M. Sc. BOTANY – Syllabus

Syllabus as Per the Choice Based Credit System (CBCS)

&

Learning Outcomes-based Curriculum Framework (LOCF)

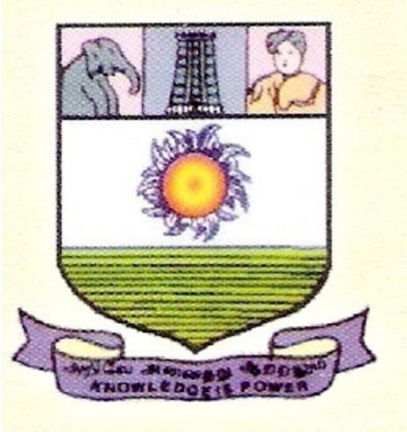
(Curriculum Effective from the academic year 2022- 2023)

Submitted by

Dr. P. RAVICHANDRAN

Professor & Head and Chairperson

Approved in the 53rd SCAA July 2022



Board of Studies in Plant Science

DEPARTMENT OF PLANT SCIENCE

Manonmaniam Sundaranar University, Tirunelveli

May 2022

The vision of the University

To provide quality education to reach the un-reached

Mission of the University

- To conduct research, teaching and outreach programs to improve conditions of human living.
- To create an academic environment that honors women and men of all races, castes, creeds, cultures, and an atmosphere that values intellectual curiosity,the pursuit of knowledge, academicfreedom, and integrity.
- To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups.
- To develop a partnership with industries and government so as to improve the quality of the workplace and to serve as a catalyst for economic and cultural development.
- To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently abled.

Preamble of the Department

Botany is a vital branch of science deals with the study of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms, their classification, structure, growth, reproduction, metabolism, development, diseases, chemical properties, uses and ecological & evolutionary relationships among the different groups. The continued investigations of plants are fundamental in this post-industrial, knowledge-based modern era because they provide countless precious goods and services that underpin almost all life on the planet Earth. A greater understanding and knowledge of plants and their unique processes is inevitable to the future of human societies as it will enable us to overcome the challenges posed and reap benefits from the opportunities offered in this century.

The constantly updated curriculum, continuous performance appraisal and feedbacks, and regular career counseling are ideally designed to help the aspiring students to get through the SLET/ NET/IFS and many other competitive exams. To make the students more competent and confident, the multidisciplinary approach as well as the scope for training in personality development and communication skills are given importance.

Eligibility:

- Undergraduate (B. Sc.) Botany, Plant Biology & Plant Biotechnology with a minimum of 55 % Marks and for reserved categories 50 %.
- Admission will be based on an entrance test for 50 marks and UG marks will be taken for another 50 %. The average of both shall be above 50%.
- **Total number of seats sanctioned is 16 (sixteen only).**

Vision of the Department

To elevate teaching, learning and research in Plant Science as the epitome of human survival, sustenance of other organisms and natural resources with practical and field-based activity

Aim and Objectives

- To provide equal credit for theoretical, practical and field based systematic learning
- To inculcate postgraduate research-oriented scholarship with inclusive understanding of both basic and advanced areas of Plant science
- To offer cognition towards international competition and out reaching students' knowledge for global requirement
- To reach the unreached and needy by extension activities from the embodiment of our research findings

Mission of the Department

- ✓ Creating student friendly atmosphere in the class room and laboratories
- ✓ Providing all basic requirements in the class room and laboratories for comfortable teaching and learning
- ✓ Generating sufficient opportunities for students' assignments and seminar presentations with an epitome of inquisition
- ✓ Providing equal opportunity, unbiased treatment and valuations of students' performances to motivate enthusiastic learning
- ✓ Organising frequent special lectures with an umbrella of intellectual and subject experts for better student interaction and discussions
- ✓ Furnishing a common platform for scholars and students to teach and learn the basics and advances in plant science by organising workshops/training programs/seminars/conference of international repute

Choice Based Credit System (CBCS):

The CBCS and Learning Outcomes-based Curriculum Framework (LOCF)provides an opportunity for students to choose courses from the prescribed list, comprising core, elective/supportive/MOOCS courses. The courses are evaluated following the grading system, which is considered to be better than the conventional marking system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, which enables the student to move across institutions of higher learning. The uniformity in evaluation system also enables potential employers in assessing the performance of the candidates.

Definitions:

(i) 'Academic Program' refers to an entire course of study comprising its objectives, outcomes, course structure, course objectives, evaluation schemes, course outcomes that are designed to be taught and evaluated in a teaching and research department.

(ii) 'Course' is a segment of a subject that is part of an Academic Program.

(iii) 'Program Structure' is a list of different courses (Core, Elective, supportive, practical) that constitutes an Academic Program, specifying the syllabus, credits, hours of teaching, evaluation and examination schemes, minimum number of credits required for successful completion of the Programprepared in conformity to University Rules and eligibility criteria for admission.

(iv) 'Core Course' is a course that all students admitted to a particular Program will have to study and successfully complete to receive the degree.

(v) 'Elective Course' refers to an optional course, which is lighter in content without practical's that can be selected by a student out of a three such courses offered in a semester in the same department.

(vi) 'Supportive Course' is also a kind of elective course, which is available for students of all Programs at the MOOCs or NPTL online platforms. Students of other Department will opt these courses subject to fulfilling of eligibility criteria laid down by the Department offering the course.

(vii) 'Credit' refers to the value assigned to a course, which indicates the level of instruction; One-hour lecture per week equals 1 Credit, 2 hours practical class per week equals 1 credit. Credit for a practical is proposed as a separate practical course either singly or in combination of two courses.

(viii) Project work/ Dissertation – in the fourth semester all students will be allowed toselect their choice of special subject to carry out a research project work and the results, findings and interpretations will be compiled as a dissertation as per the format given by the university which should be submitted for evaluation during the fourth semester practical examination.

(ix) Viva-voce examination refers the oral presentation of the project work in front of the examiners and fellow postgraduate students and scholars of the department. Questions will be raised by the students, scholars and the examiners the presenting students has to answer and clarify the questions. External marks for the viva voce examination will be awarded by both internal and externa examiners.

(x) CGPA' is Cumulative Grade Points Average calculated for all courses completed by the students at any point of time. CGPA is calculated for every semester by the controller of exams.

(xi) final CGPA' is calculated in the last year of the course by combining the CGPA of all four semesters. Final CGPA is given in the form of a grade sheet. For the benefit of students, a formula for conversation of Grand CGPA into percentage marks is provided in the Grade sheet by the controller of exams.

Program- Master of Science (M.Sc.)

PROGRAM learning OUTCOMES (PO)

PO-1	Postgraduates of diverse, interrelated, and interdisciplinary knowledge will be produced to serve mankind through the dissemination of their acquaintance and learning in both basic and advanced aspects of sciences.
PO-2	Students will acquire combined theoretical, conceptual, analytical, and experimental knowledge and skills in both basic and applied areas of science to promote innovation and discovery.
PO-3	Students will be able to have a strong research aptitude, pursue independent research and contribute to the growth and development of emerging skill-oriented areas of science.
PO-4	To enhance students' capability to develop solutions for the welfare of human life and environmental problems through the applications of acquired knowledge and skills.
PO-5	Students will be acquainted to make observations and collect data both in the laboratory and in the field and evaluate the results, derive conclusions, and communicate their findings effectively in the form of research papers, project reports, patents, and policy documents.
PO-6	To promote the proficiency of learning through ICT-based digital platforms and educate other computer-based applications for the popularization of self and business.

M.Sc. Botany - PROGRAM SPECIFIC OUTCOMES (PSO)

After the successful completion of M.Sc. Botany program, **the students are expected to demonstrate comprehensive knowledge and skills in the following**:

PSO-1	Be proficient in basic, modern, and applied areas of Botany along with critical and reflective thinking and problem-solving potentials.
PSO-2	Able to differentiate various divisions of plants in relation to origin, structure, development, and functions; demonstrate disciplinary knowledge
PSO-3	Have vertical knowledge and analytical abilities in fundamental (Evolution, Diversity), and applied (Horticulture, Phytochemistry, Instrumentation, Bioenergy, Plant Biotechnology) areas of Botany.
PSO-4	Possess across subject knowledge through self-directed learning to enhance their skills and employability
PSO-5	Ability to understand and apply analytical and scientific reasoning towards the

	conduct of experiments, data collection, interpretation, and arriving at a conclusion in an unbiased ethical manner
PSO-6	Be capable in digital literacy through appropriate botany-related (ICT, Biostatistics, Bioinformatics, Phylogeny) and other software; reporting of findings and effective communication.

M. Sc. BOTANY REVISED PROGRAM STRUCTURE – July 2022 onwards

Choice Based Credit System (CBCS) and

Learning Outcomes-based Curriculum Framework (LOCF)

Semester I - Core Theory 4, Practical 2, Elective 1						
					Int. 25	Ext. 75
	Code	**Name of Course Papers**	**Hrs/ wk**	**Cre dits**	**Marks**	
CORE 1	PBYC11	Plant Diversity-I – Algae, Fungi and Lichens	4	4	100	
CORE 2	PBYC12	Plant Diversity- II –Bryophytes, Pteridophytes, Gymnosperms and Paleobotany	4	4	100	
Practical – 1	PBYL11	Plant Diversity I & II	5	4	100	
CORE 3	PBYC13	Microbiology	4	4	100	
CORE 4	PBYC14	Cell and Molecular Biology	4	4	100	
Practical – 2	PBYL12	Microbiology and Cell and Molecular Biology	6	4	100	
Elective -1	PBYEA	Evolutionary Biology	3	3	100	
	PBYEB	Plant Diseases and Insect Pest Control				
	PBYEC	Aquatic and Marine Plants				
		Total	**30**	**27**	**700**	
Semester II- Core theory 3, Practical 2, Elective1 and Supportive course 1						
	Code	**Name of Course Papers**	**Hrs/ wk**	**Cre dits**	**Marks**	
CORE 5	PBYC21	Anatomy and Embryology of Angiosperms	4	4	100	
Practical – 3	PBYL21	Anatomy and Embryology of Angiosperms	4	2	100	
CORE 6	PBYC22	Instrumentation and Research Methodology	4	4	100	
CORE 7	PBYC23	Genetics, Genomics and Bioinformatics	4	4	100	
Practical - 4	PBYL22	Instrumentation& Biotechniques	8	4	100	
Elective – 2	PBYED	Plants in Tamil Culture	3	3	100	
	PBYEE	Horticulture and Plant Breeding				
	PBYEF	Plants for Bio-energy and Space Research				
Supportive course – I *		Online MOOCS Course Offered by other Departments	3	3	100	
		Total	**30**	**24**	**700**	
Semester III- Core theory 3, Practical 3, Supportive 1						
	Code	**Name of Course Papers**	**Hrs/ wk**	**Credits**	**Marks**	

CORE 8	PBYC31	Plant Physiology and Biochemistry	4	4	100
Practical - 5	PBYL31	Plant Physiology and Biochemistry	5	2	100
CORE 9	PBYC32	Angiosperm Taxonomy	4	4	100
Practical - 6	PBYL31	Angiosperm Taxonomy	5	2	100
CORE 10	PBYC33	Ecology and Conservation Biology	4	4	100
Practical - 7	PBYL33	Ecology and Conservation Biology	5	2	100
Supportive course –II *		Online MOOCS course Offered by other departments	3	3	100
		Total	**30**	**21**	**700**
Semester IV- Core theory 2, Practical 2 and Dissertation 1					
	Code	**Name of Course Papers**	**Hrs/ wk**	**Credits**	**Marks**
CORE 11	PBYC41	Phytochemistry and Traditional Medicine	4	4	100
CORE 12	PBYC42	Plant Biotechnology	4	4	100
Practical - 8	PBYL41	Plant Biotechnology and Phytochemistry	8	4	100
Practical - 9	PBYI 41	Field Study	2	2	100
Dissertation	PBYP41	Project and Viva – Voce	12	8	100
		Total	**30**	**22**	**500**

Distribution of Credits	**Total Credits**	**Total grade points**
Core Theory - 12 x 4	48	4800
Practical papers - 4 x 4	16	1600
Practical papers - 4 x 2	8	800
Field Study (Practical) - 1 x 2	2	200
Electives - 2 x 3	6	600
**Supportive course - 2 x 3	6	600
Dissertation/Project and Viva-Voce – 1 x 8	8	800
***Grand Total Credits/ Marks**	**94**	**9400**
Cumulative Grade Points Average (CGPA) = Grade Points /Total Credits	**9400/94**	**100%**

* Students have to earn a minimum of 92 credits in order to get degree in the M.Sc. program

**Students of M.Sc. Botany will study supportive courses from MOOCS platform offered by other departments during II & III semesters

** Supportive course for students of other departments will be offered by Plant Science faculty during II & III semesters from courses available in MOOCS platform

Teaching:

The faculty of the Department is primarily responsible for organizing lectures for Master of Science in Botany. The instructions related to tutorials are provided by the respective registering units under the overall guidance of the Department. Faculty from some other Departments and constituent colleges are also associated with lectures and tutorial work in the Department.

There shall be 90 instructional days excluding examination in a semester.

The Department proposes to offer an option of Dissertation in lieu of one discipline specific elective paper to the top 20% students only (subject to a maximum of 15 students; not exceeding one student per faculty) in order of merit. Merit list would be based on their consolidated performance in semester examinations till the end of semester II. This would provide students with the option of research-based specialization in the subject.

Scheme - Examination and Evaluation

1. For each theory paper 25 marks for internal & 75 marks for External.
2. There is no passing minimum for internal examination. For internal marks, the split up is 15 marks for test, 5 marks for seminar and 5 marks assignment. The average of two tests will be taken for final internal marks. Passing minimum for external is 50 % and the total passing minimum including internal & external is 50 %.
3. For Field study 50 marks maximum for internal will be based on periodical submission of study reports, field note books and 50 marks maximum for external based on submission a summary study report, field note book and viva-voce examination and thereby the total maximum marks for Field study are 100.
4. For Project work, maximum 50 marks for internal assessment based on periodical review of the progress made. Submission of dissertation and appearance of viva-voce at the final semester will carry 50 marks, which will be evaluated by both internal and external examiners.

   Grant Total for Project (50 marks internal) + Dissertation submission and Viva Voce (50 marks external) = 100 marks.

5. The question paper pattern for theory exam is as follows**:**

   Section - A MCQ – 10 x 1 mark = 10 marks

(Two questions from each unit - following blooms taxonomy pattern)

Section - B – 5 x 5 marks = 25 marks

(One question - following blooms taxonomy pattern from each unit with either or choice)

Section - C – 5 x 8 marks = 40 marks

(One question - following blooms taxonomy pattern from each unit with either or choice)

Total 75 marks

Model Question Paper based on blooms taxonomy

MANONMANIAM SUNDARANAR UNIVERSITY

DEPARTMENT OF PLANT SCIENCE

PBYC31: PLANT PHYSIOLOGY AND BIOCHEMISTRY

TIME: 3 HOURS **MARKS: 75**

PART A: Answer all questions. Choose the best answer from the choices (10x1=10 marks)

1 If ΔG is said to be positive, it means
(A) H is lower (B) S in the system is higher
(C) Reactants contain more energy than the product does (D) Products of the reaction contain more energy than the reactants

2 An enzyme promotes a chemical reaction by
(A) Lowering the activation energy (B) Increasing the activation energy
(C) Changing the free energy (D) None of these

3 0.1 M solution of a solute has a water potential of
(A) -2.3 bar (B) 0 bar
(C) 22.4 bar (D) +2.3 bar

4 The water readily available to plants for absorption by roots is
(A) Gravitational water (B) Capillary water
(C) Rain water (D) Hygroscopic water

5 Photorespiration occurs in the organelles of
(A) Chloroplast, vacuole, mitochondria (B) Chloroplast, mitochondria
(C) Chloroplast, peroxisome, mitochondria (D) Chloroplast, cytosol, mitochondria

6 The 'Bell jar' experiment to demonstrate that plants produce oxygen was conducted by
(A) Joseph Priestly (B) Stephen Hales
(C) Jean Senebier (D) Jan van Helmont

7 NAD^+ is a(n)
(A) Enzyme (B) Coenzyme
(C) Active site (D) High-energy bond

8 Which fatty acid is dominant in peanut oil
(A) Oleic acid (B) Palmitic acid
(C) Linoleic acid (D) Stearic acid

9. Relatively high amounts of gibberellins are synthesized in
(A) Young leaves (B) Immature seeds
(C) Young roots (D) Flower

10 Which of the following pigment involved in red-far red-light interconversion?
(A) Cytochrome (B) Lycopene
(C) Phytochrome (D) Xanthophyll

PART B: Answer ALL questions choosing either (a) or (b) from each (5x5=25 marks)

11. (a). Write The details of 'action spectrum experiment'? Demonstrate the significance of this experiment on the development of plant physiology.
    (b). Explain the Induced Fit Model of enzymes.
12. (a). Water and minerals can travel through a plant by three routes. Illustrate the routes using a schematic figure?
    (b). What facilitates the process of Guttation and water absorption by trees.
13. (a). Inspect the factors affecting the rate of photosynthesis
    (b). Present the features of 'Light-Harvesting Antennas and Photochemical Reaction Centers
14. (a). Summarize the components of a triacylglycerol
    (b). Briefly describe the pathway of β-oxidation
15. (a). Compose the commercial applications of Vernalization
    (b). Describe the polar transport of auxins by chemiosmotic theory.

PART C: Answer ALL questions choosing either (a) or (b) from each (5x8= 40 marks)

16. (a). Construct the hierarchical structure of proteins
    (b). Compare Lineweaver-Burk equation and Michaelis-Menten Equation.
17. (a). Critically comment on the mechanism of Mass Flow hypothesis
    (b). Describe the stomatal structure and function in relation to transpiration
18. (a). Write an essay on Calvin cycle and indicate how this metabolism is controlled.
    (b). Demonstrate the structural features involved in CAM cycle and compare it with C4 photosynthesis.
19. (a). Give an outline of fatty acid biosynthesis in plants
    (b). Illustrate the processes involved in electron transport system.
20. (a). Clarify the synthesis, transport and functions of auxin in plants
    (b). Illustrate the synthesis and function of volatile hormone ethylene in plants.

6. Practical Examinations - Question Paper Pattern

QUESTIONS	INTERNAL 50 Marks	EXTERNAL 50 Marks	TOTAL Marks
1. MAJOR	20	20	
2. MINOR	10	10	
3. SPOTTERS	15 (5 x 3 marks)	15 (5 x 3 marks)	
4. RECORD	5	Submission of completed record isthe eligibilitycriterion to appear for the semester practical examination	
5.VIVA-VOCE	-	5	
TOTAL	**50**	**50**	**100**
Field study	**50** Field study Field notebook, submission of regular field study reports	**50** Summary report, Field notebook and viva-voce examination	**100**

Course completion Requirements

Students should have a minimum of 85% attendance in each course to appear in every semester examination.

To complete the PG Program students should earn a minimum of 90 credits over a period of two years. Carrying out a project/dissertation work during the fourth semester and submission of dissertation within the date fixed by the department is a must. Selection of guide and specialization subject to carryout project /dissertation work is based on students' preference. They may give three preferences as per the list provided in common. Based on their choices and merit of last three semester marks students will be allocated a guide provided the limitations of the guide are met. Interchange of guide is possible only if the guides are willing to otherwise change of guide is not possible. A minimum of three hard copies of dissertations should be submitted. Field study is also a compulsory course for which students should prepare a periodical field study report from first year onwards. All one-day field collection trips and long study tour reports should be individually submitted within 10 days after the completion of such events with the approval of the course teacher. A summary of field study report should be submitted at the end semester and appear for a viva-voce examination.

[2022/MSU 53rd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/CORE-1]

Semester : I
Course Type : Core
Title of the Course : Plant Diversity-I: Algae, Fungi and Lichens
Course Code : PBYC11

L	T	P	C
4	-	-	4
60 Hours/Semester			

Course objectives: To teach the students on

1. thallus organization, evolution and life cycle patterns of algae
2. salient features and types of selected algae and their economic importance
3. evolution, role of sex hormone in fungi and heterothallism in fungi
4. general account, phylogeny of fungi and their role in environment
5. the structure and types of lichens and their mutualism

UNITS	CONTENT	CO	K Level	Hours
I	Origin and evolution of algae; General characteristics of algae; Diversity and Habitats-Terrestrial, Freshwater and Marine. Phylogeny and interrelationship of algae. Thallus organization - cell and chloroplast structure. Reproduction: vegetative- asexual- sexual- life cycle patterns Classification (FE. Fritsch, 1945; Chapman and Chapman, 1973); pigments, reserve food, flagella (criterions). Phylogeny and molecular evolution of the green algae. Contributions of Indian Phycologists: T.V. Desikachary, M.O.P.Iyengar, V.K. Krishnamurthy, M.S. Balakrishnan, V.S.S. Sundaralingam	1	K1-K3	12
II	**Algae –Type studies** Salient features of Protochlorophyta (*Spirulina*), Chlorophyta (*Ulva, Chaetomorpha*), Charophyta (*Chara*), Xanthophyta (*Botrydium*), Bacillariophyta (*Cyclotella*), Phaeophyta (*Sargassum*) and Rhodophyta (*Ceramium*). Algal blooms, Algae as biofertilizer, food and feed; industrial (commercial) products from algae.	2	K1-K4	12
III	**Fungi** Origin and evolution of fungi; General Characteristics; cell ultrastructure; unicellular and multicellular organization; cell wall composition; nutrition (saprobic, biotropic and symbiotic); reproduction (vegetative, sexual and asexual); life cycle patterns: Homothallism, heterothallism; heterokaryosis; parasexuality.	3	K1-K4	12
IV	**Classification and Type studies of Fungi** Classification: Alexopoulus and Mims (1979) and recent	4	K1-K4	12

	trends. General account of Mastigomycotina (*Phytopthora*), Zygomycotina (*Rhizopus*), Ascomycotina (*Taphrina)*, Basidiomycotina (*Polyporus)*, and Deuteromycotina (*Trichoderma, Fusarium)*; Phylogeny and interrelationships of major groups of fungi. Fungi in industry, medicine and as food; fungal diseases in plants (*Magnaporthe oryzae* and *Puccinia* spp. In plants; Red rust of tea) mycorrhizae; as biocontrol agents. Contributions of Indian Mycologists			
V	**Lichens** Origin and evolution of lichens; General characteristics of lichens; Classification (Hawksworth and Hill, 1984; Hale, 1969). Occurrence and interrelationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basidiolichens and Deuterolichens. Lichens as indicators of Pollution; Economic importance of Lichens.	5	K1-K4	12

Text Books

1. Alexopoulos, C.J. and Mims, M. Blackwell. 1996. Introductory Mycology. John Wiley SonsInc.
2. Morris, I. 1986. An Introduction to the Algae. Cambridge University Press,UK.
3. Raven, P.H., Johnson, G.B.,Losos, J.B., Mason, K.A. and Singer, S.R. 2008. Biology. (8thEdition).
4. Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky, P.V., Reece, J.B. 2016. Campbell Biology, Pearson, USA (11th Edition).

References

5. Kumar, H.D. 1988. Introductory Phycology. Affiliated East-West Press,New Delhi.
6. Mehrotra, RS. &Aneja, RS. 1998.An Introduction to Mycology. New Age InternationalPress.
7. Rangaswamy, G. and A. Mahadevan. 1999. Disease of Crop Plants in India (4th Edition). Prentice Hall of India Pvt. Ltd., NewDelhi.
8. Webster, J. 1985. Introduction to Fungi. Cambridge UniversityPress.
9. Sharma, O.P. Text book of Algae. Tata McGraw Hill, NewDelhi.
10. Raven, P. H. and G. B. Johnson. 2002. BIOLOGY 6th ed. McGraw-Hill. Boston.
11. Leliaert F et al. 2012. Phylogeny and Molecular Evolution of the Green Algae. Critical Reviews in Plant Sciences. 31:1-46.
12. Lee RE. 2008. Phycology. Cambridge University Press. (4th Edition).
13. Watkinson SC, Boddy L, Nicholas PM. 2015. The Fungi. Academic Press, Elsevier. (Third Edition).
14. Ranker TA, Haufler CH. 2008. Biology and Evolution of Ferns and Lycophytes. Cambridge University Press.
15. Nash TH. 2008. Lichen Biology. Cambridge University Press (2nd Edition).

Web Resources:Lichens | University of Maryland Extension (umd.edu)

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	the outline and illustration of the types of non-vascular cryptogams	K1-K3
CO -2	the demonstration of the vegetative and reproductive structure of the thallophytes	K1-K4
CO -3	the examination of ultrastructure and spore dispersal mechanism of fungi	K1-K4
CO -4	the evolution of sporophytes and sporophytes of thallophytes	K1-K4
CO -5	the characteristic features of Lichen and their economic importance	K1-K4

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	1	1	0	0
CO-2	3	3	1	1	0	0
CO-3	3	3	1	1	0	0
CO-4	3	3	2	1	0	0
CO-5	3	3	3	1	0	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	3	3	2	1	0
CO-2	3	3	2	2	1	0
CO-3	3	3	2	2	1	0
CO-4	3	3	2	2	1	0
CO-5	3	3	2	1	1	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Course Designer: Dr. P. Ravichandran

Addition of objectives, outcomes and mapping: Dr. S. Muthukrishnan

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/CORE-2]

Semester : I
Course Type : Core
Title of the Course : Plant Diversity II (Bryophytes, Pteridophytes, Gymnosperms and Paleobotany)
Course Code : PBYC12

L	T	P	C
4	-	-	4
60 Hours/Semester			

Course objectives: To enable the students to

1. have a comprehensive knowledge (Structure, reproduction and life cycle) of Bryophytes and get familiar with the classification.
2. learn the salient features of Pteridophytes, evolution of stele and its classification.
3. understand the general and reproductive characters of Gymnosperms with economic importance.
4. acquire the knowledge of classification and types studies in Gymnosperms.
5. learn about geological time scale, methods of fossilization and salient features of fossil forms of Pteridophytes and Gymnosperms.

UNITS	CONTENT	CO	K Level	Hours
I	**Bryophytes** Origin and evolution of bryophytes; General characteristics of bryophytes; Morphology, structure, reproduction and life history; distribution; classification (Watson/ Rothmaler); phylogeny. General account of Hepaticopsida: Marchantiales, Jungermaniales; Anthocerotopsida: Anthoceratales; Bryopsida: Sphagnales, Funariales and Polytrichales. Economic and ecological importance.	1	K1-K3	12
II	**Pteridophytes** Origin and evolution of Pteridophytes; General characteristics of Pteridophytes; Morphology, distribution, anatomy and reporduction; classification (Reimer/ Sporne);Phylogeny. Evolution of stele; heterospory and origin of seed habit.Characteristics features of Psilopsida, Lycopsida, Sphenopsida and Pteropsida.	2	K1-K4	12
III	**Gymnosperms** Origin and evolution of gymnosperms and angiosperms; General characters; the vessel-less and fruitless seed plants, variations in reproductive structures (cones), pollen germination and the complexity of their female gametophyte. Economic	3	K1-K4	12

	importance.			
IV	**Gymnosperms – Classification & Type studies** Classification (Sporne, Pilger &Melchoir); Distribution in India; General account of Pteridospermales:(Lyginopteridaceae, Medullosaceae, Caytoniaceae and Glossopteridaceae). Cycadeoidales and Cordaitales. Structure and reproduction in Cycadales, Ginkgoales, Coniferales, Ephedrales and Gnetales	4	K1-K4	12
V	**Paleobotany** Geological time scale; Fossilization process; Fossils and Types: general account. Fossils: algae, fungi, bryophytes and pteridopytes. Study of fossil forms: Lyginopteris, Heterangium, Medullosa, Cycadeoidea, Pentaxylon, Williamsonia and Cordaites. Major fossil sites of India: Thiruvakkarai, Sriperumbudhur, Rajmahal Hills. Paleobotany in phylogeny; Indian Paleobotanists: Birbal Sahni, D.D.Pant, M. Ramanujam.	5	K1-K4	12

Text Books

1. Alam, A. 2015. Text book of Bryophyta. 1/e, I.K. International Publishing House, New Delhi
2. Sporne, K.K. 1991. The Morphology of Pteridophytes. BI Publishing, Bombay.
3. Sporne, K.R.1965. The Morphology of Gymnosperms. BI Publications, New Delhi.
4. Sharma, O.P. 2014. Bryophyta. McGraw Hill Education, New Delhi

References

5. Parihar, N. S. 1991. Bryophyta. Central Book Department, Allahabad
6. Bhatnagar, SP and Moitra, A.1996.Gymnosperms. New Age International, New Delhi.
7. Parihar, NS. 1996. Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
8. Boid, H. C. 1982. Bryophyta. Wiley-Eastern.
9. Jon C. Herron and Scott Freeman. 2014. Evolutionary analysis (5^{th} Edition.).
10. Peter H. Raven, George B. Johnson Jonathan B. Losos, Kenneth A. Mason and Susan R. Singer. 2008. Biology. (8^{th} Edition)
11. Peter J. Russell, Stephen L. Wolfe, Paul E. Hertz and Cecie Starr. 2008. Biology: The Dynamic Science, (1^{st} Edition).

Web Resources:

1. https://www.easybiologyclass.com/classification-of-gymnosperms-by-sporne-short-notes/

2. https://www.britannica.com/plant/plant/Evolution-and-paleobotany
3. https://indiabiodiversity.org
4. Practical 2_Plant Diversity.pptx - Practical 2 Part 1 – Plant Diversity Dr Azma Abdul Malek PUSPA 2020 / | Course Hero
5. Identification manual for fungi from utility poles in the eastern United States: Free Download, Borrow, and Streaming: Internet Archive

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	classification, characteristic and comparative features of the specified orders and economic importance of Bryophytes	K1-K3
CO -2	classification, characteristic features of the specified orders, evolution of stele types, comparative features of sporophytes and gametophytes and economic importance of Pteridophytes	K1-K3
CO -3	the reproductive structures, development of male and female gametes, embryogeny and economic importance of Gymnosperms.	K1-K3
CO -4	classification, characteristic and comparative features of the specified orders of Gymnosperms.	K1-K3
CO -5	the geological time scale, fossilization methods and of fossil forms.	K1-K3

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	2	1	0	0
CO-2	3	3	2	1	0	0
CO-3	3	3	1	1	0	0
CO-4	3	3	2	1	0	0
CO-5	3	3	1	1	0	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	1	1	2	2	1
CO-2	3	1	1	2	2	1
CO-3	3	1	1	2	2	1
CO-4	3	1	1	2	2	1

CO-5	3	1	1	2	1	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Course Designer: Dr. P. Ravichandran
Addition of Objectives, outcomes and mapping: Dr. S. Vallinayagam

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/PRACTICAL-1]

Semester : I
Course Type : Practical
Title of the Course : Plant Diversity I & II
Course Code : PBYL11

L	T	P	C
-	-	6	4
90 Hours/Semester			

Course objectives: To enable the students in understanding

1. Vegetative and reproductive structures of selected algal species
2. Morphology and reproductive structures of fungal species
3. The anatomical structure and morphology of bryophytes
4. Structural details of the vegetative and reproductive parts of pteridophytes and gymnosperms
5. the past history and evolution of plants through fossils

UNITS	CONTENT	CO	K Level	Hours
I	Study of following algal flora with special reference to morphology and anatomy of vegetative & reproductive structures: *Spirulina, Scytonema, Ulva, Chaetomorpha*(Hill streams*), Chara, Cephaleuros*(Tea and Mango leaves) *Codium, Halimeda, Padina, Sargassum, Gracliaria, Ceramium (*epiphytic), *Cyclotella* (Diatoms- freshwater).	1	K1-K5	15
II	Study of morphology and reproductive features of following Fungi: *Albugo, Aspergillus, Peziza, Polyporus, Puccinia, Colletotrichum, Fusarium, Cercospora; Parmelia*and *Usnea* (Lichens). Root section of grasses for localization of ecto and endomycorrhizae	2	K1-K5	15
III	Study of Morphological, anatomical and reproductive parts using whole mount preparation, dissection and sections; bryophytes: *Marchantia, Reboulia, Porella, Anthoceros, Funaria, Polytrichum* Pteridophytes: *Psilotum, Lycopodium, Selaginella, Isoetes, Equisetum, Lygodium, Adiantum, Marsilea, Salvinia.*	3	K1-K5	15
IV	Comparative Morphological and anatomical studies of vegetative and reproductive parts of *Cycas, Cupressus, Araucaria, Podocarpus, and Gnetum.* Structural details	4	K1-K5	15

	of the following fossil types: *Lyginopteris, Medullosa. Rhynia, Lepidodendron, Sphenophyllum, Calamites*. Démonstration of sectioning of plant fossiles by vidéo clippings.			
V	Visit to National Fossil sites – Thiruvakkarai. Field trip - Algal collection	5	K1-K5	20

References

1. Bendre, A., "A Textbook of Practical Botany", Seventh Edition, Rastogi Publications, Meerut, 2000.
2. Malhotra, M. and Pathak, C., "A Text Book of Bryophyta", First Edition, Wisdom Press, New Delhi, 2012.
3. Parihar, N.S., "An Introduction to Embryophyta", Vol.II, Pteridophyta, Fourth Reprint Edition, Central Book Depot, Allahabad, 1963.
4. Rashid, A., "An Introduction to Bryophyta", Vikas Publishing House (P) Ltd., New Delhi,1998.
5. Rashid, A., "An Introduction to Pteridophyta", Vikas Publishing House (P) Ltd., New Delhi, 1999.
6. Sharma, P. D., "Fungi and Allied Organisms", Fifth Edition, Narosa Publishing House, New Delhi, 2005.
7. Sharma. O.P., "Pteridophyta", Second Edition, MacMillan India Ltd., New Delhi, 2006.
8. Sporne, K.R. "The Morphology of Gymnosperms", First Edition (Reprint),Scientific Publishers, Jodhpur, 2015.
9. Sporne, K.R. "The Morphology of Pteridophytes", Second Edition, Hutchinson University Library, London, 1966.
10. Vashista, P.C., Sinha, A.K. and Kumar, A., "Pteridophyta", First Edition (Reprint), S. Chand & Company Ltd., New Delhi, 2012.
11. Vashista, P.C., Sinha, A.K., and Kumar, A., "Gymnosperms", First Edition (Reprint), S. Chand & Company Ltd., New Delhi, 2013.

Web Resources:

1. Practical 2_Plant Diversity.pptx - Practical 2 Part 1 – Plant Diversity Dr Azma Abdul Malek PUSPA 2020 / | Course Hero

Course Outcomes (CO):

	CO Statement: Students will be able to understand, gain knowledge, apply and analyse	Knowledge Level
CO -1	the vegetative and reproductive structure of micro and macro algae	K1-K5
CO -2	the vegetative and reproductive structure of fungi	K1-K5
CO -3	the characters of Pteridophytes and Gymnosperms	K1-K5
CO -4	the evolutionary history of bryophytes, pteridophytes and gymnosperms	K1-K5
CO -5	the Bryophytes, Pteridophytes and Gymnosperms from other plant	K1-K5

	groups through filed collection					
Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	3	3	3	0
CO-2	3	3	3	2	2	0
CO-3	3	3	3	3	3	0
CO-4	3	3	3	3	3	0
CO-5	3	3	3	3	3	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	3	3	2	3	0
CO-2	3	3	2	2	2	0
CO-3	3	3	2	1	2	0
CO-4	3	3	2	1	3	0
CO-5	3	3	2	3	3	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Course Designer: Dr. P. Ravichandran

Addition of Objectives, outcomes and mapping: Dr. S. Muthukrishnan

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/CORE-3]

Semester : I
Course Type : Core
Title of the Course : Microbiology
Course Code : PBYC13

L	T	P	C
4	-	-	4
60 Hours/Semester			

Course objectives: Enable the students to:

Learn the historical developments in the field of microbiology, types of microbes and their classification, and the structure of selected microbes

1. study the nutritional behavior and methods to cultivate the microbes
2. understand how the microbes exchange genetic information and its consequence
3. Acquire the knowledge on nature and classification viruses and their importance in causing plant and human diseases.
4. comprehend the human immunological response to microbial infections

UNITS	CONTENT	CO	K Level	Hours
I	**Historical Developments & Classification** Introduction: Fundamentals, definition and scope; history and recent developments. Spontaneous generation, biogenesis. Diversity of microorganisms. Classification of Bacteria according to Bergey's manual. Ultra-structure of Archaea (*Methanococcus*); Eubacteria (*E. coli*); unicellular eukaryotes (*Yeast*).	1	K1-K3	10
II	**Microbial Techniques & Physiology** Microbial Techniques: microbial nutrition; types of culture media. Physical &chemical methods of sterilization. Cultivation of microorganisms: Pure culture, Batch, fed-batch, continuous culture, synchronous growth. Culture enrichment methods; culture collection and maintenance. Microbial growth estimation methods. Microbial Physiology**:** Bacterial growth, multiplication, nutritional requirements, growth inhibitors, bacteriostatic and antibiotic agents.	2	K1-K4	14
III	**Microbial Genetics** Microbial Genetics: Introduction and history of microbial genetics. Bacterial reproduction - transformation, conjugation and transduction. Plasmids: characteristics and types; Bacterial genomes (*E. coli);* recombination; transposons. Microbial Interactions and Infection:	3	K1-K4	12

	virulence, mechanism of pathogenesis, pathogenic properties. Microbial Toxins- types, structure and properties.			
IV	**Virology and microbial interactions** Virology: Structure and Classification of viruses; Bacterial, Plant, Animal viruses, bacteriophages, λ phage life cycle, RNA /retroviruses, severe acute respiratory syndrome corona virus 2 (SARS-CoV-2); satellite viruses, Viroids, Virusoids, control of virus - antiviral drugs. Microbial associations: Symbiotism, Amensalism, Commensalism, Parasitism and Predation with suitable examples. Plant-microbe interactions, molecular mechanisms. Rhizosphere bacteria. Role of *Rhizobium* and related bacteria in nitrogen fixation.	4	K1-K4	12
V	**Immunology** Basic concepts, cells and organs of immune system, adaptive and innate immunity, production and properties of T & B cells, types, structure & functions of immunoglobulin's, antigen-antibody interactions, MHC, agglutination, monoclonal and polyclonal antibodies, biological allergens, hypersensitivity, autoimmunity, immunodeficiency. Active and passive immunizations, vaccines types including Covid -19, production and uses.	5	K1-K4	12

Text Books

1. Tortora, G.J., Funke, B.R. and Case, C.L. 2016. Microbiology: An Introduction. Pearson Education, Inc., USA, 12th Edition.
2. Willey, J., Sandman, K. and Wood, D. 2019. Prescott's Microbiology. McGraw Hill, 11th Edition.
3. Pelczar, M.J. Jr, Chan, E.C.S and Kreig, N.R. 2006. Microbiology. Tata Mc Graw-Hill INC. New Delhi. 5th Edition
4. Dubey, R. C. and Maheswari, D. K. 2012. A text of Microbiology (Revised Edition). S. Chand and Company Ltd., New Delhi.
5. Parija, S.C. 2012. Textbook of Microbiology and Immunology, Reed Elsevier India Private Limited, 2nd Edition.

References

6. Madigan, M.T., Martinko, J.M., Stahl, D.A. and Clark, D.P. 2012. Brock Biology of Microorganisms. Pearson Education, Inc., publishing as Benjamin Cummings, San Francisco, 13th Edition.
7. Black, J.G. and Black, L.J. 2017. Microbiology: Principles and Explorations, Wiley, 10th Edition.
8. Alexander, A. M. 1974. Microbiology Ecology, John Willy & Sons.
9. Hyde, D.R. 2010. Genetics and Molecular biology: With Fundamentals of Biostatistics. Special Indian edition, Tata Mc Graw Hill P. Ltd., New Delhi.

10. Sumbali, G. and Mehrotra, R.S. 2009. Principles of Microbiology. 1st Edition, Tata Mc Graw Hill P. Ltd., New Delhi.
11. Moat, A.G., Foster, J.W. and Spector, M.P. 2002. Microbial physiology. 4th Edition, John Wiley sons, Inc., New Delhi
12. Ramawat, K.G. and Goyal, S. 2010. Molecular biology and Biotechnology. S. Chand & Co. Ltd., New Delhi.
13. Robert F Boyd. 1984. General microbiology. Times Mirror and Mosby College Publishers.
14. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12th Edition.

Web Resources:

1. https://microbiologysociety.org/
2. https://www.lecturio.com/medical-courses/microbiology.course #/
3. https://library.fvtc.edu/Microbiology/Videos
4. https://nptel.ac.in/courses/102103015
5. https://onlinecourses.nptel.ac.in/noc22_ce15/preview

Course Outcomes (CO):

	CO Statement: After successful completion of the course, the student will be able to	Knowledge Level
CO -1	Appreciate the co-existence of microbes in our environment and distinguish them based on the structural and functional features.	K1-K3
CO -2	understand the nutritional behavior of microbes and design media to cultivate microbes	K1-K5
CO -3	recognize how and why the microbes exchange genetic material; and the way to exploit such exchange for the benefit of cloning purposes	K1-K5
CO -4	differentiate the viruses from other microbes, understand the infection mechanism and classification of viruses	K1-K4
CO -5	comprehend the mechanism by which human body fights a pathogenic infection or an antigen; and the components of such a defense system	K1-K3

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	2	1	1	1	1
CO-2	3	2	1	1	1	1
CO-3	3	2	2	1	1	1

CO-4	3	2	1	1	1	1
CO-5	3	2	1	1	1	1
1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	2	2	1	-	-
CO-2	3	3	2	2	1	-
CO-3	3	3	2	2	1	-
CO-4	3	3	2	2	1	-
CO-5	3	3	2	2	1	-
1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Course Designer: Dr. P. Ravichandran
Addition of Objectives, outcomes and mapping: Dr. A. Selvam

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/CORE-4]

Semester : I
Course Type : Core
Title of the Course : Cell and Molecular Biology
Course Code : PBYC14

L	T	P	C
4	-	-	4
65 Hours/Semester			

Course objectives: To provide students an understanding on

1. Cell theory, structure and function of cells and its elements, mainly physicochemical properties of the organelles.
2. Membrane organization and signaling mechanism of the prokaryotic and eukaryotic cell.
3. Structure and function of nucleus and its parts, phases of cell cycle and its regulation, cell division, specialized chromosomes and banding patterns.
4. Basic organization of genetic material and the realms of events accompanied with replication and gene expression.
5. Mechanism of transcription, translation and post translational modifications of proteins.

UNITS	CONTENT	CO	K Level	Hours
I	**Cell structure** Cell theory, ultra-structure, prokaryotic and eukaryotic cells. Structure and functions of cytoplasmic organelles – Mitochondria and Chloroplast; Golgi apparatus, Ribosomes, Lysosome, Glyoxysome and Vacuoles. Cytoplasm: physicochemical properties and chemical composition.	1	K1-K4	10
II	**Membrane Organization and Cell Signaling** Plasma membrane: structure, chemical nature, models and functions, transport across cell membranes. Signal transduction**:** Overview, cell surface receptors, signal transduction cascades-second messengers and pathways. Regulation of signal transduction- e.g. two-component sensor-regulator system in bacteria and plants, bacterial chemotaxis and quorum sensing.	2	K2-K4	10
III	**Nucleus and Cell Division** Structure and functions of nucleus, nuclear envelope and nucleolus. Chromosome structure and packaging of DNA, organization of centromere and telomere. Phases of cell cycle and its regulation role of cyclins and Cdks. Cell divisions: Mitosis, Meiosis - Chromosomal aberrations-, duplications, inversions (paracentric and pericentric) and translocation. Euchromatin and heterochromatin; banding patterns; specialized types of chromosomes; polytene, lamp brush, sex chromosomes; Physical mapping of genes on	3	K1-K5	15

	chromosomes, Karyotype analysis.			
IV	**Nucleic Acids** Nucleic acids: Physical and chemical properties of DNA & RNA, Types of DNA & RNA, Watson and Crick model, Methylation of DNA and mismatch repair; C-value paradox; cot curve. Genetic code. Central Dogma of Molecular Biology; DNA as genetic material, DNA synthesis and replication, semi-conservative, DNA replication enzymes, replication in prokaryotic and eukaryotic cells.	4	K2-K5	15
V	**Transcription and Translation** Transcription: prokaryotic and eukaryotic transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, elongation and termination, RNA processing (capping, polyadenylation, RNA editing, and splicing), m-RNA transport and transcription inhibitors. Transcriptomics. Translation: prokaryotic and eukaryotic translation machinery, aminoacylation of tRNA, initiation factors, formation of initiation complex, elongation and elongation factors, termination, translational proof-reading, translational inhibitors. Post-translational modification of proteins.	5	K2-K4	15

Text Books

1. Karp, G., Iwasa, J. and Marshall, J. 2019. Karp's Cell and Molecular Biology, Wiley, 9th Edition.
2. Hyde, D.R. 2010. Genetics and Molecular biology: With Fundamentals of Biostatistics. Special Indian edition, Tata Mc Graw Hill P. Ltd., New Delhi.
3. Klein smith, L.J. and Kish, V. M. 1995. Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York, USA.
4. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12th Edition.
5. Rastogi, S.C. 2020. Cell and Molecular Biology, New Age International Publishers.

References

6. Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K. and Walter, P.2014. Molecular Biology of the Cell. Norton Publishers, 6th Edition.
7. David Freifelder. 2008. Essentials of Molecular Biology. Narosa Publishing house. New Delhi.
8. Krishnamurthy, K. V. 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
9. Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. 2018. Lewin's Genes XII. Oxford University Press, New York, 12th Edition
10. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Martin, K.C. 2016. Molecular Cell Biology. 4th Edition. WH Freeman and Co., 8th Edition.
11. Wolfe. S. L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co., California, USA.

12. Grierson, D and Covey, S.N. 1984. Plant Molecular Biology. Blackie and sons. ISBN 0 2169 1632 1.
13. Lewin. 2007. Gene XI. Jones and Barlett Pub. ISBN 0 7637 5222 3.
14. Watson, J.D. 2004. Molecular Biology of Gene 5th Edn. Pearson Edu. ISBN 0 321 223683.

Web Resources:

1. http://www.cytochemistry.net/cell-biology
2. http://www.e-booksdirectory.com/listing.php?category=344
3. http://door.library.uinc.edu/bix/biologicalliterature/molbiol.HTM
4. http://vlib.org/Science/Cell_Biology
5. http://www.goshen.edu/bio/Biol307/Biol307MCBRes.html

Course Outcomes (CO):

	CO Statement: Students would have understood the	**Knowledge Level**
CO -1	Basic structure and functions of unit of life and its components.	K1-K4
CO -2	Cell membrane organization and signaling mechanism in prokaryotes and eukaryotes.	K2-K4
CO -3	Details of nucleus, chromosomes, DNA packaging, cell cycle and cell division.	K1-K5
CO -4	DNA as a genetic material, physicochemical properties of nucleic acids and its replication mechanism.	K2-K5
CO -5	To acquire the knowledge of transcription and translation.	K2-K4

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	3	2	2	1
CO-2	3	2	3	2	2	0
CO-3	3	3	3	2	2	0
CO-4	3	3	3	2	2	0
CO-5	3	2	3	1	2	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	3	2	2	1	0
CO-2	3	2	1	2	0	0
CO-3	3	3	2	1	0	0
CO-4	3	3	2	2	1	0

CO-5	3	2	1	1	0	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Course Designer: Dr. P. Ravichandran
Addition of Objectives, outcomes and mapping: Miss. K. NANDHINI

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/PRACTICAL-2]

Semester : I
Course Type : Practical
Title of the Course : Microbiology, Cell and Molecular Biology
Course Code : PBYL12

L	T	P	C
-	-	8	4
90 Hours/Semester			

Course objectives: Enable the students to

1. understand the concepts of media sterilization, culturing of bacteria and differential staining of bacteria.
2. isolate the bacteria from different environmental matrices and evaluate the impacts of physical and chemical factor on the bacterial growth
3. determine microbial populations from soil and water matrices; and screening of microbes for specific functions.
4. perform extraction of DNA and clone and transform into a *E. coli* cell
5. study cell division types - mitosis and meiosis in plants

UNITS	CONTENTS	CO	K Level	Hours
I	1. Methods of sterilization and preparation of culture media for microbial growth. 2. Determination of bacterial growth & growth curve by turbidimetric method. 3. Simple and Differential staining for bacteria	1	K1-K5	15
II	4. Isolation of bacteria and achieving pure cultures from soil and water; and maintenance of organisms by plating, streaking and serial dilution methods. 5. Effect of temperature, pH and carbon and nitrogen sources on bacterial growth. 6. Assay of antibiotics and demonstration of antibiotic resistance.	2	K1-K5	20
III	7. Analysis of water for potability and determination of MPN. 8. Screening for amylase/ cellulase producing organisms. 9. Preparation of alcohol from fruit juice(s).	3	K1-K5	20

IV	10. Isolation and observation of genomic and plasmid DNA from microorganisms. 11. Transformation of E. coli.	4	K1-K6	25
V	12. Study of mitosis - onion root tip squash for chromosomal examination – Haematoxylin staining 13. Study of meiosis – *Tradescantia/Rheo* for chromosomal examination – acetocarmine staining	5	K1-K3	10

References

1. Willey, J., Sandman, K. and Wood, D. 2019. Prescott's Microbiology. McGraw Hill, 11th Edition.
2. Pelczar, M.J. Jr, Chan, E.C.S and Kreig, N.R. 2006. Microbiology. Tata Mc Graw-Hill INC. New Delhi. 5th Edition
3. Cappuccino, G., and Sherman, N. 2014. Microbiology: a laboratory manual, 10th ed., Pearson Education, Inc
4. Glick, B. R. and J. E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
5. Glover, D. M. and B. D. Hames (Eds). 1995. DNA cloning 1: A Practical Approach; Core Techniques, 2nd Edition PAS, IRL press at Oxford University Press, Oxford.
6. Gunning, B. E. S. and M. W. Steer. 1996. Plant Cell Biology: Structure and function. Jones and Bartlett Publishers, Boston, Massachusetts.
7. Hackett, P.B. and J. A. Fuchs, J. W. Messing. 1988. An Introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/ Cummings Publishing Co., Inc Menlo Park, California.
8. Hall, RD. (Ed). 1999. Plant Cell Culture Protocols. Humana Press, New Jersey.
9. Harris, N. and K. J. Oparka. 1994. Plant cell Biology: A Practical Approach. IRL Press, At Oxford University Press, Oxford, UK.
10. Shaw, C. H (Ed). 1988. Plant Molecular Biology: A Practical Approach. IRL Press, Oxford.

Web Resources:

1. https://mvi-au.vlabs.ac.in/
2. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
3. https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf
4. http://www-personal.umd.umich.edu/~poelkers/OelkersMolbiolmanualUMD2016.pdf
5. https://www.youtube.com/c/jacksonlaboratory/videos

Course Outcomes (CO):

	CO Statement: After successful completion of this course, student will be able to	Knowledge Level
CO -1	prepare and sterilize media, culture bacteria and staining through Gram staining	K1-K5

CO -2	isolate the bacteria from different environmental matrices and obtain pure culture	K1-K5
CO -3	determine microbial populations from soil and water matrices; and screening of microbes for specific functions.	K1-K5
CO -4	clone and transform into a *E. coli* cell	K1-K6
CO -5	study cell division types - mitosis and meiosis in plants	K1-K3

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	1	2	1	1	0
CO-2	3	1	2	1	1	0
CO-3	3	1	2	1	1	0
CO-4	3	1	1	1	1	0
CO-5	3	1	1	1	1	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	1	2	1	0	0
CO-2	3	1	2	1	0	0
CO-3	3	1	2	1	0	0
CO-4	3	1	1	1	0	0
CO-5	3	1	1	1	0	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – Advance application						

Course Designer: Dr. P. Ravichandran

Addition of Objectives, outcomes and mapping: Dr. A. Selvam

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/Elective - 1]

Semester : I
Course Type : Elective
Title of the Course : Evolutionary Biology
Course Code : PBYEA

L	T	P	C
3	-	-	3
50 Hours/Semester			

Course objectives: To teach students on

1. Origin, evolution and early history of living organisms, evolutionary theories, experiments and concepts
2. Origin and selection of species based on Darwin's theory and human evolution
3. Evolutionary genetics and extinction of species
4. Origin and life cycle of non-vascular and vascular plants
5. Evidences of evolution based on fossil records

UNITS	CONTENT	CO	K Level	Hours
I	**Origin and Early History of Life** Definition of Life, Fundamental properties of life. Theories about origin of Life - special creation, extraterrestrial origin, spontaneous origin. Scientific view point – Miller Urey experiment, chemical evolution, RNA world, protein world, a peptide nucleic acid world, Microevolution – Endosymbiosis, Prokaryotes, Protists, Fungi, and Plants. Macroevolution, Geological time scale.	1	K1-K2	10
II	**Origin of Species and Selections** Nature of species, Species concept, Natural selection and speciation, Geography of speciation; levels of selection. Darwin and theory of evolution. Units and Types of selection; sexual selection genetic drift; gene flow; adaptation; convergence. Human evolution – Earliest Primates, Prosimians, Anthropoids, Apes and Hominoids, Australopithecines, Early Homo, Modern Human evolution – Homo sapiens.	2	K1, K3	10
III	**Evolutionary Genetics** Origin of genetic variation; Mendelian genetics; quantitative and polygenic traits, linkage and recombination; epistasis, gene-environment interaction; heritability; population genetics; molecular evolution. Mutation and migration; phylogenetic	3	K2-K4	10

	analysis and comparative methods; extinction and diversity of life forms.			
IV	**Evolutionary History of plants** Origin of plants, Early plant life cycles. Non vascular plants – Mosses, Liverworts, Hornworts. Features of vascular plants. Seedless vascular plants. Seed plants – Gymnosperms and Angiosperms.	4	K2-K4	10
V	**Fossil Records and Evidences of Evolution** Role of environment in development and evolution; major transition in evolution; co-evolution; Evidences for Evolution-from fossils, anatomical and embryological evidences, homologous and analogous organs.	5	K2-K5	10

Text Books

1. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12thEdition.
2. Futuyma, D.J. and Kirkpatric, M.2017. Evolution. Sinauer Associates, U.S.A, 4th Edition

References

3. Hartl, D. L. 1988.A primer of population genetics (2nd Edition).
4. Jon C. Herron and Scott Freeman. 2014. Evolutionary analysis (5th Edition.).
5. Mark Ridley. 2004. Evolution (3rd Edition). Blackwell Publishing Ltd., UK
6. Peter J. Russell, Stephen L. Wolfe, Paul E. Hertz and Cecie Starr. 2008. Biology: The Dynamic Science.
7. Sean, BC, Grenier J Kand Weather Bee, SD. From DNA to Diversity (2nd Edition).
8. Sober, E. 1994. Conceptual issues in evolutionary biology.
9. Steven Gaulin & Donald Mc Burney. 2004. Evolutionary Psychology (2nd Edition).

Web Resources:

1. https://www.youtube.com/watch?v=ehV-MmuvVMU - Human Origins 101 | National Geographic
2. https://www.youtube.com/watch?v=DZv8VyIQ7YU - Seven Million Years of Human Evolution
3. https://www.youtube.com/watch?v=K3n370ww3L4- Hominin Evolution, Part 1: The First 5 Million Years
4. https://www.youtube.com/watch?v=_ANNQKKwWGk - The Humans That Lived Before Us
5. https://www.youtube.com/watch?v=dyiZaHIRM6w&list=PLi6K9w_UbfFSxHPEDWcXxIxSA6gDR4OeZ

- How Evolution Works (And How We Figured It Out)

6. https://www.youtube.com/watch?v =FFI50iSPWeI&list=PLi6K9w_ UbfFSxHPEDWcXxIxSA6gDR4OeZ&index=7 - When We First Made Tools

Course Outcomes (CO):

	CO Statement: Students will be able to	Knowledge Level
CO -1	understand the Origin, evolution and early history of living organisms, evolutionary theories, experiments and concepts	K1-K2
CO -2	gain knowledge on the Origin and selection of species based on Darwin's theory and human evolution	K1, K3
CO -3	analyse and interpret the evolutionary genetics and extinction of species	K2-K4
CO -4	comprehend how plants originated and remember the life cycle of non-vascular and vascular plants	K2-K5
CO -5	appreciate the evolution of all living organisms based on available fossil and experimental evidences	K2-K5

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	2	1	1	0
CO-2	3	2	2	0	2	1
CO-3	2	1	3	1	3	1
CO-4	2	3	2	0	2	1
CO-5	1	2	2	0	1	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	2	0	0	0	0
CO-2	2	2	0	0	0	0
CO-3	2	2	1	0	1	0
CO-4	2	2	0	0	0	0
CO-5	2	2	1	0	1	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. P. Ravichandran

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/Elective - 1]

Semester : I
Course Type : Elective
Title of the Course : Plant Diseases and Insect Pest Control
Course Code : PBYEB

L	T	P	C
3	-	-	3
45 Hours/Semester			

Course objectives: Enable the students to

1. learn the concepts of diseases, classification of disease based on the pathogens, and diagnostic methodologies.
2. know the diseases caused by fungi and bacteria and demonstrate the mechanism of infection
3. learn the diseases caused by viruses and MLOs and the mechanism of infection
4. understand the damages caused by the insect pest and know about the structure and function of insects
5. apprehend the life cycle of insects in relation to plant diseases and biological methods to control the same caused by insects

UNITS	CONTENTS	CO	K Level	Hours
I	**Concept of Plant Diseases and Diagnosis** Concepts of Plant diseases, Classification of plant disease based on casual organisms such as Fungi, Bacteria, Viruses, MLO's. Impact of plant diseases on crop production. Assessment, Diagnosis, Identification of casual organism by Koch postulates, microscopic principles of plant disease control, Histochemical and Serological methods of studying plant pathogens. Molecular basis of diagnosis, Chemicals, Enzymes of pathogens in infective, Microbial toxins. Modern techniques in analysis of plant diseases.	1	K1-K3	9
II	**Fungal and Bacterial Diseases** Fungi and fungal disease, and Storage fungi, Infectious fungi, Mechanism of infection and Dissemination of fungal diseases, Symptomology and Identification of fungal diseases. Bacteria and bacterial disease, Classification, Mechanism of infection, Dissemination, Symptomology and Identification.	2	K1-K3	9
III	**Viral Disease** Viruses and viral diseases: Mechanism of Infection and Dissemination symptoms and Methods of Identification, MLO's as diseases causing Prokaryotes, Classification of MLO'S. Diseases caused, Symptoms, Method of infection	3	K1-K3	9

	and Identification. Parasitic Green algae and parasitic higher plants – Symptoms and Identification.			
IV	**Insects** Introduction of insects: Pests, General characters, Habitats, Damage, Economic Threshold Level, Natural enemies, Parasitoids and Predators. General description and morphology of the Insect: Head, Thorax and Abdomen. Anatomy and Physiology of the Insect: Digestive system, Nervous system, excretory system, Reproductive system and Circulatory system.	4	K1-K4	9
V	**Classification of Insect Pests and Biological Control** Classification of Insect pests based on Nature of damage, Mouth parts, Metamorphosis. General life cycle patterns of insect pests: Grasshopper, Aphid, Lepidopteron Borer, White grub, Red hairy caterpillar, Snails, Slug, Nematodes, Rat. Application of insecticides – Targets, Droplet size, Application equipment, rational application. Biological control - Types of biocontrol agents. Techniques of biocontrol. Genetic control and area-wide management.	5	K1-K4	9

Text Books

1. Agrios, G.N. Plant Pathology. 2004 (5th Edition). Academic Press.
2. Larry P. Pedigo. Entomology and pest management.
3. Tarr, S. A. J. 1972. Principles of plant pathology.

References

4. Atwal, A. S. Agriculture pest of India and South East Asia.
5. Green, M. B. Chemical for crop improvement and pest management.
6. Maniloff, J.1992. Mycoplasma molecular biology and pathogenesis.
7. Mundkar, B. B. 1972. Fungi and plant diseases.
8. Paul and Khurana, S. M. 1998. Pathological problems of economic crop plant and their management.
9. Raychandhuri, S. P. and Varma, A. 1989. Plant diseases caused by fastidious Prokaryotes.
10. Srivastava, K. P. A textbook of applied entomology.
11. Thurston, H. D. 1993. Tropical plant diseases.

Web Resources:

1. https://www.youtube.com/c/usuextension/search?query=pathology
2. http://hillagric.ac.in/edu/coa/ppath/lectures.htm
3. https://onlinecourses.swayam2.ac.in/cec21_bt16/preview
4. http://ecoursesonline.iasri.res.in/course/view.php?id=143
5. http://ecoursesonline.iasri.res.in/course/view.php?id=143

Course Outcomes (CO):

	CO Statement: After successful completion of the course, the student will be able to	Knowledge Level
CO -1	distinguish the diseases caused by different groups of organisms, method to identify the diseases, and mechanism of plant defense against pathogens	K1-K3
CO -2	identify the diseases caused by fungi and bacteria and demonstrate the knowledge on the mechanism of infection	K1-K3
CO -3	determine the diseases caused by viruses and MLOs; and demonstrate the knowledge on the mechanism of infection	K1-K3
CO -4	assess the damage caused by insects on plant production and acquire the knowledge on the mechanism of action	K1-K4
CO -5	understand the link between the life cycle of insects and the disease; and know the control strategies	K1-K4

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	2	3	1	0	0
CO-2	3	2	3	1	0	0
CO-3	3	2	3	1	0	0
CO-4	3	2	3	1	0	0
CO-5	3	2	3	1	0	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	1	1	1	0	0
CO-2	3	1	1	1	0	0
CO-3	3	1	1	1	0	0
CO-4	3	1	1	1	0	0
CO-5	3	1	1	1	0	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. P. Ravichandran
Addition of objectives, outcomes and mapping: Dr. A. Selvam

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/Elective - 1]

Semester	**:**	**I**
Course Type	**:**	**Elective**
Title of the Course	**:**	**Aquatic and Marine Plants**
Course Code	**:**	**PBYEC**

L	T	P	C
3	-	-	3
45 Hours/Semester			

Course objectives:

1. To understand distribution, morphology, reproduction and life cycles of aquatic plants.
2. To provide insights into culture techniques, importance and applications of micro algae and higher macrophytes.
3. To know the range of factors affecting growth and development of aquatic plants.
4. To understand the structure, growth, development and reproduction of angiosperms.
5. To acquaint carbon storage, sequestration potential; and chemical structure, properties of metabolites from aquatic plants.

UNITS	CONTENT	CO	K Level	Hours
I	**Plant aquaculture** History, principles, scope and importance. Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques of two sea weeds. Important cultivable species of aquatic plants, sea weeds, micro algae and their systematic position. Biodiversity of Seaweeds along the coast of India. Products from seaweeds.	1	K1-K4	5
II	**Freshwater Algae and Higher Vascular Plants** Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques and Importance of *Spirulina* and *chlorella*. Application of microalgae in water treatment and bioremediation. Biodiversity of freshwater macrophytes in India. Taxonomy of economically important macrophytes. Distribution, morphology, reproduction, life cycle, growth physiology and Culture techniques of freshwater higher vascular plants (*Trapa*, *Typha*), products of aquatic macrophytes.	2	K1-K4	10
III	**Phytoplankton (Freshwater and Marine)** Methods of assessment - spatial and temporal variations – succession - diversity; Nanoplankton; Algal blooms; Role in carbon sequestration. Classifications of plankton; Primary and secondary production - estimation, significance, affecting factors; Production - biomass (P/B ratio); Indices of productivity; Community interrelationships.	3	K1-K4	10
IV	**Storage and Structural Components in Algae** Seaweed polysaccharides- Chemical structure, properties	4	K1-K4	10

	and extraction of Agar. Nutrient requirement- Essential elements, vitamins for growth of algae. Metabolic role of essential nutrients. Salt regulation in halophytes: Salt glands and salt secretion. Significance of vivipary. Leaf succulence, selective ion absorption. Salinity and metabolism: Influence of salinity on photosynthesis of halophytes. Carbon fixation in CAM plants. Membrane transport under salinity. Effect of salinity on growth and phytohormones.			
V	**Biodiversity of Mangroves** Brief idea of Creek, Estuary, Lagoon and Delta. Definition -'Mangrove'. Distribution – biogeography of Indian mangroves, East and West coast mangroves, Mangrove shores and forests. Salient features of important mangrove families such as *Rhizophoraceae, Sonneratiaceae, Avicenniaceae, Myrsinaceae, Acanthaceae*. Methods of natural and artificial regeneration in mangroves. Carbon sequestration potential of mangrove ecosystem.	5	K1-K4	10

Text Books

1. Chapman, V. J. 1976. Costal Vegetation 2nd edition. Pergamon Press, New York.
2. Fasset, NG.1997. A Manual of Aquatic Plants. Allied Scientific Publishers, Bikaner

References

1. Jackson, D. F. 1972. Algae and Man. Plenum Press.
2. Lobban, C. S. and P. J. Harrison. 1985. Seaweed Ecology and Physiology.
3. Lund, H. C. and J. W. G. Lund. 1995. Freshwater Algae. Biopress Ltd., Bristol.
4. Mc Connaughey, BH.1974. Introduction to Marine Biology.CV Mosby Co, St. Louis.
5. Ring, M. 1982. The Biology of Marine Plants. Edward Arnold Publishers, London.
6. Sournia, A. 1978. Phytoplankton Manual. UNESCO Publication, Paris.
7. Tomas, C. R. 1997. Identifying Marine Phytoplankton. Academic Press, San Diego.
8. Subramanyam, K. 1962. Aquatic Angiosperms. A systematic account of common Indian aquatic angiosperms. Council of Scientific and Industrial research, New Delhi, India.
9. Lucas J S, Southgate PC, Tucker CS. Aquaculture: Farming Aquatic Animals and Plants. 2019. John Wiley and Sons. (1st Edition).

Web Resources:

1. https://tamilandvedas.com/tag/tamil-culture/
2. https://peacefulsocieties.uncg.edu/2013/01/31/flowering-plants-tamil-poetry-and-the-paliyans/
3. https://www.speakingtree.in/blog/flowers-in-tamil-culture
4. https://irjt.iorpress.org/index.php/irjt/article/view/181
5. https://www.youtube.com/watch?v=5iOTq6kb4qM
6. https://www.youtube.com/watch?v=Il-EFqB9c0Q

Course Outcomes (CO):

	CO Statement: Students will be able to remember, understand, apply and analyse	Knowledge Level
CO -1	Distribution, morphology, reproduction, life cycle, growth physiology and culture techniques of cultivable aquatic plants.	K1-K4
CO -2	Application and economic importance of lower and higher aquatic plants.	K1-K4
CO -3	Productivity indices, carbon storage and sequestration potentials of aquatic micro and macrophytes.	K1-K4
CO -4	Chemical structure, properties and extraction of metabolites from economically important micro and macrophytes.	K1-K4
CO -5	Diversity, cultivation, biology and carbon sequestration of Indian mangroves	K1-K4

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	2	1	1	-
CO-2	3	3	2	2	2	-
CO-3	3	2	1	1	2	-
CO-4	3	3	1	1	2	-
CO-5	3	2	2	1	3	-
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	2	1	2	2	1
CO-2	3	2	2	2	1	1
CO-3	3	2	2	2	1	1
CO-4	3	2	2	2	2	1
CO-5	3	2	2	3	2	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. P. Ravichandran
Modified by: Dr. M. Udayakumar

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-II/CORE-5]

Semester	**:**	**II**
Course Type	**:**	**Core**
Title of the Course	**:**	**Anatomy and Embryology of Angiosperms**
Course Code	**:**	**PBYC21**

L	T	P	C
6	-	-	4
65 Hours/Semester			

Course objectives:

1. To provide insights into basic concepts of development and internal structures of the most evolved group of plants, the angiosperms.
2. To know salient features and evolutionarily advanced anatomical and reproductive characteristics of angiosperms through molecular biology.
3. To understand the structure, growth, development and reproduction of angiosperms.
4. To get an insight in to pollination, fertilization and post-fertilization changes takes place in angiosperms through biochemistry.
5. To familiarize with plant histo-chemistry with special reference to various stains and staining procedures.

UNITS	CONTENT	CO	K Level	Hours
I	**Basic concepts of development** Cell structure and its components, ergastic substances; potency, commitment, specification, induction, competence, determination and differentiation; cell fate and cell lineages; classification of tissues, origin, development and functions of simple and complex tissues. Senescence and Programed cell death (PCD): Basic concepts, types of cell death, PCD in the life cycle of plants, metabolic changes associated with senescence and its regulation; nutrient resorption during senescence; influence of hormones and environmental factors on senescence.	1	K1-K4	15
II	**Morphogenesis and organogenesis in plants** Structure, development and functions of root hairs; types of vascular bundles; Meristem and types, theories on root and shoot apical meristems; Organization of shoot and root apical meristem; molecular biology of SAM and RAM; leaf initiation and development, types of phyllotaxy; tropisms; internal structures of root, stem, leaf, petiole and node; epidermal zone, types of trichomes; oil glands, latex cells and vessels; cambium, secondary thickening, anomalous secondary thickening; ecological anatomy: mesophytes, hydrophytes and xerophytes; transition to flowering, floral meristems and floral development in *Antirrhinum*, sex determination; genes involved in growth and development;	2	K1-K4	15

	Unique features of plant development; difference between plant and animal development.			
III	**Reproduction** Vegetative and sexual reproduction; Male gametophyte: anther structure; microsporogenesis; role of tapetum; pollen development and gene expression; sperm dimorphism; pollen germination, pollen tube growth and guidance; pollen embryos; Female gametophyte: Ovule development; megasporogenesis; organization of the embryo sac, structure of the embryo sac cells; establishment of symmetry in plants.	3	K1-K4	10
IV	**Pollination and fertilization** Pollen-pistil interaction and fertilization: Floral characteristics, pollination mechanisms. Structure of pistil; pollen-stigma interactions, sporophytic and gametophytic self-incompatibility (cytological, biochemical, molecular aspects); double fertilization. Embryogenesis: dicot and monocot, polyembryony, apomixes. Endosperm development and types; storage proteins of endosperm; anatomy of seed, seed types, seed germination types, biochemistry of seed germination, genes involved in seed development and germination; Dynamics of fruit growth, biochemistry and molecular biology of fruit maturation, seed to seed lifecycle of angiosperm.	4	K1-K5	15
V	**Histological staining and procedures** Usage and Preparation of common lab stains and reagents: Basic stains (Safranin, Crystal violet, Basic fuchsine, Cotton blue); Acidic stains (Fast green, Orange G, Erythrosine, Eosin, and Toluidine blue O). Staining procedures: Single, double and triple staining. Staining combinations (safranin and fast green /cotton blue crystal violet/ orange-G and safranin). Histochemical analysis of plant tissues. Histochemical staining and analysis of plant metabolites. Histochemical localization of minerals, proteins, nucleic acids, insoluble carbohydrates and lipids.	5	K1-K5	10

Text Books

1. Dickson, W.C. 2000. Integrative Plant Anatomy, Elsevier, USA.
2. Crang, R., Lyons-Sobaski, S and Wise, R. 2019. Plant Anatomy: A Concept Based Approach to the Structure of Seed Plants. Springer Nature, Switzerland.
3. Beck, C.B. 2010. An Introduction to Plant Structure and Development: Plant Anatomy for the Twenty-First Century. 2nd Edition. Cambridge University Press, United Kingdom.

4. Bhojwani, S. S. and S. P Bhatnager. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
5. James D. Mauseth. 2003. Botany: An Introduction to Plant Biology. Jones & Bartlett Learning.
6. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
7. Ray F. Evert. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development. John Wiley & Sons. Hoboken, New Jersey.

References

8. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
9. Fageri, K. and L. Van der Piji. 1979. The Principles of Pollination Ecology. Pergamon Press, Oxford.
10. Fahn, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford.
11. Fosket, DE.1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Diego.
12. Howell, S. H. 1998. Molecular Genetics of Plant Development. Cambridge University Press, Cambridge.
13. Leins, P. and S. C. Tucker, P. K. Endress. 1988. Aspects of Floral Development. J. Cramer, Germany.
14. Raven P.H. and G.B. Johnson, J.B. Losos, K.A. Mason, S.R. Singer. 2008. Biology 8th ed. Mc Graw Hill, Higer Education. Boston, Madison, New Delhi.
15. Proctor, M. & Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London.
16. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
17. Shivanna, K. R. and B. M. Johri. 1985. The Angiosperm Pollen: Structure and Function. Wiley Eastern Ltd., New York.

Web Resources:

1. https://cms.botany.org/media/collection/id.24.html
2. https://www.ccber.ucsb.edu/ucsb-natural-history-collections-botanical-plant-anatomy/glossary-terms-related-plant-anatomy
3. https://www.enchantedlearning.com/subjects/plants/plant/

Course Outcomes (CO):

	CO Statement: Students will be able to remember, understand, apply and analyse	Knowledge Level
CO -1	Basic concepts of origin, development, fate and functions of range of cells and tissues of angiosperms.	K1-K4
CO -2	Morphogenesis and organogenesis of angiosperms and molecular aspects of growth and development	K1-K4
CO -3	Vegetative, sexual reproductions, and micro-, and megasporogenesis of angiosperms	K1-K4
CO -4	Pollination mechanisms and biochemistry of fruit maturation and	K1-K5

	seed germination	
CO -5	Preparation and use of selected natural and synthetic stains to understand the internal structures of angiosperms	K1-K5

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	2	2	2	1
CO-2	3	3	2	2	1	1
CO-3	3	3	2	1	1	-
CO-4	3	3	2	2	2	1
CO-5	3	3	2	2	2	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	2	2	2	2	1
CO-2	3	3	2	2	2	1
CO-3	3	2	2	2	1	1
CO-4	3	2	2	2	2	1
CO-5	3	2	2	2	2	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. M. Udayakumar

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- II/Practical -3]

Semester	**:**	**II**
Course Type	**:**	**Practical**
Title of the Course	**:**	**Anatomy and Embryology of Angiosperms-Practical**
Course Code	**:**	**PBYL21**

L	T	P	C
-	-	4	2
60 Hours/Semester			

Course objectives:

1. To conceptually integrate organismal structure, function and development.
2. To understand the relationships among structure and functions of various organs of angiosperms.
3. To distinguish internal anatomy of dicotyledons with that of monocotyledons.
4. To understand clearly about the young and mature reproductive organs of angiosperms.
5. To differentiate range of cells and tissues through natural, synthetic, acidic and basic stains.

UNITS	CONTENT	CO	K Level	Hours
I	**Seed germination and internal structures of organs** 1. Study of seed germination processes (monocotyledon and dicotyledon) 2. Estimation of moisture content of seeds and its relation to loss of viability 3. Anatomy of monocotyledon root, stem, leaf and C_3,C_4 leaf anatomy in grasses 4. Anatomy of dicotyledon root, stem, leaf and petiole 5. Leaf epidermal peelings to study types of stomata, stomatal index	1	K1-K4	15
II	**Apical meristems and secondary thickening** 6. Study of living shoot apices by dissection using aquatic plants such as *Ceratophyllum* and *Hydrilla.* 7. Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordia. 8. Anomalous secondary thickening in stem of *Achyranthes*, *Bougainvillaea* and *Dracaena*	2	K1-K4	15
III	**Ecological anatomy** 9. Leaf Anatomy of hydrophyte and xerophyte 10. Estimation of wood density and carbon content 11. Study of leaf area, specific leaf area and leaf dry matter content	3	K1-K5	10
IV	**Reproduction process** 12. Study of flower diversity in tropical dry forest 13. Acetolysis of pollen grains 14. *In vitro* germination of pollen grains	4	K1-K4	15

	15. Morphology and anatomy of stigma, style ovary and embryo and tracing different stages of embryos			
V	**Histological staining and procedures** 16. Single and double staining Methods using fresh hand sections	5	K1-K5	10

Text Books

1. Ramsay JL. 2012. Plant Anatomy and Diversity: A Botany Lab Manual. Kendall/Hunt Publishing Co., USA.
2. Popham RA. 1966. Laboratory Manual for Plant Anatomy (Digitized version 2010), The University of Michigan, Kimpton, USA.
3. Peterson RL, Peterson RA, Melville LH. 2008. Teaching Plant Anatomy through Creative Laboratory Exercises. Canadian Science Publishing, NRC Research Press.
4. de Bary A. 2020. Comparative Anatomy of the Vegetative Organs of the Phanerogams and Ferns. Alpha Editions, USA.
5. Mauseth JD. Botany: A Lab Manual. 6th Edition, Jones and Bartlett Publishers. Massachusetts, USA.

Web Resources:

1. http://cupac.bh.cornell.edu/anatomy_manual/CUPACplantanatomy.pdf
2. http://www1.biologie.uni-hamburg.de/b-online/library/webb/BOT410/anatweb/labs.htm
3. http://amrita.olabs.edu.in/?sub=79&brch=18&sim=228&cnt=4

Course Outcomes (CO):

	CO Statement: Students will be able to remember, understand, apply and analyse	Knowledge Level
CO -1	Basic processes of seed germination, and internal structures of leaf, stem and root.	K1-K4
CO -2	Apical meristems and anomalous secondary thickening in angiosperms	K1-K4
CO -3	Ecological anatomy, cardinal leaf traits, wood density and carbon contents of angiosperms.	K1-K5
CO -4	Structure of range of flowers, pollen grains; and embryo development.	K1-K4
CO -5	Preparation and use of selected natural and synthetic stains to understand the internal structures of angiosperms	K1-K5

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	2	1	2	1

CO-2	3	3	2	2	2	1
CO-3	3	3	2	2	2	1
CO-4	3	3	2	2	2	1
CO-5	3	3	2	2	2	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	2	2	2	2	1
CO-2	3	2	2	1	2	1
CO-3	3	2	2	2	2	1
CO-4	3	2	2	1	2	1
CO-5	3	2	2	2	2	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. M. Udayakumar

[2022/MSU 53rd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- I/CORE-6]

Semester : II
Course Type : Core
Title of the Course : Instrumentation and Research Methodology
Course Code : PBYC22

L	T	P	C
4	-	-	4
60 Hours/Semester			

Course objectives: To enable the students

1. To understand the knowhows on principles and practical knowledge onpH and EC, spectroscopy and chromatography.
2. To understand the principles and applications of electrophoresis, microscopy, centrifugation and blotting techniques
3. To understand the principles of data management and statistical analysis.
4. To understand the theory of microtome, sectioning and staining
5. To understand the types of research and ethics relevant to research and publications

UNITS	**CONTENT**	**CO**	**K Level**	**Hours**

I	**Buffering, spectroscopy and chromatography** Principles and operations: pH meter, Electrical conductivity and salinity meters. Preparation of Molar, Normal, ppm, percentage and buffer solutions. Spectrophotometry: Beer's Lambert law and its application, UV- visible spectrophotometer, AAS, GC-MS, IR, NMR and Raman spectroscopy. Chromatography: Principles and applications; Paper, Thin Layer, Column and HPLC.	1	K1-K4	10
II	**Electrophoresis, Microscopy and Centrifugation** Electrophoresis: principles and applications, support media and buffers, electrophoresis of proteins and nucleic acids, and capillary electrophoresis. Blotting Techniques: Southern, Western and Northern blots. Gel documentation systems. Radioactive and Non-Radioactive probes and uses. Autoradiography. DNA finger printing Techniques. Microscopy: Principles and applications of Light, Compound, Phase-Contrast microscopes, Fluorescent microscopy, Electron microscopy: TEM, SEM; Confocal microscopy. Micrometry: Ocular and stage meter and Image analysis. Centrifugation: principles; types: low-speed, High speed, Micro and Ultra centrifuges. Sedimentation coefficient, Svedberg (S) unit, RPM, RCF, g; rotor types (fixed angle, swinging bucket, vertical, zonal), Preparative centrifugation: differential &density gradient centrifugations.	2	K1-K4	15
III	**Biostatistics** Principles, practice of statistical methods in biological research; sources and presentation of data. Measures of Central Tendency: Mean, Median and Mode. Measures of Dispersion: Range, mean deviation, standard deviation, coefficient of variation and standard error. Simple correlation and linear regression analysis. Probability: Basic concepts. Theoretical distributions: Binomial, Poisson and Normal. Tests of statistical significance: Chi-square and *t*-tests. F-distribution and Analysis of Variance (ANOVA): one way & two-way. Data presentation	3	K1-K5	15

	in MS-Excel.			
IV	**Microtome sectioning** Microtome types: Rotary, Sledge, and Cryostat. Micro preparation processing procedure; Fixing: common fixatives, preparation & specific uses; Dehydration: Dehydrating agents, Clearing – Xylol/TBA series, Paraffin infiltration; Wax embedding. Blocks Preparation: wax blocks & paper boats. Sectioning paraffin blocks in rotary microtome. Adhesives & their preparations. Mounting and spreading of paraffin ribbons on micro slides. Processing & preparation of ultrathin sections-TEM.	4	K1-K4	10
V	**Research Methodology** Types of research, scientific research: hypothesis, experimentation, theory. Preparation of research articles: review article, research papers, online publications, thesis writing, editorial process, proof-reading symbols, Science communication, popular writing in magazines and newspapers. Presentation of research papers in seminar, symposia and conferences. Research ethics.	5	K1-K5	10

Text Books

1. Boyer, R.F. 2000. Modern Experimental Biochemistry. 3rdedn. Prentice Hall Publ. ISBN 0 8053 31115.
2. Gurumani, N.2014. Research Methodology for Biological Sciences. MJP publishers, Chennai.
3. Kothari, C.R. and Garg, G. 2019. Research Methodology: Methods and Techniques. New Age International Publications, New Delhi.
4. Hofmann, A. and Clokie, S. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, New Delhi.

References

5. Jensen, W. A. 1962. Botanical Histochemistry. WH Freeman & Company.
6. Johansen, D. A. 1940. Plant Micro technique. McGraw Hill.
7. Khasim, S. M. 2002. Botanical Microtechnique: Principles and Practice. Capital Publishing Company.
8. Miksche, J. P. 1976. Botanical Microtechnique and Cytochemistry. Dowa StateUniversity Press.
9. Panse and Sukhatme. 1992. Statistical Methods for Agricultural workers. ICAR, New Delhi.
10. Sanderson, J. B. 1994. Biological Micro technique. Bios Scientific Publishers.
11. Sandhu, G.S. 1990. Research techniques in biological sciences. Anmol Publications, New Delhi.

12. Jeyaram, J.1998. Laboratory Manual in Biochemistry. New Age InternationalPublishers Ltd.
13. Raven P.H. and G.B. Johnson, J.B. Losos, K.A. Mason, S.R. Singer. 2008. Biology 8th ed. Mc Graw Hill, Higher Education. Boston, Madison, New Delhi.

Web resources

1. https://onlinecourses.nptel.ac.in/noc22_ge08/preview
2. https://nptel.ac.in/courses/121106007
3. https://onlinecourses.nptel.ac.in/noc21_hs85/preview
4. https://onlinecourses.nptel.ac.in/noc21_ge12/preview
5. https://nptel.ac.in/courses/103108100

Course Outcomes (CO):

Course Outcomes	CO Statement: After successful completion of the course, the student will be able to	Knowledge Level
CO -1	measure the pH, EC and salt contents using electrodes, prepare buffering solutions to be used in experimental assays, analyze the samples through different spectroscopic procedures.	K1-K4
CO -2	efficiently use electrophoretic technique to separate biomolecules; use various types of microscopes through a thorough understanding of optics and dyes involved; demonstrate the knowledge of different types of centrifuges	K1-K4
CO -3	be proficient in collection, presentation and statistical analyses of data; proficiency to make a conclusion; and use of excel to organize data.	K1-K5
CO -4	understand the nature and applicability of different chemicals used in microtechnique; process plant materials for microtome sectioning; and handle microtomes to take fine sections.	K1-K4
CO -5	design unbiased experimental design and conduct experiments to test the hypothesis following the ethics and codes; and proficient in presenting the results in scientific forums and in thesis.	K1-K5

Knowledge Level	K1	K2	K3	K4	K5	K6
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes (PSO) with Course Outcomes (CO):

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	2	3	2	3	1
CO-2	3	3	3	2	2	1
CO-3	3	2	2	2	3	3

CO-4	3	2	2	2	2	3
CO-5	3	2	2	2	3	3
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes (PO) with Course Outcomes (CO):

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	3	3	2	2	1
CO-2	3	3	3	2	2	1
CO-3	3	3	3	2	3	2
CO-4	3	3	3	2	2	1
CO-5	3	3	3	2	3	2
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. P. Ravichandran
Addition of Objectives, outcomes and mapping: Dr. A. Selvam

[2022/MSU 53rd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-II/ CORE – 7]

Semester : II
Course Type : Core
Title of the Course : Genetics, Genomics and Bioinformatics
Course Code : PBYC23

L	T	P	C
4	-	-	4
70 Hours/Semester			

Course objectives:

1. To understand the laws of inheritance, modified mendelian ratios, gene mapping, cytoplasmic inheritance, ploidy types and population genetics.
2. To know about the nature of mutations and its molecular mechanism, diagnosing methods, applications of mutations and homeotic mutants in plants.
3. To introduce the modern concepts of genomics and proteomics.
4. To know the history, introduction and scope of Bioinformatics, role of computers in biology, search engines and database management systems.
5. To find out the biological databases, Primary nucleotide sequence databases, Sequence Alignment and Analysis, Molecular modeling and visualization tools, Phylogenetics.

UNITS	CONTENT	CO	K Level	Hours
I	**Mendelian Genetics** Laws of inheritance, modified Mendelian ratios: complementary and supplementary genes. Lethal genes, alleles, multiple alleles, pseudo alleles. Quantitative genetics: Polygenic inheritance (kernel colour in wheat, ear head length in maize), QTL mapping. Behavior of chromosomes during meiosis, non-disjunction, chiasma formation, linkage and crossing over – theories. Ploidy types and significance - haploids, aneuploids and euploids, auto and allopolyploids. Self-incompatibility in *Nicotiana*. Population genetics; Hardy-Weinberg Equilibrium. Extra-chromosomal or Cytoplasmic inheritance: male sterility.	1	K2-K4	10
II	**Mutation and Repair of DNA** Nature of Mutations, types of mutations, methods of detection of mutation: Ames test, CIB method and attached-X method, Molecular mechanism of spontaneous and induced mutations, site directed mutagenesis. Mutagenic effects of food additives and drugs. DNA damage and repair. Homeotic mutants in *Arabidopsis* and *Antirrhinum*. Transposons and types.	2	K1-K4	8
III	**Genomics and Proteomics** Modern Concept of gene. Genomes: definition, size, approximate number of genes in sequenced organisms (viral, bacterial, fungal, plant, animal, and human genomes), plastomes & chondriomes. Genome map,	3	K2-K4	20

	genome sequence - differences. Plant gene structure. EST maps and markers. Identification of protein-coding genes, determining gene functions from gene sequence; introns and exons, repetitive sequences; Accessing and annotating genomes; The Bio Project; Specialized genomic data bases**:** *Arabidopsis* Information Resource; crop genomes: rice (INE, RGAP, and IRGSP). Metagenomics, functional genomics, comparative genomics, and proteomes. Genomics and ethics. Practical applications of genomics. Next (2^{nd}, 3^{rd}) Generation sequencing. Proteomes: deducing proteome from genome sequence, post-translation modification prediction, and metabolomics. Transcriptomics, metabolomics, barcoding, Architecture of genomics.			
IV	**Bioinformatics** History, introduction and scope; role of computers in biology. The internet, World Wide Web, search engines, meta search engines, metadata; Boolean searching, search engine algorithms, iterative searches. Search and Retrieval in literature databases (Pubmed). Bioinformatics Workstations. Databases: Concepts, Database Management Systems (DBMS): Hierarchical, Relational and Network; database security. Biological databases; types: sequence, structures, genome and organism-specific databases; open source and web services. Data warehousing, data capture, data mining, data analysis.	4	K2-K4 & K6	14
V	**Biological Databases** Primary nucleotide sequence databases: Genbank, European Nucleotide Archive, DDBJ. Primary protein sequence databases: NCBI, PIR, EMBL, ExPAsy, Uniport, Data submission and retrieval with: Entrez, DBGET/Link, and SRS. Sequence Alignment and Analysis: Structural databases (PDB, CSD). Gene expression databases and transcriptomes, DNA microarray. Molecular modeling and visualization tools; docking and drug designing. Phylogenetics: phylogenetic trees and clades, software and online tools; inference methods (UPGMA). Biodiversity informatics: world flora online, plants of the world online.	5	K2-K4	18

Text Books

1. Campell and Heyer. 2003. Discovering Genomics, Proteomics and Bioinformatics. Cold Spring Harbor Laboratory.
2. Hartl, D.L. 2020. Essential genetics and genomics. Jones & Bartlett Learning, 7th Edition.
3. Mishra, N. and Blobel, G. 2010. Introduction to Proteomics: Principles and Applications. Wiley.
4. Pevsner, J. 2015. Bioinformatics and Functional Genomics. Wiley Blackwell, 3^{rd}edition

5. Sangeetha, J. and Thangadurai, D. 2015. Genomics and proteomics: principles, technologies, and applications. Apple Academic Press.

References

6. Bergeron BP. 2002. Bioinformatics Computing. Prentice Hall.
7. Brown, T. A. 2002. Genomes. Wiley-Liss Publications.
8. Gardner, E.J., Simons, M.J. Snustard, D.P. 2006. Principles of Genetics. John Wiley and Sons Inc. ISBN: 81 -265- 1043 -9.
9. Herron J.C. and Freeman, S. 2014. Evolutionary analysis (5^{th} Edition.).
10. JinXiong. 2006. Essential Bioinformatics. Cambridge University Press.
11. Jolles, O. and H. Jornvall (eds.). 2000. Proteomics in Functional Genomes. BirkhauserVerlag, Basel, Switzerland.
12. Lesk, AM. 2002. Introduction to Bioinformatics. Oxford University Press.
13. Liebler. 2001. Introduction to Proteomics: Tools for the new biology. Humana Press.
14. Mount, D. 2004. Sequence and Analysis. Cold Spring Harbor Laboratory Press. New York.
15. Pennington, S. and Dunn, MJ. 2001. Proteomics: From protein sequence to function 2ndEd. Ed Bios Scientific Publications Ltd.
16. Primrose, SB.1995. Principles of Genome Analysis. Blackwell Science, Oxford.
17. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12th Edition.
18. Sinnott, E.W., Dunn, L.C and Dobzhansky, T. 2004. Principles of genetics. Tata Mc Graw Hill. ISBN: 0-07-099-413-7
19. Westhead, D.R., Parish, J.H. 2002. Bioinformatics Instant notes. Bios Scientific Publishers Ltd. ISBN 1 85996 272 6.

Web Resources:

1. http://molbio.info.nih.gov/molbio
2. http://molbio.info.nih.gov/molbio/desk.html
3. http://molbio.info.nih.gov/molbio/servers.html
4. http://www.lib.berkeley.edu/BIOS/molebio.html
5. http://www.yk.rim.or.jp/~aisoai/tool.html
6. https://libguides.asu.edu/c.php?g=478797&p=3398019
7. https://libguides.asu.edu/bioinformatics#s-lg-box-10109881
8. http://www.worldfloraonline.org/
9. https://powo.science.kew.org/

Course Outcomes (CO):

	CO Statement: Students will be able to	Knowledge Level
CO -1	understand the classical and modern genetics, cytoplasmic inheritance and population genetics.	K2-K4
CO -2	analyse the molecular mechanism of mutation, detection of mutation and homeotic mutants in plants.	K1-K4
CO -3	explore the modern concept of genomics and proteomics.	K2-K4
CO -4	gain knowledge about rapidly growing field bioinformatics and its elements.	K2-K4 & K6

CO -5	know the biological databases, especially nucleic acids and protein databases.	K2-K4

Knowledge Level	K1	K2	K3	K4	K5	K6
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	3	3	1	1	1
CO-2	3	3	3	2	0	0
CO-3	3	3	3	3	0	0
CO-4	3	3	3	2	1	0
CO-5	3	3	2	3	0	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

3 – Advance application; 2 – Intermediate level; 1 – Basic level

Mapping Program Outcomes with Course Outcomes:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	2	1	1	0	0
CO-2	3	2	1	1	0	0
CO-3	3	1	1	1	1	0
CO-4	3	1	1	0	0	0
CO-5	3	1	1	0	0	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: P. Ravichandran

[2022/MSU 53rd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- II/CORE-practical 4]

Semester	**:**	**II**
Course Type	**:**	**Practical**
Title of the Course	**:**	**Instrumentation& Biotechniques - Practical**
Course Code	**:**	**PBYL22**

L	T	P	C
	-	8	4

80 Hours/Semester

Course objectives: Enable the students

1 To have hands-on training on handling of instruments commonly used for research purpose.
2. To understand the principles of electrophoresis and spectrophotometer.
3. To acquire the knowledge of phytochemicals
4. To learn the microtomy and histological processing of plant specimens.
5. To familiarize the tissue processing for localization ofsoluble components and preparation of permanent and semi-permanent slide preparation.

UNITS	CONTENT	CO	K Level	Hours
I	1. Fractionation of proteins using gel filtration chromatography by Sephadex G100 or Sephadex G200. 2. Separation of amino acids using thin-layer chromatography. 3. Separation of plant pigments using column chromatography.	1	K1-K3	15
II	4. SDS-PAGE for soluble proteins extracted from the given plant materials and comparison of their profile by staining with Coomassie Brilliant Blue or silver nitrate. 5. Verification of Beer and Lambert's law using spectrophotometry.	2	K1-K4	15
III	6. Spectroscopic estimation of some natural products. 7. Preparation of stains. 8. Microtomy – Preparation of thin sections and permanent slides.	3	K1-K4	15
IV	9. Staining starch, cell wall, lipids, proteins, and nucleic acids using bright field dyes 10. Preparation of double-stained free hand sections, semi-permanent slides, and identification of the tissues with reasons (Normal or anomalous secondary thickening).	4	K1-K4	15
V	11. Free-hand sections showing localization of soluble components-Proteins, Sugars, and Lipids. 12. Preparation of serial sections, from the given block and identification of the tissues with histological reasoning. 13. Preparation of squashes and smears. Maceration of tissues for separating cell types. 14. Students are expected to get a thorough understanding of reagents and buffers for tissue processing and they	5	K1-K4	20

	should submit 20 slides (10 microtome sections, 10 hand sections for permanent and semi-permanent slides) for valuation.			

Text Books

1. Boyer, R.F. 2000. Modern Experimental Biochemistry. 3rdedn. Prentice Hall Publ. ISBN 0 8053 31115.
2. Hofmann, A. and Clokie, S. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, New Delhi.
3. Harborne, J.B. 1998. Phytochemical Methods: A guide to Modern Techniques of Plant Analysis, Chapman &Hall, London, 3rdEdition.

References

4. Khasim, S. M. 2002. Botanical Microtechnique: Principles and Practice. Capital Publishing Company.
5. Jeyaram, J.1998. Laboratory Manual in Biochemistry. New Age International Publishers Ltd.
6. Cotton, CM. 1996. Ethnobotany: Principles& Applications. John Wiley & Sons, New York.

Web Resources:

1. https://www.tuscany-diet.net/category/phytochemicals/
2. https://chem.libretexts.org/Courses/University_of_California_Davis/CHE_115%3A_Instrumental_Analysis_-_Lab_Manual
3. http://www.sarajapharmacycollege.com/downloads/HDT.pdf
4. https://ocw.mit.edu/courses/res-5-0001-digital-lab-techniques-manual-spring-2007/resources/column-chromatography/
5. https://www.youtube.com/watch?v=B_QyhG2-VBI

Course Outcomes (CO):

	CO Statement: Students will be able to	Knowledge Level
CO -1	The experience in handling common instruments and techniques for research purpose.	K1-K3
CO -2	The preparation of reagents, buffers and stains.	K1-K3
CO -3	The extraction and quantification of phytochemicals.	K1-K3
CO -4	The anatomy of plants in depth through microtome sectioning.	K1-K3
CO -5	The identification of tissues and visualization with histological sections of plant specimens.	K1-K3

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	1	3	2	3	-
CO-2	3	2	3	2	3	-
CO-3	3	3	3	2	3	1
CO-4	3	3	2	2	2	1
CO-5	3	3	2	2	2	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	3	2	2	2	1
CO-2	3	3	2	2	2	1
CO-3	3	3	2	2	2	1
CO-4	3	3	2	2	2	1
CO-5	3	3	2	2	2	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Prof. P. Ravichandran
Addition of Objectives, outcomes and mapping: Dr. S. Vallinayagam

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-II/ELECTIVE -2]

Semester	**:**	**II**
Course Type	**:**	**Optional Elective**
Title of the Course	**:**	**Plants in Tamil Culture**
Course Code	**:**	**PBYED**

L	T	P	C
3	-	-	3
45 Hours/Semester			

Course objectives:

1. To understand the antiquity of Tamil land.
2. To provide insights into relationship between Tamil people and plants.
3. To know usage of native plants through Tamil literature.
4. To acquaint conservation and sustainable utilization of plants.
5. To familiarize with plants relevant to astrological importance.

UNITS	CONTENT	CO	K Level	Hours
I	**Land, People and Literature** Antiquity of Tamil land – occurrence of Paleolithic, Mesolithic, Neolithic and megalithic sites of human settlement. Landscape and vegetation and rainfall patterns.	1	K1-K3	9
II	**A Brief Introduction to Sangam Literature** Plants in "Kurinjipattu".Tinai as landscape and ecosystem concept. Importance of plants in five landscapes: Mullai, Marutham, Kurinji, Neythal and Palai.	2	K1-K3	9
III	**Plants in Tholkkapiaym** Plants used in early Tamil culture as food and economy. Plants in love and war.	3	K1-K3	9
IV	**Sacred Plants** Sacred plants and V*enerated plants* Plants and poetic convention. Recent plant introductions and their adoption in Tamil culture.	4	K1-K3	9
V	**Plants Relevant to Astrological Importance** Constellation (Rasi) and star plants. The continuing influence of plants, present-day Tamil culture.	5	K1-K4	9

Text Books

1. Hart, G.L. III. 1975. The Poems of Ancient Tamil. Their Milieu and Their Sanskritic Counterparts. University of California Press, Berkeley.
2. Ramanujam, A.K. 1975. The Interior Landscape: Love Poems from a Classical Tamil Anthology. Fitzhenry and Whiteside Limited. Ontario.

References

1. Samy, P.L. 1967. *Sanga IllakkiathilSedikodiVilakkam*. Saiva Siddhanta Publishing Society. Thirunelveli.
2. Samy, P.L. 1972. *Plants in KurinjiPattu*. Journal of Tamil Studies.
3. Sasivalli, V.C. 1989. *PandaiTamilarTolilkal*. International Institute of Tamil Studies. Madras.
4. Sobidhraj, K.K.S. 1993. Thala Marangal. Sobitham. Tambaram East. Madras.
5. Srinivasan, C. *Sanga IlakiaThavarangal*, Tamil University Publication. Thanjavur.
6. Thaninayagam, X.S. 1966.Landscape and Poetry: A study of Nature in Classical Tamil Poetry. Asia Publishing House, Madras.
7. Varadarajan, M. 1957. The treatment of Nature in Sangam literature. S.I.S.S.W Publishing Society, Madras.

Web Resources:

1.https://manoa.hawaii.edu/exploringourfluidearth/biological/aquatic-plants-and-algae/introduction-algae-and-aquatic-plants
2. https://www.nps.gov/subjects/oceans/plants-alga-plankton.htm
3. https://www.scuba.com/blog/explore-the-blue/marine-gardens-5-types-plants-ocean/
4. https://kascomarine.com/blog/introduction-aquatic-plants/
5. https://www.invasivespeciesinfo.gov/aquatic/plants

6. https://www.1800flowers.com/blog/flower-facts/all-about-aquatic-plants/**Course Outcomes (CO):**

	CO Statement: Students will be able to remember, understand, apply and analyse	Knowledge Level
CO -1	Antiquity of Tamil land, evidences for human settlements, landscape, vegetation and rainfall patterns	K1-K3
CO -2	Classification of Tamil lands and plant diversity	K1-K3
CO -3	Plants used in early Tamil culture as food and economy	K1-K3
CO -4	Plants associated with Gods, temples, religions and rituals	K1-K3
CO -5	Influences of plants in modern day Tamil culture	K1-K4

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	2	1	2	1	1
CO-2	3	2	1	2	2	1
CO-3	3	1	1	1	1	1
CO-4	3	1	1	2	1	1
CO-5	3	1	1	2	1	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	2	2	1	1	1
CO-2	3	1	1	1	1	1
CO-3	3	1	1	1	1	1
CO-4	3	2	1	1	1	1
CO-5	3	2	1	1	1	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. P. Ravichandran
Modified by: Dr. M. Udayakumar

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-II/ELECTIVE -2]

Semester : II
Course Type : Elective
Title of the Course : Horticulture and Plant Breeding
Course Code : PBYEE

L	T	P	C
3	-	-	3
45 Hours/Semester			

Course objectives: Enable the students to

1. explore the garden types and different cultivation models
2. learn different cultivation techniques in plant propagation and interpret its importance
3. understand Pollination mechanism and reproduction types in plant breeding
4. study the parents' selection and genetic consequences of hybridization
5. transfer the different types of characters through breeding and their application

UNITS	CONTENT	CO	K Level	Hours
I	**Horticulture** Concepts and Scope; famous gardens in world & India. Tools & Implements. Plant growing structures: Green houses : Glass house, Mist chamber, Shade net and Poly house. Arches, Pergolas, and Topiary. Lawns and Landscapes, Hydroponics, Terrarium.	1	K1-K3	9
II	**Plant Propagation** Cutting, Layering, Grafting & Budding. Cultural practices: Thinning, Training, Trimming & Pruning. Fertilizers, Biofertilizers, Green manures, NPK, Compost, Vermicompost. Out-door horticulture-Gardens: Vegetable Garden, Medicinal plant garden, Roof top garden/Terrace Garden, Vertical Garden, Fruit Garden, Kitchen Garden. Bonsai.	2	K1-K4	9
III		3	K1-K3	9
IV		4	K1-K4	9
V		5	K1-K4	9

Text Books

1. Adams, C.R., Bamford, K.M. and Early, M.P. 2012. Principles of Horticulture. Routledge, 6th Edition.
2. Acquaah, G. 2009. Horticulture: Principles and Practices. Pearson Prentice Hall, 4th edition.
3. Kumar, N. 1990. Introduction to Horticulture. Rajalakshmi Publication, Nagercoil.

4. Manibhushan Rao, K. 1991. Text book of Horticulture. Macmillan India Pvt. Ltd. New Delhi.
5. Christopher, E. P. 1981. Introductory Horticulture, McGraw Hill, New Delhi.

References

6. Kumar, N. 1990. Introduction to Horticulture. Rajalakshmi Publication, Nagercoil.
7. Christopher, E. P. 1981. Introductory Horticulture, McGraw Hill, New Delhi.
8. Manibhushan Rao, K. 1991. Text book of Horticulture. Macmillan India Pvt. Ltd. New Delhi.
9. Arnold, R. W. 1960. Principles of Plant Breeding. John Wily & Sons, New York.
10. Darbeswhar Roy. 2000. Plant Breeding. Narosa Publishing House, New Delhi.
11. Edmond, J. B. et al.1977. Fundamentals of Horticulture. Tata McGraw Hill, New Delhi.
12. Fred. W. Briggs and Knorotes, P.F. 1967. Introduction to Plant Breeding. Reinhold Publishing Corporation. New York.
13. Graf, A.B. 1981. Tropica (2nd Edition). Roehrs co., USA.
14. Mandal, A. K. 2000. Advances in Plant Breeding. CBS Publishers and Distributors, New Delhi.
15. Rao, A.B. 1991. Text Book of Horticulture. Mac-Millan India Ltd., New Delhi.
16. Sadhu, MK. 1996. Plant Propagation Methods. New Age International, New Delhi.
17. Sing, D.D. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
18. Singh, B. D. 1999. Plant Breeding. Kalyani publishers, New Delhi.
19. Singh and Pawar, 2006. Genetic basis and methods of plant breeding. CBS Publishers and Distributors, New Delhi.

Web Resources:

1. Principles-of-Plant-Breeding.pdf (agrimoon.com)
2. https://nptel.ac.in/courses/126104001
3. http://ecoursesonline.iasri.res.in/course/view.php?id=134

Course Outcomes (CO):

	CO Statement: Students will be able to understand, gain knowledge, apply and analyse	Knowledge Level
CO -1	The horticultural tools and structures for the development of agriculture	K1-K3
CO -2	the various cultivation techniques influence in the production of horticultural plants	K1-K4
CO -3	The Identification of barriers in self and cross pollination in plant	K1-K3

	breeding	
CO -4	The comparative statement of selection and failure of hybridization and their role in clonal propagation	K1-K4
CO -5	On transfer of various characters into breeds and their application in hybrid production	K1-K4

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	3	3	3	0
CO-2	3	3	3	2	2	0
CO-3	3	3	3	1	3	0
CO-4	3	3	3	1	3	0
CO-5	3	3	3	1	3	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	3	3	2	3	0
CO-2	3	3	2	2	2	0
CO-3	3	3	2	2	2	0
CO-4	3	3	2	2	3	0
CO-5	3	3	2	1	2	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. P. Ravichandran

Addition of Objectives, outcomes and mapping: Dr. S. Muthukrishnan

[2022/MSU 53rd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-II/ELECTIVE – 2]

Semester : II
Course Type : Elective
Title of the Course : Plants for Bio Energy and Space Research
Course Code : PBYEF

L	T	P	C
3	-	-	3
45 Hours/Semester			

Course objectives: Enable the students to

1. learn the concept of energy plantations and the plants of interest in such systems the basic processing of materials to liquid fuels
2. apprehend the availability of different physicochemical and biological processing methods to convert the plants to fuels
3. understand the basic processes and organisms involved in anaerobic digestion and biohydrogen production
4. learn the principles and methodologies involved in remote sensing
5. know the principles and methodologies involved in Geographical Information System

UNITS	CONTENT	CO	K Level	Hours
I	**Energy Sources - General Account** Energy sources - General account. Bio energy-energy plantations, social forestry and Silviculture energy farms. Bio energy sources: Petroleum plants (petro plants)-hydrocarbons for higher plants like *Hevea* and *Euphorbia.* Algal hydrocarbons. Alcohols: Alcohol as a liquid fuel-Hydrolysis of lignocellulosic materials, Ethanol production - sources and processing of oils and fats for liquid fuels, Sugarcane molasses and other sources for fermentation and recovery of ethanol.	1	K1-K3	9
II	**Biomass Conversion** Biomass conversion: Non biological process- Direct combustion (hog fuel), pyrolysis, Gasification and Liquification. Biological process: Enzymatic digestion, aerobic and anaerobic digestion	2	K1-K4	9
III	**Gaseous Fuels** Gaseous fuels: Biogas and hydrogen: Biogas technology profit from biogas plants. Biogas production: aerobic digestion solubilization, acidogenesis, methanogenesis. Biogas production from different feed stocks like *Salvinia* and *Eichornia.* Hydrogen as a fuel: Photo biological process of hydrogen production. Hydrogenase and hydrogen production. Halobacteria.	3	K1-K6	9

IV	**Principles and Concepts of Remote Sensing** Principles and concepts of Remote Sensing. Electromagnetic spectrum; spectral characteristics of surface features (rocks, soils, vegetations, water). Space imaging - Landsat, SPOT, IRS, NOAA, Seasat, ERS, RADARSAT, INSAT. Satellites and their sensors, geometry and radiometry. Digital Image Processing: Principles, Image Rectification and restoration, Image enhancement and Mosaicing. Image classification. Supervised, Unsupervised, Ground truth data and training set manipulation, Classification accuracy assessment.	4	K1-K4	9
V	**Geographical Information System (GIS)** Geographical Information System (GIS): Basic principles and terminologies, Raster and vector data, Map projection, Topology creation, Overlay analysis, Data structure and Digital cartography; Software used in GIS Surveying: Leveling, Triangulation, Geodetic survey; Global Positioning System (GPS): basic principles, applications to environmental studies.	5	K1-K4	9

Text Books

1. Chen, H. and Wang, L. 2016. Technologies for Biochemical Conversion of Biomass. Academic Press.
2. Hood, E., Nelson, P. and Powell, R. 2011. Plant Biomass Conversion. Wiley.
3. Borst, W.L. and Fricke, J. 2013. Essentials of energy technology: sources, transport, storage, and conservation. Wiley-VCH.
4. Reddy, M.A. 2012. Text Book of Remote Sensing and Geographical Information Systems, BS Publications, 4th Edition
5. Sahu, K.C. 2008. Textbook of Remote Sensing and Geographical Information Systems. Atlantic Publishers and Distributors, New Delhi

References

6. Agarwal, N. K. 2004. Essentials of GPS. Spatial Networks Pvt. Ltd.
7. Chakraverthy, A. 1989. Biotechnology and alternative technologies for utilization of biomass or agricultural wastes. Oxford & IBA pub. Co., New Delhi.
8. Floyd, F. and W. H. Jr. Sabins. 1987. Remote Sensing, Principles and Interpretation (2nd Edition). Freeman & Company.
9. International Encyclopedia of Ecology and Environment, Volumes1 – 30. Indian Institute of Ecology & Environment, New Delhi.
10. Kerry Turner, R. 1988. Sustainable Environment Management. Westview Press, Colorado.

11. Lilles, T. M. and R. F. Kiefer. 1994. Remote Sensing and Image interpretation. John Wiley & Sons.
12. Maguire, D. and M. Batty. 2005.GISSpatial Analysis &Modelling. Esri Press.
13. Meadows, D. & Randers, J. 2004. Limits to Growth*:* The 30 Year Update. EarthScan Publications, London.
14. Michael, L. and McKinney, Robert M Schoch. 2012. Environmental Science-Systems and Solutions. 5th edition. Jones & Bartlett Learning. Massachusetts.
15. Mittal, K. M. 1996. Biogas systems: Principles and Applications. New Age International Publishers (P) Ltd. New Delhi.
16. Simon Dresner. 2008. The Principles of Sustainability Solutions. Earth Scans.
17. *The Ecological Footprint Atlas* 2010. Oakland: Global Footprint Network.
18. Venkataramana, P. & Srinivas, SN. 1996. Biomass Energy Systems. Tata Energy Research Institute, New Delhi.

Web Resources:

1. https://nptel.ac.in/courses/102104057
2. https://nptel.ac.in/courses/103107125
3. https://nptel.ac.in/courses/103107157
4. https://nptel.ac.in/courses/109101171

Course Outcomes (CO):

	CO Statement: After successful completion of the course, the student will be able to	Knowledge Level
CO -1	analyze the suitability of different plantation crops and plant- based oils and fats for bioenergy production	K1-K3
CO -2	demonstrate knowledge on the pros and cons on different treatment technologies for the conversion of plant-based biomass into fuels	K1-K4
CO -3	demonstrate knowledge on the principles and organisms involved in biological treatment processes; and develop biological treatment facilities using local invasive plants as feedstock.	K1-K6
CO -4	understand the principles and application potential of remote sensing in biological research	K1-K4
CO -5	utilize the Geographical Information System for the botanical and environmental research	K1-K4

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	2	2	1	1	1
CO-2	3	2	2	1	1	1

CO-3	3	2	2	1	1	1
CO-4	3	2	2	1	1	1
CO-5	3	2	2	1	1	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	2	2	1	0	0
CO-2	3	2	2	2	0	0
CO-3	3	2	2	2	0	0
CO-4	3	2	2	2	0	0
CO-5	3	2	2	2	0	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. P. Ravichandran
Addition of Objectives, outcomes and mapping: Dr. A. Selvam

[2022/MSU 532rd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/ CORE – 8]

Semester : III
Course Type : Core
Title of the Course : Plant Physiology and Biochemistry
Course Code : PBYC31

L	T	P	C
4	-	-	4
60 Hours/Semester			

Course objectives: Enable the students to

1. learn the energy flow in biological system and the enzyme catalysis
2. understand water and nutrient absorption and translocation in plants
3. comprehend the components and processes involved in photosynthesis.
4. know the metabolic pathways of respiration and energy flow.
5. understand the influence of plant growth regulators on plant functions

UNITS	CONTENT	CO	K Level	Hours
I	**Thermodynamics and enzymology** Energy flow: Thermodynamic Laws, free energy and chemical potential, redox reaction, structure and functions of ATP. Fundamentals of enzymology: Enzyme-substrate properties, function and classification. Allosteric mechanism, regulatory and active sites, isozymes, kinetics of enzymatic catalysis, Michaelis-Menten equation.	1	K1-K4	7
II	**Translocation of water and solutes** Plant-water relations, mechanism of water transport through xylem, root-microbe interactions and nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport proteins; sucrose-sensing mechanism.	2	K1-K4	8
III	**Photosynthesis** General concepts, historical background, evolution of photosynthetic apparatus, photosynthetic pigments light harvesting complexes, photo-oxidation of water, mechanisms of electron and proton transport. Carbon assimilation: Calvin cycle; photorespiration and its significance, C_4 cycle; the CAM pathway; biosynthesis of starch &sucrose.	3	K1-K4	15
IV	**Respiration** Overview of plant respiration, glycolysis, TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylatecycle, alternative oxidation systems.	4	K1-K4	15

	Lipid metabolism: Structures and functions of lipids, structural & storage lipids, biosynthesis of fatty acid and membrane lipids, catabolism of lipids. Nitrogen and Sulphur metabolism: Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, sulfate uptake, transport and assimilation.			
V	**Plant Growth and Development** Plant hormones and growth regulators: physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, polyamines, jasmonic acid and salicylic acid, hormone receptors. Signal transduction and gene expression. Flowering process: Photoperiodism, endogenous clock and its regulation, floral induction and development – genetic and molecular analysis, role of vernalization. Stress physiology: Plant responses to biotic and abiotic stresses, mechanisms of biotic and abiotic stress tolerance, water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress. Molecular biology of plant stress responses. Sensory photobiology: History, discovery of phytochromes and cryptochromes; photochemical and biochemical properties, photophysiology of light-induced responses, cellular localization, molecular mechanism of action of photomorphogenic receptors, signaling and gene expression.	5	K1-K5	15

Text Books

1. Bhatla, S.C., Lal, M.A. 2018. Plant Physiology, Development and Metabolism. Springer Singapore.
2. Taiz, l., Zeiger, E., Møller, I.M. and Murphy, A. 2018. Plant Physiology and Development. Sinauer, 7th Edition.
3. Kochhar, S.L. and Gujral, S.K. 2020. Plant physiology: theory and applications. Cambridge University Press, 2nd Edition.
4. Nelson, D.L. and Cox, M.M. 2021. Lehninger Principles of Biochemistry. MacmMillan publishers, 8th Edition.
5. Hopkins, W.G. and Hüner, N.P.A. 2008. Introduction to Plant Physiology. Wiley, 4th Edition.

References

6. Buchanan, B. B., W. Gruissem and R. L. Jones. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland.

7. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California
8. Willey, N. 2016. Environmental plant physiology. Garland Science Publishers, New-York.
9. Dennis, D. T., Turpin, D. H., Lefebvre, D. D and D. B. Layzell (eds). 1997. Plant Metabolism (second edition), Longman, Essex.
10. Galston, A. W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.
11. Hooykaas, P. J. J., M. A. Hall and K. R. Libbenga (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam, the Netherlands.
12. Nobel, P. S. 2020. Physiochemical and Environmental Plant Physiology. Academic Press, San Diego, 5th Edition.
13. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12th Edition.
14. Thomas, B. and D. Vince-Prue. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego.
15. Westhoff, P. 1998. Molecular Plant Development: from Gene to Plant. Oxford University Press, Oxford.

Web Resources:

1. https://onlinecourses.swayam2.ac.in/cec19_bt09/preview
2. https://onlinecourses.swayam2.ac.in/cec21_bt20/preview
3. https://onlinecourses.swayam2.ac.in/cec22_bt13/preview
4. https://www.youtube.com/watch?v=RT-w2xHVl_E
5. https://www.youtube.com/c/TheScienceMediaProductionCenteratCornell/search?query=plant%20physiology

Course Outcomes (CO):

	CO Statement: After successful completion of the course, the student will be able to	Knowledge Level
CO -1	demonstrate knowledge in fundamental processes of energy flow through redox reactions, enzyme catalysis and the principle behind the enzyme action.	K1-K4
CO -2	explain the theory behind water absorption and transportation through xylem; and translocation of food through phloem.	K1-K4
CO -3	appreciate the potential and metabolic pathways of plants to synthesize their food through photosynthesis and way in which the energy is channeled towards anabolic processes.	K1-K4
CO -4	realize the importance of respiration in sustaining the energy production; and the way nitrogen and sulphur are assimilated in plants	K1-K4
CO -5	understand the role of plant hormones in plant growth and development and exploit such phenomena to promote plant growth and production	K1-K5

Knowledge	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**

Level	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	3	1	1	0	0
CO-2	3	3	1	1	0	0
CO-3	3	3	1	1	0	0
CO-4	3	3	2	1	0	0
CO-5	3	3	3	1	0	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	2	2	2	0	0
CO-2	3	2	2	1	0	0
CO-3	3	2	2	1	0	0
CO-4	3	2	2	1	0	0
CO-5	3	2	2	2	0	0
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. P. Ravichandran
Addition of Objectives, outcomes and mapping: Dr. A. Selvam

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/PRACTICAL - 5]

Semester : III
Course Type : Practical
Title of the Course : Plant Physiology and Biochemistry
Course Code : PBYL31

L	T	P	C
-	-	4	2
60 Hours/Semester			

Course objectives: Enable the students to

1. to learn specific enzyme assays and determine the reaction rate and Km values
2. to gain proficiency in extracting the chlorophyll and other pigments from leaves and documenting the absorption spectrum
3. to learn the methodologies behind the extraction and analysis of protein through electrophoresis
4. perform seed viability tests; and enzyme assay to correlate the respiration and peroxidase activity
5. observe the effect of plant hormones on plant growth and development; and determine auxin concentration in plant tissue

UNIT	CONTENT	CO	K Level	Hours
I	1. Effect of time and enzyme concentration on the rate of reaction of enzyme (e.g. acid phosphatase, nitrate reductase). 2. Effect of substrate concentration on activity of any enzyme and determination of its *K*m value. 3. Demonstration of the substrate inducibility of the enzyme nitrate reductase.	1	K1-K4	12
II	4. Extractionof chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids and demonstration of fluorescence by chlorophyll. 5. Extraction and determination of chlorophyll a /chlorophyll b ratio in C_3 and C_4 plants. 6. Isolation of intact chloroplasts and estimation of chloroplast proteins by spot protein assay.	2	K1-K4	12
III	**7**. To demonstrate photophosphorylation in intact chloroplasts, resolve the phosphoproteins by SDS-PAGE. 8. Extraction of seed proteins depending upon the solubility. 9. Determination of succinate dehydrogenase activity, its kinetics, and sensitivity to inhibitors.	3	K1-K4	12

	10. Estimation of the protein content in extracts of plant material by Lowry's or Bradford's method.			
IV	11. Determination of seed viability by tetrazolium chloride test (TTC). 12. Demonstration of respiration in flower buds by enzyme peroxidase activity.	4	K1-K5	8
V	13. Demonstration of PGR effects – photomorphogenesis, stem elongation, apical dominance 14. Effect of plant growth regulators on seed germination and seedling growth of monocot and Eudicots 15. Determination of the presence of IAA from plant tissues and quantification by Salkowski test.	5	K1-K6	16

References

1. Inam, A. 2012. A Laboratory Manual of Plant, Physiology, Biochemistry and Ecology. Agrobios Publications, Jodhpur, India.
2. Hofmann, A. and Clokie, S. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, New Delhi.
3. Harborne, J.B. 1998. Phytochemical Methods: A guide to Modern Techniques of Plant Analysis, Chapman &Hall, London, 3rd Edition.
4. Bajracharya, D. 1999. Experiments in Plant Physiology: A Laboratory Manual. Narosa Publishing House, New Delhi.
5. Copeland, R. A. 1996. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis. VCH Publishers, New York.
6. Dennison, C. 1999. A Guide to Protein Isolation. Kluwer Academic Publishers, Dordrecht, Netherland.
7. Devi, P. 2000. Principle and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios , Jodhpur, India.
8. Dryer, R. L. and G. F. Lata. 1989. Experimental Biochemistry. Oxford University Press, New York.
9. Ninfa, A. J. and D. P. Ballou. 1998. Fundamental Laboratory Approaches for Biochemistry and Biotechnology. Fitzgerald Science Press, Inc., Maryland, USA.
10. Plummer, D. T. 1988. An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
11. Scott, R. P. W. 1995. Techniques and Practice of Chromatography. Marcel Dekker, Inc., New York.

Web Resources:

https://www.youtube.com/channel/UCpP2LPY2snwGItExpDTTMvQ
https://www.youtube.com/channel/UCrlBRhzvEn5Ix8Rd7fI1krA
https://jru.edu.in/studentcorner/lab-manual/agriculture/Fundamentals%20of%20Crop%20Physiology.pdf
http://www.umt.edu/media/facultysenate/archives/currreview/09%20Writing%20Review/BIOL%20445.pdf

Course Outcomes (CO):

	CO Statement: After successful completion of the course, the student will be able to	Knowledge Level
CO -1	assay specific plant enzymes and determine the effect of time and substrate concentration on reaction rates of enzymes	K1-K4
CO -2	isolate chlorophyll and other accessory plant pigments, quantify and correlate with the rate of photosynthesis	K1-K4
CO -3	extract the protein from chloroplast and seeds, quantify them and analyze them using electrophoresis	K1-K4
CO -4	determine the viability of seeds through simple chemical tests and demonstrate the respiration through peroxidase activity	K1-K5
CO -5	Devise application strategies to exploit the plant hormones to improve the plant growth and yield and attempt commercial developments of formulations of plant hormones.	K1-K6

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	2	2	1	2	1
CO-2	3	2	2	1	2	1
CO-3	3	2	2	1	2	1
CO-4	3	2	2	1	2	1
CO-5	3	2	2	1	2	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	3	3	2	2	1
CO-2	3	3	3	2	2	1
CO-3	3	3	3	2	2	1
CO-4	3	3	3	2	2	1
CO-5	3	3	3	2	2	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. A. Selvam

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/Core - 9]

Semester : III
Course Type : Core
Title of the Course : Angiosperm Taxonomy
Course Code : PBYC32

L	T	P	C
5	-	-	4
70 Hours/Semester			

Course objectives:

1. To acquire knowledge on morphology of range of structures in angiosperms.
2. To get an understanding of the history and theories underlying different approaches to plant taxonomy and classification; and, to widen knowledge and fluency with scientific names and the rules governing their application.
3. To become familiar with classical and modern approaches in angiosperm classification
4. To understand general and unique characters of major taxa and their systematic positions; and to build up commendable knowledge on selected important plant families.
5. To become familiar with economically important plants, their parts and uses.

UNITS	CONTENT	CO	K Level	Hours
I	**Morphology** Habitat, Habit, Root system, Rootless plants, Root modifications; Shoot system, Shootless plants, Buds, Branching, Shoot classification, Stems specialized for reproduction, Stem modifications; Phyllotaxy, Heterophylly, Simple and compound leaves, Parts of leaf, Leaf base, apex, margin and surface, Venation, Leaf modifications; Inflorescence and fruit classifications.	1	K1-K4	12
II	**Evolution and nomenclature of angiosperms** The origin and evolution, Cradles of angiosperms, Abominable mystery, Pre-cretaceous presumed angiosperms, Lower and mid-cretaceous records, Rules of nomenclature, ICBN to ICN, Botanical congress, Fundamental and guiding principles, Binomial nomenclature, Hierarchy in nomenclature, Author citation, Type method, Rule of priority; Bracketed and Indented keys; Botanic gardens and herbaria, Preparation of herbarium specimen - methods and techniques, virtual herbarium; Icones, Monographs and Floras; BSI and NBRI.	2	K1-K4	18
III	**Classical and modern taxonomy** Types of botanical classification, Hutchinson's principles, Modern concept of primitive and advanced characters, Artificial and Natural system of classification, Hutchinson's classification, History and development of APG system and detailed study on APG IV, Cladistics and molecular taxonomy; Numerical and chemotaxonomy; Taxonomic evidences: Morphology, Anatomy, Cytology,	3	K1-K4	10

	Palynology and Embryology.			
IV	**General characters and diagnostic features of families** *Magnoliaceae, Nymphaeaceae, Capparidaceae, Tiliaceae, Meliaceae, Rhamnaceae, Anacardiaceae, Mimosaceae, Combretaceae, Ebenaceae, Oleaceae, Boraginaceae, Bignoniaceae, Acanthaceae, Nyctaginaceae, Orchidaceae, Amaryllidaceae, Commelinaceae, Arecaceae, Poaceae.*	4	K1-K4	20
V	**Economic botany** Perspectives in economic botany, Cereals, Millets, Pulses, Vegetables, Tubers, Fruits and nuts, Oil seeds, Plantation crops, Spices and condiments, Fumitories and masticatories, Fibers, Wood, Medicinal plants, Ornamental plants, Weeds, Resins and Gums, Beverages, Rubber, Forage crops, Plant insecticides, Dyes and tannins.	5	K1-K3	10

Text Books

1. Singh G. 2019. Plant Systematics: An Integrated Approach. Fourth Edition, Oxford & IBH, New Delhi.
2. Pandey AK, Kasana S. 2021. Plant Systematics, Om Publications, New Delhi.
3. Simpson, M. G. 2019. Plant Systematics. Third Edition, Elsevier Academic Press, California.
4. Sinha SK. 2013. Taxonomy of Angiosperms. Anmol Publications, New Delhi.
5. Stuessy, TF. 2009. Plant Taxonomy: The Systematic Evaluation of Comparative Data. Second Edition, Columbia University Press, New York.
6. Heywood, V. H. and D. M. Moore. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
7. Naik, VN. 2000. Taxonomy of Angiosperms. Tata McGraw – Hill Publishing Company Limited, New Delhi.
8. Subramaniam, NS. 1997. Modern Plant Taxonomy. Vikas Publishing, New Delhi.

References

9. Gamble, J. S. and C. E. C. Fischer. 1967. Flora of the Presidency of Madras. Vols. I - III. Botanical Survey of India, Calcutta.
10. Grant, W. F. 1984. Plant Biosystematics. Academic Press, London.
11. Greuter, W (Ed.). 2000. International Code of Botanical Nomenclature. (St. Louis Code). KoeltzVesentific Books, Germany.
12. Harrison, H. J. 1971. New Concepts in Flowering Plant Taxonomy. Hieman Educational Books Ltd., London.
13. Judd, W. S. and C. S. Campbell, E. A. Kellog, P. F. Stevens, N. J. Donoghue. 2008. Plant Systematics: A phylogenetic approach. 3rd edition. Sinauer Associates Inc, Massachusetts.
14. Lawrence, G. H. M. 1951. Taxonomy of Vascular Plants. The Macmillan Company, New York.
15. Moore, R. and W. D. Clark, K. R. Stern, D. Vodopich. 1995. Botany: Plant Diversity. Wm. C. Brown Publishers, London.
16. Nordenstam, B. and E. l. Gazaly, M. Kassas. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.
17. Raven, P. H. and R.F. Evertand S. E. Eichhon. 1992. Biology of Plants. 5th Edition. Worth Publishers. New York.

18. Soltis, D. E. and P. S. Soltis, P. K. Endress, M. W. Chase. 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates, Inc., Massachusetts, USA.
19. Takhtajan, A. 1997. Diversity and Classification of Flowering Plants. Bishen Singh and Mahendrapal Singh, Dehra Dun.

Web Resources:

1. http://www.mobot.org/MOBOT/research/APweb/http://www1.biologie.uni-hamburg.de/b-online/library/webb/BOT410/anatweb/labs.htm
2. https://www.iaptglobal.org/
3. https://libguides.bodleian.ox.ac.uk/plant_taxonomy/databases
4. http://www.sci.sdsu.edu/plants/plantsystematics/class.html

Course Outcomes (CO):

	CO Statement: Students will be able to remember, understand, apply and analyse	Knowledge Level
CO -1	Morphological structures of vegetative and reproductive plant organs.	K1-K4
CO -2	Evolution of angiosperms; fundamental and guiding principles of nomenclature; range of taxonomical literatures.	K1-K4
CO -3	Classical and modern approaches in the classification of angiosperms.	K1-K4
CO -4	General and diagnostics vegetative and reproductive characters of families.	K1-K4
CO -5	Economic importance of whole plant, vegetative parts, flowers, seeds and fruits.	K1-K3

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	2	1	1	1
CO-2	3	3	2	2	2	1
CO-3	3	3	2	2	2	1
CO-4	3	3	1	1	1	1
CO-5	3	3	1	2	1	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	1	1	1	2	1

CO-2	3	2	2	2	1	1
CO-3	3	2	1	1	2	1
CO-4	3	2	1	2	2	1
CO-5	3	2	1	1	1	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. M. Udayakumar

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/PRACTICAL - 6]

Semester : III
Course Type : Practical
Title of the Course : Angiosperm Taxonomy
Course Code : PBYL32

L	T	P	C
-	-	5	2
70 Hours/Semester			

Course objectives:

1. To gain knowledge about how plant specimens are collected, identified, curated, and documented for a permanent record.
2. To understand technical terminologies of taxonomical studies through live specimens.
3. To become familiar with diagnostic features of major plant families and economically important plants.
4. To distinguish angiosperms from other classes of plants using vegetative and reproductive characters.
5. To acquaint with evolution and primitive, advanced characters of angiosperms.

UNITS	CONTENT	CO	K Level	Hours
I	**Morphological characters and modifications** 1. Study on range of leaf shape, apex, margin and base and their uses in plant identification. 2. Study on plant organ modifications. 3. Study on fruit types and its significance in plant identification.	1	K1-K4	12
II	**Qualitative plant survey and description of selected plant families** 4. Qualitative plant survey in M.S. university campus and record flora 5. Description of a specimen from representative, locally available families. 6. Description of various species of genus; location of key characters and preparation of keys at generic level (indented or bracketed) 7. Identification of key characters and use of keys at family level using Standard Flora.	2	K1-K4	18
III	**Modern approaches in taxonomy** 8. Estimation of simple matching and Jaccard coefficients (Numerical taxonomy) 9. Resemblance and sortex matrices (Numerical taxonomy) 10. Phytochemical analyses for the presence of alkaloids, fixed oil, fats, saponins, gums and mucilages 11. Study of advanced and primitive characters	3	K1-K5	10

	(Hutchinson's dicta) 12. Solving nomenclatural problems.			
IV	**Field survey** 13. Field trips within and around the forest areas; compilation of field notes and preparation of herbarium sheets of such plants (20 different sheets), wild or cultivated, as are abundant.	4	K1-K3	20
V	**Economic botany** 14. Collection of at least 10 economically important plants from local markets and study on their origin, distribution and cultivation.	5	K1-K3	10

Text Books

1. Sinha RK. 2021. Practical Taxonomy of Angiosperms. 2nd Edition, Wiley India, Noida
2. Sundara-Rajan S. 2000. Practical Manual of Angiosperm Taxonomy. 1st Edition, Anmol Publications, New Delhi.
3. Semple JC. 2016. Flowering Plants Laboratory Manual: A Guide to the Morphology of Flowers. 1st Edition, Aster Graphics, Waterloo, Canada.
4. Kumar S. 2012. Plant Taxonomy and Embryology (with Practical Manual), First Edition, KNRN Publications, Meerut, India.
5. Mauseth JD. Botany: A Lab Manual. 6th Edition, Jones and Bartlett Publishers. Massachusetts, USA.
6. Besse P. 2021. Molecular Plant Taxonomy: Methods and Protocols. Springer Science & Business Media, Springer Nature, Netherland.

Web Resources:

1. https://bio.libretexts.org/Bookshelves/Botany/Botany_Lab_Manual_(Morrow)
2. http://www.ibiblio.org/unc-biology/herbarium/courses/CHPT25.html
3. https://treelib.ca/

Course Outcomes (CO):

	CO Statement: Students will be able to remember, understand, apply and analyse	Knowledge Level
CO -1	Morphological structures and modifications of plant parts.	K1-K3
CO -2	General and diagnostics vegetative and reproductive characters of families.	K1-K4
CO -3	Classical and modern approaches in the classification of angiosperms.	K1-K3
CO -4	Field survey, collection, identification and preparation of herbarium specimens.	K1-K4
CO -5	Origin, distribution and cultivation of selected economically important plants	K1-K4

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	2	1	1	1
CO-2	3	3	2	1	1	1
CO-3	3	3	2	2	1	1
CO-4	3	3	1	1	1	1
CO-5	3	3	1	1	1	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	2	1	1	1	1
CO-2	3	2	1	1	1	1
CO-3	3	2	1	1	1	2
CO-4	3	3	2	1	1	1
CO-5	3	2	1	1	1	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. M. Udayakumar

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/ CORE –10]

Semester : III
Course Type : Core
Title of the Course : Ecology and Conservation Biology
Course Code : PBYC33

L	T	P	C
4	-	-	4
75 Hours/Semester			

Course objectives: To enable the students

1. To understand the climate, soil and its fertility, physiographic and biotic factors.
2. To learn the characteristics of population and the importance of ecological indicators and endemic plants.
3. To acquire the knowledge of community ecology and succession.
4. To know the structure, components and functions of different ecosystems, flow of energy and minerals and various biogeographical zones of India.
5. To emphasize the importance of conserving rare plants.

UNITS	CONTENT	CO	K Level	Hours
I	**Environment, habitat and niche** Climatic factors - light, temperature and water, soil, physiographic and biotic factors - producers, consumers, decomposers; Ecosystem: structure, components and functions; types of species interactions, interspecific competition - consumers-resource models of competition, herbivory, carnivory, pollination, symbiosis. Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource allocation in plants; character displacement.	1	K1-K3	15
II	**Population Ecology** Characteristics of a population; population growth curves; population regulation; life history strategies - r and K selection; semel-parity and itero-parity; keystone species; concept of metapopulation - Levins metapopulation model –demes and dispersal, interdemic extinctions, age structured populations; ecological indicators; ecotype formation and its significance; industrial melanism; endemism and endemic plant species of India.	2	K1-K4	15
III	**Community Ecology** Nature of communities; community structure and attributes; levels of species diversity and its measurement – Shannon and Simpson indices; meta communities in homo and heterogeneous environments, edges and ecotones. Ecological succession: causes, types, mechanisms, changes involved in succession; concept of climax - mono and polyclimax theories; invasive species and process of	3	K1-K4	15

	invasion; phenology and its importance.			
IV	**Ecosystem Ecology and biogeography** Ecological pyramids; energy flow and mineral cycling (C, N, P); primary production and decomposition of litter - process, chemistry, organisms involved; estuarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India; Indian forest and vegetation types.	4	K1-K4	15
V	**Applied Ecology and Conservation Biology** Biodiversity: alpha, beta and gamma diversity, inventory, documentation, status, monitoring; major drivers of biodiversity change or loss; Environmental pollution; global environmental change. IUCN and threat categories; Biodiversity conservation and climate change; *in situ* and *ex situ* conservation; indicators of biodiversity conservation, management approaches - reserve selection and reserve size. Indian case studies on conservation/management strategy - Project Tiger, Biosphere reserves.	5	K1-K4	15

Text Books

1. Ambasht, R.S. 2017. A Text Book of Ecology, 15th Edition, CBS Publishers, New Delhi.
2. Keddy, P.A. 2017. Plant Ecology: Origins, Processes, Consequences, 2nd Edition, Cambridge University Press, United Kingdom.
3. Shukla, R.S and Chandel P.S. 2015. A Textbook of Plant Ecology. S. Chand & Co. Ltd. New Delhi.
4. Heywood, V. H. and R. T. Watson. 1995. Global Biodiversity Assessment. Cambridge University Press.
5. Odum, E. P. 1983. Basic Ecology. Saunders, Philadelphia.
6. Smith, R. L. 1996. Ecology and Field Biology. Harper Collins, New York.

References

7. Begon, M., J.L. Harper and C.R. Townsend. 1996. Ecology. Blackwell Science, Cambridge.
8. Chapman, J. L. and M. J. Reiss. 1988. Ecology: Principles and Applications. Cambridge University Press.
9. Hill, MK.1997.Understanding Environmental Pollution. Cambridge University Press.
10. Kormondy, E. J. 1996. Concepts of Ecology. Prentice Hall of India, New Delhi.
11. Ludwig, J. and J. F. Reynolds. 1988. Statistical Ecology. John Wiley & Sons.
12. Mason, C. F. 1991. Biology of Fresh Water Pollution. Longman.
13. Molden, B. and S. Billharz. 1997. Sustainability Indicators. John Wiley & Sons, New York.
14. Mullaer- Dombois, D. and H. Ellenberg. 1974. Aims and Methods of Vegetative Ecology. Willey, New York.
15. Odum, E. P. 1971. Fundamentals of Ecology. Saunders, Philadelphia.
16. Raven, P. H. and G. B. Johnson. 2002. BIOLOGY 6th ed. McGraw-Hill. Boston.

Treshow, M.1985. Air Pollution and Plant Life. Wiley-Inter science.

Web Resources:

1. https://www.easybiologyclass.com/biodiversity-introduction-definition-classification-importance-measurement-of-biodiversity/
2. https://www.easybiologyclass.com/biological-interactions-positive-negative-interactions-ecosystem-ppt/
3. https://www.youtube.com/watch?v=6O29MqFkbAg

Course Outcomes (CO):

	CO Statement: Students will be able to	Knowledge Level
CO -1	The climatic, edaphic, physiographic and biotic factors.	K1-K3
CO -2	The characteristics of population, ecological indicators and endemism.	K1-K3
CO -3	The ecological succession and community ecology.	K1-K3
CO -4	The structure, components and functions of different ecosystems and biogeography of India.	K1-K3
CO -5	The importance of biodiversity conservation and methods.	K1-K3

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	2	1	2	-
CO-2	3	3	2	1	2	-
CO-3	3	3	2	1	1	-
CO-4	3	3	2	1	2	-
CO-5	3	3	2	2	2	-
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	2	2	2	2	1
CO-2	3	2	2	2	2	1
CO-3	3	2	2	2	2	1
CO-4	3	2	2	2	2	1
CO-5	3	2	2	2	2	1

0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level

Course Designer: Dr. M. Udayakumar

[2022/MSU 53rd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-III/PRACTICAL – 7]

Semester : III
Course Type : Practical
Title of the Course : Ecology and Conservation Biology - Practical
Course Code : PBYL33

L	T	P	C
	-	5	2
80 Hours/Semester			

Course objectives: To enable the students

1. To analyze the physico-chemical properties of soil from natural ecosystem.
2. To understand the species density, richness, abundance, frequency and diversity indices of plant communities.
3. To determine the similarity among the plant communities, population structure and biomass of the specified ecosystem.
4. To learn about different forms of ecosystem.
5. To undertake the field visits to familiarize the students with the natural habitats of a forest ecosystem.

UNITS	CONTENT	CO	K Level	Hours
I	1. To calculate mean, variance, standard deviation, standard error, coefficient of variation and to use t-test and ANOVA for composing two means related to ecological data. 2. To estimate C, N, P and K from soil samples of natural ecosystem. 3. To find out size, moisture content and water holding capacity of soil types. 4. To prepare ombrothermic diagram for different sites on the basis of given data set and to comment on climate.	1	K1-K3	15
II	5. To find out species density, richness, abundance and frequency through plot method 6. To construct species-area curve for woody plant community 7. To find species and family important value indices for plant community/communities from grassland or forest 8. To estimate Shannon and Simpson diversity indices for plant community	2	K1-K4	15
III	9. To estimate Jaccard community coefficient index for determining the similarity among plant communities 10. To find the population structure of woody plant community using basal area, tree size and density 11. To quantify height and volume of trees non-destructively using mathematical formulas 12. To estimate accumulated above ground dry biomass of tree using allometric formula developed for tropical	3	K1-K4	15

	forests.			
IV	13. To find relationship among important leaf and wood plant functional traits (plants from tropical dry forests) 14. To find reproductive allocation of selected herbs and trees 15. To record diversity of woody plants in tropical dry forest located in and around Tirunelveli.	4	K1-K4	15
V	**Field visits/scientific tours** The students should be taken to one of the following: i. A protected area (biosphere reserve, national park, or a sanctuary), wet lands, mangroves ii. Head Quarters of the Botanical Survey of India or one of its regional circles. iii. A CSIR laboratory doing research on plants and their utilization. iv. An ICAR Research Institute or a field station dealing with one major crop or crops (ICRISAT). v. A recognized botanical garden or museum (such as those at the Forest Research Institute, Dehra Dun: National Botanical Research Institute, Lucknow; Tropical Botanical Garden and Research Institute, Trivandrum), which has rich collection of plant products. ***Note:** the students are expected to prepare a brief illustrated narrative of the field survey and scientific visits. After evaluation, the marks/grades awarded to students by teachers will be added to the final assessment of credits for Field study/tour.	5	K1-K4	20

Text Books

1. APHA- Standard Methods for the Examination of Water and Waste Water. American Public Health Association, Washington, DC.
2. Krebs, C. J. 1989. Ecological Methodology. Harper and Row, New York, USA.
3. Ludwig, J. A. and J. F. Reynolds. 1988. Statistical Ecology. Wiley, New York.
4. Magurran, A. E. 1988. Ecological Diversity and Its Measurement. Chapman & Hall, London.
5. Misra, R. 1968. Ecology work Book. Oxford & IBH, New Delhi.
6. Moore, P. W. and S. B. Chapman. 1986. Methods in Plant Ecology. Blackwell Scientific Publications.
7. Mullaer- dombois, D. and H. Ellenberg. 1974. Aims and Methods of Vegetative Ecology. Willey, New York.
8. Pielou, E. C. 1984. The Interpretation of Ecological Data. Wiley, New York.

References

1. Smith, R. L. 1996. Ecology and Field Biology. Harper Collins, New York.
2. Sokal, RR and F. J. Rohlf. 1995. Biometry. W.H. Freeman & Co., San Francisco.

Web Resources:

1. https://www.easybiologyclass.com/biodiversity-introduction-definition-classification-importance-measurement-of-biodiversity/
2. https://www.easybiologyclass.com/biological-interactions-positive-negative-interactions-ecosystem-ppt/
3. https://www.youtube.com/watch?v=6O29MqFkbAg

Course Outcomes (CO):

	CO Statement: Students will be able to	Knowledge Level
CO -1	Analyze the physic-chemical properties of soil from natural ecosystem.	K1-K3
CO -2	Understand the species density, richness, abundance, frequency and diversity indices of plant communities.	K1-K3
CO -3	Determine the similarity among the plant communities, population structure and biomass of the specified ecosystem.	K1-K3
CO -4	Learn about different forms of ecosystem.	K1-K3
CO -5	Undertake the field visits to familiarize the natural habitats of forest ecosystem.	K1-K3

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	1	2	1	-
CO-2	3	3	1	2	2	-
CO-3	3	3	1	2	2	-
CO-4	3	3	1	2	2	-
CO-5	3	3	1	2	2	-
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	2	2	2	2	1
CO-2	3	2	2	2	2	1
CO-3	3	2	2	2	2	1

CO-4	3	2	2	2	2	1
CO-5	3	2	2	2	2	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Dr. M. Udayakumar

[2022/MSU 53rd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.- IV/CORE-11]

Semester	**:**	**IV**
Course Type	**:**	**Core**
Title of the Course	**:**	**Phytochemistry and Traditional Medicine**
Course Code	**:**	**PBYC41**

L	T	P	C
4	-	-	4
60 Hours/Semester			

Course objectives: To enable the students to

1. have a comprehensive knowledge of secondary metabolites of plants and their ecological role.
2. learn the isolation and quantification of phytochemicals.
3. understand the biosynthetic pathways and applications of phytochemicals.
4. comprehend the history of herbalism and ethnobotany.
5. acquire the knowledge of traditional system of medicine.

UNITS	CONTENT	CO	K Level	Hours
I	**Secondary Metabolites and Classification** Phytochemistry: Definition, history, principles. Secondary metabolites: definitions, classification, occurrence and distribution in plants, their functions, chemical constituents. Alkaloids, Terpenoids, Flavonoids, Steroids, and Coumarins. Qualitative tests for the detection of different classes of phytochemicals.	1	K1-K3	15
II	**Isolation and Quantification of phytochemicals** Techniques for isolation of medicinally important biomolecules: solvent extraction, chemical separations, steam distillation, soxhlet extraction. Purification, concentration, determination and quantification of compounds (TLC, Column, HPLC). Characterization of phytochemicals: spectroscopic methods.	2	K1-K4	12
III	**Biosynthetic pathways and Application of phytochemicals** Biosynthetic pathways of secondary compounds: Shikimic Acid pathway; Mevalonic Acid Pathway; Pathways for commercially important phytochemicals: Forskolin, Taxol and *Vinca* alkaloids. Applications of phytochemicals in medicine, pharmaceuticals, food, flavour and cosmetic industries.	3	K1-K4	10
IV	**Herbalism and Ethnobotany** Herbs and healing: Historical perspectives: local, national and global level; Herbal cultures: origin and development of human civilizations; Ethnobotany: Concept, Scope and objectives; Ethnobotany as an interdisciplinary science,	4	K1-K4	8

	Tribals of India; Methodology of ethnobotanical studies; Medico-ethnobotanical sources in India; Benefit sharing with examples; Traditional Knowledge Digital Library (TKDL); Conservation practices of biodiversity - Sacred groves. Ethnopharmacology: Importance of ethnopharmacological studies.			
V	**Traditional Systems of Medicine** Classical health traditions: Systems of medicine: origin and development of biomedicine; Indian Systems of Medicine (Ayurveda, Siddha, Unani, Tibetan, Yoga and Naturopathy) Ayurveda: Historical perspective, Fundamental principles of Ayurveda: Panchabhootha theory, Thridosha theory, Saptadhatu theory and *Mala* theory; Siddha: Origin and Concept of Siddha system of Medicine; Plants used in Siddha medicine, Siddha formulations; Unani: History, Concept: *Umoor-e-tabiya*, tumors treatment of therapy, polyherbal formulations.	5	K1-K4	15

Text Books

1. Shah, B., Seth, A.K. 2010. Textbook of Pharmacognosy and Phytochemistry, Elsevier India.
2. Wallis T. E. 2005. Textbook Of Pharmacognosy, CBS, New Delhi, 5th Edition.
3. Bannerman, R. H., J. Burton and C. Wen Chen (eds). 1983. Traditional medicine and health care coverage. WHO, Geneva.
4. Harborne, J.B. 1998. Phytochemical Methods: A guide to Modern Techniques of Plant Analysis, Chapman &Hall, London, 3rdEdition.
5. Shah, B., Seth, A.K. 2010. Textbook of Pharmacognosy and Phytochemistry, Elsevier India.
6. Wallis T. E. 2005. Textbook Of Pharmacognosy, CBS, New Delhi, 5th Edition

References

1. Gingauz, A. 2001.Medicinal Chemistry. Oxford University Press & Wiley Publications.
2. Mann J. Davidson, R. S and J. B. Hobbs, D. V. Banthorpe, J. B. Harborne. 1994. *Natural Products*. Longman Scientific and Technical Essex.
3. Hofmann, A. and Clokie, S. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, New Delhi.
4. Cotton, CM. 1996. Ethnobotany: Principles& Applications. John Wiley & Sons, New York.
5. Kameswara Rao, C. 2000. Database of Medicinal Plants. KSCST, Bangalore
6. Knight, R. L and L. White. 2009. Conservation for a new generation redefining natural resources management. Island Press.
7. Crozier, A., Clifford, M.N. and Ashihara, H. 2006. Plant Secondary Metabolites: Occurrence, Structure and Role in the Human Diet. Blackwell Publishing Ltd, UK.
8. Saroya, A.S. 2011. Herbalism, Phytochemistry and Ethnopharmacology. CRC Press, Boca Raton, FL.
9. Handa, S.S., Khanuja, S.P.S., Longo, G. and Rakesh, D.D. 2008. Extraction Technologies for Medicinal and Aromatic Plants. ICS-UNIDO, Earth,

Environmental and Marine Sciences and Technologies, International Centre for Science and High Technology, Italy.

Web Resources:

1. https://www.udemy.com/course/introduction-to-the-science-of-plant-chemistry/?utm_source=adwords&utm_medium=udemyads&utm_campaign=LongTail_la.EN_cc.INDIA&utm_content=deal4584&utm_term=.ag118445032537.ad533094112755.kw.dec.dm.pl.tidsa-1212271230479.li1007810.pd.&matchtype=&gclid=Cj0KCQjwr-SSBhC9ARIsANhzu176r6grK6yUapUwSbCFDeblzZlair8ZyiVJ5hojcfg3yLX1AOJVNTcaAuT8EALwwcB
2. https://www.tuscany-diet.net/category/phytochemicals/
3. https://www.intechopen.com/chapters/62876

Course Outcomes (CO):

	CO Statement: Students will be able to learn	Knowledge Level
CO -1	classification, characteristic and comparative features of secondary metabolites from plants.	K1-K3
CO -2	isolation and quantification of phytochemicals from plants.	K1-K3
CO -3	biosynthetic pathways of secondary compounds and application of phytochemicals.	K1-K3
CO -4	herbalism and ethnobotanical studies.	K1-K3
CO -5	traditional system of medicines viz. Ayurveda, Siddha, Unani, Tibetan, Yoga and Naturopathy.	K1-K3

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	3	1	1	-
CO-2	3	3	3	1	3	-
CO-3	3	3	3	1	2	-
CO-4	3	3	2	1	2	-
CO-5	3	3	2	1	1	-
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**

CO-1	3	2	2	2	1	1
CO-2	3	2	2	2	2	1
CO-3	3	2	2	2	2	1
CO-4	3	2	2	2	2	1
CO-5	3	2	1	2	2	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Course Designer: Prof. P. Ravichandran
Addition of Objectives, outcomes and mapping: Dr. S. Vallinayagam

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-IV/ CORE – 12]

Semester : IV
Course Type : Core
Title of the Course : Plant Biotechnology
Course Code : PBYC42

L	T	P	C
4	-	-	4
66 Hours/Semester			

Course Objectives: To teach students on

1. History, basic principles and concepts of plant cell, tissue, organ culture and organogenesis
2. Techniques of micropropagation, synthetic seed production and conservation of RED listed and economically important plants
3. Protoplast isolation, culture and somatic hybridization and conservation of germplasm by cryopreservation
4. Mechanism of recombination, gene cloning and molecular marker technology for understanding genetic diversity
5. Methods of producing transgenic plants, advances in genetic engineering and production of hybrid seeds

UNITS	CONTENT	CO	K Level	Hours
I	**Basics of Tissue culture** History and scope; concept of totipotency. Culture room and lab facilities. Sterilization methods. Types of media, medium components and preparation; plant growth regulators, adjuvants, antioxidants. Callus induction and types. Cellular differentiation, dedifferentiation, redifferentiation and regeneration. Organogenesis - caulogenesis, rhizogenesis, Cell line, soma clones. Cell Suspension culture: Culture vessels and bioreactors, culture initiation, growth curve, cell aggregates, secondary metabolites synthesis, increased production, use of precursors and elicitors, cell immobilization, biotransformation.	1	K1-K6	16
II	**Techniques in Plant Tissue Culture** Micropropagation - Preparative stage: Germplasm acquisition and explant selection. Establishment stage: Axenic and viable cultures. Multiplication stage: plantlet production. Conservation by Slow or retarded growth. Rooting and Field Transfer: induction of roots and acclimatization/hardening of plantlets in greenhouse condition. Somatic embryogenesis, process, essential factors and synthetic seed production. Anther, pollen	2	K1-K5	12

	culture and production of gametoclones, haploid plants. Embryo rescue in hybrid plants.			
III	**Somatic hybridization & Cryopreservation** Protoplast isolation and culture methods, Somatic hybridization - fusion types, hybrid selection and regeneration, cybrids,possibilities, achievements and limitations of protoplast research. Principles, Cryoprotection, Freezing and long-term cryogenic storage, protocols and recovery of germplasm.	3	K1-K5	12
IV	**Mechanism of Recombination** Role of RecA and RecBCD enzymes chi-sequences. Site specific recombination. Genetic markers, construction of molecular maps, correlation of genetic and physical maps. Applications of PCR in cloning genes, probes and DNA sequencing. PCR in molecular marker technology - RAPD, ISSR, AFLP, SCAR. Sterns and McClintock-Creighton experiments.	4	K1-K5	12
V	**Transgenic plants** Transgenic plants - development strategies (*Bt* cotton, Golden Rice, *FlavrSavr* tomato), *Agrobacterium:* Nature's genetic engineer, crown gall and hairy roots, *Ri*, *Ti*plasmid vectors, roles of virulence genes, T-DNA. Direct and indirect plant gene transfer mechanisms, construction of genomic and cDNA libraries. Production of transgenic insect-resistant, virus-resistant, salinity and drought tolerant, herbicide-resistant plants. Hybrid seeds and Terminator gene technology and molecular farming for production of pharmaceutical products.	5	K1-K6	14

Text Books

1. Bhojwani, S.S. and Dantu, P.K. 2013. Plant Tissue Culture: An Introductory Text. Springer India.
2. Chawla, H.S. 2009. Introduction To Plant Biotechnology, CRC Press.
3. Bubey, R.C. 2013. A textbook of Biotechnology. S. Chand & Company Private Ltd
4. Slater, A., Scott, N.W., and Fowler, M.R. 2008. Plant Biotechnology: An Introduction to Genetic Engineering. Oxford University Press.

References:

5. Bhojwani, SS. 1990. Plant tissue Culture: application and Limitations. Elsevier Science Publishers, New York.
6. Collins, H.A.and Edwards, S.1998. Plant Cell Culture. Bio Scientific Publishers, Oxford.

7. Dixon, R.A. 1994. Plant cell culture, A Practical Approach. IRL Press. Oxford, London.
8. Benson, E.E. 1999.Plant Cconservation Biotechnology. Taylor & Francis.
9. Freifelder. D. 1990. Molecular Biology. Narosa Publishing, New Delhi.
10. George, E.F. 1994. Plant Propagation by Tissue culture. Exegetics Ltd.
11. Lindsay. 1992. Plant Tissue Culture Manual. Kluwer Academic Publishers, Netherlands.
12. Narayanasamy, S. 1994. Plant cell and tissue culture. Tata McGraw-Hill Publishing Co., New Delhi.
13. Raven, P.J, Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12thEdition.
14. Raghavan, V. 1986. Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York.
15. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

Web resources for both theory and Practical's:

1. https://labassociates.com/7-methods-of-plant-tissue-culture
2. https://www.youtube.com/watch?v=TORRxwbz7aY
3. https://www.youtube.com/watch?v=HHYDmfj4ojk
4. https://www.youtube.com/watch?v=xuwV3ywCxW8
5. https://www.youtube.com/watch?v=cD9CFtpLL2s
6. https://www.youtube.com/watch?v=tLunC7ICx2w
7. https://www.youtube.com/watch?v=hfNSiB0fW64
8. https://www.youtube.com/watch?v=9ymaAV3gfxg
9. https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/transgenic-plant
10. https://www.youtube.com/watch?v=-UqR__NESSM
11. https://www.youtube.com/watch?v=NXNFR4cj68U
12. https://www.youtube.com/watch?v=I3fCD0uUJk0
13. https://www.youtube.com/watch?v=wTO-KmpZQgQ
14. https://www.youtube.com/watch?v=L7qnY_GqytM
15. https://www.youtube.com/watch?v=K1ZyzvsHhOE
16. https://www.youtube.com/watch?v=4fBQ2umTaMA
17. https://www.frontiersin.org/articles/10.3389/fpls.2020.00509/full

	Course Outcome Statement: Students would have	Knowledge Level
CO -1	Developed skills for medium composition, initiating plant cell, tissue and organ culture, production and extraction of secondary metabolites	K1-K6
CO -2	Gained knowledge on various methods of producing large number of plants by *in vitro* for conservation and horticultural purposes	K1-K5

CO -3	Mastered the procedures for protoplast isolation, culture and somatic hybridization and conservation of germplasm by cryopreservation	K1-K5
CO -4	Learnt to produce and create different mechanisms for recombination, gene cloning for producing recombinants and molecular marker technology for assessing genetic diversity	K1-K5
CO -5	Understood to generate transgenic plants, be acquainted with advances in genetic engineering and production of hybrid seeds	K1-K6

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Correlation/Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	3	2	2	0
CO-2	3	3	3	2	2	1
CO-3	2	2	3	2	2	0
CO-4	3	2	3	2	2	1
CO-5	3	2	3	2	2	1
0-Insignificant level; 1 – Low level; 2 – Moderate level; 3 – High level						

Correlation/Mapping Program Outcomes with Course learning Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	3	3	1	1	1	0
CO-2	3	3	2	1	1	0
CO-3	3	3	2	1	1	0
CO-4	3	3	2	1	1	0
CO-5	3	3	2	1	1	0
0-Insignificant level; 1 – Low level; 2 – Moderate level; 3 – High level						

Course Designer: P. Ravichandran

[2022/MSU 53rdSCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-IV/PRACTICAL – 8]

Semester : IV
Course Type : Practical
Title of the Course : Plant Biotechnology
Course Code : PBYL41

L	T	P	C
-	-	8	4
90 Hours/Semester			

Course Objectives: Enable students to be trained in:

1. Setting up of a plant tissue culture laboratory, preparation and formulation of stock and culture media and sterilization procedures
2. Micropropagation procedures including in vitro seed germination, callus induction and clonal propagation of RED listed and economically important plants
3. Isolation, culture of protoplasts and single cells, somatic embryogenesis and hybridization and production of synthetic seeds, haploid plants by anther culture and natural products
4. Isolation, purification and separation of DNA and amplification of DNA sequences using PCR techniques
5. Mechanism of recombination, cloning of vectors and visits to plant conservation Centre's and institutions

UNIT	CONTENT	CO	K Level	Hours
I	1. Sterilization of culture vials, equipment, and culture room and surface sterilization of explants. 2. Preparation of Culture media and PGR stock solutions and working medium: solid and liquid medium. 3. Isolation of some natural products: Piperine, caffeine, flavone, coumarin, triterpenoids	1, 3	K1-K6 K1-K4	15
II	4. *In vitro* germination of Orchid seeds. 5. Callus induction in carrot or any other plant material. 6. Regeneration through callus and somatic embryogenesis. 7. Clonal Propagation by shoot tip/axillary bud culture.	2	K1-K6	18
III	8. Whole cell immobilization/Encapsulation of somatic embryos and production of synthetic seeds. 9. Demonstration of protoplast isolation, culture and fusion. 10. Demonstration of haploid plant production in *Datura.*	3	K1-K6	24

IV	11. Isolation of DNA and identification of DNA by AGE. 12. Restriction digestion and estimation of the size of various DNA fragments 13. Polymerase Chain Reaction amplification of DNA and analysis of the products	4	K1-K6	18
V	14. Cloning of DNA fragments in a plasmid vector. 15. Transformation of the given bacterial population and selection of recombinants 16. Visit to germplasm centers and commercial Plant Biotechnology laboratories.	5	K1-K6	18

Course Outcomes (CO):

Course Outcome Statement: Students would have practically acquainted on		Knowledge Level
CO -1	Setting up of a plant tissue culture laboratory, preparation and formulation of stock and culture media and sterilization procedures	K1-K3
CO -2	Micropropagation procedures including in vitro seed germination, callus induction and clonal propagation of RED listed and economically important plants	K1-K5
CO -3	Isolation, culture of protoplasts and single cells, somatic embryogenesis and hybridization and production of synthetic seeds, haploid plants by anther culture	K1-K6
CO -4	Isolation, purification and separation of DNA and amplification of DNA sequences using PCR techniques	K1-K4
CO -5	Mechanism of recombination, cloning of vectors and visits to plant conservation Centre's and institutions	K1-K6

Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Correlation/Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	3	3	3	2	2	0
CO-2	3	3	3	2	2	1
CO-3	2	2	3	2	2	0
CO-4	3	2	3	2	2	1
CO-5	3	2	3	2	2	1

0-Insignificant level; 1 – Low level; 2 – Moderate level; 3 – High level

Correlation/Mapping Program Outcomes with Course learning Outcomes:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	3	1	1	1	0
CO-2	3	3	2	1	1	0
CO-3	3	3	2	1	1	0
CO-4	3	3	2	1	1	0
CO-5	3	3	2	1	1	0

0-Insignificant level; 1 – Low level; 2 – Moderate level; 3 – High level

Text Books

1. Bhojwani, S.S. and Dantu, P.K. 2013. Plant Tissue Culture: An Introductory Text. Springer India.
2. Dixon, R.A. 1994. Plant cell culture, A Practical Approach. IRL Press. Oxford, London.
3. Lindsay. 1992. Plant Tissue Culture Manual. Kluwer Academic Publishers, Netherlands Adrian Slater, Nigel W.Scott, Mark R. Fowler. 2008. Plant Biotechnology: An Introduction to Genetic Engineering. Oxford University Press.

References:

4. Bhojwani, SS. 1990. Plant tissue Culture: application and Limitations. Elsevier Science Publishers, New York.
5. Collins, HA & Edwards S.1998. Plant Cell Culture. Bio Scientific Publishers, Oxford.
6. Benson, E.E.1999.Plant Cconservation Biotechnology. Taylor & Francis.
7. Freifelder. D. 1990. Molecular Biology. Narosa Publishing, New Delhi.
8. George, E. F. 1994. Plant Propagation by Tissue culture. Exegetics Ltd.
9. Narayanasamy, S. 1994. Plant cell and tissue culture. Tata McGraw-Hill Publishing Co., New Delhi.

Course Designer: P. Ravichandran

[2022/MSU 53rd SCAA/Univ. Dept./PG/M.Sc. Bot. Sem.-IV/PRACTICAL –9]

Semester	**:**	**IV**
Course Type	**:**	**Practical**
Title of the Course	**:**	**Field Study**
Course Code	**:**	**PBYI41**

L	T	P	C
-	-	2	2
Every semester one day field study (3); and 3 -5 days field study (1) for the entire program			

Course objectives:

1. to observe the plants in their habitat and collect specimens for further study in the laboratory.
2. To learn the methodologies of recording the observations on plants habit and habitats
3. To understand the interaction of plants with other organisms of forests and engage in discussion with tribal peoples
4. visit relevant industries to understand how the theoretical learning is being put into practice
5. to translate the recorded information in the tour diary into a technical report

UNITS	CONTENT	CO	K Level	Hours
I	**Collection and fixing/preservation of plant specimens** Collection of Algae, Fungi, Lichens, Bryophytes, Gymnosperms, Fossils, Monocotyledons and Dicotyledons from different habitats, forests and Ecosystems. Preparation and use of fixatives and preparation of specimens for killing and preservation either in liquid or as dry specimens and Herbarium. Visit to places like freshwater ponds, lakes, rivers, Mangroves, marine ecosystems, coastal areas, hillocks, and mountains of higher elevations with different forest, vegetation types and grasslands. Ex. Collection sites Kanyakumari, Rameswaram, Manapadu, Uvari Coastal areas. Western ghats – KMTR, Servalar, Tribal hamlets, Dam sites, Karaiyar, Kodaiyar, Kuthiraivetti, Winch point grasslands, Achenkoil forests, waterfalls and streams, Aryankavu, Kollam, Palode and Ponmudi.	1	K1-K4	12
II	**Identification and documentation of plant specimens** Learning to identify specimens based on the morphological characteristics, anddevelopmental characteristics of the entire plant, using hand lenses, questioning by students, and if required helping by teachers and experts in the field. Documentation of information on plants or their parts used, various economic aspects, medicinal properties,and sensing plants by touch, smell and taste. Trying to identify wild cultivars of crops, vegetables and fruits in the field.	2	K1-K4	18
III	**Recording habitat and Field characters**	3	K1-K4	10

	Self or group -recording of habitat conditions, hosts, substrates, soil parameters, environmental factors and other field characters of live plants. Learning about plant morphological variations, forest and vegetation types, soil types, occurrence of plants at different altitudes and elevations, plant communities, associated organisms, plant animal interactions, dependency of tribal communities, and survival skills like mimicry. Conservation areas and Protected forests and sanctuaries. Nilgiri Biosphere reserve, Agastiyamalai biosphere reserve, Island vegetations, deserts etc.			
IV	Visit to Industries and Research institutions and Commercial organizations pertaining to courses mentioned in the Syllabus. State and central research laboratories, Herbaria, Museums, Wood research institutes, Live gene banks, Botanical gardens, Medicinal parks, paper or cotton mills, Floriculture, Horticultural, Pharmaceutical research stations or institutions.	4	K1-K4	20
V	Report preparation and documentation, Periodical Submission and Evaluation Students should prepare very detailed information directly from the field/lab/ institution visited and prepare a document with picture evidences, filed note book and approval from the mentors of respective subject and tour coordinator. Final summary report shall be submitted for valuation. Students should also appear for the viva-voce examination on the day of practical exam**.**	5	K1-K3	10

Course Outcomes (CO):

	CO Statement: After successful completion of the field trip, the student will be able to	Knowledge Level
CO -1	demonstrate the knowledge of sample collection from various ecosystems and the availability of specific plants in specific locations	K1-K4
CO -2	technically document the information on plants and make them a source of information for future reference	K1-K4
CO -3	critically analyze the plant ecosystems and their co-existence with other organisms and the interaction with both biotic and abiotic factors in the field.	K1-K4
CO -4	to realize the application potential of the knowledge acquired in the industrial sectors	K1-K4
CO -5	write technical report on a field trip translating the observations made during the trip	K1-K3

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CO-1	3	3	2	1	1	1
CO-2	3	3	2	2	2	1
CO-3	3	3	2	2	2	1
CO-4	3	3	1	1	1	1
CO-5	3	3	1	2	1	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						

Mapping Program Outcomes with Course Outcomes:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	1	1	1	2	1
CO-2	3	2	2	2	1	1
CO-3	3	2	1	1	2	1
CO-4	3	2	1	2	2	1
CO-5	3	2	1	1	1	1
0 – Insignificant level, 1 – Basic level, 2 – Intermediate level; 3 – High level						