowledge into value added products.

CO5 : Build idea to make digitization of ethnobotanical knowledge..

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3
CO4	3	3	3	3	2	3	3	2	3
CO5	3	3	3	3	3	3	3	3	3
Total Contribution of COs to POs	15	15	15	14	14	15	15	14	15
Weighted Percentage of COs contribution to POs	100.00	100.00	100.00	93.33	93.33	100.00	100.00	93.33	100.00

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

COURSE CONTENTS

UNIT I

ETHNOBOTANY: (L 14+ T-1 Hours)

Concept, important landmarks in the development, scope, sub disciplines of ethno botany. Interdisciplinary approaches. Knowledge of following sociological and anthropological terms: culture, values and norms, institutions, culture diffusion and ethnocentrism. History of ethnobotany: A brief history of ethno botanical studies in the world and in India.

UNIT II

PLANTS USED BY TRIBALS OF INDIA: **(L 14+ T-1 Hours)**

Distribution of tribes in India. Basic knowledge of following tribes of Tamil Nadu: Irulas, Kanis, Paliyars Badagas, Kurumbres, Thodas and Malayalis. Plants used by tribals of Tamil Nadu..

UNIT – III

SOURCES OF ETHNOBOTANICAL DATA: **(L 14+ T-1 Hours)**

Primary – archeological sources and inventories, Secondary - travelogues, folklore and literary sources, herbaria, medicinal texts and official records. Methods in ethnobotanical research. Prior Informed Consent, PRA techniques, interviews and questionnaire methods, choice of resource persons. Folk

taxonomy – plants associated with culture and socio- religious activities. Non – timber forest products (NTFP) and livelihood – Sustainable harvest and value addition.

UNIT – IV

NATUROPATHIC MEDICINE: (L 14+ T-1 Hours)

Role of plants in naturopathy- Importance and relevance of medicinal drugs in India. Indian Systems of Medicine (Ayurveda, Siddha, Allopathy, Homeopathy, Unani, Tibetan, Yoga and Naturopathy). Disease diagnosis, treatment, and cure using natural therapies including dietetics, botanical medicine, homeopathy, fasting, exercise, lifestyle counseling, detoxification, and chelation, clinical nutrition, hydrotherapy, naturopathic manipulation, spiritual healing, environmental assessment,

TRADITIONAL HEALTH CARE: (L 14+ T-1 Hours)

Health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral based medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illnesses or maintain well-being.

UNIT – V

BIOPROSPECTING AND VALUE ADDITION: (**L 14+ T-1 Hours)**

Bio-prospecting of drug molecules derived from Indian traditional plants; Methods for bioprospecting of natural resources; From folk Taxonomy to species confirmation - evidences based on phylogenetic and metabolomic analyses; Ethno botanical databases and Traditional knowledge Digital Library (TKDL).

Recommended Text:

1. Subramaniam, S.V and V.R. Madhavan (Eds,). 1983. Heritage of the Tamil Siddha Medicine. International Institute of Tamil Studies. Madras.

2. Jain, A. and Jain, S.K. 2016. Indian Ethno botany - Bibliography of 21st Century Scientific Publishers (India).

3. Gokhale, S.B., Kokate, C.K and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. 1st ed. NiraliPrakashan, Pune.

4. Gringauz. 2012. Introduction to Medicinal Chemistry: How Drugs Act & Why? Wiley India Pvt Ltd. Noida.

5. Joshi, S.G. 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi.

Reference Books:

1. CSIR. 1940-1976. Wealth of India. A Dictionary of Raw Materials and Industrial Products - Raw Materials. Vol.1-11. CSIR Publication & Information Directorate. New Delhi.

2. Gokhale, S.B., Kokate, C.K and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. 1st ed. Nirali Prakashan, Pune.

3. Laird, S.A. 2002. Biodiversity and Traditional knowledge equitable partnerships in Practice. Earthscan Publications Ltd., London.

4. Ministry of Environment and Forests. 1994. Ethno biology in India. A Status Report. All India Coordinated Research Project on Ethno biology. Ministry of Environment and Forests. New Delhi.

5. Kumar, N. 2018. A Textbook of Pharmacognosy. Aitbs Publishers, India.

6. Premendra Singh. 2013. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Publishing House, New Delhi.

7. Albuquerque, U.P., Ramos, M.A., Júnior, W.S.F., and De Medeiros, P.M. 2017. Ethnobotany.

Web resources:

1. file:///C:/Users/HP/Downloads/8-Vol.-5-Issue-3-March-2014-IJPSR-1178-A-Paper-81.pdf 2

2. http://www.plantsjournal.com/archives/2017/vol5issue3/PartB/5-3-8-217.pdf 3

3. https://shodhganga.inflibnet.ac.in/bitstream/10603/116454/7/07_chapter%201.pdf 4

4. https://www.cell.com/action/showPdf?pii=S1360-1385%2817%2930001-8 5

5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3465383/pdf/pnas.201202242.pdf 6

6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4151377/pdf/1746-4269-10-48.pdf 7 Jain, S. K. 1994. http://www.worldcat.org/identities/lccn-n85-4353/

7. http://www.frlht.org/

ELECTIVE-II HORTICULTURE - P23BO1E2C

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**:**	**No. of Credit**	**: 3**
Contact Hours per Semester: 75			
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- Know about the brief history, divisions, classification and structure of horticultural plants.
- Acquire knowledge on plant growth processes and stages of plant growth.
- Understand the plant growth environment in relation to soil, nutrients, fertilizers, and bio inoculants.
- Study the sexual and vegetative propagation methods including propagation through specialized vegetative structures.
- Develop practical skills in micro propagation techniques and soil-less production of horticultural crops.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : Identify and categorize various horticultural plants and the conditions that affect their growth and productivity.

CO2 : Explain the various structures and growth processes of horticultural plants.

CO3 : Demonstrate the propagation, growth, and maintenance of plants in horticulture systems.

CO4: Correlate the soil characteristics and fertility to good plant growth.

CO5 : Utilize the role plant tissue culture techniques in the production of quality planting stock in horticulture.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3
CO2	2	1	3	3	3	3	3	3	2
CO3	3	1	3	3	3	3	2	3	3
CO4	3	3	3	1	1	2	3	1	3
CO5	3	3	3	3	3	3	3	3	2
Total Contribution of COs to POs	14	11	15	13	13	14	14	13	13
Weighted Percentage of COs contribution to POs	93.33	73.33	100.00	86.67	86.67	93.33	93.33	86.67	86.67

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

COURSE CONTENTS

UNIT I

INTRODUCTION TO HORTICULTURE (L 14+ T-1 Hours)

Definition; Brief History, Divisions of Horticulture, Classification of horticultural plants, Structure of Horticultural Plants –Cell and Tissue systems, Anatomy of stem root and leaf, Morphological structures, Plant growth processes-A brief account of Photosynthesis, Respiration, Transpiration and Translocation, Stages of plant growth.

UNIT II

FACTORS AFFECTING PLANT GROWTH **(L 14+ T-1 Hours)**

Plant Growth Environment: Abiotic factors, Soil –Profile structure, Primary and Secondary nutrients and their functions, Organic matter, Fertilizers –organic, Inorganic and Potting Media, Bio inoculants, Methods of fertilizer application, Directing Plant growth-Training -Pruning and thinning..

UNIT – III

PLANT PROPAGATION **(L 14+ T-1 Hours)**

Plant propagation: Seeds –Advantages, Viability, Mechanism of Dormancy and Dormancy Breaking: Methods of Direct and Indirect Seedling Production in Nurseries and Transplantation; Propagation

through specialized underground structures –Corm, Tuber, Sucker, Bulb, Bulbil, Rhizome; Vegetative Propagation –Cutting, Layering, Grafting and Budding.

UNIT – IV

MICROPROPAGATION TECHNIQUES **(L 14+ T-1 Hours)**

Stages, multiplication by shoot tip, Nodal culture and Callus culture-Application and Limitations, Somatic embryogenesis, Synthetic seeds –Preparation and Potential uses of artificial seeds, Embryo Rescue, Soil-less Production of Horticultural crops –Hydroponics, sand culture, gravel culture.

UNIT – V

AESTHETICS OF HORTICULTURE (L 14+ T-1 Hours)

Design: Elements and Principles of Design, Flower Arrangement, Terrarium Culture, Bonsai, Growing Plants Indoors, Turf Production, Landscaping-Principles, Types of Parks, Xeriscaping. Postharvest handling of Horticultural Products –Harvesting, Storage, Processing, Elements of Marketing. Robotics in Horticulture.

Recommended Text:

1. Acquaah, G. 2011.Horticulture: Principles and Practices. (4th ed), Pearson Education, London, UK.
2. Janik, J. 1972. Horticultural Science. W.H. Freeman & Company, San Francisco.
3. Kumar, N. 1994. Introduction to Horticulture, Rajalakshmi Publication, India.
4. Manibhushan Rao, K. 2005. Text Book of Horticulture. (2nd ed), Macmillan India Ltd., New Delhi.
5. Schilletter, J. C. and Richey, H. W. 2005. Text Book of general Horticulture. 2nd ed. Biotech Books, Delhi.
6. Sharma, R.R. 2016. Propagation of horticultural crops. Kalyani Publishers, New Delhi.
7. Subba Rao, N.S. 1997. Biofertilizers in Agriculture and Forestry. India Book House Limited, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.

Reference Books:

1. Acquaah, G. 2002. Horticulture Principles and Practices. 2nd ed. Pearson Education (Singapore) Pvt. Ltd.
2. Ashman, M.A. and Puri, G. 2002. Essential soil science-A clear and concise introduction to soil science. Blackwell scientific publishers, London.
3. Denisen, E.L. 1979. Principles of Horticulture. MacMillan Publishing co, Inc. New York.
4. Dirr, M. and Heuser, C.W. 2009. The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture. Timber Press, Oregon, USA.

5. Thomson, L.M. and Troen, F.R. 1975. Soils and soil fertility Tata, McGraw Hill Publication Co. Ltd. New Delhi.

6. Tolanus, S. 2006. Soil fertility, Fertilizer and Integrated Nutrient management. CBS Publication, Delhi, India.

Web resources:

1. https://www.kobo.com/in/en/ebooks/horticulture
2. https://www.gale.com/gardening-and-horticulture
3. https://www.iaritoppers.com/p/horticulture-icar-ecourse-pdf-books.html
4. https://www.amazon.in/Introduction-Horticulture-N-Kumar-ebook/dp/B08M4289M6
5. https://www.researchgate.net/publication/316438576_ Polyembryony_in_Horticulture_and_ its_ significance

ELECTIVE-II HERBAL TECHNOLOGY - P23BO1E2D

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester: 75			
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To understand various plants based drugs used in ayurvedha, unani, homeopathy, siddha etc.
- To apply the knowledge to cultivate medical plants.
- To know the pharmacological importance of medicinal plants.
- To enlist phytochemicals and secondary metabolites of market and commercial value.
- To design and develop their own business prepositions such as theo in the making of herbal insecticides.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : Recollect the importance of herbal technology.

CO2 : Understand the classification of crude drugs from various botanical sources.

CO3 : Analyze on the application of secondary metabolites in modern medicine.

CO4: Create new drug formulations using therapeutically valuable phytochemical compounds for the healthy life of society.

CO5 : Comprehend the current trade status and role of medicinal plants in socio economic growth.

Mapping with Programme Outcomes:

COs	Program Outcomes (Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	1	3
CO2	3	3	3	3	3	3	1	3	3
CO3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	1	3	3
CO5	3	3	3	3	3	3	1	2	3
Total Contribution of COs to POs	15	15	15	15	15	15	7	12	15
Weighted Percentage of COs contribution to POs	100.00	100.00	100.00	100.00	100.00	100.00	46.67	80.00	100.00

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

COURSE CONTENTS

UNIT I

PHARMACOGNOSY **(L 14+ T-1 Hours)**

Pharmacognosy scope and importance - source - Crude Drugs – Scope and Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection and processing of crude drugs. Cultivation and utilization of medicinal and aromatic plants in India.

UNIT II

PLANT TISSUE CULTURE AS SOURCE OF MEDICINES **(L 14+ T-1 Hours)**

Plant tissue culture as source of medicines, Role of plant tissue culture in enhancing secondary metabolite production (*Withania somnifera, Rauwolfia serpentina, Catheranthus roseus, Andrographis paniculata* and *Dioscorea* sp) - Elicitation - Biotransformation, Hairy root culture. Factors affecting secondary metabolites production. Biogenesis of phytopharmaceuticals.

UNIT – III

PLANT PROPAGATION

ANALYSIS OF PHYTOCHEMICALS **(L 14+ T-1 Hours)**

Methods of Drug evaluation (Morphological, microscopic, physical and chemical). Phytochemical investigations – standardization and quality control of herbal drugs. Preliminary screening, Assay of Drugs - Biological evaluation/assays, Microbiological methods - Chemical Methods of Analysis, Detection of Adulterants: Chemical estimations, Spectrophotometry and fluorescence analysis. Drug adulteration - Types of adulterants.

UNIT – IV **(L 14+ T-1 Hours)**

GENERAL METHODS OF PHYTOCHEMICAL AND BIOLOGICAL SCREENING

Carbohydrates and derived products: Glycosides - extraction methods (Digitalis, Dioscorea); Tannins (Hydrolysable and Condensed types); Volatile oils - extraction methods (Clove, Mentha). Study of some herbal formulation techniques as drug cosmetics.

UNIT – V

TYPES OF PHYTOCHEMICALS **(L 14+ T-1 Hours)**

Alkaloids - extraction methods (Taxus, Cinchona); Flavonoids- extraction methods, Resins- extraction method: Application of phytochemicals in phytopharmacueticals; Biocides, Biofungicides, Biopesticides. Women entrepreneurship development – marketing cultivated medicinal plants – National Medicinal Plants Board of India.

Recommended Text:

1. Kokate, C.K., Purohit, A.P and S.B. Gokhale. 1996. Pharmacognosy. Nirali Prakashan, 4th Ed.
2. Roseline, A. 2011. Pharmacognosy. MJP publishers, Chennai.
3. Tilgner, Sharol Marie. 2018. Herbal ABC's: The Foundation of Herbal Medicine.
4. Natural Products in medicine: A Biosynthetic approach. 1997. Wiley.

Hornok, L. (ed.).

5. Chichister, U.K.J. 1999. Cultivation and Processing of Medicinal Plants, Wiley & Sons.

Treaseand Evans.

6. Mukherjee, P.K. 2008. Quality control of herbal drugs. 3rd edition. Business Horizons Pharmaceutical Publishers, New Delhi, India.
7. Kirthikar and Basu. 2012. Indian Medicinal Plants. University Bookstore, Delhi. India
8. Biswas, P.K. 2006. Encyclopedia of Medicinal plants (Vol. I-VII). Dominant Publishers, New Delhi.
9. Chaudhuri, A.B. 2007. Endangered Medicinal Plants. Daya Publishing House, New Delhi.
10. Tilgner, SharolMarie. 2018. Herbal ABC's: The Foundation of Herbal Medicine.

Reference Books:

1. Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.

2. Kumaresan, V and Annie Regland. 2004. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany & Ethnobotany.

3. Anonymous, 2004. Cultivation of Selected Medicinal Plants. National Medicinal Plants Board, Govt. of India, New Delhi.

4. Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.

5. Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.

6. Dey, A.C. 1998. Indian medicinal plants used in Ayurvedic preparations, Bishen Singh Mahendra Pal Singh.

7. Sathya, S., Jaiganesh, K.P and Sudha, T. 2019. Current Trends in Herbal Drug Technology. Pharmacy Council of India New Delhi.

8. Lewis, W.H and M.P.F. Elwin Lewis. 1976. Medical Botany. Plants affecting Man's Health. A Wiley Inter Science Publication. John Wiley and Sons, New York.

Web resources:

1. https://www.kopykitab.com/Herbal-Science

2. https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurClUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_BwE

3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu

4. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404

5. https://www.dattanibookagency.com/books-herbs-science.html

6. https://www.springer.com/gp/book/9783540791157

CYBER SECURITY - P23BO1C1

Lecture Hours	**: -**	**Tutorial Hours**	**: -**
Practical Hours	**:-**	**No. of Credit**	**: 2**
Contact Hours per Semester: -			
Contact hours per Week	**: -**		
Internal Marks	**: -**		
External Marks	**: 50**		
Total Marks	**: 50**		

Objective of the Course

To understand the basics of cyber law, its related issues and ethical laws of computer for different countries.

INTERNAL ASSESMENT TEST- III

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 understand key terms and concepts in cyber law, intellectual property and cybercrimes, trademarks and domain theft.

CO2 determine computer technologies, digital evidence collection, and evidentiary reporting in forensic acquisition

CO3 evaluate Secure both clean and corrupted systems, protecting personal data, securing simple computer networks, and safe Internet usage..

CO4 Incorporate approaches for incident analysis and response.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	3	3	3	2	1	3
CO2	3	3	2	3	2	2	1	3	3

CO3	3	3	3	3	1	1	2	3	3
CO4	2	2	2	2	2	2	1	3	3
CO5	3	3	3	3	3	3	1	2	3
Total Contribution of COs to POs	14	13	13	14	11	11	7	12	15
Weighted Percentage of COs contribution to POs	93.33	86.67	86.67	93.33	73.33	73.33	46.67	80.00	100.00

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

COURSE CONTENTS

Unit-II: Cyber Crime Types **(L- 7 HOURS)**

Cybercrime—The Present and the Future- Classification of Cybercrime - Cybercrime against Individuals - Cybercrime against Property - Cybercrime against Nation. Cryptocurrency - Blockchain- Ransomware - Deep Web and Dark Web.

Unit-III: Cyber Forensics **(L- 3 HOURS)**

Interrelation among Cybercrime, Cyber Forensics, and Cyber Security. Cyber Forensics– Definition, steps, process, classification and Benefits. Email Forensics and Disk forensics - Handling of Digital Evidence

Unit-IV: Digital Evidences **(L- 7 HOURS)**

Preliminaries of Electronic or Digital Evidence - Acquisition and Seizure of Evidence - Acquisition of Computer and Electronic Evidence - Acquisition of Evidence from Mobile Phone and PDA. Legal Recognition of Digital Signatures - Presenting Digital Evidence

Unit-V: Cyber Laws **(L- 13 HOURS)**

Need for cyber laws – Legal Issues – Cyber Security. Strategies Involved in Cyber Security - Minimizing Risk with Cyber Laws - Initiatives Promoting Cyber Security -National and International Cyber Laws-Cyber Laws in India–Case Studies. International Cyber Laws and Case Studies – Cyber Laws in Malaysia – United States

Text Books

1. Dejey and S. Murugan IPS, Cyber Forensics , Oxford University Press, New Delhi. 2018 (ISBN-13: 978-0-19-948944-2 ISBN-10: 0-19-948944-0).
2. Jack Balkin, *et al.* eds., Cybercrime: Digital Cops in a Networked World (NYU Press 2007) (ISBN:0814799833).

Reference Books

1. Orin S. Kerr, Computer Crime Law: American Casebook Series (2006) (ISBN:0314144005).
2. Ralph D. Clifford, Cybercrime: the Investigation, prosecution and Defense of A computer-related crime (second edition 2006) (ISBN:0890897239).

II SEMESTER

Course Type	Course code	Course Title	Contact Hrs.	Exam Hrs.	Marks			Credit
					CIA	ESE	Total	
Semester-II								
Core-4	P23BO204	Taxonomy of Angiosperms and Economic Botany	5	3	25	75	100	4
Core -5	P23BO205	Plant Anatomy and Embryology of Angiosperms	5	3	25	75	100	4
Core -6	P23BO206	Ecology, Phytogeography, Conservation Biology and Intellectual property rights	5	3	25	75	100	3
Core Lab - II	P23BO2P2	Core Practical Covering Core 4, 5 & 6	6	3	40	60	100	3
Elective- III	P23BO2E3A	Medicinal Botany	3	3	25	75	100	3
	P23BO2E3B	Phytochemistry						
	P23BO2E3C	Research Methodology, Computer Applications & Bioinformatics						
	P23BO2E3D	Bio Pesticide Technology						
Elective- IV	P23BO2E4A	Applied Bioinformatics	3	3	25	75	100	3
	P23BO2E4B	Biostatistics						
	P23BO2E4C	Intellectual Property Rights						
	P23BO2E4C	Nanobiotechnology						
Skill Enhancement (SE1)	P23BO2SE1	Agriculture and Food Microbiology	3	3	25	75	100	2
Comprehension - 1(Self Study Course-Online Exam)	P23BO2C2	Comprehension in Botany - II	-	-	-	50	50	1
Ability Enhancement	P232AE202	Teaching Skill	-	-	50		50	1
			30				**800**	**24**

Core – II PLANT TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY - P23BO204

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 4**
Contact Hours per Semester: 75			
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To be familiar with the basic concepts and principles of plant systematics.
- To develop a suitable method for correct characterization and identification of plants.
- To understand the importance of taxonomic relationships in research of plant systematics.
- To provide information on various classification systems
- To know about the economic importance of plants.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1: Recollect the basic concepts of morphology of leaves, flowers. Identify the types of compound leaves , inflorescence and fruits Describe their characteristic features

CO2: Explain the principles of taxonomy. Summarize the taxonomic hierarchy. Define Binomial nomenclature. Group Activity – Construct key preparation

CO3 : Explain the various types of classification. Distinguish its advantages and disadvantages Construction of floral formula and floral diagram.

CO4 : Illustrate and explain the characteristic features and list out the economic importance of the families Field trip to local botanical garden and regional botanical garden.

CO5: Illustrate and explain the characteristic features and list out the economic importance of the families.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	2	1	2	2
CO3	3	3	2	3	1	3	3	3	1
CO4	3	2	3	3	2	3	1	3	3
CO5	3	3	2	2	1	2	3	2	1
Total Contribution of COs to POs	15	14	12	14	10	13	11	13	10
Weighted Percentage of COs contribution to POs	100.00	93.33	80.00	93.33	66.67	86.67	73.33	86.67	66.67

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

COURSE CONTENTS

UNIT I

TAXONOMY AND SYSTEMATICS **(L 14+ T-1 Hours)**

Botanical exploration and contribution with special reference to India by William Roxburgh, J.D. Hooker, Robert Wright, Nathanial Wallich and Gamble, J.S. Principles of classification as proposed – Artificial – Linnaeus, Natural – Bentham and Hooker, Phylogenetic system - Hutchinson, Modern – Takhtajan. Botanical gardens and herbaria of world, preparation and maintenance of Herbarium, Botanical survey of India – its organization and role.

UNIT II

MODERN TRENDS IN TAXONOMY **(L 14+ T-1 Hours)**

Modern trends in taxonomy, chemotaxonomy, numerical taxonomy, biosystemics. ICBN uninominal systems- genesis binomial nomenclature, importance and principle. Important articles, typification, principles of priority, effective and valid publication, author citation, recommendations and amendents of code. Glossories and dictionaries, Taxonomic literature (Index Kewensis)

UNIT – III

SYSTEMATIC ANALYSIS OF PLANTS-I **(L 14+ T-1 Hours)**

Polypetalae – Nympheaceae, Sterculiaceae, Portulaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae, Turneraceae.

UNIT – IV

SYSTEMATIC ANALYSIS OF PLANTS-II **(L 14+ T-1 Hours)**

Gamopetalae – Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae, Bignoniaceae, Convolvulaceae, Acanthaceae, Verbenaceae.

Monochlamydeae – Nyctaginaceae, Aristolochiaceae, Casuarinaceae. Monocots – Orchidaceae, Amarylidaceae, Lilliaceae, Commelinaceae, Cyperaceae.

UNIT – V

ECONOMIC BOTANY **(L 14+ T-1 Hours)**

General account on utilization of selected crop plants: (i) Cereals (rice and wheat) – (ii) Pulses (red gram and black gram), (iii) Drug yielding plants (*Withaniasomnifera*and *Coleus aromaticus)* (iv) Oil yielding plants (Groundnut, sunflower). (v) Sugar yielding plants (sugarcane and sugar beet), (vi) Spices and condiments (cardamom, cinnamon). (vii) Commercial crops - fibre (jute), (viii) Timber (Teak and red sanders wood), (ix) Resins and gums (Asafoetida and gum arabic) – (x) Essential oils (lemon grass and menthol), (xi) Beverages (tea, coffee), (xii) Plants used as avenue trees for shade, pollution control and aesthetics (xiii) Energy plantation - uses of *Casuarina.*

Recommended Text:

1.Pandey, B.P. 2013. Taxonomy of Angiosperms, S. Chand Publishing, New Delhi.

2.Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.

3.Singh, G. 2007. Plant systematics theory and practices. Oxford and IBH Publishing Co.

4.Jain, S.K and Rao R.R. 1993. A handbook of field and herbarium methods. Today and Tomorrow Publ.

5.Pandurangan, A.G., Vrinda, K.B and Mathew Dan. 2013. Frontiers in plant taxonomy. JNTBGRI, Thiruvananthapuram, Kerala.

6.Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.

7.Subramaniam, N.S. 1997. Modern plant taxonomy. Vikas Publishing House, New Delhi.

Reference Books:

1.Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.

2.Kumaresan, V and Annie Regland. 2004. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany & Ethnobotany.

3.Anonymous, 2004. Cultivation of Selected Medicinal Plants. National MedicinalPlants Board, Govt. of India, New Delhi.

4.Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.

5.Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.

6.Dey, A.C. 1998. Indian medicinal plants used in Ayurvedic preparations, Bishen Singh Mahendra Pal Singh.

7.Sathya, S., Jaiganesh, K.P and Sudha, T. 2019. Current Trends in Herbal Drug Technology. Pharmacy Council of India New Delhi.

8.Mohamad Ali. 2009. Pharmacognosy and Phytochemistry. CBS Publications& Distribution, New Delhi, Volume.1.

9.Lewis, W.H and M.P.F. Elwin Lewis. 1976. Medical Botany. Plants affecting Man's Health. A Wiley Inter Science Publication. John Wiley and Sons, New York.

Web resources:

1.https://www.ipni.org/

2.http://www.theplantlist.org/

3.https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592

5.https://www.tropicos.org/home

6.http://apps.kew.org/herbcat/gotoHerbariumGrowthPage.do

7.https://www.absbooksindia.com/shop/science/botany/textbook-of-economic-botany

Core – V PLANT ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS - P23BO205

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 4**
Contact Hours per Semester: 75			
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- Learn the importance of plant anatomy in plant production systems.
- Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants.
- Understand the mechanism underling the shift from vegetative to reproductive phase.
- Trace the development of male and female gametophyte.
- Understand the recent advances in palynology.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1: Learn the structures, functions and roles of apical vs lateral meristems in monocot and dicot plant growth.

CO2 Study the function and organization of woody stems derived from secondary growth in dicot and monocot plants.

CO3 Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.

CO4 Understand the various concepts of plant development and reproduction.

CO5 Profitably manipulate the process of reproduction in plants with a professional and entrepreneurial mindset.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3
CO2	3	1	3	3	3	3	3	3	3
CO3	3	1	3	3	3	3	2	3	1
CO4	3	3	3	1	1	2	2	2	1
CO5	3	3	3	3	3	3	3	3	2
Total Contribution of COs to POs	15	11	15	13	13	14	13	14	10
Weighted Percentage of COs contribution to POs	100.00	73.33	100.00	86.67	86.67	93.33	86.67	93.33	66.67

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

COURSE CONTENTS

UNIT I

CELL WALL: **(L 14+ T-1 Hours)**

Morphological and physico-chemical changes; Plasmodesmata- types of pits – growth of cell wall – formation of intercellular spaces; Meristems: Classifications: Theories of shoot and root apices, Cytological zonation in shoot apex. Vascular Cambium: Composition and organization – multiplicative and additive divisions. Xylem: Primary and secondary xylem – tracheary elements and vessels – vesselless dicots – xylem rays and axial parenchyma of angiosperm wood; Dendrochronology – grain, texture and figure in wood; reaction wood; ring porous and diffuse porous wood. Phloem: Ultra structure and ontogeny of sieve tube elements and companion cell. Evolution of tracheary elements.

UNIT II

PERIDERM: **(L 14+ T-1 Hours)**

Structure, organization and activity of phellogen. Polyderm and Rhytiderm – wound periderm. Normal secondary thickening in Dicots; Anomalous secondary growth in Dicots (Amaranthaceae, Aristolochiaceae, Bignoniaceae, Piperaceae, Nyctaginaceae) and arborescent Monocots. Primary thickening in palms; Ontogeny of leaf, Structure and types of Stomata; Leaf abscission; Major nodal

types; Kranz anatomy and its significance. Microtechnique: Principle of killing and fixation, dehydration and rehydration of botanical specimens. Stains: Principle of double staining (fast-green and light green) of free hand sections; Protocol for serial sectioning of paraffin wax impregnated specimens; Mounting and mounting media.

UNIT – III

MICROSPORANGIUM AND MALE GAMETOPHYTE: **(L 14+ T-1 Hours)**

Structure and development of Anther; Ultrastructure and physiology of anther tapetum; Male gametophyte; Palynology: Morphology and ultrastructure of pollen wall, pollen kitt, pollen analysis, pollen storage, pollen sterility and pollen physiology.

UNIT – IV

MEGASPORANGIUM AND FEMALE GAMETOPHYTE: **(L 14+ T-1 Hours)**

Structure and development of Megasporangium; Types of ovules, Endothelium, obturator and nucellus. Megasporogenesis: Female gametophyte: Structure, types, haustorialbehavior and Nutrition of embryo sacs. Fertilization: Double fertilization and triple fusion; Endosperm: Development of endosperm, types, physiological efficiency of endosperm haustoria and functions; Ruminate endosperm. Embryogeny: Development of monocot (Grass) and dicot (Crucifer) embryos.

UNIT – V

POLYEMBRYONY: **(L 14+ T-1 Hours)**

Causes of Polyembryony, classification, induction and practical application. Apomixis and its significance. Seed and Fruit development and role of growth substances. Parthenocarpy and its importance.

Recommended Text:

1.Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.

2.Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.

3.Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.

4.Pandey.S.N and Ajanta Chandha. 2006. Plant Anatomy and Embryology. Vikas Publishinf House Pvt. Ltd, New Delhi.

5.Narayanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi.

Reference Books:

1. Krishnamurthy, K.V. 1988. Methods in Plant Histochemistry. S. Viswanathan & Co., Madras.

2. Swamy, B.G.L and Krishnamurthy. K.V 1990. From flower to fruits, Tata – McGraw Hill

publishing Co Ltd, New Delhi.

3. Pullaiah, T., Lakshiminarayana, K and Hanumantha Rao, B. 2006. Text book of Embryology of Angiosperms. Regency Publications, New Delhi.

4. Bierhorst, D.W. 1971. Morphology of Vascular Plants. Macmillan publishers, New York.

1.Crang, R., Lyons-Sobaski, S and Wise, R. 2018. Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants. Springer International Publishing.

2.Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.

3.Eames, A.J and Mac Daniels, L.H. 2013. Introduction to Plant Anatomy, 3rd Edition. McGraw-Hill Inc., US.

Web resources:

1. https://www.ipni.org/
2. http://www.theplantlist.org/
3. https://faculty.etsu.edu/liuc/plant_anatomy_sites.htm
4. http://aryacollegeludhiana.in/E_BOOK/Botany/plant_anatomy.pdf
5. https://www.uou.ac.in/sites/default/files/slm/BSCBO-202.pdf
6. http://greenlab.cirad.fr/GLUVED/html/P1_Prelim/Bota/Bota_typo_014.html
7. https://www.askiitians.com/

Core – VI ECOLOGY, PHYTOGEOGRAPHY, CONSERVATION BIOLOGY & INTELLECTUAL PROPERTY RIGHTS - P23BO206

Lecture Hours	**: 70**	**Tutorial Hours**	**: 5**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester: 75			
Contact hours per Week	**: 5**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To analyze and comprehend the fundamental ideas of plant ecology as a scientific study of environment.
- To study the plant communities and plant succession stages.
- To be aware of the causes, impacts and control measures of pollution.
- To study biodiversity management and conservation.
- To enhance the knowledge of the students and equip them in evaluate and protecting invaluable components of nature and interactions with the environment.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : Understand the scope and importance of population ecology, plant communities and ecosystem ecology.

CO2 : Understand the applied aspect of environmental botany.

CO3 : Students will spot the sources and pollution and seek remedies to mitigate and rectify them.

CO4 : Identify different plant communities, categorize plant biomes and identify threatened, endangered plant species and create awareness program in protection of biodiversity.

CO5 : Analyze insight into the vegetation types, species interaction and their importance and the factors influencing the environmental conditions.

Mapping with Programme Outcomes:

COs	Program Outcomes (Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	1	2	3
CO2	3	3	2	3	3	2	3	2	3
CO3	3	2	3	2	2	2	1	2	1
CO4	3	3	2	3	3	3	3	1	3
CO5	3	3	3	3	3	3	3	3	2
Total Contribution of COs to POs	15	14	13	14	13	13	11	10	12
Weighted Percentage of COs contribution to POs	100.00	93.33	86.67	93.33	86.67	86.67	73.33	66.67	80.00

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

COURSE CONTENTS

UNIT I

ECOLOGICAL PRINCIPLES: (L 14+ T-1 Hours)

Introduction – History, scope, concepts. Diversity of plant life; growth form, life form. Basic concepts of population ecology– population dynamics – Regulation of population density. Basics concepts of community characteristics, composition, structure, origin and development–community dynamics–trends of succession.

UNIT II

ECOSYSTEMECOLOGY AND RESOURCEECOLOGY: **(L 14+ T-1 Hours)**

Introduction – kinds – major types – functional aspects of ecosystem: Food chain and food web, energy flow, laws of thermodynamics. Productivity– primary and secondary productivity – GPP& BPP. Resource Ecology: Energy resources; renewable and non-renewable. Soil: Formation, types and profile-erosion and conservation, Water resources–conservation and management. Environment Deterioration: Climate change –Greenhouse effect and global warming, ozone depletion and acidrain. Waste management-

Solidande-waste, recycling of wastes. Eco-restoration/remediation ecological foot prints - carbon foot print - ecolabeling - environmental auditing.

UNIT – III

PHYTOGEOGRAPHY: **(L 14+ T-1 Hours)**

Phytogeographical Zones - Vegetation types of India and Tamil Nadu, Distribution: Continuous, Discontinuous and Endemism. Theories of discontinuous distribution: Continental drift, Ageandarea hypothesis. Geographical Information System (GIS) Principles of remote sensing and its applications.

UNIT – IV

BIODIVERSITY AND CONSERVATION ECOLOGY: **(L 14+ T-1 Hours)**

Definition, types of biodiversity – values of biodiversity – Hot spots – Threats to biodiversity: habitat loss. Poaching of wild life – Invasion of exotic species, man and wild life conflicts-endangered and endemic plant species of India, Red list categories of IUCN, Biotechnology assisted plant conservation-in situ and ex situ methods.

UNIT – V

INTELLECTUAL PROPERTY RIGHTS**:** **(L 14+ T-1 Hours)**

Intellectual Property Rights – Introduction, Kinds of Intellectual Property Rights- Patents, Trademarks, Copyrights, Trade Secrets. Need for intellectual property right, Advantages and Disadvantages of IPR. International Regime Relating to IPR – TRIPS, WIPO, WTO, GATTS. IPR in India genesis and development. Geographical Indication – introduction, types. Patent filing procedure for ordinary application.

Recommended Text:

1.Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.

2.Pushpa Dahiya and Manisha Ahlawat. 2013. Environmental Science- A New Approach, Narosa Pub. House, New Delhi.pp.2.1-2.60.

3.Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru.

4.Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut.

5.Neeraj Nachiketa. 2018 Environmental & Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.

6.Chandra, A.M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Narosa Publishing House Pvt. Ltd. New Delhi.

Reference Books:

1.Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge

2.University Press. ISBN. 978-1107114234.

3.Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and

4.Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.

5.Ahuja, V.K. 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

6.Nithyananda, K.V. 2019. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.

7.Venkataraman M. 2015. An introduction to Intellectual property rights. Create space Independent Pub.North Charleston, USA.

8.Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.

9.Gillson, L. 2015. Biodiversity Conservation and Environmental Change, Oxford University Press, Oxford.

Web resources:

1.https://www.intechopen.com/chapters/56171

2.https://plato.stanford.edu/entries/biodiversity/

3.https://sciencing.com/four-types-biodiversity-8714.html.

4.https://www.iaea.org/topics/plant-biodiversity-and-genetic-resources

5.http://www.bsienvis.nic.in/Database/Status_of_Plant_Diversity_in_India_17566.aspx

6.https://www.youtube.com/watch?v=qtTLiQoYTyQ

7.https://www.youtube.com/watch?v=208B6BtX0Ps

8.https://www.youtube.com/watch?v=6p1TpVJYTds

9.https://www.amazon.in/Intellectual-Property-Rights-Vijay-Durafe-ebook/dp/B08N4VRQ86

Core – VII LABORATORY COURSE-II COVERING PAPERS, IV, V AND VI - P23BO2P2

Lecture Hours	**: -**	**Tutorial Hours**	**: -**
Practical Hours	**: 90**	**No. of Credit**	**: 3**
Contact Hours per Semester: 90			
Contact hours per Week	**: 6**		
Internal Marks	**: 40**		
External Marks	**: 60**		
Total Marks	**: 100**		

Objective of the Course

- Understand and develop skill sets in plant morphological, floral characteristics and artificial key preparation.
- Expedite skilled workers to carry out research in frontier areas of plant science.
- Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants
- Learn the importance of plant anatomy in plant production systems.
- Know about different vegetation sampling methods.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : To gain recent advances in plant morphological and floral characteristics.

CO2 : Understand about different floral characteristics and artificial key preparation which employed for plant identification and conservation.

CO3 : Recall or remember the information including basic and advanced in relation with plant anatomy and embryology.

CO4 : Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.

CO5 : Know about different vegetation sampling methods.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	3	S	3	3
CO2	3	3	2	3	3	3	2	3	2
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	1	2	3
CO5	3	2	2	3	3	2	2	3	3
Total Contribution of COs to POs	15	14	13	15	15	14	8	14	14
Weighted Percentage of COs contribution to POs	100.00	93.33	86.67	100.00	100.00	93.33	53.33	93.33	93.33

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

EXPERIEMENTS

UNIT I

TAXONOMY AND ECONOMIC BOTANY OF ANGIOSPERMS **(P 17+ T-1 Hours)**

Preparation of artificial keys.

Description of a species, based on virtual herbarium and live specimens of the families mentioned in the theory.

Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.

Solving nomenclature problems.

Field trip:

A field trip at least 3-4 days to a floristically rich area to study plants in nature and field report submission of not less than 20 herbarium sheets representing the families studied.

UNIT II **(P17+ T-1 Hours)**

ANATOMY

1. Study of shoot apex of *Hydrilla*
2. Observation of cambial types.
3. Sectioning and observation of nodal types.

4. Study of anomalous secondary growth of the following:

STEM- *Nyctanthus, Bouerhhavia, Aristolochia, Bignonia, Piper* petal and *Mirabilis*.

ROOT: *Acyranthus*

5. Observation of stomatal types by epidermal peeling.

6. Maceration of wood and observation of the components of xylem.

7. Double staining technique to study the stem anomali.

UNIT – III

EMBRYOLOGY **(P 17+ T-1 Hours)**

1. Observation of T.S. of anther.
2. Observation of ovule types.
3. Observation of mature embryo sacs.
4. Dissection and observation of embryos (globular and cordate embryos).
5. Study of pollen morphology
6. Study of in vitro pollen germination.
7. Observation of endosperm types.

UNIT – IV **(P17+ T-1 Hours)**

ECOLOGY,

1. Determination of the quantitative characters of a plant community by random quadrat method (abundance, density, dominance, species diversity, frequency) in grazing land, forests.

2. Estimation of above ground and below ground biomass in a grazing land employing minimum size of quadrat.

3. To determine soil moisture, porosity and water holding capacity of soil collected from varying depth at different locations.

4. Determination of pH of soil and water by universal indicator (or) pH meter.

5. Determination of dissolved oxygen.

6. Estimation of carbonate.

7. Estimation of bicarbonate.

UNIT – V **(P 17+ T-1 Hours)**

PHYTOGEOGRAPHY, CONSERVATION BIOLOGY &INTELLECTUAL PROPERTY RIGHTS

1. Mapping of world vegetation
2. Mapping of Indian vegetation.
3. Remote sensing – Analyzing and interpretation of Satellite photographs- Vegetation/ weather.

4. Visit to remote sensing laboratory (at Anna University, Regional Meteorological Centre at Numgambakkam).

RecommendedText:

1.Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.

2.Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. NiraliPrakashan, 1st Edition. ISBN: 9351642062.

3.Joshi, S.G. 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi. ISBN: 9788120414143.

4.Cutler, D.F., Botha, C.E.J., Stevenson, D.W., and William, D. 2008. Plant anatomy: an applied approach (No. QK641 C87). Oxford: Blackwell, UK.

5.Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.

6.Panshin, A.J and C. de Zeeuw.1980.Textbook of wood technology. Structure, identification and uses of the commercial woods of the United States and Canada. Fourth Edition. New York: McGraw-Hill Book Company.

7.Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.

Reference books:

1.Aler Gingauz.2001. Medicinal Chemistry. Oxford University Press & Wiley Publications.

2.Mann J. Davidson,R.S and J.B.Hobbs,D.V.Banthorpe, J.B.Harborne.1994. Natural Products. Long man Scientific and Technical Essex.

3.Gopalan, C.,B.V.Ramasastri and S.C.Balasubramanian.1985.Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.

4.Harborne. J.B. 1998. Phytochemical methods. A guide to modern techniques of Plant Analysis, Chapman and Hall publication, London.

5.Traditionalplantmedicinesassourcesofnewdrugs.P.JHoughtoninPharmacognosy.Treaseand Evan's.16Ed.2009.

6.Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.

7.Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.

Web resources:

1.https://www.kobo.com/gr/en/ebook/phytochemistry-2

2.https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H
3.https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ
4.https://studyfrnd.com/pharmacognosy-and-phytochemistry-book/
5.https://www.worldcat.org/title/textbook-of-pharmacognosy-and- phytochemistry/oclc/802053616
6.https://www.worldcat.org/title/phytochemistry/oclc/621430002

ELECTIVE-III MEDICINAL BOTANY - P23BO2E3A

Lecture Hours	**: 35**	**Tutorial Hours**	**: 10**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester: 45			
Contact hours per Week	**: 3**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To understand the uses and effects of medicinal plants and herbal supplements.
- Togain knowledge about the historical and modern uses of plants in medicine.
-
- To gain insights into the perspectives of ethnobotanical research.
- To know the various methods of harvesting, drying and storage of medicinal herbs.
- To create new strategies to enhance growth and quality check of medicinal herbs.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1: Recognize plants and relate to their medicinal uses

CO2: Explain about the phytochemistry, pharmacognosy and bioprospecting of medicinal plant extracts.

CO3 : Apply techniques for conservation and propagation of medicinal plants.

CO4 :Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.

CO5 : Develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	3	3
CO2	3	2	3	3	3	2	1	3	2
CO3	3	2	3	3	3	2	2	3	3
CO4	3	2	2	3	3	2	2	3	3
CO5	3	2	2	3	3	2	2	3	3
Total Contribution of COs to POs	3	3	3	3	3	3	1	3	3
Weighted Percentage of COs contribution to POs	3	2	3	3	3	2	1	3	2

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

COURSE CONTENTS

UNIT I

HISTORY AND TRADITIONAL SYSTEMS OF MEDICINE: **(L 7+ T-2 Hours)**

Historical Perspectives – European, African, American, Southeast Asian Practices. Scope and Importance of Medicinal Plants; Traditional systems of medicine - Definition and Scope. Classical health traditions - Naturopathy, Siddha, Ayurveda, Homeopathy, Unani and Materia Medica. Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in Ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e-tabiya, tumors treatments/ therapy, polyherbal formulations.

UNIT II

PHYTOCHEMISTRY AND PHARMACOGNOSY: **(L 5+ T- 2Hours)**

Phytochemistry, important phytoconstituents, their plant sources, medicinal properties. Histochemistry – definition, principles, staining methods. Biological stains – bright field dyes and flurochromes, detection and localization of phytochemicals. Raw drugs, authenticity, study through physical, microscopic and analytical methods. Different types of formulations. Adulteration and Admixtures.

UNIT – III

ACTIVE PRINCIPLE &DRUG DISCOVERY: **(L 7+ T-2 Hours)**

Brief description of selected plants, Active principles, biochemical properties and medicinal uses of Guggul (Commiphora) for hypercholesterolemia, Boswellia for inflammatory disorders, Arjuna (Terminalia arjuna) for cardio protection, turmeric (Curcuma longa) for wound healing, antioxidant and anticancer properties, Kutaki (Picrorhizakurroa) for hepato protection, Opium Poppy for analgesic and antitussive, Salix for analgesic, Cinchona and Artemisia for Malaria, Rauwolfiaas tranquilizer, Belladona as anticholinergic, Digitalis as cardiotonic, Podophyllum as antitumor, Stevia rebaudianafor antidiabetic, Catharanthusroseus for anticancer. Bioprospecting, drug discovery from plants with reference to diabetes and cancer.Product development and quality control.

UNIT – IV

CONSERVATION AND AUGMENTATION: **(L 7+ T-2Hours)**

Significance of Cultivation, management, policies for conservation and sustainable use of medicinal plants. Conservation of endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethno medicinal plant Gardens. Propagation of Medicinal Plants: seeds, cuttings, layering, grafting and budding.

UNIT – V

ETHNO BOTANY AND FOLK MEDICINE: **(L 8+ T-2Hours)**

Concepts and definition of Ethno botany and folk medicines. A brief history of ethnobotanical studies – globally & locally. Methods to study ethno botany; Applications of Ethno botany: Folk medicines of ethno botany, ethno medicine, ethno ecology, ethnic communities of India. Understanding the traditions of tribes in Tamil Nadu – Irulas and Kanis. Repository of Ethnobotanical data – Archeology, inventories, folklore and literature. Traditional Knowledge Sharing - Prior information consent, interviews, questionnaires and knowledge partners. Plants associated with culture, social, religious and medicinal purposes. Commercial use of traditional knowledge – ethics, IPR, biopiracy, equitable benefit sharing models.

Recommended Text:

1.AYUSH (www.indianmedicine.nic.in). 2014. About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.

2.Bhat, S.V., Nagasampagi, B.A., & Meenakshi, S. 2009. Natural Products – Chemistry and Applications. Narosa Publishing House, India Ltd.

3.CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow. 2016. AushGyanya: Handbook of Medicinal and Aromatic Plant Cultivation.

4.Kapoor, L. D. 2001. Handbook of Ayurvedic medicinal plants. Boca Raton, FL: CRC Press.

5.Saroya, A.S. 2017. Ethno botany. ICAR publication.

6.Sharma, R. 2003. Medicinal Plants of India-An Encyclopedia. Delhi: Daya Publishing House.

7.Sharma, R. 2013. Agro Techniques of Medicinal Plants. Daya Publishing House, Delhi.

8.Thakur, R. S., H. S. Puri, and Husain, A. 1989. Major medicinal plants of India. Central Institute of Medicinal and Aromatic Plants, Lucknow, India.

Reference Books:

1.Akerele, O., Heywood, V and Synge, H. 1991. The Conservation of Medicinal Plants. Cambridge University Press.

2.Evans, W.C. 2009. Trease and Evans Pharmacognosy, 16th edn. Philadelphia, PA: Elsevier Saunders Ltd.

3.Jain, S.K. and Jain, Vartika. (eds.). 2017. Methods and Approaches in Ethnobotany: Concepts, Practices and Prospects. Deep Publications, Delhi

4.Amruth. 1996. The Medicinal plants Magazine (All volumes) Medicinal plant Conservatory Society, Bangalore.

5.Bhattacharjee, S.K. 2004. Hand Book of Medicinal plants. Pointer Publishers, Jaipur.

6.Handa, S.S and V.K. Kapoor. 1993. Pharmacognosy. VallabhPrakashan, New Delhi.

Web resources:

1.https://www.amazon.in/Medical-Botany-Plants-Affecting-Health/dp/0471628824

2.https://www.amazon.in/Current-Trends-Medicinal-Botany-Muhammad/dp/9382332502

3.https://link.springer.com/book/10.1007/978-3-030-74779-4

4.https://www.elsevier.com/books/medicinal-plants/da/978-0-08-100085-4

5.https://www.pdfdrive.com/medicinal-plants-books.html

ELECTIVE-III PHYTOCHEMISTRY - P23BO2E3B

Lecture Hours	**: 35**	**Tutorial Hours**	**: 10**
Practical Hours	**:**	**No. of Credit**	**: 3**
Contact Hours per Semester: 45			
Contact hours per Week	**: 3**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To comprehend the various classesofphytochemicals presentinthe plantkingdom.
- Tounderstandthebiosyntheticprocessesthroughwhichdiversephytochemicalsare synthesizedand tostudy theirstructuralandfunctional characteristics.
- Tolearnabouttheisolationofdifferentphytochemicalsusingthestate-of-thearttechniques.
- Tolearnabouttheapplicationofdifferentphytochemicalstocurediseasesinhumanandanimals.
- To understand the information of the traditional system of medicine.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1: Understand the role of plants in the survival of human beings and other Organisms.

CO2 : Recognition of the contribution made by primitive people in exploration of plant knowledge to alleviate common diseases and development of systems of medicine.

CO3 : Gaining knowledge on different classes of phytochemicals present In higher and lower plants species.

CO4 : Demonstrate the various aspects of extraction, isolation and characterization of secondary metabolites.

CO5 : Know the methods of screening of secondary metabolites for various biological properties**.**

Mapping with Programme Outcomes:

COs	Program Outcomes (Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	3	3	3
CO2	3	3	3	2	2	1	3	2	3
CO3	3	3	3	3	3	2	2	1	3
CO4	2	3	3	3	3	2	3	2	3
CO5	2	3	3	3	3	2	2	3	2
Total Contribution of COs to POs	13	15	15	14	13	8	13	11	14
Weighted Percentage of COs contribution to POs	86.67	100.00	100.00	93.33	86.67	53.33	86.67	73.33	93.33

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

COURSE CONTENTS

UNIT I

SECONDARY METABOLITES AND CLASSIFICATION (L 7+ T-2 Hours)

Phytochemistry: Definition, history, principles. Secondary metabolites: definition, classification, occurrence and distribution in plants, functions, chemical constituents. Alkaloids, terpenoids, flavonoids, steroids, and coumarins.

UNIT II

ISOLATION AND QUANTIFICATION OF PHYTOCHEMICALS **(L 5+ T-2 Hours)**

Techniques for isolation of medicinally important biomolecules: solvent extraction, chemical separations, steam distillation, soxhlet extraction. Purification, concentration, determination and quantification of compounds (TLC, Column, HPLC).Characterization of phytochemicals: spectroscopic methods..

UNIT – III

BIOSYNTHETIC PATHWAYS AND APPLICATION OF PHYTOCHEMICALS (L 5+ T-2 Hours)

Biosynthetic pathways of secondary compounds: Shikimic pathway; Mevalonic Acid Pathway; Pathways for commercially important phytochemicals: Taxol and *Vinca* alkaloids. Applications of phytochemicals in medicine, pharmaceuticals, food, flavor and cosmetic industries.

UNIT – IV

HERBALISM AND ETHNOBOTANY **(L 8+ T-2 Hours)**

Herbs and healing: Historical perspectives: local, national and global level; Herbal cultures: origin and development of human civilizations; Ethnobotany and Ethno medicine; Development of European, South and Central American, African, Indian, Chinese, and South East Asian Herbal Cultures.

UNIT – V

TRADITIONALSYSTEMOFMEDICINE **(L 10+ T-2 Hours)**

Classical health traditions: Systems of medicine: origin and development of biomedicine; Indian Systems of Medicine (Ayurveda, Siddha, Unani, Tibetan,Yoga and Naturopathy) Ayurveda: Historical perspective, *Athuravritta* (disease management and treatment which involves eight specialties including Internal medicine and surgery); Fundamental principles of Ayurveda:Panchabhoothatheory,Thridoshatheory,Saptadhatu theory and *Mala* theory; Ayurvedic Pharmacology Ayurvedic Pharmacopoeia; *Vriksh ayurveda*.

RecommendedText:

1.Kokate, C.K., Purohit, A.P and Gokhale, S.B. 2010. Pharmacognosy. Vol. I & II. NiraliPrakashan, Pune.

2.Mohamed Ali. 2012. Textbook of Pharmacognosy. CBS Publishers & Distributors Pvt. Ltd., New Delhi.

3.Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. NiraliPrakashan, 1st Edition. ISBN: 9351642062. 2.

4.Joshi, S.G. 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi.

5.Kumar, N. 2018. A Textbook of Pharmacognosy. Aitbs Publishers, India.

Reference Books:

1.Shah, B.N. 2005. Textbook of Pharmacognosy and phytochemistry. Cbs Publishers &Distributors, New Delhi.

2.Harshal A andPawar. 2018.Practicalbookof pharmacognosyandphytochemistry-EverestPublishinghouse.

3.Varsha TiwariandShamim Ahmad. 2018.Apracticalbookofpharmacognosy and phytochemistry.Niraliprakashanadvancementofknowledge.

4.Braithwaite,AandF.J.Smith.1996.ChromatographicMethods(5thEdition)BlackieAcademic&Professional London.

5.Wilson,KandJ.Walker(Eds).1994.PrinciplesandTechniquesofPracticalBiochemistry(4thEdition)CambridgeUniversityPress,Cambridge.

6.Harborne. J.B. 1998. Phytochemical methods. A guide to modern techniques of Plant Analysis,Chapman and Hall publication, London.

Web resources:

1.https://www.kobo.com/gr/en/ebook/phytochemistry-2

2.https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H

3.https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ

4.https://studyfrnd.com/pharmacognosy-and-phytochemistry-book/

5.https://www.worldcat.org/title/textbook-of-pharmacognosy-and-phytochemistry/oclc/802053616

6.https://www.worldcat.org/title/phytochemistry/oclc/621430002

ELECTIVE-III RESEARCH METHODOLOGY, COMPUTER APPLICATIONS & BIOINFORMATICS - P23BO2E3C

Lecture Hours	**: 35**	**Tutorial Hours**	**: 10**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester: 45			
Contact hours per Week	**: 3**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.
- To provide an overview on modern equipments that they would help students gain confidence to instantly commence research careers and/or start entrepreneurial ventures.
- To develop interdisciplinary skills in using computers in botany to learn about the biological database.
- Students aware with the most recent technologies for sequencing and bioinformatics analysis and is able to apply them to the structural and functional genomics of plants.
- Operate various software resources with advanced functions and its open office substitutes.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : Realize the need of centrifuges and chromatography and their uses in research

CO2 : Learn the principles and applications of electrophoresis.

CO3 : Construct the phylogenetic trees for similar characteristic feature of plant genomes and study de novo drug design through synthetic biology.

CO4: Understand the concept of pairwise alignment of DNA sequences using algorithms.

CO5 : Interpret the features of local and multiple alignments.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	3	1	3	3
CO2	3	2	2	3	3	3	2	3	3
CO3	3	1	2	3	3	3	1	3	3
CO4	3	2	1	3	3	3	1	3	2
CO5	3	1	2	2	3	3	2	3	3
Total Contribution of COs to POs	15	8	9	13	15	15	7	15	14
Weighted Percentage of COs contribution to POs	100.00	53.33	60.00	86.67	100.00	100.00	46.67	100.00	93.33

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

COURSE CONTENTS

UNIT I (L 8+ T-2 Hours)

Literature collection and citation: bibliography —bibliometrics (scientometrics): definition-laws — citations and bibliography - *biblioscape— plagiarism— project proposal writing — dissertation writing – paper presentation (oral/poster) - E-learning tools- monograph — introduction and writing-Standard operating procedure (SOP) – introduction and preparation — Research Institutions - National and International.

UNIT II (L 7+ T-2 Hours)

Basic principles and applications of pH meter, UV-visible spectrophotometer, centrifuge, lyophilizer, chromatography- TLC, Gas chromatography with mass spectrum (GC/MS), and HPLC-Scanning electron microscopy-Agarose gel Electrophoresis — Polyacrylamide GelElectrophoresis –Polymerase chain reaction

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UNIT – III (L 9+ T-2 Hours)

Introduction to computers and Bioinformatics. Types of hardware and software operating systems. Fundamentals of networking, operation of networks, telnet, ftp, www, Internet. Biological Research on the web: Using search engines, finding scientific articles.

UNIT – IV **(L 4+ T-2 Hours)**

Public biological databases, searching biological databases. Use of nucleic acid and protein data banks.

UNIT – V **(L 9+ T-2Hours)**

NCBI, EMBL, DDBJ, SWISSPORT, Protein prediction and Gene finding tools. Techniques in Bioinformatics- BLAST, FASTA, Multiple Sequence Analysis.

Recommended Text:

1.Veerakumari, L. 2017. Bioinstrumentation. MJP Publisher, India. p578.

2.SreeRamulu, V.S.1988. Thesis Writing, Oxford& IBH Pub. New Delhi.

3.Kothekar, V and T.Nandi. 2009. An introduction to Bioinformatics. Panima publishing crop, New Delhi.

4.Mani, K and N. Vijayaraj. 2004. Bioinformatics – A Practical Approach.1st Edn. Aparna publication, Coimbatore.

5.Gurumani, N. 2019. Research Methodology: For Biological Sciences, MP. Publishers.

Reference Books:

1.Jayaraman, J. 2000. Laboratory manual of Biochemistry, Wiley Eastern Limited, New Delhi 110 002.

2.Pevsner,J.2015.Bioinformaticsandfunctionalgenomics.Hoboken,NJ:Wiley-Blackwell.

3.Arthur Conklin W.M and Greg White, 2016. Principles of computer security. TMH. McGraw-Hill Education; 4 edition.

4.Irfan Ali Khan and Attiya Khanum (eds.). 2004. Introductory Bioinformatics. Ukaaz Publications, Hyderabad.

5.Arthur Conklin W.M., and Greg White. 2016. Principles of computer security. TMH., McGraw-Hill Education; 4th edition

6.Mishra Shanthi Bhusan. 2015. Handbook of Research Methodology - A Compendium for Scholars & Researchers, Ebooks2go Inc.

7.Narayana, P.S.D. Varalakshmi, T. Pullaiah. 2016. Research Methodology in Plant Science, Scientific Publishers, Jaipur, Rajasthan.

Web resources:

1.https://www.kobo.com/in/en/ebook/bioinstrumentation-1

2.https://www.worldcat.org/title/bioinstrumentation/oclc/74848857

3.https://www.amazon.in/Bioinstrumentation-M-H-Fulekar-Bhawana-Pandey-ebook/dp/B01JP3M9TW

4.https://en.wikipdia.org/wiki/bioinstrumentation
5.https://www.britannica.com/science/chromatography
6.https://en.wikipedia.org/wiki/electrophoresis

ELECTIVE-III BIOPESTICIDE TECHNOLOGY - P23BO2E3D

Lecture Hours	**: 35**	**Tutorial Hours**	**: 10**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester: 45			
Contact hours per Week	**: 6**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To understand the value and applications of biopesticides.
- To comprehend the various issues related to the use of chemical pesticides in horticulture, forestry, and agriculture.
- To gain knowledge about several biopesticides (bio-insecticides, bio-fungicides, bio-bactericides, bio-nematicides and bio-herbicides).
- To gain knowledge of the techniques for mass production of selected biopesticides.
- To be aware of the application strategies and weeds, nematodes, and disease targets.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 Understand the issues in use of chemical pesticides and their harmful effects on life.

CO2 Aware the significance of biopesticides and their beneficial role in controlling insect pests, diseases, nematodes and weeds.

CO3 Knowledge on identification of promising biopesticides and their mechanisms of action against insect pests, diseases, nematodes and weeds.

CO4 Learn the mass production and formulation technology of selected biopesticides.

CO5 Knowledge on product development for commercialization of biopesticides.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3
CO2	3	2	2	2	3	3	1	3	3
CO3	3	3	3	3	1	1	2	3	2
CO4	3	2	2	2	3	2	1	2	1
CO5	3	3	3	3	2	3	3	2	3
Total Contribution of COs to POs	15	13	13	13	12	12	10	13	12
Weighted Percentage of COs contribution to POs	100.00	86.67	86.67	86.67	80.00	80.00	66.67	86.67	80.00

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

COURSE CONTENTS

UNIT I

INTRODUCTION (L 7+ T-2 Hours)

Introduction of biopesticides. Biological control, History and concept of biopesticides. Importance, scope and potential of biopesticide. Advantages for the use of biopesticides.

UNIT II

TYPES OF BIOPESTICIDES **(L 10 T-2Hours)**

Classification of biopesticides, botanical pesticides and biorationales. Mass production technology of bio-pesticides. Major classes-Properties and uses of Bioinsecticides, biofungicides, biobactericides, bionematicides and bioherbicides. Importance of neem in organic agriculture.

UNIT – III

IMPORTANT BIOINSECTICIDES (L 8+ T-2 Hours)

Bacillus thuringiensis, NPV, entomopathogenic fungi (*Beauveria, Metarhizium, Verticillium, Paecilomyces*). Biofungicides: *Trichoderma, Gliocladium,* non-pathogenic *Fusarium, Pseudomonas* spp.,

Bacillus spp. Biobactericides: *Agro bacterium radiobacter*. Bionematicides: *Paecilomyces*, *Trichoderma*, Bioherbicides: *Phytophthora*, *Colletotrichum*.

UNIT – IV

STANDARDIZATION OF BIOPESTICIDES **(L 5+ T-2 Hours)**

Target pests and crops of important biopesticides and their mechanisms of action. Testing of quality parameters and standardization of biopesticides.

UNIT – V

FORMULATION **(L 5+ T-2Hours)**

Mass multiplication and formulation technology of biopesticides. Prospects and problems in commercialization and efficiacy of biopesticides. Commercial products of biopesticides.

RecommendedText:

1.Johri,J.2020.RecentAdvancesinBiopesticides:BiotechnologicalApplications.NewIndiaPublishingAgency (NIPA), NewDelhi.

2.Kaushik,N.2004.Biopesticidesforsustainableagriculture:prospectsandconstraints.TERIPress,New Delhi.

3.Sahayaraj,K.2014.BasicandAppliedAspectsofBiopesticides.SpringerIndia,NewDelhi.

4.Tebeest,D.O.2020.MicrobialControlofWeeds.CBSPublishersandDistributors,New Delhi.

5.Joshi, S.R. 2020. Biopesticides: A Biotechnological Approach. New Age International (P) ltd. New Delhi.

Reference Books:

1.Ainsworth, G.C. 1971. A Dictionary of the Fungi. Commonwealth Mycological Institute, Kew, Surrey, England.

2.Carlile, M.J., Watkinson, S.C and Gooday, G.W. 2001. The Fungi. 2nd Edition. Academic Press, San Diego

3.Manoj Parihar, Anand Kumar. 2021. Biopesticides. Volume 2: Advances in Bio-inoculants. Elsevier.

4.Bailey, A., Chandler, D., Grant, W. P., Greaves, J., Prince, G., Tatchell, M. 2010. Biopesticides: pest management and regulation.Plumx.

5.Manoharachary, C., Singh, H.B., Varma, A. 2020. Trichoderma: Agricultural Applications and Beyond. Springer International Publishing, New York, USA.

6.Nollet, L.M.L and Rathore, H.S. 2019. Biopesticides Handbook. CRC Press, Florida, USA.

7.Anwer, M.A. 2021. Biopesticides and Bioagents: Novel Tools for Pest Management. Apple Academic Press, Florida, USA.

8.Awasthi, L.P. 2021. Biopesticides in Organic Farming: Recent Advances. CRC Press, Florida, USA.
9.Bailey, A., Chandler, D., Grant, W., Greaves, J., Prince, G., Tatchell, M., 2012. Biopesticides: Pest Management and Regulation. CABI, Surrey, UK.
10.Glare, T.R and Moran-Diez, M.E. 2016. Microbial-Based Biopesticides: Methods and Protocols. Humana Press, New Jersey, USA.
11.Gnanamanickam,S.S.2019.BiologicalControlofCropDiseases.CRCPress,Florida,USA.

Web resources:

1.https://www.kobo.com/gr/en/ebook/phytochemistry-2
2.https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H
3.https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ
4.https://studyfrnd.com/pharmacognosy-and-phytochemistry-book/
5.https://www.worldcat.org/title/textbook-of-pharmacognosy-and-phytochemistry/oclc/802053616
6.https://www.worldcat.org/title/phytochemistry/oclc/621430002

ELECTIVE-IV APPLIEDBIOINFORMATICS - P23BO2E4A

Lecture Hours	**: 35**	**Tutorial Hours**	**: 10**
Practical Hours	**: -**	**No. of Credit**	**: 3**
Contact Hours per Semester: 45			
Contact hours per Week	**: 3**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To learn about the bioinformatics databases, databanks, data format and data retrieval from the online sources
- To explain the essential features of the interdisciplinary field of science for better understanding biological data.
- To outline the types of biological databases.
- To demonstrate different online bioinformatics tools.
- To summarize the strong foundation for performing further research in bioinformatics.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 Familiarize with the tools of DNA sequence analysis.

CO2 Use and explain the application of bioinformatics.

CO3 Master the aspects of protein-protein interaction, BLAST and PSI- BLAST.

CO4 Describe the features of local and multiple alignments.

CO5 Interpret the characteristics of phylogenetic methods and bioinformatics applications.

Mapping with Programme Outcomes:

COs	**Program Outcomes(Pos)**						**Program Specific Outcomes (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	3	3	3	3

CO2	2	3	3	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	1	3	3
CO5	3	2	2	2	3	2	3	3	3
Total Contribution of COs to POs	14	14	14	14	15	14	13	14	14
Weighted Percentage of COs contribution to POs	93.33	93.33	93.33	93.33	100.00	93.33	86.67	93.33	93.33

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

COURSE CONTENTS

UNIT I

BIOINFORMATICSANDINTERNET: **(L 6+ T-2Hours)**

Internet Basics –File Transfer Protocol-The World Wide Web-Internet Resources–databases–types-Applications-NCBI Data Model-SEQ-Ids–Biosequences-

Biosequence sets–Sequence annotation–Sequence description.

UNIT II

GENBANK SEQUENCE DATABASE: **(L 5+ T-2 Hours)**

Introduction- Primary And Secondary Databases - Format Vs. Content- Genbank Flatfile -Submitting DNA Sequences to the Databases - DNA/RNA-Population, Phylogenetic, and Mutation Studies - Protein-Only Submissions - Consequences of DNA Model -EST/STS/GSS/HTG/SNP and Genome Centers -Contact points for submission of sequence data to DBJ/EMBL/Genbank..

UNIT – III

STRUCTURE DATABASES: **(L 8+ T-2 Hours)**

Introduction to Structures- Protein Data Bank (PDB) – Molecular Modeling Database at NCBI Structure File Formats - Visualizing Structural Information –Database Structure Viewers –Advanced Structure Modeling-Structure Similarity Searching.

UNIT – IV

SEQUENCEALIGNMENTANDDATABASESEARCHING: **(L 8+ T-2Hours)**

Introduction-EvolutionaryBasisofSequenceAlignment-ModularNatureofProteins-Optimal Alignment Methods-Substitution Scores and Gap Penalties-DatabaseSimilaritySearching-FASTA–BLAST(BlastP,BlastN,etc.,)-PositionSpecificScoringMatrices, Spliced Alignments..

UNIT – V

PREDICTIVE METHODS: (L 8+ T-2 Hours)

Using Protein Sequences Protein Identity Based on Composition – Physical Properties Based on Sequence - Motifs and Patterns - Secondary Structure and Folding Classes –Specialized Structures or Features-Tertiary Structure.

Recommended Text:

1.Baxevanis,A.D.&Ouellette,B.F.2001.Bioinformatics:Apracticalguidetotheanalysisofgenesand proteins. New York: Wiley-Inter science.

2.Bourne,P.E.,& Gu,J.2009. Structural bioinformatics. Hoboken, NJ: Wiley-Liss.

3.Lesk,A.M.2002. Introduction to bioinformatics. Oxford: Oxford University Press.

4.Mount,D.W.2001.Bioinformatics:Sequence and genome analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

5.Pevsner,J.2015.Bioinformaticsandfunctionalgenomics.Hoboken,NJ:Wiley-Blackwell.

Reference Books:

1.Campbell,A.MandHeyer,L.J.2003.Discovering genomics, proteomics, and bioinformatics. SanFrancisco: Benjamin Cummings.

2.Green,M.R and Sambrook,J.2012.Molecularcloning:Alaboratorymanual.ColdSpringHarbor,NY: Cold Spring Harbor Laboratory Press.

3.Liebler,D.C.2002.Introduction to proteomics: Tools for the new biology. Totowa, NJ: Humana Press.

4.Old,R.W.,Primrose,S.B.,andTwyman,R.M.2001.Principlesofgenemanipulation:Anintroductionto genetic engineering. Oxford: Blackwell Scientific Publications.

5.Primrose,S.B.,Twyman,R.M.,Primrose,S.B.,andPrimrose,S.B.2006.Principlesofgene manipulation and genomics. Malden, MA: Black well Pub.

Web resources:

1.Bioinformatics:Algorithms&ApplicationsbyProf.M.MichaelGromihaIIT-Madras.
https://nptel.ac.in/courses/102/106/102106065/#.

2.ChristopherBurge,DavidGifford,andErnestFraenkel.

7.91.JFoundationsofComputationalandSystemsBiology.
Spring2014.MassachusettsInstituteofTechnology:MITOpenCourseWare,https://ocw.mit.edu.

3.https://link.springer.com/book/10.1007/978-3-540-72800-9.

4.https://www.amazon.in/Applied-Bioinformatics-Paul-Maria-Selzer-ebook/dp/B001AUOYY2.

5.https://books.google.co.in/books/about/Applied_Bioinformatics.html?id=PXZZDwAAQBAJ&redir_esc=y.

ELECTIVE-IV BIOSTATISTICS - P23BO2E4B

Lecture Hours	**: 40**	**Tutorial Hours**	**:5**
Practical Hours	**:**	**No. of Credit**	**: 3**
Contact Hours per Semester: 45			
Contact hours per Week	**: 6**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To provide the student with a conceptual overview of statistical methods.
- To emphasis on usefulness of commonly used statistical software for analysis, research, and experimentation.
- To understand and evaluate critically the acquisition of data and its representation.
- To gain the knowledge about the probability and statistical inference are all topics that will be taught in order to obtain knowledge about the graphical representation of data.
- To learn more about how to organize, create, and carry out the distribution of scientific knowledge.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 Create and interpret visual representations of quantitative information, such as graphs or charts.

CO2 Solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods

CO3 Know the latest version using in statistical tools and apply the tools to interpret the results

CO4 To develop their competence in hypothesis testing and interpretation.

CO5 Understand why biologists need a background in statistics.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)							Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	3	3	3	3	1	3	1
CO2	3	2	2	3	3	3	2	1	2	1
CO3	3	1	2	3	3	3	3	2	2	2
CO4	3	2	1	3	2	2	3	3	3	3
CO5	3	2	3	3	3	3	3	1	3	1
Total Contribution of COs to POs	15	9	9	15	14	14	14	8	13	8
Weighted Percentage of COs contribution to POs	100.00	60.00	60.00	100.00	93.33	93.33	93.33	53.33	86.67	53.33

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

COURSE CONTENTS

UNIT I

INTRODUCTION TO STATISTICS **(L 8+ T-1 Hours)**

Introduction to biostatistics, basic principles, variables - Collection of data, sample collection and representation of Data - Primary and Secondary - Classification and tabulation of Data – Diagrams, graphs and presentation.

UNIT II

DESCRIPTIVE STATISTICS **(L 6+ T-1 Hours)**

Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range of variation, standard deviation and standard error and coefficient variation.

UNIT – III

PROBABILITY **(L 7+ T-1 Hours)**

Basic principles - types - Rules of probability - addition and multiplication rules.

PROBABILITY DISTRIBUTION

Patterns of probability distribution; binomial - Poisson and normal.

UNIT – IV

HYPOTHESIS TESTING **(L 9+ T-1 Hours)**

Chi-square test for goodness of fit; Null hypothesis, level of Significance - Degrees of Freedom. Student 't' test – paired sample and mean differences 't' tests. ANOVA. Basic introduction to Multivariate Analysis of Variance (MANOVA).

UNIT – V

CORRELATION AND REGRESSION **(L 10+ T-1 Hours)**

Correlation - types of correlation - methods of study of correlation - testing the significance of the coefficients of correlation. Regression and types. Sampling and experimental designs of research- Randomized block design and split plot design.

Recommended Text:

1.Gurumani, N. 2005. Biostatistics, 2nd edn. MJP publications, India.

2.Datta, A.K. 2006. Basic Biostatistics and Its Applications. New Central Book Agency. ISBN 8173815038.

3.Pillai, R.S.N and Bagavathi, V.S. 2010. Statistics theory and practice. Chand & Co. Ltd, New Delhi.

4.Mahajan, B.K. 1984. Methods in Biostatistics for Medical students and Research works. Smt. Indu Mahajan, New Delhi.

5.Pillai, R.S.N and Bagavathi, V.S. 2010. Statistics theory and practice. Chand & Co. Ltd, New Delhi.

6.Khan, I.Dand Khanum, A. 2004. Fundamentals of Biostatistics, Ukazsz Publications, Hyderabad, India.

7.Gupta, S.C. 2013. Fundamentals of statistics, Himalaya Publishers, Mumbai.

8.Kothari, C.R and Garg, G. 2014. Research methodology –Method and techniques. New Age International (P) Ltd. New Delhi.

Reference books:

1.Milton, J.S. 1992. Statistical method in Biological and Health Sciences. McGraw Hill Inc., New York.

2.Schefler, W.C. 1968. Statistics for biological sciences, Addision- Wesely Publication Co., London.

3.Spiegel, M.R. 1981. Theory and Problems of statistics, Schaum's Outline series McGraw-Hill International Book Co., Singapore.

4.Pillai, R.S.N and Bagawathi, V. 1987. Practical Statistics (For B.Com. and B.A., Students) S.Chand & Co. (Pvt.) Ltd., New York.

5.Sobl. R.R and Rohif, F.J. 1969. Biometry. The principles and Practice and Statistics in Biological Research. W.H. Freman and Co., San Francisco.

6.Zar, J.K. 2011. Biostatistical Analysis, Fourth Edition, Prantice-Hall International, New Jersey, USA.

Web resources:

1.nu.libguides.com/biostatistics

2.https://newonline courses.sciences.psu.edu/

3.https://bookauthority.org/books/beginner-biostatistics-ebooks

4.https://www.amazon.com/dp/1478638184?tag=uuid10-20

5.https://hastie.su.domains/ElemStatLearn/

ELECTIVE-IV INTELLECTUAL PROPERTY RIGHTS - P23BO2E4C

Lecture Hours	**: 35**	**Tutorial Hours**	**: 10**
Practical Hours	**:**	**No. of Credit**	**: 3**
Contact Hours per Semester: 45			
Contact hours per Week	**: 3**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- Cater to the needs of the stakeholders of knowledge economy is designed for those interested in managers and similar individuals.
- Create awareness of current IPR and innovation trends.
- Disseminate information on patents, patent system in India and overseas and registration related issues.
- Pursue a career in IPR, which offers chances for IP consultants and Attorneys.
- Develop skill sets to enable you to comprehend and assess the methods used in knowledge based economy and innovation ecosystems.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 Recall the history and foundation of Intellectual Property.

CO2 Understand the differences of Property and Assets and Various Categories of Intellectual Creativity.

CO3 Apply the methods to protect the Intellectual Property.

CO4 Differentiate if the Said Intangible property be protected under law or protected by strategy.

CO5 Create a recommendation document on the methods and procedures of protecting the said IP and search documents to substantiate them.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)							Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	3	2
CO2	3	3	3	3	3	3	2	2	3	3
CO3	3	2	3	2	2	3	3	3	2	1
CO4	3	2	3	2	2	3	1	3	2	3
CO5	3	2	1	3	2	3	2	3	2	3
Total Contribution of COs to POs	15	12	13	13	12	14	11	13	12	12
Weighted Percentage of COs contribution to POs	100.00	80.00	86.67	86.67	80.00	93.33	73.33	86.67	80.00	80.00

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

COURSE CONTENTS

UNIT I

INTRODUCTION TO IPR (L 8+ T-2 Hours)

History and Development of IPR. Theories on concept of property: Tangible *vs* Intangible. Subject matters patentable in India. Non patentable subject matters in India. Patents: Criteria of Patentability, Patentable Inventions - Process and Product. Concept of Copyright. Historical Evolution of Copyright Ownership of copyright, Assignment and license of copyright.

UNIT II

OVERVIEW OF THE IPR REGIME AND DESIGN (L 6+ T-2 Hours)

International treaties signed by India. IPR and Constitution of India. World Intellectual Property Organization (WIPO): Functions of WIPO, Membership, GATT Agreement. Major Conventions on IP: Berne Convention, Paris Convention. TRIPS agreement. Industrial Designs – Subject matter of Design – Exclusion of Designs – Novelty and originality – Rights in Industrial Design.

UNIT – III

TRADE MARK, LEGISLATIONS AND PATENT ACT **(L 7+ T-2 Hours)**

History of Indian Patent Act 1970. Overview of IP laws in India. Major IP Laws in India. Patent Amendment Act 2005. WTO-TRIPS – Key effect on Indian Legislation. Organization of Patent System in India. Concept of Trademarks, Different kinds of marks, Criteria for registration, Non Registrable Trademarks, Registration of Trademarks. Infringement: Remedies and Penalties.

UNIT – IV

PRIOR ART SEARCH AND DRAFTING (L 7+ T-2 Hours)

Overview of Patent Search. Advantages of patent search. Open source and paid databases for Patent Search. International Patent classification system. Types of specifications: Drafting of Provisional specifications. Drafting of complete specifications. Drafting of claims.

UNIT – V

GIAND PATENT FILING PROCEDURES (L 7+ T-2Hours)

Geographical Indications of Goods (Registration and Protection) Infringement – Offences and Penalties Remedies. Plant Variety and Farmers Right Act (PPVFR). Plant variety protection: Access and Benefit Sharing (ABS). Procedure for registration, effect of registration and term of protection. Role of NBA. Filing procedure for Ordinary application. Convention application. PCT National Phase application. Process of Obtaining a Patent. Infringement and Enforcement.

RecommendedText:

1.Kalyan, C.K.2010. Indian Patent Law and Practice, India, Oxford University Press.

2.Ahuja, V.K. 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

3.Arthur Raphael Miller, Micheal Davis H. 2000. Intellectual Property: Patents, Trademarks and .Copyright in a Nutshell, West Group Publishers.

4.Margreth, B. 2009. Intellectual Property, 3nd, New York Aspen publishers.

5.Nithyananda, K.V. 2019. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.

6.Venkataraman M. 2015. An introduction to Intellectual property rights. Create space Independent Pub.North Charleston, USA.

ReferenceBooks

1.World Intellectual Property Organization. 2004. WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf Journal of Intellectual Property Rights (JIPR): NISCAIR.

2.Anant Padmanabhan. 2012. Intellectual Property Rights: Infringement and Remedies Lexis Nexis Butterworths Wadhwa.

3.Intellectual Property Law in the Asia Pacific Region. 2009. Kluwer Max Planck Series,

4.Pradeep, S. Mehta (ed.). 2005. Towards Functional Competition Policy for India, Academic Foundation, Related.

5.Ramakrishna B and Anil Kumar, H.S. 2017. Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers, Notion Press, Chennai.

6.James Boyle, Jennifer Jenkins. 2018. Intellectual Property: Law & the Information Society—Cases and Materials, Create space Independent Pub. North Charleston, USA.

7.Damodar Reddy, S.V. 2019. Intellectual Property Rights -- Law and Practice, Asia Law House, Hyderabad.

Web resources:

1.http://cipam.gov.in/

2.https://www.wipo.int/about-ip/en/

3.http://www.ipindia.nic.in/

4.https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.

5.https://swayam.gov.in/nd2_cec20_ge04/preview

ELECTIVE-IV NANOBIOTECHNOLOGY - P23BO2E4D

Lecture Hours	**: 45**	**Tutorial Hours**	**: 10**
Practical Hours	**:-**	**No. of Credit**	**: 3**
Contact Hours per Semester: 45			
Contact hours per Week	**: 3**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To introduce the learners to the basic concepts in the emerging frontiers of nanotechnology.
- To give perspective to researchers and students who are interested in nanoscale physical and biological systems and their applications in medicine.
- To introduce the concepts in nanomaterials and their use with biocomponents to synthesize and interact with larger systems.
- To impart knowledge on the most recent molecular diagnostic and therapeutic tools used to treat various diseases.
- Incorporate sustainability in to account when you develop nanotechnology responsibly.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 : Recall the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology.

CO2 : Formulate procedures for the synthesis of nanoparticles which are of medical importance which could be used to treat specific diseases.

CO3 : Characterize the various types of nano particle synthesis and advocate promotes the use of nano materials and anno composites.

CO4: Analyze and apply the important of nanoparticles in plant diversity.

CO5 : Construct various types of nanomaterial for application and evaluate the impact on environment.

Mapping with Programme Outcomes:

COs	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	1	2	3
CO3	3	3	3	2	3	3	2	2	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3
Total Contribution of COs to POs	15	15	15	14	15	15	12	13	15
Weighted Percentage of COs contribution to POs	100.00	100.00	100.00	93.33	100.00	100.00	80.00	86.67	100.00

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

COURSE CONTENTS

UNIT I

BASIC CONCEPTS IN NANOBIOLOGY (L 5+ T-2 Hours)

History of Nanotechnology, Difference between Nanoscience and Nanotechnology, Green nanotechnology, Bottom up and top down approaches.

UNIT II

DIVERSITY IN NANOSYSTEMS (L 7+ T-2 Hours)

Carbon based nanostructures - fullerences, nanotubes, nanoshells, buckyballs – biomolecules and nanoparticles, nanosensors, nanomaterials -Classification based on dimensionalityquantum dots, wells and wires – metal based nano materials (gold, silver and oxides) - Nanocomposites- Nanopolymers – Nanoglasses–Nano ceramics..

UNIT – III

METHODS OF NANOBIOTECHNOLOGY (L8+ T-2Hours)

Optical tools – Nanoforce and imaging – Surface methods – Mass spectrometry – Electrical Characterization and Dynamics of Transport – Microfludics: Concepts and applications to the Life Sciences.

UNIT – IV

NANOBIOTECHNOLOGY **(L 5+ T-2Hours)**

Nanodevices and nanomachines based on biological nanostructures - Protein and DNA nano arrays, tissue engineering, and luminescent quantum dots for biological labeling.

UNIT – V

APPLICATIONS OF NANOBIOTECHNOLOGY **(L 10+ T-2 Hours)**

Real Time PCR – Biosensors : From the glucose electrode to the Biochip – DNA Microarrays – Protein Microarrays – Cell Biochips – Lab on a chip – Polyelectrolyte multilayers – Biointegrating materials – Pharmaceutical applications of nanoparticles carriers.

Recommended Text:

1.Dupas, C, Houdy, P., Lahmani, M. 2007. Nanoscience: ―Nanotechnologies and Nanophysics‖, Springer-Verlag Berlin Heidelberg.

2.Sharon, M and Sharon, M. 2012. Bio-Nanotechnology- Concepts and Applications, CRC Press.

3.Atkinson, W.I.2011. Nanotechnology. Jaico Book House, New Delhi.

4.Nalwa, H.S. 2005. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology. American Scientific Publ.

5.Lindsay, S.M. 2011. Introduction to Nanoscience, Oxford universal Press, First Edition.

6.Jain K.K. 2006. Nanobiotechnology molecular diagnostics: Current techniques and application (Horizon Bioscience).Taylor & Francis 1st edition.

7.Pradeep, T. 2012. Textbook of Nanoscience and Nanotechnology, McGraw Hill Education(India)Private Limited.

8.XiuMeiWang,MuruganRamalingam,XiangdongKongandLingyunZhao.2017.Nanobiomaterials: Classification, Fabrication and Biomedical Applications, Wiley-VCHVerlagGmbH & Co. KGaA.

Reference Books:

1.Claudio Nicolini. 2009. Nanotechnology Nanosciences, Pon Stanford Pub.Pvt.Ltd,

2.Robert, A and Ferias, Jr. 1999.Nanomedicine, Volume I: Basic capabilities,Landes Bioscience.

3.Barbara Panessa-Warren. 2006 Understanding cell-nanoparticle interactions making nanoparticles more biocompatible. Brookhaven National Laboratory.

4.European Commission, SCENIHR. 2006. Potential risks associated with engineered and adventitious products of nanotechnologies, European Union.

5.Gysell Mortimer, 2011. The interaction of synthetic nanoparticles with biological systems PhD Thesis, School of Biomedical Sciences, Univ.of Queensland.

6.Murty, B.S.,Shankar, P., Raj, B., Rath,B.B.,Murday, J. 2013. Textbook ofNanoscience and Nanotechnology.Spirnger Publication.

7.Prashant Kesharwani. 2019. Nanotechnology-Based Targeted Drug Delivery Systems for Lung Cancer. Academic Press. An imprint of Elsevier.

Web resources:

1.https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453

2.https://www.elsevier.com/books/nanobiotechnology/ghosh/978-0-12-822878-4

3.https://www.routledge.com/Nanobiotechnology-Concepts-and-Applications-in-Health-Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179

4.https://www.nanowerk.com/nanotechnology/periodicals/ebook_a.php

5.https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html

6.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/

7.https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html

8.http://www.particle-works.com/applications/controlled-drug-release/Applications

SKILL ENHANCEMENT COURSE (SE1)

AGRICULTURE AND FOOD MICROBIOLOGY - P23BO2SE1

Lecture Hours	**: 35**	**Tutorial Hours**	**: 10**
Practical Hours	**:**	**No. of Credit**	**: 2**
Contact Hours per Semester: 45			
Contact hours per Week	**: 3**		
Internal Marks	**: 25**		
External Marks	**: 75**		
Total Marks	**: 100**		

Objective of the Course

- To provide comprehensive knowledge about plant – microbe interactions.
- To provide basic understanding about factors affecting growth of microbes
- To appreciate the role of microbes in food preservation.
- To understand about the benefits of microbes in agriculture and food industry.
- To gain knowledge about practices involved in food industry.

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 Recognize the general characteristics of microbes and factors affecting its growth

CO2 Explain the significance of microbes in increasing soil fertility

CO3 Elucidate concepts of microbial interactions with plant and food.

CO4 Analyze the impact of harmful microbes in agriculture and food Industry.

CO5 Determine and appreciate the role of microbes in food preservation and as biocontrol.

Mapping with Programme Outcomes:

COs	Program Outcomes (Pos)						Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	3	2	2	2	2	1
CO2	3	3	2	2	3	3	3	3	3
CO3	2	2	3	3	1	1	3	1	2

CO4	3	3	3	3	3	3	3	3	2
CO5	3	3	2	3	2	2	3	2	3
Total Contribution of COs to POs	14	14	11	14	11	11	14	11	11
Weighted Percentage of COs contribution to POs	93.33	93.33	73.33	93.33	73.33	73.33	93.33	73.33	73.33

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

COURSE CONTENTS

UNIT I

ROLE OF MICROORGANISMS IN AGRICULTURE **(L 7+ T-2 Hours)**

Role of symbiotic and free-living bacteria and cyanobacteria in agriculture., Mycorrhiza, Plant Growth Promoting Microorganims (PGPM) and Phosphate Solubilizing Microorganims (PSM).

UNIT II

BIOCONTROL AND BIOFERTILIZATION **(L 7+ T-2 Hours)**

Biocontrol of plant pathogens, pests and weeds, Restoration of waste and degraded lands, Biofertilizers: Types, technology for their production and application, vermi-compost.

UNIT – III

FOOD MICROBIOLOGY **(L 6+ T-2 Hours)**

Intrinsic and extrinsic factors influencing growth of microorganisms in food, Microbes as source of food: Mushrooms, single cell protein.

UNIT – IV

FOOD MICROBIOLOGY **(L 8+ T-2 Hours)**

Microbial spoilage of food and food products: Cereals, vegetables, prickles, fish and dairy products. Food poisoning and food intoxication. Food preservation processes. Microbes and fermented foods: Butter, cheese and bakery products..

UNIT – V

PREDICTIVE METHODS: (L 8+ T-2 Hours)

Using Protein Sequences Protein Identity Based on Composition – Physical Properties Based on Sequence - Motifs and Patterns - Secondary Structure and Folding Classes –Specialized Structures or Features-Tertiary Structure.

Recommended Text:

1.Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

2.Subba Rao, N. S. 2000. Soil microbiology. 4th Edition, Oxford and IBH publishing Co. Pvt. Ltd., Calcutta, New Delhi, India.

3.Rangaswami, G. and Bagyaraj, D.J. 2006. Agricultural Microbiology. 2nd Unit 2nd Edition, PHI Learning, New Delhi, India.

4.Prescott,L.M.,HarleyJ.P.,KleinD. A. 2005.Microbiology,McGrawHill,India. 6thedition.

5.Goldman,E.andGreen,L.H.2015.PracticalHandbookofMicrobiology(3rdEd.).CRCPress.

Reference Books:

1.Adams, M.R. and Moss M. O. 2008. Food Microbiology, 3rd Edition, Royal Society of Chemistry, Cambridge, U.K.

2.Sylvia D.M. 2004. Principles and Applications of Soil Microbiology, 2nd Edition, Prentice Hall, USA.

3.Frazier, W.C. 1995. Food Microbiology, 4th Edition, Tata McGraw Hill Education, Noida, India.

4.Waites M.J., Morgan N.L., Rockey J.S. and Higton G. 2001. Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.

5.Das,S.andSaha,R.2020.MicrobiologyPracticalManual.CBSPublishersandDistributors(P) Ltd., New Delhi,India.

Web resources:

1.https://www.kopykitab.com/Agriculture-And-Food-Microbiology-In-Hindi-by-Dr-Q-J-Shammi

2.https://agrimoon.com/agricultural-microbiology-icar-ecourse-pdf-book/

3.https://play.google.com/store/books/details/Applied_Microbiology_Agriculture_Environmental_Foo?id=DgVLDwAAQBAJ&hl=en_US&gl=US

4.https://www.scientificpubonline.com/websitebooks/ebooks/agriculture/microbiology

5.https://www.amazon.in/Food-Microbiology-Martin-R-Adams-ebook/dp/B01D6B7V6A

TEACHING AND LEARNING PROCESS – P232A202

Lecture Hours	**: -**	**Tutorial Hours**	**: -**
Practical Hours	**:**	**No. of Credit**	**: 1**
Contact Hours per Semester: -			
Contact hours per Week	**: -**		
Internal Marks	**:**		
External Marks	**: 50**		
Total Marks	**: 50**		

Objective of the Course

To facilitate the students to understand Teaching and Learning Process and Core Teaching Skills

Course Learning Outcomes (for Mapping with Pos and PSOs)

CO1 Examine and interpret the concept of teaching and its relationship with learning process in the classroom.

CO2 modify the needed shifts in teaching-learning process.

CO3 explain subject related broad objectives in terms of specific relations objectives

CO4 estimate core teaching skills at competence level

CO5 design the physiological background of leaner

Mapping with Programme Outcomes:

Cos	Program Outcomes(Pos)						Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	2	2	2	2
CO2	3	3	2	2	3	3	3	2	3
CO3	2	2	3	3	1	1	3	1	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	2	2	3	3	3

Total Contribution of COs to POs	14	14	12	14	11	11	14	11	14
Weighted Percentage of COs contribution to POs	93.33	93.33	80.00	93.33	73.33	73.33	93.33	73.33	93.33

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

COURSE CONTENTS

Unit I:

Concept of Teaching - Teaching- an art or a science. Relationship between Teaching and Learning. Analysis of the concept of Teaching - Teaching as a deliberately planned process: Analysis in terms of teaching skills.

Unit II:

Learner in the present Day Context - Four pillars of learning in the context of higher education. Socio-cultural background of the learner. Psychological background of the learner.

Unit III:

Teaching in the present day context - Needed shifts in teaching -teaching knowledge acquisition -teaching meaningful and transformative learning. Cognitive and constructivist perspectives to teaching.

Unit IV:

Planning for teaching - Analysis of the nature of different disciplines. Basic concepts and understandings methodology of different disciplines (logical grammar of disciplines) -Broad objectives of teaching different disciplines

Unit V: **(L 7Hours)**

Core Teaching skills in classroom instruction -Purpose, components and use of skills in classroom teaching with specific reference to: 1.Ways of introducing a topic, 2.Employing effective questioning, 3.Illustrating with examples, 4.Making different types explanations, 5.Reinforcing student responses, 6.Managing classroom learning, 7.Ways of closing a lesson.

References:

1. Jangira N K and Ajit Singh (1982) Core Teaching Skills: The Microteaching Approach, NCERT, New Delhi.
2. Passi, BK (1976) Becoming better teacher Micro-teaching Approach, SahityaMudranalaya, Ahmedabad.
3. Dale Edgar (1961) Audio-visual Methods in Teaching (Revised) Hoft, Rinehart and Winston, New York.
4. Das RC (1993), Educational Technology – A Basic Text, Sterling Publishers, New Delhi.

5. Kumar, K L (1996) Educational Technology; New Age International (P) Ltd Publishers, New Delhi.

E-References

1. https://physicscatalyst.com/graduation/teaching-definition/
2. https://www.ero.govt.nz/publications/leading-innovative-learning-in-new-zealand-schools-april-2018/pedagogy-for-modern-learners/
3. https://www.skillsyouneed.com/learn/teaching-skills.html
4. https://www.kqed.org/mindshift/42494/what-core-skills-do-teachers-need-to-be-effective