

**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 2020-2022 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
					Internal	External	Total	
I	20PBY101	<b>Core – 1</b> Plant Diversity I (Phycology, Mycology, Lichenology and Bryology)	6	3	30	70	100	4
	20PBY102	<b>Core – 2</b> Plant Diversity II (Pteridophytes, Gymnosperms and Palaeobotany)	6	3	30	70	100	4
	20PBY103	<b>Core - 3</b> Applied Microbiology and Plant Pathology	6	3	30	70	100	5
	20PBY104	<b>Core - 4 Laboratory course-I</b> (for core papers 1, 2, 3)	6	4	40	60	100	4
	20PBY1E1/ 20PBY1E2	<b>Elective -1</b> Ecology and Phytogeography/ <b>Elective -2</b> Economic Botany	6	3	30	70	100	4
II	20PBY205	<b>Core - 5</b> Plant Anatomy and Reproductive Biology	6	3	30	70	100	4
	20PBY206	<b>Core - 6</b> Plant physiology	6	3	30	70	100	4
	20PBY207	<b>Core – 7</b> Cytology, Genetics and Plant Breeding	6	3	30	70	100	5
	20PBY208	<b>Core - 8 Laboratory course-II</b> (for core papers 5,6,7)	6	4	40	60	100	4
	20PBY2E3/ 20PBY2E4	<b>Elective-3</b> Horticulture and Landscaping / <b>Elective-4</b> IPR and Bioethics	5	3	30	70	100	4
	20PBY2N1	<b>Non- Major Elective</b> Entrepreneurship Botany	1	3	-	100	100	2
III	20PBY309	<b>Core - 9</b> Taxonomy of Angiosperms	6	3	30	70	100	4
	20PBY310	<b>Core -10</b> Plant Biochemistry and Biophysics	6	3	30	70	100	5
	20PBY311	<b>Core -11</b> Research Methodology	6	3	30	70	100	4
	20PBY3E5/ 20PBY3E6	<b>Elective -5</b> Forestry and Wood science / <b>Elective -6</b> Herbal Technology	6	3	30	70	100	4
	20PBY312	<b>Core – 12Laboratory course - III</b> (for core paper 9)	3	4	40	60	100	4
	20PBY313	<b>Core – 13Laboratory course –IV</b> (for core papers 10 and 11)	3	4	40	60	100	4
	20 PBY314	Internship	-	-	-	-	40	2
	20PBY315	Extra Credit course:Plant ecology, tissue culture and Phytochemical techniques –(Advanced Learners)	-	2	-	-	-	(2)
IV	20PBY414	<b>Core - 14</b> Plant Biotechnology and Nanobiology	6	3	30	70	100	5
	20PBY415	<b>Core - 15</b> Bioinformatics and Cyber Security	6	3	30	70	100	4
	20PBY4CE	Online-Comprehensive examination	-	2	-	-	-	(2)
	20PBY416	<b>Core – 16Laboratory course -V</b> (for core papers 14 and 15)	6	4	40	60	100	4
	20PBY4P1	<b>Core - 17</b> Project Work and Viva -Voce	12	-	40	120	160	6
		<b>Total</b>					<b>2200</b>	<b>90 + (4)</b>

### List of elective papers offered

Semester	Course Code	Course Title
I	20PBY1E1/ 20PBY1E2	Elective -1 Ecology and phytogeography
		Elective -2 Economic Botany
II	20PBY2E3/ 20PBY2E4	Elective-3 Horticulture and Landscaping /
		Elective-4 IPR and Bioethics
III	20PBY3E5/ 20PBY3E6	Elective -5 Forestry and Wood science /
		Elective -6 Herbal Technology

### Bloom's Taxonomy Based Assessment Pattern

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

#### 1. Theory: 70 Marks

##### TEST- I & II and ESE:

Knowledge Level	Section	Marks	Description	Total
K1	A (Answer all)	10x1=10	1-5 MCQ   6-10 Define	70
K2	B (Either or pattern)	5x4=20	Short Answers	
K3 & K4	C (Answer 4 out of 6)	4x10=40	Descriptive/ Detailed	

#### 2. NME--Theory: 100 Marks

Knowledge Level	Section	Marks	Description	Total
K2 and K3	A ((Either or pattern))	5x5=25	Short Answers	100
K2, K3 & K4	B (Answer 5 out of 8)	5 x 15=75	Descriptive/ Detailed	

#### 3. Practical Examinations:

Knowledge Level	Section	Marks	Total
K3	Practicals & Record work	60 (External)	100
K4		40 (Internal)	
K5			

#### 4. Project & viva voice:

Knowledge Level	Section	Marks	Total
K3	Project & viva voice	120 (External)	160
K4		40 (Internal)	
K5			

### Components of Continuous Assessment

Components	Marks	Calculation	CIA Total
Test 1	70	$\frac{70+70 +20+20+20+10}{07}$	30
Test 2	70		
Assignment	20		
Seminar/Tutorial	20		
Knowledge Enhancement	20		
Information Acquisition	10		

## Programme Objectives

1. To bring out the scientific potentialities
2. To inculcate the teaching and technical skills in the subject
3. To learn about the organization of plants and their role in functioning of plant system
4. To understand the biological principles and their importance
5. To create awareness in research and development

## Programme Outcomes

- PO1** Postgraduate students are to be exposed to technical, analytical and creative skills.
- PO2** Postgraduate students are to be employed in the core industry and also to form a bridge for research and development
- PO3** Postgraduate students are prepared to apply new ideas in the field of biological science and to become an entrepreneur.
- PO4** Postgraduate students are trained to take up higher learning programmes.
- PO5** Postgraduate students are trained to acquire enough competent to be an environmentalist

## Programme Specific Outcomes

- PSO1 Graduates will acquire knowledge on botanical terms, facts, concepts and principles
- PSO2 Graduates will become a good academician/ researcher
- PSO3 Graduates will get Opportunity to lead as a successful entrepreneur
- PSO4 Graduates will get a Chance to be aware of advanced research in plant sciences
- PSO5 Graduates will hone their skills to practice modern agricultural techniques.

## 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	Name: Mr. K.Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY101</b>		<b>Title: Core - 1 Plant Diversity I (Phycology, Mycology, Lichenology and Bryology)</b>	<b>Batch</b>	<b>2020 -2022</b>
			<b>Semester</b>	<b>I</b>
<b>Hrs/Week:</b>	<b>6</b>		<b>Credits</b>	<b>4</b>

### Course Objective

To know the diversity and the chrematistic features of the non-flowering group of plants

### Course Outcomes (CO)

K1	CO1	Remembering the values of lower plant forms and its diversity
K2	CO2	Will get an idea on evolution of lower plants and its architectural specialization in cells
K3	CO3	Apply economic values of lower plants to manufacture value added products
K4	CO4	Review the developmental stages of lower group of plant diversity
K4	CO5	Understand and learn the classification and economic importance of lower plants

Unit	Content	Hrs
<b>Unit I</b>	<b>Phycology:</b> 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>	<b>15</b>
<b>Unit II</b>	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.	<b>14</b>
<b>Unit III</b>	<b>Mycology:</b> General Characteristics - classification of fungi (J. Alexopoulos and C.W. Mims 1979) - cell wall composition, mode of nutrition- range of structure, 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.	<b>14</b>
<b>Unit IV</b>	<b>Lichenology:</b> 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.	<b>15</b>

<b>Unit V</b>	<b>Bryology:</b> Classification (Watson, 1955), 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.	<b>15</b>
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*\*Self-study topics*

Power point presentations, Group discussions, Seminar, Quiz and Assignment.
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### Text Books

1. Sharma, O.P. 2011. Diversity of microbes & Cryptogams – Algae, Tata McGraw Hill Education Private Limited, New Delhi.
2. Pandey, B.P. 1979. College Botany Vol I., S. Chand Publishing, Ram Nagar, Qutab Road, New Delhi.
3. Alexopoulos, C.J. and Mims, C.W. 1979. Introductory Mycology. Wiley Eastern Ltd., New Delhi.
4. DharaniDharAwasthi, 2000. A Handbook of Lichens. Vedams eBooks (P) Ltd. New Delhi.
5. Singh, S.K. 2006. Text Book of Bryophyta, Campus Books, New Delhi.
6. Gangulee and Kar, 1970. College Botany Vol. II. New Central Book Agency, New Delhi.

### Reference Books

1. Kumar, H.D. 1988. Introductory Phycology. Affiliated East-West Press Ltd. New Delhi.
2. Sureshkumar, 2009. An Introduction to Algae. Campus Book International, New Delhi.
3. Webster, J. 1970. Introduction to Fungi. Cambridge University Press, UK.
4. Muthukumar, S. and Tarar, J.L. 2006. Lichen Flora of Central India, Eastern book Corporation, New Delhi.
5. Nash, T.H. 1996. Lichen Biology. Cambridge University Press, London.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	L	L
CO2	H	M	L	H	M
CO3	M	M	H	H	L
CO4	H	M	L	H	L
CO5	M	M	H	L	L

H-High M- Medium L -Low

Course Designed by Name and Signature	Verified by HOD Name and Signature	Checked by CDC	Approved by COE
Name: Dr. A. M. Anandakumar  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K.Srinivasan  Signature:	Name: Dr. R. Muthukumaran  Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY102</b>		<b>Title: Core – 2 Plant Diversity II (Pteridophytes, Gymnosperms and Palaeobotany)</b>	<b>Batch</b>	<b>2020-2022</b>
<b>Hrs/Week:</b>	<b>6</b>		<b>Semester</b>	<b>I</b>
			<b>Credits</b>	<b>4</b>

### Course Objective

To know the various dynamics and characteristic features of lower vascular plants

### Course Outcomes (CO)

K1	CO1	Remember the diverse forms of plants in the plant kingdom
K2	CO2	Will understand the vascular plants and fossils
K3	CO3	Study the classification, phylogeny and economic importance of Pteridophytes
K4	CO4	Study the classification, phylogeny and economic importance of Gymnosperms
K4	CO5	Review the evolutionary idea of fossil diversity

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	<b>Pteridophytes:</b> Introduction - classification of Pteridophytes (Sporne, 1970) - characteristic features and types of life cycles in Pteridophytes - comparative account of sporophytes, gametophytes and embryogeny in Psilotopsida, Lycopsida and Sphenopsida.	<b>13</b>
<b>Unit II</b>	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>	<b>13</b>
<b>Unit III</b>	<b>Gymnosperms:</b> 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.	<b>13</b>
<b>Unit IV</b>	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>	<b>13</b>
<b>Unit V</b>	<b>Palaeobotany:</b> 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.	<b>13</b>

*\*Self study topics*

Power point Presentations, Group discussions, Seminar, Quiz and Assignment.
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### Text Books

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

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	L	M	M
CO2	H	M	L	M	L
CO3	M	M	H	M	L
CO4	M	M	L	L	L
CO5	M	M	L	L	L

H-High M- Medium L -Low

Course Designed by Name and Signature	Verified by HOD Name and Signature	Checked by CDC	Approved by COE
Name: Ms. D. Sowmiya  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K.Srinivasan  Signature:	Name: Dr. R. Muthukumaran  Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY103</b>		<b>Title : Core – 3 Applied Microbiology and Plant Pathology</b>	<b>Batch</b>	<b>2020-2022</b>
<b>Hrs/Week:</b>	<b>6</b>		<b>Semester</b>	<b>I</b>
			<b>Credits</b>	<b>5</b>

### Course Objective

To introduce the various aspects of microbial techniques for agriculture, food and medicinal industry

### Course Outcomes (CO)

K1	CO1	Students will recollect the basics of microbiology
K2	CO2	One can understand the interaction of microorganism with the environment and food
K3	CO3	Apply the microbial culture in the manufacturing of value added products
K4	CO4	To understand the various types of defence mechanism
K4	CO5	Analyze the plant diseases commonly occurring in crops

Unit	Content	Hrs
<b>Unit I</b>	<b>Microbiology:</b> 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	<b>13</b>
<b>Unit II</b>	<b>Microbiological Media:</b> 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 - <i>*bacterial growth curve - nutritional types of microorganisms.</i>	<b>13</b>
<b>Unit III</b>	<b>Food Microbiology:</b> 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 - <i>* Food adulteration- identification of adulteration in foods-</i> concept of prebiotics and probiotics.	<b>13</b>
<b>Unit IV</b>	<b>Industrial Microbiology:</b> 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.	<b>13</b>
<b>Unit V</b>	<b>Pathology:</b> 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.	<b>13</b>

*\*Self study topics*

Power point presentations, Seminar and Assignment
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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, 9<sup>th</sup> edition, McGraw-Hill Companies.

**Reference Books:**

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

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	H	L
CO2	L	H	L	M	M
CO3	L	L	H	M	H
CO4	L	L	L	H	L
CO5	L	M	M	L	M

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. R. Rakkimuthu	Name: Dr. R. Rakkimuthu	Name: Mr. K.Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY104</b>	<b>6</b>	<b>Title : Core - 4 Laboratory course -I (Phycology, Mycology, Lichenology and Bryology, Pteridophytes, Gymnosperms and Palaeobotany Applied Microbiology and Plant Pathology)</b>	<b>Batch</b>	<b>2020 - 22</b>
<b>Hrs/Week:</b>			<b>Semester</b>	<b>I</b>
			<b>Credits</b>	<b>4</b>

### Course Objective

To understand the organization of plant forms and get hands on experience on microbial and algal culture techniques

### Course Outcomes (CO)

K3	CO1	Manufacturing of value added products from microbes and lower plants
K4	CO2	Understand the morphological and anatomical features of lower plants.
K5	CO3	Execute the culture techniques in laboratories

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	<b>Phycology, Mycology, Lichenology and Bryology</b> 1. Range of thallus structures in algae 2. Reproductive structures in algae 3. Collection of microalgae using phytoplankton net 4. Culturing of microalgae 5. Culturing of macro algae/seaweed (demo only) 6. Commercial products from macroalgae	<b>23</b>
<b>Unit II</b>	7. Vegetative and reproductive structures of <i>Phytophthora, Rhizopus, Penicillium Pleurotus</i> and <i>Cercospora</i> 8. Fungal spore count using Haemocytometer. 9. Slide culture technique 10. Lichen - <i>Usnea</i> sp. 11. Morphological and anatomical study of bryophytes with reference to the following genera: <i>Marchantia, Anthoceros, Sphagnam</i> and <i>Polytrichum</i> . 12. Field trip for lower plant collection and submission of reports.	<b>23</b>
<b>Unit III</b>	<b>Pteridophytes, Gymnosperms and Palaeobotany</b> Study of morphology, anatomy and reproductive structures of the following genera: 1. Pteridophytes: <i>Ophioglossum, Selaginella, Equisetum</i> and <i>Adiantum</i> 2. Gymnosperms: <i>Ephedra, Pinus, Araucaria</i> and <i>Gingko</i> . 3. Palaeobotany : Impression, Petrification, <i>Rhynia, Lepidodendron, Lepidocarpon, Williamsonia, Lagenostoma, Lyngiopteris</i> and Amber.	<b>24</b>
<b>Unit IV</b>	<b>Microbiology and Plant Pathology</b> 1. Preparation of Basic medium - solid agar and broth 2. Preparation of agar plates, agar slants and agar deep tubes.	

	3. Simple staining of bacteria. 4. Gram's staining of bacteria. 5. Isolation of Bacteria, Fungi from soil 6. Isolation of microorganisms from the infected plant tissues. 7. Subculture, pure culture and maintenance of culture. 8. Bacterial growth curve 9. Biochemical tests for bacteria	<b>24</b>
<b>Unit V</b>	10. Production of Alcohol - chart. 11. Effect of antibiotics on pathogenic microorganism by Kerby - Bayer method. 12. Testing the milk quality - Methylene Blue Reduction Test (MBRT) 13. Identification of adulteration in foods 14. Pathology Submission of herbarium of infected plant specimens (not less than five)	<b>23</b>

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

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	H	H	L	M	L
<b>CO2</b>	M	H	M	L	M
<b>CO3</b>	M	H	H	L	L

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. R. Rakkimuthu	Name: Dr. R. Rakkimuthu	Name: Mr. K.Srinivasan	Name: Dr. R. Muthukumar
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code:</b>	<b>20PBY1E1</b>	<b>Title : Elective -1 Ecology and Phytogeography</b>	<b>Batch</b>	<b>2020 - 22</b>
<b>Hrs/Week:</b>	<b>6</b>		<b>Semester</b>	<b>I</b>
			<b>Credits</b>	<b>4</b>

### Course Objective

To create awareness about the environmental problems and their consequences

### Course Outcomes (CO)

K1	CO1	Students will keep in mind the ecosystem concepts and functions
K2	CO2	Able to understand the importance of biodiversity
K3	CO3	They can execute the remedies of pollution in the environment
K4	CO4	Evaluate the geographical distribution of plants
K4	CO5	Learn the conservation strategies of biodiversity

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	History and Scope of Ecology. Concept of Ecosystem, its structure and function –types of ecosystem - Ecological factors; edaphic, climatic, topographic, biotic and abiotic factors- Energetics: productivity - energy flow and mineral cycling- carbon cycle; nitrogen cycle; phosphorous cycle.	<b>15</b>
<b>Unit II</b>	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, * <i>Biodiversity Hotspots (RET species)</i> .	<b>16</b>
<b>Unit III</b>	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.	<b>15</b>
<b>Unit IV</b>	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.	<b>15</b>
<b>Unit V</b>	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.	<b>17</b>

\*Self study topics

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

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	M	L
CO2	M	H	L	L	M
CO3	M	L	L	L	L
CO4	M	H	M	M	M
CO5	L	L	L	L	L

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. Muthukumaran
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code:</b>	<b>20PBY1E2</b>	<b>Title : Elective -2 Economic Botany</b>	<b>Batch</b>	<b>2020 – 22</b>
			<b>Semester</b>	<b>I</b>
<b>Hrs/Week:</b>	<b>6</b>		<b>Credits</b>	<b>4</b>

### 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)

K1	CO1	Understand the applied facet of botany
K2	CO2	Be familiar with the various commercial products of plant origin
K3	CO3	Understand the utility of different plant families
K4	CO4	To have a first- hand knowledge on economic Botany
K4	CO5	Acquire the knowledge on marketing of oil products

Unit	Content	Hrs
<b>Unit I</b>	<b>Cereals and legumes:</b> Origin and History - Botanical description - Cultivation, Harvesting and uses of Cereals and Legumes: Wheat, Rice, Maize, Sorghum, Barley, Black gram, Red gram, Chick pea, Pigeon pea and Broad beans.	<b>15</b>
<b>Unit II</b>	<b>Vegetables and fruits:</b> Origin and History - Botanical description and economic importance of Vegetables and Fruits: Banana, Grapes, Citrus, Mango, Jack fruit, Potato, Cassava, <i>Dioscorea</i> and Tomato.	<b>16</b>
<b>Unit III</b>	<b>Spices and condiments:</b> 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.	<b>15</b>
<b>Unit IV</b>	<b>Beverages plants, fibres and timber:</b> 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, Sun hemp, Teak, Rosewood, Ebony, Sal and Mahogany.	<b>15</b>
<b>Unit V</b>	<b>Oil yielding plants:</b> Origin and history - botanical description – harvesting - extraction and uses of fatty oils and vegetable fats: sun flower, soya bean, peanut, palm oil, coconut and gingelly - medicinal plants: <i>Rauvolfia</i> , <i>aconitum</i> , Jatamansi, Sathavari, Goggul, Basil, <i>Saraca</i> and Neem	<b>17</b>

\*Self study topics

Power point Presentations, Group discussions, Seminar ,Quiz, Assignment, Case study
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### Text Books

1. Vardhana, R. 2009. Economic Botany (1<sup>st</sup> ed.), Sarup Book Publishers Pvt. Ltd., New Delhi.
2. Hill, A.F. 1952. Economic Botany; A Textbook of Useful Plants and Plant Products (2<sup>nd</sup>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.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	L	L	M
CO2	M	M	M	M	L
CO3	M	L	M	M	M
CO4	L	M	M	M	L
CO5	L	H	M	H	M

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. Muthukumaran
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY205</b>		<b>Title: Core – 5</b> Plant Anatomy and Reproductive Biology	<b>Batch</b>	<b>2020 – 22</b>
			<b>Semester</b>	<b>II</b>
<b>Hrs/Week:</b>	<b>6</b>		<b>Credits</b>	<b>4</b>

### Course Objective

To acquire knowledge on the anatomical structure and reproductive phase of Angiosperms

### Course Outcomes (CO)

K1	CO1	Keep in mind the basic terminologies in anatomy of plants
K2	CO2	Understand the vascular system and cellular developmental
K3	CO3	Implement the techniques for <i>in vitro</i> culture by understanding the ontogeny
K4	CO4	Understand the polyembryony and its uses.
K4	CO5	Get aware of economically viable fruit crops and techniques

Unit	Content	Hrs
<b>Unit I</b>	<b>Anatomy:</b> 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>	<b>16</b>
<b>Unit II</b>	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 – Kranz anatomy - stomatal types – nodal anatomy – petiole anatomy – trichomes – glands – secretory tissues – nectaries – laticifers and their significance.	<b>16</b>
<b>Unit III</b>	<b>Reproductive Biology:</b> Microsporangium - microsporogenesis - microspores - arrangement - morphology - ultra structure - microgametogenesis - pollen - stigma - incompatibility - methods to overcome incompatibility - palynology .	<b>15</b>
<b>Unit IV</b>	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>	<b>15</b>
<b>Unit V</b>	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.	<b>16</b>

*\*Self study topics*

Power point Presentations, Group discussions, Seminars and Assignment.
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### Text Books

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.

### Reference Books

1. Pullaiah, T., Lakshiminarayana, 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.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	M	H
CO2	M	H	H	H	M
CO3	H	H	L	M	M
CO4	M	M	H	M	M
CO5	M	M	M	H	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. A.M Anandakumar	Name: Dr. R. Rakkimuthu	Name: Mr. K.Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY206</b>		<b>Title: Core – 6 Plant Physiology</b>	<b>Batch</b>	<b>2020 – 22</b>
			<b>Semester</b>	<b>II</b>
<b>Hrs/Week:</b>	<b>6</b>		<b>Credits</b>	<b>4</b>

### Course Objective

To understand the metabolic components involved in the functioning of plants.

### Course Outcomes (CO)

K1	CO1	Remember the basic metabolism in plants
K2	CO2	Deduce the biological pathways
K3	CO3	Execute the molecular based modification of metabolism in plants
K4	CO4	Understand the physiological processes and apply in agriculture.
K4	CO5	Understand the physiology of flowering

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	Plant- water relations: 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.	<b>16</b>
<b>Unit II</b>	Signal transduction: overview - receptors and G-proteins - jasmonic acid signaling - Cadmium and cellular signaling cascades. 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.	<b>16</b>
<b>Unit III</b>	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 and C4 cycle - crassulacean acid metabolism- photorespiration.	<b>15</b>
<b>Unit IV</b>	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 - nif gene - nitrate assimilation GDH and GS/GOGAT pathway - biosynthesis of nitrogen, Carbohydrate and amino acids- radical scavenging activity	<b>15</b>
<b>Unit V</b>	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 - <i>*Stress physiology: Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic stress tolerance.</i>	<b>16</b>

*\*Self study topics*

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

**Text Books**

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

**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.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	M	H
CO2	M	H	M	H	M
CO3	H	M	L	H	M
CO4	M	H	L	H	H
CO5	L	M	M	L	M

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: Ms. D. Sowmiya  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K.Srinivasan  Signature:	Name: Dr. R. Muthukumaran  Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title: Master of Science in Botany</b>		
<b>Course Code: 20PBY207</b>		<b>Title : Core – 7 Cytology, Genetics and Plant Breeding</b>	<b>Batch</b>	<b>2020 – 22</b>
<b>Hrs/Week: 6</b>			<b>Semester</b>	<b>II</b>
			<b>Credits</b>	<b>5</b>

### Course Objective

To acquire knowledge on genetic traits and breeding techniques in plants

### Course Outcomes (CO)

K1	CO1	Remember the principles of genetics
K2	CO2	Understand the role of genes in expression of characters
K3	CO3	Gain knowledge on chromosome structure and cell cycle
K4	CO4	Review the innovative techniques in plant breeding
K4	CO5	Learn the hybridization techniques

Unit	Content	Hrs
<b>Unit I</b>	<b>Cytology:</b> 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.	<b>15</b>
<b>Unit II</b>	<b>Genetics:</b> 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	<b>16</b>
<b>Unit III</b>	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)	<b>15</b>
<b>Unit IV</b>	<b>Plant Breeding:</b> 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>	<b>16</b>
<b>Unit V</b>	Intervarietal, interspecific and intergeneric hybridization - heterosis - hybrid vigour - marker assisted breeding - <i>*national and international organizations for crop improvement</i> - protection of plant varieties &farmers rights Act, India - Dus - Germplasm - The role of IBPGR and NBPGR - germplasm conservation (Rice and Sugarcane).	<b>16</b>

*\*Self study topics*

**Text Books:**

1. Gupta, P.K. 1994. Genetics, Rashtogi Publication, Meerut, India.
2. Singh, E.D. 1990. Plant Breeding. Kalyani Publishers, New Delhi.
3. Sinha, U. and Sunita Sinha 1998. Cytogenetics, Plant breeding and evolution. Vikas Publishing House Private, Limited.
4. Sambamurthy A.V.S.S, 2005. Genetics, Published by Narosa Publishing House.
5. Verma P.S. and Agarwal V.K. 1999. Concept of Genetics, Human Genetics and Eugenics, Published by S Chand & Company Pvt Ltd.
6. Sukhla R.M. 2012. Molecular Genetics, Published by Wisdom Press.

**Reference Books:**

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

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	M	L
CO2	M	L	L	H	L
CO3	H	M	M	M	H
CO4	H	M	H	H	H
CO5	L	H	M	M	M

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. R. Rakkimuthu	Name: Dr. R. Rakkimuthu	Name: Mr. K.Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title: Master of Science in Botany</b>		
<b>Course Code: 20PBY208</b>	<b>6</b>	<b>Title : Core – 8 Laboratory course – II (Plant Anatomy and Reproductive Biology, Plant Physiology, Cytology, Genetics and Plant Breeding)</b>	<b>Batch</b>	<b>2020 – 22</b>
<b>Hrs/Week:</b>			<b>Semester</b>	<b>II</b>
			<b>Credits</b>	<b>4</b>

### Course Objective

To experimentally study the anatomical, physiological and breeding techniques in plants

### Course Outcomes (CO)

K3	CO1	Applying the plant anatomical characters in techno based designing
K4	CO2	Estimate the physiological carbon transition forms in plants and carbon budgeting
K5	CO3	Validate the scientific hypothesis by using various experiments

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	<b>Anatomy</b> 1. Staining of various plant tissues 2. Primary structure of dicot and monocot stem ( <i>Tridax procumbens</i> , <i>Zea mays</i> ) 3. Normal secondary thickening of dicot stem 4. Anomalous secondary thickening Multiple and successive cambial rings – <i>Boerhaavia</i> Included or interxylary phloem – <i>Achyranthes</i> Intraxylary phloem/Ridged xylem – <i>Bignonia</i> Inverted cortical bundles – <i>Nyctanthes</i> 5. Secondary growth in monocot stem – <i>Dracaena</i>	<b>24</b>
<b>Unit II</b>	1. Study of stomatal types in plant leaves 2. T.S of dicot leaf – Dorsiventral & isobilateral ( <i>Nerium</i> ) 3. T. S. of monocot leaf – Bamboo 4. Maceration of plant tissues 5. Microtomy – Demo 6. Slide submission (Permanemt slide submission)	<b>23</b>
<b>Unit III</b>	<b>Reproductive Biology</b> 1. Study of pollen morphology 2. Study of pollen germination 3. Test for pollen viability 4. Types of ovules 5. Dissection of mature embryo sac 6. Observation of endosperm types 7. Dissection of embryos – dicot, monocot and polyembryony	<b>23</b>
<b>Unit IV</b>	<b>Plant Physiology</b> 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.	<b>24</b>
<b>Unit V</b>	<b>Cytology, Genetics And Plant Breeding</b> 1. Preparation of slide for Mitotic study from allium ceba root tips 2. Preparation of slide for meiotic study from flower bud 3. Problems in Mendelian and non – Mendelian inheritance 4. Problems in Mutation 5. Charts on plant breeding techniques	<b>24</b>

Ultrascope images, Group discussions, Sectioning, Experimental setups and Genetic problems

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	M	H	M	H	H
<b>CO2</b>	M	H	M	H	M
<b>CO3</b>	H	H	M	L	L

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. A. M. Anandakumar	Name: Dr. R. Rakkimuthu	Name: Mr. K.Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY2E3</b>		<b>Title : Elective – 3 Horticulture and Landscaping</b>	<b>Batch</b>	<b>2020 – 22</b>
			<b>Semester</b>	<b>II</b>
<b>Hrs/Week:</b>	<b>5</b>		<b>Credits</b>	<b>5</b>

### Course Objective

To understand the principles, aspects of horticulture

### Course Outcomes (CO)

K1	CO1	Remember the importance of horticultural crops
K2	CO2	Understand the propagation methods of commercially important crops
K3	CO3	Apply the horticultural techniques in self-employment
K4	CO4	Figure out the principles of various types of landscaping
K4	CO5	Acquire knowledge on floriculture

Unit	Content	Hrs
<b>Unit I</b>	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	<b>16</b>
<b>Unit II</b>	Organic matter; fertilizers - organic, inorganic and potting media; bioinoculants; methods of fertilizer application; irrigation types- sprinkler irrigation, trickle irrigation- surface, furrow, surge, pitcher. directing plant growth - pruning and thinning.	<b>15</b>
<b>Unit III</b>	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.	<b>15</b>
<b>Unit IV</b>	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 garden.	<b>16</b>
<b>Unit V</b>	Ethetics 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 - principles, xeriscaping. post-harvest handling of Horticultural products - harvesting; <i>*storage; processing</i> - 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.	<b>16</b>

*\*Self study topics*

Power point Presentations, Group discussions, Seminar, Quiz, Assignment, Field study
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**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.
4. Tolanus, S. 2006. Soil fertility, Fertilizer and Integrated Nutrient management. International Book Distributory Co.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	H	M
CO2	H	H	H	L	H
CO3	M	H	M	L	M
CO4	M	H	H	M	L
CO5	L	L	H	L	M

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. Muthukumaran
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY2E4</b>		<b>Title : Elective – 4 IPR and Bioethics</b>	<b>Batch</b>	<b>2020 – 22</b>
			<b>Semester</b>	<b>II</b>
<b>Hrs/Week:</b>	<b>5</b>		<b>Credits</b>	<b>4</b>

### Course Objective

To enable the students know the importance of Biosafety, Bioethics and IPR

### Course Outcomes (CO)

K1	CO1	Remember the basic knowledge of IPR
K2	CO2	Understand the types of applications of IPR
K3	CO3	Apply the knowledge on patenting of the product
K4	CO4	Gain an insight into the biosafety and farmers rights
K4	CO5	Acquire knowledge on Protection of Plant Varieties and Farmers' Rights Act

Unit	Content	Hrs
<b>Unit I</b>	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.	<b>16</b>
<b>Unit II</b>	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.	<b>15</b>
<b>Unit III</b>	Geographical Indications -Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position. Industrial Designs Objectives, Rights, Assignments, Infringements, Defences of Design Infringement	<b>15</b>
<b>Unit IV</b>	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.	<b>16</b>
<b>Unit V</b>	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.	<b>14</b>

*\*Self study topics*

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

1. Arthur Raphael Miller, Micheal Davis H., 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, 1<sup>st</sup> 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.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	L	L	L
CO2	L	M	M	L	L
CO3	L	H	H	M	M
CO4	L	L	M	L	M
CO5	L	L	M	L	L

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. Muthukumaran
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY2N1</b>		<b>Title : Non Major Elective - 1 Entrepreneurship Botany</b>	<b>Batch</b>	<b>2020 - 22</b>
			<b>Semester</b>	<b>II</b>
<b>Hrs/Week:</b>	<b>1</b>		<b>Credits</b>	<b>2</b>

### Course Objective

To impart mushroom cultivation, horticulture techniques and vermicompost making skills to promote entrepreneurship

### Course Outcomes (CO)

K1	CO1	Apply the mushroom cultivation technique in improving the economic status of society
K2	CO2	Acquiring knowledge on Horticulture techniques and land scaping for self employment
K3	CO3	Acquire knowledge on floriculture to become
K4	CO4	Acquire knowledge on fruit and vegetable preservation
K4	CO5	Acquire knowledge on production of vermin-compost

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	Introduction and scope of mushroom cultivation- Biology and cultivation of paddy straw and oyster mushroom- Nutritional value and uses –diseases- Postharvest technology- marketing, packing, storage and recipes	<b>3</b>
<b>Unit II</b>	History and importance of gardening - garden tools and implements- different types of gardens- Rockery, water garden, lawn formation and maintenance - Landscape layout gardening-nursery structure and maintenance.	<b>3</b>
<b>Unit III</b>	Vegetable carving and floral arrangement – importance of Green house – Bonsoi technique and topiary – floriculture- rose, chrysanthemum, Jasmine and cutflowers- cultivation and marketing bouquet making.	<b>2</b>
<b>Unit IV</b>	Food spoilage –causes – preservation of foods and vegetables-principles- different methods of preservatives – canning of fruits and vegetables – Mango, carrot, tomato and apple.- drying of fruits –Dates, Banana and Mango. Preparation of juices- Methods of canning, packing technology.	<b>2</b>
<b>Unit V</b>	Vermicomposting and organic farming -methods of organic farming – Vermicomposting- methods – preparation – Entrepreneurship –funding agencies for promoting green industries – Entrepreneurship development programme (EDP)- Need and importance.	<b>2</b>

*\*Self study topics*

Power point Presentations, Group discussions, Seminar, Quiz, Assignment and Field visit

**Text Books:**

1. Hand book of mushroom cultivation, 1999, TNAU publication.
2. Tripathi, D. P. 2005. Mushroom Cultivation. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Bansil. P.C. 2008. Horticulture in India. CBS Publishers and Distributors, New Delhi.
4. Steindraus, K.H. (ed.) 1983. Hand Book of Indigenous Fermented Food, Parcel Dekker Inc., New York.
5. Keshav Singh, 2014. Textbook of Vermicompost: Vermiwash and Biopesticides Astral International, New Delhi

**Reference Books:**

1. Alice, D., Muthusamy and Yesuraja, M. 1999. Mushroom Culture. Agricultural College, Research Institute Publications, Madurai.
2. Pathak, V. N. and Yadav, N. 1998. Mushroom Production and Processing Technology. Agrobios, Jodhpur.
3. Tewari Pankaj Kapoor, S. C. 1988. Mushroom Cultivation. Mittal Publication, New Delhi.
4. Bose, T.K., Maiti, R.G., Dhua, R.S. and Das, P. 1999. Floriculture and Landscaping. Naya Prokash, Calcutta
5. Prescott, Harley and Klein' S. 2008. Microbiology 7<sup>th</sup> edition, McGraw hill International Edition, New York.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	M
CO2	H	M	M	H	M
CO3	M	M	M	M	M
CO4	M	M	M	H	H
CO5	M	L	H	L	L

H-High M- Medium L -Low

Course Designed by Name and Signature	Verified by HOD Name and Signature	Checked by CDC	Approved by COE
Name: Dr. P. Sathishkumar  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K.Srinivasan  Signature:	Name: Dr. R. Muthukumaran  Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>			
<b>Course Code:20 PBY309</b>		<b>Title : Core - 9 Taxonomy of Angiosperms</b>	<b>Batch</b>	<b>2020– 22</b>	
<b>Hrs/Week:</b>			<b>5</b>	<b>Semester</b>	<b>III</b>
				<b>Credits</b>	<b>4</b>

### Course Objective

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

### Course Outcomes (CO)

K1	CO1	Remember the methods and principles of classification and plant nomenclature
K2	CO2	Understand the patterns in the evolution of seed plants
K3	CO3	Execute the distribution of seed plant diversity
K4	CO4	Evaluate the economic uses of plants
K4	CO5	Understand salient features of selected families

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	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.	<b>13</b>
<b>Unit II</b>	Biosystematics – aim and scope –biosystematic categories – phenotypic plasticity – Herbarium technique, <i>*major herbaria in India and World, floras, *monograph and revision</i> . Modern trends in taxonomy: Anatomical, embryological, cytological, chemical characters and their use in taxonomy.	<b>13</b>
<b>Unit III</b>	Vegetative, floral characters and economic importance of the following families: Polypetalae: Magnoliaceae, Portulacaceae, Caryophyllaceae, Zygophyllaceae, Oxalidaceae, Tiliaceae, Aizoaceae, Lythraceae, Rhamnaceae, Sapindaceae and Combretaceae.	<b>13</b>
<b>Unit IV</b>	Gamopetalae: Oleaceae, Plumbaginaceae, Verbenaceae, Gentianaceae, Boraginaceae, Pedaliaceae and Bignoniaceae. Monochlamydeae: Moraceae, Loranthaceae, Nyctaginaceae and Chenopodiaceae. Monocots: Commelinaceae, Liliaceae, Orchidaceae, Poaceae and Cyperaceae.	<b>13</b>
<b>Unit V</b>	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	<b>13</b>

*\*Self study topics*

Power point Presentations, Group discussions, Seminar ,Quiz, Assignment, Case study
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**Text Books:**

1. Gamble J.S. 2012. Flora of the Presidency of MadraVoll ,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.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	M	M
CO2	M	H	L	M	L
CO3	H	M	M	H	L
CO4	H	M	M	M	M
CO5	L	H	M	L	L

H-High M- Medium L -Low

Course Designed by Name and Signature	Verified by HOD Name and Signature	Checked by CDC	Approved by COE
Name: Dr. P. Sathishkumar  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K. Srinivasan  Signature:	Name: Dr. R. Muthukumaran  Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY310</b>		<b>Title: Core - 10 Plant Biochemistry and Biophysics</b>	<b>Batch</b>	<b>2020 - 22</b>
			<b>Semester</b>	<b>III</b>
<b>Hrs/Week:</b>	<b>5</b>		<b>Credits</b>	<b>5</b>

### Course Objective

To understand the biomolecular basis of life

### Course Outcomes (CO)

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

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	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>	<b>13</b>
<b>Unit II</b>	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.	<b>13</b>
<b>Unit III</b>	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	<b>13</b>
<b>Unit IV</b>	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>	<b>13</b>
<b>Unit V</b>	<b>Biophysics:</b> 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, their detection and measurement - incorporation of radioisotopes in biological tissues and cells - molecular imaging of radioactive material safety guidelines	<b>13</b>

*\*Self study topics*

**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, Kanyakumari Dt,

**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.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	L	M	M
CO2	H	L	M	H	H
CO3	M	H	L	M	M
CO4	H	M	M	H	M
CO5	L	L	L	M	L

H-High M- Medium L -Low

Course Designed by Name and Signature	Verified by HOD Name and Signature	Checked by CDC	Approved by COE
Name: Dr. R. Rakkimuthu  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K.Srinivasan  Signature:	Name: Dr. R. Muthukumar  Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY311</b>		<b>Title: Core — 11 Research Methodology</b>	<b>Batch</b>	<b>2020—22</b>
			<b>Semester</b>	<b>III</b>
<b>Hrs/Week:</b>	<b>5</b>		<b>Credits</b>	<b>4</b>

### Course Objective

To provide the knowledge on research and interpretation

### Course Outcomes (CO)

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

Unit	Content	Hrs
<b>Unit I</b>	<b>Research Methodology:</b> 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.	<b>13</b>
<b>Unit II</b>	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.	<b>13</b>
<b>Unit III</b>	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.	<b>13</b>
<b>Unit IV</b>	Tools and applications of Excell 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.	<b>13</b>
<b>Unit V</b>	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	<b>13</b>

	Electrophoresis –Polymerase chain reaction	
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*\*Self study topics*

Power point Presentations, Seminar, Assignment, group discussions and demonstrations
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**Text Books**

1. Mount, D. W. 2004. *Bioinformatics: Sequence and genome analysis. Cold Spring Harbour Laboratory Press.*
2. Kothari, C.R. and GauravGarg, 2014. *Research Methodology: Methods and Techniques (3<sup>rd</sup> revised edition). New Age International publisher, New Delhi.*
3. Gurumani, N 2010, *An introduction to Biostatistics, , MJB publisher*
4. Ramakrishnan,P. 2015, *Biostatistics Saras publication*
5. VeerabalaRastogi, 2009. *Fundamentals of Biostatistics, Ane Books India*

**Reference Books**

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

**Journals:**

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

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	M	H	L	M	L
<b>CO2</b>	M	H	M	H	M
<b>CO3</b>	M	M	L	M	L
<b>CO4</b>	M	M	M	M	L
<b>CO5</b>	M	L	M	L	M

H-High M- Medium L -Low

Course Designed by Name and Signature	Verified by HOD Name and Signature	Checked by CDC	Approved by COE
Name: Ms. D. Sowmiya  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K.Srinivasan  Signature:	Name: Dr. R. Muthukumar  Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY312</b>		<b>Title : Core — 12 Laboratory course — III (Taxonomy of Angiosperms)</b>	<b>Batch</b>	<b>2020 — 22</b>
<b>Hrs/Week:</b>			<b>4</b>	<b>Semester</b>
			<b>Credits</b>	<b>4</b>

### Course Objective

To acquire practical skills in plant identification

### Course Outcomes (CO)

K3	CO1	Identify salient features of families
K4	CO2	Understand the key characters for identification of plants
K5	CO3	Apply techniques to conserve importance of forests

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	<b>Taxonomy of Angiosperms</b> 1. Terminologies related to taxonomy. 2. Identification of taxonomic features from plant parts 3. Dissection 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).	12
<b>Unit II</b>	1. Identification and description of families belongs to Monochlamydeae (Moraceae, Loranthaceae, Nyctaginaceae and Chenopodiaceae) 2. Identification and description of families for Monocots (Commelinaceae, Liliaceae, Orchidaceae, Aroideae, Cyperaceae and Poaceae)	10
<b>Unit III</b>	1. Preparation of artificial keys at family, generic and species level by locating key characters. 2. Field identification of plants	10
<b>Unit IV</b>	1. Economic importance of all the families given in the theory 2. Herbarium techniques	10
<b>Unit V</b>	3. Preparation of herbarium sheets — 50 minimum. 4. Botanical tour to any vegetation rich places. 5. Identification of plants using software's and mobile apps.	10

Power point Presentations, Group discussions, Floral dissection, Field visit and Case study
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CO \ PSO	PSO	PSO1	PSO2	PSO3	PSO4	PSO5
	<b>CO1</b>		H	H	M	L
<b>CO2</b>		M	H	H	M	L
<b>CO3</b>		H	M	M	M	L

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  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K.Srinivasan  Signature:	Name: Dr. R. Muthukumaran  Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title: Master of Science in Botany</b>		
<b>Course Code:20PBY313</b>		<b>Title : Core — 13 Laboratory course — IV (Plant Biochemistry and Biophysics and Research Methodology)</b>	<b>Batch</b>	<b>2020— 22</b>
			<b>Semester</b>	<b>III</b>
<b>Hrs/Week:</b>	<b>5</b>		<b>Credits</b>	<b>4</b>

### Course Objective

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

### Course Outcomes (CO)

K3	CO1	Understand the nature of bio molecules in plants
K4	CO2	Analyze the plants for its biochemical components
K5	CO3	Access recent techniques in molecular biology

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	<b>Plant Biochemistry:</b> 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	<b>13</b>
<b>Unit II</b>	1. Plant extraction by soxhelt apparatus. 2. Phytochemical screening of plant extrac 3. Separation of proteins by Sodium Dodecyl Sulfate Polyacrylamide Gelectrophoresis(SDS-PAGE). 4. Determination of enzyme activities — catalase, ascorbic acid oxidase and polyphenoloxidase.	<b>13</b>
<b>Unit III</b>	<b>Research Methodology</b> 1. Research writing 3.1. How to write a research proposal? 3.2. How to write a research report? 3.3. Dissertation writing 2. Bibliometrics 3. Citation index & Citation 4. Bibliography and biblioscope	<b>13</b>
<b>Unit IV</b>	1. Collection, analysis and graphical representation of data 2. Measures of central tendency — mean, median and mode 3. Measures of dispersion: range, standard deviation, coefficient of variation correlation 4. Test of significance — Chi-square test and Student‘t’ test. 5. Statistical calculations and chart preparation in MS-Excel and SPSS.	<b>13</b>
<b>Unit V</b>	<b>Instrumentation</b> 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	<b>13</b>
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CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	H	H	L	M	L
<b>CO2</b>	H	H	H	H	M
<b>CO3</b>	H	H	H	M	M

H-High M- Medium L -Low

Course Designed by Name and Signature	Verified by HOD Name and Signature	Checked by CDC	Approved by COE
Name: Dr. R. Rakkimuthu  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K.Srinivasan  Signature:	Name: Dr. R. Muthukumaran  Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20 PBY3E5</b>		<b>Title: Elective — 5 Forestry and Wood science</b>	<b>Batch</b>	<b>2020 — 22</b>
			<b>Semester</b>	<b>III</b>
<b>Hrs/Week:</b>	<b>5</b>		<b>Credits</b>	<b>4</b>

### Course Objective

To understand the components and role of forest ecosystem

### Course outcomes (CO)

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

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	General introduction to forests – natural and manmade; tropical, temperate, evergreen, semi evergreen, deciduous; Monoculture, multipurpose, social and industrial – forest and gene conservation; *forest types in south India with special emphasis to Tamil Nadu. IUCN red listed categories.	<b>13</b>
<b>Unit II</b>	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.	<b>13</b>
<b>Unit III</b>	Social and agro forestry: Selection of species and role of multipurpose trees. Food, fodder and energy – avenue plantation – sacred groves – definition, status and importance – seed dormancy – Types of dormancy, physical and chemical methods to overcome seed dormancy. 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).	<b>13</b>
<b>Unit IV</b>	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 –role of NMPB, AYUSH in medicinal plant conservation* - Medicinal Plant Conservation Area (MPCA) sites.	<b>13</b>
<b>Unit V</b>	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.	<b>13</b>

*\*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.
7. Sagreiya, K.P. 1994. Forests and Forestry (Revised by S.S. Negi). National Book Trust. New Delhi.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	M	H	H
CO2	H	H	M	M	M
CO3	H	L	H	M	L
CO4	H	L	M	M	L
CO5	H	L	L	L	M

H-High M- Medium L -Low

Course Designed by Name and Signature	Verified by HOD Name and Signature	Checked by CDC	Approved by COE
Name: Dr. A.M. Anandakumar  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K.Srinivasan  Signature:	Name: Dr. R. Muthukumar  Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code: 20PBY3E6</b>		<b>Title: Elective – 6 Herbal Technology</b>	<b>Batch</b>	<b>2020 – 22</b>
			<b>Semester</b>	<b>III</b>
<b>Hrs/Week:</b>	<b>5</b>		<b>Credits</b>	<b>4</b>

### Course Objective

To understand the components and role of forest ecosystem

### Course outcomes (CO)

K1	CO1	Recollect the importance of herbal technology
K2	CO2	Understand various plant based drugs from ayurvedha, unani, homeopathy, siddha etc.
K3	CO3	Apply the knowledge to medicinal plant cultivation
K4	CO4	Review the the protection of biodiversity
K4	CO5	Know the pharmacological importance of medicinal plants

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	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).	<b>13</b>
<b>Unit II</b>	Pharmacognosy– definition and scope – drug adulteration, drug evaluation, chemical evaluation, physical evaluation and biological evaluation – phytochemical investigations – standardization and quality control of herbal drugs.	<b>13</b>
<b>Unit III</b>	Cultivation and collection of natural drugs – Detailed study of the following medicinal plants: <i>Plantag oovata</i> , <i>Hypericum perforatum</i> , <i>Digitalis purpurea</i> , <i>Terminalia chebula</i> , <i>Saraca indica</i> , <i>Olea europoea</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.	<b>13</b>
<b>Unit IV</b>	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.	<b>13</b>
<b>Unit V</b>	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– mythology and conservation of ecosystems – conservation of selected plant species: sacred groves, forestry and unique ecosystems and their ethno biological values, plants and animals in art, tradition and ethnography: ethnobotanical field methods.	<b>13</b>

\*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.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	L	L	L
CO2	L	M	M	L	L
CO3	L	H	H	M	M
CO4	L	L	M	L	L
CO5	L	L	M	L	M

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. A.M. Anandakumar	Name: Dr. R. Rakkimuthu	Name: Mr. K.Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title : Master of Science in Botany</b>		
<b>Course Code:20PBY315</b>		<b>Title : Faculty Research based course: Plant Ecology, tissue culture and Phytochemical techniques</b>	<b>Batch</b>	<b>2020 - 22</b>
			<b>Semester</b>	<b>III</b>
			<b>Credits</b>	<b>2</b>

### Course Objective

The primary goal of this course is to carry out research on the field of ecology, plant tissue culture and phytochemistry

### Course Outcomes (CO)

K1	CO1	Students will keep in mind the ecosystem concepts and functions
K2	CO2	Gain the knowledge on basic tissue culture techniques
K3	CO3	Demonstrate the various aspects of extraction, isolation and Characterization of secondary metabolites
K4	CO4	Know the methods of screening of secondary metabolites for various biological properties

Unit	Content	Hrs
<b>Unit I</b>	<b>Ecology:</b> Principles of ecology - populations and their ecosystems, distribution, biotic communities and environmental relationships - density, frequency, abundance and relative indexes - quadrat method-Autecological studies - GCV and PCV of Plant communities - Soil analysis –Physical and chemical parameters	<b>13</b>
<b>Unit II</b>	<b>Plant tissue culture:</b> introduction to plant tissue culture - laboratory design and sterilization techniques - tissue culture media and preparation - concepts of tissue culture - initiation of plant tissue culture – micropropagation- callus culture – hardening methods	<b>13</b>
<b>Unit III</b>	<b>Phytochemistry:</b> Extraction of secondary metabolites (cold and hot) - Qualitative phytochemical analysis – alkaloids, flavonoids, glycosides, saponins, steroids, tannins, terpenoids, anthocyanins and phenols- Quantitative phytochemical analysis Alkaloids, flavonoids, glycosides, saponins, anthocyanins, and phenols.	<b>13</b>
<b>Unit IV</b>	Bioinstrumentation -AGE, Characterization of secondary metabolites and–TLC, Column chromatography, HPTLC, HPLC, LCMS/MS, GC/MS, UV, IR, <sup>1</sup> H–NMR	<b>13</b>
<b>Unit V</b>	<b>Biological studies of secondary metabolites:</b> Estimation of antioxidant content (enzymatic and non-enzymatic) - antimicrobial activity (disc diffusion and agar well method) – cytotoxicity assay (MTT Assay )	<b>13</b>

### Reference

1. Odum, E.P., 1975. Fundamentals of ecology, W.B. Saunders & Co., Philadelphia, USA.
2. Sharma P. D., 2005. Ecology And Environment, Rastogi Publications, India.
3. Rakkimuthu R., 2015. Title of the thesis: “*In vitro* propagation, phytochemical screening and biological activity of *Cocculushirsutus* (L.) Diels.
4. P. Sathishkumar, 2010. Title of the thesis: Evaluation of populations of the folklore medicinal plant, *Acacia caesia* (L.) Willd. in the Western Ghats of India for eco-morphological and phytochemical traits.

5. A.M. Anandakumar, 2010. Title of the thesis: Ecological, morphological, genetic and phytochemical variations between the populations of the medicinal plant, *Acalypha fruticosa* Forssk. Inhabiting lower Western Ghats, India.

**Text Book**

1. Satyanarayanan U., 2007. Biotechnology. Books and Allied (P) Ltd., Kolkata.
2. Harborne, 1998. Phytochemical methods, Springer Netherlands
3. Prasad and Prasad, 2000. Micro technique, EMKAY Publications.
4. Sadasivam, S. and Manickam, A. 2008. Biochemical Methods. New Age International Publishers, New Delhi.

<b>CO \ PSO</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	H	H	H	H	H
<b>CO2</b>	H	H	H	H	H
<b>CO3</b>	H	H	H	H	H
<b>CO4</b>	H	H	H	H	H

H-High M- Medium L -Low

<b>Course Designed by</b>	<b>Verified by HOD</b>	<b>Checked by</b>	<b>Approved by</b>
<b>Name and Signature</b>	<b>Name and Signature</b>	<b>CDC</b>	<b>COE</b>
Name: Dr. R. Rakkimuthu	Name: Dr. R. Rakkimuthu	Name: Mr. K.Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title: Master of Science in Botany</b>		
<b>Course Code: 20PBY414</b>		<b>Title: Core - 14 Plant Biotechnology and Nanobiology</b>	<b>Batch</b>	<b>2020 – 22</b>
			<b>Semester</b>	<b>IV</b>
<b>Hrs/Week:</b>	<b>5</b>		<b>Credits</b>	<b>5</b>

### Course Objective

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

### Course Outcomes (CO)

K1	CO1	Students will keep in mind the knowledge on techniques in plant tissue culture
K2	CO2	Understand the fundamentals of gene regulation
K3	CO3	Execute knowledge on molecular achievements in environmental stress management in plants
K4	CO4	Understand the basic concepts of Nanotechnology
K4	CO5	Analyze and apply the important of nanoparticles in plant diversity

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	<b>Essential Plant biology concepts for plant biotechnology:</b> Genome organization- mitochondrial genome organization- chloroplast genome organization- nuclear genome organization.-protein targeting- protein targeting to nuclear, mitochondria and chloroplast –molecular markers in plants.	<b>13</b>
<b>Unit II</b>	Replication of Eukaryotic chromosome: Replication origin, replication fork, terminals, replication apparatus – replication of RNA genome (replicase and reverse transcriptase) – semi conservative mode of DNA replication – Transcription: RNA polymerase – signals – chemistry and process, translation – mechanism of initiation – elongation and termination of protein synthesis – PCR – DNA sequencing methods.	<b>13</b>
<b>Unit III</b>	<b>Plant Tissue Culture:</b> 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.	<b>13</b>
<b>Unit IV</b>	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	<b>13</b>
<b>Unit V</b>	Types of nanomaterials: nano rods, nanowires, nanoparticles, nanocapsules, nano membranes, nanomeshe, 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>	<b>13</b>



*\*Self study topics*

Power point Presentations, Seminar and Assignment
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**Text Books:**

1. Slater A. Scott N. and Fowler M., 2008. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University Press Inc.
2. Satyanarayanan U., 2007. Biotechnology. Books and Allied (P) Ltd., Kolkata.

**Reference Books:**

1. Lea, P.J, Leegood, R.C. 1993. Plant Biochemistry and Molecular Biology. Eds. John Wiley and Sons, Chichester and New York.
2. Mahesh S. 2008. Plant Molecular Biotechnology. New Age International Publishers.
3. Ramavat K.G. 2006 Plant Biotechnology S. Chand and Co. Ltd., New Delhi
4. Trivedi P.C. 2000. Plant Biotechnology – Recent Advances. Panima Publication Corporation, New Delhi
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.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	H	M	H
CO2	M	H	M	H	M
CO3	H	H	H	M	H
CO4	H	M	M	H	H
CO5	H	M	H	H	M

H-High M- Medium L -Low

Course Designed by Name and Signature	Verified by HoD Name and Signature	Checked by CDC	Approved by COE
Name: Dr. R. Rakkimuthu  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K.Srinivasan  Signature:	Name: Dr. R. Muthukumaran  Signature:

Programme code	M.Sc.	Programme Title : Master of Science in Botany		
Course Code: 20 PBY415	5	Title : Core - 15 Bioinformatics and Cyber security	Batch	2020 - 22
			Semester	IV
Hrs/Week:			Credits	4

### Course Objective

To provide an *in silico* platform for biomolecular study.

### Course Outcomes (CO)

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

Unit	Content	Hrs
<b>Unit I</b>	<b>Bioinformatics:</b> 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.	<b>13</b>
<b>Unit II</b>	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.	<b>13</b>
<b>Unit III</b>	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>	<b>13</b>
<b>Unit IV</b>	<b>Cybersecurity:</b> 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.	<b>13</b>
<b>Unit V</b>	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>	<b>13</b>

\**Self studytopics*(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.
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### 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

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	M	L
CO2	H	H	M	H	H
CO3	H	M	H	H	H
CO4	M	H	M	H	M
CO5	H	L	H	H	M

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. A.M. Anandakumar	Name: Dr. R. Rakkimuthu	Name: Mr. K.Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

<b>Programme code</b>	<b>M.Sc.</b>	<b>Programme Title: Master of Science in Botany</b>		
<b>Course Code: 20PBY416</b>	<b>6</b>	<b>Title: Core - 16 Laboratory course- V (Plant Biotechnology &amp; Nanobiology and Bioinformatics &amp; Cyber security)</b>	<b>Batch</b>	<b>2020- 22</b>
<b>Hrs/Week:</b>			<b>Semester</b>	<b>IV</b>
			<b>Credits</b>	<b>4</b>

### Course Objective

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

### Course Outcomes (CO)

K3	CO1	Implement research execution, data interpretation and thesis writing
K4	CO2	Evaluate the principles and techniques for conducting research
K5	CO3	Validate the experimental results using statistical tools

<b>Unit</b>	<b>Content</b>	<b>Hrs</b>
<b>Unit I</b>	<b>Molecular Biology and Plant Biotechnology</b> 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	<b>16</b>
<b>Unit II</b>	1. Preparation of MS Medium 2. Shoot tip culture for plant regeneration 3. Induction of Callus from leaf 4. Production of shoot and root from callus 5. Production of somatic embryo from leaf 6. Anther culture for haploid plant production 7. Preparation of synthetic seeds 8. Hardening for <i>in-vitro</i> produced plantlet	<b>15</b>
<b>Unit III</b>	<b>Bioinformatics &amp; Cyber Security</b> 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 6. Construction of phylogenetic tree using CLUSTAL W and PHYLIP 7. Gene finding using Gen Mark Hmm.	<b>15</b>
<b>Unit IV</b>	1. Conserved domain search 2. Motifs search 3. CpG islands	<b>15</b>

<b>Unit V</b>	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	<b>17</b>
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Power point presentations, group discussions, online demonstration and field visit

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	H	H	H	H	M
<b>CO2</b>	H	M	M	H	L
<b>CO3</b>	H	H	H	M	M

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. A.M. Anandakumar  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K. Srinivasan  Signature:	Name: Dr. R. Muthukumaran  Signature:

<b>Department</b>	<b>Botany</b>	
<b>Course</b>	<b>M.Sc., Botany</b>	<b>2020-22</b>
	<b>Subject Code : 20PB4P1</b> <b>Title : Project and Viva Voce</b>	<b>Semester:IV</b>
<b>Hrs/Week :</b>	<b>12</b>	<b>Credits: 6</b>

### **Course Objective**

To identify innovative modules in research and to develop the thesis writing skills

### **Course Outcomes (CO)**

K3	CO1	Execute the advanced research areas
K4	CO2	Apply the methodology for the development of societal needs in the present scenario
K5	CO3	Validate the research process.

### **Individual Project and Viva Voce**

Each faculty will be allotted 4/5 students. A specific problem will be assigned to the students or they will be asked to choose a problem/area of interest. The topic/area of work will be finalized at the end of III semester. The research work can be carried out in the college or at any other organization approved by the guide and the HOD. Viva Voce/presentation will be conducted by a panel comprising of HOD, internal / external examiners. A power point presentation by the student before the audience will be evaluated on the basis of student's response to the questions.

### **Suggested areas of work**

Phytochemistry, Plant tissue culture, Nanotechnology, Plant taxonomy, enthono botany, Ecology, Microbiology, cytogenetics, Sustainable agriculture, Biocontrol agents, Herbal formulations.

### **Methodology**

Each project should contain the following details:

Brief introduction on the topic

Review of Literature

Materials and Methods

Results and Discussions – evidences in the form of figures, tables and photographs

Conclusion / Summary Bibliography

**Evaluation - Total - 160 Marks (Internal – 40 marks, External – 120 marks)**

**Internal**

**Total - 40 marks**

I Review – Selection of the field of study, Topic & Literature collection - 15 marks

II Review – Research Design and Data Collection - 10 marks

III Review – Analysis & Conclusion, Preparation of rough draft - 15marks

**External**

**Total - 120 marks**

**Project**

**Total – 120 marks**

Relevance of the topic to the academic / society - 20 Marks

Objectives - 10 Marks

Experimental design - 20Marks

Expression of results and discussion - 40 Marks

**Viva Voce**

Presentation - 15 Marks

Discussion - 15 Marks

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name and Signature	CDC	COE
Name: Dr. R. Rakkimuthu	Name: Dr. R. Rakkimuthu	Name: Mr. K.Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

### Course Objective

To equip the students as a biological entrepreneurs

Programme Title : Value added course			
Course Code:		Title : Biological entrepreneurship	Credits 1
Hrs/Week:	2		

### Course Outcomes (CO)

K1	CO1	Will get an idea on Integrated farming systems
K2	CO2	Remembering the values of Mushroom, Biofertilizer and <i>Azolla</i>
K3	CO3	Implement the techniques for cultivation, propagation and maintenance of biological resources
K4	CO4	Build entrepreneur skills in mushroom cultivation, Biofertilizer production and <i>Azolla</i> cultivation.
K4	CO5	Facilitate students to take-up successful business career

Unit	Content	Hrs
<b>Unit I</b>	<b>Mushroom Cultivation</b> Introduction - morphology - types of mushroom - nutritive and medicinal values - Methods of cultivation (Hanging bag, bed and rack method) - Diseases and post harvest technology - harvesting - freezing, dry freezing, drying, packaging and marketing - recipes from mushrooms.	<b>8</b>
<b>Unit II</b>	<b>Biofertilizers</b> General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers. Symbiotic N <sub>2</sub> fixers: <i>Rhizobium</i> , <i>Azospirillum</i> and <i>Azotobacter</i> - Isolation, characteristics, inoculum production and field application.	<b>8</b>
<b>Unit III</b>	<b><i>Azolla</i> Cultivation</b> - Isolation, characterization, mass multiplication - Nutrition value in <i>Azolla</i> - Cultivation process - Precaution to be adopted - Costing of fodder plot - Mass cultivation of <i>Azolla</i> -demonstration.	<b>8</b>
<b>Unit IV</b>	<b>Practical</b> <b>1. Cultivation of mushroom</b> <b>2. Spawn preparation</b> <b>3. Production of Biofertilizer</b> <b>4. <i>Azolla</i> cultivation techniques</b>	<b>6</b>

Power point Presentations, Group discussions, Seminar, Quiz, Assignment and Field visit



**Text Books:**

1. Nita Bhal. 2000. Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Mahendra K. Rai, 2005. Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Masakuni Kawasumi, 2005. The Secret Techniques of Bonsai: A Guide to Starting, Raising, and Shaping Bonsai, Published by Kondansha International Ltd., Tokyo.

**Reference Books:**

1. Kannaiyan, S., 2003. Bioetchnology of Biofertilizers, CHIPS, Texas.
2. John Yoshio Naka, 1984. Bonsai Techniques, Published June 1<sup>st</sup> 1984 by Bonsai Institute of California.

**E- Book links**

1. <https://archive.org/details/in.ernet.dli.2015.219901/page/n1>
2. [https://books.google.co.in/books?id=ID1u7mzdnUC&pg=PA324&lpg=PA324&dq=biofertilizers+virtual+book+online&source=bl&ots=cd2bc8kTuf&sig=ACfU3U22Y0Zq2OufL0Pfr456Q5SCvi382w&hl=en&sa=X&ved=2ahUKEwi\\_ve22oa\\_mAhUczTgGHcePCngQ6AEwA3oECAoQAQ#v=onepage&q=biofertilizers%20virtual%20book%20online&f=false](https://books.google.co.in/books?id=ID1u7mzdnUC&pg=PA324&lpg=PA324&dq=biofertilizers+virtual+book+online&source=bl&ots=cd2bc8kTuf&sig=ACfU3U22Y0Zq2OufL0Pfr456Q5SCvi382w&hl=en&sa=X&ved=2ahUKEwi_ve22oa_mAhUczTgGHcePCngQ6AEwA3oECAoQAQ#v=onepage&q=biofertilizers%20virtual%20book%20online&f=false)
3. [http://agritech.tnau.ac.in/banking/nabard\\_pdf/Azolla%20Cultivation/Model\\_projct\\_on\\_Azolla\\_cultivati on.pdf](http://agritech.tnau.ac.in/banking/nabard_pdf/Azolla%20Cultivation/Model_projct_on_Azolla_cultivati on.pdf)

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	H
CO2	H	H	H	H	H
CO3	H	H	H	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H

H-High M- Medium L -Low

Course Designed by Name and Signature	Verified by HOD Name and Signature	Checked by CDC	Approved by COE
Name: Dr. P. Sathishkumar  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K. Srinivasan  Signature:	Name: Dr. R. Muthukumar  Signature:

Programme Title : Value added course				
<b>Hrs/Week:</b>	<b>2</b>	<b>Title : Medicinal plants for human welfare</b>	<b>Credits</b>	<b>1</b>

### Course Objective

To understand the role of herbs as a source of human welfare

### Course Outcomes (CO)

K1	CO1	Remembering the knowledge on basics of medicinal plants
K2	CO2	To study the selected medicinal plants and their popular drugs
K3	CO3	To understand the medicinal values of various parts of the medicinal plants
K4	CO4	To know the present scenario on marketing of medicinal plants.
K4	CO5	To acquire knowledge on herbal drug formulations

Unit	Content	Hrs
<b>Unit I</b>	Historical account of medicinal plants usage in India - some important medicinal plants in India; folk healing practices and household remedies followed in India against illnesses.	<b>8</b>
<b>Unit II</b>	Identification of medicinal plants - Field morphology - Basic chemical components - Field demonstration - Processing, packaging and marketing.	<b>8</b>
<b>Unit III</b>	Industrial uses of medicinal plants land to lab, constraints associated with medicinal plants - value added herbal products. Trade in Medicinal plants: Medicinal Plants demand and supply - major importing and exporting countries and regions.	<b>8</b>
<b>Unit IV</b>	<b>Practical</b> 1. Identification of medicinal plants 2. Soxhlet extraction of medicinal plants (Demo) 3. Herbal formulation basics (Demo)	<b>6</b>

Power point Presentations, Group discussions, Assignment and Field visit
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### Text Books:

1. Andrew Chevallier, 1996. Encyclopaedia of Medicinal Plants, Dorling Kindersley; American . edition (10 January 1996).
2. A.N. Kalia, Textbook of Industrial Pharmacognosy, 2005, CBS Publishers, New Delhi.

**Reference Books:**

1. Dr.C.K. Kokate, Practical Pharmacognosy, 1988, Vallabh Prakashan, Delhi.
2. C.K. Atal & B.M. Kapur, 1982. Cultivation and utilization of medicinal plants / edited, Published by Jammu-Tawi : Regional Research Laboratory, Council of Scientific & Industrial Research.
3. Triavedi P. C. 2006. Medicinal plants: Ethnobotanical Approach Agrobios, India.

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	H	H	H	H	H
<b>CO2</b>	H	H	H	H	H
<b>CO3</b>	H	H	H	H	H
<b>CO4</b>	H	H	H	H	H
<b>CO5</b>	H	H	H	H	H

H-High M- Medium L -Low

Course Designed by Name and Signature	Verified by HOD Name and Signature	Checked by CDC	Approved by COE
Name: Dr. P. Sathishkumar  Signature:	Name: Dr. R. Rakkimuthu  Signature:	Name: Mr. K.Srinivasan  Signature:	Name: Dr. R. Muthukumar  Signature: