

**NALLAMUTHU GOUNDER MAHALINGAM COLLEGE
(AUTONOMOUS) POLLACHI - 642 001.**

M.Sc., BOTANY

**SYLLABUS
&
SCHEME OF EXAMINATION**

OUTCOME BASED EDUCATION (OBE)

**[FOR THE STUDENTS ADMITTED DURING THE
ACADEMIC YEAR 2023-2025 BATCH & ONWARDS]**

NGM COLLEGE (AUTONOMOUS)

Vision

Our dream is to make the College an Institution of Excellence at the national level by imparting quality education of global standards to make students academically superior, socially committed, ethically strong and culturally rich citizens to contribute to the holistic development of the self and society.

Mission

Training students to become role models in academic arena by strengthening infrastructure, upgrading extension through an enlightened management and committed faculty who ensure knowledge transfer, instill research aptitude and infuse ethical and cultural values to transform students into disciplined citizens in order to improve quality of life.

PG AND RESEARCH DEPARTMENT OF BOTANY

Vision

Our vision is to perform cutting-edge education, research and outreach on the patterns and processes of life, with a particular emphasis on plants and their habitats.

Mission

Our mission is to make students become scientifically well-trained and highly skilled botanists and on cutting edge technologies in life sciences and make good citizens with environmental and social concern.

Program Educational Objectives (PEOs)	
The M. Sc. Botany program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO 1	Postgraduate students are prepared to apply new ideas in the field of biological science and to become an entrepreneur
PEO 2	Postgraduate students are trained to take up higher learning programmes in research
PEO 3	Postgraduate students are known about the organization of plants and their role in Human Welfare
PEO4	Postgraduate students are prepare for competitive examinations, especially UGC-CSIR NET, SET and TNPSC Examinations.
PEO5	Postgraduate students are perform their competency with professional ethics in their working place.

Programme Outcomes

On successful completion of the M. Sc. Botany program to	
PO1	Disciplinary knowledge: Apply the fundamental knowledge of science and technology for solving complex problems.
PO2	Research-related skills : Ensure the use of advanced tools and techniques in understanding the scope and significance of Botany.
PO3	Problem solving: Develop the scientific problem solving skills during experimentation, research projects, analysis and interpretation of data.
PO4	Life long learner : Exploration of diverse plant life-forms, anatomical, Physiological and Biochemical disciplines and to conserve the biodiversity.
PO5	Critical thinking: Enhanced capacity to think critically; ability to understand, design and execute experiments independently and/or team under multidisciplinary settings
PO6	Multicultural competence: Design and standardize protocols for public health and safety, and cultural, societal and environmental considerations.
PO7	Information/digital literacy: Apply appropriate techniques, resources, and modern ICT tools for understanding plant resources.
PO8	Reflective thinking: Demonstrate the contextual knowledge in sustainable exploitation of medicinal, economically important and endangered plants as per the National Biodiversity Act.
PO9	Professional ethics: Follow the concept of professional ethics and bioethics norms for practicing the value of plant kingdom
PO10	Communication Skills: Communicate proficiently with various stakeholders and society, to comprehend and to write and present reports effectively

Programme Specific Outcomes

After the successful completion of M.Sc., Botany program the students are expected to	
PSO1	acquire deep knowledge on botanical terms, facts, concepts, theories and principles of plant sciences and become a good academician and a successful researcher
PSO2	become highly skilled in advanced techniques in biological science and become suitable for various careers.

MAPPING

PEOs POs/PSOs	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	M	H	M	H	M
PO2	H	H	M	M	M
PO3	M	M	L	M	M
PO4	L	M	M	H	L
PO5	M	M	M	L	M
PO6	M	M	H	L	L
PO7	L	M	L	L	M
PO8	M	L	M	M	L
PO9	L	L	M	L	L
PO10	L	L	M	M	H
PSO1	M	M	M	H	M
PSO2	H	M	M	H	M

OBE Rubric Mapping System

The attainment level of the students as Low, Medium, High is replaced by the numerals as 1, 2 and 3

HOD	CDC	COE
Name: Dr. R. Rakkimuthu Signature:	Name: Mr. K.Srinivasan Signature:	Name: Dr. R. Manicka Chezhan Signature:

SCHEME OF EXAMINATION

Semester	Course Code	Course Title	Class hours /Week		Exam Hrs	Maximum marks			Credits
			T	P		CIA	ESE	Total	
I	23PBY101	Core – 1 Plant Diversity I (Phycology, Mycology, Lichenology and Bryology)	6	3	3	25	75	100	4
	23PBY102	Core – 2 Plant Diversity II (Pteridophytes, Gymnosperms and Palaeobotany)	6	2	3	25	75	100	4
	23PBY103	Core - 3 Applied Microbiology and Plant Pathology	6	1	3	25	75	100	4
	23PBY104	Core - 4 Laboratory course-I (for core courses 1, 2, 3)	-	6	4	40	60	100	4
	23PBY1E1/ 23PBY1E2/ 23PBY1E3	Elective -1 Ecology and Phytogeography/ Ethano Botany/ Seed technology	6	-	3	25	75	100	4
Total			24	6		140	360	500	20
II	23PBY205	Core - 5 Plant Anatomy and Reproductive Biology	6	3	3	25	75	100	4
	23PBY206	Core - 6 Plant physiology	6	2	3	25	75	100	4
	23PBY207	Core – 7 Cytology, Genetics and Plant Breeding	5	1	3	25	75	100	4
	23PBY208	Core - 8 Laboratory course II (for core courses 5,6,7)	-	6	4	40	60	100	4
	23PBY2E4/ 23PBY2E5/ 23PBY2E6	Electi ve -2 Horticulture and Landscaping /IPR and Bioethics/ Organic forming	5	-	3	25	75	100	4
	23PBY2N1	Non- Major Elective Industrial Botany	2	-	2	-	100	100	2
Total			24	6		140	460	600	22

	CO-SCHOLASTIC COURSES						
SEMESTER	COURSE	Hours/ week	Total Hours	Internal mark	External mark	Total	Credits
	ADVANCED LEARNER COURSE (Optional)						
III	Plant ecology, tissue culture and Phytochemical techniques	-	-	50	50	100	Grade
IV	Online-Comprehensive examination	-	-	50	50	100	Grade
	ONLINE COURSES						
I/II	Swayam, MOOC Course etc.,	-	-	-	-	-	2
	VALUE ADDED COURSES						
III	Value Added Course – I / Value Added Course - II	2	30	25	25	50	2
	CERTIFICATE COURSES (Optional)						
III	Certificate Course - I	2	40	50	50	100	2
	Certificate Course - II	2	40	50	50	100	2
	The scholastic courses are only counted for the final grading and ranking. However for the award of the degree, the completion of co-scholastic one online course is mandatory. All other co-scholastic courses are optional only.						

Question Paper Pattern (Based on Bloom's Taxonomy)

K1-Remember; K2- Understanding; K3- Apply; K4-Analyze; K5- Evaluate

1. Theory Examinations: 75 Marks (Part I, II, & III)

(i) Test- I & II, ESE:

Knowledge Level	Section	Marks	Description	Total
K1 & K2 (Q1 -10)	A (Q1 – 5 MCQ) (Q6–10 Define/Short Answer/MCQ)	10 * 1 = 10	MCQ /Define	75
K3 (Q11-15)	B (Either or pattern)	5 * 5 = 25	Short Answers	
K4 & K5 (Q16 – 20)	C (Either or pattern)	5 * 8 = 40	Descriptive/ Detailed	

2. Theory Examinations: 100 Marks (NME)

Knowledge Level	Section	Marks	Description	Total
K1 & K2 (Q 1 -10)	A – (Answer 5 out of 8)	5 x 5 = 25	Short Answers	100
K3, K4 & K5 (Q 11-18)	B (Answer 5 out of 8)	5 x 15 = 75	Descriptive/ Detailed	

3. Practical Examinations: 100 Marks

Knowledge Level	Criterion	External/Internal Marks	Total
K3	Record work & Practical	60/40	100
K4			
K5			

4. Project:

Paper	Maximum Marks	Marks for		
		CIA	CEE	
			Evaluation	Viva-voce
Project	200	50	100	50

* CIA – Continuous Internal Assessment & CEE – Comprehensive External Examinations

Components of Continuous Assessment

THEORY

Maximum Marks: 100; CIA Mark: 25

Components		Calculation	CIA Total
Test 1	75	$75+75+15+10=175/7$	25
Test 2 / Model	75		
Assignment / Digital assignment	15		
Others	10		

*Others may include the following: Seminar / Socratic Seminars, Group Discussion, Role Play, APS, Class participation, Case Studies Presentation, Field Work, Field Survey, Term Paper, Workshop / Conference Participation, Presentation of Papers in Conferences, Quiz, Report / Content Writing, etc.

PRACTICAL

Maximum Marks: 100; CIA Mark: 40

Components		Calculation	CIA Total
Test / Model	30	$20+10+10=40$	40
Observation Note	05		
Record	05		

PROJECT

Maximum Marks: 200; CIA Mark: 50; CEE Mark: 150;

Components		Calculation	CIA Total
Review I	10	$10+10+10+20$	50
Review II	10		
Review III	10		
Report Submission	20		

** Components for 'Review' may include the following:*

Originality of Idea, Relevance to Current Trend, Candidate Involvement, and Presentation of Report

S. No	External Components	Marks
1	Originality of Idea	20
2	Relevance to Current Trend	20
3	Candidate Involvement	20
4	Thesis Style / Language	20
5	Presentation of Report	20
6	Viva-Voce	50
Total		150

STUDENT SEMINAR EVALUATION RUBRIC

Grading Scale:

A	B	C	D
8-10	5-7	3-4	0-2

CRITERIA	A - Excellent	B - Good	C - Average	D - Inadequate
Organization of presentation	Information presented as an interesting story in a logical, easy-to-follow sequence	Information presented in logical sequence; easy to follow	Most of the information is presented in sequence	Hard to follow; sequence of information jumpy
Knowledge of the subject & References	Demonstrated full knowledge; answered all questions with elaboration & Material sufficient for clear understanding AND exceptionally presented	At ease; answered all questions but failed to elaborate & Material sufficient for clear understanding AND effectively presented	At ease with information; answered most questions & Material sufficient for clear understanding but not clearly presented	Does not have a grasp of information; answered only rudimentary Questions & Material not clearly related to the topic OR background dominated seminar
Presentation Skills using ICT Tools	Uses graphics that explain and reinforce text and presentation	Uses graphics that explain the text and presentation	Uses graphics that relate to text and presentation	Uses graphics that rarely support text and presentation
Eye Contact	Refers to slides to make points; engaged with the audience	Refers to slides to make points; eye contact the majority of the time	Refers to slides to make points; occasional eye contact	Reads most slides; no or just occasional eye contact

Elocution – (Ability to speak English language)	Correct, precise pronunciation of all terms The voice is clear and steady; the audience can hear well at all times	Incorrectly pronounces a few terms Voice is clear with few fluctuations; the audience can hear well most of the time	Incorrectly pronounces some terms Voice fluctuates from low to clear; difficult to hear at times	Mumbles and/or Incorrectly pronounces some terms Voice is low; difficult to hear
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WRITTEN ASSIGNMENT RUBRIC

Grading Scale:

A	B	C	D	F
13-15	10-12	7-9	4-6	0-3

CRITERION	A - Excellent	B - Good	C - Average	D - Below Average	F - Inadequate
Content & Focus	Hits on almost all content exceptionally clear	Hits on most key points and the writing is interesting	Hits in basic content and writing are understandable	Hits on a portion of content and/or digressions and errors	Completely off track or did not submit

Sentence Structure & Style	* Word choice is rich and varies * Writing style is consistently strong * Students own formal language	* Word choice is clear and reasonably precise * Writing language is appropriate to the topic * Words convey intended message	* Word choice is basic * Most writing language is appropriate to the topic * Informal language	* Word choice is vague * Writing language is not appropriate to the topic * Message is unclear	* Not Adequate
Sources	Sources are cited and are used critically	Sources are cited and some are used critically	Some sources are missing	Sources are not cited	Sources are not at all cited
Neatness	Typed; Clean; Neatly bound in a report cover; illustrations provided	Legible writing, well-formed characters; Clean and neatly bound in a report cover	Legible writing, some ill-formed letters, print too small or too large; papers stapled together	Illegible writing; loose pages	Same as below standard
Timeliness	Report on time	Report one class period late	Report two class periods late	Report more than one week late	Report more than 10 days late

Industrial Training / Internship

The students may undergo industrial training for a period as specified in the Curriculum during summer/winter vacation. In this case, the training has to be undergone for 7-14 days period.

The students may undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) for the period prescribed in the curriculum during summer / winter vacation, in lieu of Industrial training.

Mark Split UP

Internal	External	Total
25	75	100

Industrial Training or Internship for students is evaluated for 100 marks, out of which 25 are given by the HOD and 75 by an external examiner.

Guidelines for Project

The final year students should undergo a project work during IV semester

- ❖ The period of study is for 2-3 Months.
- ❖ Work on the project must be done in the department laboratory (or) work on any industrial problem outside the organization is permitted.
- ❖ Students are divided into groups and each group is guided by a mentor.
- ❖ The group should not exceed four students, also interested student can undergo individually.
- ❖ A problem is chosen, objectives are framed, and data is collected, analyzed and documented in the form of a report / Project.
- ❖ Viva – Voce is conducted at the end of 4th semester, by an external examiner and concerned mentor (Internal Examiner).
- ❖ Project work constitutes 200 marks, out of which 50 is internal and 150 is external marks.

Mark Split UP

Internal	External	Total
50	150	200

S. No	Internal Components	Marks
1	Review - I	10
2	Review - II	10
3	Review - III	10
4	Rough Draft Submission	20
Total		50

Review I – 10 marks

- Title of dissertation relevant to the core subject - 05 marks
- Idea of the Dissertation- 05 marks
- The objective of the dissertation is very specific to the dissertation title -10 marks

Review II- 10 marks

- Feasibility of the Dissertation -05 marks
- Literature collection - 05 marks
- The complete methodology of the dissertation is relevant to the objective -10 marks

Review III- 10 marks

- Attainment of all objectives of the Dissertation -05marks
- Interpretation of results -10 marks
- The Outcome and Application of the Dissertation - 05 marks

S. No	External Components	Marks
1	Originality of Idea	20
2	Relevance to Current Trend	20
3	Candidate Involvement	20
4	Thesis Style / Language	20
5	Presentation of Report	20
6	Viva-Voce	50
Total		150

Program Educational Objectives (PEOs)	
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PO6	Design and standardize protocols for public health and safety, and cultural, societal and environmental considerations.
PO7	Apply appropriate techniques, resources, and modern ICT tools for understanding plant resources.
PO8	Demonstrate the contextual knowledge in sustainable exploitation of medicinal, economically important and endangered plants as per the National Biodiversity Act.
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MAPPING

PEOs POs/PSOs	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	M	H	M	H	M
PO2	H	H	M	M	M
PO3	M	M	L	M	M
PO4	L	M	M	H	L
PO5	M	M	M	L	M
PO6	M	M	H	L	L
PO7	L	M	L	L	M
PO8	M	L	M	M	L
PO9	L	L	M	L	L
PO10	L	L	M	M	H
PSO1	M	M	M	H	M
PSO2	H	M	M	H	M

OBE Rubric Mapping System

The attainment level of the students as Low, Medium, High is replaced by the numerals as 1, 2 and 3

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 23PBY101		Title: Core - 1 Plant Diversity I (Phycology, Mycology, Lichenology and Bryology)	Batch	2023 -2025
			Semester	I
Hrs/Week:	6		Credits	4

Course Objective

The main objectives of this course are to:

- Study the classification, characteristic features, distribution, and reproduction cycle of algae, fungi, lichens and bryophytes.
- Know the ecological and economic importance of algae, fungi, lichens and bryophytes
- Understand the concept of lichens and bryophytes as indicator for air pollution

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Remember the values of lower plant forms and its diversity	K1
CO2	Get an idea on evolution of lower plants and its architectural specialization in cells	K2
CO3	Apply economic values of lower plants to manufacture value added products	K3
CO4	Review the developmental stages of lower group of plant diversity	K4
CO5	Understand and learn the classification and economic importance of lower plants	K2&K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Unit	Content	Hrs
Unit I	Phycology: Phycology – introduction - history - definition- classification of algae (Fritsch, 1945) – Phylogeny and interrelationship – thallus organization (range of thallus), evolution of thallus in green algae- reproduction (vegetative, asexual, sexual) - modes of perennation- Ultra structure of cell, flagella, chloroplast, pyrenoids and eye spot in major groups of algae- algae in diverse habitats (terrestrial, fresh water, marine)- algae distribution in India - life cycle patterns in algae and algal blooms - <i>*economic importance of algae as food - bio-fuels - source of chemicals and drugs - algal bioinoculants.</i>	14
Unit II	Comparative study of classes of Cyanophyceae, Chlorophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae with reference to range of structure of plant body including - ultra structure - methods of reproduction and variations in life cycles - life histories of <i>Nostoc, Caulerpa, Vaucheria</i> , Diatoms, <i>Padina</i> and <i>Gracilaria</i> - Culture and cultivation of fresh and marine algae- fossil algae.	14
Unit III	Mycology: General characteristics - classification of fungi (J. Alexopoulos and C.W. Mims 1979) - cell wall composition, mode of nutrition- range of structure, Heterothallism, reproduction and interrelationship of Myxomycetes, Oomycetes, Zygomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes -structure and life-histories of <i>Plasmodiophora, Phytophthora, Rhizopus, Penicillium, Pleurotus</i> and <i>Cercospora</i> - ecology of fungi (Habit and Habitat) - VAM Ecto and endophytic mycorrhiza - economic importance of fungi- fossil fungi - comparison of algae and fungi.	14

Unit IV	Lichenology: Origin and evolution of lichens - classification of Lichens (Miller, 1984) - thallus types and structure - occurrence and Inter-relationship of Phycobionts and Mycobionts - structure and reproduction in Ascolichens, Basidiolichens and Deuterolichens – Lichens as indicators of pollution - ecology of lichens- economic importance of lichens.	15
Unit V	Bryology: Classification(Proskauer, 1957), general and reproductive characters of major classes -distribution of bryophytes - comparative study of gametophytes and sporophytes of major classes -Hepaticopsida: <i>Marchantia</i> , <i>Porella</i> , Anthocerotopsida: <i>Anthoceros</i> , Bryopsida: <i>Sphagnum</i> and <i>Polytrichum</i> - alternation of generations in the life-cycle of bryophytes- Economic importance of bryophytes- bryophytes as pollution indicators- fossil bryophytes.	15

**Self-study topics*

Power point presentations, Group discussions, Seminar, Quiz and Assignment.

Text Books

1. Sharma, O.P. 2011. Diversity of microbes & Cryptogams – Algae, Tata McGraw Hill Education Private Limited, New Delhi.
2. Singh, S.K. 2006. Text Book of Bryophyta, Campus Books, New Delhi.
3. DharaniDharAwasthi, 2000. A Handbook of Lichens. Vedams eBooks (P) Ltd. NewDelhi
4. Alexopoulos, C.J. and Mims, C.W. 1979. Introductory Mycology. Wiley Eastern Ltd., New Delhi.

Reference Books

1. Sureshkumar, 2009. An Introduction to Algae.Campus Book International, New Delhi.
2. Muthukumar, S. and Tarar, J.L. 2006. Lichen Flora of Central India, Eastern book Corporation, New Delhi.
3. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram &Sons. Lucknow, India
4. Kevin K. 2018. Fungi biology and Application, 3rd Edition, Wiley Blackwell.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

- 1.Algae lecture Notes: http://www.uobabylon.edu.iq/eprints/paper_11_20160_754.pdf
- 2.Fungi YouTube Videos: <https://www.youtube.com/watch?v=vcYPI6y-Udo>
- 3.Lichen YouTube Videoshttps://www.youtube.com/watch?v=XQ_ZY57MY64
- 4.Bryophytes lecture Notes: <http://www.plb.ucdavis.edu/courses/bis/1c/text/Chapter22nf.pdf>

PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	H	M	M	H	M	H	M	H	L	L	H	H
CO2	H	M	M	H	H	M	M	H	M	L	H	H
CO3	H	L	H	M	H	H	L	H	H	M	H	M
CO4	H	H	L	H	M	M	L	L	M	L	H	H
CO5	H	H	H	M	H	H	L	H	M	H	H	H

H-High

M- Medium

L –Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 23PBY102		Title: Core – 2 Plant Diversity II (Pteridophytes, Gymnosperms and Palaeobotany)	Batch	2023-2025
			Semester	I
Hrs/Week:	6		Credits	4

Course Objective

The main objectives of this course are:

- To understand the composition level of plant diversity emphasized in ecological, organizational, genetic and cultural.
- To realize the fundamental values of diversity and their importance of human welfare.
- To define and characterize diversity of lower vascular plants to understand the dynamics of diversity to realize the significance of diversity.

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Remember the diverse forms of plants in the plant kingdom	K1
CO2	Understand the life cycles of vascular plants	K2
CO3	Discover the importance of vascular plants to the Human community	K3
CO4	Connect the lower plants and higher plants by phylogenetic study	K4
CO5	Review the evolutionary idea of fossil diversity	K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Unit	Content	Hrs
Unit I	Pteridophytes: Introduction - classification of Pteridophytes (Sporne, 1970) - characteristic features and types of life cycles in Pteridophytes - comparative account of sporophytes, gametophytes and embryogeny in Psilotopsida, Lycopsidea and Sphenopsida.	14
Unit II	Comparative account of sporophytes - gametophytes and embryogeny in Pteropsida - types of steles and their evolution in Pteridophytes - telome theory- heterospory and seed habit - apospory, apogamy and parthenogenesis - <i>*economic importance of Pteridophytes - origin and evolution of Pteridophytes.</i>	14
Unit III	Gymnosperms: Introduction – classification of Gymnosperms (Sporne, 1974) – characteristic features and life cycles of Gymnosperms. Comparative study of morphology, anatomy, reproduction and phylogeny of Ephedrales, Pteridospermales, Bennettitales, Pentoxylales, Cycadales, Corditales and Taxales.	15
Unit IV	Comparative study of morphology, anatomy, reproduction and phylogeny of Ginkgoales and Gnetales –affinities of Gymnosperms with Angiosperms and Pteridophytes - <i>*economic importance of Gymnosperms</i>	14
Unit V	Palaeobotany: Concepts of Palaeobotany – a general account on Geological Time Scale - techniques for Palaeo botanical study- fossil types: compressions, Impression, incrustation, casts, molds, petrifications, coalballs and compactions- age determination and methods of study of fossils- systematic and nomenclature of fossil plants- role of fossil in oil exploration and coal excavation - Palaeopalynology.	15

**Self study topics*

Text Books

1. Vashishta, P.C. 2006. Gymnosperms. S. Chand & Company Ltd., Ram Nagar, New Delhi.
2. Vashishta, P.C. 2005. Pteridophyta S. Chand & Company Ltd., Ram Nagar, New Delhi.
3. Gangulee and Kar, 1970. College Botany Vol. II. New Central Book Agency, New Delhi.
4. Vashishta, P.C. 1991. Vascular Cryptogams. S. Chand & Company Ltd., Ram Nagar, New Delhi

Reference Books

1. Arnold, C.A. 2013. An Introduction to Palaeobotany. Academic Press, New York and London
2. Biswas, C. and Johrc, B.M. 1977. The Gymnosperms. Narosa publishing House, New Delhi.
3. Bower, F.O. 1923-28. The ferns. Vol., 1-3; Cambridge University Press, London.
4. Eames, A.J. 1936. Morphology of Vascular Plants. Lower groups, New York and London.
5. Meyen, S.V. 1987. Fundamentals of Palaeobotany. Chapman and Hall, New York.
6. Sporne, K.R. 1965. The Morphology of Pteridophytes. Hutchinson & Co., London
7. Sporne, K.R. 1967. The Morphology of Gymnosperms. Hutchinson & Co., London.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. Pteridophytes : <https://www.easybiologyclass.com/pteriophytes-free-online-study-materials-tutorials-lecture-notes-ppts-mcqs/>
2. Gymnosperms : <https://www.easybiologyclass.com/general-characters-of-gymnosperms-lecture-notes-with-ppt/>
3. Palaeobotany: <https://www.biologydiscussion.com/botany/paleobotany/palaeobotany-concept-technique-and-important-strata-botany/18744>

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	H	M	M	H	L	M	M	H	H	M	H	L
CO2	M	L	M	H	M	L	H	H	M	L	H	L
CO3	M	M	M	H	L	H	M	H	M	M	H	L
CO4	M	M	M	H	M	H	M	H	H	M	H	L
CO5	H	L	H	H	M	M	H	H	H	L	H	L

H-High M- Medium L – Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 23PBY103		Title : Core – 3 Applied Microbiology and Plant Pathology	Batch	2023-2025
			Semester	I
Hrs/Week:	6		Credits	4

Course Objective

The main objectives of this course are to:

- Provide students with the latest information in the field of microbiology and plant pathology.
- Explain the theoretical basis of the tools, technologies and methods commonly used in microbiology and plant pathology.
- Develop practical skills in the use microbiological methodologies, tools and techniques.

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Recognize the different types of microorganisms present in an environment and their importance.	K1
CO2	Characterize and culture microorganisms present in soil, water and infected plant tissue using appropriate techniques.	K2
CO3	Demonstrate the role of microorganisms in food processing and spoilage	K3
CO4	Apply the microbial culture in manufacturing of value added products	K3
CO5	Assess the role of microorganisms in plant diseases commonly occurring in crops	K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Unit	Content	Hrs
Unit I	Microbiology: History, scope and branches of microbiology - a general account, classification, growth and reproduction of bacteria (Bergey's manual of classification), virus and protozoa - economic importance of microbes	14
Unit II	Microbiological Media: Media types - preparation- methods of sterilization- enumeration of microorganisms in soil and water - isolation of microorganisms from infected plant tissue- isolation of microorganisms from industrial waste - techniques of pure culture- maintenance and preservation of microbes- staining techniques - *bacterial growth curve - nutritional types of microorganisms.	15
Unit III	Food Microbiology: Single cell protein- fermented foods (pickles, silage, sausages and bread) - microbial spoilage of foods - food borne infections & intoxication - preservation of foods - preservation of milk and milk products - * Food adulteration- identification of adulteration in foods- concept of prebiotics and probiotics.	14
Unit IV	Industrial Microbiology: Fermenters - batch fermentation - continuous fermentation - industrial production of enzymes (amylase), amino acids (glutamic acid and L- Lysine), Antibiotics (penicillin), organic acids (lactic and citric acid) and biofuels (ethanol) - methods of cell and enzyme immobilization - applications of immobilized cells and enzymes - medicinal plants as antimicrobial agents.	14

Unit V	Pathology: Introduction to plant pathology – disease – concept, component and causes – Defense mechanisms in plants- plant diseases: symptoms, causative organisms and control measures of following diseases: Blast disease of Paddy - Red rot of Sugar cane - Late blight of Potato - Bunchy top of Banana - TMV- biotechnology in relation to plant pathology - agricultural terrorism.	15
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Text Books:

1. Bilgrami, K.S. & H.C. Dube, 2010 A text book of Modern Plant Pathology – Vikas Publishing House (P) Ltd., New Delhi
2. Dubey RC, Maheswari D.K., 2014. A text book of Microbiology, S.Chand & company, New Delhi.
3. Joanne Willey, Linda Sherwood and Chris Woolverton, 2013. Prescott's Microbiology, 9th edition, McGraw-Hill Companies.

Reference Books:

1. Prescott, Harley and Klein' S. 2008. Microbiology 7th edition, McGraw hill International Edition, New York.
2. Sharma, P.D. 2006. Plant Pathology. Narso Publishing House, New Delhi.
3. Michael, J. Pelczar, Jr. E.C.S. Chan and N.R. Krief. 1995. Microbiology. Tata McGraw-Hill (Ed), New Delhi.
4. Alexopoulos, C.J. and Mims, C.W. 1979. Introductory Mycology. Wiley Eastern Ltd, New Delhi.
5. Steindraus, K.H. (ed.) 1983. Hand Book of Indigenous Fermented Food, Parcel Dekker Inc., New York.
6. Das Gupta M.K. 1988. Principles of Plant Pathology. Allied publishers Ltd., New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. Food Microbiology and Food Safety (https://swayam.gov.in/nd2_cec20_ag13/preview)
2. General Microbiology (https://swayam.gov.in/nd2_cec19_bt11/preview)

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	M	H	M	M	H	M	H	L	H	H	H	H
CO2	H	H	H	H	H	H	M	H	H	H	H	H
CO3	H	H	H	H	H	H	H	M	M	H	H	H
CO4	H	H	H	H	M	H	H	L	M	H	H	H
CO5	H	H	H	H	M	M	H	M	H	H	H	H

H-High M- Medium L –Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 23PBY104		Title : Core - 4 Laboratory course -I (Phycology, Mycology, Lichenology and Bryology, Pteridophytes, Gymnosperms andPalaeobotany Applied Microbiology and Plant Pathology)	Batch	2023-2025
			Semester	I
Hrs/Week:	6		Credits	4

Course Objective

The main objectives of this course are to:

- Acquire practical skills in the use of instruments, technologies and methods in microbiology, thallophytes and non-flowering plant groups.
- Provides opportunities to collect and examine samples from various environments.
- Compare the structural diversity of fossil and extant plant species.

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Demonstrate practical skills in microbiology, thallophytes, pteridophytes and gymnosperms.	K3
CO2	Classify bacteria based on staining techniques as well as isolate, culture and characterize microorganisms from different substrates.	K4
CO3	Apply practical skills for Manufacturing of value added products from microbes and lower plants	K3
CO4	Analyze the morphological and anatomical features of lower plants.	K4
CO5	Execute the culture techniques in laboratories	K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Part	Content	Hrs
Part 1	Phycology, Mycology, Lichenology and Bryology 1. Observe the range of thallus diversity in algae 2. Understand the Reproductive structures and their arrangement in algae 3. The collection of microalgae using phytoplankton net from various water bodies. 4. Culturing of microalgae using artificial media 5. Culturing of macro algae/seaweed using various methods (demo only) 6. Aware on Commercially available algal products available in markets 7. Vegetative and reproductive structures of <i>Phytophthora</i>, <i>Rhizopus</i>, <i>Penicillium</i>, <i>Pleurotus</i> and <i>Cercospora</i> 8. Demonstration of Fungal spore count using Haemocytometer. 9. Performing slide culture technique for fungal culturing. 10. Display of Lichens specimens - <i>Usnea</i> sp. 11. Morphological and anatomical study of bryophytes with reference to the following genera: <i>Marchantia</i>, <i>Anthoceros</i>, <i>Sphagnum</i> and <i>Polytrichum</i>. 12. Field trip for lower plant collection and submission of reports.	45

Part 2	Pteridophytes, Gymnosperms and Palaeobotany Study of morphology, anatomy and reproductive structures of the following genera: 1. Pteridophytes: <i>Ophioglossum</i> , <i>Selaginella</i> , <i>Equisetum</i> and <i>Adiantum</i> 2. Gymnosperms: <i>Ephedra</i> , <i>Pinus</i> , <i>Araucaria</i> and <i>Gingko</i> . 3. Palaeobotany : Impression, Petrification, <i>Rhynia</i> , <i>Lepidodendron</i> , <i>Lepidocarpon</i> , <i>Williamsonia</i> , <i>Lagenostoma</i> , <i>Lyngiopteris</i> and Amber.	45
Part 3	Microbiology and Plant Pathology 1. Preparation of Basic medium - solid agar and broth 2. Preparation of agar plates, agar slants and agar deep tubes. 3. The staining of bacteria using simple staining process 4. Identification of bacteria using Gram's staining. 5. Isolation of Bacteria, Fungi from soil 6. Isolation of microorganisms from the infected plant tissues. 7. Culturing, sub culturing and maintaining the culture of bacteria isolated from various sources 8. Understanding the growth of bacteria using bacterial growth curve. 9. Making of biochemical tests to understand the character of the bacteria 10. Demonstration of role of Micrometry in microbiology 11. Demonstration of commercial production of Alcohol 12. Effect of antibiotics on pathogenic microorganism by Kerby - Bayer method. 13. Testing the milk quality using Methylene Blue Reduction Test (MBRT) 14. Identification of adulteration in some common foods Pathology Submission of herbarium of infected plant specimens (not less than five)	

Power point presentation, Specimen observation, Sectioning, Field/Industrial visit, Experience discussion, and Case study

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	H	H	M	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	M	H	H	H	H	H
CO3	H	L	L	H	H	H	M	H	H	M	H	M
CO4	H	M	L	H	L	H	H	H	L	H	H	M
CO5	H	H	H	H	L	M	H	H	H	H	H	H

H- High M- Medium L -Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code:	23PBY1E1	Title : Elective -I Ecology and Phytogeography	Batch	2023-2025
			Semester	I
Hrs/Week:	5		Credits	4

Course Objective

The main objectives of this course are to:

- Empower the student to know the concept and principle of ecology.
- Know the causes, effects and control measure of pollution.
- Learn Biodiversity conservation and management

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Recall or remember environmental condition influenced by many factors	K1
CO2	Understand the applied aspect of environmental botany	K2
CO3	Apply their idea to protect the biodiversity	K3
CO4	Analyze insight into the vegetation types, species interaction and their importance and the factors influencing the environmental conditions	K4
CO5	Evaluate skills in biodiversity conservation through In- situ and Ex- situ.	K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate		

Unit	Content	Hrs
Unit I	History and Scope of Ecology. Concept of Ecosystem, its structure and function –types of ecosystem - Ecological factors; edaphic, climatic, topographic, biotic and abiotic factors; Population Ecology - Characteristics - - growth curves - regulation - life history strategies (r and K selection); concept of metapopulation - demes and dispersal, interdemec extinctions, age structured populations.	14
Unit II	Ecological succession - Hydrosere, Xerosere. Bog succession, sand dune succession. Plant indicators - Terrestrial ecosystems, Fresh water ecosystem, Marine ecosystem. Biodiversity: cause for loss of Biodiversity, benefits, and conservation of (<i>in-situ</i> and <i>ex-situ</i>) Biodiversity, Phytosociological studies * <i>Biodiversity Hotspots (RET species)</i> .	14
Unit III	Environmental pollution – causes, effect and control measures of Air, Water, Soil, Thermal, Radiation, Noise, E-waste and solid waste pollution; Cumulative effect of Pollution on global environment; * <i>Global warming</i> , climate change and its consequences – acid rain, ozone depletion – disaster management.	15
Unit IV	Environmental Impact Assessment (EIA) - Scope, importance and application of EIA process - eco-restoration/remediation- ecological foot prints - carbon foot print - ecolabeling - environmental auditing –application of remote sensing in ecological studies and GIS – environmental acts and laws.	14
Unit V	Phytogeography - principles of plant geography - phytogeographic regions of India –latitudinal and longitudinal vegetations- continental drift hypothesis - Factors involved in distribution -Endemism, Age and Area hypothesis; dispersal and migration and their aims and methods.	15

Text Books:

1. Krishnamoorthy, K.V. 2003. An Advanced Text book on Biodiversity, Oxford & IBH Book Company, New Delhi.
2. P. D. Sharma, 2005. Ecology And Environment, Rastogi Publications, India.
3. Trivedi, R.K. and Goel, P.K. 1986. Chemical and Biological methods for water pollution studies, Environmental publication, India.
4. Shukla R. S. and P.S. Chandel, 2005. A Textbook of Plant Ecology, S Chand & Co Ltd

Reference Books:

1. Chiras, D. D., 2009. Environmental Science, 8th edition, Jones and Bartlett Publishers, Sudbury, Massachusetts (www.jbpub.com).
2. Melchias, G. 2001. Biodiversity and Conservation. Oxford IBH. New Delhi. 236pp.
3. Odum, E.P. 1975. Fundamentals of ecology, W.B. Saunders & Co., Philadelphia, USA.
4. Ambasht, R.S. 1974. A text book of plant ecology (3rd ed.), Students' Friends. & Co., Varanasi, India.
5. Chapman, J.L. and Reiss, M.J. 1999. Ecology; Principles and Applications. I Ed. Cambridge University Press. New York.
6. Groombridge, B. (Ed.) 1994. Global Biodiversity status of the Earth's living resources. Chapman & Hall, London.

Related Online Contents [MOOC,SWAYAM,NPTEL,Websitesetc.]

1. <https://www.youtube.com/watch?v=qtTLiQoYTyQ>
2. <https://www.youtube.com/watch?v=208B6BtX0Ps>
3. <https://www.youtube.com/watch?v=6p1TpVJYTds>

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	M	H	H	H	M	H	H	L	H	M	L	L
CO2	M	M	H	L	H	M	H	L	L	M	L	M
CO3	H	M	H	H	M	H	L	H	L	H	L	L
CO4	H	L	H	M	M	H	H	M	H	H	M	L
CO5	H	H	H	H	H	H	H	H	H	M	M	H

H-High M- Medium L –Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code:	23PBY1E2	Title : Elective -1 Ethno Botany	Batch	2023-2025
			Semester	I
Hrs/Week:	5		Credits	4

Course Objective

The main objectives of this course are:

- To conserve the indigenous knowledge of the region and create awareness in the young generation.
- To develop new products for food, herbal, and pharmaceutical companies and assist in managing biological resources

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Understand the ethnic knowledge of tribes	K2
CO2	Be familiar with the methodology and procedure for collecting information from ethnic communities	K2
CO3	Apply and use of different plants for human welfare	K3
CO4	Evaluate the medicinal and economic importance of plants used by indigenous communities	K5
CO5	Understand and analyze about the ethnic plants for modern drug manufacture	K2 ,K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate		

Unit	Content	Hrs
Unit I	Ethno botany: Introduction -concept, scope and objectives - its significance in state level, national and global level- Landmarks in history of ethnobiology- relation between geology, phyto geography and ethnobotany.	14
Unit II	Methodology of Ethno botany : Field work - Herbarium - Ancient Literature - Temples and sacred places- Plants used by the tribal: Food plants - intoxicants and beverages - Resins and oils and miscellaneous uses- Indigenous societies and interactions with plants- a global view-Relationship between man and plants- for benefit of developmental strategies-mutually destructive approaches.	14
Unit III	Ethno botany Practices : Linkage of ethnobotany with other sciences and disciplines in biology- food and nutrition, medicine, sociological and cultural practices, religions and social costumes and economic relations, archaeology, history and politics- Plants and Tribal medicine: Significance of the following plants in ethno botanical practices (along with their habitat and morphology) <i>Azadirachta indica</i> - <i>Ocimum sanctum</i> - <i>Vitex negundo</i> . <i>Gloriosa superba</i> - <i>Tribulus terrestris</i> – <i>Pongamia pinnata</i> - <i>Cassia auriculata</i> – <i>Indigofera tinctoria</i> .	15

Unit IV	Ethno botany in Modern Medicine: Role of ethnobotany in modern medicine with special example <i>Morinda citrifolia</i> - <i>Trichopus zeylanicus</i> . Major tribes of south India and their ethnobotanical and ethno- biological heritage- Naikas, Shola Naikas, Thodas, Kothas, Kurumbas, Irulas, Malayali and KattuNaikas	15
Unit V	Applications and Conservation of Ethnobotany: Ethnobotany and conservation of plants with special reference to India- Mythology and conservation of ecosystems - conservation of selected medicinal plant species: scared groves, forestry and unique ecosystems, and their ethnobiological values - plants and animals in art, tradition and ethnography: methodologies in ethno-botanical research - Ethnobotany as a source of drug.	14

**Self study topics*

Power point Presentations, Group discussions, Seminar ,Quiz, Assignment, Case study

Text Books

1. Das, A.P. and Pandey, A.K. (2007). Advances in Ethnobotany. Bishen Singh and Mahendra Pal Singh, Dehradun.
2. Sahu, T.R. (2007). Indigenous Knowledge: An application. Scientific Publishers. Jodhpur.
3. Gary J Martin, 2008. Ethnobotany A Methods manual, Earth scan, London.

Reference Books

1. Jain, S.K. (1995). Manual of Ethnobotany, Scientific Publishers, Jodhpur.
2. 3. Cotton, C.M. (1997). Ethnobotany – Principles and Applications. John Wiley and Sons – Chichester.
4. Jain, S.K. (ed.) (1989). Methods and Approaches in Ethnobotany. Society of Ethnobotanists, Lucknow, India.

Related Online Contents [MOOC,SWAYAM,NPTEL,Websitesetc.]

1. <https://www.biologydiscussion.com/botany/ethno-botany-definitions-development-and-importance/7158>
2. <https://www.studocu.com/en-us/document/university-of-central-florida/culinary-botany-across-the-cultures/ethnobotany-chapter-1-lecture-notes-1/11828890>

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	H	H	H	L	M	M	M	L	M	H	M	M
CO2	H	M	H	L	M	L	M	L	M	H	L	M
CO3	H	H	H	L	M	L	M	L	M	H	M	H
CO4	H	H	H	L	M	L	M	L	M	H	M	H
CO5	H	H	M	L	M	L	M	L	L	H	M	H

H- High

M- Medium

L –Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code:	23PBY1E3	Title : Elective -1 Seed technology	Batch	2023-2025
			Semester	I
Hrs/Week:	5		Credits	4

Course Objective

The main objective of this course is:

- To refresh the basic knowledge of seed development and structures and apprise students with its relevance to production of quality seed.

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Express knowledge gained on the principles of seed technology	K1
CO2	Understand biological bases of technologies used in modern seed science and technology.	K2
CO3	Apply knowledge on the seed multiplication and certification.	K3
CO4	Gaining knowledge on principles of seed processing, Seed drying and methods.	K2
CO5	Get aware on biological and technological aspects of seed production.	K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Unit	Content	Hrs
Unit I	Type of seeds, Classification of seeds, Recalcitrant seeds, Dicot and monocot seeds - Morphology and types, Seed reserves. External and internal structures of seed and their functional significance, Albuminous and Ex-Albuminous seeds	14
Unit II	Types of dormancy - physical, Physiological, Morphological, Chemical and mechanical, Primary and secondary dormancy, Photo and Skoto dormancy. Methods to overcome dormancy. Ecological significance of seed dormancy	15
Unit III	Seed maturation and germination - metabolism during germination. Epigeal and Hypogeal germination, Germination mechanism. Brief account of Germination value, Germination rate, Germination percentage. Germination ecology: Environmental factors and germination behaviour.	14
Unit IV	Seed production in self and cross pollinated plants, Classes of seeds- traditional, breeder, foundation and certified seeds. Viability tests- their significance and importance. Seed harvesting, processing, treatments, testing and seed sampling, viability and vigour. Critical role of seed moisture content and environmental factors on viability. Viability period of Indian forestry Species.	15
Unit V	Effect of storage on seed longevity, Seed germplasm and storage in different conditions. Cryopreservation, Static conservation of seeds. Seed borne pathogens and pests - seed treatments. Seed certification, Standard inspection, registration and seed law enforcement. Clonal seed orchards, seed banks.	14

**Self study topics*

Text Books

1. Copeland LO& McDonald MB. 2001. Principles of Seed Science and Technology. 4thEd. Chapman & Hall.
2. Desai BB. 2004. Seeds Handbook. Marcel Dekker.
3. Thompson JR. 1979. An Introduction to Seed Technology. Leonard Hill.
4. Murray DR. 1984. Seed Physiology. Vols. I, II. Academic Press.
5. Singh SV. 1988. Indian Minimum Seed Certification Standards. Central Seed Certification Board, Ministry of Agriculture, New Delhi.

Reference Books

1. Agarwal, R.L. 1997. Seed Technology, Scientific Publishers, Jodhpur.
2. Agarwal. P.K. and M. Dadlani, 1992. Techniques in seed science and technology, Scientific Publisher, Jodhpur.
3. Khan, A.A. 1977. Physiology and Biochemistry of Seed dormancy and germination, Oxford & IBH Publishing company (P) Ltd, New Delhi. Online resources available at internet sites

Related Online Contents [MOOC,SWAYAM,NPTEL,Websitesetc.]

1. http://www.jnkvv.org/PDF/30032020194456Principles_of_Seed_Technology_Dr_Rudrasen_Singh.pdf
2. <https://www.slideshare.net/KarlLouisseObispo/seed-technology>

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	H	H	H	L	M	M	M	L	M	H	M	M
CO2	H	M	H	L	M	L	M	L	M	H	L	M
CO3	H	H	H	L	M	L	M	L	M	H	M	H
CO4	H	H	H	L	M	L	M	L	M	H	M	H
CO5	H	H	M	L	M	L	M	L	L	H	M	H

H- High

M- Medium

L –Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 23PBY205		Title: Core – 5 Plant Anatomy and Embryology	Batch	2023-2025
			Semester	II
Hrs/Week:	6		Credits	4

Course Objectives

The main objectives of this course are to:

- Understand the mechanism underling the shift from vegetative to reproductive phase.
- Trace the development of male and female gametophyte.
- Highlight the physiological role of endosperm in the morphogenesis of embryo.
- Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants.

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Recall and remember the relationship between Plant anatomy and Embryology	K1
CO2	Understand the vascular system, cellular development and reproduction in various plant system of angiosperm	K2
CO3	Learn the structures, functions and roles of meristems, pre and post fertilizational change and embryological tissues in angiospermic plants	K2, K4
CO4	Apply the idea on study of plant anatomical structures and reproduction in plants growth and development for attaining green cover.	K3
CO5	Get aware of applied aspects and techniques for making profitable cultivation in agriculture.	K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Unit	Content	Hrs
Unit I	Anatomy: General account and theories of organization of shoot apex and root apex – quiescent centre and modern concept on meristems – structural diversity, functional complexity and phylogenetic trends in specialization of complex permanent tissues (xylem and phloem) - cambium – origin – structure, storied and non-storied types – formation of cork cambium, and periderm - <i>*Anomalous secondary growth in dicot and monocot.</i>	15
Unit II	Vascular differentiation in primary and secondary structure of root and stem in dicot and monocot – origin of lateral roots – root stem transition – anatomy of dicot and monocot leaves - stomatal types – nodal anatomy – petiole anatomy – trichomes – glands – secretory tissues – nectaries – laticifers and their significance.	14
Unit III	Reproductive Biology: Microsporangium - microsporogenesis - microspores - arrangement - morphology - ultra structure - microgametogenesis - pollen – stigma- Interaction - incompatibility – types mechanism and methods to overcome incompatibility – palynology .	14
Unit IV	Classification, structure and development of megasporangium, megasporogenesis, female gametophyte - types, ultra structure, and haustorial behavior - nutrition of embryo sac - double fertilization and triple fusion - endosperm - types and functions of endosperm- <i>*Embryogeny: classification, development of monocot (grass) and dicot (crucifer) embryos.</i>	15
Unit V	Polyembryony- types - classification - causes - induction and practical application- apomixis and its significance - seed and fruit development and role of growth substances - parthenocarpy and its importance.	14

Power point Presentations, Group discussions, Seminars and Assignment.

1. Bhojwani, S.S. and Bhatnagar, S.P. 2009. The Embryology and Angiosperms. Vikas publishing house pvt. Ltd, New Delhi.
2. Easu, K. 1985. Plant Anatomy, Wiley Eastern Pvt. Ltd., New Delhi.
3. Johri, B.M. (ed.) 1983. Embryology of Angiosperms, Springer-Verlag, New York.
4. Pandey, B.P. 1993. Plant anatomy, S. Chand & Co, New Delhi.

1. Pullaiah, T., Lakshminarayana, K. and HanumanthaRao, B. 2006. Text book of Embryology of Angiosperms. Regency Publications, New Delhi.
2. Bierhorst, D.W. 1971. Morphology of Vascular Plants. Macmillan publishers, New York.
3. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
4. Swanson, P. and Webster, P. 1977. The Cell. Prentice Hall, Inc. Englewood Cliffs, New Jersey, USA.

1. <https://www.askiitians.com/biology/sexual-reproduction-in-flowering-plants/>
2. <https://www.easybiologyclass.com/plant-anatomy-online-tutorials-lecture-notes-study-materials/>
3. Introduction to Developmental Biology. https://swayam.gov.in/nd1_noc20_bt35/preview
4. Kishore, K. 2015. Polyembryony in Horticulture and its significance. https://www.researchgate.net/publication/316438576_Polyembryony_in_Horticulture_and_its_significance
5. Morphogenesis (<https://www.youtube.com/watch?v=YVvUPQUjSNE>)
6. Structural Organization: Anatomy of flowering Plants – 1 (<https://www.youtube.com/watch?v=WfURKyslthI>)

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	H	H	L	H	L	M	L	M	M	H	H	H
CO2	H	M	L	H	L	H	M	M	H	M	H	H
CO3	M	H	L	M	L	M	M	M	H	M	H	M
CO4	H	M	L	H	L	M	L	L	L	M	M	M
CO5	M	H	M	H	M	H	L	H	H	M	H	H
	H-High		M- Medium		L -Low							

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 23PBY206		Title: Core – 6 Plant Physiology	Batch	2023-2025
			Semester	II
Hrs/Week:	6		Credits	4

Course Objectives

The main objectives of this course are to:

- Learn physiological mechanisms underlying plant metabolism.
- Be familiar with the phytohormones and its metabolism in plants generating plant growth.
- Study about the movements in plants.
- Know the various responses of plants against stress and its mechanism of resistance.

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Remember the basic metabolism in plants	K1
CO2	Deduce the biological pathways	K2
CO3	Execute the molecular based modification of metabolism in plants	K3
CO4	Able to identify the plant stress based on its responses and anti-oxidative defense.	K4
CO5	Validate the plant physiological scientific hypothesis by using various experiments	K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate		

Unit	Content	Hrs
Unit I	Plant- water relations: imbibitions, diffusion and osmosis - water potential and chemical potential - absorption of water - water transport through xylem - transpiration and its significance - <i>*factors affecting transpiration - physiology of stomatal movement</i> - transport of photosynthate - the mechanism of translocation in the phloem, assimilate partitioning.	14
Unit II	Signal transduction: overview - receptors and G-proteins - jasmonic acid signaling – Calcium and protein signalling. Mineral nutrition: Criteria of essentiality of elements; macro and micro- nutrients; role of essential elements; mineral deficiency symptoms and plant disorders - nutrient uptake and transport mechanism - role of cell membrane, ion pump carrier.	15
Unit III	Photosynthesis: Historical background and significance - photosynthetic pigments - accessory pigments and photoprotective carotenoids - reaction center complexes - photochemical reactions - electron transport pathways in chloroplast membrane - photo phosphorylations - C3 cycle, photorespiration and C4 cycle - crassulacean acid metabolism.	14
Unit IV	Respiration: Glycolysis - TCA cycle and its regulation - aerobic and anaerobic respiration - electron transport in mitochondria - redox potential - oxidative phosphorylations - pentose phosphate pathway. nitrogen metabolism: importance of nitrogen to plants - nitrogen cycle -biological nitrogen fixation - <i>nif</i> gene - nitrate assimilation GDH and GS/GOGAT pathway - biosynthesis of nitrogen - radical scavenging activity	14

Unit V	Growth and development: Kinetics of growth - seed dormancy - seed germination and influencing factors of their regulation - the concept of photoperiodism - physiology of flowering - florigen concept - vernalization - biological clocks - physiology of senescence - fruit ripening. Plant hormones - auxins, gibberellins, cytokinins, abscisic acid ethylene, history of their discovery - biosynthesis - role and mechanism of action. Photomorphogenesis: phytochromes and cytochromes, their discovery - physiological role and mechanism of action - *Stress physiology: Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic stress tolerance.	15
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**Self study topics*

Power point Presentations, Group discussions, Seminar, Quiz and Assignment.

Text Books

1. Pandey, S.N. and Sinha, B.K. 2010. Plant Physiology, Vikas Publishing, New Delhi.
2. Steward, F.C. 2012 Plant Physiology Academic Press, US
3. Jain, V.K. 2000. Fundamentals of Plant Physiology (5th ed.), S. Chand & Co Ltd; New Delhi.

Reference Books

1. Devlin, R.M. and Baker, N.R. 1973. Photosynthesis, Reinhold Affiliated East-West Press Pvt. Ltd, New Delhi.
2. Moore, T.C. 1979. Biochemistry and physiology of plant hormones. Narosa book Distributors, New Delhi.
3. Roberts, E.A. 1987. Plant growth regulators. Kluwer Academic publishers, London.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf>
2. <https://basicbiology.net/plants/physiology>
3. <https://learn.careers360.com/biology/plant-physiology-chapter/>
4. https://swayam.gov.in/nd2_cec20_bt01/preview
5. <https://www.nature.com/subjects/plant-physiology>

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	H	H	H	H	M	M	H	L	M	L	H	L
CO2	H	H	M	H	L	M	H	L	L	L	H	L
CO3	H	M	M	H	M	H	H	H	H	M	H	M
CO4	H	H	H	H	M	H	M	L	H	L	H	M
CO5	H	H	H	H	M	H	H	M	M	H	H	M

H-High M- Medium L –Low

Programme code	M.Sc.	Programme Title: Master of Science in Botany		
Course Code: 23PBY207		Title : Core – 7 Cytology, Genetics and Plant Breeding	Batch	2023-2025
			Semester	II
Hrs/Week:	5		Credits	4

Course Objectives

The main objectives of this course are to:

- Enable to learn various cell structures and functions of prokaryotes and eukaryotes and understand the salient features and functions of cellular organelles.
- To study the fundamental principles of Genetics and understand the structure, function and changes in the genetic materials.
- To learn the principles of Plant Breeding and the application of molecular techniques in crop improvement.

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Remember the general features and organization of Ultra structure of cell wall and cell organelles in prokaryotes and eukaryotes	K1
CO2	Understand the structure and function of cell organelles in prokaryotes and eukaryotes	K2
CO3	Gain knowledge on chromosome structure and cell cycle process	K3
CO4	Gain knowledge on various types of genes and mutation	K3
CO5	Learn the different principles of plant breeding and the application of molecular marker techniques in crop improvement	K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Unit	Content	Hrs
Unit I	Cytology: Cell structure- organization of prokaryotic and eukaryotic cell - Cell wall - nucleus- mitochondria - Golgi bodies - lysosomes- endoplasmic reticulum- peroxisomes- plastids - vacuoles - structure and function of cytoskeleton - Chromosome: Structure and types - overview of mitosis and meiosis - regulations of cell cycle.	14
Unit II	Genetics: Mendelian and non Mendelian inheritance - interaction of genes, complementary genes, epistasis, multiple factor inheritance - Sex- linked inheritance - theories of sex determination - sex determination in plants - linkage and crossing over - kinds of linkage – significance - types of crossing over mechanism- models for homologous recombination - Construction of genetic map - two point test cross- three point test cross- cytoplasmic male sterility in plants	16
Unit III	Classification of mutations - spontaneous and induced mutations – physical and chemical mutagens - molecular basis of gene mutation - chromosomal aberrations - epigenetics - genetic code - DNA as a genetic material. - gene regulatory mechanisms (prokaryotes & eukaryotes)	13
Unit IV	Plant Breeding: Introduction to breeding of cultivated plants - objectives of breeding - polyploidy and haploids in plant breeding –double haploid-Selection – mass selection - pureline selection - clonal selection merits and demerits - <i>*Improvement of crop plants by pedigree method, bulk method, backcross method</i>	14

Unit V	Intervarietal, interspecific and intergeneric hybridization - heterosis - hybrid vigour - marker assisted breeding - *national and international organizations for crop improvement - protection of plant varieties & farmers rights Act, India - DUS - Germplasm - The role of IBPGR and NBPGR - germplasm conservation (Rice and Sugarcane).	15
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*Self study topics

Power point Presentations, Seminar and Assignment

Text Books:

1. Singh, B.D. 2015. Plant Breeding: Principles and Methods. Kalyani Publications, Chennai, India
2. Sambamurthy A.V.S.S, 2005. Genetics, Published by Narosa Publishing House.
3. Sukhla R.M. 2012. Molecular Genetics, Published by Wisdom Press.
4. Verma P.S. and Agarwal V.K. 1999. Concept of Genetics, Human Genetics and Eugenics, Published by S Chand & Company Pvt Ltd.
5. Sinha, U. and Sunita Sinha 1998. Cytogenetics, Plant breeding and evolution. Vikas Publishing House Private, Limited.
6. Gupta, P.K. 1994. Genetics, Rashtogi Publication, Meerut, India.

Reference Books:

1. Chaudhary, R.C. 2001. Introduction to Plant Breeding, India Book House Pvt Ltd
2. Lodish, et al. 2000. Molecular and Cell Biology. W.H. Freeman & Co. New York.
3. Allard, R.W. 1960. Principles of Plant Breeding, John Wiley and Sons, Inc. New York.
4. Gilber, N.W. 1978. Organellar heredity, Revan press, New York.
5. Simmonds, N.W. 1979. Principles of Crop improvement. Longman, London.
6. Strickberger, M.V. 1977. Genetics, Macmillan publishers, New York.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. Animations: <https://www.videezy.com/free-video/genetic>
2. Lecture Notes: <https://www.mysciencework.com/publication/download/lecture-notes-cell-biology>
3. Plant Breeding: <https://www.youtube.com/watch?v=1WuwwYcDHMg>
4. PPT slides: <https://www.slideshare.net/earshadshinichi/cell-biology-the-cell-its-structure-and-history>
5. Video lecture: <https://www.youtube.com/watch?v=OIN4keY8q3k>

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
COs												
CO1	L	M	L	M	M	L	L	H	L	M	M	M
CO2	L	M	L	M	M	M	L	H	L	M	M	M
CO3	M	M	H	L	M	H	H	L	L	M	H	H
CO4	L	H	L	L	H	L	H	M	L	L	H	H
CO5	L	H	M	L	H	L	H	M	L	L	H	H

H-High

M- Medium

L –Low

Programme code	M.Sc.	Programme Title: Master of Science in Botany		
Course Code: 23PBY208		Title : Core – 8 Laboratory course – II (Plant Anatomy and Embryology, Plant Physiology, Cytology, Genetics and Plant Breeding)	Batch	2023-2025
			Semester	II
Hrs/Week:	6		Credits	4

Course Objectives

The main objectives of this course are to:

- Get knowledge on plant and water relations, chromatographic techniques and *in vitro* antioxidants quantification.
- Gain knowledge on various plant anatomical features through free hand sections, microtome sections and maceration method.
- Get adequate knowledge in internal structure of anther, pollen types and germination behaviors, L.S. of ovule, types of endosperms and dicot embryo dissection.
- Observe the different stages of mitosis and chromosome behaviour and organization during various stages and to learn staining techniques of various plant tissues.
- Understand the principles of genetics and plant breeding to apply crop improvement programmes.

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Recall or remember the various aspects of plant physiology, embryology, plant tissue culture, anatomy and cytology	K1
CO2	Understand and apply various concepts of plant physiology, embryology, anatomy and cytology.	K3
CO3	Analyze the theory knowledge gained from Plant Anatomy and Reproductive Biology, Plant Physiology, Cytology into practical mode in order to acquire applied knowledge by hands-on experiences.	K4
CO4	Analyze or interpret the results achieved in practical session in the context of existing theory and knowledge	K4
CO5	Evaluate the theory and practical skills gained during the course to make any new product	K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate		

Part	Content	Hrs
Part 1	Anatomy	45
	1. Demonstration of process of Staining for various plant sections	
	2. Sectioning of Primary structure of dicot and monocot stem (<i>Tridax procumbens</i> , <i>Zea mays</i>)	
	3. Sectioning of dicot stem for Normal secondary thickening	
	4. Sectioning of stems for Anomalous secondary thickening Multiple and successive cambial rings – <i>Boerhaavia</i> Included or inter xylary phloem – <i>Achyranthes</i> Intra xylary phloem/Ridged xylem – <i>Bignonia</i> Inverted cortical bundles – <i>Nyctanthes</i>	
	5. sectioning of monocot stem for secondary growth in <i>Dracaena</i> sp.	

	6. Identification of stomatal types of various plant leaves 7. Sectioning of T.S of dicot leaf to study the Dorsiventral & isobilateral (<i>Nerium</i>) leaves 8. Sectioning of T. S. of monocot leaf using Bamboo or grass leaves. 9. Maceration of plant tissues to understand the anatomical nature 10. Demonstration of microtome and process of microtomy Prepare five permanent slide using standard staining and mounting procedures.	
Part 2	Reproductive Biology 1. Study on morphological features of pollens of various flowers 2. Estimation of pollen germination 3. Test for pollen viability using acetocarmine method 4. Charts on types of ovules 5. Display the mature embryo sac for its characters. 6. Observation of various types of endosperm 7. Dissection of embryos – dicot, monocot and polyembryony	
Part 3	Plant Physiology 1. Determination of DPD of plant tissues by plasmolytic method 2. Extraction and estimation of chlorophyll. 3. Separation of plant pigments by Thin Layer Chromatography. 4. Determination of stomatal frequency and stomatal index. 5. Measurement of respiration by simple respiroscope. 6. Hill reaction by isolated chloroplasts (demonstration). 7. Estimation of Nitrate reductase activity. 8. Determination of Total antioxidant activity by phosphomolybdenum reduction method. 9. Determination of Superoxide radical scavenging activity	30
Part 4	Cytology, Genetics And Plant Breeding 1. Preparation of slide for Mitotic study from <i>Allium cepa</i> root tips 2. Preparation of slide for meiotic study from flower bud 3. Problems in Mendelian and non – Mendelian inheritance 4. Problems in Mutation –Gene code alteration 5. Charts on plant breeding techniques- Emasculation, Bagging, Mass selection, Pureline selection and clonal selection	15

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	H	H	H	H	H	M	H	H	M	H	H	M
CO2	H	H	H	H	H	H	H	H	L	H	H	M
CO3	H	H	H	H	H	H	M	H	M	H	H	H
CO4	H	H	M	H	H	H	L	L	L	H	H	H
CO5	H	H	H	M	M	M	H	H	M	H	H	M

H-High M- Medium L –Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 23PBY2E4		Title : Elective -2 Horticulture and Landscaping	Batch	2023-2025
			Semester	II
Hrs/Week:	5		Credits	4

Course Objectives

The main objectives of this course are to:

- Know about the brief history, divisions, classification and structure of horticultural plants.
- Understand the plant growth environment in relation to soil, nutrients, fertilizers, and bio inoculants.
- Study the sexual and vegetative propagation methods including propagation through specialized vegetative structures.
- Highlight the aesthetics of horticulture and postharvest handling of horticultural products.

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Understand about the importance of horticulture	K2
CO2	Apply knowledge on soil, climate and reclamation of soil	K3
CO3	Apply and analyze knowledge on crop establishment activities	K3,K4
CO4	Analyze plant growth structures in horticulture	K4
CO5	Understand about the importance of bio-organic fertilizers and crop establishment methods	K2,K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate		

Unit	Content	Hrs
Unit I	Brief history - scope and importance - divisions of horticulture - Classification of horticultural plants - Plant growth environment: biotic and abiotic factors - primary and secondary nutrients and their functions	15
Unit II	Organic matter; fertilizers - organic, inorganic and potting media; bio-inoculants; methods of fertilizer application; irrigation types- sprinkler irrigation, trickle irrigation- surface, furrow, surge, pitcher. directing plant growth - pruning and thinning.	14
Unit III	Plant propagation: Seeds - advantages, viability, mechanism of dormancy and dormancy breaking methods - direct and indirect seedling production in nurseries and transplantation - medicinal plant cultivation - adaptive cultivation.	14
Unit IV	Propagation through specialized underground structures - corm, tuber, sucker, bulb, bulbil, rhizome; vegetative propagation - cutting, layering, grafting and budding. Soil- less production of horticultural crops - hydroponics, sand culture, gravel culture, terrace garden, rockery, vertical gardening.	14

Unit V	Esthetics of horticulture - design; elements and principles of design; flower arrangement - cut flowers - Significance of cut flower industry in India; terrarium culture; bonsai; growing plants indoors; turf production-landscaping . Post- harvest handling of Horticultural products - harvesting; *storage; processing - pomology - cultivation of apple and pineapple. Commercial floriculture – cultivation of jasmine and rose. Commercial horticulture - extraction of Jasmine concrete and papain- fruit and vegetable carving techniques.	15
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**Self study topics*

Text Books : 1. Adams, C.R. and M. P. Early. 2004. Principles of horticulture. Butterworth – Heinemann, Oxford University Press. 2. Bansil. P.C. 2008. Horticulture in India. CBS Publishers and Distributors, New Delhi. 3. Kumar, N.2020. Introduction to Horticulture, Published by Oxford &Ibh Publishing Co PvtLtd.New Delhi.
Reference Books: 1. Bose, T.K., Maiti, R.G., Dhua, R.S. and Das, P. 1999. Floriculture and Landscaping. NayaProkash, Calcutta. 2. Denisen, E.L. 1979. Principles of Horticulture. MacMillan Publishing co, Inc. New York. 3. Janik, J. 1972. Horticultural Science. W.H. Freeman & Company, San Francisco. Tolanus, S. 2006. Soil fertility, Fertilizer and Integrated Nutrient management. International Book Distributory Co
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.] 1. https://ncert.nic.in/textbook/pdf/ievs101.pdf 2. https://www.youtube.com/watch?v=rge2UnxJhNI 3. https://www.slideshare.net/biologyexams4u/horticulture-introduction-definition-and-branches-of-horticulture

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	H	M	H	H	H	M	H	H	M	H	H	H
CO2	M	H	M	H	L	H	L	M	H	H	L	L
CO3	M	M	M	M	M	L	H	H	L	M	M	M
CO4	H	H	H	M	M	H	M	H	M	H	M	H
CO5	M	H	H	M	H	M	H	L	M	H	M	H

H-High

M- Medium

L –Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 23PBY2E5		Title : Elective – 2 IPR and Bioethics	Batch	2023-2025
			Semester	II
Hrs/Week:	5		Credits	4

Course Objective

The main objectives of this course are to:

- Cater to the needs of the stakeholders of knowledge economy is designed for those interested in Managers and the like.
- Create awareness about current trends in IPR and Innovation
- Disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- Pursue a career in IPR, which opens opportunities in the fields of IP Attorneys and IP Consultants

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Remember the basic knowledge of IPR	K1
CO2	Understand the types of applications of IPR	K2
CO3	Apply the knowledge on patenting of the product	K3
CO4	Gain an insight into the biosafety and farmers rights	K4
CO5	Acquire knowledge on Protection of Plant Varieties and Farmers' Rights Act	K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate		

Unit	Content	Hrs
Unit I	Introduction to intellectual property right (IPR) - Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples. IPR and WTO (TRIPS, WIPO). Patent -Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement.	14
Unit II	Copyrights -Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement. Trademarks- Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name.	14
Unit III	Geographical Indications -Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position. Industrial Designs Objectives, Rights, Assignments, Infringements, Defences of Design Infringement	14
Unit IV	Protection of Traditional Knowledge - Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prospecting and Bio-Piracy, Alternative ways, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library.	15

Unit V	Protection of Plant Varieties - Plant Varieties Protection-Objectives, Justification, International Position, Plant varieties protection in India- Rights of farmers, Breeders and Researchers - National gene bank, Benefit sharing- Protection of Plant Varieties and Farmers' Rights Act, 2001.	15
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**Self study topics*

Power point Presentations, Group discussions, Seminar, Quiz, Assignment, Field study
Text books: 1. Arthur Raphael Miller, Micheal DavisH.,2000. Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers. 2. Erbish, F.H. and M. Maredia, 1998, Intellectual Property Rights in Agricultural Biotechnology. Universities Press, India. 3. BAREACT, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd.,. 4. Kankanala, K.C. 2007. Genetic Patent Law & Strategy, 1st Edition. Manupatra Information Solution Pvt.Ltd.,Noida, India
Reference Books: 1. Recombinant DNA safety guidelines (January 1990), Department of biotechnology , Ministry of Science and Technology , Government of India, New Delhi. 2. Revised guidelines for research in transgenic plants (August 1998), department of Biotechnology, Ministry of science and technology, Government of India ,NewDelhi. 3. N.Subbaram, 2003. Patents, pharma book syndicate , Hyderabad. 4. Glick , B.R., and pasternack , J.J., 1998. Molecular Biotechnology, Second Edition , ASM Press , Washington, DC.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.] 1. Cell for IPR Promotion and Management (http://cipam.gov.in/) 2. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/) 3. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/) 4. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf 5. https://swayam.gov.in/nd2_cec20_ge04/preview

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	M	L	M	M	L	L	M	L	M	M	M	M
CO2	H	L	M	L	M	L	L	L	L	M	M	M
CO3	H	M	M	L	M	H	M	L	M	M	M	H
CO4	M	L	L	L	M	L	L	L	L	M	M	M
CO5	M	L	M	L	M	M	M	L	M	M	M	H

H-High M- Medium L -Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 23PBY2E6		Title : Elective-2 Organic farming	Batch	2023-2025
			Semester	II
Hrs/Week:	5		Credits	4

Course Objectives

The main objectives of this course are to:

- Know the about the organic farming and its practice for sustainable agriculture.
- Know the about the marketing and export potential of organic farming products

Course Outcomes (CO)

On the successful completion of the course, student will be able to:		
CO1	Remembering the importance and practice of organic farming	K1
CO2	Will get an idea on organic farming and eventual characterization	K2
CO3	Apply economic values of organic way for holistic development	K3
CO4	Review the various stages of organic farming to make eco-friendly agriculture	K4
CO5	Understand and learn the organic farming multidimensional improvement of society	K2 & K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Unit	Content	Hrs
Unit I	Organic farming – concept and definition, its relevance to India and global agriculture and future prospects; land and water management – land use, minimum tillage; shelter zones, hedges, pasture management, agro-forestry.	14
Unit II	Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers.	14
Unit III	Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.	13
Unit IV	Weeds – introduction to weeds -definition- common weeds on crop fields – Types of weed Control- Biological weed control, plant diseases and insect pest management, biological agents and pheromones, biopesticides.	16
Unit V	Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.	15

**Self study topics*

Power point Presentations, Group discussions, Seminar, Quiz, Assignment, Field study
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Text books:

1. Dahama AK. 2005. Organic Farming for Sustainable Agriculture. 2nd Ed. Agrobios.
2. Palaniappan, S.P and Annadurai, K. (1999) Organic Farming – Theory and Practice. Scientific Publ.
3. Sharma, A. (2002) Hand Book of Organic Farming. Agrobios.

Reference Books:

1. Ananthakrishnan, T. N. (ed.) (1992) Emerging Trends in Biological Control of Phytophagous Insects. Oxford & IBH.
2. Gaur, A.C. (1982) A Manual of Rural Composting, FAO/UNDP Regional Project Document, FAO.
3. Lampkin, N. (1990) Organic Farming. Press Books, Ipswich, UK.
4. Rao, B.V.V. (1995) Small Farmer Focused Integrated Rural Development: Socio- economic Environment and Legal Perspective: Publ.3, Parisaraprajna Parishtana, Bangalore.
5. Reddy M.V. (ed.). (1995) Soil Organisms and Litter Decomposition in the Tropics. Oxford & IBH.
6. Singh, S. P. (ed.) 1994. Technology for Production of Natural Enemies. PDBC, Bangalore.
7. Subba Rao, N.S. (2002) Soil Microbiology. Oxford & IBH.
8. Trivedi, R. N. (1993) A Text Book of Environmental Sciences, Anmol Publ.
9. Veeresh, G. K, Shivashankar, K. and Singlachar, M. A. (1997) Organic Farming and Sustainable Agriculture. Association for Promotion of Organic Farming, Bangalore.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://www.slideshare.net/GhulamAsghar8/organic-farming-148631470>
2. <https://www.youtube.com/watch?v=WhOrIUlnPo>
3. https://www.youtube.com/watch?v=iwIlyXTr_bQ

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	H	M	H	L	M	M	M	L	M	H	M	M
CO2	H	H	M	L	M	M	M	L	M	H	M	H
CO3	H	M	H	L	M	M	M	L	M	H	M	M
CO4	H	M	M	L	M	M	M	L	M	M	M	M
CO5	H	M	H	L	M	M	M	L	M	M	H	H

H-High M- Medium L -Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 23PBY2N1		Title : Non Major Elective – 1 INDUSTRIAL BOTANY	Batch	2023-2025
			Semester	II
Hrs/Week:	2		Credits	2

Course Objective

The main objectives of this course are to:

- To learn the applied aspects of industrial application of algae, fungi, bacteria, plants, molecular biology and recombination technology.
- The student would be competent to work in industries.
- To educate people about the widespread commercial uses of fungi.
- To know about the economic importance of plants.
- To acquire knowledge on *in vitro* cultivation techniques to develop protocols targeted towards commercialization.

Course Outcomes (CO)

On completion of this course, the students will be able to:		
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.	K3
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 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Unit	Content	Hrs
Unit I	ALGAE IN INDUSTRIES: Introduction to Algae -Fertilizer industry-Seaweeds, pharmaceutical industry – antibiotics, agar, carageenin, alginin, diatomate earth, mineral industry, fodder industry	6
Unit II	FUNGI IN INDUSTRIES: Introduction to fungi Beneficial use of yeast, Fermentation of alcohol, preparations of enzyme, organic acid preparation, cheese production, protein manufacture, vitamins, fats.	6
Unit III	PLANT PRODUCTS: Fibres and Fibre-Yielding Plants, wood and cork, tannins and dyes, rubber, fatty oils and Vegetable fats, sugars and starches, pulp and paper, gums and resins.	6
Unit IV	BACTERIA IN INDUSTRY: Bacteria introduction - Food industry, dairy products, bioleaching, biogas production,	6

	bioremediation	
Unit V	RECOMBINANT PLANTS: Plant Tissue culture: introduction - Micropropagation, somatic seeds, cell culture.	6
Power point Presentations, Group discussions, Seminar, Quiz, Assignment and Field visit		

Text Books :

1. Trivedi, P.C. 2001. Algal Biotechnology. Point publisher, Jaipur. India.
2. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
3. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.

References:

1. Becker. E.W. 1994. Micro algae Biotechnology and Microbiology. Cambridge University press.
2. Borowitzka, M.A. and borowizka, L.J. 1996. Microalgal Biotechnology. Cambridge University Press, Cambridge,
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 N. Glazer and Hiroshi Nikaido. 1994. Microbial Biotechnology.
7. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company.

Related Online Contents

1. <https://www.elsevier.com/books/algal-biotechnology/ahmad/978-0-323-90476-6>
2. <https://www.amazon.in/Fungi-Biotechnology-Prakash-ebook/dp/B07PBF2R3D>
3. <https://www.amazon.in/Plant-Based-Natural-Products-Derivatives-Applications-ebook/dp/B07438N1CJ>
4. <https://link.springer.com/book/10.1007/978-981-16-5214-1>
5. <https://link.springer.com/book/10.1385/0896031616>

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	H	M	H	H	H	M	H	H	M	H	H	H
CO2	M	H	M	H	L	H	L	M	H	H	L	L
CO3	M	M	M	M	M	L	H	H	L	M	M	M
CO4	H	H	H	M	M	H	M	H	M	H	M	H
CO5	M	H	H	M	H	M	H	L	M	H	M	H

H- High M- Medium L -Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name and Signature	CDC	COE

Name: Dr. P. Sathishkumar	Name: Dr. R. Rakkimuthu	Name: Mr. K.Srinivasan	Name: Dr. R. Manicka Chezhan
Signature:	Signature:	Signature:	Signature:

HOD

Dr. R. Rakkimuthu, M.Sc., Ph.D.,
Assistant Professor and Head,
BG & Research Dept. of Botany,
N.G.M. College (Autonomous)
Pollachi - 642 001.

Principal

PRINCIPAL
N G M COLLEGE, POLLACHI

**NALLAMUTHU GOUNDER MAHALINGAM COLLEGE (AUTONOMOUS)
POLLACHI - 642 001.**

M.Sc., BOTANY

**SYLLABUS
&
SCHEME OF EXAMINATION**

OUTCOME BASED EDUCATION (OBE)

**[FOR THE STUDENTS ADMITTED DURING THE
ACADEMIC YEAR 2022-2024 BATCH & ONWARDS]**

NGM COLLEGE (AUTONOMOUS)

Vision

Our dream is to make the College an Institution of Excellence at the national level by imparting quality education of global standards to make students academically superior, socially committed, ethically strong and culturally rich citizens to contribute to the holistic development of the self and society.

Mission

Training students to become role models in academic arena by strengthening infrastructure, upgrading extension through an enlightened management and committed faculty who ensure knowledge transfer, instill research aptitude and infuse ethical and cultural values to transform students into disciplined citizens in order to improve quality of life.

PG AND RESEARCH DEPARTMENT OF BOTANY

Vision

Our vision is to conduct innovative research, teaching and outreach on the patterns and process of life with a focus on plants and their environments.

Mission

Our mission is to foster an environment of excellence by attracting and supporting the outstanding students, faculty and staff needed to sustain our vision.

SCHEME OF EXAMINATION

Semester	Course Code	Course Title	Class hours /Week		Exam Hrs	Maximum marks			Credits
			T	P		CIA	ESE	CIA	
III	21PBY309	Core - 9 Taxonomy of Angiosperms	4	3	3	50	50	100	4
	21PBY310	Core -10 Plant Biochemistry and Biophysics	4	2	3	50	50	100	4
	21PBY311	Core -11 Plant Biotechnology	4	1	3	50	50	100	4
	21PBY312	Core – 12 Laboratory course - III (for core paper 9,10 and 11)	-	-	4	50	50	100	4
	21PBY3E7/ 21PBY3E8/ 21PBY3E9	Elective-3 Forestry and Wood science / Herbal Technology/ Pharmacognosy	4	-	3	50	50	100	4
	21PBY3N3	Non- Major Elective 3 Economic Botany	2	-	2	50	50	50	2
	22PBY3IN	Industrial Training / Internship	-	-	-	25	25	50	2
		Total	24	6		275	275	550	22
IV	21PBY413	Core - 13 Research Methodology	4	3	3	50	50	100	4
	21PBY414	Core - 14 Bioinformatics and Cyber Security	4	3	3	50	50	100	4
	21PBY415	Core – 15 Laboratory course -IV (for core papers 13 and 14)	-	-	4	50	50	100	4
	21PBYFVI	Field / Industry / Institute visit	-	-	-	25	25	50	1
	21PBY4P1	Core - 16 Project Work and Viva –Voce	-		-	100	100	200	10
		Total	8	6	-	170	330	500	23
		Grand Total	90	24	-	1100	1100	2200	90

Question Paper Pattern
(Based on Bloom's Taxonomy)

K1-Remember; K2- Understanding; K3- Apply; K4-Analyze; K5- Evaluate

1. Theory Examinations: 70 Marks (Part I, II, & III)

(i) Test- I &II, ESE:

Knowledge Level	Section	Marks	Description	Total
K1 & K2 (Q 1 -10)	A (Q 1 – 5 MCQ) (Q 6–10 Define/Short Answer)	10 x 1 = 10	MCQ Define	70
K3 (Q 11-15)	B (Either or pattern)	5 x 4 = 20	Short Answers	
K4 &K5 (Q 16 – 21)	C (Q -16 is Compulsory and Q 17 – 21 answer any 3)	4 x 10 = 40	Descriptive/ Detailed	

2. Theory Examinations: 50 Marks

Knowledge Level	Section	Marks	Description	Total
K1&K2 (Q 1 -10)	A (Q 1 – 5 MCQ) (Q 6–10 Define/Short Answer)	10 x 1 = 10	MCQDefine	50
K3, K4 & K5 (Q 11-18)	B (Answer 5 out of 8)	5 x 8 = 40	Short Answers	

3. Practical Examinations: 100Marks

Knowledge Level	Criterion	External/Internal Marks	Total
K3	Record work & Practical	60/40	100
K4			
K5			

4. Components of Continuous Assessment

Components		Calculation	CIA Total
Test 1	70	$\frac{70+70+20+20+20+10}{7}$	30
Test 2 (Model)	70		
Seminar	20		
Assignment / Digital Assignment	20		
Group Task : GD, Role Play, APS	20		
Information Acquisition	10		

STUDENT SEMINAR EVALUATION RUBRIC

Grading Scale:

D	C	B	A
01 -05	06 - 10	11 - 15	16 - 20

CRITERIA	D - Inadequate	C - Average	B - Admirable	A - Outstanding
Organization of presentation	Hard to follow; sequence of information jumpy	Most of information presented in sequence	Information presented in logical sequence; easy to follow	Information presented as interesting story in logical, easy to follow sequence
Knowledge of subject & References	Does not have grasp of information; answered only rudimentary Questions & Material not clearly related to topic OR background dominated seminar	At ease with information; answered most questions & Material sufficient for clear understanding but not clearly presented	At ease; answered all questions but failed to elaborate & Material sufficient for clear understanding AND effectively presented	Demonstrated full knowledge; answered all questions with elaboration & Material sufficient for clear understanding AND exceptionally presented
Presentation Skills using ICT Tools	Uses graphics that rarely support text and presentation	Uses graphics that relate to text and presentation	Uses graphics that explain text and presentation	Uses graphics that explain and reinforce text and presentation
Eye Contact	Reads most slides; no or just occasional eye contact	Refers to slides to make points; occasional eye contact	Refers to slides to make points; eye contact majority of time	Refers to slides to make points; engaged with audience
Elocution -not ability to speak English language	Mumbles and/or Incorrectly pronounces some terms Voice is low; difficult to hear	Incorrectly pronounces some terms Voice fluctuates from low to clear; difficult to hear at times	Incorrectly pronounces few terms Voice is clear with few fluctuations; audience can hear well most of the time	Correct, precise pronunciation of all terms Voice is clear and steady; audience can hear well at all times

WRITTEN ASSIGNMENT GRADING RUBRIC

Grading Scale:

F	D	C	B	A
01 - 04	05 - 08	09 - 12	13 - 16	17 - 20

CRITERION	A - Excellent	B - Good	C - OK	D - Below Standard	F - Missing
Content & Focus	Hits on almost all content exceptionally clear	Hits on most key points and writing is interesting	Hits in basic content and writing is understandable	Hits on a portion of content and/or digressions and errors	Completely off track or did not submit
Sentence Structure & Style	* Word choice is rich and varies * Writing style is consistently strong * Students own formal language	* Word choice is clear and reasonably precise * Writing language is appropriate to topic * Words convey intended message	* Word choice is basic * Most writing language is appropriate to topic * Informal language	* Word choice is vague * Writing language is not appropriate to topic * Message is unclear	* Did not include
Sources	Sources are cited and are used critically	Sources are cited and some are used critically	Some sources are missing	Sources are not cited	Did not include
Neatness	Typed; Clean; Neatly bound in a report cover; illustrations provided	Legible writing, well-formed characters; Clean and neatly bound in a report cover	Legible writing, some ill-formed letters, print too small or too large; papers stapled together	Illegible writing; loose pages	Same as below standard
Timeliness	Report on time	Report one class period late	Report two class periods late	Report more than one week late	Did not include

Industrial Training / Internship

The students may undergo industrial training for a period as specified in the Curriculum during summer/winter vacation. In this case, the training has to be undergone for 7-14 days period.

The students may undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) for the period prescribed in the curriculum during summer / winter vacation, in lieu of Industrial training.

Mark Split UP

Internal	External	Total
25	25	50

Industrial Training / Internship for students is evaluated for 50 marks out of which 25 marks Are given by supervisor, HOD and 25 marks by external examiner.

Field / Industry / Institute visit

Every student is required to go for at least one Field / Industry / Institute visit every year of the Programme. The Heads of Departments shall ensure that necessary arrangements are made in this regard.

Mark Split UP

Internal	External	Total
25	25	50

Field / Industry / Institute visit for students is evaluated for 50 marks out of which 25 marks are given by HOD and 25 marks by external examiner.

Guidelines for Project

The final year students should undergo a project work during IV semester

- ❖ The period of study is for 2-3 Months.
- ❖ Work on the project must be done in the department laboratory (or) work on any industrial problem outside the organization is permitted.
- ❖ Students are divided into groups and each group is guided by a mentor.
- ❖ The group should not exceed four students, also interested student can undergo individually.
- ❖ A problem is chosen, objectives are framed, and data is collected, analyzed and documented in the form of a report / Project.
- ❖ Viva – Voce is conducted at the end of 4th semester, by an external examiner and concerned mentor (Internal Examiner).
- ❖ Project work constitutes 200 marks, out of which 100 is internal and 100 is external marks.

Mark Split UP

Internal	External	Total
100	100	200

S. No	Internal Components	Marks
1	Review - I	20
2	Review - II	20
3	Review - III	20
4	Rough Draft Submission	40
Total		100

Review I – 20 marks

- Title of dissertation relevant to the core subject - 05 marks
- Idea of the Dissertation- 05 marks
- The objective of the dissertation is very specific to the dissertation title -10 marks

Review II- 20 marks

- Feasibility of the Dissertation -05 marks
- Literature collection - 05 marks
- The complete methodology of the dissertation is relevant to the objective -10 marks

Review III- 20 marks

- Attainment of all objectives of the Dissertation -05marks
- Interpretation of results -10 marks
- The Outcome and Application of the Dissertation - 05 marks

S. No	External Components	Marks
1	Originality of Idea	10
2	Relevance to Current Trend	10
3	Candidate Involvement	10
4	Thesis Style / Language	10
5	Presentation of Report	20
6	Viva-Voce	40
Total		100

Program Educational Objectives (PEOs)	
The M. Sc. Botany program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO 1	Postgraduate students are prepared to apply new ideas in the field of biological science and to become an entrepreneur
PEO 2	Postgraduate students are trained to take up higher learning programmes in research
PEO 3	Postgraduate students are known about the organization of plants and their role in Human Welfare
PEO4	Postgraduate students are prepare for competitive examinations, especially UGC-CSIR NET, SET and TNPSC Examinations.
PEO5	Postgraduate students are perform their competency with professional ethics in their working place.

Programme Outcomes

On successful completion of the M. Sc. Botany program	
PO1	Apply the fundamental knowledge of science and technology for solving complex problems.
PO2	Ensure the use of advanced tools and techniques in understanding the scope and significance of Botany.
PO3	Develop the scientific problem solving skills during experimentation, research projects, analysis and interpretation of data.
PO4	Exploration of diverse plant life-forms, anatomical, Physiological and Biochemical disciplines and to conserve the biodiversity.
PO5	Enhanced capacity to think critically; ability to understand, design and execute experiments independently and/or team under multidisciplinary settings
PO6	Design and standardize protocols for public health and safety, and cultural, societal and environmental considerations.
PO7	Apply appropriate techniques, resources, and modern ICT tools for understanding plant resources.
PO8	Demonstrate the contextual knowledge in sustainable exploitation of medicinal, economically important and endangered plants as per the National Biodiversity Act.
PO9	Follow the concept of professional ethics and bioethics norms for practicing the value of plant kingdom
PO10	Communicate proficiently with various stakeholders and society, to comprehend and to write and present reports effectively

Programme Specific Outcomes

After the successful completion of M.Sc., Botany program the students are expected to	
PSO1	Post Graduates are acquire deep knowledge on botanical terms, facts, concepts, theories and principles of plant sciences and become a good academician and a successful researcher
PSO2	Post Graduates are become highly skilled in advanced techniques in biological science and become suitable for various careers.

OBE Rubric Mapping System

The attainment level of the students as Low, Medium, High is replaced by the numerals as 1,2 and 3

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code:21PBY309		Title : Core - 9 Taxonomy of Angiosperms	Batch	2022– 24
			Semester	III
Hrs/Week:	4		Credits	4

Course Objective

To learn the systems of nomenclature in plants and its economic value

Course Outcomes (CO)

CO1	Remember the basic principles of systematics, including identification, nomenclature, classification, and the inference of evolutionary patterns from data.	K1
CO2	Demonstrate understanding of evolutionary processes and patterns in the major plant groups	K2
CO3	Demonstrate the ability to handle and analyze plant materials in the laboratory and herbarium and in the field.	K4
CO4	Demonstrate comprehension of basic concepts and the ability to use scientific terminology accurately through effective oral and written communication and the use of dichotomous keys in a regional floristic manual.	K3
CO5	Evaluate the medicinal and economic importance of plants.	K5

Unit	Content	Hrs
Unit I	History of classification – detailed study of Bentham & Hooker, Engler&Prantl and Hutchinson – merits and demerits of the systems – ICBN –typification, principles of priority, effective and valid publication, citation, and retention - APG I, II,III & IV systems of classification.	13
Unit II	Biosystematics – aim and scope –biosystematic categories – phenotypic plasticity – Herbarium technique, *major herbaria in India and World,floras, *monograph and revision. Modern trends in taxonomy: Anatomical, embryological, cytological, chemical characters and their use in taxonomy.	13
Unit III	Vegetative, floral characters and economic importance of the following families: Polypetalae: Magnoliaceae, Portulacaceae, Caryophyllaceae, Zygophyllaceae, Oxalidaceae, Tiliaceae, Aizoaceae, Lythraceae, Rhamnaceae, Sapindaceae and Combretaceae.	15
Unit IV	Gamopetalae: Oleaceae, Plumbaginaceae, Verbenaceae, Gentianaceae, Boraginaceae, Pedaliaceae and Bignoniaceae. Monochlamydeae: Moraceae, Loranthaceae, Nyctaginaceae and Chenopodiaceae. Monocots: Commelinaceae, Liliaceae, Orchidaceae, Poaceae and Cyperaceae.	16

Unit V	Molecular taxonomy and its applications – DNA Fingerprinting and barcoding in plants – numerical taxonomy. Computer aided taxonomy – taxonomy softwares– DELTA, GRIN, IPNI. Biodiversity portal. GIS in taxonomy- software's and mobile apps for plant identification	15
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**Self study topics*

Power point Presentations, Group discussions, Seminar ,Quiz, Assignment, Case study

Text Books: 1. Gamble J.S. 2012. Flora of the Presidency of MadraVolI ,II, III, Revized edition, Pragun Publications. 2. Pandey B.P. 2001. Taxonomy of Angiospersm, S.Chand (G/L) & Company Ltd; New edition. 3. Singh V and Jain K. 2009. Taxonomy of Angiosperms, Rastogi Publication 4. Jones B., 1987. Plant Systematics, McGraw-Hill, 1987 5. N.S. Subrahmanyam, 1997. Modern Plant Taxonomy, Vikas Publication House Pvt Ltd; First edition (1 January 1997). 6. Lawerance. H.M., 1962.Taxonomy of vascular plants.The Mac Millan& Co. publishers. 7. Pandey, S. N. and S. P. Misra, 2009. Taxonomy of Angiosperms.Ane Books Pvt. Ltd, New Delhi.
Reference Books: 1. Devis& Hey wood, 1963. Principles of angiosperm Taxonomy. Published by Oliver & Boyd, Edinburgh ; London. 2. Jain and R.R. Rao. 1926. A hand book of field and Herbarium methods, Today and Tomorrow Publications. New Delhi. 3. An update of the Angiosperm Phylogeny Group Classification for the Orders and Families of Flowering Plants: APG III. Botanical Journal of the Linnean Society, Volume 181, Issue 1, 1 May 2016, Pages 1–20.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.] 1. https://www.biologydiscussion.com/essay/angiosperms-essay/taxonomy-of-angiosperms-aims-and-principles-essay-botany/76587 2. https://www.youtube.com/watch?v=67RKWdWTnPA 3. https://www.easybiologyclass.com/angiosperm-systematics-and-taxonomy-free-online-study-materials-and-lecture-notes/ 4. https://www.slideshare.net/avishekbhattacharjee7/flora-revision-and-monograph

PO/PSO												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	H	H	H	H	M	H	M	H	H	H	H	M
CO2	H	H	H	M	M	M	H	L	M	L	M	M
CO3	H	H	M	H	L	H	M	H	H	L	M	H
CO4	H	M	H	H	M	H	M	L	M	H	M	H
CO5	H	H	M	H	L	H	L	H	H	H	M	M

H-High
 M- Medium
 L -Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 21PBY310		Title: Core - 10 Plant Biochemistry and Biophysics	Batch	2022– 24
			Semester	III
Hrs/Week:	4		Credits	4

Course Objective

To understand the biomolecular basis of life

Course Outcomes (CO)

CO1	Remember the fundamentals of biochemistry	K1
CO2	Get an idea on Biochemical pathways and its significance	K2
CO3	Learn the structure and functions of carbohydrates, Lipids, Proteins	K3
CO4	Analyze and apply the biomolecular techniques	K4
CO5	Execute the biophysical laws	K4

Unit	Content	Hrs
Unit I	Basic principles: Structure of atoms, molecules and chemical bonds- ionic bond - covalent bond - Vander Vaal's forces- hydrogen bonding and hydrophobic interactions - pH - pH scale - Henderson-Hasselbalch equation - buffers - definition- <i>*biological role of buffer system.</i>	13
Unit II	Carbohydrates: Introduction - metabolism - gluconeogenesis, glycogenolysis and glycogenesis - classification and properties of amino acids - biosynthesis and degradation of amino acids- structure, classification and properties of Protein - structure-lipids: classification, structure and properties - biosynthesis and oxidation of fatty acids - plant waxes, cholesterol and lecithin.	14
Unit III	Secondary metabolites: classification, functions and biosynthesis of alkaloids, phenols, terpenoids and flavonoids - plant pigments - structure, classification and functions of chlorophyll, anthocyanins, carotenoids and antho-xanthins	15
Unit IV	Enzymes: Nomenclature, classification and properties - mechanism of enzyme action (Lock and key & induced fit model) and factors affecting enzyme activity (substrate, pH and temperature) - Michaelis - Menton kinetics - enzyme inhibition and its types - enzyme utilization in industry - enzymes - <i>*enzymes applications in medicine.</i>	16
Unit V	Biophysics: Energy flow - laws of thermodynamics - concept of free energy - energy transfer and redox potential - radio labeling techniques - properties of different types of radioisotopes normally used in biology,	14

	their detection and measurement - incorporation of radioisotopes in biological tissues and cells - molecular imaging of radioactive material safety guidelines	
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**Self study topics*

Power point Presentations, Seminar and Assignment

Text Books:

1. Satyanarayana, U. 2005. Biochemistry. Books and Allied (P) Ltd. Calcutta.
2. Satyanarayana, U. and chakrapani, U. 2005 Biochemistry, Books and Allied (P) Ltd. Calcutta.
3. Casey, E.J. 1962. Biophysics: Concepts and Mechanics. Van Nostrand Reinhold Co. and East-West Press, New Delhi.
4. Lehninger, A.I. 1987. Biochemistry, Kalyani Publishers, New Delhi
5. Veerakumari, I. 2004. Biochemistry, MJP Publishers, Chennai.
6. Meyyan R.P. Prasannakumar S *et al.*, 1994. Elements of Biochemistry, Saras Publications, ARP Camp Road, Kottar, Nagercoil, KanyakumariDt,

Reference Books:

1. Campbell, M.K. 1999. Biochemistry, Saunders College Publishing, New York.
2. Harborne, J.B. 1999. Plant Biochemistry. Chapman & Hall, New Delhi. Jain, J.L. 2005. Fundamentals of Biochemistry. S. Chand & Co. New Delhi.
3. Plummer, D.T. 1996. An introduction to practical biochemistry. McGraw Hill.
4. Conn E.E. and P.K. Stumpf. 1987. Outlines of Biochemistry, Wiley Eastern Ltd, Chennai.
5. LubertStryer. 1986. Biochemistry, CBS Publishers, New Delhi.
6. Salil Bose, S. 1982. Elementary Biophysics. Vijaya Printers, Madurai.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

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/Plant-Biochemistry-Lecture-Notes-Study-Materials-and-Important-questions-answers>

PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	H	H	M	M	H	M	H	H	M	M	H	H
CO2	H	H	M	M	H	M	H	H	M	M	H	H
CO3	M	H	M	L	H	M	H	M	H	M	M	H
CO4	H	H	H	L	H	M	M	M	H	M	H	H
CO5	H	H	H	L	H	M	M	M	L	M	H	H

H-High M- Medium L -Low

Programme code	M.Sc.	Programme Title: Master of Science in Botany		
Course Code: 21PBY311		Title: Core - 11 Plant Biotechnology and Nanobiology	Batch	2022– 24
			Semester	III
Hrs/Week:	4		Credits	4

Course Objective

To acquire knowledge on molecular basis of life and applications of plant biotechnology

Course Outcomes (CO)

CO1	Students will keep in mind the knowledge on techniques in plant tissue culture	K1
CO2	Understand the fundamentals of DNA Replication and central dogma of life	K2
CO3	Execute knowledge on molecular achievements in environmental stress management in plants	K3
CO4	Apply the basic concepts of Nanotechnology to synthesis the nanoparticles from plants	K4
CO5	Analyze the important of nanoparticles in Environment	K4

Unit	Content	Hrs
Unit I	Essential Plant biology concepts for plant biotechnology: Genome organization- mitochondrial genome organization- chloroplast genome organization- nuclear genome organization.-protein targeting- protein targeting to nuclear, mitochondria and chloroplast –molecular markers in plants.	14
Unit II	DNA Replication (Eukaryotic and prokaryotic) – semi conservative mode of DNA replication –protein synthesis – PCR – DNA sequencing methods (Sanger and Maxam and Gilbert)	14
Unit III	Plant Tissue Culture: History, Laboratory organization, sterilization methods – media preparation –micropropagation– meristem culture – callus culture – suspension culture- organogenesis – somatic embryogenesis – artificial seed preparation- cryopreservation. Haploid production – protoplast isolation and culture- somatic hybridization –cybrids–somoclonal variation.	14
Unit IV	Development of plant transformation cassettes – Structure and function of Ti plasmid of <i>Agrobacterium</i> – mechanism of T-DNA transfer to plants – Ti plasmid vectors for plant transformation – promoter and marker genes in plant transformation - <i>*physical , chemical and biological method for plant gene transfer</i> – transgenic plants for viral resistance – herbicide tolerance – delay of fruit ripening – resistance to insects, pests and pathogens - ethics in plant biotechnology – IPR	15
Unit V	Types of nanomaterials: nano rods, nanowires, nanoparticles, nanocapsules, nano membranes, nanomesh, nanofibres, nano catalysts, and carbon nano tubes -	

	silver nano-particle synthesis – methods of preparation of nanomaterial: top down and bottom up approaches- emulsifiers, homogenizers, MOCVD etc. Environmental applications: Nano clays, nano adsorbents, zeolites, release of nutrients and pesticides, biosensors – green technologies - <i>*treatment of industrial waste waters using nano-particles.</i>	15
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**Self study topics*

Power point Presentations, Seminar and Assignment

Text Books:

1. Slater A. Scott N. and Fowler M., 2008. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University Press Inc.
2. Lodish, H. 2008. Molecular Cell Biology. 6th ed. W. H. Freeman and Company, New York, USA.
3. Satyanarayanan U., 2007. Biotechnology. Books and Allied (P) Ltd., Kolkata.

Reference Books:

1. Mahesh S. 2008. Plant Molecular Biotechnology. New Age International Publishers.
2. Ramavat K.G. 2006 Plant Biotechnology S. Chand and Co. Ltd., New Delhi
3. Trivedi P.C. 2000. Plant Biotechnology – Recent Advances. Panima Publication Corporation, New Delhi
4. Lea, P.J, Leegood, R.C. 1993. Plant Biochemistry and Molecular Biology. Eds. John Wiley and Sons, Chichester and New York.
5. Ignacimuthu, S. 1998. Plant Biotechnology. Oxford and IBH publishers.
6. Reynolds P.H.S 1999. Inducible Gene Expression in Plants. CABI Publishing, U.K.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://www.youtube.com/watch?v=1LAKKvhVLms&list=PLKlDmFiIyAIE_WaNGQU0wAnectCOMvR1
2. <https://www.youtube.com/watch?v=G5Wo8dCivWs>
3. <https://www.youtube.com/watch?v=I4uaBXwaXXw>
4. <https://www.youtube.com/watch?v=47pkFey3CZ0>
5. <https://www.youtube.com/watch?v=XKboZQMCrB0>
6. <https://www.youtube.com/watch?v=BExZrIqlvWU>
7. <https://ocw.mit.edu/courses/biology/7-014-introductory-biology-spring-2005/>

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	H	H	H	H	H	L	M	H	H	H	H	H
CO2	H	H	H	H	H	L	H	H	H	H	H	H
CO3	H	H	H	L	H	M	M	L	L	H	H	H
CO4	H	H	H	L	H	H	H	L	M	H	H	H
CO5	H	H	H	L	H	H	H	L	M	H	H	H

H-High M- Medium L -Low

Programme code	M.Sc.	Programme Title: Master of Science in Botany		
Course Code:21PBY312		Title : Core – 12 Laboratory course - IV (Taxonomy of Angiosperms, Plant Biochemistry and Biophysics and Plant Biotechnology and Nanobiology)	Batch	2022– 24
			Semester	III
Hrs/Week:	6		Credits	4

Course Objective

To get a hands on experience biomolecular and plant tissue culture techniques

Course Outcomes (CO)

CO1	Identify salient features of families	K3
CO2	Understand about different floral characteristics and artificial key preparation which employed for plant identification and conservation	K4, K5
CO3	Apply the various techniques to produce disease free plants	K3
CO4	Analyze the conditions that are suitable for direct and indirect plant regeneration	K4
CO5	Analyze the plants for its biochemical components	K4

Unit	Content	Hrs
Unit I	Taxonomy of Angiosperms 1. Terminologies related to taxonomy. 2. Identification of taxonomic features from plant parts 3. Desection of flower parts 4. Identification and description of families belongs to Polypetalae (Magnoliaceae, Portulacaceae, Caryophyllaceae, Zygophyllaceae, Oxalidaceae, Tiliaceae, Aizoaceae, Lythraceae, Rhamnaceae, Sapindaceae and Combretaceae) 5. Identification and description of families belongs to Gamopetalae (Oleaceae, Plumbaginaceae, Verbenaceae, Gentianaceae, Boraginaceae, Pedaliaceae and Bignoniaceae). 6. Identification and description of families belongs to Monochlamydeae (Moraceae, Loranthaceae, Nyctaginaceae and Chenopodiaceae) 7. Identification and description of families for Monocots (Commelinaceae, Liliaceae, Orchidaceae, Aroideae, Cyperaceae and Poaceae)	24

Unit II	1. Preparation of artificial keys at family, generic and species level by locating key characters. 2. Field identification of plants 3. Economic importance of all the families given in the theory 4. Herbarium techniques 5. Preparation of herbarium sheets — 50 minimum. 6. Botanical tour to any vegetation rich places. 7. Identification of plants using software's and mobile apps.	2
Unit III	Plant Biochemistry: 1. Estimation of Carbohydrates (Anthrone method) 2. Estimation of Proteins (Lowry & Bradford). 3. Quantification of total free amino acids. 4. Estimation of free fatty acids. 5. Estimation of total phenolics (Folin-Ciocalteu reagent method). 6. Estimation of flavonoids by colorimetric method 7. Plant extraction by soxhelt apparatus. 8. Phytochemical screening of plant extrac 9. Separation of proteins by Sodium Dodecyl Sulfate Polyacrylamide Gelelectrophoresis (SDS-PAGE). 10. Determination of enzyme activities — catalase, ascorbic acid oxidase and polyphenoloxidase.	36
Unit IV	Biology and Plant Biotechnology 1. DNA Replication, protein targeting, structure of m - RNA charts 2. Isolation of plasmid DNA from bacteria 3. Isolation of genomic DNA from plants 4. Estimation of RNA by orcinol method 5. Amplification of a plant gene using PCR 6. Synthesis of silver nano particles from plant extracts	12
Unit V	7. Preparation of MS Medium 8. Shoot tip culture for plant regeneration 9. Induction of Callus from leaf 10. Production of shoot and root from callus 11. Production of somatic embryo from leaf 12. Anther culture for haploid plant production 13. Preparation of synthetic seeds 14. Hardening for <i>in-vitro</i> produced plantlet	24

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	H	M	H	L	H	L	M	L	H	H	M	H
CO2	H	H	H	H	H	H	M	M	L	H	M	H
CO3	H	H	H	H	M	H	M	M	H	L	H	H
CO4	H	H	H	M	H	H	H	H	M	H	H	H
CO5	H	M	H	H	H	M	H	H	H	H	H	H

H-High M- Medium L –Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 21PBY3E7		Title: Elective -3 Forestry and Wood science	Batch	2022– 24
			Semester	III
Hrs/Week:	4		Credits	4

Course Objective

To understand the components and role of forest ecosystem

Course outcomes (CO)

CO1	Recollect the importance of forests and wood science on every aspects	K1
CO2	Understand the unique features of forests types and to impart conservation strategy	K2
CO3	Apply the forest units in the manufacturing of value added products	K3
CO4	Review the laws for the protection of forest and its resources	K4
CO5	Understand the physical, chemical and mechanical properties of commercial wood	K4

Unit	Content	Hrs
Unit I	General introduction to forests – natural and manmade; tropical, temperate, evergreen, semi evergreen, deciduous; Monoculture, multipurpose, social and industrial – forest and gene conservation; <i>*forest types in south India with special emphasis to TamilNadu</i> . IUCN red listed categories.	14
Unit II	Silviculture– regeneration of forests – clear felling, uniform shelter wood selection, coppice and conservation systems –silviculture of some of the economically important species <i>Azadirachta indica</i> , <i>Tectona grandis</i> , <i>Eucalyptus</i> , Mahogany (<i>Swietenia mahagoni</i>), <i>Dalbergia sissoo</i> , <i>Santalum album</i> , <i>Madhuca longifolia</i> , Rubber (<i>Hevea brasiliensis</i>), Sal (<i>Shorea robusta</i>), Iron wood (<i>Mesua ferrea</i>) and Padauk (<i>Pterocarpus</i> sp.). Barks – Nature and types.	15
Unit III	Social and agro forestry: Selection of species and role of multipurpose trees. Food, fodder and energy – avenue plantation – sacred groves – definition, status and importance –Forest laws- necessity, General principles, Indian forest act 1927 and their amendment—biological diversity act (2002 in force) - World Conservation Strategy (WCS) and National Biodiversity Strategy and Action Plan (NBSAP).	13
Unit IV	Ethnobotany– definition – sub divisions – methodology – major tribes in Southern India – regional studies –ethnobotany in human welfare – food – medicine – importance of ethnobotany in Indian context – role of tribes in medicinal plants conservation – <i>role of NMPB, AYUSH in medicinal plant conservation* - Medicinal Plant Conservation</i> Area (MPCA) sites.	14

Unit V	Nature and properties of wood: physical, chemical, mechanical and anatomy of wood. Durability of wood- wood seasoning and preservation; Defects and abnormalities of wood; types of commercial wood species of India. Wood deterioration- fungi, insects and other agents; Wood protection Practical methods for preserving and protection, Chemical processing of wood- Composite wood: adhesives-manufacture, properties and uses- manufacture and uses of plywood, fiber boards and particle boards. Present status of composite wood, paper and rayon industries. Present position of supply of raw materials to industries and wood substitution.	16
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**Self study topics*

Power point Presentations, Group discussions, Seminar, Quiz and Assignment.

Text Books

1. Dhiman, A.K. 2003. Sacred plants and their medicinal uses. Daya publishing house, New Delhi.
2. Kocchar S.L. 2009. Economic botany in the tropics, Macmillan publishers, Chennai
3. Jain S.K. Mudgal V. 1999. A Handbook of Ethnobotany. BSMPS, Dehradun.
4. Avery, T.E. 1967. Forest Measurements. Mc Grand Hill Book Company, Newyork.
5. Ramprakash, 1986. Forest management. IBD Publishers, Debra Dun.
6. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agroforestry. Oxford and IBH publisher, New Delhi
7. Rao, K.R. and Juneja, J.D. 1971. A handbook for field identification of fifty important timbers of India. The Manager of Publications, Govt. of India, New Delhi.
8. WWF. 2007. Timber identification manual. TRAFFIC, New Delhi.
9. Singhi G.B. 1987. Forest Ecology of India, Publisher: Rawat.

Reference Book

1. Jain S.K., Philipps R.D. 1991. Medicinal Plants of India. Ref. Publ. Algonac, U.S.A. Vol. 2 1-849.
2. Saklani A., Jain S.K.1994. Cross Cultural Ethnobotany of Northeast India. Deep Publ. Delhi 1-453
3. Sagreiya, K.P. Forests and Forestry, 1997. National Book Trust India.
4. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, Delhi. 298 p.
5. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.
6. Gupta, T. and Guleria, A. 1982. Non-wood forest products in India: Economic potential. Oxford and IBH Publication, New Delhi. 147 p.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://agritech.tnau.ac.in/forestry/forest_index.html
2. https://agritech.tnau.ac.in/forestry/timber_trees_index.html
3. <https://www.slideshare.net/VivekSrivastava22/introduction-to-forestry>
4. https://www.brainkart.com/article/Vegetation-types-of-India-and-Tamil-Nadu_38271/
5. <https://www.pmfias.com/forests-natural-vegetation-of-india-classification-of-natural-vegetation-of-india/>

PO/PSO												
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	M	H	M	M	H	H	L	H	M	L	H	M
CO2	H	H	M	M	H	H	M	L	L	H	M	H
CO3	M	H	M	H	M	H	M	H	H	H	H	H
CO4	M	M	H	M	H	L	L	L	M	M	H	M
CO5	M	H	L	H	M	L	H	M	H	M	H	M

H-High M- Medium L -Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 21PBY3E8		Title: Elective – 3 Herbal Technology	Batch	2022– 24
			Semester	III
Hrs/Week:	4		Credits	4

Course Objective

To understand the components and role of forest ecosystem

Course outcomes (CO)

CO1	Recollect the importance of herbal technology and traditional system of medicine	K1
CO2	Understand various plant based drugs from ayurvedha, unani, homeopathy, siddha etc.	K2
CO3	Apply the knowledge to medicinal plant cultivation for sustainable supply	K3
CO4	Understand the various steps in manufacturing of plant based drugs.	K4
CO5	Know the ethanobotanical and pharmacological importance of medicinal plants	K4

Unit	Content	Hrs
Unit I	History, definitions and scope of herbals – traditional medicinal systems: ayurvedha, unani, homeopathy, siddha, naturopathy and yoga. Definition of drug – classification of natural drugs, (alphabetical, morphological, pharmacological, chemical and chemo taxonomical).	14
Unit II	Cultivation and collection of natural drugs – Detailed study of the following medicinal plants: <i>Plantago ovata</i> , <i>Hypericum perforatum</i> , <i>Digitalis purpurea</i> , <i>Terminalia chebula</i> , <i>Saraca indica</i> , <i>Olea europaea</i> , <i>Strychnos nux -vomica</i> , <i>Withania somnifera</i> and <i>Coleus forskohlii</i> -women entrepreneurship development – marketing cultivated medicinal plants – National Medicinal Plants Board of India.	16
Unit III	General methods of phytochemical and biological screening – Natural sources - Extraction - Purification and isolation of plant constituents - Alkaloids - glycosides - Volatile oils – Study of some herbal formulation techniques as drug cosmetics.	14
Unit IV	Ethnobotany – definition – traditional and folklore medicines – native medicine – major tribes of south india and their ethnobotanical and ethnobiological heritage – ethno medicines –ethnobotany and conservation of plants with special reference to india	14
Unit V	Mythology and conservation of ecosystems – conservation of selected plant species: sacred groves, forestry and unique ecosystems and their ethnobiological values, plants and animals in art, tradition and ethnography: ethnobotanical field methods.	14

**Self study topics*

Power point Presentations, Group discussions, Seminar, Quiz and Assignment.

Text Books:

1. John JothiPrakash, E. 2003. Medicinal Botany and Pharmacognosy. JPR Publication, Vallioor, Tirunelveli.
2. Kokate, C.K. Gokhale, S.B., and Purohit, A.P. 2003. Pharmacognosy. NiraliPrakashan, Pune.
3. Kumar, N.C. 1993. An Introduction to Medical Botany and Pharmacognosy.
4. Kumaresan, V. and Annie Regland, 2004. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany & Ethnobotany.
5. Prajapathi, Purohit, Sharma and Kumar, 2003. A Hand book of Medicinal plants. Agrobios Publications, Jodhpur.

Reference Books:

1. Anonymous, 2004. Cultivation of Selected Medicinal Plants. National Medicinal Plants Board, Govt. of India, New Delhi.
2. Bhattacharjee, S.K., 2004. Hand Book of Medicinal plants. Pointer Publishers, Jaipur.
3. Biswas, P.K. 2006. Encyclopedia of Medicinal plants (Vol. I-VII). Dominant Publishers, New Delhi.
4. Chaudhuri, A.B. 2007. Endangered Medicinal Plants. Daya Publishing House, New Delhi.
5. Chopra, R.N. 1980. Glossary of Indian Medicinal plants. CSIR, New Delhi.
6. Handa, S. S. and V. K. Kapoor, 1993. Pharmacognosy. VallabhPrakashan. New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://www.slideshare.net/SudheerKandibanda/traditional-system-of-medication-tsm>
2. <https://www.biologydiscussion.com/essay/essay-on-traditional-herbal-medicines/2059>
3. <https://www.biologydiscussion.com/medicinal-plants/medicinal-plants-and-treatment-of-disease/25149>
4. <https://www.biologydiscussion.com/botany/ethno-botany-definitions-development-and-importance/7158>

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	H	H	M	H	H	H	L	H	M	M	H	H
CO2	H	H	L -	M	H	M	L	H	H	M	H	M
CO3	M	M	M	H	H	M	L	H	H	L	H	M
CO4	H	M	H	H	M	H	L	H	M	M	H	H
CO5	H	M	H	H	M	M	H	M	H	M	H	M

H-High M- Medium L –Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 21PBY3E9		Title: Elective-3 Pharmacognosy	Batch	2022– 24
			Semester	III
Hrs/Week:	4		Credits	4

Course Objective

The programme objective is to prepare the students for a career in Pharmacognosy

Course outcomes (CO)

CO1	Recall the knowledge about modern concept and scope of Pharmacognosy.	K1
CO2	Identify their professional role in the healthcare system	K2
CO3	Design methods of standardization for herbal drug or formulations	K3
CO4	Analyze herbal extracts for the identification of phytoconstituents	K4
CO5	Demonstrate various pharmacognostic parameters of crude drugs	K4

Unit	Content	Hrs
Unit I	Pharmacognosy– definition and scope – drug adulteration, drug evaluation, organoleptic, microscopic, chemical, physical and biological evaluation – phytochemical investigations – standardization and quality control of herbal drugs.	14
Unit II	Types of Plant drug and their Pharmacognostic study - root drugs: <i>Glycyrrhiza</i> and <i>Ipecac</i> , <i>Raulwolfia</i> , <i>Satavari</i> , <i>Withania</i> - rhizome drugs: <i>Ginger</i> - leaf drugs - <i>Andrographis</i> , <i>Clitoria</i> , <i>Senna</i> - bark drugs: <i>Terminalia arjuna</i> , <i>Holorrhena</i> - flower drugs: Saffron - Seed drugs: <i>Piperlongum</i> , <i>Mucuna</i> - Fruit drugs: Cumin, Amla, Senna pods - Whole plant drugs: <i>Catheranthus roseus</i> .	15
Unit III	Medicinal Principles and powder analysis of Curcuma, cloves, senna, Fennel and cinnamon - large scale Industrial preparation of Crude Drugs - I import and export potentials of Crude Drugs	14
Unit IV	Nutraceuticals and cosmeceuticals - Ayurvedic pharmacy- principles, formulations of drugs-Natural pesticides- Pyrethrum, Neem, Derris, Tobacco – Immuno-modulatory medicinal plants.	14
Unit V	Perfumes and flavorings agents- peppermint oil, Lemon oil, Orange oil, Lemon grass oil and Sandal wood. Pharmaceutical aids- honey. Starch, Kaolin, Pectin, Olive oil, Lanolin, Bees wax, Sodium alginate, Agar, and Gelatin.	15

*Self study topics

Power point Presentations, Group discussions, Seminar, Quiz and Assignment.

Text Books:

1. John JothiPrakash, E. 2003. Medicinal Botany and Pharmacognosy. JPR

Publication, Vallioor, Tirunelveli.

2. Kokate, C.K. Gokhale, S.B., and Purohit, A.P. 2003. Pharmacognosy. Nirali Prakashan, Pune.
3. Kumar, N.C. 1993. An Introduction to Medical Botany and Pharmacognosy.
4. Prajapathi, Purohit, Sharma and Kumar, 2003. A Hand book of Medicinal plants. Agrobios Publications, Jodhpur.

Reference Books:

1. Horborne. J.B. 1983. Phyto chemical methods. Chapman and Hall. London.
2. Biren Shah and A.k. Seth 2010. Textbook of pharmacognosy and Phytochemistry. 8th Edn. Reed Elsevier India Pvt. Ltd.
3. Pharmacopoeia of India. Govt. of India. Ministry of health 1955 and 1966.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://www.biologydiscussion.com/botany/pharmacognosy/short-notes-on-pharmacognosy/42921>
2. <https://www.slideshare.net/SudheerKandibanda/introduction-to-pharmacognosy-and-scope-of-pharmacognosy>
3. <https://www.youtube.com/watch?v=bwC2vmLmLKQ>

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	H	M	H	H	M	M	M	L	M	M	M	H
CO2	H	M	H	H	H	M	M	L	M	M	M	H
CO3	H	H	H	L	M	M	M	M	M	M	M	H
CO4	H	M	H	L	M	M	M	M	M	M	M	H
CO5	H	M	M	L	M	M	M	M	M	M	M	H

H-High M- Medium L -Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code:	21PBY3N3	Title : Non Major Elective -3 Economic Botany	Batch	2022– 24
			Semester	III
Hrs/Week:	2		Credits	2

Course Objective

To enable the students to study the economic importance of vegetables, fruits, spices, condiments, fibres, timber and oil yielding plants

Course Outcomes (CO)

CO1	Understand the applied facet of botany	K1
CO2	Be familiar with the various commercial products of plant origin	K2
CO3	Understand the utility of different plant families	K3
CO4	Evaluate the medicinal and economic importance of plants.	K4
CO5	Understand and analyze about the economic importance of plants	K2 K4

Unit	Content	Hrs
Unit I	Cereals and legumes: Origin and History - Botanical description - Cultivation, Harvesting and uses of Cereals and Legumes: Wheat, Rice, Black gram, Red gram and Broad beans.	7
Unit II	Vegetables and fruits: Origin and History - Botanical description and economic importance of Vegetables and Fruits: Canavalia, <i>Dioscorea</i> , <i>Dragon fruit</i> and <i>Elaeagnus</i>	7
Unit III	Spices and condiments: Origin and History - Botanical description, Cultivation and uses of Spices and Condiments: Ginger, Pepper, Cardamom, Clove, Nut-Meg, Chilly, <i>Coriandrum</i> , Turmeric and All-spice.	7
Unit IV	Beverages plants, fibres and timber: Origin and History - Botanical description, Cultivation, Processing and uses of Beverages plants: Tea, Coffee and Cocoa. <i>Sugars and Starch:</i> Sugarcane and <i>Manihot</i> . Fibers and Timber: Cotton, Jute, Rosewood and Mahogany.	8
Unit V	Oil yielding plants: Origin and history - botanical description – harvesting - extraction and uses of fatty oils and vegetable fats: sun flower, soya bean, coconut and gingelly - medicinal plants: <i>Rauvolfia</i> , Basil and <i>Saraca</i>	7

*Self study topics

Power point Presentations, Group discussions, Seminar ,Quiz, Assignment, Case study

Text Books

1. Vardhana, R. 2009. Economic Botany (1st ed.), Sarup Book Publishers Pvt. Ltd., New Delhi.
2. Hill, A.F. 1952. Economic Botany; A Textbook of Useful Plants and Plant Products (2nd ed.), McGraw- Hill Book Co., Inc., New York.
3. Pandey, B.P. 1990. Economic Botany (4th ed.), S. Chand & Company Ltd, New Delhi.

Reference Books

1. Thompson, H.C. 1949. Vegetable Crops (4th ed.), McGraw- Hill Book Co., Inc., New York.
2. Wallis, T.E. 1946. Text book of Pharmacognosy. J. & A. Churchill Ltd, London.
3. Verma, V.A. 1980. Textbook of Economic Botany (3rd ed.), Emkay Publications, New Delhi.
4. Maheshwari, P. and Singh, U. 1965. Dictionary of Economic plants in India. I.C.A.R. New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://www.slideshare.net/AtiyyahB/economic-botany-111132336>
2. <https://www.slideshare.net/BhimsenKumar2/economic-botany>
3. <https://www.biologydiscussion.com/economic-botany/economic-botany-questions-and-answers/56568>
4. <https://www.biologydiscussion.com/medicinal-plants/medicinal-plants-found-in-india-economic-botany/56868>

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	H	M	M	L	M	L	M	L	H	M	M	M
CO2	M	L	H	L	L	L	M	L	M	M	L	L
CO3	H	M	M	H	M	L	M	L	M	M	M	M
CO4	H	H	M	H	L	H	L	H	H	H	H	M
CO5	H	H	H	H	L	H	L	H	M	H	H	M

H-High M- Medium L -Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 21PBY413		Title: Core — 13 Research Methodology	Batch	2022– 24
			Semester	IV
Hrs/Week:	4		Credits	4

Course Objective

To provide the knowledge on research and interpretation

Course Outcomes (CO)

CO1	Remember the basic knowledge on research	K1
CO2	Get the idea in the developing strong hypothesis and methodology for research	K2
CO3	Acquire knowledge on basic concepts in Biostatistics	K3
CO4	Evaluate scientific findings through various statistical tools	K4
CO5	Execute the basic research activities using biophysical instruments	K4

Unit	Content	Hrs
Unit I	Research Methodology: Research- introduction, objectives, types (fundamental, applied, qualitative and quantitative) and significance -selecting research problem -research design - needs and feature of a good design - Basic principles of experimental designs.	14
Unit II	Literature collection and citation: bibliography - bibliometrics (scientometrics): definition-laws - citations and bibliography - <i>*biblioscape-plagiarism</i> - project proposal writing - dissertation writing - <i>paper presentation (oral/poster)</i> - E-learning tools- monograph - introduction and writing- monograph for <i>Aloe vera</i> and <i>Ocimum sanctum</i> -Standard operating procedure (SOP) – introduction and preparation - Research Institutions - National and International.	14
Unit III	Bio statistics - definition - basic principles - variables - collection of data, sample, population and sampling techniques - primary and secondary data - tabulation and presentation of data - measures of central tendency - mean, mode, median and geometric mean - measures of dispersion - range, standard deviation and standard error -hypothesis testing - test of significance - test in large and small sample - t-test, f-test and chi square test - correlation and regression analysis.	16
Unit IV	Tools and applications of Excel and SPSS: measures of central tendency and dispersion -measures of significance - analysis of variance (ANOVA-single factor) - multivariate analysis - probability of distribution (binomial, poisson and normal) -cluster analysis.	14
Unit V	Basic principles and applications of pH meter, UV-visible spectrophotometer, centrifuge, lyophilizer, chromatography- TLC, Gas chromatography with mass	

	spectrum (GC/MS), and HPLC-Scanning electron microscopy-Agarose gel Electrophoresis - Polyacrylamide Gel Electrophoresis –Polymerase chain reaction	14
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**Self study topics*

Power point Presentations, Seminar, Assignment, group discussions and demonstrations

Text Books

1. Kothari, C.R. and GauravGarg, 2014. Research Methodology: Methods and Techniques (3rd revised edition). *New Age International publisher, New Delhi.*
2. Gurumani, N 2010, An introduction to Biostatistics, , MJB publisher
3. Veerabala Rastogi, 2009. Fundamentals of Biostatistics, Ane Books India
4. Mount, D. W. 2004. *Bioinformatics: Sequence and genome analysis. Cold Spring Harbour Laboratory Press.*

Reference Books

1. Jayaraman, J. 2011. Laboratory Manual of Biochemistry, New Age International Private Limited.
2. Sadasivam, S. and Manickam, A. 2008. Biochemical Methods. New Age International Publishers, New Delhi.
3. Prasad and Prasad, 2000. Micro technique, EMKAY Publications.
4. Harborne, 1998. Phytochemical methods, Springer Netherlands
5. M.H. Cordon and R. Macrae, 1987. Instrumental analysis in the Biological Science, Blackie and Son Limited, London.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. https://www.youtube.com/watch?v=w_Ujkt83i18
2. <https://www.youtube.com/watch?v=8iFzYVuCuM>
3. https://www.youtube.com/watch?v=XEMyDu_VoeQ
4. https://www.youtube.com/watch?v=1Q6_LRZwZrc
5. <https://www.youtube.com/watch?v=Bku1p481z80>

Journals:

1. Journal of Mixed Methods Research.
2. Journal of Research Methods and Methodological Issues.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	H	H	M	H	H	H	H	M	H	M	H	H
CO2	H	H	L	H	H	M	H	H	H	H	H	H
CO3	H	H	M	H	H	H	H	M	H	M	H	H
CO4	H	H	M	H	H	H	H	M	H	M	H	H
CO5	H	H	H	H	H	H	L	H	M	H	H	H

H-High M- Medium L –Low

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 21PBY414		Title : Core - 14 Bioinformatics and Cyber security	Batch	2022– 24
			Semester	IV
Hrs/Week:	4		Credits	4

Course Objective

To provide an *insilico* platform for biomolecular study.

Course Outcomes (CO)

CO1	Apprehend the ideas on molecular biology	K1
CO2	Apply various tools for genomic and proteomic studies	K2
CO3	Figure out the characteristics of biomolecules <i>insilico</i>	K3
CO4	Know the importance of Bioinformatics in Biology for the welfare of society	K4
CO5	Keep in mind the threats to cyber security and related social issues	K5

Unit	Content	Hrs
Unit I	Bioinformatics: Definition and Scope. Biological databases - Primary and secondary. Genomics: Definition - Gen Bank, DDBJ - Sequence and molecular file formats. Biological information portal: NCBI and EMB net. BLAST- An overview of BLAST tools available with NCBI - conserved domains - CpG islands.	14
Unit II	Gene prediction methods (Homology, <i>ab initio</i> , and comparative method). Pair wise and multiple sequence alignment, scoring matrices (PAM and BLOSUM). Molecular phylogeny (Cladistics and phenetic methods) CLUSTAL and PHYLIP.	14
Unit III	Proteomics: Definition, Levels of protein structure, Protein secondary structure prediction (SOPMA and JPRED). Molecular visualization tool - Rasmol and Swiss PDB Viewer. Protein modeling methods - Comparative and <i>De novo</i> methods. Model refinement and evaluation of model. Over view of SWISS PROT. Outline of computer aided drug designing. <i>*Systems biology - concept and applications.</i>	15
Unit IV	Cybersecurity: Overview of cyber security - confidentiality, integrity and availability - Threats - malicious software (viruses, Trojans, rootkits, worms, botnets) - memory exploits (buffer overflow, heap overflow. Integer overflow, format string) - cryptography - authentication - password system - windows security.	15
Unit V	Network security - network intrusion detection and prevention systems - firewalls - software security - vulnerability auditing, penetration testing, sandboxing, control flow integrity - web security - user authentication - legal and ethical issues - cyber crime, <i>*intellectual property rights, copyright, patent, trade secret, hacking and intrusion, privacy, identity threat.</i>	14

**Self study topics*(Study material for cyber security is available in college website in the form of e-book)

Power point Presentations, Group discussions, Seminar, Assignment and online demonstration.

Text Books

1. Arthur Conklin W.M., and Greg White, 2016. Principles of computer security. TMH., McGraw-Hill Education; 4 edition
2. Rastogi, S. C., N. Mendiratta, and P. Rastogi, 2008. Bioinformatics - Methods and applications, Genomics, Proteomics and Drug discovery, PHI Learningpvt Ltd., New Delhi.
3. Baxevanis and Quellette, 1998. Bioinformatics. A practical guide to analysis of genes and proteins.
4. Arthur M. Lesk, 2002. Introduction to Bioinformatics. Published by Oxford University Press.

Reference Books

1. Stuart M. Brown, 2000. Bioinformatics: A biologist's guide to biocomputing and the internet, Eaton publishers.
2. T. K. Attwood and Parry-Smith, 1999. Introduction to Bioinformatics, Pearson Education India Publishers.
3. S. Sundararajan and R. Balaji, 2002. Introduction to Bioinformatics. Himalaya Publishing House.
4. Chwan-Hwa (John) Wu, J. David Irwin, 2016. Computer networks and cyber security. CRC press.
5. Matt Bishop, 2018. Computer security art and science, second edn., Pearson/PHI. Publisher: Addison-Wesley Professional

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. <https://www.slideshare.net/biinoida/bioinformatics>
2. <https://www.slideshare.net/pubudu/genomics>
3. <https://www.youtube.com/watch?v=vnW9kH0agcE>
4. <https://www.youtube.com/watch?v=5teoROLvjg>
5. <https://www.slideshare.net/vidhyakalaivani29/protein-structure-visualization-toolsrasmol>

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	H	L	H	M	H	M	M	L	L	L	H	M
CO2	H	M	M	M	M	M	M	H	L	L	H	M
CO3	H	M	H	H	M	H	H	H	L	M	H	M
CO4	H	M	H	M	H	M	H	H	M	M	H	M
CO5	H	M	M	M	H	M	L	M	H	H	H	M

H-High M- Medium L -Low

Programme code	M.Sc.	Programme Title: Master of Science in Botany		
Course Code: 21PBY415		Title: Core – 15 Laboratory course- V (Research Methodology and Bioinformatics & Cyber security)	Batch	2022– 24
			Semester	IV
Hrs/Week:	6		Credits	4

Course Objective

To provide hands on experience on biomolecular *insilico* analysis and to enrich the research analysis and interpretation skills

Course Outcomes (CO)

CO1	Apply plan, design and execute the dissemination of scientific knowledge	K3
CO2	Evaluate knowledge on Chromatography, pH meter, SDS-PAGE and spectrophotometer	K4
CO3	Validate the experimental results using biological tools	K5

Unit	Content	Hrs
Unit I	Research Methodology 1. Research writing 1.1. How to write a research proposal? 1.2. How to write a research report? 1.3. Dissertation writing 2. Bibliometrics 3. Citation index & Citation 4. Bibliography and biblioscope 5. Collection, analysis and graphical representation of data 6. Measures of central tendency — mean, median and mode 7. Measures of dispersion: range, standard deviation, coefficient of variation correlation 8. Test of significance — Chi-square test and Student 't' test. Statistical calculations and chart preparation in MS-Excel and SPSS.	54
Unit II	Instrumentation 1. Separation of lipids by TLC 2. Separation of plant pigments by Column Chromatography. 3. Electrophoretic separation of Nucleic acid /protein 4. Measurement of pH from fruit juice. 5. Separation of sugar/Amino acid by paper chromatography 6. Verification of Beer-Lambert law using spectrophotometer	
Unit III	Bioinformatics & Cyber Security 1. Observation and analysis of biological databases 2. Data mining -sequence and structure retrieval 3. FASTA format 4. Pair wise alignment using BLAST 5. Multiple sequence alignment using CLUSTAL X	54

	6. Construction of phylogenetic tree using CLUSTAL W and PHYLIP 7. Gene finding using Gen Mark Hmm.	
Unit IV	1. Conserved domain search 2. Motifs search 3. CpG islands	
Unit V	4. Protein primary structure prediction using PROTPARAM 5. Protein secondary structure prediction using GOR 6. Protein translation using TRANSLATE 7. Protein structure visualization with Rasmol and Swiss PDB Viewer	

Power point presentations, group discussions, online demonstration and field visit

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO												
CO1	H	M	H	L	H	M	M	M	M	H	M	H
CO2	H	M	H	H	H	M	H	H	H	H	H	H
CO3	H	M	H	M	H	H	M	M	H	H	M	H

H-High M- Medium L -Low

HOD

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