M. Sc. BOTANY – Syllabus

Syllabus as Per the Choice Based Credit System (CBCS),

TANSCHE 2023

&

Learning Outcomes-based Curriculum Framework (LOCF)

(Curriculum Effective from the academic year 2023 - 2024)

Submitted by

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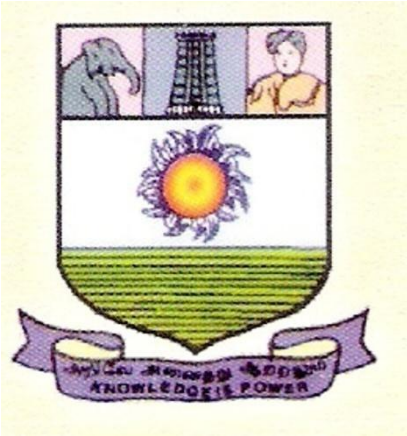
Professor & Head and Chairperson

First semester

APPROVED IN THE 54TH SCAA 15.06.2023

Changes made thereafter

To be ratified in the next SCAA



Board of Studies in Plant Science

DEPARTMENT OF PLANT SCIENCE

Manonmaniam Sundaranar University, Tirunelveli

June 23, 2023

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, academic freedom, 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 able.

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) provide 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, Skill enhancement, practical, internship, field study) 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 Program prepared in conformity to University Rules and eligibility criteria for admission.

(iv) 'Core Course' is a course that all students admitted to a major Discipline 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 or four such courses offered in a semester in the same department.

(vi) 'Skill enhancement Course (SEC)' is also a kind of elective course, which is available for students of all Programs at the MOOCs or NPTL online platforms. Students of any Department will choose 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 to select 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 have to answer and clarify the questions. External marks for the viva voce examination will be awarded by both internal and external 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 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, Bio-energy, Plant Biotechnology) areas of Botany.**
PSO-4	**Possess across subject knowledge through self-directed learning to enhance their skills, entrepreneurship and employability**
PSO-5	**Ability to understand and apply analytical and scientific reasoning on 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 PROGRAM STRUCTURE – July 2023 onwards

Choice Based Credit System (CBCS) (TANSCHE) and

Learning Outcomes-based Curriculum Framework (LOCF)

		SEMESTER - I	**Lecture & Tutorial**			
Core/ Elective/ Skill courses	**Course Code**	**Title of the Course**	**Weekly contact hours**	**No. of credits**	Int. 25	Ext 75
					Total	
Core-1	RBYC11	Plant Diversity - I (Algae, Fungi, Lichens, and Bryophytes)	4L+1T	4	100	
Core-2	RBYC12	Plant Diversity – II (Pteridophytes, Gymnosperms, and Paleobotany)	4L+1T	4	100	
Core -3	RBYC13	Cell and Molecular Biology	4L+1T	4	100	
Core- Practical -1	RBYL11	Plant Diversity I, II & Cell & Molecular Biology	9P	4	100	
Elective Course – I Discipline Centric		Any one-course choice based				
	RBYEAA	**Microbiology, Immunology, and Plant Pathology**	3L	3	100	
	RBYEAB	Conservation of Natural Resources and Policies				
	RBYEAC	Mushroom cultivation				
	RBYEAD	Phytopharmacognosy				
		Any one-course choice based				
Elective Course–II Generic Centric	RBYEBA	Algal Technology	3L	3	100	
	RBYEBB	Ethno botany, Naturopathy, and Traditional healthcare				
	RBYEBC	**Evolutionary Biology**				
	RBYEBD	Herbal Technology				
		Subtotal	**30**	**22**	**600**	

		SEMESTER- II	Lecture & Tutorial		
Core/ Elective/ Skill courses	**Course Code**	**Title of the course**	**Weekly contact hours**	**No. of credits**	Int. 25 / Ext. 75 **Total**
Core-4	RBYC21	Genetics, Genomics & Plant Breeding	3L+1T	4	100
Core-5	RBYC22	Anatomy and Embryology of Angiosperms	3L+1T	4	100
Core -6	RBYC23	Research methodology, Instrumentation & Computer applications	3L+1T	4	100
Core Practical 2	RBYL21	Genetics, Plant Breeding, and Instrumentation.	5P	2	100
Core Practical 3	RBYL22	Anatomy and Embryology of Angiosperms	5P	2	100
Elective Course –III Discipline centric	Any one-course choice based		2L+1T	3	100
	RBYECA	Medicinal Botany			
	RBYECB	Agriculture and Food Microbiology			
	RBYECC	Bio-pesticide technology			
	RBYECD	**Intellectual property rights**			
Elective Course –IV Generic Centric	Any one-course choice based		2L+1T	3	100
	RBYEDA	Applied Bioinformatics			
	RBYEDB	**Horticulture**			
	RBYEDC	Plants for Bioenergy and Space Research			
	RBYEDD	Plants in Tamil literature			
Skill Enhancement Course (SEC)1	**RBYMSA**	**Speaking Effectively offered from MOOCS**	1L+1T	1	100
		Subtotal	**30**	**23**	**800**

		III Semester	Lecture & Tutorial		
Core/ Elective/ Skill courses	**Course Code**	**Title of the course**	**Weekly contact hours**	**No. of credits**	Int. 25 / Ext 75 / Total
Core-7	RBYC31	Taxonomy and Molecular Systematics of Angiosperms	3L+1T	4	100
Core-8	RBYC32	Ecology, Phytogeography & Conservation Biology	3L+1T	4	100
Core-9	RBYC33	Plant Physiology & Biochemistry	3L+1T	4	100
Core Practical 4	RBYL31	Taxonomy, Molecular Systematics and Ecology	8P	4	100
Core Practical 5	RBYL32	Plant Physiology & Biochemistry	6P	3	100
Elective Course – V Discipline Centric	Any one-course choice based		2L	2	100
	RBYEEA	Secondary Plant Products and Fermentation Technology			
	RBYEEB	Entrepreneurial opportunities in Botany			
	RBYEEC	**Industrial Botany**			
Skill Enhancement Course (SEC) 2	**RBYMSB**	**Wild Life Ecology - offered from MOOCS**	2L	3	100
Practical- Internship-Extension Activity-Field Study-Industrial Visit			Summer vacation		
		Subtotal	**30**	**24**	700

		Semester- IV	Lecture & Tutorial			
Core/ Elective/ Skill courses	**Course Code**	**Title of the course**	**Weekly contact hours**	**No. of credits**	Int. 25	Ext .75
					Total	
Core-10	RBYC41	Recombinant DNA Technology and Industrial Applications	3L+1T	4	100	
Core-11	RBYC42	Applied Plant Biotechnology	3L+1T	4	100	
Core Practical-6	RBYL41	rDNA and Plant biotechnology	8P	4	100	
Elective Course – VI Discipline Centric	Any one-course choice based		3L+1T	3	100	
	RBYEFA	Organic farming				
	RBYEFB	**Forestry and wood technology**				
	RBYEFC	Gene Cloning and gene therapy				
	RBYEFD	Farm Sciences - Green Wealth				
Project	RBYP41	Project/Dissertation and viva voce	8	6	100	
Skill Enhancement Course (SEC) 3	Professional Competency Skill		2	2	100	
	RBYMSC	NET/UGC - CSIR/SET/ TRB General Studies for UPSC / TNPSC				
	RBYMSD	**Botany for Advanced Research** ***Naan Mudhalvan Scheme***				
Practical-7	RBYFS 41	Field Study-Lab/Industrial Visit	All the four semesters	2	100	
		Subtotal	**30**	**25**	**700**	
		Grand Total	**120**	**95**	**9500**	

Distribution of Credits

Name of Courses	No. Courses	Credits	Total Credits	Total grade points
Core Theory	11	4	44	4400
Core Practical	3	4	12	1200
Core Practical	1	3	3	300
Core Practical	**2**	**2**	4	400
Practical: Internship/Extension activity / Field Study/ Industrial Visit	**1**	**2**	2	200
Elective -1	**5**	**3**	15	1500
Elective -2	**1**	**2**	2	200
Skill Enhancement Course (SEC)	**1**	**3**	3	300
	1	**2**	2	200
	1	**1**	1	100
Dissertation-Project and Viva-Voce	**1**	**6**	6	600
***Grand Total Credits/ Marks**			**94**	**9400**
Cumulative Grade Points Average (CGPA) = Grade Points /Total Credits			**9400/94**	**100%**
Value added course - extra teaching hours			**1**	**2**

* 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 skill enhancement courses from MOOCS platform

** Elective courses if required for students of other departments will be offered by Plant Science or from 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. 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. Students will have to opt for any three specializations available with the faculties. Selection will be on the choice and interest of the students. A faculty may be given a minimum of two and a maximum of four students in a batch. If there is any issue in selection of the specialization HOD and the concerned faculty should discuss and solve the issue. Once the selection is over there will be minimal chance for changing the guides, except for the rare situations like illness or long absence of the guide.

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 Internship-Extension Activity-Field Study-Industrial Visit 50 marks maximum for internal will be based on periodical submission of reports, records, 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 (Blooms taxonomy based) 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

RBYC31: 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 a plant.
    (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 certain plants?
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 Line weaver-Burk equation and Michaelis-Menten Equation.
17. (a). Critically comment on the mechanism of Mass Flow hypothesis
    (b). Describe the stomata 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 is the eligibility criterion to appear for the semester practical examination	
5.VIVA-VOCE	-	5	
TOTAL	**50**	**50**	**100**
Internship-Extension Activity-Field Study-Industrial Visit	**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 92 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.

[2023/MSU 54th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- I/CORE-1]

Title of the Course	**PLANT DIVERSITY–I: ALGAE, FUNGI, LICHENS AND BRYOPHYTES**			
Category & Course No.	**Core Theory-I**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**4**	RBYC11
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	1	--	5
Pre-requisite	Students should be familiar with the basics of Algae, Fungi, Lichens and Bryophytes.			
Learning Objectives	• To learn about the classification, distinguishing traits, distribution, and reproductive cycle of algae • To understand the classification, distinguishing traits, distribution, and reproductive cycle of Fungi • To gain knowledge about the general characters, ecological and economic importance of lichens • To study and describe the morphology and reproductive processes of bryophytes • To familiarize with phylogeny and interrelationships in Algae, Fungi, lichens and Bryophytes			

UNITS	**CONTENT**	**CO**	**K Level**	**Hrs.**
I	**Algae** Origin and evolution of algae; General characteristics of algae; Diversity and Habitats-Terrestrial, Freshwater and Marine. Thallus organization - cell and chloroplast structure. Reproduction: vegetative-asexual- sexual- life cycle patterns Recent Classification criterions pigments, reserve food, flagella (P.C. Silva (1982), Phylogeny and interrelationship of algae (Lee, 2008). Contributions of Indian Phycologists: M.O.P.Iyengar, T.V. Desikachary, V.K. Krishnamurthy, M.S. Balakrishnan, V.S.S. Sundaralingam.	1	K1-K3	12
II	**Algae –Type studies** Salient features of major classes: Cyanophyceae, Chlorophyceae, Xanthophyceae, Chrysophyceae, Cryptophyceae, Dinophyceae, Chloromonadineae, Euglenophyceae, Charophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Structure, reproduction and life histories of the following genera: *Oscillatoria (Cyanophyceae), Ulva (Chlorophyceae), Diatoms (Bacillariophyceae, Dictyota, Padina (Phaeophyceae)* and *Ceramium (Rhodophyceae).* Algae - Economic importance in	2	K1-K4	12

	Food and feed - Single cell protein, Industrial products (Agar-Agar, Carrageenan, Alginic acid, Iodine, biofertilizers, Vitamins and biofuel), Medicinal value and Diatomaceous earth.			
III	**Fungi** General Characteristics; cell ultrastructure; unicellular and multicellular organization; cell wall composition; nutrition (saprophytic, biotrophic and symbiotic); reproduction (vegetative, sexual and asexual); life cycle patterns: Homothallism, heterothallism; heterokaryosis; parasexuality. Classification: Alexopoulus and Mims (1979) and recent trends. General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, and Deuteromycotina. Phylogeny and interrelationships of major groups of fungi. Structure, reproduction and life histories of the following genera: *Plasmodiophora*, *Phytophthora*, *Rhizopus*, *Taphrina*, *Polyporus* and *Colletotrichum.* Contributions of Indian Mycologists – C.V. Subramanian. Economic importance of Fungi in food, industries and medicine.	3	K1-K4	12
IV	**Lichens** Origin and evolution of lichens; General characteristics of lichens; Classification (Hawksworth and Hill, 1984). Occurrence and interrelationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basidiolichens and Deuterolichens. Economic importance Lichens and as indicator of pollution.	4	K1-K4	12
V	**BRYOPHYTES:** Origin and evolution of bryophytes; General characteristics of bryophytes; Morphology, structure, reproduction and life history; distribution; classification (Watson 1971), phylogeny. General account of Hepaticopsida: Marchantiales, Jungermaniales; Anthocerotopsida: Anthoceratales; Bryopsida: Sphagnales, Funariales and Polytrichales. Economic and ecological importance of Bryophytes. Structure, reproduction and life histories of the following genera: *Reboulia*, *Porella*, *Anthoceros* and *Polytrichum.*	5	K1-K4	12

Text Books

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3. Alexopoulos, C.J. and Mims, M. Blackwell. 1996. Introductory Mycology. John Wiley Sons Inc.
4. Morris, I. 1986. An Introduction to the Algae. Cambridge University Press, UK.
5. Sambamurty, A. V. S. S 2013. A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany, I K International Publishing House Pvt. Ltd, ISBN-13 978-8188237456

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15. Cryptogamic Botany, Vol I. 1938. Smith, Gilbert. M, McGraw Hill Book Company, Inc**.**

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 ultra structure 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

[2023/MSU 54th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- I/CORE-2]

Title of the Course	**PLANT DIVERSITY – II (PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY)**			
Category & Course No.	**Core Theory-II**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**4**	RBYC12
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3	2	--	5
Pre-requisite	Students should know about the fundamental of Pteridophytes, Gymnosperms and fossil records.			
Learning Objectives	1. To study classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes. 2. To study the structure, anatomy, reproduction and life histories of the important genera through type studies in Pteridophytes. 3. To understand the general and reproductive characters of Gymnosperms with economic importance and its classification. 4. To acquire the knowledge of anatomy, reproduction and life histories of the important genera through types studies in Gymnosperms. 5. To learn about the concept of fossils and process of fossilization; distinctive characteristics of fossil records of Pteridophytes and Gymnosperms.			

UNITS	**CONTENT**	**CO**	**K Level**	**Hrs**
I	**Pteridophytes** Origin and evolution of Pteridophytes; General characteristics of Pteridophytes; Morphology, distribution, anatomy and reporduction; classification (K.R. Sporne, 1966);Characteristics features of Psilopsida, Lycopsida, Sphenopsida and Pteropsida. Phylogeny. Evolution of stele; heterospory and origin of seed habit.Economic importance of Pteridophytes.	1	K1-K4	12
II	**Pteridophytes** Structure, anatomy, reproduction and life histories of the following genera: *Isoetes*, *Equisetum Angiopteris*, *Osmunda*, *Pteris* and *Azolla.*	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. Distribution of Gymnosperms. Phylogeny and classification (K.R. Sporne, 1965) of Gymnosperms. Economic importance.	3	K1-K4	12

IV	**Gymnosperms** General account of Pteridospermales: (Lyginopteridaceae, Medullosaceae, Caytoniaceae and Glossopteridaceae). Cycadeoidales and Cordaitales. Structure and reproduction in Cycadales, Ginkgoales, Coniferales, Ephedrales and Gnetales. Structure (Exomorphic and Endomorphic), anatomy, reproduction and life histories of the following genera: *Thuja*, *Cupressus*, *Araucaria*, *Podocarpus*, *Gnetum* and *Ephedra*.	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: Rhynia, Lepidocarpon, Lyginopteris, Heterangium, Medullosa, Cycadeoidea, Pentaxylon, Williamsonia and Cordaites. Gondwana flora of India. Major fossil sites of India: Thiruvakkarai, Sriperumbudhur, Rajmahal Hills. Paleobotany in phylogeny; Indian Paleobotanists: Birbal Sahni, D. D. Pant, M. Ramanujam. Economic importance of fossils – fossil fuels and industrial raw materials.	5	K1-K4	12

Text Books

1. Sporne, K.R. 2023. The Morphology of Pteridophytes the Structure of Ferns and Allied Plants, United Book Prints, ISBN-13 978-9392590474
2. Singh,V., Pande,P. CandJain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
3. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
4. Vashishta.P.C., A.K. Sinha and Anil Kumar. 2018. Botany for Degree students-Gymnosperms. S. Chand and Company Ltd., New Delhi.
5. Sharma, O.P. 2017. Pteridophyta, McGraw Hill Education, New York.
6. Vashishta, P.C. Sinha, A.K and Anil Kumar. 2016. Botany for Degree students. Gymnosperms. S. Chand and Company Ltd., New Delhi Sporne, K.K. 1991. The Morphology of Pteridophytes. BI Publishing, Bombay.
7. Taylor, E, Taylor, T, Krings, M. 2008. Paleobotany: The Biology and Evolution of Fossil Plants, 2nd Edition, Academic Press.
8. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.
9. Sporne, K.R. 1967. The Morphology of Gymnosperms. Hutchinson & Co., London.

References

1. Parihar, N.S. 2019. An Introduction to Embryophyta Pteridophytes. 5th Edition, Surjeet Publication, Delhi.
2. Sporne, K.R. 2017. The morphology of Pteridophytes (The structure of Ferns and Allied Plants), Andesite Press.
3. Pandey, S.N and Trivedi, P.S. 2015. A Text Book of Botany Vol. II- 12th edition, Vikas Publishing.
4. Jon C. Herron and Scott Freeman. 2014. Evolutionary analysis (5th Edition.).

5. Rashid, A. 2013. An introduction to Pteridophyta – Diversity, Development and differentiation (2nd edition), Vikas Publications.
6. Peter H. Raven, George B. Johnson Jonathan B. Losos, Kenneth A. Mason and Susan R. Singer. 2008. Biology. (8th Edition)
7. Peter J. Russell, Stephen L. Wolfe, Paul E. Hertz and Cecie Starr. 2008. Biology: The Dynamic Science, (1st Edition).
8. ArnoldA.C.2005. An Introduction to Paleobotany. Agrobios (India).Jodhpur.
9. Bhatnagar, S.P and Moitra, A.1996.Gymnosperms. New Age International, New Delhi.
10. Thomas N. Taylor · 1981 Paleobotany An Introduction to Fossil Plant Biology, ISBN:9780070629547, 0070629544, Page count:589, Published:1981 Publisher: Mc Graw-Hill The University of California
11. Sporne, K.R.1965. The Morphology of Gymnosperms. BI Publications, New Delhi.

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

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	origin, classification, evolution of stele types, comparative features of sporophytes and gametophytes and economic importance of Pteridophytes	K1-K3
CO -2	characteristic and comparative features of the specified orders, and economic importance of Pteridophytes	K1-K3
CO -3	the classification, reproductive structures, development of male and female gametes, embryogeny and economic importance of Gymnosperms.	K1-K3
CO -4	the structure, anatomy, reproduction and life histories of the important genera 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	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

[2023/MSU 54th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- I/CORE-3]

Title of the Course	**Cell and Molecular Biology**			
Category & Course No.	**Core Theory-I**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**4**	RBYC13
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	1	--	5
Pre-requisite	Students should be familiar with the basics of Plant cell and Molecular Biology			
Learning Objectives	Students will be able to learn 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**	**Hrs**
I	**Cell structure** Cell theory, ultra-structure, prokaryotic and eukaryotic cells. Cell wall-structure, functions and chemical composition. 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. Apoptosis-mechanism of	3	K1-K5	15

	programmed cell death. 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 chromosomes, Karyotype analysis.			
IV	**Nucleic Acids** Nucleic acids: Physical and chemical properties of DNA & RNA, Types of DNA & RNA, Watson and Crick model. DNA damage and repair-methylation of DNA and mismatch repair; Organellar genome organization. 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, reverse transcription. 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. DNA/gene manipulating enzymes-endonuclease, ligase, polymerase, phosphatase, transcriptase, transferase, topoisomerase.	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. Kleinsmith, 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., 8thEdition.
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 5thEdn. Pearson Edu. ISBN 0 321 22368 3.

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

[2023/MSU 54thSCAA/Univ.Dept./PG/M.Sc. Bot.Sem.- I/Core Practical-1]

Title of the Course	**PLANT DIVERSITY I & II & CELL AND MOLECULAR BIOLOGY**			
Category & Course No.	**Core Practical -1**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**4**	RBYL11
Instructional Hours per week	**Lecture**	**Tutorial/ Field**	**Lab Practice**	**Total**
			8	5
Pre-requisite	Students should be familiar with the fundamentals of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, Gymnospersms and Paleobotany in addition to essential laboratory techniques.			
Learning Objectives	1. To learn how to employ the use of instruments, technologies and methodologies related to thallophytes and non-flowering plant groups. 2. To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of algae, and fungi. 3. To comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction. 4. To develop the technical abilities in staining, sectioning, sterilizing, and characterizing. thallophytes, and other varieties of non-flowering plants. 5. To compare the structural diversity of fossil and extant plant species.			

UNITS	CONTENT	CO	K Level	Hrs
I	Study of following **Algal flora** with special reference to morphology and anatomy of vegetative & reproductive structures: *Oscillatoria, Spirulina, Scytonema, Ulva, Chaetomorpha* (Hill streams*), Chara, Cephaleuros* (Tea and Mango leaves) *Codium, Halimeda, Padina, Sargassum, Dictyota, Gelidium, Gracilaria, Ceramium (*epiphytic), *Cyclotella* (Diatoms- fresh water). Visit to Achenkoil, Kodaiyar, Courtallam forest areas for Fresh water Algae, For marine Algae to Rameshwaram, Manapadu, Uvari	1	K1-K5	15
II	Study of morphology and reproductive features of following **Fungi:** *Albugo, Aspergillus, Peziza, Polyporus, Puccinia, Plasmodiophora, Phytophthora, Colletotrichum, Fusarium, Rhizopus, Taphrina, Cercospora; Parmelia* and *Usnea* (Lichens). Root section of grasses for localization of ecto and endomycorrhizae. Visit to Achenkoil, Kodaiyar, Courtallam forest areas for Fungi.	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, Targionia, Lunularia.* **Pteridophytes:** *Psilotum, Lycopodium, Selaginella, Isoetes, Equisetum, Lygodium, Adiantum, Marsilea, Salvinia, Angiopteris, Osmunda, Pteris* and *Azolla.*	3	K1-K5	15
IV	Comparative Morphological and anatomical studies of vegetative and reproductive parts of **Gymnosperms** : *Cycas, Cupressus, Araucaria, Podocarpus, Gnetum, Thuja,* and *Ephedra.* Structural details of the following **Fossils**: *Lyginopteris, Medullosa. Rhynia, Lepidodendron, Sphenophyllum, Calamites* and *Cordaites.* Démonstration on sectioning of plant fossils by vidéos. Visit to Achenkoil, Kodaiyar, Courtallam forest areas for Bryophytes, Pteridophytes and Gymnosperms. National Fossil sites – Thiruvakkarai, Sri Perumbudhur and Nanmangalam	4	K1-K5	15
V	**Cell & Molecular biology:** 1. General and ultra-structure of Chloroplast, mitochondrion, Golgi bodies and Nucleus 2. Cell cycle and phases 3. Isolation and observation of genomic and plasmid DNA from microorganisms. 4. Isolation and observation of genomic DNA from plants. 5. Transformation of *E. coli*. 6. Study of mitosis - onion root tip squash for chromosomal examination – Haematoxylin staining 7. Study of meiosis – *Tradescantia /Rheo* flower buds for chromosomal examination – acetocarmine staining	5	K1-K5	20

References

1. Bendre, A., 2000. "A Textbook of Practical Botany", Seventh Edition, Rastogi Publications, Meerut.
2. Malhotra, M. and Pathak, C., 2012 "A Text Book of Bryophyta", First Edition, Wisdom Press, New Delhi.
3. Parihar, N.S., 1963. "An Introduction to Embryophyta", Vol.II, Pteridophyta, Fourth Reprint Edition, Central Book Depot, Allahabad.
4. Rashid, A., 1999. "An Introduction to Pteridophyta", Vikas Publishing House (P) Ltd., New Delhi.
5. Sharma, P. D., 2005. "Fungi and Allied Organisms", Fifth Edition, Narosa Publishing House, New Delhi.
6. Sporne, K.R. 2015. "The Morphology of Gymnosperms", First Edition (Reprint), Scientific Publishers, Jodhpur.
7. Sporne, K.R. 2006. "The Morphology of Pteridophytes", Second Edition, Hutchinson University Library, London.
8. Vashista, P.C., Sinha, A.K. and Kumar, A., 2012. "Pteridophyta", First Edition (Reprint), S. Chand & Company Ltd., New Delhi.
9. Vashista, P.C., Sinha, A.K., and Kumar, A., 2013. "Gymnosperms", First Edition (Reprint), S. Chand & Company Ltd., New Delhi.
10. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
11. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
12. Sharma O.P and S, Dixit.2002.Gymnosperms.PragatiPrakashan.
13. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.
14. Chmielewski, J.G and Krayesky, D. 2013.GeneralBotany laboratory Manual. Author House, Bloomington, USA.
15. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rdEd. Cambridge University Press, Cambridge.
16. Sharma, O. P.2017. Bryophyta, Mac Millan India Ltd, New Delhi.
17. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
18. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand publication.

Web Resources:

1. https://www.frontiersin.org/articles/10.3389/fmicb.2017.00923/full
2. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
3. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover

Course Outcomes (CO):

	CO Statement: Students will be able to understand, gain knowledge, apply and analyses	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 vegetative and reproductive characters of Pteridophytes and Gymnosperms	K1-K5
CO -4	the evolutionary history of bryophytes, pteridophytes and	K1-K5

	gymnosperms	
CO -5	the Bryophytes, Pteridophytes and Gymnosperms from other plant groups through filed collection; analysis, evaluate, synthesis	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	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. Vallinayagam.

[2023/MSU 54th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- I/Elec. 1]

Title of the Course	MICROBIOLOGY, IMMUNOLOGY, AND PLANT PATHOLOGY			
Category & Course No.	**Elective –I**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**3**	RBYEAA
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3	-	--	3
Pre-requisite	Provide students with basic understanding of microbiology, immunology, plant pathology and the etiology of specific			

	plant diseases.
Learning Objectives	Enable the students 1. To provide comprehensive knowledge about microbes and its effect on man and environment 2. To provide comparative analysis of major groups of microbes 3. To study the principles of immune system, immunizing agents like antibodies and vaccines and gene therapy methods. 4. To enhance the knowledge and skills needed for self-employment using the microbial derived products. 5. To appreciate the role of immune system in conferring disease resistance.

UNITS	CONTENT	CO	K Level	Hrs
I	**Bacteria** Types of microorganisms. General characteristic of bacteria – Outline classification of Bergey's manual of 9th edition. Classification of bacteria based on Morphological, cultural, physiological and molecular characteristics. Bacterial growth – batch culture and continuous culture. Growth Curve. Factors affecting growth. Determination of bacterial growth – Direct method: Haemocytometer, Viable plate count; Indirect method: Turbidity. Nutritional types. Reproduction - Fission and sporulation. Genetic recombination- Transformation, Transduction and Conjugation. Isolation and cultivation of bacteria. Maintenance of bacterial culture.	1	K1	10
II	**Viruses** General characters, Classification, Structure, Multiplication. Overview of Phycoviruses and Mycoviruses. Viruses of Eukaryotes – Animal & Plant viruses. Cultivation of viruses – in embryonated egg and in plants. Control of viral infections. Bacteriophages-classification, replication of DNA and RNA phages -Lytic and Lysogenic cycle. Viroids and prions. Mycoplasma: Structure and classification. **COVID**	2	K2	14
III	**Food Microbiology** Beneficial role of microbes – yoghurt, Olives, Cheese, Bread, Wine, Tempeh, Miso & Fermented green tea. Spoilage of fruits, vegetables, meats, poultry, eggs, bakery products, dairy products and canned foods. Microbial toxins - Exotoxin, Endotoxin & Mycotoxin. Action of Enterotoxin, Cytotoxin & Neurotoxin. Food Preservation – temperature, drying, radiation and chemicals. Soil Microbiology: Importance of Microbial flora of soil and factors affecting the microbial community in soil. Interaction among soil microbes (positive and negative interactions) & with higher plants (rhizosphere & phyllosphere). Microorganisms in organic matter decomposition. Environmental Microbiology: Microbiology of water and air. Water borne diseases - diphtheria, chicken pox. Air	3	K3	12

	borne diseases - Swine flu and **Measles.** Microbial degradation of chemical pesticides and hydrocarbon.			
IV	**Immunology** Introduction; Immune System; Types of Immunity - Innate and Acquired. Immune Cells - Hematopoiesis, B and T lymphocytes - Maturation, NK cells. Introduction to inflammation, Adaptive immune system, Innate Immune system. Antigen: Definition, Properties and types. Antibody – Structure, types and function. Generation of antibody diversity. Antigen - Antibody interactions: definition, types- Precipitation, Agglutination, Complement fixation. Immune Response – Humoral and Cell Mediated. Vaccines – history, types and recombinant vaccines. Immunodiagnosis – Blood Grouping, Widal test, Enzyme-Linked Immunosorbent Assay (ELISA), Immunoelectrophoresis and Immunodiffusion	4	K4	12
V	**Plant Pathology** **History and significance of plant pathology. Classification of plant diseases, Symptomology (important symptoms of** plant pathogens). Principles of plant infection –Inoculums, inoculum potential, Pathogenicity. Disease triangle. Host parasite interrelationship and interaction. Causal agents of plant diseases - biotic causes (fungi, bacteria virus, mycoplasma, nematodes, parasitic algae, angiospermic parasites - Abiotic causes (Physiological, deficiency of nutrients & minerals and pollution). Mechanism of penetration- Disease development of pathogen (colonization) and dissemination of pathogens. Role of enzymes and toxins in disease development. Defence mechanism of host – structural and biochemical defences. Important diseases of crop plants in India - Sheath blight of rice, Late blight of potato, Little leaf of Brinjal and Red rust of tea. Principles of disease management – Cultural practices, physical, chemical and biological methods, disease controlled by immunization. Biocontrol - merits and demerits; Plant quarantine and legislation. Integrated Pest Management system. Diagnostic technique to detect pest/pathogen infection – Immuno-fluorescence (IF).	5	K5-K6	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, 11thEdition.
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.
6. Singh, R.S. 2018. Introduction to Principles of Plant Pathology, 4th Edition.
7. Bilgrami, K.S and H.C. Dube. 2010 A text book of Modern Plant Pathology – Vikas Publishing House (P) Ltd., New Delhi
8. Mehrotra, R.S. and Aggarwal, A. 2017. Plant Pathology. McGraw Hill Publisher.

9. Dube, H.C. 2010. A text Book of Fungi, Bacteria and Viruses, 3rd Edition, Agrobios India, ISBN: 8188826383.
10. Vaman Rao, C. 2006. Immunology. 2nd Edition. Narosa Publisher.
11. Kenneth, M. 2017. Janeway's Immunobiology. 9th Edition. Garland Publisher.

References

12. 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.
13. Black, J.G. and Black, L.J. 2017. Microbiology: Principles and Explorations, Wiley, 10th Edition.
14. Alexander, A. M. 1974. Microbiology Ecology, John Willy & Sons.
15. Hyde, D.R. 2010. Genetics and Molecular biology: With Fundamentals of Biostatistics. Special Indian edition, Tata Mc Graw Hill P.Ltd., New Delhi.
16. Sumbali, G. and Mehrotra, R.S. 2009. Principles of Microbiology. First edition, Tata Mc Graw Hill P. Ltd., New Delhi.
17. Moat, A.G., Foster, J.W. and Spector, M.P. 2002. Microbial physiology. 4th edition, John Wiley sons, Inc., New Delhi
18. Ramawat, K.G. and Goyal, S. 2010. Molecular biology and Biotechnology. S. Chand & Co. Ltd., New Delhi.
19. Robert F Boyd. 1984. General microbiology. Times Mirror and Mosby College Publishers.
20. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12thEdition.
21. Ravi Chandra, N.G. 2013. Fundamentals of Plant Pathology, Phi Learning, ISBN:812034703X
22. Willie, J. and Sherwood, L. 2016. Prescott's Microbiology McGraw-Hill Education; 10thEdition, ISBN: 978-1259281594
23. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi.
24. Mishra, A., A. Bohra and A, Mishra. 2011. Plant Pathology-Disease and Management. Agro Bios, Jodhpur

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
6. https://www.wileyindia.com/a-textbook-of-plant-pathology.html
7. https://www.britannica.com/science/plant-disease.
8. https://www.planetatural.com/pest-problem-solver/plant-disease/
9. https://www.elsevier.com/books/plant-pathology/agrios/978-0-08-047378-9

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	K1

	distinguish them based on the structural and functional features.	
CO -2	differentiate the viruses from other microbes, understand the infection mechanism and classification of viruses	K2
CO -3	elucidate concepts of microbial interactions with plant and humans	K3
CO -4	comprehend the mechanism by which human body fights a pathogenic infection or an antigen; and the components of such a defense system	K4
CO -5	determine and interpret the detection of pathogens and appreciate their adaptive strategies	K5-K6

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

Extended Professional Component (is a part of internal component only, not to be included in the External Examination question paper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (To be discussed during the Tutorial hour)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Mapping Program Specific Outcomes with Course Outcomes:

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

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

[2023/MSU 54th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- I/Elec 1]

ELECTIVE-I CONSERVATION OF NATURAL RESOURCES AND POLICIES

Title of the Course	**CONSERVATION OF NATURAL RESOURCES AND POLICIES**			
Category & Course No.	**Elective I**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**3**	RBYEAB
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3		--	3
Pre-requisite	To create awareness of environmental problems and their consequences.			
Learning Objectives	1. Explain the term natural resources. 2. Describe the reasons for degradation of natural resources and suggest measures to prevent these. 3. List the various endangered species of animals and plants. 4. State the various environmental laws passed to conserve the natural resources. 5. Explain sustainable development and justify its need; and describe the various conventional as well as non-conventional sources of energy.			

UNIT	CONTENTS	CO	K Level	Hrs
I	**NATURAL RESOURCES:** Definition – Importance – Classification – Human physiological socio-economic and cultural development – Human Population Explosion – Natural Resource Degradation – Concept of conservation – Value system – Equitable resource use for sustainable life system.	**1**	**K1-K2**	**10**
II	**FOREST RESOURCES:** Forest cover in India and the World – Importance – Desertification – Forest Wealth – Afforestation – Vanasamrakshna Samithi– Agroforestry – Social Forestry – Joint Forest Management Strategy for Forest Conservation. **Wild Life:** Resources – Importance – Benefits – Wild life Extinction – Causes for Extinction – List of Endanger species in India and in the World – Ecological approach in wild life management – Eco Tourism – Wild Life projects in India – Sanctuaries and National Parks In India – Man and Bio sphere Programme.	**2**	**K1-K3**	**10**
	LAND AND SOIL RESOURCES: Soil, Complexity of soil nature, regional deposits, Land use	**3**	**K1-K2**	**10**

III	and capability classification systems, Land use Planning models and their limitations. Impacts of natural and man-made activities on land characteristics and land use planning– Soil Erosion – Loss of Soil Nutrients – Restoration of Soil Fertility – Soil Conservation Methods and Strategies in India. Wet Land Conservation and Management – Ecological Importance of wet lands in India – Conservation Strategy and ecological Importance. Water Resources: Rivers and Lakes In India – Water Conservation and ground water level increase - Watershed Programme.			
IV	**MINERAL RESOURCES:** Use and exploitation – Environmental effects of extracting and using mineral resources – Restoration of mining lands – Expansion of supplies by substitution and conservation. Food Resources: World Food Problems – Changes caused by agriculture – overgrazing effects of modern agriculture – Fertilizer-Pesticide problems – Water Logging – Salinity – Sustainable agriculture, life stock breeding and farming.	**4**	**K1-K3**	**10**
V	**ENVIRONMENTAL POLICY IN INDIA:** Need for policies- Public Policy – Economic policies – Relationship between economic development and environment – Implementing Environmental Public Policy Strategies in pollution control – Constitutional provisions in India regarding environment – Public Awareness and Participation in Environmental Management – National Land Use Policy 1988 – Industrial Policy 1991.	5	K3-K45	10

	CO Statement: After successful completion of the course, the student will be able to	Knowledge Level
CO -1	Understand the concept of different natural resources and their utilization.	K1
CO -2	Critically analyze the sustainable utilization land, water, forest and energy resources	K2
CO -3	Evaluate the management strategies of different natural Resources	K3
CO -4	Reflect upon the different national and international efforts in resource management and their conservation.	K4
CO -5	State the various environmental policy passed to conserve the natural resources.	K5-K6

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

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text:
1. Trivedi R.K.1994. Environment and Natural Resources Conservation. 2. Murthy J.V.S.1994. Watershed Management in India. 3. Raymond, F Dasmann. 1984. Environmental Conservation, John Wiley. 4. Nalini, K.S. 1993. Environmental Resources and Management, Anmol Publishers, New Delhi. 5. Shyam Divan and Armin Rosencranz. 2001. Environmental Law and Policy in India, Oxford Uni. Press.
Reference Books:
1. Haue, R and Freed V.H. 1975. Environmental Dynamics of Pesticides, Menum Press, London 2. Singh, B. 1992. Social Forestry for Rural Development, Anmol Publishers, New Delhi. 3. Shafi. R. 1992. Forest Ecosystem of the World. 4. Stacy Keach. 2016. Natural Resources Management. Syrawood Publishing House. 5. Rathor B.S. 2013. Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.
Web resources:
1. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y 2. https://www.kobo.com/ww/en/ebook/natural-resources-conservation-law 3. https://www.scribd.com/book/552185119/Natural-Resources-Conservation-and-Advances-for-Sustainability 4. https://www.scribd.com/document/354699536/Conservation-of-Natural-Resources

[2023/MSU 54th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- I/Elec 1]

Title of the Course	**MUSHROOM CULTIVATION**			
Category & Course No.	**ELECTIVE-I**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**3**	RBYEAC
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3	2	--	5
Pre-requisite	Basic knowledge on structure and function of various groups of mushrooms.			
Learning Objectives	To teach the identification of mushrooms. To differentiate the edible mushrooms with toxic and hallucinating fungi. To study the cultivation technique of mushrooms To learn the economic importance of mushroom in various fields. To study how to establish mushroom cultivation as business enterprise. To teach the identification of mushrooms.			

UNIT	**CONTENTS**	**CO**	**K Level**	**Hrs**
I	**INTRODUCTION:** Mushroom, Edible Mushroom, commercial production, medicinal value of mushrooms, nutraceuticals and dietary supplements	**1**	**K1-K3**	**10**
II	**IDENTIFICATION OF EDIBLE AND POISONOUS MUSHROOMS**: Keys for identification of edible mushrooms: *Agaricus bisporus*, *Pleurotus sajorcaju*, *Volvariella volvcea* and *Calocybe indica.* Key for identifying hallucinogenic mushroom (*Psilocybe* sp.) Medicinal Mushroom – *Cordyceps*, *Ganoderma lucidum* and *Lentinus edodes.*	**2**	**K2-K4**	**10**
III	**CULTIVATION:** Substrate sterilization, bed preparation, cropping room and maintenance, raising of pure culture and spawn preparation, factors effecting button mushroom production (Temp, pH, air and water management, competitor moulds and other disease).	**3**	**K4-K6**	**10**
IV	**POST-HARVEST MANAGEMENT:** Harvest, storage, quality assurance of mushrooms. Pest management.	**4**	**K4-K5**	**10**
V	World production edible mushroom, Legal and regulatory issues of introducing the medicinal mushrooms in different countries. Developing small scale industry and Government schemes. Mushroom Research Centres – International and National levels.	5	**K4-K5**	10

Course Outcomes	On completion of this course the student will be able to	Programme outcomes
Co1	Knowledge on identification of edible and toxic mushrooms belonging to*Ascomycota and Basidiomycota*.	K1, K3
Co2	Outline the nutraceutical properties of edible mushrooms.	K2, K4
Co3	Knowledge on cultivation techniques of edible and medicinal mushrooms.	K3, K6
Co4	Understand the harvest and post-harvest techniques of mushroom crops.	K4
Co5	Knowledge on the production and marketing strategies for mushrooms.	K5

Extended ProfessionalComponent (is a part of internal component only Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitiveexaminations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text:

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

Reference books:

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

Distributors, New Delhi.
Web resources:
1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X 2. http://nrcmushroom.org/book-cultivation-merged.pdf 3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf 4. http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/ 5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

[2023/MSU 54th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- I/Elec. 1]

Title of the Course	**PHYTOPHARMACOGNOSY**			
Category & Course No.	**ELECTIVE -1**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**3**	RBYEAD
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3	2	--	5
Pre-requisite	Students should aware of traditional use of plant derived drugs in world.			
Learning Objectives	To learn the traditional knowledge on plant derived drugs and their conventional classification. To elucidate the biosynthetic pathway of major classes of secondary metabolites. To study the general pharmacological mode of action of crude drugs of few medicinal plants. To elucidate the isolation and characterization of plant derived drugs using modern biotechniques. Knowledge on pharmacological action of drugs. To learn the traditional knowledge on plant derived drugs and their conventional classification.			

UNIT	CONTENTS	CO	K Level	Hrs
I	General introduction – History and scope of Pharmacognosy including indigenous system of medicine. Various systems of classification of drugs. Pharmacological action of plant drugs. Significance of Pharmacopoeial standards.	1	K1	
II	MORPHOLOGICAL AND MICROSCOPICAL Biosynthetic pathway of secondary metabolites: Acetate pathway (fatty acids and polyketides), mevalonate and deoxyxylulose phosphate pathway (terpenoids and steroids), shikimate pathway (phenols, amino acids etc.).	2	K2	
III	Characterization of Therapeutic drugs: Extraction, separation, isolation (Chromatographic techniques) and characterization of secondary metabolites (Spectroscopic techniques). Quality	3	K3-K6	

	control of plant drugs: Classical and modern approaches of drugs. Significance of Pharmacopoeial standards.			
IV	Pharmacological action of Plant Drugs: Anti-cancer, Bitter tonic, Carminatives and G.I.regulators, Cardiotonics, CNS-Stimulatant, Expectorant, Laxatives, Puragatives. Outline of pharmacogenomics functions.	4	K4-K5	
V	Hallucinogenic, allergenic and other toxic plants, poisonous plants - biopesticides -biocides – biofungicides.	5	K6	

Course outcomes:	**On completion of this course the student will be able to**	**Programme outcomes**
CO1	Review on the traditional knowledge and classification of plant derived drugs.	K1
CO2	Knowledge on biosynthetic pathway of different classes of plant metabolites.	K2
CO3	Knowledge on modern instrumentation on characterization of plant metabolites.	K3, K6
CO4	Discuss various aspects of Pharmacological action of herbal drugs.	K4 K5
CO5	Understanding medical and non-medical potential of plant derived in various sectors.	K6

Recommended Text:

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

Reference books:

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

Web resources:

1. https://pharmabookbank.files.wordpress.com/2019/03/14.2.pharmacognosy-by-biren-shahavinash-seth-1.pdf
2. https://www.pdfdrive.com/pharmacognosy-books.html

[2023/MSU 54th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- I/Elec. 2]

Title of the Course	**ALGAL TECHNOLOGY**			
Category & Course No.	**ELECTIVE 2**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**3**	RBYEBA
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3	-	-	3
Pre-requisite	Students should be familiar with the basic and applied knowledge on algal biotechnology.			
Learning Objectives	To provide a basic overview of algae cultivation techniques and resource potentials. To educate people about the widespread commercial uses of algae. To educate people about the therapeutic uses of algae. To enrich the current knowledge of how algae are used in basic research andtechnological applications. To spread awareness of the value of algae biotechnology and its applications in diverse industries.			

ELECTIVE-II ALGAL TECHNOLOGY

UNIT	CONTENTS	CO	K Level	Hrs
I	**SCOPE OF ALGAL TECHNOLOGY** Scope of algal technology – Commercial potential and utility of algae. Algae as sources for food, feed, pigments, Pharmaceuticals and neutraceuticals, fine chemicals, fuel, biofertilizers and hormones. Economic importance of algae in India.	**1**	K1& K3	**10**
II	**ALGAL PRODUCTS** Industrial application of algae - fuel, algal lipids – trans esterification to ester fuel - substitutes for petroleum derived fuel. Algal products - Spirulina mass cultivation and its applications. Mass cultivation of micro-algae as source of protein and as feed. Liquid seaweed fertilizers - method of preparation, applications and its advantages over inorganic fertilizers.	**2**	K5	**10**
III	**ALGAL PRODUCTION AND UTILIZATION** Algal production systems; Strain selection; Algal growth curve; Culture media; cultivation methods – small scale and Large-scale cultivation of algae. Harvesting and packing. Therapeutic uses - antioxidant, anti-ulcerogenic, antifungal, antibiotics, antitumor and antiviral compounds. Production of pigments and their utilization.	**3**	K2 &K4	**10**
IV	**IMMOBILIZATION AND RDNA TECHNOLOGY IN ALGAE** Algal immobilization and its applications - culturing for metabolite production and natural compounds. Methods of immobilization - alginate beads-extraction of compounds. Recombinant DNA technology in algae - Transformation systems in algae. Isolation of protoplasts, regeneration of fusion of macro algae. Role of algae in nanobiotechnology.	**4**	K4	**10**
V	**ROLE OF ALGAE IN ENVIRONMENT MANAGEMENT** Role of algae in environmental health - Sewage treatment, treating industrial effluent, Phytoremediation- heavy metal removal, algae as indicators in assessing water quality and pollution; Saprobic index; Monitoring, assessment, restoration and management of coastal and marine ecosystem environment. Algal culture collection centers in India and abroad and their importance.	**5**	K3 & K6	**10**

Course outcomes:	On completion of this course the student will be able to	Programme outcomes
CO1	Understand the applied facet of botany and acquire a complete knowledge about the cultivation methods in algae.	K1& K3
CO2	Realization of the commercial potential of algal products.	K5
CO3	Analyze emerging areas of algal biotechnology for identifying therapeutic importance of algal products and their uses.	K2 & K4
CO4	Gain more information about algae genetics.	K4
CO5	Translate various algal technologies for the benefit of the ecosystem.	K3 & K6

Extended ProfessionalComponent (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Text:

1. Trivedi, P.C. 2001. Algal Biotechnology. Point publisher, Jaipur. India.
2. Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi.
3. Sahoo, D. 2000. Farming the ocean: seaweed cultivation and utilization. Aravali International, New Delhi.
4. Bast, F. 2014. An Illustrated Review on Cultivation and Life History of Agronomically Important Sea plants. In Seaweed: Mineral Composition, Nutritional and Antioxidant Benefits and Agricultural Uses, Eds. Vitor Hugo Pomin, 39-70. Nova Publishers, New York. ISBN: 978-1-63117-571-8**.**
5. Rapouso, M.F.J., Morais, R.M.S.C., Morais, A.M.M.B. 2013. Bioactivity and applications of sulphated polysaccharides from marine microalgae. Marine Drugs, 11, 233-252.
6. Bajpai, Rakesh, K., Prokop,Ales,Zappi,Mark,E.2014.AlgalBiorefineriesVolume1:

Reference Books:

1. Kumar H.D and H.N. Singh.1982. A text Book on Algae. Affiliated East- West Press Pvt. Ltd
2. Suganya, T and Renganathan, S. 2015. Biodiesel production using algal technology. Academic Press. ISBN: 0128009713.
3. Bajpai, Rakesh K., Prokop, Ales, Zappi, Mark E. 2014. Algal Biorefineries Volume 1: Cultivation of Cells and Products. Springer. ISBN: 9400774931.
4. Hojnacka, K., Wieczorek, P.P., Schroeder, G., Michalak, I. (Eds.). 2018. Algae Biomass: Characteristics and Applications. Developments in Applied Phycology.
5. Aziz, Farhad and Rasheed, Rezan. 2019. A Course Book of Algae. Publisher: University of Sulaimani. ISBN: 978-9922-20-391-1.
6. Dinabandhu, S and Kaushik. B.D. 2012. Algal Biotechnology and Environment. I.K. International, New Delhi.
7. Trivedi, P.C. 2001. Algal Biotechnology. Point publisher, Jaipur. India.
8. Becker. E.W. 1994. Micro algae Biotechnology and Microbiology. Cambridge University press.
9. Borowitzka, M.A. and borowizka, L.J. 1996. Microalgal Biotechnology. Cambridge University Press, Cambridge,
10. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. Resonance, 19(2) 1032-1043 *ISSN*: 0971-8044.
11. Faizal, Band Yusuf, C. 2016.Algal biotechnology: Products and processes. Springer.
12. Gouveia, L. 2011. Microalgae as a feedstock for biofuels. Springer Briefs in Microbiology, London.

Web resources:

1. https://www.springer.com/gp/book/9783319123332
2. https://www.researchgate.net/publication/318449035_Algae_Biotechnology
3. https://www.energy.gov/sites/prod/files/2015/04/f21/algae_marrone_132100.pdf
4. https://www.amazon.in/Prospects-Challenges-Algal-Biotechnology-Tripathi-ebook/dp/B0779BF366
5. https://www.degruyter.com/view/product/177050
6. https://www.amazon.in/Algal-Biotechnology-Mihir-Kumar-Das/dp/B0072I61LA
7. https://www.elsevier.com/books/algal-biotechnology/ahmad/978-0-323-90476-6
8. https://www.appleacademicpress.com/phycobiotechnology-biodiversity-and-biotechnology-of-algae-and-algal-products-for-food-feed-and-fuel/9781771888967

[2023/MSU 54th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- I/Elec. 2]

Title of the Course	**ETHNOBOTANY, NATUROPATHY AND TRADITIONAL HEALTHCARE**			
Category & Course No.	**ELECTIVE 2**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**3**	RBYEBB
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3	-	--	3
Pre-requisite	The training imparts the knowledge and abilities required to conduct field studies on how humans use plants			
Learning Objectives	Understand the concept of ethnobotany and the life style and traditional practices of plants by Indian tribal's. Emphasize the importance of non-timber forest products for Indian tribal people livelihoods. Evaluate the various research techniques to gather tribal knowledge of ethnobotany. Use strategies to turn ethno botanical knowledge into goods with value additions. To save and document ethno botanicals in order to use plant resources sustainably.			

UNIT	CONTENTS	CO	K Level	Hrs
I	**ETHNOBOTANY:** Concept, important landmarks in the development, scope, sub disciplines of ethno botany. Interdisciplinary approaches. Knowledge of following sociological and anthropological terms: culture, values and norms, institutions, culture diffusion and ethnocentrism. History of ethnobotany: A brief history of ethno botanical studies in the world and in India.	**1**	K1	**10**
II	**PLANTS USED BY TRIBALS OF INDIA:** Distribution of tribes in India. Basic knowledge of following tribes of Tamil Nadu: Irulas, Kanis, Paliyars Badagas, Kurumbres, Thodas and Malayalis. Plants used by tribals of Tamil Nadu.	**2**	K2 & K6	**10**
III	**SOURCES OF ETHNOBOTANICAL DATA:** Primary - archeological sources and inventories, Secondary - travelogues, folklore and literary sources, herbaria, medicinal texts and official records. Methods in ethnobotanical research. Prior Informed Consent, PRA techniques, interviews and questionnaire methods, choice of resource persons. Folk taxonomy – plants associated with culture and socio- religious activities. Non – timber forest products (NTFP) and livelihood – Sustainable harvest and value addition.	**3**	K3	**10**

IV	**NATUROPATHIC MEDICINE:** Role of plants in naturopathy- Importance and relevance of medicinal drugs in India. Indian Systems of Medicine (Ayurveda, Siddha, Allopathy, Homeopathy, Unani, Tibetan, Yoga and Naturopathy). Disease diagnosis, treatment, and cure using natural therapies including dietetics, botanical medicine, homeopathy, fasting, exercise, lifestyle counseling, detoxification, and chelation, clinical nutrition, hydrotherapy, naturopathic manipulation, spiritual healing, environmental assessment, **TRADITIONAL HEALTH CARE:** Health practices, approaches, knowledge and beliefs incorporating plant, animal and mineral based medicines, spiritual therapies, manual techniques and exercises, applied singularly or in combination to treat, diagnose and prevent illnesses or maintain well-being.	**4**	K4	**10**
V	**BIOPROSPECTING AND VALUE ADDITION:** Bioprospecting of drug molecules derived from Indian traditional plants; Methods for bioprospecting of natural resources; From folk Taxonomy to species confirmation - evidences based on phylogenetic and metabolomic analyses; Ethno botanical databases and Traditional knowledge Digital Library (TKDL).	**5**	K5	**10**

Course outcomes:	**On completion of this course the student will be able to**	**Programme outcomes**
CO1	Recall or remember concept of ethnobotany.	K1
CO2	Understand the life style and traditional practices of plants by Indian tribals.	K2 & K6
CO3	Highlight the role of Non-Timber Forest products for livelihood of tribal people of India	K3
CO4	Assess the methods to transform ethno botanical knowledge into value added products.	K4
CO5	Build idea to make digitization of ethno botanical knowledge.	K5

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TRB/ NET/ UGC–CSIR/ GATE/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

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

2. Jain, A. and Jain, S.K. 2016. Indian Ethno botany - Bibliography of 21st Century Scientific Publishers (India).
3. Gokhale, S.B., Kokate, C.K and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. 1st ed. NiraliPrakashan, Pune.
4. Gringauz. 2012. Introduction to Medicinal Chemistry: How Drugs Act & Why? Wiley India Pvt Ltd. Noida.
5. Joshi, S.G. 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi.

Reference Books:

1. CSIR. 1940-1976. Wealth of India. A Dictionary of Raw Materials and Industrial Products - Raw Materials. Vol.1-11. CSIR Publication & Information Directorate. New Delhi.
2. Gokhale, S.B., Kokate, C.K and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. 1st ed. NiraliPrakashan, Pune.
3. Laird, S.A. 2002. Biodiversity and Traditional knowledge equitable partnerships in Practice. Earthscan Publications Ltd., London.
4. Ministry of Environment and Forests. 1994. Ethno biology in India. A Status Report. All India Coordinated Research Project on Ethno biology. Ministry of Environment and Forests. New Delhi.
5. Kumar, N. 2018. A Textbook of Pharmacognosy. Aitbs Publishers, India.
6. Premendra Singh. 2013. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Publishing House, New Delhi.
7. Albuquerque, U.P., Ramos, M.A., Júnior, W.S.F., and De Medeiros, P.M. 2017. Ethnobotany.

Web resources:

1. file:///C:/Users/HP/Downloads/8-Vol.-5-Issue-3-March-2014-IJPSR-1178-A-Paper-81.pdf 2
2. http://www.plantsjournal.com/archives/2017/vol5issue3/PartB/5-3-8-217.pdf 3
3. https://shodhganga.inflibnet.ac.in/bitstream/10603/116454/7/07_chapter%201.pdf 4
4. https://www.cell.com/action/showPdf?pii=S1360-1385%2817%2930001-8 5
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3465383/pdf/pnas.201202242.pdf 6
6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4151377/pdf/1746-4269-10-48.pdf 7 Jain, S. K. 1994. http://www.worldcat.org/identities/lccn-n85-4353/
7. http://www.frlht.org/

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

[2023/MSU 54th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- I/Elec. 2]

Title of the Course	**Evolutionary Biology**			
Category & Course No.	**Elective -II**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**3**	RBYEBC
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3		--	3
Pre-requisite	Students should know about the fundamentals on Evolution of life and organisms			
Learning 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	Hrs
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,	1	K1-K2	10

	Geological time scale.			
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 analysis and comparative methods; extinction and diversity of life forms.	3	K2-K4	10
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, 12th Edition.
2. Futuyma, D.J. and Kirkpatric, M.2017. Evolution. Sinauer Associates, U.S.A, 4th Edition

References

1. Hartl, D. L. 2020. A primer of population genetics and Genomics (4th Edition). Oxford publication, UK. ISBN-13 978-0198862307.
2. Jon C. Herron and Scott Freeman. 2021. Evolutionary analysis (5th Edition.). University of Washington, Pearson, ISBN-13: 9780137521029
3. Mark Ridley. 2004. Evolution, Wiley-Blackwell Publishing Ltd., UK. ISBN: 978-1-405-10345-9 (3rd Edition).
4. Peter J. Russell, Stephen L. Wolfe, Paul E. Hertz and Cecie Starr. 2008. Biology: The Dynamic Science, Publisher: Cengage Learning; ISBN-10 : 0534403212
5. Carroll, Sean B - Grenier, Jennifer - Weatherbee, Scott 2004. From DNA to Diversity - Molecular Genetics & the Evolution of Animal Design (2nd, 05). Blackwell Publishing Ltd., UK. ISBN-13 978-1405119504.
6. Sober, E. 1994. Conceptual Issues in Evolutionary Biology. The Mit Press. Bradford Books, ISBN 9780262691628.

7. Steven Gaulin & Donald Mc Burney. 2004. Evolutionary Psychology. Pearson/Prentice Hall, Upper Saddle River, N.J., (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

[2023/MSU 54th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- I/Elec. 2]

Title of the Course	**HERBAL TECHNOLOGY**			
Category & Course No.	**ELECTIVE-II**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**I**	**3**	RBYEBD
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3	-	--	3
Pre-requisite	An understanding on the importance of herbal technology			
Learning Objectives	1. To understand various plants based drugs used in Ayurvedha, Unani, Homeopathy and Siddha 2. To apply the knowledge to cultivate medical plants. 3. To know the pharmacological importance of medicinal plants. 4. To enlist phytochemicals and secondary metabolites of market and commercial value. 5. To design and develop their own business prepositions such as the making of herbal insecticides.			

UNIT	CONTENTS	CO	K Level	Hrs
I	**PHARMACOGNOSY** Pharmacognosy scope and importance - source - Crude Drugs – Scope and Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection and processing of crude drugs. Cultivation and utilization of medicinal and aromatic plants in India.	1	K1-K3	10
II	*Withania somnifera*, *Rauwolfia serpentina, Catheranthus roseus, Andrographis paniculata* and *Dioscorea sp*	2	K1, K3	10
	ANALYSIS OF PHYTOCHEMICALS	3	K2-K4	10

III	Methods of Drug evaluation (Morphological, microscopic, physical and chemical). Phytochemical investigations – standardization and quality control of herbal drugs. Preliminary screening, Assay of Drugs - Biological evaluation/assays, Microbiological methods - Chemical Methods of Analysis, Detection of Adulterants: Chemical estimations, Spectrophotometry and fluorescence analysis. Drug adulteration - Types of adulterants.			
IV	**GENERAL METHODS OF PHYTOCHEMICAL AND BIOLOGICAL SCREENING** Carbohydrates and derived products: Glycosides - extraction methods (*Digitalis, Dioscorea*); Tannins (Hydrolysable and Condensed types); Volatile oils - extraction methods (Clove, Mentha). Study of some herbal formulation techniques as drug cosmetics.	4	K2-K4	10
V	**TYPES OF PHYTOCHEMICALS** Alkaloids - extraction methods (*Taxus, Cinchona*); Flavonoids- extraction methods, Resins- extraction method: Application of phytochemicals in phytopharmacueticals; Biocides, Biofungicides, Biopesticides. Women entrepreneurship development – marketing cultivated medicinal plants – National Medicinal Plants Board of India.	5	K2-K5	10

Recommended Text:

1. Kokate, C.K., Purohit, A.P and S.B. Gokhale. 1996. Pharmacognosy. Nirali Prakashan, 4th Ed.
2. Roseline, A. 2011. Pharmacognosy. MJP publishers, Chennai.
3. Tilgner, Sharol Marie. 2018. Herbal ABC's: The Foundation of Herbal Medicine.
4. Natural Products in medicine: A Biosynthetic approach. 1997. Wiley.
   Hornok, L. (ed.).
5. Chichister, U.K.J. 1999. Cultivation and Processing of Medicinal Plants, Wiley & Sons.
   Trease and Evans.
6. Mukherjee, P.K. 2008. Quality control of herbal drugs. 3rd edition. Business Horizons Pharmaceutical Publishers, New Delhi, India.
7. Kirthikar and Basu. 2012. Indian Medicinal Plants. University Bookstore, Delhi. India
8. Biswas, P.K. 2006. Encyclopedia of Medicinal plants (Vol. I-VII). Dominant Publishers, New Delhi.
9. Chaudhuri, A.B. 2007. Endangered Medicinal Plants. Daya Publishing House, New Delhi.
10. Tilgner, Sharol Marie. 2018. Herbal ABC's: The Foundation of Herbal Medicine.

Reference Books:

1. Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.
2. Kumaresan, V and Annie Regland. 2004. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany & Ethno botany.

3. Anonymous, 2004. Cultivation of Selected Medicinal Plants. National Medicinal Plants Board, Govt. of India, New Delhi.
4. Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.
5. Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.
6. Dey, A.C. 1998. Indian medicinal plants used in Ayurvedic preparations, Bishen Singh Mahendra Pal Singh.
7. Sathya, S., Jaiganesh, K.P and Sudha, T. 2019. Current Trends in Herbal Drug Technology. Pharmacy Council of India New Delhi.
8. Lewis, W.H and M.P.F. Elwin Lewis. 1976. Medical Botany. Plants affecting Man's Health. A Wiley Inter Science Publication. John Wiley and Sons, New York.

Web resources:

1. https://www.kopykitab.com/Herbal-Science
2. https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurClUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_BwE
3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu
4. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts= 1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404
5. https://www.dattanibookagency.com/books-herbs-science.html
6. https://www.springer.com/gp/book/9783540791157

Course Outcomes (CO):

	CO Statement: Students will be able to	Knowledge Level
CO -1	Recollect the importance of herbal technology.	K1
CO -2	Understand the classification of crude drugs from various botanical sources.	K2
CO -3	Analyze on the application of secondary metabolites in modern medicine.	K3
CO -4	Create new drug formulations using therapeutically valuable phytochemical compounds for the healthy life of society.	K4
CO -5	Comprehend the current trade status and role of medicinal plants in socio economic growth.	K5 & K6

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

Extended ProfessionalComponent (is a part of internal component only,Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitiveexaminations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

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

Course Designer: Dr. P. Ravichandran

M. Sc. BOTANY – Syllabus

Syllabus as Per the Choice Based Credit System (CBCS),

TANSCHE 2023

&

Learning Outcomes-based Curriculum Framework (LOCF)

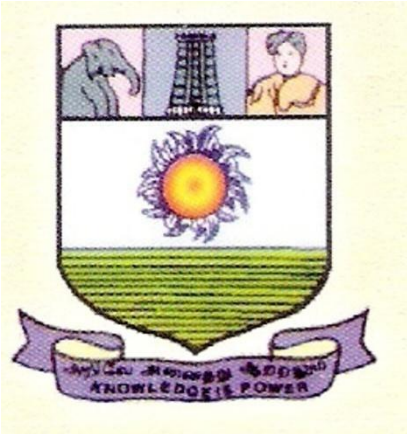
(Curriculum Effective from July 2023)

Submitted by

Dr. P. RAVICHANDRAN

Professor & Head and Chairperson

Approved in the 55th SCAA dt. 30.04.2024



Board of Studies in Plant Science

DEPARTMENT OF PLANT SCIENCE

Manonmaniam Sundaranar University, Tirunelveli

Jan 12, 2024

M. Sc. BOTANY PROGRAM STRUCTURE – July 2023 onwards

Choice Based Credit System (CBCS) and

Learning Outcomes-based Curriculum Framework (LOCF) (TANSCHE)

		SEMESTER- II	Lecture & Tutorial		
Core/ Elective/ Skill courses	**Course Code**	**Title of the course**	**Weekly contact hours**	**No. of credits**	Int. 25 / Ext. 75 **Total**
Core-4	RBYC21	Genetics, Genomics & Plant Breeding	3L+1T	4	100
Core-5	RBYC22	Anatomy and Embryology of Angiosperms	3L+1T	4	100
Core -6	RBYC23	Research Methodology, Instrumentation & Computer Applications	3L+1T	4	100
Core Practical 2	RBYL21	Genetics, Plant Breeding, and Instrumentation	5P	2	100
Core Practical 3	RBYL22	Anatomy and Embryology of Angiosperms	5P	2	100
Elective Course –III Discipline centric	Any one-course choice based		2L+1T	3	100
	RBYECA	Medicinal Botany			
	RBYECB	Agriculture and Food Microbiology			
	RBYECC	Bio-pesticide Technology			
	RBYECD	**Intellectual Property Rights**			
Elective Course –IV Generic Centric	Any one-course choice based		2L+1T	3	100
	RBYEDA	Applied Bioinformatics			
	RBYEDB	**Horticulture**			
	RBYEDC	Plants for Bioenergy and Space Research			
	RBYEDD	Plants in Tamil Literature			
Skill Enhancement Course (SEC)1	**RBYMSA**	**Speaking Effectively Offered by NPTEL Mentor – Dr. A. Selvam**	1L+1T	2	100
		Subtotal	**30**	**24**	**800**

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- II/CORE-4]

Title of the Course	**GENETICS, GENOMICS and PLANT BREEDING**			
Category & Course No.	**Core Theory-IV**			
	Year	**Semester**	**Credits**	**Course Code**
	I	**II**	**4**	RBYC21
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	3	1	--	4
Pre-requisite	Students should have learnt basics of genetics, genomics and plant breeding for crop improvement. By studying this course students will be able to			
Learning Objectives	1. understand the laws of inheritance, modified Mendelian ratios, gene mapping, cytoplasmic inheritance, ploidy types and population genetics. 2. learn the nature of mutations and their molecular mechanism, diagnosing methods, applications of mutations and homeotic mutants in plants. 3. upgrade the modern concepts of genomics and proteomics. 4. familiarize with plant breeding methods and genetic basis of heterosis. 5. reflect upon the role of various non-conventional methods used in crop improvement.			

UNITS	**CONTENT**	**CO**	**K Level**	**Hrs**
I	**MENDELIAN GENETICS:** Laws of inheritance modified Mendelian ratios: complementary and supplementary genes. Lethal genes, alleles, multiple alleles, pseudo alleles. Sex determination in plants and theories of sex determination. Sex linked characters. Structure of Gene, operon concept. Gene function and regulation in prokaryotes and eukaryotes- Arabidopsis- gene regulation in flowering. 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-concept and its types. Genetic drift. Epigenetics. Non-Mendelian inheritance	1	K1-K4	14
II	**MUTATION AND REPAIR OF DNA:** Nature of Mutations, types of mutations, methods of detection of mutation: Ames test, CIB method and attached method, Molecular mechanism of spontaneous mutation. Mutagenic effects of food additives and drugs. DNA damage and repair. Homeotic mutants in *Arabidopsis* and *Antirrhinum*. Transposable elements and its	2	K1-K4	8

	types. Induced mutations, site directed mutagenesis. Directed Evolution.			
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. C-value paradox. Genome map, 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. Gene sequencing and technology-next generation sequencing (1^{st}, 2^{nd}, and 3^{rd} generations). Proteomes: deducing proteome from genome sequence, post-translation modification prediction, and metabolomics. Transcriptomics, barcoding, Architecture of genomics.	3	K2-K4	20
IV	**PLANT BREEDING:** Origin, domestication and introduction of crop plants. Objectives of plant breeding, characteristics improved by plant breeding, Genetic basis of breeding. Nature of crops and methods of breeding. Pure line theory, pure line selection and mass selection, clonal selection methods. Hybridization, Genetics and physiological basis of heterosis. Gene pyramiding.	3	K1-K4	12
V	**PLANT BREEDING METHODS:** Basic breeding methods for self- and cross-pollinated crops, clonal crops. Hybridization of methods-pedigree, bulk and back cross. Mutation breeding, ploidy breeding. Hybridization for crop improvement. Breeding for disease and insect resistance. Innovative methods in plant breeding. Organization and achievements of plant breeding. Examples of hybrids.	4	K1-K5	10

Text Books

1. Baxevanis, A.D. & Ouellette, B.F.2001. Bioinformatics: A practical guide to the analysis of genes and proteins. New York: Wiley-Inter science.
2. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England.
3. Brown, T. A. 1992. Genetics a Molecular Approach, second Edison. Chapman and Hall.
4. Chahal, G. S and Gosal, S. S. 2018. Principles and Procedures of Plant Breeding Biotechnological and Conventional Approaches, Narosa Publishing House, New Delhi.
5. Chaudhari, H. K. 1984. Elementary Principles of Plant Breeding. Oxford & IBH Publishing Company.

6. Chaudhary, R. C. 2017. Introductory Principles of Plant breeding, Oxford IBH Publishers, New Delhi.
7. Gupta, P. K. 2009. Genetics. Rastogi publications, Meerut, New Delhi.
8. Mount, D.W.2001.Bioinformatics: Sequence and genome analysis. NY: Cold Spring Harbor Laboratory Press.
9. Singh, B. D. 2013. Plant Breeding: Principles and Methods, Kalyani Publishers, New Delhi
10. Singh, P. 2017. Fundamentals of Plant Breeding, Kalyani Publishers.
11. Sinnott, E. W. Dunn, L. E and Dobzhansky, T. 1973. Principles of Genetics. McGraw-Hill. New York.

References

1. Acquaah, G.2007. Principles of Plant Genetics and Breeding. Blackwell Publishing.
2. Allard, R.W. 2010. Principles of Plant Breeding. 2nd ed. John Wiley and Sons, Inc. New Jersey, US.
3. Friefelder, D. 2005. Molecular Biology. Second Edition. Narosa Pub. House.
4. Lewin, B. 2003. Genes VIII. Oxford University Press.
5. Simmonds, N.W. 1979. Principles of Crop improvement. Longman, London.
6. Smith-Keary, P. 1991. Molecular Genetics. Macmillan Pub. Co. Ltd. London.
7. Sobtir. C. and Gobe. 1991. Eukaryotic chromosomes. Narosa Publishing house.
8. Stansfield, W. D. 1969. Theory and problems of Genetics. McGraw-Hill
9. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.
10. Watson, J. D. *et al.* 2003. Molecular Biology of the Gene. Fourth Edition. The Benjamin Cummings Pub. Co.
11. William. S., Klug and Michael, R. Cummings, 2003. Concepts of Genetics. Seventh edition. Pearson Education (Singapore) Pvt. Ltd.

Web Resources:

1. https://www.cdc.gov/genomics/about/basics.htm
2. https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/lecture-notes/
3. http://galaxy.ustc.edu.cn:30803/zhangwen/Biostatistics/Fundamentals+of +Biostatistics+8th+edition.pdf
4. https://www.britannica.com/science/evolution-scientific-theory
5. https://www.britannica.com/science/cell-biology
6. https://medlineplus.gov/genetocs/understanding/basics/cell/

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	Understand the classical and modern genetics, cytoplasmic inheritance and population genetics.	**K1-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	Understand the objective, principles of plant breeding and genetic basis of breeding self and cross – pollinated crops.	**K1-K4**
CO -5	Gain knowledge about different kinds of plant breeding methods.	**K1-K5**

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

Extended Professional Component (is a part of internal component only not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/ GATE/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Mapping Program Specific Outcomes with Course Outcomes:

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

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

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- II/CORE - 5]

Title of the Course	**ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS**			
Category & Course No.	**Core Theory-V**			
	Year	**Semester**	**Credits**	**Course Code**
	I	**II**	**4**	RBYC22
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	3	1	--	4
Pre-requisite	The students are expected to have fundamental knowledge on internal structures and processes involved in reproduction of angiosperms. By studying this course students will be able			
Learning Objectives	1. To provide insight into basic concepts of development and internal structures 2. To know salient features and evolutionarily advanced anatomical and reproductive organs 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 higher plants 5. To familiarize with plant histo-chemistry with special reference to various stains and reagents			

UNITS	**CONTENT**	**CO**	**K Level**	**Hrs**
I	**Basic concepts of development** Meristem and types, theories on root and shoot apical meristems; Organization of shoot and root apical meristem; molecular biology of SAM and RAM. Origin, development and functions of simple and complex tissues. Vessel-less dicots. 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&K2	14
II	**Morphogenesis and organogenesis in plants** Structure, development and functions of root hairs; types of vascular bundles; Kranz anatomy and its significance; 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; Unique features of plant development; difference between plant and animal development.	2	K1&K4	14

III	**Microsporangium and male gametophyte** 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; Morphology and ultrastructure of pollen wall, pollen kitt, pollen analysis, pollen storage and pollen sterility. Female gametophyte: Ovule development; megasporogenesis; organization of the embryo sac, structure of the embryo sac cells; establishment of symmetry in plants.	3	K2&K6	10
IV	**Megasporangium and female gametophyte** Pollen-pistil interaction and fertilization; pollination mechanisms. Structure of pistil; pollen-stigma interactions, sporophytic and gametophytic self-incompatibility; 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 and maturation; seed to seed lifecycle of angiosperm.	4	K3&K6	12
V	**Histological staining and procedures** Principle of killing and fixation, dehydration and rehydration of botanical specimens. 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 proteins, nucleic acids, insoluble carbohydrates and lipids.	5	K5	10

Text Books

1. Beck, C.B. 2010. An Introduction to Plant Structure and Development: Plant Anatomy forthe Twenty-First Century. 2nd Edition. Cambridge University Press, United Kingdom.
2. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6^{th} revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Crang, R., Lyons-Sobaski, S and Wise, R. 2019. Plant Anatomy: A Concept BasedApproach to the Structure of Seed Plants. Springer Nature, Switzerland.
4. Dickson, W.C. 2000. Integrative Plant Anatomy, Elsevier, USA.
5. James D. Mauseth. 2003. Botany: An Introduction to Plant Biology. Jones & BartlettLearning.
6. Pandey. S.N and Ajanta Chandha. 2006. Plant Anatomy and Embryology. VikasPublishinf House Pvt. Ltd, New Delhi.
7. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New

8. Ray F. Evert. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the PlantBody: Their Structure, Function, and Development. John Wiley & Sons. Hoboken, New Jersey.
9. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.
York.

Reference Books

1. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
2. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
3. Eames, A.J and Mac Daniels, L.H. 2013. Introduction to Plant Anatomy, 3rd Edition. McGraw-Hill Inc., US.
4. Fageri, K. and L. Van der Piji. 1979. The Principles of Pollination Ecology. Pergamon
5. Fahn, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford.
6. Fosket, DE.1994. Plant Growth and Development. A Molecular Approach. Academic
7. Howell, S. H. 1998. Molecular Genetics of Plant Development. Cambridge University
8. Krishnamurthy, K.V. 1988. Methods in Plant Histochemistry. S. Viswanathan & Co., Madras.
9. Leins, P. and S. C. Tucker, P. K. Endress. 1988. Aspects of Floral Development. J.Cramer, Oxford Press, San Diego.
10. Proctor, M. & Yeo, P. 1973. The Pollination of Flowers. William Collins Sons, London.
11. Raven P.H. and G.B. Johnson, J.B. Losos, K.A. Mason, S.R. Singer. 2008. Biology 8thed. Mc Graw Hill, Higer Education. Boston, Madison, New Delhi.
12. 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-plantanatomy/glossary-terms-related-plant-anatomy
3. https://www.enchantedlearning.com/subjects/plants/plant/

Course Outcomes (CO):

	CO Statement: Students would have understood	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 seed germination.	K1-K5
CO -5	Preparation and use of selected natural and synthetic stains to understand the internal structures of angiosperms	K1-K5

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 – 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	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 – Advance application						

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- II/CORE-6]

Title of the Course	**RESEARCH METHODOLOGY, INSTRUMENTATION & COMPUTER APPLICATIONS**			
Category & Course No.	**Core Theory-6**			
	Year	**Semester**	**Credits**	**Course Code**
	I	**II**	**4**	RBYC23
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	3	1	--	4
Pre-requisite	Students should be aware of basic information on scientific research, instruments and computers used for botanical research			
Learning Objectives	1. To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner. 2. To provide an overview on modern equipment that they would help students gain confidences to instantly commence research careers and/or start entrepreneurial ventures. 3. To develop interdisciplinary skills in using computers in botany to learn about their applications. 4. To learn the method of collection, presentation and statistical analyses of data; perform methodological research and make a conclusion 5. Learn and effectively use commonly used and scientific software for data preparation, data analysis and presentation			

UNITS	CONTENT	CO	K Level	Hrs
I	**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. Literature collection and citation: bibliography —bibliometrics (scientometrics): definition-laws — citations and bibliography — plagiarism. Research ethics.	1	K1-K5	10
II	**Instrumentation- 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, IR, NMR, Mass Spectroscopy and Raman spectroscopy. Chromatography: Principles and applications; Paper, Thin Layer, Column and HPLC, GC-MS.	2	K1-K3	14
III	**Instrumentation- 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 fingerprinting Techniques. Microscopy: Principles and applications of Bright field, Dark field and Phase Contrast microscopes, Fluorescence 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.	3	K1-K3	12
IV	**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, quartiles, variance, 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.	**4**	K1-K3	12
V	**Computer Applications**	**5**	K1-K4	12

	Introduction to computers. Types of hardware and software operating systems. Fundamentals of networking, operation of networks, telnet, ftp, www, Internet. Biological Research on the web: Using search engines, finding scientific articles, Online Databases and Journals - PubMed, Web of Science, Google Scholar, JSTOR, BioOne. MS Word, Excel, PPT, and other open source software. Reference indexing software – Biblioscape, EndNote and Mendeley. Statistical Analysis Software Programs; Useful AI tools for scientific research and planning: Jasper, Tetra, Quill Bot, Audiopen AI, Otter, Research rabbit, Chat PDF, Paperpal, Fireflies AI, Lab twin			

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. Hofmann, A. and Clokie, S. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, New Delhi.
4. Kothari, C.R. and Garg, G. 2019. Research Methodology: Methods and Techniques. New Age International Publications, New Delhi.
5. SreeRamulu, V.S.1988. Thesis Writing, Oxford& IBH Pub. New Delhi.
6. Veerakumari, L. 2017. Bioinstrumentation. MJP Publisher, India. p578.

Reference Books

1. Arthur Conklin W.M., and Greg White. 2016. Principles of computer security. TMH., McGraw-Hill Education; 4th edition
2. Bairagi V andMunot MV. 2019. Research Methodology: A Practical and Scientific Approach. CRC Press
3. George Thomas C. 2021. Research Methodology and Scientific Writing. Springer.
4. Goh KM. 2023. Research Methodology in Bioscience and Biotechnology. Springer.
5. Mishra Shanthi Bhusan. 2015. Handbook of Research Methodology - A Compendium for Scholars & Researchers, Ebooks2go Inc.
6. Narayana, P.S.D. Varalakshmi, T. Pullaiah. 2016. Research Methodology in Plant Science, Scientific Publishers, Jaipur, Rajasthan.
7. Panse and Sukhatme. 1992. Statistical Methods for Agricultural workers. ICAR, New Delhi.
8. Pruzan P. 2016. Research Methodology: The Aims, Practices and Ethics of Science. Springer
9. 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.
10. Sooryamoorthy R. 2021. Scientometrics for the Humanities and Social Sciences. Routledge Publishers.

Web resources:

1. https://www.kobo.com/in/en/ebook/bioinstrumentation-1
2. https://www.worldcat.org/title/bioinstrumentation/oclc/74848857
3. https://en.wikipdia.org/wiki/bioinstrumentation
4. https://www.britannica.com/science/chromatography
5. https://www.elegantthemes.com/blog/business/quillbot-ai-review#3-summarizer
6. https://www.ilovephd.com/top-7-artificial-intelligence-ai-tools-in-scientific-research/?expand_article=1
7. https://www.enago.com/academy/guestposts/harikrishna12/best-ai-tools-to-empower-your-academic-research/
8. https://wordvice.ai/blog/8-best-ai-tools-for-researchers

Course Outcomes (CO):

	CO Statement: Students will be able to	Knowledge Level
CO -1	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
CO -2	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-K3
CO -3	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-K3
CO -4	be proficient in collection, presentation and statistical analyses of data; proficiency to make a conclusion; and use of excel to organize data.	K1-K3
CO -5	apply and use commonly used and scientific software for preparation, data analysis and presentation	K1-K4

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

Mapping Programme Specific Outcomes with Course Outcomes:

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

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

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

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- II/CORE Practical -2]

Title of the Course	**GENETICS, PLANT BREEDING, AND INSTRUMENTATION**			
Category & Course No.	**Core Practical 2**			
	Year	**Semester**	**Credits**	**Course Code**
	I	**II**	**2**	**RBYL21**
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	-	-	5	4
Pre-requisite	Practical's pertaining to above subjects is important to get knowledge on fundamental principles of genetics and plant breeding. To know about the handling of various instruments.			
Learning Objectives	1. Explain the principles of linkage, crossing over and the hereditary mechanisms. 2. Understand the principles of plant breeding to apply crop improvement programmes. 3. To have hands-on training on handling of instruments commonly used for research purpose. 4. To understand the principles of electrophoresis and spectrophotometer. 5. To learn the microtomy and histological processing of plant specimens. 6. To familiarize the tissue processing for localization of			

	soluble components and preparation of permanent and semi-permanent slide preparation.

UNITS	CONTENT
I	1. Problem solving on dihybrid phenotypic, genotypic and test cross ratios. 2. Incomplete dominance in plants. 3. Interactions of factors and modified dihybrid ratios. 4. Multiple alleles in plants, blood group inheritance in human. 5. Complementation analysis to find out complementation groups in viruses. 6. Chromosome mapping from three point test cross data. Calculation of chiasmatic interference. 7. Calculate gene and genotypic frequency by Hardy- Weinberg equation.
II	8. Techniques in plant hybridization – emasculation, artificial pollination
III	9. Separation of amino acids using thin layer chromatography. 10. Separation of plant pigments using column chromatography. 11. 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. 12. Verification of Beer and Lamberts law using spectrophotometry. 13. Spectroscopic estimation of some natural products.
IV	14. Preparation of stains. 15. Microtomy – Preparation of thin sections and permanent slides. 16. Staining starch, cell wall, lipids, proteins and nucleic acids using bright field dyes. 17. Preparation of double stained free hand sections and identification of the tissues with reasons (Normal or anomalous secondary thickening).
V	18. Free-hand sections showing localization of soluble components-Proteins, Sugars and Lipids. 19. Preparation of serial sections, from the given block and identification of the tissues with histological reasoning. 20. Maceration of tissues/fibres for separating cell types. 21. Students are expected to get a thorough understanding on reagents and buffers for the tissue processing and they should submit 20 slides (10 microtome sections, 10 hand sections for permanent and semi-permanent slides) for valuation.

Text Books

1. Bharadwaj, D.N. 2012. Breeding of field crops (pp. 1-23). Agrobios (India).
2. George M Malacinski. 2015. Freifelders Essentials of Molecular Biology (4th ed.). Jones & Bartlett.
3. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
4. Gupta, P.K. 2018. Cytogenetics, Rastogi Publications, Meerut.
5. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.
6. Kumar, H.D. 2007. Molecular Biology and Biotechnology, Vikas Publishing House, New Delhi.
7. Shivakumar, S. 2002. Molecular analysis: Laboratory Manual. University press,

Palkalainagar, Madurai, India.

8. Singh, R.J. 2016. Plant Cytogenetics. CRC press, US.

Reference Books

1. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
2. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John Wiley & Sons, New York.
3. Gelvin, S.B., Schilperoort, R.A. (Eds.). 2000. Plant Molecular Biology Manual.
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.
8. Harris, N and K.J. Oparka. 1994. Plant cell Biology: A Practical Approach. IRL Press, At Oxford University Press, Oxford, UK.
9. Henry, RJ. 1997. Practical applications of plant molecular biology, Chapman & Hall, London.
10. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.
11. Jeyaram, J.1998. Laboratory Manual in Biochemistry. New Age International Publishers Ltd.
12. Khasim, S. M. 2002. Botanical Microtechnique: Principles and Practice. Capital Publishing Company.
13. Krebs, J.E., Goldstein E.S. and Kilpatrick S.T. 2017. Lewin's GENES XII (12^{th} ed.). Jones & Bartlett Learning.

Web Resources:

1. https://www.madrasshoppe.com/cell-biology-practical-manual-dr-renu-gupta-9788193651223-200674.html
2. https://www.bjcancer.org/Sites_OldFiles/_Library/UserFiles/pdf/Cell_Biology_Laboratory_Manual.pdf
3. https://www.kopykitab.com/Genetics-With-Practicals-by-Prof-S-S-Patole-Dr-V-R-Borane-Dr-R-K-Petare
4. https://www.kopykitab.com/Practical-Plant-Breeding-by-Gupta-S-k
5. https://www.kopykitab.com/Cell-And-Molecular-Biology-A-Lab-Manual-by-K-V-Chaitanya
6. https://www.tuscany-diet.net/category/phytochemicals/
7. https://chem.libretexts.org/Courses/University_of_California_Davis/CHE_115%3A_Instrumental_Analysis_-_Lab_Manual
8. http://www.sarajapharmacycollege.com/downloads/HDT.pdf
9. https://ocw.mit.edu/courses/res-5-0001-digital-lab-techniques-manual-spring-2007/resources/column-chromatography/

10. https://www.youtube.com/watch?v=B_QyhG2-VBI

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	To understand the phenotypic, genotypic ratios and gene mapping methods.	K1-K4
CO -2	To know about the hybridization techniques.	K1-K4
CO -3	The experience in handling common instruments and technique for research purpose.	K1-K5
CO -4	The preparation of reagents buffers and stains.	K1-K4
CO -5	The identification of tissues and visualization with histological sections of plant specimens.	K1-4

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

Extended Professional Component (is a part of internal component only not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TRB/ NET /UGC–CSIR/ GATE/ TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Mapping Program Specific Outcomes with Course Outcomes:

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**PSO-6**
CO-1	2	3	3	2	2	1
CO-2	3	2	2	3	2	1
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 – Advance application						

Mapping Program Outcomes with Course Outcomes:

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
CO-1	2	3	3	3	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 – Advance application						

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

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- II/ **Elective Course-3**]

Title of the Course	**MEDICINAL BOTANY**			
Category & Course No.	**Elective Course-III**			
	Year	**Semester**	**Credits**	**Course Code**
	I	**II**	**3**	RBYECA
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	2	1	--	3
Pre-requisite	Basic knowledge on the uses of medicinal plants and their conservation.			
Learning Objectives	1. To understand the uses and effects of medicinal plants and herbal supplements. 2. To gain knowledge about the historical and modern uses of plants in medicine. 3. To gain insights into the perspectives of ethnobotanical research. 4. To know the various methods of harvesting, drying and storage of medicinal herbs. 5. To create new strategies to enhance growth and quality check of medicinal herbs.			

UNITS	**CONTENT**	**CO**	**K Level**	**Hrs**
I	**HISTORY AND TRADITIONAL SYSTEMS OF MEDICINE:** Historical Perspectives – European, African, American, Southeast Asian Practices. Scope and Importance of Medicinal Plants; Traditional systems of medicine - Definition and Scope. Classical health traditions - Naturopathy, Siddha, Ayurveda, Homeopathy, Unani and	1	K1&K2	10

	Materia Medica. Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in Ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e-tabiya, tumors treatments/ therapy, polyherbal formulations.			
II	**PHYTOCHEMISTRY AND PHARMACOGNOSY:** Phytochemistry, important phytoconstituents, their plant sources, medicinal properties. Histochemistry – definition, principles, stains methods. Biological stains – bright field dyes and flurochromes, detection and localization of phytochemicals. Raw drugs, authenticity, study through physical, microscopic and analytical methods. Different types of formulations. Adulteration and Admixtures.	2	K1&K4	10
III	**ACTIVE PRINCIPLE &DRUG DISCOVERY:** Brief description of selected plants, Active principles, biochemical properties and medicinal uses of Guggul (*Commiphora*) for hypercholesterolemia, *Boswellia*for inflammatory disorders, Arjuna (*Terminalia arjuna*) for cardio protection, turmeric (*Curcuma longa*) for wound healing, antioxidant and anticancer properties, Kutaki (*Picrorhizakurroa*) for hepatoprotection, Opium Poppy for analgesic and antitussive, *Salix* for analgesic, *Cinchona* and *Artemisia* for Malaria, *Rauwolfia*as tranquilizer, *Belladona* as anticholinergic, *Digitalis* as cardiotonic, *Podophyllum* as antitumor, *Stevia rebaudiana*for antidiabetic, *Catharanthusroseus* for anticancer. Bioprospecting, drug discovery from plants with reference to diabetes and cancer. Product development and quality control.	3	K2&K6	10
IV	**CONSERVATION AND AUGMENTATION:** Significance of Cultivation, management, policies for conservation and sustainable use of medicinal plants. Conservation of endemic and endangered medicinal plants, Red list criteria; *In situ* conservation: Biosphere reserves, sacred groves, National Parks; *Ex situ* conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: seeds, cuttings, layering, grafting and budding.	4	K3&K6	7
V	**ETHNO BOTANY AND FOLK MEDICINE:** Concepts and definition of Ethnobotany and folk medicines. A brief history of ethnobotanical studies – globally & locally. Methods to study ethnobotany; Applications of Ethnobotany: Folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Understanding the traditions of tribes in Tamil Nadu – Irulas and Kanis. Repository of Ethnobotanical data – Archeology, inventories, folklore and literature. Traditional Knowledge Sharing - Prior information consent, interviews, questionnaires and knowledge partners. Plants associated	5	K5	8

	with culture, social, religious and medicinal purposes. Commercial use of traditional knowledge – ethics, IPR, biopiracy, equitable benefits sharing models.			

Text Books

1. AYUSH (www.indianmedicine.nic.in). 2014. About the systems-An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.
2. Bhat, S.V., Nagasampagi, B.A., &Meenakshi, S. 2009. Natural Products – Chemistry and Applications. Narosa Publishing House, India Ltd.
3. CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow. 2016. AushGyanya: Handbook of Medicinal and Aromatic Plant Cultivation.
4. Kapoor, L. D. 2001. Handbook of Ayurvedic medicinal plants. Boca Raton, FL: CRC Press.
5. Saroya, A.S. 2017. Ethnobotany. ICAR publication.
6. Sharma, R. 2003. Medicinal Plants of India-An Encyclopedia. Delhi: Daya Publishing House.
7. Sharma, R. 2013. Agro Techniques of Medicinal Plants. Daya Publishing House, Delhi.
8. Thakur, R. S., H. S. Puri, and Husain, A. 1989. Major medicinal plants of India. Central Institute of Medicinal and Aromatic Plants, Lucknow, India.

Reference Books

1. Akerele, O., Heywood, V and Synge, H. 1991. The Conservation of Medicinal Plants. Cambridge University Press.
2. Evans, W.C. 2009. Trease and Evans Pharmacognosy, 16th edn. Philadelphia, PA: Elsevier Saunders Ltd.
3. Jain, S.K. and Jain, Vartika. (eds.). 2017. Methods and Approaches in Ethnobotany: Concepts, Practices and Prospects. Deep Publications, Delhi
4. Amruth. 1996. The Medicinal plants Magazine (All volumes) Medicinal plant Conservatory Society, Bangalore.
5. Bhattacharjee, S.K. 2004. Hand Book of Medicinal plants. Pointer Publishers, Jaipur.
6. Handa, S.S and V.K. Kapoor. 1993. Pharmacognosy. Vallabh Prakashan, New Delhi.

Web Resources:

1. https://link.springer.com/book/10.1007/978-3-030-74779-4
2. https://www.elsevier.com/books/medicinal-plants/da/978-0-08-100085-4
3. https://www.pdfdrive.com/medicinal-plants-books.html

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	Recognize plants and relate to their medicinal uses	K1
CO -2	Explain about the phytochemistry, pharmacognosy and bioprospecting of medicinal plant extracts.	K2
CO -3	Apply techniques for conservation and propagation of medicinal plants.	K3
CO -4	Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	K4
CO -5	Develop new strategies to enhance growth and quality check of	K5 & K6

	medicinal herbs considering the practical issues pertinent to India.	

Mapping Program Specific Outcomes with Course Outcomes:

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

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- II/ **Elective Course-3**]

Title of the Course	**AGRICULTURE AND FOOD MICROBIOLOGY**			
Category & Course No.	**Elective Course –III**			
	Year	**Semester**	**Credits**	**Course Code**
	I	**II**	**3**	RBYECB
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	2	1	--	3
Pre-requisite	Students must have basic knowledge in microbes in agriculture and food industry.			
Learning Objectives	1. To provide comprehensive knowledge about plant – microbe interactions. 2. To provide basic understanding about factors affecting growth of microbes 3. To appreciate the role of microbes in food preservation. 4. To understand about the benefits of microbes in agriculture and food industry. 5. To gain knowledge about practices involved in food industry.			

UNITS	CONTENT	CO	K Level	Hrs.
I	**ROLE OF MICROORGANISMS IN AGRICULTURE** Role of symbiotic and free-living bacteria and cyanobacteria in agriculture., Mycorrhiza, Plant Growth	1	K1-K3	12

	Promoting Microorganisms (PGPM) and Phosphate Solubilizing Microorganisms (PSM).			
II	**BIOCONTROL AND BIOFERTILIZATION** Biocontrol of plant pathogens, pests and weeds, Restoration of waste and degraded lands, Biofertilizers: Types, technology for their production and application. Compost and Vermicompost.	2	K1-K4	12
III	**FOOD MICROBIOLOGY** Intrinsic and extrinsic factors influencing growth of microorganisms in food, Microbes as source of food: Mushrooms, single cell protein.	3	K1-K4	12
IV	**FOOD MICROBIOLOGY** Microbial spoilage of food and food products: Cereals, vegetables, prickles, fish and dairy products. Food poisoning and food intoxication. Food preservation processes. Microbes and fermented foods: Butter, cheese and bakery products.	4	K1-K3	12
V	**PREDICTIVE METHODS:** Using Protein Sequences Protein Identity Based on Composition - PhysicalProperties Based on Sequence - Motifs and Patterns - Secondary Structure and Folding Classes -SpecializedStructures orFeatures-Tertiary Structure.	5	K1-K6	12

Text Books

1. Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Subba Rao, N. S. 2000. Soil microbiology. 4th Edition, Oxford and IBH publishing Co. Pvt. Ltd., Calcutta, New Delhi, India.
3. Rangaswami, G. and Bagyaraj, D.J. 2006. Agricultural Microbiology. 2nd Unit 2nd Edition, PHI Learning, New Delhi, India.
4. Prescott, L.M., Harley J.P., Klein D. A. 2005. Microbiology, McGraw Hill, India. 6th edition.
5. Goldman, E. and Green, L.H. 2015. Practical Handbook of Microbiology (3rd Ed.). CRC Press.

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- II/ **Elective Course-3**]

Title of the Course	**BIOPESTICIDE TECHNOLOGY**			
Category & Course No.	**Elective Course –III**			
	Year	**Semester**	**Credits**	**Course Code**
	I	**II**	**3**	RBYECC

Instructional Hours	Lecture	Tutorial	Lab Practice	Total
Per week	2	1	--	3
Pre-requisite	Prior knowledge on impact of chemical pesticides on environment and biopesticides.			
Learning Objectives	1. To understand the value and applications of biopesticides. 2. To comprehend the various issues related to the use of chemical pesticides in horticulture, forestry, and agriculture. 3. To gain knowledge about several biopesticides (bio-insecticides, bio-fungicides, bio-bactericides, bio-nematicides and bio-herbicides). 4. To gain knowledge of the techniques for mass production of selected biopesticides. 5. To be aware of the application strategies and weeds, nematodes, and disease targets.			

UNITS	CONTENT	CO	K Level	Hrs.
I	**INTRODUCTION** Introduction of biopesticides. Biological control, History and concept of biopesticides. Importance, scope and potential of biopesticide. Advantages for the use of biopesticides.	1	K1-K3	12
II	**TYPES OF BIOPESTICIDES** Classification of biopesticides, botanical pesticides and biorationales. Mass production technology of bio-pesticides. Major classes-Properties and uses of Bioinsecticides, biofungicides, biobactericides, bionematicides and bioherbicides. Importance of neem in organic agriculture.	2	K1-K4	12
III	**IMPORTANT BIOINSECTICIDES** *Bacillus thuringiensis*, NPV, entomopathogenic fungi (*Beauveria, Metarhizium, Verticillium, Paecilomyces*). Biofungicides: *Trichoderma, Gliocladium,* non-pathogenic *Fusarium, Pseudomonas* spp., *Bacillus* spp. Biobactericides: *Agro bacterium radiobacter*. Bionematicides: *Paecilomyces*, *Trichoderma*, Bioherbicides: *Phytophthora, Colletotrichum*.	3	K1-K6	12
IV	**STANDARDIZATION OF BIOPESTICIDES** Target pests and crops of important biopesticides and their mechanisms of action. Testing of quality parameters and standardization of biopesticides.	4	K1-K6	12
V	**FORMULATION** Mass multiplication and formulation technology of biopesticides. Prospects and problems in commercialization and efficiency of biopesticides. Commercial products of biopesticides.	5	K1-K5	12

Text Books

1. Johri, J.2020. Recent Advances in Biopesticides: Biotechnological Applications. New India Publishing Agency (NIPA), New Delhi.
2. Joshi, S.R. 2020. Biopesticides: A Biotechnological Approach. New Age International (P) Ltd. New Delhi.
3. Kaushik, N.2004. Biopesticides for sustainable agriculture: prospects and constraints. TERI Press, New Delhi.
4. Sahayaraj, K.2014.BasicandAppliedAspectsofBiopesticides.SpringerIndia, NewDelhi.
5. Tebeest, D.O.2020.MicrobialControlofWeeds.CBSPublishersandDistributors,New Delhi.

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- II/ **Elective Course-3**]

Title of the Course	**INTELLECTUAL PROPERTY RIGHTS**			
Category & Course No.	**Elective Course-III**			
	Year	**Semester**	**Credits**	**Course Code**
	I	**II**	**3**	RBYECD
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	2	1	--	3
Pre-requisite	Intent to understand the legal systems governing the knowledge economy. Basic understanding of how laws are structured and interpreted.			
Learning Objectives	1. Cater to the needs of the stakeholders of knowledge economy is designed for those interested in managers and similar individuals. 2. Create awareness of current IPR and innovation trends. 3. Disseminate information on patents, patent system in India and overseas and registration related issues. 4. Pursue a career in IPR, which offers chances for IP consultants and Attorneys. 5. Develop skill sets to enable you to comprehend and assess the methods used in knowledge-based economy and innovation ecosystems.			

UNITS	**CONTENT**	**CO**	**K Level**	**Hrs**
I	**INTRODUCTION TO IPR** History and Development of IPR. Theories on concept of property: Tangible *vs* Intangible. Subject matters patentable in India. Non patentable subject matters in India. Patents: Criteria of Patentability, Patentable Inventions - Process and Product. Concept of copyright. Historical Evolution of copyright, Ownership of copyright, Assignment and license of copyright.	1	K1	9
II	**OVERVIEW OF THE IPR REGIME AND DESIGN** International treaties signed by India. IPR and Constitution of India. World Intellectual Property Organization (WIPO): Functions of WIPO, Membership, GATT Agreement. Major Conventions on IP: Berne Convention, Paris Convention. TRIPS agreement. Industrial Designs – Subject matter of Design – Exclusion of Designs – Novelty and originality – Rights in Industrial Design.	2	K2	9
III	**TRADE MARK, LEGISLATIONS AND PATENT ACT** History of Indian Patent Act 1970. Overview of IP laws in India. Major IP Laws in India. Patent Amendment Act 2005. WTO-TRIPS – Key effect on Indian Legislation. Organization of Patent System in India. Concept of Trademarks, Different kinds of marks, Criteria for registration, Non-Registerable Trademarks, Registration of Trademarks. Infringement: Remedies and Penalties.	3	K3	10

IV	**PRIOR ART SEARCH AND DRAFTING** Overview of Patent Search. Advantages of patent search. Open source and paid databases for Patent Search. International Patent classification system. Types of specifications: Drafting of Provisional specifications. Drafting of complete specifications. Drafting of claims.	4	K4	7
V	**GI AND PATENT FILING PROCEDURES** Geographical Indications of Goods (Registration and Protection) Infringement – Offences and Penalties Remedies. Plant Variety and Farmers Right Act (PPVFR). Plant variety protection: Access and Benefit Sharing (ABS). Procedure for registration, effect of registration and term of protection. Role of NBA. Filing procedure for Ordinary application. Convention application. PCT National Phase application. Process of Obtaining a Patent. Infringement and Enforcement.	5	K5&K6	10

Text Books

1. Ahuja, V.K. 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
2. Arthur Raphael Miller, Micheal Davis H. 2000. Intellectual Property: Patents, Trademarks and .Copyright in a Nutshell, West Group Publishers.
3. Kalyan, C.K.2010. Indian Patent Law and Practice, India, Oxford University Press.
4. Margreth, B. 2009. Intellectual Property, 3nd, New York Aspen publishers.
5. Nithyananda, K.V. 2019. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
6. Venkataraman M. 2015. An introduction to Intellectual property rights. Create space Independent Pub. North Charleston, USA.

Reference Books

1. Anant Padmanabhan. 2012. Intellectual Property Rights: Infringement and Remedies LexisNexis Butterworths Wadhwa.
2. Damodar Reddy, S.V. 2019. Intellectual Property Rights -- Law and Practice, Asia Law House, Hyderabad.
3. Intellectual Property Law in the Asia Pacific Region. 2009. Kluwer Max Planck Series,
4. James Boyle, Jennifer Jenkins. 2018. Intellectual Property: Law & the Information Society—Cases and Materials, Create space Independent Pub. North Charleston, USA.
5. Pradeep, S. Mehta (ed.). 2005. Towards Functional Competition Policy for India, Academic Foundation, Related.
6. Ramakrishna B and Anil Kumar, H.S. 2017. Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers, Notion Press, Chennai.
7. World Intellectual Property Organization. 2004. WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf Journal of Intellectual Property Rights (JIPR): NISCAIR.

Web Resources:

1. http://cipam.gov.in/
2. https://www.wipo.int/about-ip/en/
3. http://www.ipindia.nic.in/
4. https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf.

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

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	Recall the history and foundation of Intellectual Property.	K1
CO -2	Understand the differences of Property and Assets and Various Categories of Intellectual Creativity.	K2
CO -3	Apply the methods to protect the Intellectual Property.	K3
CO -4	Differentiate if the Said Intangible property be protected under law or protected by strategy.	K4
CO -5	Create a recommendation document on the methods and procedures of protecting the said IP and search documents to substantiate them.	K5 & K6

Mapping Program Specific Outcomes with Course Outcomes:

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

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- II/ **Elective Course-4**]

Title of the Course	**APPLIED BIOINFORMATICS**			
Category & Course No.	**Elective Course IV, Generic Centric**			
	Year	**Semester**	**Credits**	**Course Code**
	I	**II**	**3**	RBYEDA
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	2	1	--	3
Pre-requisite	Basic knowledge in molecular biology. Familiarity with operations of computers and MS office tools.			
	1. To learn about the bioinformatics databases, databanks, data format and data retrieval from the online. 2. To explain the essential features of the interdisciplinary field of			

Learning Objectives	science for better understanding biological data. 3. To outline the types of biological databases. 4. To demonstrate the different online bioinformatics tools. 5. To summarize the strong foundation for performing further research in bioinformatics.

UNITS	CONTENT	CO	K Level	Hrs
I	**BIOINFORMATICS AND INTERNET:** Internet Basics – File Transfer Protocol – The World Wide Web – Internet Resources–databases–types – Applications-NCBI Data Model – SEQ – Ids–Biosequences – Biosequence sets– Sequence annotation–Sequence description.	1	K1-K4	12
II	**GEN BANK SEQUENCE DATABASE:** Introduction- Primary and Secondary Databases - Format Vs. Content-Genbank Flat file – Submitting DNA Sequences to the Databases - DNA/RNA-Population, Phylogenetic, and Mutation Studies – Protein-Only Submissions - Consequences of DNA Model –EST/STS/GSS/HTG/SNP and Genome Centers -Contact points for submission of sequence data to DBJ/EMBL/Genbank.	2	K1-K4	12
III	**STRUCTURE DATABASES:** Introduction to Structures- Protein Data Bank (PDB) – Molecular Modelling Database at NCBI Structure File Formats - Visualizing Structural Information – Data base Structure Viewers –Advanced Structure Modelling – Structure Similarity Searching.	3	K1-K4	12
IV	**SEQUENCEALIGNMENTANDDATABASESEARCHING:** Introduction – Evolutionary Basis of Sequence Alignment – Modular Nature of Proteins – Optimal Alignment Methods – Local and global alignment – Substitution Scores and Gap Penalties –Database Similarity Searching – FASTA–BLAST (BlastP, BlastN,) – Position Specific Scoring Matrices, Spliced Alignments.	4	K1-K5	12
V	**PREDICTIVE METHODS:** Using Protein Sequences - Protein Identity Based on Composition – Physical Properties Based on Sequence - Motifs and Patterns - Secondary Structure and Folding Classes – Specialized Structures or Features-Tertiary Structure.	5	K1-K5	12

Text Books

1. Baxevanis, A. D. & Ouellette, B.F. 2001. Bioinformatics: A practical guide to the analysis of genes and proteins. New York: Wiley-Interscience.
2. Bourne, P.E., & Gu, J. 2009. Structural bioinformatics. Hoboken, NJ: Wiley-Liss.
3. Lesk, A.M. 2002. Introduction to bioinformatics. Oxford: Oxford University Press.
4. Mount, D.W.2001. Bioinformatics: Sequence and genome analysis. Cold Spring Harbor,
5. NY: Cold Spring Harbor Laboratory Press.
6. Pevsner, J.2015. Bioinformatics and functional genomics. Hoboken, NJ :Wiley-Blackwell.

References

1. Campbell, A. Mand Heyer, L .J.2003. Discovering genomics, proteomics, and bioinformatics. San Francisco: Benjamin Cummings.
2. Green, M. R and Sambrook,J.2012. Molecular cloning: A laboratory manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
3. Liebler, D.C.2002. Introduction to proteomics: Tools for the new biology. Totowa, NJ: Humana Press.
4. Old, R.W., Primrose, S.B., and Twyman, R.M.2001. Principles of gene manipulation: An introduction to genetic engineering. Oxford : Blackwell Scientific Publications.
5. Primrose, S.B., Twyman, R.M., Primrose, S.B., and Primrose, S.B. 2006. Principles of gene manipulation and genomics. Malden, MA: Blackwell Pub.

Web Resources:

1. Bioinformatics: Algorithms & Applications by Prof. M. Michael Gromiha IIT-Madras. https://nptel.ac.in/courses/102/106/102106065/#.
2. Christopher Burge, David Gifford, and Ernest Fraenkel. *7.91*. J Foundations of Computational and Systems *Biology*. Spring2014.Massachusetts Institute of Technology: MIT Open Course Ware, https://ocw.mit.edu.
3. https://books.google.co.in/books/about/Applied_Bioinformatics.html?id=PXZZDwAAQBAJ&redir_esc=y
4. https://mgcub.ac.in/pdf/material/20200406015638ec227591f9.pdf
5. http://www.russelllab.org/gtsp/dbsearch.html
6. https://www.ebi.ac.uk/Tools/sss/
7. https://bioboot.github.io/bioinf525_w16/class-material/lecture1-2_525_W16_large.pdf

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	Familiarize with the tools of DNA sequence analysis.	**K1 & K2**
CO -2	Use and explain the application of bioinformatics.	**K2 & K3**
CO -3	Master the aspects of protein –protein interaction, BLAST and PSI-BLAST.	**K3 & K4**
CO -4	Describe the features of local and multiple alignments.	**K3 & K4**
CO -5	Interpret the characteristics of phylogenetic methods and Bioinformatics applications.	**K4 & K5**

Mapping Program Specific Outcomes with Course Outcomes:

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

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- II/ **Elective Course-4**]

Title of the Course	**HORTICULTURE**			
Category & Course No.	**Elective IV**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**II**	**3**	RBYEDB
Instructional Hours per week	**Lecture**	**Tutorial**	**Field Practice**	**Total**
	3	-	2	5
Pre-requisite	Students should know fundamental knowledge on morphology of plant propagules and horticulture methods. This course will Enable the students to :			
Learning Objectives	1. Know the brief history, divisions, classification and structure of horticultural plants.			
	2. Acquire knowledge on plant growth and supporting requirements			
	3. Understand the plant growth by seed propagation method			
	4. Study the vegetative propagation methods including propagation by specialized vegetative organs			
	5. Practice and learn the aesthetics of horticultural practices			

UNIT	**CONTENTS**	**CO**	**K Level**	**Hours**
I	**INTRODUCTION TO HORTICULTURE** Definition; Brief History; Divisions of Horticulture – Pomology, Olericulture, Floriculture – commercial importance- cut flowers, Arboriculture, plantation crops, medicinal & aromatic plants. Importance of Horticulture – scope and applications.	1	K1-K2	8
II	**PLANT GROWTH ENVIRONMENT:** Abiotic factors- Light, temperature, humidity, water and wind. Soil types and properties - Organic matter of soil, Chemical compositions, nutrient properties and their functions. Fertilizers - NPK, Methods of fertilizer application, Fertigation. Manures –FYM, Vermicompost, peat moss, coconut coir, Potting mixtures, Bio inoculants. Artificial soils- Vermiculite, soilrite, perlite. Soilless Production of Horticultural crops –Hydroponics, sand culture, and gravel culture.	2	K1-K3	12
III	**PROPAGATION BY SEEDS** Plant propagation by Seeds – Advantages, seed viability, seed dormancy and breaking dormancy. Methods of Seedling Production. Direct sowing and indirect by Nursery growth and Transplantation.	3	K1-K2	8
IV	**VEGETATIVE PROPAGATION** Specialized propagules – Corm (Yam), Tuber (Potato), Sucker (Banana), Bulb (onion), Bulbils (Agave),	4		12

	Rhizome. Vegetative Propagation – Cuttings- leaf (ZZ plant), stem (Crotons), root (Curry leaf), rhizome (Turmeric). Layering - Ground layering types (Jasmine), Air layering (Guava/ Ixora), Grafting Types - Rootstock, Scion, relationship and influencing factors; Approach grafting (Mango), side grafting, (Custard apple) Whip grafting (Pear/Lemon), cleft grafting (Sapota). Budding types-T budding (Rose), patch budding ((Papaya/Sapota) and flap budding (Musanda).		K1-K4	
V	**AESTHETICS OF HORTICULTURE** Garden design and Elements - landscaping - Lawn, Hedge, Edge, Pathways, Pond, Pergola, Arch, and Rockery/Xeriscaping. Indoor plants, Roof top garden, Terrarium Culture, Bonsai, Flower Arrangement- types, Bouquets, Vegetable and Fruit carving.	5	K1-K6	10

Text books:

1. Acquaah, G. 2008. Horticulture: Principles and Practices. (4th ed), Pearson Education, London, UK, ISBN-10 : 0131592475, ISBN-13 : 978-0131592476
2. Fred Davies Jr. Robert Geneve, Sandra Wilson, Hudson Hartmann, and Dale Kester. 2017. Hartmann & Kester's Plant Propagation: Principles and Practices. Pearson; 9th edition. ISBN-10 : 9780134480893, ISBN-13 : 978-0134480893
3. Manibhushan Rao, K. 2005. Text Book of Horticulture. (2nd ed), Macmillan India Ltd., New Delhi.

Reference Books:

1. Adams, C.R., Bamford, K.M. and Early, M.P. 2012. Principles of Horticulture. Routledge, 6th Edition.
2. Ashman, M.A. and Puri, G. 2002. Essential soil science-A clear and concise introduction to soil science. Blackwell scientific publishers, London.
3. Christopher, E. P. 1981. Introductory Horticulture, McGraw Hill, New Delhi.
4. Darbeswhar Roy. 2000. Plant Breeding. Narosa Publishing House, New Delhi.
4. Dirr, M. and Heuser, C.W. 2009. The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture. Timber Press, Oregon, USA.
5. Kumar, N. 1994. Introduction to Horticulture, Rajalakshmi Publication, India.
5. Rao, A.B. 1991. Text Book of Horticulture. Mac-Millan India Ltd., New Delhi.
6. Sadhu, MK. 1996. Plant Propagation Methods. New Age International, New Delhi.
7. Schilletter, J. C. and Richey, H. W. 2005. Text Book of General Horticulture. (2nd ed.) Biotech Books, Delhi.
8. Sharma, R.R. 2016. Propagation of horticultural crops. Kalyani Publishers, New Delhi.
9. Subba Rao, N.S. 1997. Biofertilizers in Agriculture and Forestry. India Book House Limited, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi
10. Tolanus, S. 2006. Soil fertility, Fertilizer and Integrated Nutrient management. CBS Publication, Delhi, India.

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	To recognize the history, divisions and importance of horticulture	K1-K2
CO -2	The soil types, nutritional properties and various supporting structures for growing horticultural plants.	K1-K2
CO -3	Demonstration of plant propagation by seeds	K1-K3
CO -4	Various methods of vegetative propagation of horticultural and ornamentally important plants	K1-K4
CO -5	The aesthetics of plant growing and showcasing ornamental plants	K1-K5

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

Extended Professional Component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Mapping Program Specific Outcomes with Course Outcomes:

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

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

Course Designer: Dr. P. Ravichandran

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- II/ **Elective Course-**]

Title of the Course	**Plants for Bio Energy and Space Research**			
Category & Course No.	**Elective IV**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**II**	**3**	RBYEDC
Instructional Hours per week	**Lecture**	**Tutorial**	**Field Learning**	**Total**
	3	-	2	5
Pre-requisite	Students should know the basics of biological and renewable energy sources and also about using plants for research in space stations. This course will enable the students to:			
Learning Objectives	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	2	K1-K4	9

	combustion (hog fuel), pyrolysis, Gasification and Liquification. Biological process: Enzymatic digestion, aerobic and anaerobic digestion			
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

1. Agarwal, N. K. 2004. Essentials of GPS. Spatial Networks Pvt. Ltd.
2. Chakraverthy, A. 1989. Biotechnology and alternative technologies for utilization of biomass or agricultural wastes. Oxford & IBA pub. Co., New Delhi.
3. Floyd, F. and W. H. Jr. Sabins. 1987. Remote Sensing, Principles and Interpretation (2nd Edition). Freeman & Company.
4. International Encyclopedia of Ecology and Environment, Volumes1 – 30. Indian Institute of Ecology & Environment, New Delhi.
5. Kerry Turner, R. 1988. Sustainable Environment Management. Westview Press, Colorado.
6. Lilles, T. M. and R. F. Kiefer. 1994. Remote Sensing and Image interpretation. John Wiley & Sons.
7. Maguire, D. and M. Batty. 2005.GIS Spatial Analysis & Modelling. Esri Press.
8. Meadows, D. & Randers, J. 2004. Limits to Growth*:* The 30 Year Update. Earth Scan Publications, London.
9. Michael, L. and McKinney, Robert M Schoch. 2012. Environmental Science-Systems and Solutions. 5th edition. Jones & Bartlett Learning. Massachusetts.
10. Mittal, K. M. 1996. Biogas systems: Principles and Applications. New Age International Publishers (P) Ltd. New Delhi.
11. *The Ecological Footprint Atlas* 2010. Oakland: Global Footprint Network.
12. 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	K1-K4

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

Extended Professional Component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

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

Title of the Course	Plants in Tamil Culture			
Category & Course No.	Elective IV			
	Year	Semester	Credits	CourseCode
	I	II	3	RBYEDD
Instructional Hours per week	Lecture	Tutorial	Field Learning	Total
	3	-	2	5
Pre-requisite				
Learning Objectives	To understand the antiquity of Tamil land.			
	2. To provide insights on relationship between Tamil people and plants.			
	3. To know the usage of native plants through Tamil literature.			
	4. To acquaint on 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

M. Sc. BOTANY – Syllabus

Syllabus as Per the Choice Based Credit System (CBCS),

TANSCHE 2023

&

Learning Outcomes-based Curriculum Framework (LOCF)

(Curriculum Effective from July 2023)

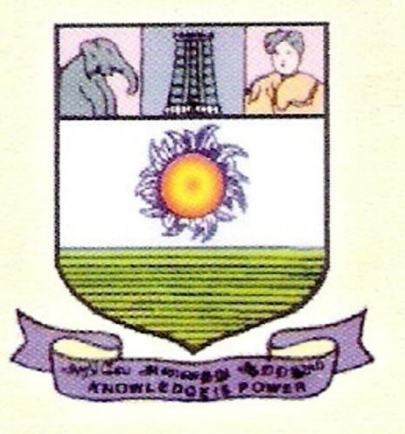
Submitted by

Dr. P. RAVICHANDRAN

Professor & Head and Chairperson

3rd & 4th Semesters

Approved in the 56th SCAA dt. 30.01.2025



Board of Studies in Plant Science

DEPARTMENT OF PLANT SCIENCE

Manonmaniam Sundaranar University, Tirunelveli

July 2024

M. Sc. BOTANY PROGRAM STRUCTURE – July 2023 onwards

Choice Based Credit System (CBCS) and

		III Semester	Lecture & Tutorial		
Core/ Elective/ Skill courses	**Course Code**	**Title of the course**	**Weekly contact hours**	**No. of credits**	Int. 25 / Ext 75 / Total
Core-7	RBYC31	Taxonomy and Molecular Systematics of Angiosperms	3L+1T	4	100
Core-8	RBYC32	Ecology, Phytogeography & Conservation Biology	3L+1T	4	100
Core-9	RBYC33	Plant Physiology & Biochemistry	3L+1T	4	100
Core Practical 4	RBYL31	Taxonomy, Molecular Systematics and Ecology	7P	4	100
Core Practical 5	RBYL32	Plant Physiology & Biochemistry	6P	3	100
Elective Course – V Discipline Centric	Any one-course choice based		2L	2	100
	RBYEEA	Secondary Plant Products and Fermentation Technology			
	RBYEEB	Entrepreneurial opportunities in Botany			
	RBYEEC	**Industrial Botany**			
Skill Enhancement Course (SEC) 2	RBYMSB	Wild Life Ecology - offered from MOOCS	3L	3	100
Practical- Internship-Extension Activity			Summer vacation		
		Subtotal	**30**	**24**	700

Learning Outcomes-based Curriculum Framework (LOCF) (TANSCHE)

		Semester- IV	Lecture & Tutorial			
Core/ Elective/ Skill courses	**Course Code**	**Title of the course**	**Weekly contact hours**	**No. of credits**	Int. 25	Ext. 75
					Total	
Core-10	RBYC41	Recombinant DNA Technology and Industrial Applications	3L+1T	4	100	
Core-11	RBYC42	Applied Plant Biotechnology	3L+1T	4	100	
Core Practical-6	RBYL41	rDNA and Plant biotechnology	8P	4	100	
Elective Course – VI Discipline Centric	Any one-course choice based		3L+1T	3	100	
	RBYEEA	Organic farming				
	RBYEFB	**Forestry and Wood Technology**				
	RBYEFC	Gene Cloning and Gene therapy				
	RBYEFD	Farm Sciences - Green Wealth				
Project	RBYP41	Project/Dissertation and viva voce	8	6	100	
Skill Enhancement Course (SEC) 3	Professional Competency Skill		2	2	100	
	RBYMSC	NET/UGC - CSIR/SET/ TRB General Studies for UPSC / TNPSC				
	RBYMSD	**Botany for Advanced Research** ***Naan Mudhalvan Scheme***				
Practical-7	RBYFS41	Field Study-Lab/Industrial Visit	All the four semesters	2	100	
		Subtotal	**30**	**25**	**700**	
		Grand Total all four semesters	**120**	**94**	**9400**	

Distribution of Credits

Name of Courses	No. Courses	Credits	Total Credits	Total grade points
Core Theory	11	4	44	4400
Core Practical	3	4	12	1200
Core Practical	1	3	3	300
Core Practical	**2**	**2**	4	400
Practical: Internship/Extension activity / Field Study/ Industrial Visit	**1**	**2**	2	200
Elective -1	**5**	**3**	15	1500
Elective -2	**1**	**2**	2	200
Skill Enhancement Course (SEC)	**1**	**3**	3	300
	1	**2**	2	200
	1	**1**	1	100
Dissertation-Project and Viva-Voce	**1**	**6**	6	600
***Grand Total Credits/ Marks**			**94**	**9400**
Cumulative Grade Points Average (CGPA) = Grade Points /Total Credits			**9400/94**	**100%**
Value added course - extra teaching hours			**1**	**2**

* 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 skill enhancement courses from MOOCS platform

** Elective courses if required for students of other departments will be offered by Plant Science or from MOOCS platform

Title of the Course	1. TAXONOMY AND MOLECULAR SYSTEMATICS OF ANGIOSPERMS			
Category & Course No.	**Core Course-VII**			
	Year	**Semester**	**Credits**	**Course Code**
	II	**III**	**4**	RBYC31
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	3	1	--	4
Pre-requisite	Prior knowledge on morphological, anatomical characteristics and uses of plants.			
Learning Objectives	1. To be familiar with the basic concepts and principles of plant systematics. 2. To develop a suitable method for correct characterization and identification of plants. 3. To understand the importance of taxonomic relationships in research of plant systematics. 4. To provide information on various classification systems. 5. To know about the economic importance of plants.			

UNITS	CONTENT	CO	K Level	Hrs
I	**TYPES OF CLASSIFICATION** The origin and evolution of Angiosperms - Cradles of angiosperms. Abominable mystery. Pre-cretaceous presumed angiosperms. Lower and mid-cretaceous records. Botanical exploration and contribution with special reference to India by William Roxburgh, J.D. Hooker, Robert Wright, Nathanial Wallich and Gamble, J.S. Principles of classification as proposed – Artificial – Linnaeus, Natural – Bentham and Hooker, Phylogenetic system – Hutchinson, Modern – APG. Botanical gardens and herbaria of world, preparation and maintenance of Herbarium, Botanical survey of India – its organization and role.	1	K1-K3	12
II	**MODERN TRENDS IN TAXONOMY** Modern trends in taxonomy, chemotaxonomy, numerical taxonomy, biosystematics. ICBN uninominal systems-genesis of binomial nomenclature, importance and principle. Important articles, typification, principles of priority, effective and valid publication, author citation, recommendations and amendments of code. Glossaries and dictionaries, Taxonomic literature (Index Kewensis)	2	K1, K2 K5, K6	12
III	**SYSTEMATIC ANALYSIS OF PLANTS-I** Polypetalae– Magnoliaceae, Nympheaceae, Sterculiaceae, Portulaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae, Turneraceae. Gamopetalae – Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae	3	K1-K4	12
IV	**SYSTEMATIC ANALYSIS OF PLANTS-II** Gamopetalae–Bignoniaceae, Convolvulaceae, Acanthaceae, Verbenaceae. Monochlamydeae –Nyctaginaceae,	4	K1-K4	12

	Aristolochiaceae, Casuarinaceae. Monocots – Orchidaceae, Amaryllidaceae, Liliaceae, Commelinaceae, Poaceae, Cyperaceae.			
V	**MOLECULAR SYSTEMATICS** Molecular Systematics: Plant genomes: nuclear, mitochondrial, chloroplast; Molecular markers; Generating molecular data: restriction site mapping, gene sequencing; Analysis of molecular data: alignment of sequences, methods of phylogeny reconstruction. Phylogenetics: The nature of phylogeny; How to depict phylogeny? The importance of homology, Polarizing characters; Rooting Trees; The problem of homoplasy, standard barcode markers: nrDNA, cpDNA and mtDNA.	5	K1-K3, K5	12

Text Books

1. Pandey, B.P. 2013. Taxonomy of Angiosperms, S. Chand Publishing, New Delhi.
2. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.
3. Singh, G. 2007. Plant systematics theory and practices. Oxford and IBH Publishing Co.
4. Jain, S.K and Rao R.R. 1993. A handbook of field and herbarium methods. Today and Tomorrow Publ.
5. Pandurangan, A.G., Vrinda, K.B and Mathew Dan. 2013. Frontiers in plant taxonomy. JNTBGRI, Thiruvananthapuram, Kerala.
6. Subramaniam, N.S. 1997. Modern plant taxonomy. Vikas Publishing House, New Delhi.

Reference Books

1. Crawford, D.J. (2003). Plant Molecular Systematics. Cambridge University Press, Cambridge, UK.
2. Cronquist, A. (1981). An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
3. Hollingsworth, P.M., Bateman, R.M. and Gornall, R.J. (1999). Molecular Systematics and Plant Evolution. Taylor and Francis, London.
4. Judd. W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.A. and Donoghue, M.J. (2002). Plant Systematics: A Phylogenetic Approach. Sinauer Associaes, Inc., Massachusetts.
5. Patané, J.S.L., Martins, J. and Setubal, J.C. (2018). Phylogenomics. In: Setubal J., Stoye J., Stadler P. (eds) Comparative Genomics. Methods in Molecular Biology, vol 1704. Humana Press, New York, NY
6. Simpson, M.G. (2019). Plant Systematics. Elsevier, Amsterdam.
7. Stuessy, T.F. (2008). Plant Taxonomy: The systematic Evaluation of Comparative Data. Columbia University Press, New York.

Web Resources:

1. https://www.ipni.org/https://www.wipo.int/about-ip/en/
2. http://www.theplantlist.org/
3. https://www.tropicos.org/home
4. http://apps.kew.org/herbcat/gotoHerbariumGrowthPage.do

	CO Statement: Students would have understood	Knowledge Level

CO -1	Explain the principles of taxonomy. Summarize the taxonomic hierarchy. Define Binomial nomenclature. Group Activity – Construct key preparation	K1-K3
CO -2	Understanding the classical and modern trends in taxonomy. Explain the various types of classification. Distinguish its advantages and disadvantages.	K1, K2, K5, K6
CO -3	Construction of floral formula and floral diagram. Illustrate and explain the characteristic features and list out the economic importance of the families.	K1-K4
CO -4	Illustrate and explain the characteristic features and list out the economic importance of the families.	K1-K4
CO -5	Understanding the molecular approaches in the classification of plants.	K1-K3, K5

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						

Title of the Course	**ECOLOGY, PHYTOGEOGRAPHY & CONSERVATION BIOLOGY**			
Category & Course No.	**Core Course-VIII**			
	Year	**Semester**	**Credits**	**Course Code**
	II	**III**	**4**	RBYC32
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	3	1	--	4
Pre-requisite	Prior knowledge on physical, chemical and biological factors. Fundamental knowledge on ecosystem and its functioning.			
Learning Objectives	1. To analyze and comprehend the fundamental ideas of plant ecology, plant communities and plant succession stages. 2. To be aware of the ecosystem resources 3. To understand the causes of climate change remedial process			

	4. To comprehend phtyogeography and GIS 5. To study the biodiversity and conservation methods

UNITS	CONTENT	CO	K Level	Hrs
I	**ECOLOGICAL PRINCIPLES:** Introduction – History, scope, concepts. Diversity of plant life; growth form, life form. Basic concepts of population ecology– population dynamics–Regulation of population density. Concepts of community– characteristics, composition, structure, origin and development–community dynamics–trends of ecological succession.	1	K1-K2	12
II	**ECOSYSTEM AND RESOURCE ECOLOGY:** Introduction – kinds – major types – functional aspects of ecosystem: Food chain and food web, energy flow, laws of thermodynamics. Productivity–primary and secondary productivity –GPP & BPP. **Resource Ecology:** Energy resources; renewable and non-renewable. **Soil**: Formation, types and profile-erosion and conservation, Water resources–conservation and management.	2	K1- K4	12
III	CLIMATE CHANGE - Environmental pollution types and threats; Greenhouse effect and global warming, ozone depletion and acid rain. Eco-restoration/remediation ecological foot prints - carbon foot print – eco labeling - environmental auditing. Functional role of IPCC.	3	K2-K4 & K6	12
IV	**PHYTOGEOGRAPHY:** Phytogeographical Zones - Major terrestrial biomes; theory of island biogeography. Vegetation types of India and Tamil Nadu, Distribution: Continuous, Discontinuous and Endemism. Theories of discontinuous distribution: Continental drift, Age and area hypothesis. Geographical Information System (GIS) Principles of remote sensing and its applications.	4	K2-K6	12

V	**BIODIVERSITY & CONSERVATION** Definition, types of biodiversity – values of biodiversity. Threats to biodiversity: habitat loss, Invasive and exotic species. IUCN red list categories. Biodiversity conservation *in situ* conservation - Hot spots–KMTR, endemic plant species of India, biosphere reserves – Agasthiaymalai Biosphere Reserve, protected areas / sanctuaries (Vallanadu wildlife sanctuary) and national parks (Indhira Ghandhi National Park) IUCN Green List of Protected and Conserved Areas. E*x situ* conservation – botanical gardens, field gene bank, *in vitro* conservation. Indicators of biodiversity conservation, management approaches - reserve selection and reserve size. Indian case studies on conservation and management strategies - Project Tiger, Project Elephant, and Project Bustard.	5	K1-K6	12

Text Books

1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
2. Pushpa Dahiya and Manisha Ahlawat. 2013. Environmental Science- A New Approach, Narosa Pub. House, New Delhi.pp.2.1-2.60.
3. Eugene P Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru.
4. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut.
5. Neeraj Nachiketa. 2018 Environmental & Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.
6. Chandra, A.M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Narosa Publishing House Pvt. Ltd. New Delhi.

Reference Books

1. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.
2. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
3. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
4. Gillson, L. 2015. Biodiversity Conservation and Environmental Change, Oxford University Press, Oxford.

Web Resources:

1. https://www.intechopen.com/chapters/56171
2. https://plato.stanford.edu/entries/biodiversity/
3. https://sciencing.com/four-types-biodiversity-8714.html.
4. https://www.iaea.org/topics/plant-biodiversity-and-genetic-resources
5. http://www.bsienvis.nic.in/Database/Status_of_Plant_Diversity_in_India_17566.aspx
6. **Course Outcomes (CO):**

	CO Statement: Students would have understood	Knowledge Level
CO -1	the scope and importance of population ecology, plant communities and ecosystem ecology.	K1-K2
CO -2	the applied aspect of environmental botany.	K1-K4
CO -3	The Role of modern tools in the understanding of phytogeography and ecology.	K2-4 & K6
CO -4	How to Identify different plant communities, categorize plant	K2-K6

	biomes and identify threatened, endangered plant species and create awareness program in protection of biodiversity.	
CO -5	The biodiversity types, conservation strategies and examples of conservation methods.	

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						

Title of the Course	**TAXONOMY, MOLECULAR SYSTEMATICS AND ECOLOGY**			
Category & Course No.	**Core Practical-III**			
	Year	**Semester**	**Credits**	**Course Code**
	II	**III**	**2**	RBYL31
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	-	-	5	5
Pre-requisite	Theoretical understanding of plant taxonomy, ecology and phytogeography as well as basic laboratory skills for the relevant core course.			
Learning Objectives	1. Understand and develop skill sets in plant morphological, floral characteristics and artificial key preparation. 2. To solve nomenclatural problems. 3. To know about different vegetation sampling methods. 4. To understand the role of environmental factors in ecosystem functioning. 5. Fundamentals of vegetation mapping and remote sensing.			

UNITS	CONTENT	CO	K Level	Hrs
I	**TAXONOMY OF ANGIOSPERMS** 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. 4. Preparation of artificial keys. 5. Description of a species, based on virtual herbarium and live specimens of the families mentioned in the theory. 6. Study on diversity of flowering plants in MS University campus	1	K1-K2	12
II	**TAXONOMY OF ANGIOSPERMS** 7. Solving nomenclature problems. 8. Field trip: A field trip at least 3-4 days to a floristically rich area to study plants in nature 9. Submission of 20 herbarium sheets representing the families studied. 10. Estimation of simple matching and Jaccard coefficients (Numerical taxonomy) 11. Resemblance and sortex matrices (Numerical taxonomy) 12. Phytochemical analyses for the presence of alkaloids, fixed oil, fats, saponins, gums and mucilage 13. Study of advanced and primitive characters (Hutchinson's dicta)	2	K1- K4	12
III	**ECOLOGY** 14. Determination of the quantitative characters of a plant community by random quadrat method (abundance, density, dominance, species diversity, frequency) in grazing land, forests. 15. Estimation of above ground and below ground biomass in a grazing land employing minimum size of quadrat. 16. To determine soil moisture, porosity and water holding capacity of soil collected from varying depth at different locations.	3	K2-K4	12
IV	**ECOLOGY** 17. Determination of pH of soil and water by universal indicator (or) pH meter. 18. Determination of dissolved oxygen. 19. Estimation of carbonate. 20. Estimation of bicarbonate.	4	K4-K5	12
V	**PHYTOGEOGRAPHY AND CONSERVATION BIOLOGY** 21. Mapping of world vegetation. 22. Mapping of Indian vegetation. 23. Remote sensing – Analyzing and interpretation of Satellite photographs- Vegetation/ weather.	5	K3-K5	12

Text Books

1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Sinha RK. 2021. Practical Taxonomy of Angiosperms. 2nd Edition, Wiley India, Noida
3. Sundara-Rajan S. 2000. Practical Manual of Angiosperm Taxonomy. 1st Edition, Anmol Publications, New Delhi.
4. Semple JC. 2016. Flowering Plants Laboratory Manual: A Guide to the Morphology of Flowers. 1st Edition, Aster Graphics, Waterloo, Canada.
5. 4. Kumar S. 2012. Plant Taxonomy and Embryology (with Practical Manual), First Edition, KNRN Publications, Meerut, India.
6. Mauseth JD. Botany: A Lab Manual. 6th Edition, Jones and Bartlett Publishers. Massachusetts, USA.
7. Besse P. 2021. Molecular Plant Taxonomy: Methods and Protocols. Springer Science & Business Media, Springer Nature, Netherland.

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	Describing the plant specimen with technical terms and understanding the general characters of families.	K1-K2
CO -2	Understand the modern methods of plant classification and preparation of herbarium specimen.	K1-K4
CO -3	Recall or remember the fundamental and applied aspects of plant ecology.	K2-K4
CO -4	Understanding the chemistry of soil, its role in plant functions.	K4-K5
CO -5	Know about different vegetation sampling methods.	K3-K5

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						

Title of the Course	**PLANT PHYSIOLOGY AND BIOCHEMISTRY**			
Category & Course No.	**Core Theory-9**			
	Year	**Semester**	**Credits**	**Course Code**
	II	**IV**	**4**	**RBYC33**
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	3	1	-	4
Pre-requisite	Basic knowledge on physiological processes in plants.			
Learning Objectives	1. To learn the energy flow in biological system and the enzyme catalysis 2. To understand water and nutrient absorption and translocation in plants 3. To comprehend the components and processes involved in photosynthesis. 4. To know the metabolic pathways of respiration and energy flow. 5. To understand the influence of plant growth regulators on plant functions			

UNITS	CONTENT
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.
II	**Translocation of water and solutes** Water Relations: Physical and chemical properties of water –Components of water potential - Plasmolysis - water absorption by roots – Apoplast and Symplast concept - water transport through the xylem — Transpiration and evapotranspiration- stomatal structure and function – mechanism of stomatal opening and closing – mineral nutrition – essential nutrients – macro and micro nutrients – deficiencies and plant disorders – absorption of solutes – translocation of solutes – pathways and mechanisms. phloem loading and unloading - translocation of photosynthates – source- sink relationship – partitioning of assimilates
III	**Photosynthesis** Photosynthesis: The physical nature of light – the absorption and fate of light energy – absorption and action spectra- photoreceptors- Ultrastructure and biochemical compartmentation of Chloroplast; Photosynthetic Electron Transport and Photophosphorylation (cyclic and noncyclic): Photosystems and reaction centres - Light Harvesting complexes - Photosystem I & II and Oxidation of Water; Carbon metabolism: C3, C4 and CAM pathways and their distinguishing features - photorespiration and its significance.
IV	**Respiration** Overview of plant respiration, glycolysis, TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylatecycle, alternative oxidation systems.

	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. 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. Molecular biology of plant stress responses. Sensory photobiology: History, discovery of phytochromes and cryptochromes; photochemical and biochemical properties, molecular mechanism of action of photomorphogenic receptors, signaling and gene expression.

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.
6. Jain, V.K. 2017. Plant Physiology, S.Chand & Company Ltd. New Delhi.
7. Pandey, N.S and Pandey, P. 2016. Textbook of Plant Physiology. Daya Publishing House, New Delhi.

References

1. Buchanan, B. B., W. Gruissem and R. L. Jones. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland.
2. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California
3. Willey, N. 2016. Environmental plant physiology. Garland Science Publishers, New-York.
4. Dennis, D. T., Turpin, D. H., Lefebvre, D. D and D. B. Layzell (eds). 1997. Plant Metabolism (second edition), Longman, Essex.
5. Galston, A. W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.
6. Hooykaas, P. J. J., M. A. Hall and K. R. Libbenga (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam, the Netherlands.
7. Nobel, P. S. 2020. Physiochemical and Environmental Plant Physiology. Academic Press, San Diego, 5th Edition.

8. Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12th Edition.
9. Thomas, B. and D. Vince-Prue. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego.
10. 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://swayam.gov.in/nd2_cec20_bt01/preview
6. https://learn.careers360.com/biology/plant-physiology-chapter/
7. https://www.biologydiscussion.com/plants/plant-physiology/top-6-processes-of- plant-physiology/24154.
8. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf
9. https://basicbiology.net/plants/physiology 7.

Course Outcomes (CO):

	CO Statement: Students 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 Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Mapping Programme 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 Programme 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						

Title of the Course	**PLANT PHYSIOLOGY & BIOCHEMISTRY**			
Category & Course No.	**Core Practical - 5**			
	Year	**Semester**	**Credits**	**Course Code**
	II	III	3	RBYL32
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	-	-	6	3
Pre-requisite	Knowledge on the theory pertaining to physiology and biochemistry of plants; and various physiological functions of plants			
Learning Objectives	1. Recognize the role that membrane and water plays in several physiological processes in plants. 2. Gain proficiency in extraction, quantification of the chlorophyll and on photosynthesis 4. Gain proficiency in the analysis of respiration and seed viability 3. Learn specific enzyme assays and determine the reaction rate and Km values 5. Observe the effect of plant hormones on plant growth and development; and determine auxin concentration in plant tissue			

UNITS	CONTENT
I	1. Determination of osmotic potential by plasmolytic method. 2. Determination of water potential using gravimetric method. 3. Effect of organic solvents on protoplasmic membrane. 4. Effect of temperature on protoplasmic membrane.
II	5. Effect of Monochromatic light on apparent photosynthesis. 6. Extraction from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids 7. Extraction and determination of chlorophyll a /chlorophyll b ratio in C_3 and C_4 plants.
III	8. Demonstration of respiration in flower buds by enzyme peroxidase activity. 9. Estimation of the protein content in extracts of plant material by Lowry's or Bradford's method. 10. Determination of seed viability by tetrazolium chloride test (TTC).
IV	11. Effect of time and enzyme concentration on the rate of reaction of enzyme (e.g. acid phosphatase, nitrate reductase). 12. Effect of substrate concentration on activity of any enzyme and determination of its K_m value. 13. Determination of succinate dehydrogenase activity, its kinetics, and sensitivity to inhibitors.
V	14. Demonstration of the effects of plant growth regulators on photomorphogenesis, stem elongation, apical dominance. 15. Effect of plant growth regulators on seed germination and seedling growth of monocot and Eudicots 16. Determination of the presence of IAA from plant tissues and quantification by Salkowski test.

Text Books

1. Inam, A. 2012. A Laboratory Manual of Plant, Physiology, Biochemistry and Ecology. Agrobios Publications, Jodhpur, India.
2. Harborne, J.B. 1998. Phytochemical Methods: A guide to Modern Techniques of Plant Analysis, Chapman &Hall, London, 3rd Edition.
3. Bajracharya, D. 1999. Experiments in Plant Physiology: A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Devi, P. 2000. Principle and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios , Jodhpur, India.
5. Dryer, R. L. and G. F. Lata. 1989. Experimental Biochemistry. Oxford University Press, New York.
6. Plummer, D. T. 1988. An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
7. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.
8. Manju Bala, Sunita Gupta, Gupta N K. 2012. Practicals in Plant Physiology and Biochemistry. Scientific Publisher.
9. Poonam Sharma – Natu, Vijay Paul and P.S. Deshmukh. 2021. Laboratory manual on Experimental Plant Physiology. Division of Plant Physiology, Indian Agricultural Research Institute, New Delhi.

References

1. Hofmann, A. and Clokie, S. 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, New Delhi.
2. Copeland, R. A. 1996. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis. VCH Publishers, New York.
3. George M Malacinski. 2015. Freifelders Essentials of Molecular Biology (4th ed.) Jones & Bartlett.
4. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
5. Rodney Boyer. 2000. Modern Experimental Biochemistry, 3rd Edition. Published by Addison Wesley Longman.

Web resources:

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

Course Outcomes (CO):

	CO Statement: Students will be able to	Knowledge Level
CO -1	1. Recognize the role that membrane and water plays in several physiological processes in plants.	K1-K5
CO -2	2. Gain proficiency in extraction, quantification of the chlorophyll and on photosynthesis	K1-K5
CO -3	4. Gain proficiency in the analysis of respiration and seed viability	K1-K5
CO -4	3. Learn specific enzyme assays and determine the reaction rate and Km values	K1-K5
CO -5	5. Observe the effect of plant hormones on plant growth and development; and determine auxin concentration in plant tissue	K1-K6

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

Mapping Programme Specific Outcomes with Course Outcomes:

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

Mapping Programme Outcomes with Course Outcomes:

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

Title of the Course	SECONDARY PLANT PRODUCTS AND FERMENTATION BIOTECHNOLOGY			
Category & Course No.	**Elective Course – V**			
	Year	**Semester**	**Credits**	**Course Code**
	II	III	3	RBYEEA
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	2	1	-	3
Pre-requisite	Knowledge on plant metabolites, microbial cultivation and manufacture of value added products from them.			
Learning Objectives	1.To familiar with the basics of biochemistry and fermentation. 2.Understand secondary metabolites. 3.To enhance the knowledge and skills needed for self-employment using the microbial derived products. 4.Apply the microbial culture in the manufacturing of value added products. 5.Critically analyze the types of bioreactors and the fermentation process.			

UNITS	CONTENT
I	**Secondary metabolites:** A brief account of acetate malonate, acetate mevalonate and shikimic acid pathways. Categories of phytochemicals – Phenols, alkaloids, flavonoids, terpenoids, steroids, glycosides, carbohydrates, proteins, amino acids, lipids, pigments, vitamins and other related compounds.
II	**Microbial growth:** Factors affecting microbial growth; Stoichiometry: mass balances; Stoichiometry: energy balances; Growth kinetics; Measurement of growth.
III	**Bioreactors:** Introduction to bioreactors; Batch and Fed-batch bioreactors, Continuous bioreactors; Immobilized cells; Bioreactor operation; Sterilization; Aeration; Sensors; Instrumentation; Culture-specific design aspects: plant/mammalian cell culture reactors. Bioseparations: Biomass removal; Biomass disruption; Membrane-based techniques; Extraction; Adsorption and Chromatography Industrial Processes and Process economics: Description of industrial processes; Process flow sheeting; Process economics.
IV	**Downstream processing:** Biomass removal and disruption; Centrifugation; sedimentation; Flocculation; Microfiltration; Sonication; Bead mills; Homogenizers; Chemical lysis; Enzymatic lysis; Membrane based purification: Ultrafiltration ; Reverse osmosis; Dialysis ; Diafiltration ; Pervaporation; Perstraction; Adsorption and chromatography: size, charge, shape, hydrophobic interactions, Biological affinity; Process configurations (packed bed, expanded bed, simulated moving beds); Precipitation (Ammonium Sulfate, solvent); Electrophoresis(capillary); Crystallization; Extraction (solvent, aqueous two phase, super critical), Drying; Case studies
V	**Important products through fermentation:** Organic acids citric acid acetic acid, enzymes – amylase, protease, lipase, antibiotics – penicillin, vitamins – B12, amino acids – glycine, glutamic acid, organic solvenst – ethanol, butanol, acetone, alcoholic beverages – wine, beer, biomass – bakers yeast, biosurfactants, biopesticides, biopolymers.

Text Books

1. Shuler, M. L and F. Kargi. 2002. Bioprocess Engineering, Prentice Hall Inc.
2. Doran, P.M. 1995. Bioprocess Engineering Principles, Elsevier.
3. Kaufman, P.B. L. J. Cseke, S. Warler, J. A. Duke, and H. L. Brielmann. 1999. Natural Products from Plants, CRC Press LLC.
4. Casia, J.R.L.E. 2009. Industrial Microbiology. New Age International (P) Ltd. Publisher, New Delhi.
5. Stanbury, P. F., Whitaker, A. and Hall, S.J. 1979. Principles of Fermentation Technology. Aditya Books (P) Ltd., New Delhi.
6. Potter, N. N. 2007. Food Science. CBS Publishers.

Text Books

1. Shuler, M. L and F. Kargi. 2002. Bioprocess Engineering, Prentice Hall Inc.
2. Doran, P.M. 1995. Bioprocess Engineering Principles, Elsevier.
3. Kaufman, P.B. L. J. Cseke, S. Warler, J. A. Duke, and H. L. Brielmann. 1999. Natural Products from Plants, CRC Press LLC.
4. Casia, J.R.L.E. 2009. Industrial Microbiology. New Age International (P) Ltd. Publisher, New Delhi.
5. Stanbury, P. F., Whitaker, A. and Hall, S.J. 1979. Principles of Fermentation Technology. Aditya Books (P) Ltd., New Delhi.
6. Potter, N. N. 2007. Food Science. CBS Publishers.

Web resources:

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

Course Outcomes (CO):

	CO Statement: Students will be able to	Knowledge Level
CO -1	Critically analyze the types of bioreactors and the fermentation process.	
CO -2	Evaluate the role of microorganisms in industry.	
CO -3	Analyze the types of bioreactors.	
CO -4	Create to understand the significance of intrinsic and extrinsic factors on growth of microorganism.	
CO -5	Evaluate the concept of downstream processing.	

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

Mapping Programme Specific Outcomes with Course Outcomes:

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

Mapping Programme Outcomes with Course Outcomes:

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

Title of the Course	**ENTREPRENEURIAL OPPORTUNITIES IN BOTANY**			
Category & Course No.	**Elective Course-V**			
	Year	**Semester**	**Credits**	**Course Code**
	II	**III**	**2**	RBYEEB
Instructional Hours/ week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	2	-	-	2
Pre-requisite	Fundamental knowledge on plant growth, development, cultivation and harvest			
Learning Objectives	Understand the different classifications of horticultural crops, nursery management, and use of technology in horticulture. To study the plant communities and plant succession stages. Develop their competency on pre- and post-harvest technology in horticultural crops. Analyze the different methods of weed control and harvest treatments of horticultural crops. To study biodiversity management and conservation. Examine the economic implications of cultivation of tropical and sub-tropical vegetable crops. Evaluate the importance of floriculture and contribution spices and condiments on economy.			

UNITS	CONTENT
I	Organic manures and fertilizers. Composition of fertilizer, NPK content of various fertilizers. Common organic manures bone meal, cowdung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost, aerobic and anaerobic – advantages. Vermicompost preparation, vermiwash. Panchakaviyam.
II	Common garden tools. Methods of plant propagation by seeds. Vegetative propagation, cutting, grafting, budding and layering. Use of growth regulators for rooting.
III	Gardening – types of garden, ornamental, indoor garden, kitchen garden, terrace garden, vegetable garden for marketing. Rockery and artificial ponds. Ornamental garden designing, garden components flower beds, borders, hedges, edges, drives, paths, garden adornments.
IV	Packaging of fruits, vegetables. Preservation techniques drying, heat treatment, low temperature storage and by chemicals. Preparation of wine, vinegar and dairy products.
V	Significance of mushrooms. Types of mushrooms (button mushroom, oyster mushroom). Spawn isolation and preparation. Cultivation. Value added products from mushroom – pickles, candies and dried mushrooms.

Text Books

1. Chmielewski, J.G and Krayesky, D. 2013.GeneralBotany laboratory Manual. Author House, Bloomington, USA.
2. Russell, T. 2012. Nature Guide: Trees: The world in your hands (Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.
3. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Webster, Jand Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge University Press, Cambridge.
5. Bendre, M. Ashok and Ashok Kumar, A. 2020.TextBookofPracticalBotany 1 (10thed).Rastogi Publications, Meerut.
6. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.

Reference Books

1. Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture.
2. Sathe, T.V. 2004. Vermiculture and Organic farming, Daya Publishers.
3. Hartman, H.T. and D.F. Kestler. 1976. Plant propagation principles and practice. Prentice Hall of India, New Delhi.
4. Jules Janick, 1982. Horticulture Science. Surjeet publications, New Delhi.
5. Ignacimuthu, S.1998. Plant Biotechnology. Tata Mc Graw Hill Ltd., New Delhi.
6. Gupta. P.K., 1998. Elements of Biotechnology. Rastogi publications, Meerut.
7. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
8. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

Web Resources:

1. https://www.kobo.com/in/en/ebook/composting-process-organic-manures-through-eco-friendly-waste-management-practices
2. https://books.google.co.in/books/about/Plant_Propagation.html?id=K-gQh6OI7GcC&redir_esc=y
3. https://www.ebooks.com/en-us/subjects/gardening/
4. https://www.elsevier.com/books/food-preservation-techniques/zeuthen/978-1-85573-530-9

Outcomes (CO):

	CO Statement: Students would have	Knowledge Level
CO -1	Learnt the basics of minerals, nutrition and fertilizers required for plant growth	K1
CO -2	Understood the tools required and propagation methods of horticultural plants	K2
CO -3	Studied and will be able to differentiate the various types of gardening and gardening adornments	K3
CO -4	Had a comprehension on preservation and packing of plant derived food items	K4
CO -5	Understood the types and methods of cultivation of mushrooms and their importance in human health	K5 & K6

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

Mapping Programme Specific Outcomes with Course Outcomes:

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

Mapping Programme Outcomes with Course Outcomes:

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

Title of the Course	INDUSTRIAL BOTANY			
Category & Course No.	**Elective Course – VI**			
	Year	**Semester**	**Credits**	**Course Code**
	II	III	3	RBYEEC
Instructional Hours Per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	2	1	-	3
Pre-requisite	The course will equip students to either obtain employment in the field or start their own business there, depending on the needs of the industry			
Learning Objectives	1. To learn the applied aspects of industrial application of algae, fungi, bacteria, plants, molecular biology and recombination technology. 2. To understand the different kinds of plant product based industries. 3. To educate students about the widespread commercial uses of fungi. 4. To know about the economic importance of industrial plant products 5. To acquire knowledge on micropropagation methods, PTC industries and commercialization plant tissue culture industries			

UNITS	CONTENT
I	**Algae in industries:** Fertilizer industry-Seaweeds, pharmaceutical industry – antibiotics, agar, carageenin, alginin, diatom ate earth, mineral industry, fodder industry
II	**Fungi in industries:** Beneficial use of yeast, Fermentation of alcohol, preparations of enzyme, organic acid preparation, cheese production, protein manufacture, vitamins, fats.
III	**Plant products:** Fibres and Fibre-Yielding Plants, wood and cork, tannins and dyes, rubber, fatty oils and Vegetable fats, sugars and starches, pulp and paper, gums and resins.
IV	**Bacteria in industries:** Food industry, dairy products, bioleaching, biogas production, bioremediation
V	**Commercial Plant Tissue culture**: Totipotency, Micropropagation patterns, Tissue cultured plants – Banana, Bamboo, Gerberas, Orchids; cell suspension culture- Capsaicin, hairy root cultures - camptothecin, Plant tissue culture industries in India.

Text Books

1. Trivedi, P.C. 2001. Algal Biotechnology. Point publisher, Jaipur. India.
2. Dinabandhu, S and Kaushik. B.D. 2012. Algal Biotechnology and Environment. I.K. International, New Delhi.
3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.

4. Dilip K. Arora. 2003. Handbook of Fungal Biotechnology. CRC Press book.
5. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.
6. Dubey R.C. 2004. A text book of Biotechnology aspects of microbiology, British Sun Publication.
7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology, Tata MaGraw Hill Publishing House, New Delhi.
8. Narayanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi

Course Outcomes (CO):

	CO Statement: Students will be able to	**Knowledge Level**
CO -1	Understand the basics of algae in industrial applications.	K1
CO -2	Demonstrate and to recollect the uses in fungi in industries.	K2
CO -3	Explain bacterial role in industries.	K3
CO -4	Compare and contrast the use of plants in industries.	K4
CO -5	Discuss and develop skills for working in industries specializingin biomolecules.	K5&K6

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

Mapping Programme Specific Outcomes with Course Outcomes:

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

Mapping Programme Outcomes with Course Outcomes:

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

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

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem.- IV/CORE Theory-10]

Title of the Course	**RECOMBINANT DNA TECHNOLOGY AND INDUSTRIAL APPLICATIONS**			
Category & Course No.	**Core Theory-10**			
	Year	**Semester**	**Credits**	**CourseCode**
	I	**IV**	**4**	RBYC41
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3	1	--	4
Pre-requisite	To understand the principles of recombinant DNA technology and its applications.			
Learning Objectives	1. Students should be familiar with the basics of biotechnology and molecular biology. 2. To develop critical understanding of cloning vectors and artificial chromosomes. 3. To learn about the gene transfer techniques. 4. To know about the gene expression and regulation of rDNA clones. 5. To enable students to gain basic understanding of ethics and applications of rDNA technology.			

UNITS	**CONTENT**	**CO**	**K Level**	**Hrs**
I	**BASICS OF NUCLEIC ACIDS:** Basics of Nucleic Acids-Physical and chemical properties, types, occurrence, structure, topology and dynamics, functions. Methods for isolation and purification of nucleic acids. Quantification of nucleic acids-spectrophotometer, nanodrop. Confirmation by Agarose gel electrophoresis.	1	K1-K5	12
II	**BASICS OF rDNA TECHNOLOGY:** Introduction to rDNA technology-recombinant DNA. Types and uses of restriction endonuclease, classification, restriction mapping. DNA modifying enzymes-nucleases, polymerases, phosphatases and ligases. Cloning vectors and their applications-definition and types of vectors. Artificial chromosomes-BAC, YAC, HACs, MAC. Expression vectors, shuttle vectors, expression vectors for eukaryotes. Cloning methods and strategies-	2	K2-K5	12

	Methods for selection of recombinant clones and screening of recombinant clones- blue white selection and alpha complementation.			
III	**GENE TRANSFER METHODS:** Direct and indirect gene transfer techniques-. Cloning in prokaryotes-transformation, transduction, conjugation, transposition, cell transformation with plasmids, transfection with phage vectors. Cloning in eukaryotes-recombinant viral technique, DNA mediated gene transfer methods, protoplast fusion or somatic cell hybridization, liposomes, microinjection, electroporation. DNA cloning-sticky ends, blunt ends, adaptors and linkers.	3	K2-K5	12
IV	**METHODS TO STUDY GENE EXPRESSION:** PCR based cloning-concept, types, primer design, analysis of products and applications. DNA and RNA probes. Synthesis of oligonucleotides. DNA finger printing. Chromosome jumping, chromosome walking. Gene expression analysis by Blotting technique, RT-PCR, EST analysis, Enzymatic and bioluminescent reporters, Reporters used in protein localization and trafficking studies, Promoters analysis, mapping transcriptional start sites, Transcriptome analysis, DNA microarrays (cDNA arrays and oligo arrays), Serial Analysis of Gene Expression (SAGE).	4	K2-K6	12
V	**APPLICATIONS & ETHICS OF rDNA TECHNOLOGY:** Synthesis of new drugs and therapies for genetic diseases. Metabolic engineering. Protein engineering, production of antibiotic medicines, Recombinant hormones**:** insulin (somatotrophin), erythropoietin used in the treatment of anemia. Production vaccines. Fungal α-amylase, silk production in sericulture. Impact and safety, moral, social, regulatory & ethical issues associated with recombinant DNA technology.	5	K1-K6	12

Text Books

1. Abdin, M.Z., Kiran, U., Kamaluddin, M., Ali, A. (Ed.). 2017. Plant Biotechnology: Principles and Applications, Springer publishers.
2. Darbeshwar Roy. 2010. Biotechnology. Narosa Publishing House Pvt. Ltd.
3. Khan. I.A. and A. Khanum .2004. Fundamentals of Biotechnology – Forensic Science Genetic Engineering. Ukaaz publication, Hyderabad.
4. Mba, C., Afza, R., Bado, S., and Jain, S.M. 2010. Plant Cell Culture: Essential Methods, John Wiley & Sons, UK.
5. Molecular Biotechnology by Bernard R. Glick and Jack J. Pasternak (2002) Panima publishing house, New Delhi.
6. Neal Stewart, Jr. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications. John Wiley & sons Inc.

References

1. Brown, T. A. 2002. Genomes. Wiley-Liss Publications.
2. Friefelder, D. 2005. Molecular Biology. Second Edition. Narosa Pub. House.
3. Glick B. R., Pasternak J. J. and Patten C. L. (2010) Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, USA.
4. Green M. R. and Sambrook J. (2012) Molecular Cloning: A Laboratory Manual.

CSHL Press, USA.
5. Lewin, B. 2003. Genes VIII. Oxford University Press.
6. Paola Fasella and Anwar Hussain. 2014. Plant Biotechnology. Scientific International Pvt. Ltd.
7. Primrose, S.B and Twyman, R.M. 2014 Principles of Gene Manipulation and Genomics. Blackwell Publishing.
8. Revised guidelines for research in Transgenic plants (August 1998), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.
9. Voet, D., Voet, J. G. and Pratt C. W. (2012) Principles of Biochemistry. John Wiley & Sons, UK.
10. Watson, J.D. *et al.* 2003. Molecular Biology of the Gene. Fourth Edition. The Benjamin Cummings Pub. Co.
11. Wolfer, S.L. 1993 Molecular and Cellular Biology, Wadsworth Publishing, USA.

Web Resources:

1. https://www.nature.com/scitable/topic/cell-biology
2. https://plato.stanford.edu/entries/molecular-biology/
3. https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular biology/bioinformatics
4. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470686522

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	To understand the basic properties of nucleic acids.	K1-K5
CO -2	To know about the different types of cloning vectors.	K2-K5
CO -3	To know the different methods of gene transfer techniques.	K2-K5
CO -4	To know the application of PCR and expression of rDNA clones.	K2-K6
CO -5	Create and develop skills for rDNA techniques and in producing hybrids varieties.	K1-K6

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

Extended Professional Component (is a part of internal component only not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Mapping Program Specific Outcomes with Course Outcomes:

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

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

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem. IV/Core Theory -11]

Title of the Course	**Applied Plant Biotechnology**			
Category & Course No.	**Core Theory-11**			
	Year	**Semester**	**Credits**	**CourseCode**
	II	**IV**	**4**	RBYC42
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3	2	--	5
Pre-requisite	Students should know about the fundamentals of Plant physiology, nutrition and environmental factors that control plant growth and development and basics of rDNA techniques. Students will be able to learn			
Learning Objectives	1. History, basic principles and concepts of plant cell, tissue, organ culture and organogenesis			
	2. Techniques of micropropagation, synthetic seed production and conservation of IUCN RED listed and economically important plants			
	3. Protoplast isolation, culture and somatic hybridization and conservation of germplasm by cryopreservation			
	4. The application of biotechnology in industrial and pharmaceutical products			
	5. Methods of producing transgenic plants, advances in genetic engineering and production of hybrid seeds with various potentials			

UNITS	CONTENT	CO	K Level	Hours
I	**Basics of Plant 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.	1	K1-K5	16
II	**Techniques in Plant Tissue Culture** Micro propagation - 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 culture and production of gametoclones, haploid plants.	2	K1-K5	12

	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	**Industrial products** Bioreactors – types, culturing Plant cells and production of Secondary metabolites. Use of precursors and elicitors, cell immobilization, biotransformation for enhancing the production of secondary products. Molecular farming for production of pharmaceutical products. Industrial Production of protease & lipase and their applications. Immobilization for enzymes production. Antibiotic-Penicillin production. Amino acid - Glutamic acid production. Production of Alcohol.	4	K1-K5	12
V	**Transgenic plants** Transgenic plants - development strategies (*Bt* cotton, Golden Rice), Production of transgenic insect-resistant, virus-resistant, salinity and drought tolerant, herbicide-resistant plants. Cytoplasmic male sterility and fertility restoration, terminator seed technology, antisense technology for Delayed fruit ripening (*Flavr Savr* tomato).	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.
5. Edwin F. George, Michael A. Hall and Geert-Jan De Klerk. 2008. Plant Propagation by Tissue Culture. 3rd Edition. Published by Springer, Dordrecht, Netherlands.

References:

6. Bhojwani, S S. 1990. Plant tissue Culture: application and Limitations. Elsevier Science Publishers, New York.
7. Collins, H.A. and Edwards, S.1998. Plant Cell Culture. Bio Scientific Publishers, Oxford.
8. Dixon, R.A. 1994. Plant cell culture, A Practical Approach. IRL Press. Oxford, London.

9. Benson, E.E. 1999.Plant Cconservation Biotechnology. Taylor & Francis.
10. Freifelder, D. 1990. Molecular Biology. Narosa Publishing, New Delhi.
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, 12th Edition.
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, 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 Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO-1	The History, basic principles and concepts of plant cell, tissue, organ culture and organogenesis	K1-K3
CO-2	The Techniques of micropropagation, somatic embryogenesis and production of synthetic seeds and conservation of IUCN RED listed and economically important plants	K1-K3
CO-3	Protoplast isolation, culture and somatic hybridization and conservation of germplasm by cryopreservation	K1-K3
CO-4	The application of biotechnology for the production of	K1-K3

	industrial and pharmaceutical products					
CO-5	Methods of producing transgenic plants, advances in genetic engineering and production of hybrid seeds with various potentials					K1-K3
Knowledge Level	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
	Remember	Understand	Apply	Analyze	Evaluate	Create

Extended ProfessionalComponent (is a part of internal component only not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

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

Course Designer: Dr. P. Ravichandran

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem. IV/Core Practical -6]

Title of the Course	**rDNA and Plant Biotechnology**			
Category & Course No.	**Practical -6**			
	Year	**Semester**	**Credits**	**CourseCode**
	II	**IV**	**4**	**RBYL41**
Instructional Hours per week	**Lecture**	**Tutorial**	**Practical**	**Total**
	0	**0**	**8**	**8**
Pre-requisite	**Students should have a strong understanding in the theoretical aspects of rDNA technology. By studying this course students will be trained in:**			
Learning Objectives	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		K1-K6	24

	seeds. 9. Demonstration of protoplast isolation and culture 10. Demonstration of haploid plant production in *Datura.* 11. To study the growth characteristics of *E. coli* by turbidometry and plating methods. . 12. To isolate plasmid from *E. coli* culture (miniprep) and estimate the DNA by fluorometry.	3		
IV	13. Isolation of Plant DNA and identification of DNA by AGE. 14. Restriction enzyme digestion and estimation of the size of various DNA fragments **15.** Polymerase Chain Reaction amplification of Plant DNA and analysis of the products	4	K1-K6	18
V	16. Cloning of DNA fragment in plasmid vector by ligation, transformation of ligation mix in *E. coli* cells and selection of transformants. 17. To perform 'Colony PCR' to screen for the positive *E. coli* transformants containing the ligated product and perform restriction digestion of the positive clone. 18. Transformation of the given bacterial population and selection of recombinants 19. 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

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem. IV/Elective -6]

Title of the Course	**ORGANIC FARMING**			
Category & Course No.	**Elective Course Discipline Centric – VI**			
	Year	**Semester**	**Credits**	**Course Code**
	II	IV	3	RBYEFA
Instructional Hours Per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	2	1	-	3
Pre-requisite	To understand the students about the organic farming.			
Learning Objectives	1. To study various aspects of organic farming. 2. To understand the relevance of organic farming, its advantages and short comings against conventional high input agriculture. 3. To know the importance of organic farming in the present scenario and its impact on environment and soil health. 4. Awareness on the importance of organic farming in the present scenario and its impact on environment and soil health. 5. Expose the students to about quality aspect and grading.			

UNITS	**CONTENT**
I	**Agronomy:** Organic farming- concept, characteristics, significance, organic ecosystem, scope of organic farming in India - Principles and types of organic farming. Choice of crops & varieties in organic farming - Initiative by Govt/NGOs/Other organizations for promotion of organic farming Operational structure of NPOP (National Programme for Organic Production) - Concept of dryland agronomy Organic nutrient resources & their fortification, restriction to nutrient use in organic farming - Organic production methods for cereals, vegetables and fruit crops
II	**Soil science:** Organic farming for sustainable agriculture; Manures- compost, methods of composting - Green manuring,vermicompostand biofertilizers. Harmful effect of non-judicious chemical fertilization - Organic farming practices for improving soil health Quality parameters of organic manures and specifications - Soil fertility in organic farming systems. Manure preparation methodology - Soil improvement
III	**Fundamental of organic farm management:** Land management in organic farming - Water management in organic farming. Organic insect disease management - Organic pest disease management. Preventive and cultural methods for insects and pest control - Identification of different fungal and bacterial biocontrol agents. Indigenous technical knowledge for insects-pest, disease - Weed and nutrient management in organic farming
IV	**Post-harvest management:** Processing, labeling of organic produce - Storage and transport of organic produce.
V	**Organic quality control standards:** Certification- types, process & procedure and agencies. Quality aspect and grading - Packaging and handling. Economic considerations and viability of organic products - Export of organic product and marketing

Text Books

1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services.
2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers.
3. Subba Rao N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition. Medtech.
4. Vayas,S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming AktaPrakashan, Nadiad.
5. Singh, S M. 2018. Organic Manure: Sources Preparation and Usage in Farming Lands,Siya Publishing House

References

1. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh
2. Tolanur, S. 2018. Fundamentals of Soil Science 2nd Edition, CBS Publishers, New Delhi
3. Reddy, S.R. 2017. Principles of Organic Farming Kalyani Publishers, New Delhi
4. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.
5. Ahmad Mehraban. 2013. The Basis of Organic Fertilizers, LAP LAMBERT Academic Publishing.

Web resources:

1. https://www.amazon.in/Healthy-earth-organic-Hari-prasad-ebook/dp/B08L5KFKDV
2. https://www.kobo.com/in/en/ebook/organic-farming-for-sustainable-agriculture
3. https://www.elsevier.com/books/organic-farming/chandran/978-0-12-813272-2
4. https://link.springer.com/book/10.1007/978-3-030-04657-6
5. https://www.afrimash.com/product-category/livestock-section/book/organic-farming-ebooks/

Course Outcomes (CO):

	CO Statement: Students will be able to	**Knowledge Level**
CO -1	Knowledge on various aspects of organic farming.	K1
CO -2	Understand the relevance of organic farming, its advantages.	K2
CO -3	Explain the short comings against conventional high input agriculture.	K3
CO -4	Compare the packaging methods of harvest.	K4
CO -5	Discuss and develop skills for post-harvest management.	K5&K6

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

Mapping Programme Specific Outcomes with Course Outcomes:

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

Mapping Programme Outcomes with Course Outcomes:

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

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem. IV/Elective -6]

Title of the Course	**FORESTRY AND WOOD TECHNOLOGY**			
Category & Course No.	**Elective Course Discipline Centric – VI**			
	Year	**Semester**	**Credits**	**Course Code**
	II	**IV**	**2**	RBYEFB
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	2	1	-	3
Pre-requisite	Prior knowledge on trees, forests and their importance.			
Learning Objectives	1. To study various aspects of Forest Botany. 2. To understand the importance and different forests and plants species. 3. To know the ecological significance of forests. 4. To enable the students to information on forests laws. 5. To raise student awareness on the need to create a sustainable way of living and the current Global issues with forestry caused by human interference.			

UNITS	CONTENT
I	**Introduction and scope of Forest Botany** - Merits of combining traditional Botany and Forestry practices. General introduction to forests, natural and manmade. Types of forests tropical, temperate, evergreen, semi evergreen, deciduous, monoculture, multipurpose, social and industrial. Forest and climate - Forest and Biodiversity - Forest and gene conservation - Forest and ecosystem - Forest and civilization. Geographical history of the forest vegetation - natural vs. artificial. Special emphasizes on social forestry, Industrial forestry and Multi-purpose forestry. Preservation of natural forestry - Pollution control.
II	**Forest genetics, Forest physiology, forest ecology** – strong interrelationships. Macro-dynamic ecosystem reserves, hydrological cycles, balance. Identification of timber plants based on vegetative features. Seedlings, leaves, bark branching pattern architectural models of trees. Major and minor forest products, use and misuse of forests by man, direct and indirect forest wealth, forest policies, forest protection through peoples committee.
III	**Silviculture:** concept and scope of study, forest in general form, composition, classification of world forests and Indian forests. Classification based on its quality density, tolerance, crown; water cycles of forest. Photosynthetic processes in forest: nitrogen and mineral nutrition in forests.
IV	**Seed dynamics in forest:** seed production, dissemination, germination, establishment and mortality, growth of trees in general terms – height, diameter, volume, growth of stands – gross increment, net increment, stand reaction to varies types of cuttings.
V	**Measurement**: definition, direct measurements, direct and indirect estimate, and prediction. Measurement of diameter – rules and methods, measurement of height – different rules, methods, instruments, total height and merchantable length. Measurement of volume – common units, different methods and procedures of volume measurements. Measurement of age: direct estimate, averages, standard error, and sampling, General concept of indirect estimate based on one or more independent variables. Forestry for social and national development. Progress to be achieved in social forestry, industrial forestry and multiple forestry. Forest Laws- Indian Forest Act, 1927; Forest conservation Act. Wild Life Protection Act, 1972.

Text Books

1. Agarwala, V.P.1990. Forests in India, Environmental and Protection Frontiers. Oxford & IBH Publishing Co. New Delhi.
2. Balakathiresan.S.1986.Essentials of Forest Management. Natraj Publishers, Dehradun.
3. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agro forestry. Oxford and IBH publisher, New Delhi.
4. Dhiman, A.K. 2003. Sacred plants and their medicinal uses. Daya publishing house, New Delhi.
5. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthrough approach to forest service. Jain Bros.
6. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi.
7. Nair, N.C and Henry, A.N. 1983. Flora of Tamil Nadu, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.
8. Ramprakash. 1986. Forest management. IBD Publishers, Debra Dun.
9. Roger Sands. 2013. Forestry in a global context, CAB international.

10. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat.
11. Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun.
12. WWF. 2007. Timber identification manual. TRAFFIC, New Delhi.

Reference Books

1. Avery, T.E. 1967. Forest Measurements. Mc Grand Hill Book Company, New York.
2. Chaturvedi, A.N. and Khanna, L.S. 2015. Hand Book of Forestry (5th Edition).
3. Donald L. Grebner.Jacek P. Siryand Pete Bettinger. 2012. Introduction to forestry and Natural resources Academic press
4. Frederick Franklin Moon, 2018. The Book of Forestry. Repro Books.
5. Kollmann, F.F.P and Cote, W.A. 1988. Wood science and Technology. Vol. I & II Springer Verlag, New York.
6. Parthiban, K.T. 2018. Introduction to Forestry & Agroforestry.
7. Pathak, P.S, Ram Newaj. 2012. Agro forestry: Potentials and Opportunities. India Agrobios.
8. Powell, Baden B.H. 2004. Manual of Forest Law. New Delhi: Biotech.
9. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.
10. Uthappa, A.R. 2015. Sangram Bhanudas Chavan, Competitive Forestry, New Vishal Publications, 1st ed.
11. West, P.W. 2015. Tree and forest measurement, Springer international publishing Switzerland.

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem. IV/Elective -6]

Title of the Course	**GENE CLONING AND GENE THERAPY**			
Category & Course No.	**Elective Course Discipline Centric – VI**			
	Year	**Semester**	**Credits**	**Course Code**
	II	**IV**	**3**	RBYEFC
Instructional Hours	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
Per week	2	1	--	3
Pre-requisite	To know about the gene cloning and gene therapy.			
Learning Objectives	6. To give a clear knowledge of genetic engineering, cloning vectors, enzymes involved in cloning. 7. To understand the procedure involved in recombinant DNA technology and restriction mapping. 8. To focus on the application of gene cloning in plants and animals. 9. To enable the students to information on gene therapy. 10. To raise student to create transgenic plants for hybrid seed production and molecular farming.			

UNITS	**CONTENT**	**CO**	**K Level**	**Hrs**
I	Definition of genetic engineering, gene cloning and recombinant DNA cloning vectors: plasmids, bacteriophages, cosmids, plant and animal vectors.	1	K1-K4	12
II	Gene cloning in prokaryotes and eukaryotes, Isolation of DNA to			

	be cloned, insertion of DNA fragment into vector. Use of Restriction Linkers: use of Homopolyer tails, Transfer of recombinant DNA into Bacteria cell. Selection of clones.	2	K1-K4	12
III	Gene Therapy: Definition, Germ cell and Somatic cell. Amniocentesis in human; patient therapy, embryo therapy. Anti-sense oligonucleotide therapy.	3	K1-K5	12
IV	Restriction mapping –. Random amplified polymorphic DNA using PCR. DNA finger printing; Gene Tagging. Physical methods of gene delivery. Gene transfer techniques. Genetic counseling – Eugenics, Euthenics.	4	K1-K6	12
V	Transgenic plants with herbicide resistance, insect resistance, virus resistance and resistance against bacterial and fungal pathogens. Transgenic plants for hybrid seed production and molecular farming.	5	K1-K6	12

Text Books

1. Das, H.K. 2010. Textbook of Biotechnology (4th edition). Wiley India Pvt. Ltd. New Delhi.
2. Halford, N. 2015. Plant Biotechnology: Current and Future Applications of Genetically Modified crops,John Wiley and Sons.
3. Khan. I.A. and A. Khanum. 2004. Fundamentals of Biotechnology – Forensic Science Genetic Engineering. Ukaaz publication, Hyderabad.
4. Kumar, Pradeep. 2018. Advances in Microbial Biotechnology: Current Trends and Future Prospects. 10.1201/9781351248914.
5. Thieman. 2014. Introduction to Biotechnology, 3rd Edition. Pearson Education India.

References

1. Brown T.A. 2001. Gene Cloning and DNA Analysis- An Introduction (4th edition). Blackwell Science. Oxford.
2. Chawla, H.S. 2009. Introduction to Biotechnology, 2nd edn. Oxford IBH, ISBN:978-81-204-1732-8.
3. Clark, D.P and Pazdernik, N.J. 2009. Biotechnology- Applying the Genetic Revolution. Elsevier Academic Press. USA.
4. Gamborg, O.L and G.C. Phillips (eds). 1995. Plants, Genes and Agriculture. Jones and Bartlett Publishers.
5. Glick B.R and J. J. Pasternak. 2009. Molecular Biotechnology, Panima Publication Co.
6. Gupta. P.K. 1998. Elements of Biotechnology. Rastogi publications, Meerut.
7. Harisha, S. 2007. Biotechnology Procedures and Experiments Handbook. Infinity Science Press Llc. Hingham. MA.
8. Ignacimuthu, S.1998. Applied Plant Biotechnology. Tata Mc Graw Hill Publishing company Ltd., New Delhi.
9. Kreuzer, H and A. Massey. 1996. Recombinant DNA and biotechnology. A guide for teachers. ASM Press.
10. Mosier N.S and Ladisch M.R. 2009. Modern Biotechnology- Connecting Innovations in Microbiology and Biochemistry to Engineering Fundamentals. John Wiley & Sons Inc. New Jersey.
11. Neal Stewart, Jr. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications. John Wiley & sons Inc.
12. Primrose S., Twyman R. and Old B. 2001. Principles of Gene Manipulation (6th ed.). Blackwell Science. Oxford.
13. Ramavat, K.G. 2006. Plant Biotechnology. S. Chand and Co. Ltd., New Delhi.
14. Reynolds, P.H.S. 1999. Inducible Gene Expression in Plants. CABI Publishing, U.K.

15. Slater, A. Scott, N and Fowler, M. 2008. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford University Press Inc.
16. Smith. J.K. 1996. Biotechnology – 3rd Ed. Cambridge Univ. Press, Cambridge.
17. Verma, P.S and Agarwal V.K. 2009. Genetic Engineering. S.Chand & Co. Ltd. New Delhi.

Web Resources:

1. https://www.researchgate.net/publication/51144570_Introduction_to_Gene_Therapy_A_Clinical_Aftermath.
2. https://unacademy.com/content/csir-ugc/study-material/life-sciences/transgenic-plants/
3. https://www.intechopen.com/chapters/63134.
4. https://link.springer.com/book/10.1007/978-88-470-1643-9.
5. https://www.mybiosource.com/learn/gene-transfer-technique/
6. https://www.hopkinsmedicine.org/institutional-review-board/guidelines-policies/guidelines/gene-transfer

Course Outcomes (CO):

	CO Statement: Students would have understood	Knowledge Level
CO -1	Recollect the basic concepts of gene cloning.	K1-K4
CO -2	Demonstrate and to identify the selection of clones.	K1-K4
CO -3	Acquire knowledge on the gene therapy.	K1-K5
CO -4	Compare and understand the concept of gene therapy.	K1-K6
CO -5	Discuss and develop skills for hybrid seed production and molecular farming.	K1-K6

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

CO-2	3	3	2	2	0	0
CO-3	3	3	2	1	0	0
CO-4	3	3	2	2	0	0
CO-5	3	3	2	3	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. S. Vallinayagam

[2024/MSU 55th SCAA/Univ. Dept. /PG/M.Sc. Bot. Sem. IV/Elective -6]

Title of the Course	**FARM SCIENCES - GREEN WEALTH**			
Category & Course No.	**Elective Course Discipline Centric – VI**			
	Year	**Semester**	**Credits**	**Course Code**
	II	IV	3	RBYEFD
Instructional Hours Per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	2	1	-	3
Pre-requisite	To understand the concept of fertilizers in crop production.			
Learning Objectives	1. Understand the concept of agronomy and sustainable agriculture. 2. Evaluate the importance of crop management technology. 3. To develop their understanding on the concept of fertilizers. 4. Develop the integrated management for better crop production by using fertilizers. 5. Develop the skills for cultivation of plants and their value added processing/storage/quality control.			

UNITS	**CONTENT**
I	**Farm management:** Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, soil-plant- water relationship, crop water requirement, water use efficiency, irrigation-scheduling criteria and methods, quality of irrigation water, water logging. Efficient utilization of water through soil and crop management practices. Management of crops in rain fed areas, Contingent crop planning for aberrant weather conditions.
II	**Weeds and weed management:** Weeds- importance, classification, crop weed competition, concepts of weed management principles and methods, herbicides- classification, selectivity and resistance, allelopathy. plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops.
III	**Seeds and crops** Identification of crops, seeds, fertilizers, pesticides and tillage implements, Effect of sowing depth on germination and seedling vigor. Growth and development of crops,

	factors affecting growth and development. Methods of herbicide and fertilizer application.
IV	**Analyses involved in farming:** Study of yield contributing characters and yield estimation, Seed germination and viability test, Numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill, Study of soil moisture measuring devices, Measurement of field capacity, particle density, bulk density and infiltration rate, Measurement of irrigation water.
V	**Field crops:** Harvesting, storage, physiological disorders of important vegetable crops like solanaceous fruit vegetables (brinjal, tomato & chilli), tuber crops (Potato), cucurbits (pumpkin, cucumber, watermelon & gourds), pod vegetables (pea & bean), cole crops (cabbage &cauliflower), bulb crops (onion, garlic), root crops (radish & carrot), common leafy vegetables, spices: turmeric and ginger, black pepper and cardamom.

Text Books

1. Reddy, T.Y and G.H. Sankar Reddi. 2015. Principles of Agronomy. Kalyani Publishers.
2. Reddy, S.R. 2016. Principles of Agronomy. Kalyani Publishers.
3. Brady, N.C and Weil, R.R. 1996. The Nature and Properties of Soils - Weil, Prentice Hall Inc.
4. Craig, C. Sheaffer and Kristine, M. Moncada. 2012. Introduction to Agronomy-Food crops and Environment (Second Edition).
5. George Acquaah. 2004. Principles of Crop production: Theory, Techniques, and Technology. Pearson education.

References

1. Yawalkar, K.S. Agarwal, J. P and S. Bokde. 1967. Manures and fertilizers – Agri Horticultural Publication House.
2. Russell, J.E. 2002. Soil Conditions and Plants Growth - Daya Books.
3. Hansen, V. E. Israelsen, O.W and G. E. Stringham. 1980. Irrigation Principles and Practices -, New York Wiley.
4. Reddy, S.R. 2017. Principles of Agronomy. Kalyani Publishers
5. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers.

Web resources:

1. https://www.amazon.in/Green-Wealth-Unusable-Moneymaking-Assets-ebook/dp/B004D2AYPW
2. https://www.kobo.com/us/en/ebook/green-wealth
3. https://nishat2013.files.wordpress.com/2013/11/agronomy-book.pdf
4. https://www.kobo.com/in/en/ebook/weed-2
5. https://www.amazon.in/Handbook-Fertilizers-Sources-Make-Up-Effects-ebook/dp/B00D45LHAK

Course Outcomes (CO):

	CO Statement: Students will be able to	Knowledge Level
CO -1	To identify the importance of agronomy and its scope.	K1
CO -2	Demonstrate both the theoretical and practical knowledge in weed management principles.	K2
CO -3	Explain the methods of herbicide and fertilizer application.	K3
CO -4	Compare and contrast the yield estimation and water management.	K4
CO -5	Discuss and develop skills for effective conservation, harvesting and storage methods.	K5&K6

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

Mapping Programme Specific Outcomes with Course Outcomes:

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

Mapping Programme Outcomes with Course Outcomes:

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

Title of the Course	**Project/Dissertation and Viva-voce**			
Category & Course No.	**Practical -7**			
	Year	**Semester**	**Credits**	**Course Code**
	II	**IV**	**6**	**RBYP41**
Instructional Hours Per week	**Lecture**	**Tutorial**	Project/Dissertation and Viva-voce	
	0	**0**	12	**12**
Pre-requisite	Students should have basic knowledge on the specialized subject of interest and PG research programs and methods. By undergoing this research students will be able to			
Learning Objectives	collect literature on the area of study that they want to specialize develop hypothesis for doing a post graduate level research project Conceive few objectives with the help of a mentor or research guide and select the choice of their plants/area of study learn the research methods and operation of certain instruments required for their research project and record data or the observations on their experiments to compile data, analyse them using statistical methods to determine the significance of the results and study understand the research problem with the available data and observations and make discussions with reference to the previously published research on the similar area of study write the major accomplishments of the research project and conclude with a scientific pursuit to translate the research findings and discussions in a order of report and compile in to a dissertation and submit for valuation present their findings and defend the questions raised during the viva voce examination.			

Title of the Course	**BOTANY FOR ADVANCED RESEARCH (Naan Mudhalvan Scheme)**			
Category & Course No.	**Skill Enhancement Course (SEC) 3**			
	Year	**Semester**	**Credits**	**Course Code**
	II	IV	2	RBYMSD
Instructional Hours Per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	2	2	-	4
Pre-requisite	Students should to improve their career prospects, or pursuing a passion.			
Learning Objectives	1. To be familiar with the basic concepts and principles of plant systematics. 2. Learn the importance of plant anatomy in plant production systems. 3. To expose the students a fundamental of the various techniques used in molecular studies. 4. To learn about the physiological processes that underlie plant metabolism. 5. To know the energy production and its utilization in plants.			

UNITS	CONTENT
I	**MOLECULAR GENETICS** (i) Molecular Biology of gene expression: Brief overview of the Central Dogma and Teminism. Transcription in prokaryotes and eukaryotes. Types and structure of RNA polymerase, Different types of RNA, Regulatory sequences and transcription factors involved. Mechanism: Initiation, elongation and termination. Split genes and RNA splicing in eukaryotes. Translation in prokaryotes and eukaryotes. Salient features, exceptions, tRNA-suppressor mutations. Mechanism of translation: Chain initiation, elongation and termination, proteins involved, factors affecting translation accuracy. Molecular mechanism of mutation, cancer biology, human cytogentics (ii) Molecular mechanism of Gene Regulation: Regulation in prokaryotes, Regulation in Eukaryotes, Epigenetic mechanisms: methylation and transcriptional inactivation, co-suppression through transcriptional silencing, genome imprinting. RNA processing->alternative splicing, RNA stability, RNA interference. Translational regulation: Gene amplification, mating type interconversion. (iii) Genomics: Structural genomics, Genetic and physical mapping (RFLP), microsatellite maps, cyotogenetic maps, physical maps, positional cloning, chromosome walks and jumps, Genome sequencing, genome databases, human genome sequencing project. Functional genomics. transcriptome, proteome and metabolome, Microarrays and gene-chips. Comparative genomics. Functional and evolutionary relationships prokaryotes, organelles and eukaryotes, orthologues and paralogues. Metabolomics: Identification and quantification of cellular metabolites in biological samples. Pharmacogenomics and drug designing.
II	**ADVANCED TRENDS IN SYSTEMATICS**

	(i) **Basic concepts of:** a. Morphology - History, general morphology, types of data, methods of gathering data, b. Anatomy - History, general anatomy, types of data, methods of gathering data, c. Embryology – History, types of data, methods of gathering data; d. Palynology: History, general palynological characters, types of data, methods of gathering data; e. Cytology and Cytogenetics: History, general cytological and cytogenetic characters, types of data, methods of gathering data; f. Ecology, History, general ecology, types of data, methods of gathering data (At least two examples from each section should be studied to substantiate the taxonomic significance) (ii) **Chemotaxonomy:** a. History, general chemical and chemotaxonomic characters, types of data, methods of gathering data. b. Identification of the major classes of the pharmaceutically important secondary metabolites from natural sources 8 (phenolics, steroids, terpenoids glycosides and alkaloids). c. Applications: Phytochemicals in cosmetics, aromatherapy, disease prevention, biotechnology in the production of phytochemicals. Phytochemical databases **(iii) Molecular trends in Biosystematics** a. Molecules and genomes in plant systematics, techniques used in molecular taxonomy, molecular systematics in crop evolution b. Serology in relation to plant taxonomy- Methods, role of serology in taxonomy. c. Cladistics and Phenetics (**iv) Molecular trends in Reproductive Biology:** (i) Apomixis – Types, cytogenetic basis and induction of apomixes, applications. (ii) Biochemistry and genetics of incompatibility, methods to overcome incompatibility, pollen viability tests, molecular basis of incompatibility (iii) Sterility – Male sterility, CMS, GMS, CGMS, temperature sensitive and photosensitive male sterility, transgenic male sterility, female sterility and zygotic sterility.
III	**PLANT PHYSIOLOGY** (i) Modern concepts Photosynthesis – Environmental and agricultural relevance; Respiration – Biochemical control of respiration (ii) Photomorphogenesis Phytochrome genes and their expression, control of photo-morphogenic responses. Dose-response relations in photomorphogenesis, light induced chloroplast differentiation, effect of photoreceptors. (iii) Biological clock: Circadian rhythms, rhythm responses to environment, clock mechanism (iv) Photoperiodism General principles, florigen concept (iii) Plant growth and development Patterns of growth and differentiation; Gene expression and mutations regulating meristem function, embryogenesis, seedling, root, leaf and flower development. Homeotic genes, ABCD model in Arabidopsis flower, hormonal control of plant tissue development, effect of auxins on root and

	root formation, gibberellin promoted growth of plants, ethylene and triple response mutants, brassinosteroids and photomorphogenesis.
IV	**Enzyme biochemistry** Enzymes: General account: Importance and properties of enzymes in biological sciences, the classification and nomenclature of enzymes with examples, Mechanism of enzyme action role of enzyme in chemical action, various factors affecting the enzyme activity Molecular genetics in plant physiology, Environmental plant physiology, Stress physiology.
V	**ECONOMC BOTANY** Economic importance of Cereals, Tuber Crops, Fibre yielding plants, Plantation Crops, Sugar yielding plants, Narcotics, Vegetables, Oil yielding plants, Pulses and Beverages

Text Books

1. Becker, W.M., Kleinsmith L.J. & Hardin J. 2005. The World of the Cell (6th edition). Benjamin/Cummings Pub. Co. New York.
2. Brooker, R. J. 1999. Genetics Analysis and Principles. Addison Wesley Longman Inc., New York.
3. Bruce, A. et. al. 2002. Molecular Biology of the Cell. Garland Publishing. New York.
4. Jain, V.K. 2017. Plant Physiology, S.Chand & Company Ltd. New Delhi.
5. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2018. Fundamentals of Plant Physiology. Sinauer Associates Inc., US.
6. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
7. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.
8. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.

References

1. Anthony J.F.G .2000. An Introduction to Genetic Analysis. W. H. Freeman &Co. New York.
2. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the embryology of angiosperms. Springer Science & Business Media, Germany.
3. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
4. Hartl, D.L & Jones E. W. 2000. Genetic analysis of Genes and Genomes Jones and Bartlett Pub, Boston.
5. Hopkins, W.G and Huner, N.P. 2009. Introduction to Plant Physiology (4th ed.). John Wiley & Sons. U.S.A.
6. Klug S.W. & Cummings, M.R. 2003. Concepts of Genetics. Pearson Education Pvt. Ltd., Singapore. Kreezer et al. 2001. Recombinant DNA and Biotechnology. American Society for Cell Biology, New York.
7. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman &Co. New York.
8. Mabberley, J.D. 2014. Mebberley's Plant-Book: A portable dictionary of plants, their classification and uses, 3rd ed. Cambridge University Press, Cambridge, U.K. 1021pp.
9. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
10. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, New Delhi.

11. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd edition). Pearson/Benjamin Cumming, San Francisco.
12. Snustad, D. P. & Simmons M.J. 2003.Principles of Genetics. John Hailey & Sons Inc. U.S.A.
13. Steward, F.C. 2012. Plant Physiology Academic Press, US.

Web resources:

1. http:// www.ornl.gov.
2. http:// ash. gene. ncl. ac .nk.
3. http://tor. cshl. org. http:www. gdb. org.
4. http: //www. neg r. org.
5. http: // www. genetics. wustl. edu.
6. http: // genome. imb- jena. dc.

Course Outcomes (CO):

	CO Statement: Students will be able to	**Knowledge Level**
CO -1	Understand of the basic principles of systematics, including identification, nomenclature, classification, and the inference of evolutionary patterns from data	K1,K2 &K5
CO -2	Learn the structures, functions and roles of apical vs lateral meristems in monocot and dicot plant growth.	K1,K3&K 5
CO -3	Understand the organization of nuclear genome	K3&K5
CO -4	Understand the various steps involved in the basic functioning of plant growth and the nutritive value of food.	K2,K3 &K5
CO -5	Gain awareness about the various process involved in the energy production in plants and metabolic pathways.	K1,K5 &K6

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

Mapping Programme Specific Outcomes with Course Outcomes:

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

Mapping Programme Outcomes with Course Outcomes:

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

Title of the Course	Field Study			
Category & Course No.	Practical -8			
	Year	Semester	Credits	CourseCode
	II	IV	2	RBYI41
Instructional Hours per week	Lecture	Tutorial	FIELD STUDY	Total
	One day field study (3); 3 -5 days field study (1) for the entire program			
Pre-requisite	Students should have basic knowledge on habits and habitats of various groups of plants and their environment. Students will be able			
Learning 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 and nearby society 4. visit relevant industries to understand how the theoretical learning is being put into practice 5. to translate the recorded information in the field note book 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, and developmental 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** Self or group -recording of habitat conditions, hosts, substrates, soil parameters, environmental factors and other	3	K1-K4	10

	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 in their filed notebook. Compile a field study report with picture evidences that should be approved by 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

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

Mapping Program Specific Outcomes with Course Outcomes:

Extended ProfessionalComponent (is a part of internal component only not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

	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						