

(AUTONOMOUS) RE-ACCREDITED WITH B⁺⁺ GRADE BY NAAC (Affiliated to Mother Teresa Women's University, Kodaikanal)

DEPARTMENT OF BOTANY

SYLLABUS

FOR

M.Sc., BOTANY

FROM THE ACADEMIC YEAR

2023-2025

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005

DEPARTMENT OF BOTANY

BOARD OF STUDIES MEETING HELD ON 12. 07. 2023

UNIVERSITY NOMINEE:

Dr. C. Thamaraiselvi Assistant Professor Department of Biotechnology Mother Teresa Women's University, Kodaikanal.

MEMBERS:

Dr. M. Anandi Associate Professor & Head PG & Research Department of Botany Arulmigu Palaniandavar College of Arts and culture Palani

> Mr. P. Badrakali (Entrepreneur) Chitra Mushroom Farm Near Sastha Mill Pappampatti Palani

Dr. C. Jayachitra (Alumni)

Associate Professor PG & Research Department of Botany Arulmigu Palaniandavar College of Arts and Culture Palani.

Ms. M. Sivaranjani (Student Representative) II M.Sc Botany Arulmigu Palaniandavar Arts College for Women Palani

Head of the Department Dr. R. Prema

Assistant Professor and Head Arulmigu Palaniandavar Arts College for Women Palani

Members of the Faculty

Mrs. V. Vanitha Assistant Professor of Botany

Mrs. P. Mohanapriya

Assistant Professor of Botany

Dr. Anjana Surendran

Assistant Professor of Botany

Dr. R. Ilamathi

Assistant Professor of Botany

PREAMBLE

The Department of Botany came into existence in the year 1971. The Department stands for its academic excellence and well equipped laboratories. The highlight of the Department is the active participation of the faculty members in skill development programmes like Mushroom cultivation, Azolla cultivation, Herbal plant cultivation etc. Many seminars, workshops and outreach programmes are conducted to encourage creative skills of the students. The faculty members have published many International and National papers in reputed Journals. Our Department renders dedicative service to empower women and also raising the status of women by developing them as a entrepreneur through skill based training by introducing relevant papers in the Curriculum to fulfill their local needs through the Board of Studies.

COLLEGE VISION

• Enlightenment and Empowerment of Rural Women.

COLLEGE MISSION

- Providing high quality teaching learning environment with practical exposure
- Imbibing research culture and collaborate programs with local communities
- Imparting strong and supportive education to promote employability
- Encouraging questioning spirit and self reliance

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VISION

- To upgrade the department into PG and Research Centre.
- To start PG diploma courses.
- To motivate the students in the research field
- To mould the students into a good citizen.

MISSION

- To focus the areas where Entrepreneurial scope for Botanists
- To create awareness about the environment, Bioethics and Biodiversity Conservation.
- To update the students with latest technologies in the field of science.

DEPARTMENT OF BOTANY

Programme Educational Objectives (PEOs)

PEO 1 Graduates of the program will develop a strong and competent knowledge in basic biological science required for critical learning and research.

PEO 2 Graduates students will develop diversified basic professional skills through various laboratory technical training, communicational and presentation skills.

PEO 3 They will possess an ability to identify, formulate, and solve biological problems to contribute to service efforts to communicate in both the professional and private realm.

PEO 4 Graduates will integrate related topics from separate parts of the course such as levels of organization, cell biology, ecology, evolution, biochemistry, genetics, embryology, basic biotechnology, physiology, molecular biology for successful career.

DEPARTMENT OF BOTANY

M.Sc., Botany

PROGRAM OUTCOME

Programme	PO1: Problem Solving Skill
Outcomes (Pos)	Apply knowledge of Management theories and Human Resource practices to solve
	business problems through research in Global context.
	PO2: Decision Making Skill
	Foster analytical and critical thinking abilities for data-based decision-making.
	PO3: Ethical Value
	Ability to incorporate quality ethical and legal value-based perspectives to all
	organizational activities.
	PO4: Communication Skill
	Ability to develop communication, managerial and interpersonal skills.
	PO5: Individual and Team Leadership Skill
	Capability to lead themselves and the team to achieve organizational goals.
	PO6: Employability Skill
	Inculcate contemporary business practices to enhance employability skills in the competitive environment.
	PO7: Entrepreneurial Skill
	Equip with skills and competencies to become an entrepreneur.
	PO8: Contribution to Society
	Succeed in career endeavors and contribute significantly to society.
	PO 9 Multicultural competence
	Possess knowledge of the values and beliefs of multiple cultures and a global perspective.
	PO 10: Moral and ethical awareness/reasoning
	Ability to embrace moral/ethical values in conducting one's life.
Programme	PSO1 – Placement
Specific Outcomes	To prepare the students who will demonstrate respectful engagement with others'
(PSOs)	ideas, behaviors, beliefs and apply diverse frames of reference to decisions and
	actions.
	PSO 2 - Entrepreneur

To create effective entrepreneurs by enhancing their critical thinking, problem
solving, decision making and leadership skill that will facilitate startups and high
potential organizations.
PSO3 – Research and Development
Design and implement HR systems and practices grounded in research that comply
with employment laws, leading the organization towards growth and development.
PSO4 – Contribution to Business World
To produce employable, ethical and innovative professionals to sustain in the
dynamic business world.
PSO 5 – Contribution to the Society
To contribute to the development of the society by collaborating with stakeholders
for mutual benefit.

Template for P.G., Programmes

Semest	Credit	Hours	Semest	Credit	Hours	Semest	Credit	Hours	Semest	Credit	Hours
er–I			er-II			er-III			er–IV		
1.1. Core-I Plant Diversi ty - I: Algae, Fungi, Lichen s and Bryoph ytes	5	7	2.1. Core- IV Taxon omy of Angios perms and Econo mic Botany	5	6	3.1. Core- VII Cell and Molec ular Biolog y	5	6	4.1. Core- XI Plant Physio logy and Plant metabo lism	5	6
1.2 Core-II Plant Diversi ty - II: Pterido phytes, Gymno sperms and Paleob otany	5	7	2.2 Core-V Plant Anato my and Embry ology of angios perms	5	6	3.2 Core- VIII Geneti cs, Plant Breedi ng & Biostat istics	5	6	4.2 Core- XII Bioche mistry & Applie d Biotec hnolog y	5	6
1.3 Core – III Core III Labora tory course- I: Coveri ng Core Papers - I and II	4	6	2.3 Core – VI Core Labora tory course- II: Coveri ng Core Papers IV and V	4	6	3.3 Core – IX Core Labora tory course- III Coveri ng Core Papers VII and VIII	5	6	4.3 Project with viva voce	7	10

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			To	otal Cred	it Points -	·91				

PG - BOTANY

Semester-wise papers

Class	Part	Title of the course	Credit	Hours		Marks	
				Theory/	Internal	External	Total
				Practical			
		Core I	5		25	75	100
		Plant Diversity - I:		7			
	Core	Algae, Fungi, Lichens and					
		Bryophytes					
		Core II	5		25	75	100
Ι		Plant Diversity - II:		7			
M.Sc.		Pteridophytes, Gymnosperms					
		and Paleobotany					
		Core III	4	6	25	75	100
		Laboratory					
		course- I: Covering Core					
		Papers - I and II					
	Elective	EG1	3	5	25	75	100
		1. Mushroom cultivation					
		2. Phytopharmacognosy					
	Elective	ED1	3	5	25	75	100
		1. Horticulture					
		2.Herbal Technology					
		Total	20	30			

Class	Part	Title of the course	Credit	Hours		Marks	
				Theory/ Practical	Internal	External	Total
	Core	Core IV Taxonomy of Angiosperms and Economic Botany	5	6	25	75	100
I M.Sc.		Core V Plant Anatomy and Embryology of Angiosperms	5	6	25	75	100
		Core VI : Core Laboratory course- II: Covering Core Papers IV and V	4	6	25	75	100
	Elective	EG2 1.Biopesticide Technology 2.Research methodology, computer applications & bioinformatics	3	4	25	75	100

Elective	ED2	3	4	25	75	100
	1.Applied bioinformatics					
	2.Intellectual Property					
	Rights					
Skill	SE1	2	4	25	75	100
Enhancement	Agriculture and Food					
(SE1) NME-I	Microbiology					
Tota	al	22	30			

Class	Part	Title of the course	Credit	Hours		Marks	
				Theory/	Internal	External	Total
				Practical			
		Core VII Cell and	5	6	25	75	100
		Molecular Biology					
	Core	Molecular Biology					
		Core VIII Genetics,	5	6	25	75	100
		Plant Breeding &					
II		Biostatistics					
M.Sc.		Core IX: Core	5	6	25	75	100
		Laboratory course- III					
		Covering Core Papers					
		VII and VIII					
	Industry	Core X : Industrial	4	6	25	75	100
	Module	Botany:					
	Elective	EG3:	3	3	25	75	100
		1.Secondary Plant					
		Products and					
		Fermentation					
		Biotechnology					
		2.Entrepreneurial					
		Opportunities in Botany					
	Skill	SE4 Seminar paper	2	3	25	75	100
	Enhancement	(Open Choice)					
	(SE2) NME-	Professional					
	II	Communication Skill					
		Internship / Industrial	2	-	-	-	-
		Activity (Carried out in					
		Summer Vacation at the					
		end of I year – 30 hours)					
	Tota	al	26	30			

Class	Part	Title of the course	Credit	Hours		Marks	
				Theory/	Internal	External	Total
				Practical			
		Core XI Plant Physiology	5		25	75	100
		and Plant metabolism		6			
	Core	Core XII Biochemistry &	5		25	75	100
		Applied Biotechnology		6			
	Project	Project with Viva-voce	7	10	25	75	100
II	Elective	EG3	3	4	25	75	100
M.Sc.		1.Organic farming					
		2. Gene Cloning And					
		Gene Therapy					
	Professional	Training for Competitive	2	4	25	75	100
	Competency	Examinations					
	Skill	Botany for NET/UGC-					
	Enhancement	CSIR/SET/TRB					
		competitive examinations					
		(2 hours)					
		General Studies for					
		UPSC/TNPSC/other					
		competitive examinations					
		(2 hours) or					
		Botany for Advanced					
		Research (4 hours)					
		Naan Mudhalvan Scheme					
		Extension activities	1	-	-	-	-
	Tota	al	23	30			
	TOTAL	CREDITS	91				

Semester Examination

The examinations shall be conducted separately for theory and practical to assess the knowledge acquired during the study. There shall be two systems of examinations *viz.*, internal and external examinations. The internal examinations shall be conducted as continuous Internal Assessment tests, Peer Team teaching, assignments and seminar. The internal assessment shall comprise of maximum 25 marks for each subject.

The external examination shall be three hours duration to each paper at the end of each semester. The external examinations shall comprise of maximum of 75 marks for each subject. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examination. Practical examinations for M.Sc. Course in Botany should be conducted at first, second and third semester. At the end of fourth semester viva- voce will be conducted on the basis of the Dissertation report submitted by the student.

Distribution of marks

Theoretical Examinations

S.No	Component	Marks
1	Internal examination*	25
2	External examination	75
3	Total	100

Internal examination*:

The following procedure shall be followed for awarding internal marks.

S.No	Component	Marks
1	Internal Test	15
2	Seminar	5
3	Assignment	5
	Total	25

Practical examinations

S.No	Component	Marks
1	Internal examination*	25
2	External examination	75
3	Total	100

Internal examination*:

The following procedure shall be followed for awarding internal marks.

S.No	Component	Marks
1	Continuous assessment	25
2	Record	10
3	Viva	5
4	Total	40

External Examination Question Paper Pattern

Time: 3 Hours Max. Marks: 75

Part A- 10 x 1 Marks = 10 Marks (Answer all questions; 2 questions from each unit)

Part B -5 x 7 Marks = 35 Marks (Answer all questions; either/or pattern; equal weightage for all units)

Part C- 3×10 Marks = 30 Marks (answer any three from five questions; equal weightage for all units)

Scheme for Evaluation

The Internal and External marks will be in 25:75

External exam

The pattern of Question Paper (External) will be Time: 3 Hours and Max. Marks: 60

Section A: (10 x 1 = 10 marks)

Question No. 1 to 10 (Multiple choice or Objective type)

Section B: (5 x 7 = 35 marks)

Answer all questions choosing either (a) or (b)

Section C: (3 x 10 = 30 marks)

Answer any three out of five (one question from each unit)

Passing Minimum

Passing minimum – 50% (aggregate) No pass minimum for internal

27/60 (45%) is the minimum in External

Teaching Methodologies

The classroom teaching would be through conventional lectures and use of OHP and Power Point presentations. The lecture would be such that the student should participate actively in the discussion. Periodic field visit enable the student for gathering the practical experience and up to date industrial scenario. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill.

In the laboratory, instruction would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

Periodic tests would be conducted and for the students of slow learners would be given special attention.

Retotalling and revaluation provision

Revaluation means to re evaluate the paper of a particular subject completely. Under this, Student has to surrender his/her original marks of particular paper and accept the final marks when declared by the University as a result of Revaluation. Application form available at Examination Section and University Website. Fee Structure Rs. 500/ per subject for Revaluation Rs. 250/ per subject for Retotalling.

Condition- Application for Revaluation is to be made within 15 days from the date of publication of result on University website. Application form is to be completely filled and signed by the student (concerned) only. Select the paper carefully in which you wish to seek revaluation. No second application for additional papers shall be accepted. The fees once paid shall not be refunded. The application is to be made by the student in his/her own handwriting and under his/her own signature and not by anyone else on his/her behalf.

Rules for Revaluation - Revaluation shall be available only for the paper of end term examination. Revaluation for the paper of end term examination shall be sent to two external evaluators for evaluation. The average of the marks awarded by two external evaluators shall be taken as final marks and the original marks obtained by the student shall have no value.

Transitory provision

PG syllabus revision once in 2 years and afterwards 2 years under transitory provision.

CORE I: PLANT DIVERSITY – I: ALGAE, FUNGI, LICHENS AND BRYOPHYTES

Programme: M.Sc.,	Subject: Botany
Semester: I	Course: PLANT DIVERSITY – I
Course Type: Core Paper - I	Course Code:
Contact Hours: 7 Hours/Week	Credits: 5
CIA: 25	CE: 75

Learning Ob	bjectives						
C1	To learn about the classification, distinguishing traits, geograp reproductive cycle of algae, fungi, lichens, and bryophytes.	hic distribution, and					
C2	To gain knowledge about the ecological and economic importance of al	gae, fungi, lichens and					
	bryophytes.						
C3	To spark interest in the evolutionary roots of plant development.						
C4	To study the biodiversity by describing and explaining the morphology processes of algae, fungi, bryophytes and microorganisms.	and reproductive					
C5	To expose the beneficial and harmful viewpoint.						
Course outcomes	On completion of this course, students will;						
CO1	Relate to the structural organizations of algae, fungi, lichens and K1 Bryophytes.						
CO2	Demonstrate both the theoretical and practical knowledge in understanding the diversity of basic life forms and their importance.	K2					
CO3	Explain life cycle patterns in algae, fungi, lichens and Bryophytes.	К3					
CO4	Compare and contrast the mode of reproduction in diverse groups of basic plant forms.	K4					
CO5	Discuss and develop skills for effective conservation and utilization of lower plant forms.	K5 & K6					
UNIT	CONTENTS						
I	ALGAE: General account of algology, Contributions of Indian Phycolog V.Krishnamurthy and V.S. Sundaralingam), Classification of algae by & Silva (1982). Salient features of major classes: Cyanophy Xanthophyceae, Chrysophyceae, Cryptophyceae, Dinophyceae,	ist (T.V.Desikachary, F.E. Fritsch (1935-45) ceae, Chlorophyceae, Chloromonadineae,					

	Euglenophyceae, Charophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Range
	sexual) and life cycles. Phylogeny and inter-relationships of algae, origin and evolution of sex
	in algae.
	Ulva, Codium, Diatoms, Dictvota and Gelidium.
	FUNGI:
П	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: <i>Plasmodiophora</i> , <i>Phytophthora</i> , <i>Rhizopus</i> , <i>Taphrina</i> , <i>Polyporus</i> and <i>Colletotrichum</i> .
	LICHENS:
III	Introduction and Classification (Hale, 1969). Occurrence and inter-relationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basiodiolichens and Deuterolichens.
	BRYOPHYTES:
IV	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: <i>Targionia, Lunularia,</i> <i>Porella</i> and <i>Polytrichum</i> .
	ECONOMIC IMPORTANCE:
V	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 <i>Pleurotus</i> . Lichen –economic importance and as indicator pollution. Bryophytes – Ecological and economic importance – industry, horticulture and medicine.

Recon	nmended texts:	
1.	Kumar, H.D.1999. Introductory Phycology. Affiliated East-West Press, Delhi.	
•		

- 2. Barsanti, L. and Guadtieri, P. 2014. Algae: Anatomy, Biochemistry and Biotechnology, 2ndEdition, 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. Edwardlee, R. 2018. Phycology, 5thEd., Cambridge UniversityPress, 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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	1	3	2	1	2	2	2	1
CO 2	3	3	2	2	3	3	2	1	3	3
CO 3	2	2	1	1	2	2	1	3	2	2
CO 4	3	3	3	3	3	2	3	3	3	2
CO 5	3	3	2	3	2	3	3	3	2	3

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

CORE II- PLANT DIVERSITY – II

(PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY)

Programme: M.Sc.,	Subject: Botany
Semester: I	Course: PLANT DIVERSITY – II
Course Type: Core Paper - II	Course Code:
Contact Hours: 7 Hours/Week	Credits: 5
CIA: 25	CE: 75

Learning O	bjectives								
C1	To investigate the classification, distinctive traits, distribution and	reproduction and life							
	nistory of the various classes and major types of Pteridophytes and Gyr	nnosperms.							
C2	To identify and characterize diversity of lower vascular plants in order to comprehend the dynamics of diversity to realize the importance of diversity.								
C3	To research the classification, phylogeny and economic importance of Pteridophytes and Gymnosperms.								
C4	To study and understand the phylogeny and Paleontology of	f Pteridophytes and							
-	Gymnosperms.								
C5	To learn about the concept of fossils and process of fossilization; distin	ctive characteristics							
	of fossil records of Pteridophytes and Gymnosperms.								
Course									
outcomes	On completion of this course, students will;								
CO1	Recall on classification, recent trends in phylogenetic relationship,	K1							
	general characters of Pteridophytes and Gymnosperms.								
CO2	Learn the morphological/anatomical organization, life history of major types of Pteridophytes and Gymnosperms.	K2							
CO3	Comprehend the economic importance of Pteridophytes, Gymnosperms, and fossils.	К3							
CO4	Understanding the evolutionary relationship of Pteridophytes and Gymnosperms.	K4							
CO5	Awareness on fossil types, fossilization and fossil records of K5 & K6 Pteridophytes and Gymnosperms K5 & K6								
K1 - Remen	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6	– Create.							
UNIT	CONTENTS								
	PTERIDOPHYTES:								
	General characteristics and classification (Reimer, 1954). Range of s	tructure, reproduction							
T	and evolution of the gametophytes. Gametophyte types $- \sec \alpha$	rgans. Apogamy and							
_	Apospory. Life cycles. Stellar evolution. Heterospory and seed h	abit, Telome theory,							

	morphogenesis, Economic importance of Pteridophytes.
	PTERIDOPHYTES:
	Structure, anatomy, reproduction and life histories of the following genera: Isoetes,
II	Equisetum Angiopteris, Osmunda, Pteris and Azolla.
	GYMNOSPERMS:
	General characters - A general account of distribution of Gymnosperms. Morphology,
III	anatomy, reproduction, phylogeny and classification (K.R.Sporne, 1965). Economic
	importance of Gymnosperms.
	GYMNOSPERMS:
	Structure (Exomorphic and endomorphic), anatomy, reproduction and life histories of the
IV	following genera: Thuja, Cupressus, Araucaria, Podocarpus, Gnetum and Ephedra.
	PALEOBOTANY:
	Geological Scale; Radiocarbon dating; Contribution of Birbal Sahni to Paleobotany.
	Gondwana flora of India. Study of fossils in understanding evolution. Fossilization and fossil
\mathbf{V}	types. Economic importance of fossils - fossil fuels and industrial raw
	materials and uses. Study of organ genera: Rhynia, Lepidocarpon, Calamites, Cordaites and
	Lyginopteris.

Recommended Text:

1.	Vashishta,	P.C.	Sinha,	A.K	and	Anil	Kumar.	2016.	Botany	for	Degree	students.
	Gymnosper	ms. S	S. Chand	and C	Comp	any L	td., 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 Anil Kumar. 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 (Paper back), 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 Fossil Plants, 2nd Edition, Academic Press.

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?hl=en&lr=&id=Pn7CAAAQBAJ&oi=fnd&pg=PA1&dq =Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4 XU8&redir_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false
- 4. https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.htm 1?id=HTdFYFNxnWQC&redir_esc=y
- 5. https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC
- 6. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf
- 7. https://www.palaeontologyonline.com/
- 8. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAAIAAJ https://trove.nla.gov.au/work/11471742?q&versionId=46695996

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3
CO 3	2	3	3	3	3	1	3	3	3	3
CO 4	3	3	2	3	3	3	3	2	3	2
CO 5	3	2	2	2	2	2	2	1	2	1

Mapping with Programme Outcomes:

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

CORE-III : LABORATORY COURSE-I COVERING THEORY PAPERS I AND II

Programme: M.Sc.,	Subject: Botany
Semester: I	Course: CORE-III LABORATORY
COURSE-I	
Course Type: Core Paper - III	Course Code:
Contact Hours: 6 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning O	bjectives			
C1	To learn how to employ the use of instruments, technologies and methodologies related to thallophytes and non-flowering plant groups.			
C2	To enhance information on the identification of each taxonomical group skill-based detection of the morphology and microstructure of algae, and	oup by developing the d fungi.		
C3	To comprehend the fundamental concepts and methods used to Pteridophytes and Gymnosperms through morphological changes an and reproduction.	identify Bryophytes, d evolution, anatomy		
C4	To develop the technical abilities in staining, sectioning, sterilizin thallophytes, and other varieties of non-flowering plants.	g, and characterizing.		
C5	To compare the structural diversity of fossil and extant plant species.			
Course outcomes	On completion of this course, students will;			
CO1	Recall and applying the basic keys to distinguish at species level identification of important algae and fungi through its structural organizations.	K1		
CO2	Demonstrate practical skills in thallophytes, Pteridophytes and Gymnosperms.	K2		
CO3	Describe the structure of algae, fungi, lichens, Bryophytes, Pteridophytes and Gymnosperms.	К3		
CO4	Determine the importance of structural diversity in the evolution of plant forms.	K4		
CO5	Formulate techniques to isolate and culture of alga and fungi as well as to understand the diversity of plant forms.	K5 & K6		
K1 - Remer	nber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6	– Create.		
UNIT	EXPERIMENTS			
	ALGAE Study of algae in the field and laboratory of the genera included in theo External morphology and internal anatomy of the vegetative and repu- the following living forms: <i>Oscillatoria, Scytonema, Ulva, Codium,</i>	ry. roductive structures of <i>Diatoms, Dictyota</i> and		

Gelidium(depending onavailability 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).
FUNGI Study of morphological and reproductive structures of the following living forms: <i>Plasmodiophora, Phytophthora, Rhizopus, Taphrina, Polyporus</i> and <i>Colletotrichum</i>
(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 <i>Parmelia</i> .
BRYOPHYTES External morphology and internal anatomy of the vagatative and reproductive organs of the
following living forms: <i>Targionia, Lunularia, Porella</i> and <i>Polytrichum</i> (depending on availability of the specimen).
PTERIDOPHYTES
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.
GYMNOSPERMS
External morphology and internal anatomy of the vegetative and reproductive organs of the following living former, Thuig Cupressus Anguagria, Redecampus Custum and Enhadra
(depending on availability of the specimen)
Fossil slides observation: Cordaites and Lyginopteris.

Recommended Text:

- 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 McGraw-Hills Ltd, New Delhi.
- 4. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.
- 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, MacMillan 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=gy mnosperms&printsec=frontcover
- 7. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	1	3	1	3
CO3	3	3	3	3	3	3	2	3	2	3
CO4	3	3	2	1	2	2	1	2	1	3
CO5	3	3	3	3	3	3	3	2	3	2

Mapping with Programme Outcomes:

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

ELECTIVE I - MUSHROOM CULTIVATION

Programme: M.Sc.,	Subject: Botany
Semester: I	Course: MUSHROOM CULTIVATION
Course Type: ELECTIVE I	Course Code:
Contact Hours: 5 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning O	bjectives	
C1	To teach the identification of mushrooms.	
C2	To differentiate the edible mushrooms with toxic and hallucinating fungi.	
C3	To study the cultivation technique of mushrooms	
C4	To learn the economic importance of mushroom in various fields.	
C5	To study how to establish mushroom cultivation as business enterprise.	
C6	To teach the identification of mushrooms.	
Course outcomes	On completion of this course, students will;	
CO1	Knowledge on identification of edible and toxic mushrooms belonging toAscomycota and Basidiomycota.	K1, K3
CO2	Outline the nutraceutical properties of edible mushrooms.	K2, K4
CO3	Knowledge on cultivation techniques of edible and medicinal mushrooms.	K3, K6
CO4	Understand the harvest and post-harvest techniques of mushroom crops.	K4
CO5	Knowledge on the production and marketing strategies for mushrooms.	K5

UNIT	EXPERIMENTS
	INTRODUCTION
Ι	Mushroom, Edible Mushroom, commercial production, medicinal value of mushrooms, nutraceuticals and dietary supplements
	MORPHOLOGICAL AND MICROSCOPICAL IDENTIFICATION OF EDIBLE
II	Keys for identification of edible mushrooms: Agaricus bisporus, Pleurotus sajorcaju, Volvariella volvcea and Calocybe indica. Key for identifying hallucinogenic mushroom (Psilocybe sp.) Medicinal Mushroom – Cordyceps, Ganoderma lucidum and Lentinus edodes.

III	CULTIVATION:
	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).
	POST-HARVEST MANAGEMENT:
IV	Harvest, storage, quality assurance of mushrooms. Pestmanagement.
	World production edible mushroom, Legal and regulatory issues of introducing the medicinal
	mushrooms in different countries. Developing small scale industry and Government schemes.
V	Mushroom Research Centres – International and National levels.

Recommended Text:

- 1. Cheung, P. C.K. 2008. Mushrooms as functional food. A John Wiley & Sons, Inc., Publication.
- 2. Dijksterhuis, J. and Samson, R.A. 2007. Food Mycology: A multifaceted approach in fungiand food. CRC press, Newyork.
- 3. Hall., R.I., Stepheson, S.L., Buchanan, P.K., Yun, W. and Cole, A.L.J. 2003. Edible and poisonous mushrooms of the world. Timber Press, Portland, Cambridge.
- 4. Ting, S. and Miles, P.G. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and nutritional environmental impact. CRC press, Newyork.
- 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. Mushroom cultivation. Mittal publisher, New Delhi.
- 2. Philips, G., Miles, Chang, S-T. 2004. Mushrooms: Cultivation, nutritional value, medicinaleffect and environmental effect. 2nd ed. CRC Press.
- 3. Diego, C.Z., Pando-Gimenez, A. 2017. Edible and medicinal mushrooms: Technology and Application. Wiley-Blackwell publishers.
- 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=6AJx99OGT KEC&redir_esc=y

Mapping with Programme Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	3	3	2	2	1	3	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3

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

ELECTIVE I: PHYTOPHARMACOGNOSY

Programme: M.Sc.,	Subject: Botany
Semester: I	Course: PHYTOPHARMACOGNOSY
Course Type: ELECTIVE I	Course Code:
Contact Hours: 5 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Ol	ojectives			
C1	To learn the traditional knowledge on plant derived drugs and their conventional classification.			
C2	To elucidate the biosynthetic pathway of major classes of secondary metaboli	tes.		
C3	To study the general pharmacological mode of action of crude drugs of few me	edicinal plants.		
C4	To elucidate the isolation and characterization of plant derived drugs using modern biotechniques.			
C5	Knowledge on pharmacological action of drugs.			
C6	6.To learn the traditional knowledge on plant derived drugs and their conv classification.	ventional		
Course outcomes	On completion of this course, students will;			
CO1	Review on the traditional knowledge and classification of plant derived drugs.	K1		

CO2	Knowledge on biosynthetic pathway of different classes of plant metabolites.	K2				
CO3	Knowledge on modern instrumentation on characterization of plant K3,K6 metabolites.					
CO4	Discuss various aspects of Pharmacological action of herbal drugs. K4 K5					
CO5	Understanding medical and non-medical potential of plant derived in various sectors.	K6				
K1 - Remen	nber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	ate.				
UNIT	EXPERIMENTS					
I	General introduction – History and scope of Pharmacognosy including indigenous system of medicine. Various systems of classification of drugs. Pharmacological action of plant drugs.					
п	MORPHOLOGICAL AND MICROSCOPICAL Biosynthetic pathway metabolites: Acetate pathway (fatty acids and polyketides), mevalonate and phosphate pathway (terpenoids and steroids), shikimate pathway (phenols, ami	of secondary d deoxyxylulose no acids etc.).				
ш	Characterization of Therapeutic drugs: Extraction, separation, isolation (C techniques) and characterization of secondary metabolites (Spectroscop Quality control of plant drugs: Classical and modern approaches of drugs. Pharmacopoeial standards.	Chromatographic pic techniques). Significance of				
IV	Pharmacological action of Plant Drugs: Anti-cancer, Bitter tonic, Carmin regulators, Cardiotonics, CNS-Stimulatant, Expectorant, Laxatives, Puragat pharmacogenomics functions.	hatives and $\overline{G.I.}$ ives. Outline of				
V	Hallucinogenic, allergenic and other toxic plants, poisonous plants - biopestic biofungicides.	ides - biocides –				

Recommended Text:

- 1. Dewick P.M., 2002. Medicinal Natural Products: A biosynthetic approach, John Wiley &Sons Ltd.
- 2. Evans W.C., 2002, Trease and Evan's Pharmacognosy, W.B. Saunders.
- 3. Harborne, J.B., 1998. Phytochemical Methods, Chapman and Hall.
- 4. Harborne, J.B., 1998. Phytochemical Methods, Chapman and Hall.
- 5. Vickery M.L. and B. Vickery, 1981. Secondary Plant Metabolism, The MacMillan PressLtd.

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 MacMillan PressLtd.
- 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
- 4. https://www.amazon.in/Pharmacognosy-Dr-C-K-Kokate-ebook/dp/B07JHNNMWB
- 5. <u>https://www.amazon.in/EXPERIMENTAL-PHYTOPHARMACOGNOSY-</u> Comprehensive-Guide-Khadabadi-ebook/dp/B07ZFMYQK8

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	2	1	2	1
CO2	3	2	3	3	3	2	2	1	2	1
CO3	3	2	3	3	3	3	2	2	3	2
CO4	3	2	2	3	3	3	3	2	3	2
CO5	3	2	2	3	3	3	3	2	3	2

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

ELECTIVE-II HERBAL TECHNOLOGY

Programme: M.Sc.,	Subject: Botany
Semester: II	Course: HERBAL TECHNOLOGY
Course Type: ELECTIVE II	Course Code:
Contact Hours: 5 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Ob	ojectives					
C1	1.To understand various plants based drugs used inayurvedha, unani, homeopathy, siddha etc.					
C2	2.To apply the knowledge to cultivate medical plants.					
C3	3.To know the pharmacological importance of medicinal plants.					
C4	4. To enlist phytochemicals and secondary metabolites of market and commer-	cial value.				
C5	5.To design and develop their own business prepositions such as theo in the insecticides.	making of herbal				
Course outcomes	On completion of this course, students will;					
CO1	Recollect the importance of herbal technology.	K1				
CO2	Understand the classification of crude drugs from various botanical K2 sources.					
CO3	Analyze on the application of secondary metabolites in modern K3 medicine.					
CO4	Create new drug formulations using therapeutically valuable	K4				
	phytochemical compounds for the healthy life of society.					
CO5	Comprehend the current trade status and role of medicinal plants in	K5 & K6				
K1 - Remem	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Cre	ate.				
UNIT	CONTENTS					
I	PHARMACOGNOSY 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.					
Ш	PLANT TISSUE CULTURE AS SOURCE OF MEDICINES Plant tissue culture as source of medicines, Role of plant tissue cultur secondary metabolite production (<i>Withania somnifera, Rauwolfia serpentin</i> <i>roseus, Andrographis paniculata</i> and <i>Dioscorea sp</i>) - Elicitation - Biotrans root culture. Factors affecting secondary metabolites production.	re in enhancing a, <i>Catheranthus</i> formation, Hairy Biogenesis of				

	phytopharmaceuticals.						
	PLANT PROPAGATION						
	ANALYSIS OF PHYTOCHEMICALS						
III	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.						
	GENERAL METHODS OF PHYTOCHEMICAL AND BIOLOGICAL SCREENING						
	Carbohydrates and derived products: Glycosides - extraction methods (Digitalis, Dioscorea);						
IV	Tannins (Hydrolysable and Condensed types); Volatile oils - extraction methods (Clove,						
	Mentha). Study of some herbal formulation techniques as drug cosmetics.						
	TYPES OF PHYTOCHEMICALS						
	Alkaloids - extraction methods (Taxus, Cinchona); Flavonoids- extraction methods, Resins-						
	extraction method: Application of phytochemicals in phytopharmacueticals; Biocides,						
\mathbf{V}	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. NiraliPrakashan, 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, Sharol Marie. 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 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. 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-downloadhowtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurClUCTdV9olKo9TbyAh 4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD BwE
- 3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicinenatural-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

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	1	3
CO2	3	3	3	3	3	3	3	1	3	3
CO3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	1	3	3
CO5	3	3	3	3	3	3	3	1	2	3

Mapping with Programme Outcomes:

S-Strong (3) M-Medium (2)

L-Low(1)

ELECTIVE II - HORTICULTURE

Programme: M.Sc.,	Subject: Botany
Semester: II	Course: HORTICULTURE
Course Type: ELECTIVE II	Course Code:
Contact Hours: 5 Hours/Week	Credits: 3
CIA: 25	CE: 75

C1	Know about the brief history, divisions, classification and structure of horticul	ltural plants.			
C2	Acquire knowledge on plant growth processes and stages of plant growth.				
C3	Understand the plant growth environment in relation to soil, nutrients, fertilizers, and bio inoculants.				
C4	Study the sexual and vegetative propagation methods including propagation through specialized vegetative structures.				
C5	Develop practical skills in micro propagation techniques and soil-less horticultural crops.	production of			
Course outcomes	On completion of this course, students will;				
CO1	Identify and categorize various horticultural plants and the conditions that affect their growth and productivity.	K1			
CO2	Explain the various structures and growth processes of horticultural plants.	K2			
CO3	Demonstrate the propagation, growth, and maintenance of plants in horticulture systems.	K3,K6			
CO4	Correlate the soil characteristics and fertility to good plant growth.	K4 K5			
CO5	Utilize the role plant tissue culture techniques in the production of quality planting stock in horticulture.	K6			
K1 - Remen	nber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	ate.			
UNIT	CONTENTS				
Ι	INTRODUCTION TO HORTICULTURE 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.				
П	FACTORS AFFECTING PLANT GROWTH Plant Growth Environment: Abiotic factors, Soil –Profile structure, Primary nutrients and their functions, Organic matter, Fertilizers –organic, Inorga	and Secondary nic and Potting			

	Media, Bio inoculants, Methods of fertilizer application, Directing Plant growth-Training -						
	Pruning and thinning.						
	PLANT PROPAGATION						
	Plant propagation: Seeds –Advantages, Viability, Mechanism of Dormancy and Dormancy						
III	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.						
	MICROPROPAGATION TECHNIQUES						
	Stages, multiplication by shoot tip, Nodal culture and Callus culture-Application and						
IV	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.						

Recommended	Text:
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- 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_a
nd_its_significance

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	2	1	3	3	3	3	3	3	3	2
CO3	3	1	3	3	3	3	3	2	3	3
CO4	3	3	3	1	1	2	2	3	1	3
CO5	3	3	3	3	3	3	2	3	3	2

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

CORE-IV : TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

Programme: M.Sc.,	Subject: Botany
Semester: II	Course: TAXONOMY OF ANGIOSPERMS AND
	ECONOMIC BOTANY
Course Type: ELECTIVE II	Course Code:
Contact Hours: 6 Hours/Week	Credits: 5
CIA: 25	CE: 75

Learning Ob	ojectives					
C1	1.To be familiar with the basic concepts and principles of plant systematics.					
C2	2. To develop a suitable method for correct characterization and identification of plants.					
C3	3.To understand the importance of taxonomic relationships in research of plan	t systematics.				
C4	4. To provide information on various classification systems					
C5	5.To know about the economic importance of plants.					
Course outcomes	On completion of this course, students will;					
	Recollect the basic concepts of morphology of leaves, flowers.	K1, K2				
CO1	Identify the types of compound leaves , inflorescence and fruits Describe their characteristic features	K3				
CO2	Explain the principles of taxonomy. Summarize the taxonomic hierarchy. Define Binomial nomenclature. Group Activity –Construct key	K1, K2 K5, K6				
CO3	Explain the various types of classification. Distinguish its advantages and disadvantages Construction of floral formula anf floral diagram.	K1, K2 K3, K4				
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.	K1, K2 K3, K4				
CO5	Illustrate and explain the characteristic features and list out the economic importance of the families.	K1, K2 K3, K5				
K1 - Remem	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	ite.				
UNIT	CONTENTS					
	TAXONOMY AND SYSTEMATICS					
	Botanical exploration and contribution with special reference to India by Wil	liam Roxburgh,				
	J.D. Hooker, Robert Wright, Nathanial Wallich and Gamble, J.S. Principles	of classification				
	as proposed - Artificial - Linnaeus, Natural - Bentham and Hooker, Phylogenetic - Content - Cont	enetic system -				
	Hutchinson, Modern - Takhtajan. Botanical gardens and herbaria of world,	preparation and				

Ι	maintenance of Herbarium, Botanical survey of India – its organization and role.							
	MODERN TRENDS IN TAXONOMY							
	Modern trends in taxonomy, chemotaxonomy, numerical taxonomy, biosystemics. ICBN							
	uninominal systems- genesis binomial nomenclature, importance and principle. Important							
II	articles, typification, principles of priority, effective and valid publication, author citation,							
	recommendations and amendents of code. Glossories and dictionaries, Taxonomic literature (Index Kewensis)							
	(Index Kewensis)							
	SYSTEMATIC ANALYSIS OF PLANTS-I							
	Polypetalae – Nympheaceae, Sterculiaceae, Portulaceae, Rhamnaceae, Vitaceae, Sapindaceae,							
III	Combretaceae, Turneraceae.							
	SYSTEMATIC ANALYSIS OF PLANTS-II							
	Gamopetalae – Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae, Bignoniaceae,							
	Convolvulaceae, Acanthaceae, Verbenaceae.							
TX 7	Manadalan Nastasian Asiatalashirana Camadian Manada							
IV	Monochiamydeae – Nyctaginaceae, Aristolochiaceae, Casuarinaceae. Monocots –							
	Consonaceae, Amaryndaceae, Linnaceae, Commennaceae, Cyperaceae.							
	Constal account on utilization of colocted aron plants: (i) Correals (rice and wheet) (ii)							
	General account on utilization of selected crop plants. (I) Cereals (fice and wheat) – (II) Pulses (red grow and black grow) (iii) $Pulses$ violding plants (With guides grow) for some of Calcus							
	ruises (ieu grain and black grain), (iii) Diug yieiding plants (<i>wununusomnijeru</i> and Coleus							
	(x) Sugar violding plants (sugarcana and sugar bact) (xi) Spices and condiments (cordemon							
17	(v) Sugar yielding plants (sugarcane and sugar beet), (vi) Spices and condiments (cardanioni, ainnamon) (viii) Commercial groups fibre (inte) (viii) Timber (Teak and red conders wood)							
v	(iv) Pasing and gume (Assfactide and gum arabia) (v) Essential ails (lamon gross and							
	(ix) Results and guilts (Asaloctida and guilt alabe) $-$ (x) Essential one (remon grass and monthol) (xi) Powersges (teal coffee) (xii) Plants used as avenue trees for shade pollution							
	control and aesthetics (viii) Energy plantation uses of Casuaring							
	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 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. 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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	2	2	1	2	2
CO3	3	3	2	3	1	3	2	3	3	1
CO4	3	2	3	3	2	3	3	1	3	3
CO5	3	3	2	2	1	2	1	3	2	1

S-Strong (3) M-Medium (2)

L-Low(1)

CORE-V PLANT ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Programme: M.Sc.,	Subject: Botany
Semester: II	Course: PLANT ANATOMY AND
	EMBRYOLOGY OF ANGIOSPERMS
Course Type: CORE V	Course Code:
Contact Hours: 6 Hours/Week	Credits: 5
CIA: 25	CE: 75

Learning O	bjectives	
C1	1.Learn the importance of plant anatomy in plant production systems.	
C2	2.Classify meristems and identify their structures, functions and roles in 1 plants growth and secondary growth of woody plants.	monocot and dicot
C3	3.Understand the mechanism underling the shift from vegetative to reprodu-	ctive phase.
C4	4. Trace the development of male and female gametophyte.	
C5	5.Understand the recent advances in palynology.	
Course outcomes	On completion of this course, students will;	
CO1	Learn the structures, functions and roles of apical <i>vs</i> lateral meristems in monocot and dicot plant growth.	K1& K2
CO2	Study the function and organization of woody stems derived from secondary growth in dicot and monocot plants.	K1&K4
CO3	Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K2& K6
CO4	Understand the various concepts of plant development and reproduction.	K3& K6
CO5	Profitably manipulate the process of reproduction in plants with a professional and entrepreneurial mindset.	K5
K1 - Remer	nber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – C	reate.
UNIT	CONTENTS	
	CELL WALL:	
I	Morphological and physico-chemical changes; Plasmodesmata- types of pi wall – formation of intercellular spaces; Meristems: Classifications: The root apices, Cytological zonation in shoot apex. Vascular Cambium: organization – multiplicative and additive divisions. Xylem: Primary and s	ts – growth of cell ories of shoot and Composition and secondary xylem –

	tracheary elements and vessels – vesselless dicots – xylem rays and axial parench	yma 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	ve tube					
	elements and companion cell. Evolution of tracheary elements.						
	PERIDERM:						
	Structure, organization and activity of phellogen. Polyderm and Rhytiderm –	wound					
	periderm. Normal secondary thickening in Dicots: Anomalous secondary growth in	Dicots					
П	(Amaranthaceae, Aristolochiaceae, Bignoniaceae, Piperaceae, Nyctaginaceae) and					
	arborescent Monocots. Primary thickening in palms: Ontogeny of leaf. Structure and t	vnes of					
	Stomata: Leaf abscission: Major nodal types: Kranz anatomy and its signif	jpes or					
	Microtechnique: Principle of killing and fixation dehydration and rehydration of ho	tanical					
	specimens. Stains: Principle of double staining (fast-green and light green) of free	e hand					
	specificities. Stands. Theope of double standing (last green and light green) of he sections: Protocol for serial sectioning of paraffin way impregnated specimens: Mount	ing and					
	mounting modia	ing and					
	MICDOSDODANCIUM AND MALE CAMETODIIVTE.						
	MICKOSPORANGIUM AND MALE GAMETOPHYTE;						
тт	Structure and development of Anthen Illtreatmenture and physicle av of onther tonature	. Mala					
111	surface and development of Annier, Onfastructure and physiology of antier tapetur sematoristic Polynology, Morphology and ultrestructure of pollon well, pollon kitt	n, Male					
	gametophyte, Falyhology. Morphology and utilastructure of policit wait, policit kitt,	ponen					
	MECASDODANCHIMAND EEMALE CAMETODIIVTE.						
	MEGASPORANGIUM AND FEMALE GAMETOPHYTE:						
	Structure and development of Magagnerongium, Types of exulas Endethelium obture	tor and					
	Structure and development of Megasporangium, Types of Ovules, Endothenum, obtura	ion and					
187	Nutation of ambuvo good Fortilization, Double fortilization and triple fusion. End						
11	Nutrition of emoryo sacs. Fertilization: Double fertilization and triple fusion; Endo	sperm:					
	Development of endosperm, types, physiological efficiency of endosperm nausto	ria and					
	(Gruss) and (Gruss	a alcot					
	POLYEMBRYONY:						
• 7	Concers of Delayer house a location in desting and any discharge list in Any minis						
v	Causes of Polyembryony, classification, induction and practical application. Apomixis	and its					
	significance. Seed and Fruit development and role of growth substances. Partnenocal	py and					
Recomm	ended Text:						
I. Bhojy	wani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th						
revise	ed and enlarged edition). Vikas Publishing House, New Delhi.						
2. Mahe	eshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant						
Morp	photogists, new Delni.						
3. Sharr	na, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.						
4. Pande	4. Pandey.S.N and Ajanta Chandha. 2006. Plant Anatomy and Embryology. Vikas Publishinf						
Hous	House Pvt. Ltd, New Delhi.						
5. Naray	yanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi.						
Reference	ce Books:						
I. Krishi	namurthy, K.V. 1988. Methods in Plant Histochemistry. S. Viswanathan & Co., Madras.						
2. Swam	y, B.G.L and Krishnamurthy. K.V 1990. From flower to fruits, Tata – McGraw Hill						
publis	hing 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.
- 6. Crang, R., Lyons-Sobaski, S and Wise, R. 2018. Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants. Springer International Publishing.
- 7. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
- 8. 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/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	3	3	3	3	3	3	3	3	3
CO2	3	1	3	3	3	3	3	3	3	3
CO3	3	1	3	3	3	3	3	2	3	1
CO4	3	3	3	1	1	2	3	2	2	1
CO5	3	3	3	3	3	3	2	3	3	2

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

CORE-VI LABORATORY COURSE-II COVERING PAPERS IV& V

Programme: M.Sc.,	Subject: Botany
Semester: II	Course: LABORATORY COURSE-II
Course Type: CORE VI	Course Code:
Contact Hours: 6 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning Ob	jectives	
C1	1.Understand and develop skill sets in plant morphological, floral char artificial key preparation.	acteristics and
C2	2.Expedite skilled workers to carry out research in frontier areas of plant scier	ice.
C3	3.Classify meristems and identify their structures, functions and roles in mo- plants growth and secondary growth of woody plants	onocot and dicot
C4	4.Learn the importance of plant anatomy in plant production systems.	
C5	5Know about different vegetation sampling methods.	
Course outcomes	On completion of this course, students will;	
CO1	To gain recent advances in plant morphological and floral characteristics.	K1
CO2	Understand about different floral characteristics and artificial key preparation which employed for plant identification and conservation.	K2
CO3	Recall or remember the information including basic and advanced in relation with plant anatomy and embryology.	K4 &K5
CO4	Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K3
CO5	Know about different vegetation sampling methods.	K3
K1 - Remem	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	ate.

UNIT	CONTENTS
	TAXONOMY AND ECONOMIC BOTANY OF ANGIOSPERMS
	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.

Ι	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.
	ANATOMY
II	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.

Rec	ommended Text:
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. OK641 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.
Ref	erence 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. <i>Natural</i>
	Products. Longman 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. Traditional plant medicines as sources of new drugs. P.J Houghton in Pharmacognosy.
	Trease and Evan's.16 Ed .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. <u>https://www.kobo.com/gr/en/ebook/phytochemistry-2</u>
- 2. <u>https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H</u>
- 3. <u>https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ</u>
- 4. <u>https://studyfrnd.com/pharmacognosy-and-phytochemistry-book/</u>
- 5. <u>https://www.worldcat.org/title/textbook-of-pharmacognosy-and-phytochemistry/oclc/802053616</u>
- 6. https://www.worldcat.org/title/phytochemistry/oclc/621430002

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	S	3	3
CO2	3	3	2	3	3	2	1	2	3	2
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	1	2	3
CO5	3	2	2	3	3	3	3	2	3	3

Mapping with Programme Outcomes:

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

ELECTIVE-III : BIOPESTICIDE TECHNOLOGY

Programme: M.Sc.,	Subject: Botany
Semester: II	Course: BIOPESTICIDE TECHNOLOGY
Course Type: ELECTIVE-III	Course Code:
Contact Hours: 4 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Ob	ojectives								
C1	1.To understand the value and applications of biopesticides.								
C2	2. To comprehend the various issues related to the use of chemical pesticides in horticulture, forestry, and agriculture.								
C3	3.To gain knowledge about several biopesticides (bio-insecticides, bio-bactericides, bio-nematicides and bio-herbicides).	fungicides, bio-							
C4	4.To gain knowledge of the techniques for mass production of selected biopes	ticides.							
C5	5.To be aware of the application strategies and weeds, nematodes, and disease	e targets.							
Course outcomes	On completion of this course, students will;								
C01	Understand the issues in use of chemical pesticides and their harmful effects on life.	K1 & K2							
CO2	Aware the significance of biopesticides and their beneficial role in K1 & K4 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.	K2 & K6							
CO4	Learn the mass production and formulation technology of selected biopesticides.	K3 & K6							
CO5	Knowledge on product development for commercialization of biopesticides.	K5							
K1 - Remem	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	ate.							
UNIT	CONTENTS								
	INTRODUCTION								
	Introduction of biopesticides. Biological control, History and concept of	of biopesticides.							
Ι	Importance, scope and potential of biopesticide. Advantages for the use of bio	pesticides.							
	TYPES OF BIOPESTICIDES								
	Classification of biopesticides, botanical pesticides and biorationales. M	Aass production							
II	technology of bio-pesticides. Major classes-Properties and uses of	Bioinsecticides,							
	biofungicides, biobactericides, bionematicides and bioherbicides. Importan	nce of neem in							
	organic agriculture.								
	IMPORTANT BIOINSECTICIDES								

	Bacillus thuringiensis, NPV, entomopathogenic fungi (Beauveria, Metarhizium, Verticillium,								
	Paecilomyces). Biofungicides: Trichoderma, Gliocladium, non-pathogenic Fusarium,								
	Pseudomonas spp., Bacillus spp. Biobactericides: Agro bacterium radiobacter.								
III	Bionematicides: Paecilomyces, Trichoderma, Bioherbicides: Phytophthora, Colletotrichum.								
	STANDARDIZATION OF BIOPESTICIDES								
	Target pests and crops of important biopesticides and their mechanisms of action. Testing of								
IV	quality parameters and standardization of biopesticides.								
	FORMULATION								
	Mass multiplication and formulation technology of biopesticides. Prospects and problems in								
V	commercialization and efficiacy of biopesticides. Commercial products of biopesticides.								

Recommended Text:

1.	Johri, J. 2020. Recent Advances in Biopesticides: Biotechnological Applications. New
	IndiaPublishing Agency (NIPA), New Delhi.

- 2. Kaushik, N. 2004. Biopesticides for sustainable agriculture: prospects and constraints. TERIPress, New Delhi.
- 3. Sahayaraj, K. 2014. Basic and Applied Aspects of Biopesticides. Springer India, NewDelhi.
- 4. Tebeest, D.O. 2020. Microbial Control of Weeds. CBS Publishers and Distributors, 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 Bioinoculants. 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. Biological Control of Crop Diseases. CRC Press, Florida, USA.

Web resources:

- 1. https://www.kobo.com/gr/en/ebook/phytochemistry-2
- 2. https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveeraebook/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

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	2	2	2	3	2	3	1	3	3
CO3	3	3	3	3	1	2	S	2	3	2
CO4	3	2	2	2	3	3	2	1	2	1
CO5	3	3	3	3	2	2	2	3	2	3

Mapping with Programme Outcomes:

S-Strong (3) M-Medium (2)

L-Low(1)

ELECTIVE-III : RESEARCH METHODOLOGY, COMPUTER APPLICATIONS & BIOINFORMATICS

Programme: M.Sc.,	Subject: Botany
Semester: II	Course: RESEARCH METHODOLOGY,
	COMPUTER APPLICATIONS &
	BIOINFORMATICS
Course Type: ELECTIVE-III	Course Code:
Contact Hours: 4 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Ob	jectives
C1	1.To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.

C2	2.To provide an overview on modern equipments that they would help students gain confidence to instantly commence research careers and/or start entrepreneurial ventures.							
C3	3.To develop interdisciplinary skills in using computers in botany to biological database.	learn about the						
C4	4.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.							
C5	5.Operate various software resources with advanced functions and its open office substitutes.							
Course outcomes	On completion of this course, students will;							
CO1	Realize the need of centrifuges and chromatography and their uses in Research	K1 &K2						
CO2	Learn the principles and applications of electrophoresis.	K2 &K3						
CO3	Construct the phylogenetic trees for similar characteristic feature of plant genomes and study <i>de novo</i> drug design through synthetic biology.	K5 &K6						
CO4	Understand the concept of pairwise alignment of DNA sequences using K3 &K4 algorithms.							
CO5	Interpret the features of local and multiple alignments.	K4 &K5						
K1 - Remen	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	ate.						
	CONTENTS							
UNIT	CONTENTS							
UNIT	CONTENTS Literature collection and citation: bibliography —bibliometrics (scientomet laws — citations and bibliography - *biblioscape— plagiarism— project pro dissertation writing – paper presentation (oral/poster) - E-learning tools- introduction and writing-Standard operating procedure (SOP) – introduction — Research Institutions - National and International.	rics): definition- posal writing — monograph — and preparation						
UNIT I II	CONTENTSLiterature collection and citation: bibliography —bibliometrics (scientomet laws — citations and bibliography - *biblioscape — plagiarism — project pro- dissertation writing – paper presentation (oral/poster) - E-learning tools- introduction and writing-Standard operating procedure (SOP) – introduction — Research Institutions - National and International.Basic principles and applications of pH meter, UV-visible spectrophotom lyophilizer, chromatography- TLC, Gas chromatography with mass spectrum HPLC-Scanning electron microscopy-Agarose gel Electrophoresis — Poly Electrophoresis —Polymerase chain reaction	rics): definition- oposal writing — oposal writing — opos						
UNIT I II III	CONTENTSLiterature collection and citation: bibliography —bibliometrics (scientometlaws — citations and bibliography - *biblioscape— plagiarism— project prodissertation writing – paper presentation (oral/poster) - E-learning tools-introduction and writing-Standard operating procedure (SOP) – introduction— Research Institutions - National and International.Basic principles and applications of pH meter, UV-visible spectrophotomlyophilizer, chromatography- TLC, Gas chromatography with mass spectrumHPLC-Scanning electron microscopy-Agarose gel Electrophoresis — PolyElectrophoresis –Polymerase chain reactionIntroduction to computers and Bioinformatics. Types of hardware and sosystems. Fundamentals of networking, operation of networks, telnet, ftp,Biological Research on the web: Using search engines, finding scientific articPublic biological databases, searching biological databases. Use of nucleic	rics): definition- oposal writing — monograph — and preparation heter, centrifuge, m (GC/MS), and yacrylamide Gel ftware operating www, Internet. les. acid and protein						
UNIT I II III	CONTENTSLiterature collection and citation: bibliography —bibliometrics (scientometlaws — citations and bibliography - *biblioscape— plagiarism— project prodissertation writing – paper presentation (oral/poster) - E-learning tools-introduction and writing-Standard operating procedure (SOP) – introduction— Research Institutions - National and International.Basic principles and applications of pH meter, UV-visible spectrophotomlyophilizer, chromatography- TLC, Gas chromatography with mass spectrumHPLC-Scanning electron microscopy-Agarose gel Electrophoresis — PolyElectrophoresis –Polymerase chain reactionIntroduction to computers and Bioinformatics. Types of hardware and sosystems. Fundamentals of networking, operation of networks, telnet, ftp,Biological Research on the web: Using search engines, finding scientific articPublic biological databases, searching biological databases. Use of nucleicdata banks.	rics): definition- oposal writing — monograph — and preparation neter, centrifuge, m (GC/MS), and yacrylamide Gel ftware operating www, Internet. les. acid and protein						
UNIT I II III IV	CONTENTS Literature collection and citation: bibliography —bibliometrics (scientomet laws — citations and bibliography - *biblioscape — plagiarism — project pro- dissertation writing – paper presentation (oral/poster) - E-learning tools- introduction and writing-Standard operating procedure (SOP) – introduction — Research Institutions - National and International. Basic principles and applications of pH meter, UV-visible spectrophotom lyophilizer, chromatography- TLC, Gas chromatography with mass spectrum HPLC-Scanning electron microscopy-Agarose gel Electrophoresis — Poly Electrophoresis –Polymerase chain reaction Introduction to computers and Bioinformatics. Types of hardware and so systems. Fundamentals of networking, operation of networks, telnet, ftp, Biological Research on the web: Using search engines, finding scientific artic Public biological databases, searching biological databases. Use of nucleic data banks. NCBI, EMBL, DDBJ, SWISSPORT, Protein prediction and Gene finding to	rics): definition- oposal writing — monograph — and preparation neter, centrifuge, m (GC/MS), and yacrylamide Gel ftware operating www, Internet. les. acid and protein						
UNIT I II III V V	CONTENTSLiterature collection and citation: bibliography —bibliometrics (scientometlaws — citations and bibliography - *biblioscape— plagiarism— project prodissertation writing – paper presentation (oral/poster) - E-learning tools- introduction and writing-Standard operating procedure (SOP) – introduction — Research Institutions - National and International.Basic principles and applications of pH meter, UV-visible spectrophotom lyophilizer, chromatography- TLC, Gas chromatography with mass spectrum HPLC-Scanning electron microscopy-Agarose gel Electrophoresis — Poly Electrophoresis —Polymerase chain reactionIntroduction to computers and Bioinformatics. Types of hardware and so systems. Fundamentals of networking, operation of networks, telnet, ftp, Biological Research on the web: Using search engines, finding scientific artic Public biological databases, searching biological databases. Use of nucleic data banks.NCBI, EMBL, DDBJ, SWISSPORT, Protein prediction and Gene finding to in Bioinformatics- BLAST, FASTA, Multiple Sequence Analysis .	rics): definition- oposal writing — - monograph — - and preparation - neter, centrifuge, m (GC/MS), and yacrylamide Gel ftware operating www, Internet. les. acid and protein						
UNIT I II III V Recomm	CONTENTSLiterature collection and citation: bibliography — bibliometrics (scientometlaws — citations and bibliography - *biblioscape — plagiarism — project prodissertation writing – paper presentation (oral/poster) - E-learning tools- introduction and writing-Standard operating procedure (SOP) – introduction — Research Institutions - National and International.Basic principles and applications of pH meter, UV-visible spectrophotom lyophilizer, chromatography- TLC, Gas chromatography with mass spectrum HPLC-Scanning electron microscopy-Agarose gel Electrophoresis — Poly Electrophoresis —Polymerase chain reactionIntroduction to computers and Bioinformatics. Types of hardware and so systems. Fundamentals of networking, operation of networks, telnet, ftp, Biological Research on the web: Using search engines, finding scientific artic Public biological databases, searching biological databases.NCBI, EMBL, DDBJ, SWISSPORT, Protein prediction and Gene finding to in Bioinformatics- BLAST, FASTA, Multiple Sequence Analysis .ended Text:	rics): definition- oposal writing — monograph — and preparation neter, centrifuge, m (GC/MS), and yacrylamide Gel ftware operating www, Internet. les. acid and protein						
I I II IV V Recomm 1. Veera	CONTENTS Literature collection and citation: bibliography —bibliometrics (scientomet laws — citations and bibliography - *biblioscape — plagiarism — project prodissertation writing – paper presentation (oral/poster) - E-learning tools-introduction and writing-Standard operating procedure (SOP) – introduction — Research Institutions - National and International. Basic principles and applications of pH meter, UV-visible spectrophotom lyophilizer, chromatography- TLC, Gas chromatography with mass spectrum HPLC-Scanning electron microscopy-Agarose gel Electrophoresis — PolyElectrophoresis —Polymerase chain reaction Introduction to computers and Bioinformatics. Types of hardware and so systems. Fundamentals of networking, operation of networks, telnet, ftp, Biological Research on the web: Using search engines, finding scientific artic Public biological databases, searching biological databases. Use of nucleic data banks. NCBI, EMBL, DDBJ, SWISSPORT, Protein prediction and Gene finding to in Bioinformatics- BLAST, FASTA, Multiple Sequence Analysis . ended Text: kumari, L. 2017. Bioinstrumentation. MJP Publisher, India. p578.	rics): definition- oposal writing — - monograph — a and preparation neter, centrifuge, m (GC/MS), and yacrylamide Gel ftware operating www, Internet. les. acid and protein						

 SreeRamulu, V.S.1988. Thesis Writing, Oxford& IBH Pub. New Delhi.
 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. Bioinformatics and functional genomics. 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-Pandeyebook/dp/B01JP3M9TW
- 4. https://en.wikipdia.org/wiki/bioinstrumentation
- 5. https://www.britannica.com/science/chromatography
- 6. https://en.wikipedia.org/wiki/electrophoresis

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	2	3	3	3	1	3	3
CO2	3	2	2	3	3	3	3	2	3	3
CO3	3	1	2	3	3	3	3	1	3	3
CO4	3	2	1	3	3	3	2	1	3	2
CO5	3	1	2	2	3	3	3	2	3	3

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

ELECTIVE-IV : APPLIED BIOINFORMATICS

Programme: M.Sc.,	Subject: Botany
Semester: II	Course: APPLIED BIOINFORMATICS
Course Type: ELECTIVE-III	Course Code:
Contact Hours: 4 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Ob	ojectives						
C1	1.To learn about the bioinformatics databases, databanks, data format and data retrieval from theonline sources.						
C2	2.To explain the essential features of the interdisciplinary field of science understandingbiological data.	for better					
C3	3.To outline the types of biological databases.						
C4	4.To demonstrate different online bioinformatics tools.						
C5	5.To summarize the strong foundation for performing further research in bioir	nformatics.					
Course outcomes	On completion of this course, students will;						
CO1	Familiarize with the tools of DNA sequence analysis.	K1 & K2					
CO2	Use and explain the application of bioinformatics.	K2 & K3					
CO3	Master the aspects of protein-protein interaction, BLAST and PSI-BLAST.	K3 & K4					
CO4	Describe the features of local and multiple alignments.	K3 & K4					
CO5	Interpret the characteristics of phylogenetic methods and bioinformatics applications.	K4 & K5					
K1 - Remem	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	ate.					
UNIT	CONTENTS						
I	BIOINFORMATICS AND INTERNET: 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.						
П	GENBANK SEQUENCE DATABASE: 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 DBI/EMBL/Conheady						

	STRUCTURE DATABASES:
III	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.
	SEQUENCE ALIGNMENT AND DATABASE SEARCHING:
IV	Introduction - Evolutionary Basis of Sequence Alignment - Modular Nature of Proteins - Optimal Alignment Methods - Substitution Scores and Gap Penalties- Database Similarity Searching - FASTA – BLAST (BlastP, BlastN, etc.,) - Position Specific Scoring Matrices, Spliced Alignments.
	PREDICTIVE METHODS:
V	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.

Rec	ommended Text:
1.	Baxevanis, A. D. & Ouellette, B. F. 2001. Bioinformatics: A practical guide to the
	analysis ofgenes and proteins. New York: Wiley-Interscience.
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. Bioinformatics and functional genomics. Hoboken, NJ: Wiley-Blackwell.
Ref	erence Books:
1.	Campbell, A.M and Heyer, L.J. 2003. Discovering genomics, proteomics, and
	bioinformatics.San Francisco: Benjamin Cummings.
2.	Green, M.R and Sambrook, J. 2012. Molecular cloning: A laboratory manual. Cold
	SpringHarbor, NY: Cold Spring Harbor Laboratory Press.
3.	Liebler, D.C. 2002. Introduction to proteomics: Tools for the new biology. Totowa, NJ:
	HumanaPress.
4.	Old, R.W., Primrose, S.B., and Twyman, R.M. 2001. Principles of gene
	manipulation: Anintroduction to genetic engineering. Oxford: Blackwell Scientific
	Publications.
5.	Primrose, S.B., Twyman, R.M., Primrose, S.B., and Primrose, S.B. 2006. Principles of
	gene manipulation and genomics. Malden, MA: Blackwell Pub.
We	b resources:
1.	Bioinformatics: Algorithms & Applications by Prof. M. Michael Gromiha IIT-
	Madras.
	https://nptel.ac.in/courses/102/106/102106065/#.
2.	Christopher Burge, David Gifford, and Ernest Fraenkel. 7.91.J Foundations of
	Computational and Systems <i>Biology</i> . Spring 2014. Massachusetts Institute of Technology:
	MIT Open Course Ware, 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-Selzerebook/dp/B001AUOYY2.
- 5. <u>https://books.google.co.in/books/about/Applied_Bioinformatics.html?id=PXZZDwAAQB_AJ&redir_esc=y</u>

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	2	3	3	3	3	2	2	3	2	2
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	1	3	3
CO5	3	2	2	2	3	3	3	3	3	3

Mapping with Programme Outcomes:

S-Strong (3)

M-Medium (2) L-Low(1)

ELECTIVE-IV - INTELLECTUAL PROPERTY RIGHTS

Programme: M.Sc.,	Subject: Botany
Semester: II	Course: INTELLECTUAL PROPERTY RIGHTS
Course Type: ELECTIVE- IV	Course Code:
Contact Hours: 4 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Ob	ojectives	
C1	1.Cater to the needs of the stakeholders of knowledge economy is desinterested in managers and similar individuals.	gned for those
C2	2.Create awareness of current IPR and innovation trends.	
C3	3.Disseminate information on patents, patent system in India and overseas a related issues.	and registration
C4	4.Pursue a career in IPR, which offers chances for IP consultants and Attorney	ys.
C5	5.Develop skill sets to enable you to comprehend and assess the methods use based economy and innovation ecosystems.	ed in knowledge
Course outcomes	On completion of this course, students will;	
CO1	Recall the history and foundation of Intellectual Property.	K1

CO2	Understand the differences of Property and Assets and Various	K)								
	Categories of Intellectual Creativity.	K2								
CO3	Apply the methods to protect the Intellectual Property.	K3								
	Differentiate if the Said Intangible property be protected under law or	K4								
CO4	protected by strategy.									
CO5	Create a recommendation document on the methods and procedures	K5 & K6								
	of protecting the said IP and search documents to substantiate them.	KJ & KO								
K1 - Remem	K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create.									
UNIT	CONTENTS									
	INTRODUCTION TO IPR									
т	History and Development of IPR. Theories on concept of property: Tangib	le vs Intangible.								
1	Subject matters patentable in India. Non patentable subject matters in India.	Patents: Criteria								
	of Patentability, Patentable Inventions - Process and Product. Concept	t of Copyright.								
	Historical Evolution of Copyright Ownership of copyright, Assignment	and license of								
	copyright.									
	UNIT II OVERVIEW OF THE IPR REGIME AND DESIGN									
	International treaties signed by India. IPR and Constitution of India. World Intellectu									
II	Property Organization (WIPO): Functions of WIPO, Membership, GATT Ag	greement. Major								
Conventions on IP: Berne Convention, Paris Convention. TRIPS agreem										
	Designs – Subject matter of Design – Exclusion of Designs – Novelty and originality – I									
	TRADE MARK I FOISI ATIONS AND PATENT ACT									
	TRADE MARK, LEOISLATIONS AND TATENT ACT									
	History of Indian Patent Act 1970. Overview of IP laws in India. Major IF	P Laws in India.								
III	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									
	Remedies and Penalties	. Init ingement.								
	PRIOR ART SEARCH AND DRAFTING									
	Overview of Patent Search, Advantages of patent search, Open source and po	aid databases for								
IV	Patent Search, International Patent classification system. Types of specificati	ons: Drafting of								
	Provisional specifications. Drafting of complete specifications. Drafting of cla	aims.								
	GI AND PATENT FILING PROCEDURES									
	Geographical Indications of Goods (Pagistration and Protection) Infringemen	t Offenees and								
V	Geographical Indications of Goods (Registration and Protection) Infringement – Offences and Densities Remedies, Plant Variaty and Formers Right Act (DRVER), Plant variaty motortion									
	Access and Benefit Sharing (ABS). Procedure for registration, effect of regis	tration and term								
	of protection. Role of NBA. Filing procedure for Ordinary application	on. Convention								
	application. PCT National Phase application. Process of Obtaining a Patent. I	nfringement and								
	Enforcement.	-								

Recon	mended Text:
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.
Refere	ence Books
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
	LexisNexis 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 r	esources:
1. ht	tp://cipam.gov.in/

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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	2	3	2	3	2
CO 2	3	3	3	3	3	3	2	2	3	3
CO 3	3	2	3	2	2	3	3	3	2	1
CO 4	3	2	3	2	2	3	1	3	2	3
CO 5	3	2	1	3	2	3	2	3	2	3

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

SKILL ENHANCEMENT COURSE (SE2) AGRICULTURE AND FOOD MICROBIOLOGY

Programme: M.Sc.,	Subject: Botany
Semester: II	Course: AGRICULTURE AND FOOD MICROBIOLOGY
Course Type: SKILL ENHANCEMENT	COURSE Course Code:
Contact Hours: 4 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning O	bjectives					
C1	To understand the benefits of microbes in agriculture and food industry.					
C2	To provide comprehensive knowledge about plant – microbe interactions.					
C3	To provide basic understanding about factors affecting growth of microbes					
C4	To appreciate the role of microbes in food preservation.					
C5	To understand about the benefits of microbes in agriculture and food industry.					
Course outcomes	On completion of this course, students will;					
CO1	Recognize the general characteristics of microbes and factors affecting its Growth	K1				
CO2	Explain the significance of microbes in increasing soil fertility	K2				
CO3	Elucidate concepts of microbial interactions with plant and food.	K3				
CO4	Analyze the impact of harmful microbes in agriculture and food Industry.	K4				
CO5	Determine and appreciate the role of microbes in food preservation and as biocontrol.	K5 & K6				
K1 - Remen	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Creat	е.				
UNIT	CONTENTS					
I	ROLE OF MICROORGANISMS IN AGRICULTURE Role of symbiotic and free-living bacteria and cyanobacteria in agriculture Plant Growth Promoting Microorganims (PGPM) and Phosphate Solubilizing N (PSM).	., Mycorrhiza, Microorganims				
	BIOCONTROL AND BIOFERTILIZATION					
п	Biocontrol of plant pathogens, pests and weeds, Restoration of waste lands Biofertilizers: Types, technology for their production and application, ver	and degraded				
11	FOOD MICROBIOLOGY	ini-composi.				

Ш	Intrinsic and extrinsic factors influencing growth of microorganisms in food, Microbes as source of food: Mushrooms, single cell protein.
	FOOD MICROBIOLOGY
IV	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.
	PREDICTIVE METHODS:
V	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., Harley J.P., Klein D. A. 2005. Microbiology, McGraw Hill, India. 6th edition.
- Goldman, E. and Green, L.H. 2015. Practical Handbook of Microbiology (3rd Ed.). CRC Press.

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. and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (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_Environm ental_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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	3	3	3
CO3	2	2	3	3	1	2	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	3	3	3	2	3

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

INTERNSHIP/INDUSTRIAL ACTIVITY

Programme: M.Sc.,	Subject: Botany
Semester: II	Course: INTERNSHIP/INDUSTRIAL ACTIVITY
Course Type: SKILL ENHANCEMENT	COURSE Course Code:
Contact Hours:-	Credits: 2
CIA: 25	CE: 75

Learning Ob	jectives
C1	The main goal of the internship programme is to give students exposure to industry and help them comprehend current management techniques by having them work for at least fifteen
	days in an industry/institution over the summer
C2	To comprehend how theoretical ideas are applied in many sectors and industries.
С3	To create a foundation for industry-integrated education, as well as to give students better practical knowledge and hands-on experience, improve their leadership qualities, and sharpen their problem-solving and management skills.
C4	The internship must focus on practice. The college will require the students to visit the offices of the research lab/industry/institution it has a memorandum of understanding (MOU) with in order to receive on-the-job training in the many different areas of those businesses' operations.
C5	Internships provide students with practical experience in a variety of fields, including manufacturing, productivity, development, and quality analysis. These experiences prepare students for competitive hiring processes in reputable MNC industries.
Course	On completion of this course, students will;

outcomes										
CO1	For students in those pertinent core areas, the internship is preparing them to become professionals after graduation.	K1								
CO2	Compile data and familiarize yourself with techniques for planning carrying out tests.									
CO3	collect data and educate yourself on how to analyse results of your cientific studies. K3 & K5									
CO4	This in-the-moment industrial exposure helps them become more knowledge b K4 killed in the latest technology. K4									
CO5	Improving communication skills and coming up with creative are crucial components of training that help someone become an entrepreneur.	K5 & K6								
K1 - Remem	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create.									
UNIT	CONTENTS									
	Guidelines for Internship Programme:	luring								
Ι	the II Semester vocation in order to acquire exposure to research labs, industr	y, and								
	2. Individual instruction is provided for the internship. The internship progr	amme								
	must be completed in order to receive a credential.									
	3. Students are required to indentify a research labs/industry/recognized institution	on for								
	their Internship Programme Coordinator in consultation with and approval o	f their								
	faculty guide. The choice of the research labs/industry/recognized insti-	tution								
	should be intimated to the internship coordinator before commencement of internship. Simultaneously, students should also have identified a guide with	in the								
	research labs/industry/recognized institution (industry guide) under	whose								
	supervision and guidance they would carry out their Internship Program.	whose								
	4. Students are expected to learn about the history of the research labs, industry	y, and								
	recognized institution during their time. They must also learn about its found	ers or								
	shareholders, the nature of business, organizational structure, rep	orting								
	relationships, and how the various management functions (such as finance	, HR,								
	marketing, sales, and operations) operate. This list is merely illustrative ar	nd not								
	comprehensive. Students should collect and gather as much as possible of w	ritten								
	5. Before leaving the research labs/industry/recognized institution obtain	n the								
	Internship Programme completion certificate on the letterhead of a res	search								
	lab/industry/, or an accredited institution.									
	6. Maintain Internship Programme record with details on activities and pe	rsonal								
	learning during their project period.									

	7. The department head and the coordinator of the internship programme form a
	committee to ensure that the internship is followed.
	8. At least two copies of the report must be prepared by the intern at the conclusion of
	the internship program-one for submission to the college and one copy for the
	student. If the organization, the guide, or both request additional copies, more
	copies may be made. The sources from which the information was gathered should
	be made crystal apparent in the report. Every page needs to have a number, which
	should be centred at the bottom of the page. All tables figures and appendices
	must be appropriately labeled and consecutively numbered or lettered. The report
	must be printed, bound (ideally with soft binding), and contain at least 25 pages
	0. The internation training report should be submitted to the department within a
	9. The internship training report should be submitted to the department within a
	10 H
	10. However, such submission shall not be accepted after the end of third semester
	Examinations.
	Evaluation of the Internship:
п	i. The internship program will be assessed by the assigned Internship Programme
	Coordinator from the host institute.
	ii. Evaluation will be done by the Internship Programme Coordinator of the host
	institute and through seminar presentation/viva-voce.
	iii. The presentation should be specific, clear and well analyzed, and indicate the
	specific sources of information.
	iv. According to the statement of the draft the evaluation of the interns will be done as
	per the sincerity and research output of the students. In addition the evaluation will
	also be assessed according to the activity of the log book, format of presentation.
	quality of the report made by the interns, uniqueness, skill sets and evaluation
	report of the internship coordinator
	report of the internation coordinator.
III	College Guide Manual – Summer Internship Program
	1. The Internship Programme Coordinator should give proper procedures to the intern
	before and after the Internship.
	2. The Internship Programme Coordinator should interact with the research
	labs/industry/recognized institution at least once before completion of the
	internship.
	3. The weekly report submitted by the student should be reviewed and reported to the
	Internship Programme coordinator.
	I G
IV	Internal: 100 marks
	Internship Programme
	Completion certificate J- 30 marks

	Internship report - 30 marks
	Presentation - 20 marks
	Viva-voce - 20 marks
	CONTENTS OF THE REPORT
X 7	Title page
v	Page for supervisory committee
	Table of
	Acknowledgement
	Internship Certificate
	Executive Summary
	Introduction of the Report
	Overview of the Organization
	What I have Learned
	Analyses
	Summary
	Recommendations and Conclusion
	References
	Appendices

Recommended Text:

1. Dawson, C. 2002. Practical research methods. UBS Publishers, New Delhi.

2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. 1995. Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	1	3	3	3	3	3	2
CO 2	3	3	3	3	3	3	2	1	3	3
CO 3	3	3	3	3	3	3	2	1	3	3
CO 4	3	2	3	3	3	3	3	2	3	3
CO 5	3	3	3	3	3	3	3	3	2	3

S-Strong (3) M-Medium (2)

L-Low(1)

II YEAR SEMESTER III

CORE VII : CELL AND MOLECULAR BIOLOGY

Programme: M.Sc.,	Subject: Botany
Semester: III	Course: CELL AND MOLECULAR BIOLOGY
Course Type: CORE VII	Course Code:
Contact Hours: 6 Hours/Week	Credits: 5
CIA: 25	CE: 75

T									
Learning O	bjectives								
C1	1.Enable to learn various cell structures and functions of prokaryotes and	eukaryotes and							
	understand the salient features and functions of cellular organelles.								
C2	2.To understand the cell division and it molecular mechanism so as to appreciate and								
	manipulate normal and abnormal cell and tissue growth.								
C3	3. To enlighten people of past molecular biology developments.								
C4	4. To comprehend the molecular processes.								
C5	5.A thorough examination of DNA structure, replication process, transcription translation processes.	on process and							
Course outcomes	On completion of this course, students will;								
CO1	Recall a plant cell structure and explain its function.	K1							
CO2	Illustrate and explain the structure of various cell organelles.	K2							
CO3	Explain the structure and functional significance of nucleic acid.	K3							
CO4	Compare and contrast the DNA replication (prokaryotes and	K4							
04	eukaryotes), enzymes involved in replication, DNA repair								
CO5	Discuss and develop skills for DNA/gene manipulating and the enzymes involved.	K5 & K6							
K1 - Remen	iber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	nte.							
UNIT	CONTENTS								
I	The dynamic cells, Concept of prokaryote and Eukaryote. Structural organization of plant cell, specialized plant cell types chemical foundation. Cell wall- Structure and functions, Plasma membrane; structure, models and functions, site for ATPase, ion carriers channels and pumps receptors. Plasmodesmata and its role in movement of molecule								
II	Chloroplast-structure and function, genome organization, gene expression Mitochondria; structure, genome organization, biogenesis. Plant Vacuo membrane, ATPases transporters as a storage organelle. Structure and function organelles- Golgi apparatus, lysosomes, endoplasmic reticulum and microbodic Nucleus: Structure and function, nuclear pore, Nucleosome organization endoplasmic reticulum and microbodic	, RNA editing, le - Tonoplast ion of other cell ies. uchromatin and							

		heterochromatin. Ribosome- Structure and functional significance. RNA and DNA Structure.				
	III	A, B and Z Forms. Replication, transcription, translation in prokaryotes and eukaryotes. DNA				
		damage and repair (Thymine dimer, photoreactivation, excision repair). Cell cycle and				
		Apoptosis;				
		Control mechanisms, role of cyclin dependent kinases. Retinoblastoma and E2F proteins,				
		cytokinesis and cell plate formation, mechanisms of programmed cell death.				
		DNA replication (prokaryotes and eukaryotes), enzymes involved in replication, DNA repair.				
		DNA sequencing. Transcription, enzymes involved in transcription, post transcription				
	IV	changes, reverse transcription, Translation. overlapping genes.				
		DNA/gene manipulating enzymes: endonuclease, ligase, polymerase, phosphatase,				
		transcriptase, transferase, topoisomerase. Gene cloning: cloning vectors, molecular cloning				
	V	and DNA libraries. Molecular genetic elements, insertion elements, transposons.				
		Recombinant DNA. Direct and indirect gene transfer. Detection of recombinant molecule,				
		production of gene products from cloned genes. Genome library, cDNA library.				
Re	commende	ed Text:				
1.	Roy, S.C a	and Kumar, K.D.C. 1977. Cell Biology, New Central Book Agency, Calcutta.				
2.	Karp, G. 2	2010. Cell and Molecular Biology: Concepts and Experiments.6 th edition. John Wiley & Sons.				
⊃. ⊿	Cooffroy l	2011. Text BOOK OF Cell BIOlogy. BOOKS and America (P) Ltd, Kolkata, India.				
4. 5	Turnor D	M. Cooper. 2019. The Cell. A Molecular Approach, Oxford University Fless.				
5. 6	Watson I	D. Bakar T.A. Ball S.B. Gann A. Lavina M. Losiak P. 2014 Molacular Piology of the Gana				
0.	(7th editio	n) Pearson Press				
7	Snustad P	n), realson riess.				
8	Clark D	2010 Molecular Biology Academic Press Publication				
9	David Fre	ifelder 2008 Essentials of Molecular Biology Narosa Publishing house New Delhi				
10.	Geoffrey	M. Cooper and Robert E. Hausman, 2015. The Cell: A Molecular Approach. 7 thedn. Sinauer				
10.	Associates	s is an imprint of Oxford University Press.				
Re	ference Bo	oks:				
1.	Alberts E	B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1989. Molecular biology of the				
	Cell (2nd	edition). Garland Pub. Inc., New York.				
2.	Karp, G.	1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc.,				
	USĀ.					
3.	Lodish S	Baltimore B, Berk, C and Lawrence K, 1995, Molecular Cell Biology, 3rd edn, Scientific				
	American	n Books, N.Y				
4.	De Rober	tis and De Robertis, 1988, Cell and Molecular Biology, 8th edn, Info-Med, Hongkong.				
5.	. Lewin, B. 2000. GENE VII. Oxford University Press, New York, USA 7. Cooper G M and Hausman R					
	E,2007, The Cell: Molecular Approach 4th Edn, Sinauer Associates, USA.					
6.	Genes X-	- Benjamin Lewin, Jones and Bartlett, 2011 4. Molecular Biology of the Cell – Alberts, B,				
	Bray, D,	Raff, M, Roberts, K and Watson JD, Garland Publishers, 1999 5. Principles of Biochemistry –				
	Lehninge	r, W.H. Freeman and Company, 200				
We	b resourc					
	https://ww	/w.pdfdrive.com/cell-biology-books.html				
$\frac{2}{2}$	nttp://www	W.DIO-NICA.INIO/BIDIIOteca/BOISOVer2004CellBiology.pdf				
5.	nttps://ww	w.e-dooksuirectory.com/iisting.pnp/category=549				

5. https://www.kobo.com/in/en/ebooks/molecular-biology

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	3	3	3
CO3	2	2	3	3	1	3	2	3	1	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	3	3	3	2	3

Mapping with Programme Outcomes:

S-Strong (3) M-Medium (2)

CORE VIII: GENETICS, PLANT BREEDING & BIOSTATISTICS

L-Low(1)

Programme: M.Sc.,	Subject: Botany
Semester: III	Course: GENETICS, PLANT BREEDING & BIOSTATISTICS
Course Type: CORE VIII	Course Code:
Contact Hours: 6 Hours/Week	Credits: 5
CIA: 25	CE: 75

Learning Ob	jectives
C1	1. The students will be able to have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.
C2	2.Develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels.
C3	3.Familiarize with genetic basis of heterosis.
C4	4.Reflect upon the role of various non-conventional methods used in crop improvement.
C5	5.Solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods

Course outcomes	On completion of this course, students will;	
CO1	Understand the Mendal's Law of inheritance and gene interactions.	K1
CO2	Analyze the various factors determining the heredity from one generation to another.	K2
CO3	Explain Gene mapping methods: Linkage maps.	K3
CO4	Compare and contrast the genetic basis of breeding self and cross – pollinated crops.	K4
CO5	Discuss and develop skills for statistical analysis of biological problems.	K5 & K6
K1 - Remem	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	te.
UNIT	CONTENTS	
І	Mendal's Law of inheritance. Gene interactions and modified dihybrid ration inheritance. Sex determination in plants and theories of sex determination characters. Structure of Gene ,Operon , inducible operon , Operator Polycistronic m RNA, Regulator, regulator constitutive,Regulator s repressor, super repressor, inducer. Gene function and regulation in pro- reference to Lac operon and trp operon. Producer gene , structural gene gene. Gene Regulation eukaryotes –Britten and Davidson model, Ara regulation in flowering. Recombination: Homologous and non-homologous recombination, recombination. Holiday model of recombination. Transposable genetic element, transposase, transposon, simple transposon, composite transposo Transposons in <i>Zea mays</i> . Transposable elements in prokaryotes. UV induce	os. Quantitative on. Sex linked site, Promoter, uper repressor, okaryotes with and integrator abidopsis- gene site-specific elements: Ac on, Is element.
	its repair mechanism. Mismatch DNA repair mechanism. Mutation type mutation, addition, deletion, substitution, transition and transversio pigmentosum.	es- frame shift n. Xeroderma
ш	ABO blood group in humans. QTL mapping, Gene mapping methods: Linka analysis, mapping with molecular markers ,mapping by using somatic cell chromosomal inheritance, maternal inheritance. Organelle genomes : On functions of chloroplast and mitochondrial DNA.	nge maps, tetrad hybrids. Extra rganization and
IV	PLANT BREEDING: Objectives of plant breeding, characteristics improved by plant breeding, C breeding self and cross – pollinated crops. Pure line theory, pure line sele selection, clonal selection methods. Hybridization ,Genetics and physiol heterosis.	Genetic basis of ction and mass ogical basis of
V	BIOSTATISTICS: Measures of central tendency (Mean, Median, Mode) and dispersal (Meandard deviation), standard errors ANOVA (One way).probabilite (Binomial, Poisson andnormal); sampling distribution; difference between non-parametric statistics; confidence interval; errors; levels of significance;	lean deviation, ty distributions parametric and regression and

correlation; t-test; analysis of variance; X2 test;; basic introduction to Multivariate statistics,
etc.
Recommended Text:
1. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York,
England.
2. Stansfield, W.D. 1969. Theory and problems of Genetics. McGraw-Hill
3. Sinnott, E.W.Dunn, L.E and Dobzhansky, T. 1973. Principles of Genetics. McGraw-Hill.New York.
4. Chaudhari, H.K.1984. Elementary Principles of Plant Breeding. Oxford & IBH Publishing Company.
5. Brown, T.A. 1992. Genetics a Molecular Approach, 2nd Ed. Chapman and Hall.
6. Chahal, G.S and Gosal, S.S. 2018. Principles and Procedures of Plant Breeding Biotechnological and
Conventional Approaches, Narosa Publishing House, New Delhi.
7. Singh, B.D. 2013. Plant Breeding: Principles and Methods, Kalvani Publishers, New Delhi
8. Singh, P. 2017. Fundamentals of Plant Breeding, Kalyani Publishers.
9. Chaudhary, R.C. 2017. Introductory principles of plant breeding, Oxford IBH Publishers, New Delhi.
10. Gupta, P.K. 2009. Genetics. Rastogi publications, Meerut, New Delhi.
11. Gupta, S.C. 2013. Fundamentals of statistics, Himalaya Publishers, Mumbai.
12. Kothari, C.R and Garg, G. 2014. Research methodology – Method and techniques. New Age International
(P) Ltd. New Delhi.
13. Gurumani, N. 2005. Biostatistics, 2 nd edn. MJP publications, India.
Reference Books:
1. Watson, J.D. <i>et al.</i> 2003. Molecular Biology of the Gene. Fourth Edition. The Benjamin Cummings
Pub. Co.
2. Lewin, B. 2003. Genes VIII. Oxford University Press.
3. Friefelder, D. 2005. Molecular Biology. Second Edition. NarosaPub.House.
4. Sobtir.C. and Gobe. 1991. Eukaryotic chromosomes. Narosa Publishinghouse.
1. Smith-Keary, P. 1991, Molecular Genetics, Macmillan Pub, Co. Ltd. London.
2. Acquaah, G.2007. Principles of Plant Genetics and Breeding. Blackwell Publishing.
3. William.S., Klug and Michael, R. Cummings, 2003. Concepts of Genetics. Seventh edition. Pearson
Education (Singapore)Pvt.Ltd.
4. Simmonds, N.W. 1979. Principles of Crop improvement. Longman, London.
5. Lewin, B. 2000. Genes VII, Oxford University Press, USA.
6. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.
7. Allard, R.W. 2010. Principles of Plant Breeding. 2 nd ed. John Wiley and Sons, Inc. New Jersey, US.
8. Pillai, R.S.N and Bagawathi, V. 1987. Practical Statistics (For B.Com. and B.A., Students) S.Chand
& Co. (Pvt.) Ltd., New York.
9. 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.
10. Zar, J.K. 2011. Biostatistical Analysis, Fourth Edition, Prantice-Hall International, New Jersey, USA.
Web Resourses
1. https://www.cdc.gov/genomics/about/basics.htm
2. https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/lecture-notes/
3. http://galaxy.ustc.edu.cn:30803/zhangwen/Biostatistics/Fundamentals+of +Biostatistics+8th+edition pdf
4. https://www.britannica.com/science/evolution-scientific-theory

- https://www.britannica.com/science/evolution-scientme-the
 https://www.britannica.com/science/cell-biology
 https://medlineplus.gov/genetocs/understanding/basics/cell/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	3	3	3
CO3	2	2	3	3	1	3	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	3	3	3	2	3

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

CORE IX : LABORATORY COURSE-III (COVERING CORE PAPERS VII AND VIII)

Programme: M.Sc.,	Subject: Botany
Semester: III	Course: LABORATORY COURSE-III
Course Type: CORE IX	Course Code:
Contact Hours: 6 Hours/Week	Credits: 5
CIA: 25	CE: 75

Learning Ob	ojectives	
C1	1.Observe the different stages of mitosis and chromosome behaviour and during various stages and to learn staining techniques of various plant tissues.	d organization
C2	2.Explain the principles of linkage, crossing over and the hereditary mechanis	ms.
C3	3.Expose the students to gain recent advances in molecular biology.	
C4	4.Understand the principles of plant breeding to apply crop improvement prog	grammes
Course outcomes	On completion of this course, students will;	
CO1	Recall or remember the various aspects of cell biology, genetics, molecular biology, plant breeding and tissue culture.	K1
CO2	Understand various concepts of cell biology, genetics, plant breeding and tissue culture.	K2
CO3	Apply the theory knowledge gained into practical mode in order to acquire applied knowledge by day-to-day hands-on experiences.	К3
CO4	Analyze or interpret the results achieved in practical session in the context of existing theory and knowledge.	K4

CO	5 Evaluate the theory and practical skills gained during the course.	K5 & K6							
K1 - R	emember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Cre	ate.							
UNI	CONTENTS								
	CELL AND MOLECULAR BIOLOGY								
Ι	 I dentification of different stages of mitosis from suitable plant material. (Onion root tips, garlic root tips). Identification of meiosis from suitable plant material. (Onion /Tradeschantia floral buds). Isolation of cell organelles : Mitochondria, Chloroplast, Nucleus, Lysosomes and there assay by succinate dehydrogenase activity (Mitochondria), acid phosphatase activity (Lysosome), acetocarmine staining (Nucleus) and microscopic observation (Chloroplast) Study of mitotic index from suitable plant material. Study of cyclosis in cells of suitable plant material. To study plant vacuole in cells of onion leaf peel. Restriction digestion of DNA samples using restriction endonucleases (RE). To study the structure and organization of plant cell in various tissues of various plants 								
	(incl. leaf, stem and roots).	(incl. leaf, stem and roots).							
	GENETICS								
II	 Problem solving on dihybrid phenotypic, genotypic and test cross ratios. Incomplete dominance in plants. Interactions of factors and modified dihybrid ratios. Multiple alleles in plants, blood group inheritance in human. Sex linked inheritance in Drosophila and plants. Quantitative inheritance in plants. Tetrad analysis in Neurospora. Complementation analysis to find out complementation groups in viruses. Chromosome mapping from three point test cross data. Calculation of chias interference. Calculate gene and genotypic frequency by Hardy- Weinberg equation. 	smatic							
Deerre	nonded Texts								
Recommendation1. Geo& B2. Gup3. Gup4. KurDell5. Bha6. Gup	rge M Malacinski. 2015. Freifelders Essentials of Molecular Biology (4th ed.). Jones artlett. ta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut. ta, P.K. 2018. Cytogenetics, Rastogi Publications, Meerut. nar, H.D. 2007. Molecular Biology and Biotechnology, Vikas Publishing House, New hi. radwaj, D.N. 2012. Breeding of field crops (pp. 1-23). Agrobios (India).	v							

Bharadwaj, D.N. 2012. Breeding of field crops (pp. 1-23). A
 Singh, R.J. 2016. Plant Cytogenetics. CRC press, US.

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- 8. Shivakumar, S. 2002. Molecular analysis: Laboratory Manual. University press, Palkalai nagar, Madurai, India.

Reference Books:

- 1. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John Wiley & Sons, New York.
- 2. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
- 3. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.
- 4. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
- 5. Glover, D.M and B.D. Hames (Eds). 1995. DNA cloning 1: A Practical Approach; Core Techniques, 2nd edition PAS, IRL press at Oxford University Press, Oxford.
- 6. Gunning, B.E.S and M. W. Steer. 1996. Plant Cell Biology: Structure and function. Jones and Bartlett Publishers, Boston, Massachusetts.
- Hackett, P.B. and J.A. Fuchs, J.W. Messing. 1988. An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/ Cummings Publishing Co., Inc Menlo Park, California. 8. Hall, RD. (Ed).1999. Plant Cell Culture Protocols. Humana Press, New Jersey.
- 8. Harris, N and K.J. Oparka. 1994. Plant cell Biology: A Practical Approach. IRL Press, At Oxford University Press, Oxford, UK.
- 9. Gelvin, S.B., Schilperoort, R.A. (Eds.). 2000. Plant Molecualr Biology Manual.
- 10. Henry, RJ. 1997. Practical applications of plant molecular biology, Chapman & Hall, London.
- 11. Krebs, J.E., Goldstein E.S. and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning.

Web sources:

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- $2. \ https://www.bjcancer.org/Sites_OldFiles/_Library/UserFiles/pdf/Cell_Biology_Laboratory_Manual.pdf$
- 3. https://www.kopykitab.com/Genetics-With-Practicals-by-Prof-S-S-Patole-Dr-V-R-Borane-Dr-R-K-Petare
- 4. https://www.kopykitab.com/Practical-Plant-Breeding-by-Gupta-S-k
- 5. https://www.kopykitab.com/Cell-And-Molecular-Biology-A-Lab-Manual-by-K-V-Chaitanya
- 6. https://www.amazon.in/Plant-Tissue-Culture-Theory-Practicals/dp/9386347350

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	3	3	3

Mapping with Programme Outcomes:

CO3	2	2	3	3	1	2	1	3	1	2	
CO4	3	3	3	3	3	2	3	3	3	2	
CO5	3	3	2	3	2	3	3	3	2	3	

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

INDUSTRY MODULE - INDUSTRIAL BOTANY

Programme: M.Sc.,	Subject: Botany
Semester: III	Course: INDUSTRIAL BOTANY
Course Type: CORE X	Course Code:
Contact Hours: 6 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning Ol	bjectives					
C1	1.To learn the applied aspects of industrial application of algae, fungi, bacteria, plants, molecular biology and recombination technology.					
C2	2. The student would be competent to work in industries.					
C3	3.To educate people about the widespread commercial uses of fungi.					
C4	4. To know about the economic importance of plants.					
C5	5.To acquire knowledge on <i>in vitro</i> cultivation techniques to develop p towards commercialization.	rotocols targeted				
Course outcomes	On completion of this course, students will;					
CO1	Understand the basics of algae in industrial applications.	K1				
CO2	Demonstrate and to recollect the uses in fungi in industries.	K2				
CO3	Explain bacterial role in industries.	К3				
CO4	Compare and contrast the use of plants in industries.	K4				
CO5	Discuss and develop skills for working in industries specializing in biomolecules.	K5 & K6				
K1 - Remen	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Cr	reate.				
UNIT	CONTENTS					
	ALGAE IN INDUSTRIES: Fertilizer industry-Seaweeds, pharmaceutical industry – antibiotics, agar, ca	arageenin, alginin,				

Ι	diatomate earth, mineral industry, fodder industry
	FUNGI IN INDUSTRIES:
	Beneficial use of yeast, Fermentation of alcohol, preparations of enzyme, organic acid
II	preparation, cheese production, protein manufacture, vitamins, fats.
	PLANT PRODUCTS:
	Fibres and Fibre-Yielding Plants, wood and cork, tannins and dyes, rubber, fatty oils and
III	Vegetable fats, sugars and starches, pulp and paper, gums and resins.
IV	BACTERIA IN INDUSTRY:
	Food industry, dairy products, bioleaching, biogas production, bioremediation
V	RECOMBINANT PLANTS:
	Tissue culture: Micropropagation, somatic seeds, cell culture.
Recommended Text:	
1. Trivedi, P	.C. 2001. Algal Biotechnology. Point publisher, Jaipur. India.
2. Dinaband	hu, S and Kaushik. B.D. 2012. Algal Biotechnology and Environment. I.K. International, New
Delhi.	
3. Poonam S	ingh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
4. Dilip K. A	Arora. 2003. Handbook of Fungal Biotechnology. CRC Press book.
5. Vardhana	, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.
6. Dubey R.	C. 2004. A text book of Biotechnology aspects of microbiology, British Sun Publication.
7. Pelzer, M	J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology, Tata MaGraw Hill Publishing House,
New Dell	
8. Narayana	swamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi
Reference books:	
1. Becker. E	.W. 1994. Micro algae Biotechnology and Microbiology.Cambridge University press.
2. Borowitzl	ka, M.A. and borowizka, L.J. 1996. Microalgal Biotechnology. Cambridge University Press,
Cambridg	e,
3. Sahoo, D	. 2000. Farming the ocean: seaweed cultivation and utilization. Aravali International, New
Delhi.	
4. Mahendra	Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New
Delhi.	
5. Street, H.	E. 1978. Essay in Plant Taxonomy, Academic Press, London, UK.
6. Alexander	r N. Glazer and Hiroshi Nikaido. 1994. Microbial Biotechnology.
7. Pandey,	B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant
Pathology	y, Industrial Microbiology and Bryophyta. S Chand & Company.
8. Chichister	r, U.K.J. 1999. Cultivation and Processing of Medicinal Plants, Wiley & Sons
9. William C	Charles Evans. 1989. Pharmacognosy, 14th ed. Harcourt Brace & Company.
10. Kumar,H.	D.1999. Introductory Phycology. Affiliated East-West Press, Delhi.
11. Das,Sand	Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New
Delhi, Ind	
12. Willie, J	and Snerwood, L. 2016. Prescott's Microbiology McGraw-Hill Education; 10th
Edition,	ISBN: 9/8-1239281394 Bajai T.P.S. 1977 Applied and Fundamental Aspects of Plant call tissue and ergen Culture
Springer -	- Verlaug.
Web resources:	
1. https://wv	vw.elsevier.com/books/algal-biotechnology/ahmad/978-0-323-90476-6
2. https://ww	ww.amazon.in/Fungi-Biotechnology-Prakash-ebook/dp/B07PBF2R3D
5. mups.//wv	w.amazon.nvi ianc-based-ivatulari iouucis-Delivatives-Applications-e000k/up/b0/458NICJ
- 4. https://link.springer.com/book/10.1007/978-981-16-5214-1
 5. https://link.springer.com/book/10.1385/0896031616

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	1	2	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	2	2	3	3	1	2	1	2	1	3
CO4	3	3	3	3	3	2	3	2	3	3
CO5	3	3	2	3	2	3	3	3	3	3

Mapping with Programme Outcomes:

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

ELECTIVE V - SECONDARY PLANT PRODUCTS AND FERMENTATION BIOTECHNOLOGY

Programme: M.Sc.,	Subject: Botany
Semester: III	Course: SECONDARY PLANT PRODUCTS AND
	FERMENTATION BIOTECHNOLOGY
Course Type: ELECTIVE V	Course Code:
Contact Hours: 3 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Ob	ojectives			
C1	1. To familiar with the basics of biochemistry and fermentation.			
C2	2.Understand secondary metabolites.			
C3	3.To enhance the knowledge and skills needed for self-employment using the microbial derived products.			
C4	4. Apply the microbial culture in the manufacturing of value added products.			
C5	5. Critically analyze the types of bioreactors and the fermentation process.			
Course outcomes	On completion of this course, students will;			
CO1	Critically analyze the types of bioreactors and the fermentation process.	K1		

CO2	Evaluate the role of microorganisms in industry.	K2						
CO3	Analyze the types of bioreactors.	К3						
CO4	Create to understand the significance of intrinsic and extrinsic factors on growth of microorganism.	K4						
CO5	Evaluate the concept of downstream processing.	K5 & K6						
K1 - Remem	K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create.							
UNIT	CONTENTS							
I	SECONDARY METABOLITES: A brief account of acetate malonate, acetate mevalonate and shikimic Categories of phytochemicals – Phenols, alkaloids, flavonoids, terpe glycosides, carbohydrates, proteins, amino acids, lipids, pigments, vitamins a compounds.	acid pathways. noids, steroids, and other related						
Ш	MICROBIAL GROWTH: Factors affecting microbial growth; Stoichiometry: mass balances; Stoichi balances; Growth kinetics; Measurement of growth.	iometry: energy						
ш	BIOREACTORS: Introduction to bioreactors; Batch and Fed-batch bioreactors, Continuous bioreactors; Immobilized cells; Bioreactor operation; Sterilization; Aeration; Sensors; Instrumentation; Culture-specific design aspects: plant/mammalian cell culture reactors. Bioseparations: Biomass removal; Biomass disruption; Membrane-based techniques; Extraction; Adsorption and Chromatography Industrial Processes and Process economics: Description of industrial							
IV	DOWNSTREAM PROCESSING: Biomass removal and disruption; Centrifugation; sedimentation; Microfiltration; Sonication; Bead mills; Homogenizers; Chemical lysis; E Membrane based purification: Ultrafiltration ; Reverse osmosis; Dialysis Pervaporation; Perstraction; Adsorption and chromatography: size, hydrophobic interactions, Biological affinity; Process configurations (packed bed, simulated moving beds); Precipitation (Ammonium Suff Electrophoresis(capillary); Crystallization; Extraction (solvent, aqueous tw critical), Drying; Case studies	Flocculation; Enzymatic lysis; ; Diafiltration ; charge, shape, d bed, expanded fate, solvent); vo phase, super						
V	 IMPORTANT PRODUCTS THROUGH FERMENTATION: Organic acids citric acid acetic acid, enzymes – amylase, protease, lipase, antibiotics – penicillin, vitamins – B12, amino acids – glycine, glutamic acid, organic solvenst – ethanol, butanol, acetone, alcoholic beverages – wine, beer, biomass – bakers yeast, biosurfactants, biopesticides, biopolymers. 							
Recommend	ed Text: L and E Kargi 2002 Bioprocess Engineering Prontice Hell Inc.							
 Snuler, M Doran, P. Kaufman, Plants, C 	M. L and F. Kargi. 2002. <i>Bioprocess Engineering</i> , Prentice Hall Inc. M. 1995. <i>Bioprocess Engineering Principles</i> , Elsevier. , P.B. L. J. Cseke, S. Warler, J. A. Duke, and H. L. Brielmann. 1999. <i>Natura</i> RC Press LLC.	l Products from						

^{4.} Casia, J.R.L.E. 2009. Industrial Microbiology. New Age International (P) Ltd. Publisher, New Delhi.

- 5. Stanbury, P. F., Whitaker, A. and Hall, S.J. 1979. Principles of Fermentation Technology. Aditya Books (P) Ltd., New Delhi.
- 6. Potter, N. N. 2007. Food Science. CBS Publishers.

Reference Books:

- 1. Rehm, H. J and G. Reed, *Biotechnology-A multi- Volume Comprehensive Treatise*, 2nd Ed, Vol 3, Wiley-VCH, 1993
- 2. Moo-Young, M. 2004. Comprehensive Biotechnology, Vol. 2, Pergamon Press,
- 3. Dicosmo, F and M. Missawa, 1996. Plant Cell Culture Secondary Metabolism: Towards Industrial Application. CRC LLC.
- 4. Frazier, W.C. and Weshoff, D.C. (2015). Food Microbiology (5th edition) McgrawHill.
- 5. Kumari, S. 2012. Basics of Food Biochemistry and Microbiology. Koros Press.
- 6. Whitaker. J.R. 2016. Handbook of Food Enzymology. CRC press
- 7. Shewfelt, R.L.2013. Introducing Food Science. CRC Press.
- 8. Smith, J.S and Hui, Y.H.2014. Food Processing. Wiley.
- 9. Varzakas, T and Tzia, C. 2016. Handbook of Food Processing. CRC Press.

Web resources:

- 1. https://link.springer.com/book/9783642673627
- 2. https://www.elsevier.com/books/secondary-plant-products/stumpf/978-0-12-675407-0
- 3. https://www.amazon.in/Secondary-Plant-Products-Comprehensive-Biochemistryebook/dp/B01E3II0E2
- 4. https://www.pdfdrive.com/principles-of-fermentation-technology-e40900163.html
- 1. https://link.springer.com/book/10.1007/978-3-030-16230-6

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	3	3	3
CO3	2	2	3	3	1	2	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	3	3	3	2	3

Mapping with Programme Outcomes:

S-Strong (3) M-Medium (2)

L-Low(1)

ELECTIVE V - ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

Programme: M.Sc.,	Subject: Botany
Semester: III	Course: ENTREPRENEURIAL OPPORTUNITIES IN BOTANY
Course Type: ELECTIVE V	Course Code:
Contact Hours: 3 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Ol	bjectives					
C1	1.Understand the different classifications of horticultural crops, nursery mana of technology in horticulture.	gement, and use				
C2	2.Develop their competency on pre and post-harvest technology in horticultura	al crops.				
C3	3.Analyze the different methods of weed control and harvest treatments of horticultural crops.					
C4	4.Examine the economic implications of cultivation of tropical and sub-tro- crops.	opical vegetable				
C5	5.Evaluate the importance of floriculture and contribution spices and economy.	condiments on				
Course outcomes	On completion of this course, students will;					
CO1	Students can acquire knowledge about organic farming and their Advantages	K1				
CO2	Analyze both the theoretical and practical knowledge in understanding various horticultural techniques.	K2				
CO3	To develop kitchen garden or terrace garden in their living area.	K3				
CO4	Evaluate the horticultural techniques to students can develop self employment and economical improvement.	K4				
CO5	Create and develop skills for mushroom cultivation.	K5 & K6				
K1 - Remem	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	ate.				
UNIT	CONTENTS					
I	Organic manures and fertilizers. Composition of fertilizer, NPK content of various fertilizers. Common organic manures bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost, aerobic and anaerobic – advantages. Vermicompost preparation, vermiwash. Panchakaviyam.					
II	Common garden tools. Methods of plant propagation by seeds. Vegetati cutting, grafting, budding and layering. Use of growth regulators for rooting.	ve propagation,				
ш	Gardening – types of garden, ornamental, indoor garden, kitchen garden, terrace garden, vegetable garden for marketing. Rockery and artificial ponds. Ornamental garden designing, garden components flower beds, borders, hedges, edges, drives, paths, garden adornments.					

IV	Packaging of fruits, vegetables. Preservation techniques drying, heat treatment, low temperature storage and by chemicals. Preparation of wine, vinegar and dairy products.					
11	Significance of mushrooms Types of mushrooms (button mushroom oyster mushroom)					
	Snawn isolation and preparation Cultivation Value added products from mushroom –					
V	pickles, candies and dried mushrooms.					
Recomme	ended Text:					
7. Chmie	lewski, J.G. and Kravesky, D. 2013. General Botany laboratory Manual AuthorHouse.					
Bloom	lington USA					
8. Russel	1. T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukheriee D.					
Garder	ning in India. Oxford IBH publishing co. New Delhi.					
9. Kumar	r. N. 1997. Introduction to Horticulture. Rajalakshmi Publications. Nagercoil.					
10. Webst	er, J and Weber, R. 2007. Introduction to Fungi, 3 rd Ed. Cambridge UniversityPress.					
Cambr	ridge.					
11. Bendre	e, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 (10 th ed). Rastogi					
Public	ations, Meerut.					
12. Singh,	R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.					
Reference	Reference Books:					
10 Adams	C R Banford K M and Farly M P 1993 Principles of Horticulture					
10. Adding	T V 2004 Vermiculture and Organic farming Daya Publishers					
12. Peter	K V. 2017 Basic Horticulture					
13. Hartm	an. H.T. and D.F. Kestler. 1976. Plant propagation principles and practice. Prentice Hall of India.					
New D	Delhi.					
14. Jules J	anick, 1982. Horticulture Science. Surject publications, New Delhi.					
15. Ignaci	muthu, S.1998. Plant Biotechnology. Tata Mc Graw Hill Ltd., New Delhi.					
16. Gupta.	. P.K., 1998. Elements of Biotechnology. Rastogi publications, Meerut.					
17. Edmor	nd Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co.,					
New D	Delhi.					
18. Janick	Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.					
Web reso	urces:					
2. https://	/www.kobo.com/in/en/ebook/composting-process-organic-manures-through-eco-friendly-waste-					
manag	management-practices					
3. https://	https://books.google.co.in/books/about/Plant_Propagation.html?id=K-gQh6OI7GcC&redir_esc=y					
4. https://	/www.ebooks.com/en-us/subjects/gardening/					
5. https://	/www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-					
ebook	/dp/B00RXCXB3Q					
6. https://	https://www.elsevier.com/books/food-preservation-techniques/zeuthen/978-1-85573-530-9					

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	3	2
CO2	3	3	2	2	3	3	2	3	2	3

Mapping with Programme Outcomes:

CO3	2	2	3	3	1	2	1	3	3	1
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	2

S-Strong (3)

M-Medium (2) L-Low(1)

SKILL ENHANCEMENT COURSE (SE4)

Programme: M.Sc.,	Subject: Botany
Semester: III	Course: Skill Enhancement (SE1)
	Seminar paper (Open Choice)
Course Type: Skill Enhancement Course	Course
Code:	
Contact Hours: 3 Hours/Week	Credits: 2
CIA: 25	CE: 75

IV Semester

CORE XI : PLANT PHYSIOLOGY AND PLANT METABOLISM

Programme: M.Sc.,	Subject: Botany
Semester: IV	Course: PLANT PHYSIOLOGY AND PLANT METABOLISM
Course Type: CORE XI	Course Code:
Contact Hours: 6 Hours/Week	Credits: 5
CIA: 25	CE: 75

Learning Ob	ojectives						
C1	1.To acquire knowledge on the functional aspects of plants.						
C2	2.To understand the biophysical and biochemical processes of plants.						
C3	3.To study the metabolism of plants.						
C4	4.To learn the plant growth regulations.						
C5	5.To know the adaptive mechanisms of plants in adverse environmental conditions.						
Course outcomes	On completion of this course, students will;						
CO1	Relate understand properties and importance of water in biological system, nutrients and its translocation.	K1					
CO2	Demonstrate the importance of light in plant growth and the harvest of energy.	K2					
CO3	Explain the energy requirement and nitrogen metabolism.	K3					
CO4	Compare the various growth regulators that influence plant growth.	K4					
CO5	Discuss the senescence and plant response to environmental stress.	K5 & K6					

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create.

UNIT	CONTENTS								
	Water Relations: Physical and chemical properties of water -Components of water potential -								
	Plasmolysis - water absorption by roots – Apoplast and Symplast concept - water transport								
	through the xylem — Transpiration and evapotranspiration- stomatal structure and function –								
Ι	mechanism of stomatal opening and closing – mineral nutrition – essential nutrients – macro								
	and micro nutrients – deficiencies and plant disorders – absorption of solutes – translocation								
	of solutes – pathways and mechanisms. phloem loading and unloading - translocation of								
photosynthates – source- sink relationship – partitioning of assimilates and harve									
	Photosynthesis: The physical nature of light – the absorption and fate of light energy –								
	absorption and action spectra- photoreceptors- Ultrastructure and biochemical								
	compartmentation of Chloroplast; Photosynthetic Electron Transport and								

II	Photophosphorylation (cyclic and noncyclic): Photosystems and reaction centres - Light									
	Harvesting complexes - Photosystem I & II and Oxidation of Water; Carbon metabolism: C3,									
	C4 and CAM pathways and their distinguishing features - photorespiration and its significance. Biochemistry and Molecular Biology of RUBISCO.									
	significance. Biochemistry and Molecular Biology of RUBISCO.									
	An overview of plant respiration – Glycolysis – TCA cycle– Electron Transport – oxidative									
	An overview of plant respiration – Grycorysis – TCA cycle– Electron Transport – Oxidative									
	phosphorylation and ATP synthesis – Chemiosmotic Theory - Pentose Phosphate Pathway–									
111	Respiration and its significance in crop improvement. Cyanide resistant respiration; Nitrogen									
	fixation (Biological - symbiotic and non-symbiotic), Physiology and Biochemistry of nitrogen									
	fixation State Integrated Board of Studies – Botany PG 40.									
Growth and development – Phases of plant growth – growth types- Growth substan										
Auxins, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids - physiolo effect and mechanism of action in agricultural and horticultural crops –Photoperiodi										
effect and mechanism of action in agricultural and horticultural crops –Photoperiodism										
IV	Classification of plants and mechanism of flowering – Phytochrome and their action on									
	flowering – Vernalization- Mechanism and its practical application biological rhythms and									
Howering – Vernalization- Mechanism and its practical application, biological rhythms movements. Seed dormancy and causes and Seed germination and their biochemical char										
	Plant sanassance. Types and Machanism of sanassance. Abspission: Morphological and									
	high hand series cence - Types and Mechanism of senescence- Abscission. Morphological and									
	biochemical changes – Significance. Fund Inpening- Diochemical, Filysiological changes and									
V Victor torrespond to the second sec										
V	water, temperature, light and salinity- Adaptive mechanism to various stresses (avoidance,									
	escape, tolerance)–stress responsive proteins – anti-oxidative mechanism.									
Recommend	ed Text:									
1. Gauch, H.	G.1972. Inorganic Plant Nutrition. Hutchinson & Dowd. New York.									
2. Govindji.	1982. Photosynthesis. AP. New York.									
3. Jacob, W.	P. 1979. Plant Hormones and Plant Development. Cambridge University Press. Cambridde									
4. Khan, A.A	A. 1982. The Physiology and Biochemistry of Seed development, Dormancy and Germination.									
Elesiver.	Amsterdam.									
5. Salisbury,	F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.									
6. Ting, I.P.	1982. Plant Physiology. Addison Wesley Pb. Philippines.									
7. Sage, R a	nd R.K. Monson (eds), 1999. The Biology of C4 Plants AP New York.									
8. Postgate.	I. 1987. Nitrogen Fixation. 2nd Edition Cassel, London.									
9 Lincoln T	aiz Eduardo Zeiger Ian Max Moller and Angus Murphy 2015 Plant Physiology 6th Ed									
Singuer A	scoriates									
10 Stacey G	B H Burris and Evans H I 1002 Biological Nitrogen Eivation Chanman and Hall New									
Vork	.K.II. Durits and Evans, II.J. 1992. Diological Willogen Tixation. Chapman and Han, Wew									
11 Monn I	1087 Sacandary Matchalism Clarandron Pross. Oxford									
11. Ivianii, J.	2017 Diant Divisiology S Chand & Company I td. New Dalhi									
12. Jain, V.K.	2017. Plant Physiology, S.Chand & Company Ltd. New Deini.									
13. Lincoin,	3. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2018. Fundamentals of Plant Physiology. Sinauer									
Associate	s Inc., US.									
14. Pandey, N	I.S and Pandey, P. 2016. Textbook of Plant Physiology. Daya Publishing House, New Delhi.									
15. Taiz, L.	Zeiger, E., Moller, I.M and Murphy, A. 2015. Plant Physiology and Development									
6th Editio	n. Sinauer Associates, Sunderland, CT.									
16. Guowei I	i Veronique Santoni ChristopheMaurel. 2014. Plant aquaporins: Roles in plant physiology.									
Biochimic	ca et Biophysica Acta (BBA) - General Subjects Volume 1840, Issue 5, Pages 1574-1582.									
Reference Bo	ooks:									

- Bidwell, R.G.S. 1974. Plant Physiology, Macmillan Publisher, Boston.
 Devlin, R.M. 1996. Plant Physiology, PWS publisher, Boston.

- 3. Jain, V.K. 2017. Fundamentals of Plant Physiology. Chand & Company Ltd., New Delhi.
- 4. Gontia. 2016. A textbook of Plant Physiology. Satish Serial publishing House, New Delhi.
- 5. Leopold, A.C, 1994. Plant Growth and Development, McGraw Hill, New York.
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- 7. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nd Edition). SpringerVerlag, New York, USA.
- 8. Noggle, R.G and Fritz, G.J. 2010. Introductory Plant Physiology, PHI Learning Pvt Ltd, New Delhi.
- 9. Park S. Nobel. 2005. Physicochemical and Environmental Plant Physiology. Elsevier Academic Press, New York.
- 10. Panda, S.K, 2005. Advances in Stress Physiology of Plants. Scientific Publishers India, Jodhpur.
- 11. Salisbury, F.B and Cleon Ross, 2007. Plant Physiology, Wadsworth Publishing Company, Belimont.
- 12. Shinha. R.K. 2007. Modern Plant Physiology. Ane Books India, New Delhi.
- 13. William G. Hopkins, 1999. Introduction to Plant Physiology, John Wiley and sons, INC, New York. 14. Heldt, H.W. 2005. Plant Biochemistry, 3rd Edition. Elsevier Academic Press.

Web resources:

- 1. https://www.sciencedirect.com/topics/agriculture-and0biological-sciences/plant-physiology.
- 2. https://learn.careers360.com/biology/plant-physiology-chapter/
- 3. https://www.biologydiscussion.com/plants/plant-physiology/top-6-processes-of- plant-physiology/24154.
- 4. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf
- 5. https://basicbiology.net/plants/physiology
- 6. https://learn.careers360.com/biology/plant-physiology-chapter/4
- 7. https://swayam.gov.in/nd2_cec20_bt01/preview
- 7. https://www.nature.com/subjects/plant-physiology

Mapping with Programme Outcomes:

					1001		1505	1004	1005
	3	1	3	2	1	2	2	3	2
,	3	2	2	3	3	2	3	2	3
	2	3	3	1	2	1	3	3	1
,	3	3	3	3	2	3	3	3	3
,	3	2	3	2	3	3	3	3	2
		3 2 3 3 3	$ \begin{array}{c cccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$

S-Strong (3)

M-Medium (2) L-Low(1)

CORE XII : BIOCHEMISTRY & APPLIED BIOTECHNOLOGY

Programme: M.Sc.,	Subject: Botany
Semester: IV	Course: BIOCHEMISTRY & APPLIED BIOTECHNOLOGY
Course Type: CORE XII	Course Code:
Contact Hours: 6 Hours/Week	Credits: 5
CIA: 25	CE: 75

Learning O	bjectives					
C1	1.To study the fundamentals and significance of Plant Biochemistry.					
C2	2.To know the structure and properties of plant biomolecules.					
C3	3.To learn the fundamental and applications of Plant Biotechnology.					
C4	4.To study the mechanism of enzyme action and inhibition.					
C5	5.To expose the students on the fundaments of genetic transformation.					
Course outcomes	On completion of this course, students will;					
CO1	Knowledge on the fundamentals and significance of Plant Biochemistry	K1				
CO2	Understanding on the structure and properties of plant biomolecules.	K2				
CO3	Explain the role of enzymes in plants. K3					
CO4	Compare and contrast the methods of transgenic plants production and K4 natural plants.					
CO5	Discuss and develop skills for effective utilization of microbial/plant enzymes and their role in biological cells.	K5 & K6				
K1 - Remen	nber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	ate.				
UNIT	CONTENTS					
I	Atomic structure: chemical bonds - ionic bond, covalent bond, coordinate hydrogen bond, hydrogen ion concentration (pH), buffers. Thermodynamics Law of Thermodynamics a) energy (b) Enthalpy (ii) second law of ther Spontaneity and disorder (b) entropy (c) free energy, redox potential, of association constant, activation energy, binding energy.	e covalent bond, s principle, First modynamics (a) dissociation and				
п	Photosynthesis: The physical nature of light – the absorption and fate of absorption and action spectra- photoreceptors- Ultra structure ar compartmentation of Chloroplast; Biomolecules and Enzymes: C carbohydrates; Structure and properties of monosaccharides, C Polysaccharides – Glycoproteins. Protein and Amino acids: Structure, C properties; Peptides - Structure: Primary, secondary, Ramachandran pl	f light energy – nd biochemical lassification of Digosaccharides, lassification and ot, tertiary and				

		quaternary structures. Classification of Lipids: Structure and properties of fatty acids,									
	ш	 Enzymes- Classification and nomenclature chemical nature of enzymes – factors affecting enzyme action – Michaelis – Menton constant, MM equation, Lineweaver Burk plot, Enzyme inhibition, co enzymes- mechanism of enzyme action, isoenzymes. Secondary Metabolites: Structure, classification and properties of alkaloids, steroids, terpenoids, flavonoids. Glycosides - their chemical nature and role. 									
	IV	 Transgenic plants - pest resistance, herbicidal resistance, Disease resistant, abiotic and biotic stress tolerant, in improving crop yield, food quality- Golden rice, Edible vaccines, Virus and Bacteria based transient gene expression systems. Virus induced gene complementation, Virus State Integrated Board of Studies – Botany PG 42 induced gene silencing. Cytoplasmic male sterility and fertility restoration, terminator Seed technology, antisense technology for Delayed fruit ripening, Plants as factories for useful products and pharmaceuticals. 									
	V	 Screening of Biotransformants - Fermentation techniques- Types. Industrial Production of enzymes-amylase, protease & lipase and their applications. Immobilization for enzymes production. Antibiotic Penicillin production. Amino acid - Glutamic acid production. Production of Alcohol and Xanthan Gum. Bioreactors for culturing Plant cells and production of Secondary metabolites, Super bug and its role in biodegradation. Bioremediation - <i>In situ</i> and <i>Ex situ</i>. 									
Re	commende	ed Text:									
1.	Satyanara	yana, U and chakrapani, U. 2005. Biochemistry, Books and Allied (P) Ltd. Calcutta.									
2.	A.L.Lehni	nger, D.L.Nelson & M.M.Cox. 1993. Principles of Biochemistry. Worth Publishers, New									
	York.										
3	Strver, L	1994 Biochemistry Freeman & Co. New York									
4	Zubay, G.	1988 Biochemistry, 1988 Macmillan Publishing Co. New York									
5	Harold F	M 1986 The vital force: A study of Bioenergetics Freeman & Co New York									
5.	Indio II.	2005 Fundamentals of Biochemistry S. Chand & Co. New Dolhi									
0.	Jaili, J.L.	A L 1082 Dringinlag of biochemistry CDS Dubligation Halford N 2015 Diant									
1.	Distant	, A.L. 1982. Principles of biochemistry, CBS Publication. Hallord, N. 2015. Plant									
8.	Kumar, P 10.1201/9	radeep. 2018. Advances in Microbial Biotechnology: Current Trends and Future Prospects. 781351248914.									
Re	ference Bo	ooks:									
1.	Bonner, L	and Warner, W.H. 1961. Plant Biochemistry, Academic Press, Inv. New York.									
2	Gupta S	N. 2016. Biochemistry Rastogi Publications. Meerut									
3	Satvanara	vana, U. and Chakkrapani, U. 2013. Biochemistry Elsevier India Pyt Ltd & Books Allied									
] .	Pvt.Ltd. N	lew Delhi.									
4.	Nelson D	L. and Cox, M.M. 2017. Lehninger's Principles of Biochemistry. Prentice Hall. International									
	N J. 7th Edition										
5	Heldt H-V	W. 2005. Plant Biochemistry, 3rd Edition, Elsevier Academic Press									
6	Buchanan	B.B., Grissem, W. and Jones, R.L. 2000. Biochemistry and molecular biology of plants 5th									
-	Edition. W	Viley-Blackwell.									
7.	Jain, J.L.,	Jain, S. and Jain, N. 2016. Fundamentals of Biochemistry. Chand Publishing, New Delhi.									
8.	Chawla, H	I.S. 2009. Introduction to Biotechnology, 2nd edn. Oxford IBH, ISBN:978-81-204-1732-8									
9.	Halford, N	N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified									
	Crops, Joh	nn Wiley and Sons.									

Web resources:

- 1. http://priede.bf.lu.lv/grozs/AuguFiziologijas/Augu_biokimija/Plant%20Biochemistry 204.pdf
- 2. http://www.brainkart.com/subject/Plant-Biochemistry_257/
- 3. https://swayam.gov.in/nd2_cec20_bt12/preview
- 4. https://www.biorxiv.org/content/10.1101/660639v2
- 5. https://www.scribd.com/document/378882955/
- 6. https://nptel.ac.in/courses/102/107/102107075/
- 7. https://plantae.org/plant-physiology-top-articles-of-2020-based-on- altmetric-scores/
- 8. https://.britannica.com/technology/biotechnolog/
- 9. https://manavrachna.edu.in/blog/scope-of-biotechnology/

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	3	1
CO2	3	3	2	2	3	3	2	3	2	3
CO3	3	2	3	3	1	2	1	3	3	1
CO4	3	3	3	3	3	2	3	1	3	3
CO5	3	3	2	3	2	3	3	1	3	2

Mapping with Programme Outcomes:

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

ELECTIVE VI-ORGANIC FARMING

Programme: M.Sc.,	Subject: Botany
Semester: IV	Course: ORGANIC FARMING
Course Type: ELECTIVE VI	Course Code:
Contact Hours: 4 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning O	bjectives							
C1	1. To study various aspects of organic farming.							
C2	2.To understand the relevance of organic farming, its advantages and short comings against conventional high input agriculture.							
C3	3.To know the importance of organic farming in the present scenario and its impact on environment and soil health.							
C4	4.Awareness on the importance of organic farming in the present scenario and its impact on environment and soil health.							
C5	5.Expose the students to about quality aspect and grading.							
Course outcomes	On completion of this course, students will;							
CO1	Knowledge on various aspects of organic farming.	K1						
CO2	Understand the relevance of organic farming, its advantages. K2							
CO3	Explain the short comings against conventional high input agriculture. K3							
CO4	Compare the packaging methods of harvest.	K4						
CO5	Discuss and develop skills for post harvest management. K5 & K6							
K1 - Remen	nber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Cre	ate.						
UNIT	CONTENTS							
Ι	AGRONOMY: Organic farming- concept, characteristics, significance, organic ecosystem, scope of organic farming in India - Principles and types of organic farming. Choice of crops & varieties in organic farming - Initiative by Govt/NGOs/Other organizations for promotion of organic farming Operational structure of NPOP (National Programme for Organic Production) - Concept of dryland agronomy Organic nutrient resources & their fortification, restriction to nutrient use in organic farming - Organic production methods for cereals, vegetables and fruit crops							
п	crops SOIL SCIENCE: Organic farming for sustainable agriculture; Manures- compost, methods of composting - Green manuring, vermicompost and biofertilizer II Harmful effect of non-judicious chemical fertilization - Organic farming practices for							

	improving soil health							
		Quality parameters of organic manures and specifications - Soil fertility in organic farming						
		systems						
		Manure preparation methodology - Soil improvement						
		FUNDAMENTAL OF ORGANIC FARM MANAGEMENT:						
		Land management in organic farming - Water management in organic farming. Organic						
	III	insect disease management - Organic pest disease management. Preventive and cultural						
		methods for insects and pest control - Identification of different fungal and bacterial						
		biocontrol agents						
		Indigenous technical knowledge for insects-pest, disease - Weed and nutrient management in						
		organic farming						
		POST HARVEST MANAGEMENT:						
		Processing, labeling of organic produce - Storage and transport of organic produce.						
	IV							
	ORGANIC QUALITY CONTROL STANDARDS:							
	Certification- types, process & procedure and agencies. Quality aspect and grading							
	Packaging and handling. Economic considerations and viability of organic products - Expo							
	V	of organic product and marketing						
Re	commende	ed Text:						
1.	NIIR Boa	rd. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition.						
	NIIR Proj	ect Consultancy Services.						
2.	Sathe, T.V	7. 2004. Vermiculture and Organic Farming. Daya publishers.						
3.	Subba Rad	N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition. Medtech.						
4.	Vayas,S.C	C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.						
5.	Singh, S I	M. 2018. Organic Manure: Sources Preparation and Usage in Farming Lands, Siya Publishing						
-	House	-						
Re	ference Bo	oks:						
1.	Reddy, S.	R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh						
2.	Tolanur, S	. 2018. Fundamentals of Soil Science IIndEdition, CBS Publishers, New Delhi						
3.	Reddy, S.I	R. 2017. Principles of Organic Farming Kalyani Publishers, New Delhi						
4.	Dongarjal	, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik						
	Publications, New Delhi.							
10.	Ahmad M	ehraban. 2013. The Basis of Organic Fertilizers, LAP LAMBERT Academic Publishing.						
We	eb resourc	es:						
1.	https://ww	w.amazon.in/Healthy-earth-organic-Hari-prasad-ebook/dp/B08L5KFKDV						
2.	https://ww	w.kobo.com/in/en/ebook/organic-farming-for-sustainable-agriculture						
3.	https://ww	w.elsevier.com/books/organic-farming/chandran/978-0-12-813272-2						
4.	https://link	c.springer.com/book/10.1007/978-3-030-04657-6						
5.	https://ww	w.afrimash.com/product-category/livestock-section/book/organic-farming-						
	ebooks/https://plantae.org/plant-physiology-top-articles-of-2020-based-on- altmetric-scores/							

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	2
CO2	3	3	2	2	3	3	2	3	3	2
CO3	2	2	3	1	1	2	1	3	2	1
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	2	3	2	3	3	2	3	1

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

ELECTIVE VI- GENE CLONING AND GENE THERAPY

Programme: M.Sc.,	Subject: Botany
Semester: IV	Course: GENE CLONING AND
	GENE THERAPY
Course Type: ELECTIVE VI	Course Code:
Contact Hours: 4 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Ob	jectives			
C1	1.To give a clear knowledge of genetic engineering, cloning vectors, enzymes involved in cloning.			
C2	2. To understand the procedure involved in recombinant DNA technology and restriction mapping.			
C3	3. To focus on the application of gene cloning in plants and animals.			
C4	4.To enable the students to information on Gene Therapy.			
C5	5.To raise student to create transgenic plants for hybrid seed production and molecular farming.			
Course outcomes	On completion of this course, students will;			
CO1	Recollect the basic concepts of gene cloning.	K1		
CO2	Demonstrate and to identify the selection of clones.	K2		

CO3	Acquire knowledge on the gene therapy.	К3					
CO4	Compare and understand the concept of gene therapy.	K4					
CO5	Discuss and develop skills for hybrid seed production and molecular	K5 & K6					
K1 - Romom'	tarming. hor: K2 - Understand: K3 - Apply: K4 - Applyze: K5 - Evoluate: K6 - Cree						
KI - Kemenn	KI - Kemember; KZ - Understand; KS - Apply; K4 - Analyze; K5 - Evaluate; K0 – Ureate.						
UNIT	CONTENTS						
	Definition of genetic engineering gene cloning and recombinant DNA	cloning vectors:					
	plasmids, bacteriophages, plant and animal vectors.						
-							
<u> </u>	Gana cloping in prokervotes and aukarvotes. Isolation of DNA to be clop	ad insertion of					
	DNA fragment into vector. Use of Restriction Linkers: use of Homopolyer t	ails. Transfer of					
	recombinant DNA into Bacteria cell. Selection of clones.						
II							
	Gene Therapy: Definition, Germ cell and Somatic cell. Amniocentesis in	human; patient					
ш	therapy, embryo therapy.						
	Restriction mapping –. Random amplified polymorphic DNA using PC	R. DNA finger					
	printing; Gene Tagging. Physical methods of gene delivery. Gene trans	fer techniques					
	Genetic counselling – Eugenics, Euthenics.						
IV	The second state with the third second						
	I ransgenic plants with herbicide resistance, insect resistance, virus resistance and resistance						
	molecular farming.	production and					
V							
Recommende	ed Text:						
1. Das, H.K.	2010. Textbook of Biotechnology (4th edition). Wiley India Pvt. Ltd. New Del	lhi Hatt Dublishans					
2. Gamborg, 3 Verma P	S and Agarwal V K 2009 Genetic Engineering S Chand & Co Ltd New Dell	ni					
4. Kreuzer, I	H and A. Massey. 1996. Recombinant DNA and biotechnology. A guide for tea	chers. ASM Press.					
5. Ramavat,	K.G. 2006. Plant Biotechnology. S. Chand and Co. Ltd., New Delhi.						
6. Chawla, F	6. Chawla, H.S. 2009. Introduction to Biotechnology. 2nd edn. Oxford IBH, ISBN: 978-81-204- 1732-8.						
7. Halford, f	7. Halford, N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified crops, John Wiley and Sons						
8. Kumar, F	8. Kumar, Pradeep, 2018. Advances in Microbial Biotechnology: Current Trends and Future Prospects						
10.1201/9781351248914.							
9. Thieman. 2014. Introduction to Biotechnology 3rd Edition. Pearson Education India.							
10. Khan. I.A. and A. Khanum .2004. Fundamentals of Biotechnology – Forensic Science Genetic Engineering.							
11. Gunta P	UKaaz publication, Hyderabad. 11 Gunta PK 1998 Elements of Biotechnology Rastogi publications Meerut						
11. Supta. 1.1. 1770. Elements of Diotechnology. Rustogi publications, Weerut.							
Reference Bo	ooks:						
1. Smith. J.K	K. 1996. Biotechnology – 3 rd Ed. Cambridge Univ. Press, Cambridge.						

- 2. Slater, A. Scott, N and Fowler, M. 2008. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University Press Inc.
- 3. Reynolds, P.H.S. 1999. Inducible Gene Expression in Plants. CABI Publishing, U.K.
- 4. Chawla, H.S. 2009. Introduction to Biotechnology, 2nd edn. Oxford IBH, ISBN:978-81-204-1732-8.
- 5. Halford, N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified Crops, John Wiley and Sons.
- 6. Brown T.A. 2001. Gene Cloning and DNA Analysis- An Introduction (4th edition). Blackwell Science. Oxford.
- 7. Clark, D.P and Pazdernik, N.J. 2009. Biotechnology- Applying the Genetic Revolution. Elsevier Academic Press. USA.
- 8. Glick B.R and J. J. Pasternak. 2009. Molecular Biotechnology, Panima Publication Co.
- 9. Harisha, S. 2007. Biotechnology Procedures and Experiments Handbook. Infinity Science Press Llc. Hingham. MA.
- 10. Mosier N.S and Ladisch M.R. 2009. Modern Biotechnology- Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals. John Wiley & Sons Inc. New Jersey.
- 11. Primrose S., Twyman R. and Old B. 2001. Principles of Gene Manipulation (6th ed.). Blackwell Science. Oxford.
- 12. Ignacimuthu, S.1998. Applied Plant Biotechnology. Tata Mc Graw Hill, publishing company Ltd., New Delhi.
- 13. Neal Stewart, Jr. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications. JohnWiley & sons Inc.

Web resources:

- 1. https://www.amazon.in/Gene-Cloning-Manipulation-Christopher-Howe-ebook/dp/B000SK4YLI
- 2. https://www.amazon.in/Gene-Cloning-Steve-Minchin-ebook/dp/B000SHTUT2
- 3. https://www.futuremedicine.com/doi/book/10.2217/9781780842134
- 4. https://www.researchgate.net/publication/51144570 Introduction to Gene Therapy A Clinical Aftermath
- 5. https://link.springer.com/book/10.1007/978-88-470-1643-9

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	2
CO2	3	3	2	2	3	3	2	3	3	2
CO3	3	2	3	3	1	2	1	3	2	1
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	2	3	2	3	3	3	3	3

S-Strong (3)

M-Medium (2) L-I

L-Low(1)

PROFESSIONAL COMPETENCY SKILL ENHANCEMENT

Programme: M.Sc.,	Subject: Botany
Semester: IV	Course: PROFESSIONAL COMPETENCY
	SKILL ENHANCEMENT
Course Type: SKILL ENHANCEMENT	Course Code:
Contact Hours: 4 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning O	bjectives				
C1	1.Understand the concept of agronomy and sustainable agriculture.				
C2	2.To gain knowledge about the cell, organelles and physiology.				
C3	3.To understand the biodiversity DNA recombination technology.				
C4	4.Describe the basic signal transduction pathway and to recognize the overar of prokaryotic and eukaryotic cellular communication.	ching principles			
C5	5.Understand the mechanism underling the shift from vegetative to reproducti	ve phase.			
Course outcomes	On completion of this course, students will;				
CO1	To learn about the structure of atoms, molecules, and chemical bonds.	K1			
CO2	Demonstrate both the theoretical and practical knowledge in cell biology K2 and molecular biology.				
CO3	Explain the methods of recombinant technology. K3				
CO4	Compare and contrast the physiological functions and metabolism.	K4			
CO5	Discuss and develop skills for effective comprehension and K5 & K6				
K1 - Remen	nber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Crea	ate.			
UNIT	CONTENTS				
I	IMOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGYStructure of atoms, molecules, and chemical bonds. Composition, structure, and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids, and vitamins). Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, 				

kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes Conformation of proteins (Ramachandran plot, secondary structure, domains, motif, and folds).Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).Stability of proteins and nucleic acids. Metabolism of carbohydrates, lipids, amino acids nucleotides, and

	vitamins.
	CELLULAR ORGANIZATION
	Membrane structure and function: structure of model membrane, lipid bilayer, and membrane
	protein diffusion, osmosis; ion channels; active transport; membrane pumps; mechanism of
II	sorting and regulation of intracellular transport; electrical properties of membranes.
	Structural organization and function of intracellular organelles (cell wall, nucleus,
	mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids,
	vacuoles, chloroplast, structure & function of the cytoskeleton and its role in motility).
	Organization of genes and chromosomes: Operon, unique and repetitive DNA, interrupted
	genes, gene families, the structure of chromatin and chromosomes, heterochromatin,
	euchromatin, transposons). Cell division and the cell cycle: mitosis and meiosis, their
	regulation, steps in the cell cycle, regulation, and control of the cell cycle. Microbial
	Physiology: Growth yield and characteristics, strategies of cell division, stress response.
	FUNDAMENTAL PROCESSES
	DNA replication, repair, and recombination: Unit of replication, enzymes involved,
III	replication origin and replication fork, the fidelity of replication, extrachromosomal replicons,
	DNA damage and repair mechanisms, homologous and site-specific recombination.
	RNA synthesis and processing: Transcription factors and machinery, a formation of initiation
	complex, transcription activator and repressor, RNA polymerases, capping, elongation, and
	termination, RNA processing, RNA editing, splicing, and polyadenylation, structure, and
	function of different types of RNA, RNA transport).
	Protein synthesis and processing: Ribosome, the formation of initiation complex, initiation
	factors and their regulation, elongation and elongation factors, termination, genetic code,
	aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational
	proofreading, translational inhibitors, Post-translational modification of proteins).
	Control of gene expression at transcription and translation level: Regulating the expression of
	phages, viruses, prokaryotic and eukaryotic genes, the role of chromatin in gene expression
	and gene silencing).
	CELL COMMUNICATION AND CELL SIGNALING:
	Host-parasite interaction: Recognition and entry processes of different pathogens like
	bacteria, viruses into animal and plant host cells, alteration of host cell behavior by
IV	pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and
	plants, cell-cell fusion in both normal and abnormal cells.
	Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-
	protein coupled receptors, signal transduction pathways, second messengers, regulation of
	signaling pathways, bacterial and plant two-component systems, light signaling in plants,
	bacterial chemotaxis, and quorum sensing.
	Cellular communication: Regulation of hematopoiesis, general principles of cell
	communication, cell adhesion and roles of different adhesion molecules, gap junctions,
	extracellular matrix, integrins, neurotransmission and its regulation.
	Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes,
	cancer, and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with
	normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.
	Innate and adaptive immune system:
	Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity, and
	immunogenicity. B and T cell epitopes, structure, and function of antibody molecules.

	generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-				
	antibody interactions, MHC molecules, antigen processing and presentation, activation and				
	differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune				
	responses, primary and secondary immune modulation, the complement system, Toll-like				
	receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity,				
	immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV)				
	infections, congenital and acquired immunodeficiencies, vaccines.				
	DEVELOPMENTAL BIOLOGY				
	Basic concepts of development: Potency, commitment, specification, induction,				
	competence, determination, and differentiation; morphogenetic gradients; cell fate and cell				
V	lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting;				
	mutants and transgenics in the analysis of the development.				
	Gametogenesis, fertilization, and early development: Production of gametes, cell surface				
	molecules in sperm-egg recognition in animals; embryo sac development and double				
	fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields,				
	gastrulation and formation of germ layers in animals, embryogenesis, establishment of				
	Morphogonesis and organogenesis in animals: Call aggregation and differentiation in				
	Dictyostelium: axes and pattern formation in Drosophila amphibia and chick: organogenesis				
	- vulva formation in Caenorhabditis Elegans eve lens induction limb development and				
	regeneration in vertebrates: differentiation of neurons post-embryonic development- larval				
	formation, metamorphosis: environmental regulation of normal development: sex				
	determination.				
	Morphogenesis and organogenesis in plants: Organization of shoot and root apical				
	meristem; shoot and root development; leaf development and phyllotaxy; transition to				
	flowering, floral meristems and floral development in Arabidopsis and Antirrhinum				
	Programmed cell death, aging, and senescence.				
Recommende	ed Text:				
1. Bhojwani	, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6 th revised and				
enlarged e	edition). Vikas Publishing House, New Delhi.				
2. Maheshw	ari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists,				
New Delh	ii.				
3. Roy, S.C	and Kumar, K.D.C. 1977. Cell Biology, New Central Book Agency, Calcutta.				
4. Karp, G. 2	2010. Cell and Molecular Biology: Concepts and Experiments.6 th edition. John Wiley & Sons.				
5. Ramavat,	K.G. 2006. Plant Biotechnology. S. Chand and Co. Ltd., New Delhi.				
6. Trivedi, P	V.C. 2000. Plant Biotechnology-Recent Advances. Panima Publication Corporation, New Delni.				
7. Chawla, F	1.5. 2009. Introduction to Biotechnology. 2nd edn. Oxford IBH, ISBN: 978-81-204- 1732-8.				
Reference Do	JOKS:				
1. Karp, G. 20	010. Cell and Molecular Biology: Concepts and Experiments. 6 th				
Edition. John Wiley & Sons. Inc.					
2. Gupta. P.K. 2000. Cell and Molecular Biology, Rastogi Pub. Meerut.					
3. Ignacimuthu, S. 2005. Basic Bioinformatics, Narosa publishing house.					
4. Lesk, A.M. 2002. Introduction to Bioinformatics. Oxford University press.					
5. Rastogi. 19	996. Cell and molecular biology. New age international publishers.				
6. Elliott, W.I	H. and Ellioff. 1997. Biochemistry and molecular biology. Oxford.				

7. Freifelder D., 1987. Molecular Biology. Narosa publishing house.

8. Rastoji, S.C., Mendiratta, N., Rastogi, P. 2009. Bioinformatics : Methods and Applications, PHI, Third Edition.

Web resources:

- 1. https://www.nature.com/scitable/topic/cell-biology
- 2. https://plato.stanford.edu/entries/molecular-biology/
- 3. <u>https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/bioinformatics</u>
- 4. <u>https://.britannica.com/technology/biotechnolog/</u>
- 5. https://nptel.ac.in/courses/102/107/102107075/
- 6. https://plantae.org/plant-physiology-top-articles-of-2020-based-on- altmetric-scores/

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	2
CO2	3	3	2	2	3	3	2	3	3	2
CO3	2	2	3	3	1	2	1	3	2	1
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	2	3	2	3	3	3	3	3

Mapping with Programme Outcomes:

S-Strong (3) M-Medium (2)

L-Low(1)

PROJECT: GROUP PROJECT

Programme: M.Sc.,	Subject: Botany
Semester: IV	Course: GROUP PROJECT
Course Type: SKILL ENHANCEMENT	Course Code:
Contact Hours: 10 Hours/Week	Credits: 7
CIA: 25	CE: 75

Learning Ob	jectives
C1	1.To recognize the concept of research and its various forms in the context of botany.
C2	2.To improve abilities relating to scientific experiments.
C3	3.To become proficient in data collection and the documentation of scientific findings.
C4	4.To prepare students for entry-level positions or professional training programmes in any field of Botany.

C5	5.Compare the various reporting and writing styles used in science.			
Course outcomes	On completion of this course, students will;			
C01	For students in those pertinent core areas, the project is preparing them to become professionals after graduation.	K1		
CO2	Compile data and familiarize yourself with techniques for planning and carrying out tests.	K2		
CO3	Collect data and educate yourself on how to evaluate the analyzed results of your scientific studies.	K3		
CO4	In-the-moment industrial exposure helps them become more knowledgeble and skilled in the latest technology.	K4		
CO5	Improving communication skills and coming up with creative ideas are crucial components of training that help someone become an entrepreneur.	K5 & K6		
K1 - Remem	ber; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Cre	ate.		
UNIT	CONTENTS			
Ι	 Each student will be allotted a Project Guide from the faculty of the department concerned by lot method. The topic of the dissertation shall be assigned to the candidate before the beginning of third semester. After the completion of the project work, the student has to submit four copies of dissertation with report carrying his/her project report for evaluation by examiners. After evaluation, one copy is to be retained in the College Library. Project work will be evaluated by both the external and the internal (Project Guide) examiners for the maximum of 100 marks in total on the scale of the maximum of 50 marks for the internal and the external each. Viva-voce will be conducted by the panel comprising, External examiner and Internal Examiner for the maximum of 100 marks in total on the scale of the maximum of 50 marks 			
Π	 All the candidates of M.Sc (Botany) are required to undergo a major project a following: 1. Dissertation/Thesis based on the work done by the student. 2. Soft copy of the project on CD/DVD. PROJECT EVALUATION GUIDELINES: The project is evaluated on the basis of following heads: For Viva-Voce maximum is 60 marks which will be conducted by both the external examiners during end semester university practical examinations. Internal: 40 marks I Review – Selection of the field of study, topic and literature collection - 10 	nd submit the e internal and 5 marks		

		III Review – Analysis and conclusion, preparation of rough draft- 15 marks									
		External: 60 marks									
	Thesis/ Dissertation - 30 marks										
	Presentation - 15 marks										
		Viva-voce - 15 marks									
	Suggested areas of work:										
III Algae, fungi, microbiology, biocontrol agents, plant tissue culture, plant phy											
	phytochemistry, biochemistry, anatomy, plant taxonomy, Ethnobotany, ecology, sustainable										
	agriculture, herbal formulations, cytogenetics, molecular biology, biotechnology,										
	bioinformatics, nanotechnology and applied botany.										
	IV Methodology:										
		Each project should contain the following details:									
	1. Brief introduction on the topic										
		2. Review of Literature									
	3. Materials and Methods										
		4. Results and Discussion – evidences in the form of figures, tables and photographs.									
		5. Summary									
		6. Bibliography									
Re	commende	d Text:									
1.	Wilson, K	and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4 th Edition)									
2	Cambridge University Press, Cambridge. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany, Vol. I. & II. Pastoci Dublication.										
2.	Meerut 9 th Edition										
3.	Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practicals in Plant Physiology and Biochemistry. Scientific										
4.	Wilson, K and J. Walker. 2005. Principles and Techniques of Practical Biochemistry, 5th Edition.										
5.	Rodney Boyer 2000 Modern Experimental Biochemistry 3rd Edition Published by Addison West										
Lo	ongman. Sin	gapore.									
		-									
Re	eference Bo	oks:									
1.	Dawson, C	C. 2002. Practical research methods. UBS Publishers, New Delhi.									
2.	Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. 1995. Scientific writing for agricultural										
	research se	cientists - a training reference manual. West Africa Rice Development Association, Hong									
	Kong.										
3.	Ruzin, S.E. 1999. Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.										
4.	Wilson and Goulding. 1987. Principles of biochemical techniques, Oxford University Press.										
5.	Mukherji, S. and Ghosh, A.K. 2005. Plant Physiology. First Central Edition, New Central Book Agency										
	(P) Ltd., K	olkata.									
6.	Taiz, L and Zeiger, E. 2010. Plant Physiology. 5th Edition. Sinauer Associates, USA.										
7.	Heldt, H.W and Piechulla, B. 2010. Plant Biochemistry, 4th Edition. Academic Press, NY.										
I	, ,										

8. Wilson, K and Walker, J. 2010. Principles and Techniques of Biochemistry and Molecular Biology, Seventh edition, Cambridge University Press, USA.

Web resources:

- 1. https://handbook.monash.edu > units > BIO3011
- 2. https://www.amazon.in/Practical-Manual-on-Plant-Biochemistry/dp/6200539790
- 3. <u>https://www.amazon.in/Laboratory-Manual-Physiology-Mukesh-Amaregouda/dp/6133993502</u>
- 4. <u>https://www.kopykitab.com/A-Laboratory-Manual-of-Plant-Physiology-Biochemistry-and-Ecology-by-Akhtar-Inam</u>
- 5. <u>https://kau.in/document/laboratory-manual-biochemistry</u>

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	1	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	2	1	3	2
CO 3	3	3	3	3	3	3	2	1	3	2
CO 4	3	2	3	3	3	3	3	2	3	3
CO 5	3	3	3	3	3	3	3	3	3	3

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