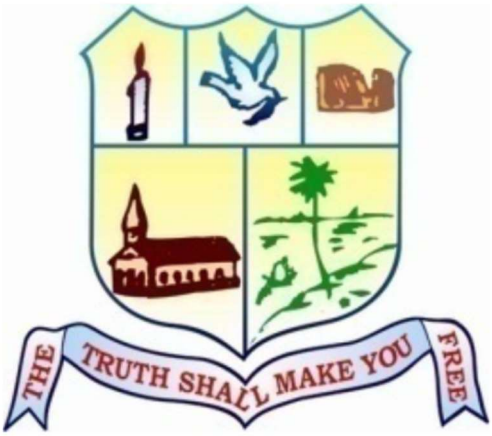
SCOTT CHRISTIAN COLLEGE (AUTONOMOUS)

NAGERCOIL



(Estd. 1893)

CURRICULUM AND SYLLABUS

DEPARTMENT OF BOTANY & RESEARCH CENTRE

(Approved by the Standing Committee of the Academic Councils held on 21.10.2023 & 13.01.2024)

POSTGRADUATE PROGRAMME

CBCS-SEMESTER SYSTEM

(For those who join from 2023 to 2026)

An evolution towards revolution …

Education is crucial for attaining full human potential, developing an unbiased and evenhanded society and promoting national and global development. The education sector in India is witnessing a sweeping wave of change. The very first policy for education, *National Policy on Education* (NPE-1968) was promulgated in 1968, with the National Policy on Education (NPE-1986) following in 1986. The National Policy on Education (NPE- 1992) and the Programme of Action 1992 (POA-1992) refined and implemented the NPE-1986. The National Education Policy 2020 (NEP 2020) is a landmark document and an evolution towards revolution in the Indian educational sector. It presents the vision for greater access, equity, excellence, inclusion, multiple entry and exit and affordability to help India emerge as the global knowledge superpower.

Providing access to quality education is the key to the curriculum and syllabus of Scott Christian College (Autonomous), in terms of social justice and equality, scientific advancement, cultural preservation and national and global integration. Students should have the freedom and flexibility in choosing their courses, skills, and capacities to become moral, successful, innovative, adaptable, and productive human beings.

Higher education plays an important role in promoting human as well as societal wellbeing and in contributing towards sustainable livelihoods and economic development. The present Outcome-Based Education (OBE) curriculum and syllabus, provides valuable insights and recommendations on aspects of education that include moving towards multidisciplinary and holistic education, mastery and high-order learning and promotion of quality research.

The current curriculum has been designed based on NEP 2020, the National Credit Framework (NCrF), the National Higher Education Qualifications Framework (NHEQF) and Curriculum and Credit Framework for Undergraduate Programmes (CCFUP) which envisage that students must develop into good, thoughtful, well-rounded, creative individuals with a standard of achievement. The themed curriculum aims to support teachers and students in developing their understanding of the curriculum design and delivery process as per the requirement of the world of work.

Dr.Sidney Shirly
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PROFILE

DEPARTMENT OF BOTANY & RESEARCH CENTRE

A village-church school founded by Rev. W.T. Ringeltaube at Mylaudy in 1809 was shifted to Nagercoil in 1818 by Rev. C. Mead and elevated to Scott Christian College in 1893 by the indefatigable efforts of Rev. Dr. J. Duthie with a legacy of £ 1000 by Mr. Septimus Scott's family.

The present department of Botany evolved from the Biology department and became independent since June 1966 and Botany major was offered at the under-graduate level. In 1983, the department rose to post-graduate level and in 1986, it became a Research Department offering regular, part-time and sequential M.Phil. programmes. Since 1999, the department is recognised as a Research Centre by the Manonmaniam Sundaranar University to which the college is affiliated.

The department has a well-maintained library established in 1965 with a remarkable collection of reference books in addition to text books. Book bank facility is also offered in the library.

As an integral part of this library, there is a research library in memory of the late Dr. T.A. Davis which started functioning since 8th September 1999 and owes its existence to the indefatigable efforts of Dr. A. Deva Sobhana Raj. It has a collection of 18 current journals, 70 back volumes and 7 popular magazines. Visitors frequent this library.

The department also possesses a well-furnished tissue-culture laboratory and a micro-algal culture laboratory.

The Bryology Laboratory

The Bryology Laboratory, was founded on **9 January, 2009**, by **A.E. Dulip Daniels** with the grant that he received from the **Ministry of Environment and Forests** (MoEF), Government of India, New Delhi, through All India Co-ordinated Project on Taxonomy (AICOPTAX). The laboratory was recognised by the **Index Herbariorum**, New York Botanical Garden, USA, on **4 July, 2012** and bears the acronym '**SCCN**'. Currently, there are **15,000** holdings.

Newsletter

Since September 2001, the department publishes a quarterly Newsletter called '**Botanical Trends**'. Staff and students contribute articles to this missive. It also provides a detailed account of the various activities of the department under the head '**Diary of events**'. Guest articles are also published. The Newsletter is being sent to at least 25 different institutions free of cost.

UG and PG Associations

Both the associations are highly active and throw opportunities to students to enrich their existing knowledge by way of invited lectures and also by offering platforms to make scientific/popular presentations.

Tours and field trips

Both UG and PG students are regularly taken out on educational tours and short field trips for a practical learning and are made to submit reports on the trips with photographs and sometimes with herbarium specimens too.

The department offers quality education in botany by way of lectures, laboratory exercises, assignments, seminars and projects. It provides a curriculum competent with that of other universities in the country. The allotted strength of students for B.Sc. is 48, M.Sc. 30, M.Phil. 10 (Full-time) and 10 (Part-time).

The research areas of the faculty range from micro-algae to orchids and tissue culture of commercially valuable and indigenous plants thereby making the studies a biodiversity network. In the last five years the faculty have published 30 research articles in reputed national and international journals and have completed 1 major project, 1 minor project and 2 student's projects.

The faculty have produced 20 Ph.Ds. and 48 M.Phils. in the last five years.

Every year the department organizes at least two regional/national level seminars and two endowment lectures.

The department has a team of highly competent teachers ready to accept challenges in research and teaching.

Financial Assistance from U.G.C.

The department was selected by the U.G.C. for special financial assistance during the 8^{th}, 9^{th}, 10^{th}, 11^{th} and 12^{th} (Funds not yet released) plans. Moreover, a grant from **'Fund for Improvement of Science & Technology'** (FIST) grants of Rs. 4 Lakhs was sanctioned for the Dept of Botany.

Our Vision

To impart quality and effective information on recent developments in plant science

Our Mission

To be a high performing department that provides information resources to student life.

Members of the Board of Studies

The following members contributed to the framing of the Curriculum and the Syllabi in the Board of Studies held on 24.6.2023. The modified Curriculum and Syllabi were approved and recommended to be placed in the Academic Council.

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1.Dr. A.E. Dulip Daniels
2.Dr. M. Reginald
3.Dr. J. Lohidas
4.Dr. J. Irene Wilsy
5.Dr. B. Christudhas Williams
6.Dr. S. Thambiraj
7.Dr. S. Jeeva
8.Dr. C.P. Ben
9.Dr. V.P. Shamal
10.Dr. Avvai M.S. Vijaya
11.Dr. Lini, J.J.
12.Dr. T.S. Shynin Brintha

The Scott Christian College (Autonomous) defines the focus reinforcing its academic programmes and student life experience on campus through the Graduate Attributes (GA), that describe the knowledge, competencies, values and skills students imbibe for holistic development, multidisciplinary development and contribution to society. These attributes comprise characteristics that are transferable beyond the sphere of study into the national and international realm through curricular, co-curricular and extra-curricular engagements. They equip graduates for life long personal development and employment. Every Graduate of Scott Christian College (Autonomous) – (SCC) is desired to possess the following Graduate Attributes:

GA 1: Intellectual Competencies

Graduates of SCC

- have a comprehensive and incisive understanding of their domain of study as well as the ability for cross-disciplinary learning
- have the ability to apply the knowledge acquired through the curriculum as well as self-directed learning to a broad spectrum ranging from analytical thinking to synthesize new knowledge through research
- are able to have critical, independent and individual outlook regarding academic work and socially relevant issues

GA 2: Problem Solving

Graduates of SCC

- have the capacity to extrapolate from what has been learnt, translate concepts to real-life situations and apply acquired competencies in the required contexts to generate solutions to specific problems
- can view a problem or a situation from multiple perspectives and think ‘out of the box’ and generate solutions to complex problems in unfamiliar contexts

- are effective problems-solvers, able to apply critical, creative and evidence-based thinking to conceive innovative responses to challenges

GA 3: Communication Skills

Graduates of SCC

- listen carefully, analyse texts and research papers, and present complex information in a clear and concise manner
- express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media
- confidently express herself/himself and construct logical arguments using correct technical language related to a field of learning and area of professional practice

GA 4: Environmental Awareness

Graduates of SCC

- lessen the effects of environmental degradation, climate change, and pollution
- learn the nuances for cleanliness, conservation and wise use of resources so that it can be used for generations
- know the nuances of waste management, conservation of biological diversity, management of biological resources and biodiversity, and sustainable development and living

GA 5: Professional Ethics

Graduates of SCC

- develop principled and expert behavior, and this will be showcased in their chosen careers and constructive roles as citizens of the world at large
- imbibe intellectual integrity and ethics in scholarly engagement and develop a spirit of inclusiveness through interactions with diverse people at all levels in life
- acquire new knowledge and skills, including 'learning how to learn' skills, for pursuing learning activities throughout life and adapting to changing demands of the workplace through knowledge, skill development and reskilling, ethically

GA 6: Leadership Qualities

Graduates of SCC

- inculcate leadership qualities and attitudes, and team behaviour along autonomous lines through curricular, co-curricular and extra-curricular activities
- develop managerial and entrepreneurial skills to create new opportunities for diverse careers and gear up to take up competitive examinations
- acttogetherasagrouporateamintheinterestsofacommoncauseandworkefficientlyas a memberofateam

GA 7: Holistic Skill Development

Graduates of SCC

- develop critical thinking, problem-solving capacity, effective communication, and social skills
- are self-aware, flexible, resilient and have the capacity to accept and give constructive feedback and cope up with stress

- develop soft skills, e-skills and life skills to live, learn and work in the technically sound society globally and use appropriate digital methods for analysis of data

GA 8: Cross-Cultural Competencies

Graduates of SCC

- gain cross-cultural competencies through engaging with diverse linguistic, ethnic and religious communities and know how to understand, accept and appreciate individuals at local, national and international levels
- develop a global perspective through contemporary curriculum, culture, language and international exchange programmes
- acquire knowledge of the values and beliefs of multiple cultures and a global perspective to honour diversity, gender sensitivity and adopt gender-neutral approach and show empathy to the less advantaged and the differently-abled

GA 9: Community Engagement

Graduates of SCC

- are sensitive to social concerns and have conviction toward social justice through active social engagement
- are endowed with a strong sense of environmental awareness through the curriculum and a friendly and serene campus eco-system.
- Formulate an inspiring vision and build a team that can help achieve the vision, and motivate people to the right destination

GA 10: Value-Based Ethical Competency

Graduates of SCC

- are rooted in the principles of ethical responsibility and integrity permeated with Christian values, leading to the building of character and constitutional values
- develop virtues such as truth, love, courage, unity, integrity, brotherhood, industry and uprightness
- practiseresponsible national and global citizenship required for responding to contemporary challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, andsustainablesocieties

Learning Outcomes Descriptors for a Higher Education Qualification at Level 6 on the NHEQF

The Bachelor's degree (Honours/ Honours with Research) or the Post-Graduate Diploma is awarded to students who have demonstrated the achievement of the outcomes located at level 6 on the NHEQF.

Descriptors for qualifications at levels 6 on the NHEQF

Element of the Descriptor	NHEQF Level Descriptors
Knowledge and Understanding	The graduates should be able to demonstrate the acquisition of: ●advanced knowledge about a specialized field of enquiry, with depth in one or more fields of learning within a broad interdisciplinary context. ●a coherent understanding and awareness of the established methods and techniques of research and enquiry ●procedural knowledge required for performing and accomplishing professional tasks
General, Technical and Professional Skills	The graduates should be able to demonstrate the acquisition of: ●a range of cognitive and technical skills required for performing and accomplishing complex tasks required to undertake research to generate solutions to real-life problems ●generating solutions to complex problems independently, requiring the exercise of full personal judgement, responsibility, and accountability for the output of the initiatives taken as a practitioner ●apply advanced knowledge relating to research methods to carry out research and investigations to formulate evidence-based solutions to complex and unpredictable problems
Generic Learning Outcomes	The graduates should be able to demonstrate the ability to: ●communicate technical information and explanations, and the findings/ results of the research studies relating to specialized fields of learning and pursue self-paced and self-directed learning ●present in a concise manner one's views on the relevance and applications of the findings of research and evaluation studies in the context of emerging developments and issues. ●define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and-effect relationships
Constitutional, Humanistic, Ethical, and Moral Values	The graduates should be able to demonstrate the willingness and ability to: ●embrace and practice constitutional, humanistic, ethical, and moral values in professional practice and life. ●present coherent arguments in support of relevant ethical and moral issues and participate in actions to address environmental and sustainable development issues. ●follow ethical practices in all aspects of research and development,
Employability and Entrepreneurship Skills	The graduates should be able to demonstrate the acquisition of knowledge and skills required for: ●adapting to the future of work and to the demands of the fast pace of technological developments and innovations that drive a shift in employers' demands for skills ●managing complex technical or professional activities or projects ●should be willing to take a calculated risk and be open to new ideas
Credit Requirements	A Post-Graduate Diploma programme builds on a 3-year/6-semester bachelor's degree and requires a minimum of 40 credits for individuals who have completed a Bachelor's programme.

Entry Requirements	●An individual seeking admission to the bachelor's degree (Honours/ Honours with Research) in a specified field of learning would normally have completed all requirements of the relevant 3-year Bachelor's degree.

Learning Outcomes Descriptors for a Higher Education Qualification at Level 6.5 on the NHEQF

The Master's degree (e.g. M.A., M.Com., M.Sc., etc.) is awarded to students who have demonstrated the achievement of the outcomes located at level 6.5 on the NHEQF.

Descriptors for qualifications at levels 6.5 on the NHEQF

Element of the Descriptor	NHEQF Level Descriptors
Knowledge and Understanding	The graduates should be able to demonstrate the acquisition of: ● advanced knowledge about a specialized field of enquiry with a critical understanding of the emerging developments and issues relating to one or more fields of learning ● advanced knowledge and understanding of the research principles, methods, and techniques applicable to the chosen field of learning or professional practice, ● procedural knowledge required for performing and accomplishing complex, specialized and professional tasks relating to teaching, and research and development.
General, Technical and Professional Skills	The graduates should be able to demonstrate the acquisition of: ● advanced cognitive and technical skills required for performing and accomplishing complex tasks related to the chosen fields of learning. ● advanced cognitive and technical skills required for evaluating research findings and designing and conducting relevant research that contributes to the generation of new knowledge. ● specialized cognitive and technical skills relating to a body of knowledge and practice to analyze and synthesize complex information and problems.
Application of Knowledge and Skills	The graduates should be able to demonstrate the ability to: ● apply the acquired advanced theoretical and/or technical knowledge about a specialized field of enquiry or professional practice and a range of cognitive and practical skills to identify and analyze problems and issues associated with the chosen fields of learning. ● apply advanced knowledge relating to research methods to carry out research and investigations and to formulate evidence-based solutions to complex and unpredictable problems. ● develop appropriate tools for data collection for research

Generic Learning Outcomes	The graduates should be able to demonstrate the ability to: • communicate in a well-structured manner, technical information and explanations, and the findings/results of the research studies undertaken in the chosen field of study, • evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and address opposing viewpoints • pursue self-paced and self-directed learning to upgrade knowledge and skills, including research-related skills, required to pursue a higher level of education and research.
Constitutional, Humanistic, Ethical, and Moral Values	The graduates should be able to demonstrate the willingness and ability to: • embrace and practice constitutional, humanistic, ethical, and moral values in one's life and in the field of study and professional practice, • participate in actions to address environmental protection and sustainable development issues, • follow ethical principles and practices in all aspects of research and development, including inducements for enrolling participants and avoid unethical practices
Employability and Entrepreneurship Skills	The graduates should be able to demonstrate the acquisition of knowledge and skill sets required for: • adapting to the future of work and responding to the demands of the fast pace of technological developments and innovations that drive the shift in employers' demands for skills • transition towards more technology-assisted work involving the creation of new forms of work and rapidly changing work and production processes. • exercising full personal responsibility for the output of own work as well as for group outputs and for managing work that is complex and unpredictable requiring new strategic approaches.
Credit Requirements	• The 2-year/4-semester Master's programme builds on a 3-year/6-semester bachelor's degree and requires a total of a minimum of 80 credits from the first and second years of the programme, with a minimum of 40 credits in the first year and minimum of 40 credits in the second year of the programme at level 6.5 on the NHEQF.
Entry Requirements	• A 3-year Bachelor's degree for the 2-year/4-semester Master's degree programme (e.g. M.A., M.Com., M.Sc., etc.).

PLO & GA Mapping

Programme Learning Objective #	Programme Learning Objective (PLO)	Description of PLO	PLO Mapped with GA#
PLO 1	Learning Dispositions	Recognize and reflect on the production of knowledge in multiple spaces	GA 1 GA 8
		Develop the leadership capacity to negotiate intercultural learning spaces	GA 1 GA 6 GA 8
		Engage dialogically with distinct and/or intersecting intellectual communities to develop the scope of inquiry	GA 2 GA 3
PLO 2	Domain specific knowledge	Develop intensive and extensive knowledge and expertise in their respective domains	GA 1
		Formulate and extrapolate the knowledge gained to be applied in real– life situations, for self-directed learning and in competitive examinations	GA 1 GA 2 GA 3
		Evaluate and create domain specific knowledge in areas of learning, research and industry	GA 1 GA 2
PLO 3	Application oriented knowledge and diverse perspectives	Translate theoretical understanding to experimental knowledge for solving complex problems	GA 1 GA 3
		Ability to solve problems using pragmatic, alternative and creative approaches	GA 1 GA 2 GA 3 GA 5
		Capacity to apply advanced knowledge and approaches to solve concrete and abstract problems in domain-related and multi-disciplinary issues.	GA 1 GA 2
PLO 4	Innovation and research	Develop aptitude for innovation and entrepreneurship	GA 6
		Identify contemporary research problems, analyze data qualitatively and quantitatively and propose solutions	GA 1 GA 2 GA 9
		Create new ideas, analyze problems, diagnose them and identify their causes independently and/or in groups	GA 6 GA 7

PLO 5	Scientific communication skills	Document, prepare and present research work as reports and articles in academic forums	GA 6
		Critically assess, review and present theories and concepts	GA 1
		Take technically complex scientific topics and craft them into accessible, informative, and compelling content for specific audiences	GA 1 GA 2
PLO 6	Digital competency	Use domain-related advanced software resources, computational skills and digital tools for data analysis and interpretation	GA 2 GA 5
		Ethically apply digital skills to creatively communicate ideas and issues related to academic experiences	GA 5 GA 10
		Acquire the ability to leverage digital technologies to communicate, collaborate, and analyze data	GA 5
PLO 7	Ethical reasoning	Apply domain specific ethical principles and practices in academic, professional and social engagements	GA 1 GA 5
		Transform the behaviour of students to preserve public interest, the environment and be a source of help	GA 4 GA 5
		Being honest and taking responsibility for academic work and environmental sustainability	GA 4 GA 5
PLO 8	Comparative and interdisciplinary knowledge practices	Develop an interdisciplinary approach to research	GA 1 GA 7
		Compare scientific, social and historical phenomena in order to yield new insights	GA 1 GA 9
		Articulate how the complexities of social differentiation, like sex, gender, disability, race, ethnicity, nation, class, and such give insights and shape intellectual projects	GA 3 GA 5 GA 8 GA 9
PLO 9	Career readiness	Choose from diverse career options available in local, national and international realms.	GA 8
		Find success in workplace, manage one's career and apply the skills learned	GA 7
		Carry out further research or pursue higher education in the country or abroad	GA 1
PLO 10	Creating collaboration with the corporate world	Cultivate relationship with mentors and advisors, whose expertise and experience can assist in the development of work	GA 3 GA 7

		Recognize and reflect on the value, effectiveness, and ethics of collaboration in different settings and situations	GA 5 GA 9
		Produce new knowledge by working at the intersection of multiple disciplines and interdisciplinary fields	GA 1

METHODS OF ASSESSMENT

Remembering (K1)	•The lowest level of questions require students to recall information from the course content • Knowledge questions usually require students to identify information in the textbook
Understanding (K2)	• Understanding of acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words • The questions go beyond simple recall and require students to combine the ideas together
Application (K3)	•Students have to solve problems by using/applying a concept learned in the classroom •Students must use their knowledge to determine exact response
Analyze (K4)	•Analyzing the question by asking students to break down something into its component parts •Analyzing requires students to identify reasons, causes or motives and reach conclusions or generalizations
Evaluate (K5)	•Evaluation requires an individual to make judgment on something •Questions to judge the value of an idea, a character, a work of art, or a solution to a problem •Students are engaged in decision-making and problem–solving
Create (K6)	•The questions of this category challenge students to get engaged in creative and original thinking •Developing original ideas and problem solving skills

Cognitive Level (CL)

No.	Code	Cognitive Level
1	R	Remember
2	U	Understanding
3	Ap	Apply
4	An	Analyse
5	E	Evaluate
6	C	Create

Knowledge Category (KC)

No	Code	Knowledge
1	F	Factual
2	C	Conceptual
3	P	Procedural
4	M	Metacognitive

Learning Activities

A. Participative Learning

No	Code	Description
1	GD	Group Discussion
2	Sem	Seminar
3	Sl	Simulation

B. Cooperative Learning

No	Code	Description
1	Lec	Lecture

C. Problem Solving Method

No	Code	Description
1	Ess	Essay
2	SP	Solution to Problem

Assessment Task

No	Code	Description
1	MCQ	Multiple Choice Question
2	Ess	Essay
3	CA	Class Assignment
4	Qui	Quiz

METHOD OF EVALUATION

Written Examination: Theory Paper (Bloom'sTaxonomy based)
Question paper Model

1. **Testing Pattern (40+60)**

Internal - 40 marks
External - 60 marks

2. **Internal Assessment**

Theory Course: For theory courses there shall be three tests conducted by the faculty concernedand the average of the best two can be taken as the Continuous Internal Assessment (CIA) for amaximumof 25marks.The duration of each test shall be one/one and a half hour.

Laboratory Courses:

For Laboratory Courses, there shall be Continuous Internal Assessment Test and Record. One test in Laboratory part, attendance and class participation. The CIA for a maximum of 40 marks. The duration of each test shall be 4 hours.

Methods of Evaluation Practicals	
Continuous Internal Assessment Test	40 Marks
Attendance and Class Participation	
End Semester Examination	50 Marks
Record	10 Marks

There is no improvement for CIA of both theory and laboratory, and, also for University End Semester Examination.

PROJECT WORK & VIVA VOCE

Credits -3; Marks-100

Marks Distribution:

Internal - 40 Marks
External - 60 Marks
Thesis/Dissertation : 30 marks
Periodical presentation :15 Marks
Viva-voce :15 marks

CURRICULUM TABLE 2023-2026

Year	Semester	Module No.	Courses		Course code	Hours							Total Hours	Credits
						Lecture	Tutorial	Practical	Internship	Self-Learning	Demonstration	Research Project		
I	I	1.1	Core Course 1 -	Plant Diversity – I	23PB11	4		2					6	4
		1.2	Core Course 2 -	Plant Diversity – II	23PB12	4		2					6	4
		1.3	Core Course 3 -	Laboratory Course – I	23PBP1		4	2					6	4
		1.4	DSE - I	Microbiology, Immunology & Plant pathology	23PBEA	4	2						6	4
		1.5	DSE - I	Ethanobotany, naturopathy & traditional medicine	23PBEB	4	2						6	4
			Project											2
	II	2.1	Core Course - 4	Cell & Molecular Biology	23PB21	4		2					6	4

		2.2	Core course – 5	Plant Anatomy & Embryology of Angiosperms	23PB22	4		2					6	4
		2.3	Core Course - 6	Laboratory Course – 2	23PBP2		4	2					6	4
		2.4	DSE - 3	Research methodology, Computer Applications & Bioinformatics	23PBEC	4	2						6	4
		2.5	DSE - 4	Organic Farming	23PBN1	4	2						6	4
		2.6	Project										2	
II	III	3.1	Core Course – 7	Taxonomy of Angiosperms & Economic Botany	23PB31	4		2					6	4
		3.2	Core course – 8	Ecology, Phytogeography, Conservation Biology and Intellectual property rights	23PB32	4		2					6	4
		3.3	Core Course – 9	Laboratory Course – 3	23PBP3		4	2					6	4
		3.4	DSE – 5	Entrepreneurial opportunities in Botany	23PBED	4	2						5	4

		3.5	DSE - 6	Biotechnology	23PBEE	4	2						5	4
		3.6	Project									2	2	2
		3.7	Internship											4
II	IV	4.1	Core Course – 10	Plant physiology & Plant metabolism	23PB41	4		2					6	4
		4.2	Core course – 11	Biochemistry and Biophysics	23PB42	4		2					6	4
		4.3	Core Course – 12	Laboratory Course – IV	23PBP4	4	2						6	4
		4.4	DSE – 5	Biostatistics	23PBEF	4	2						6	4
		4.5	DSE - 6	Genetics and Plant Breeding	23PBEG	4	2						6	4
			Total										120	90

First Year
Semester - I
(Credit Level - 6.0)

List of Courses	Name	Credits	Credit Points	No. of Hours
Core Course (CC - 1)	Plant Diversity - I	4	24	6
Core Course (CC - 2)	Plant Diversity - II	4	24	6
Core Course (CC - 3)	Laboratory Course – I	4	24	6
Discipline Specific Elective (DSE - 1)	Microbiology, Immunology & Plant Pathology	4	24	6
Discipline Specific Elective (DSE - 2)	Ethnobotany, naturopathy & Traditional Healthcare	4	24	6
Project		2	12	-
	Total	**22**	**132**	**30**

Course Title: Core Course (CC) - 1 Plant Diversity - I

Course type: Theory + Practical

Subject Code: 23PB11

Total hours: 90 Hours/Week: 6 [Th.: 4 + P.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass % : 50 [No min. for Int.]

Course Creator
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Objectives: This course enables the students to

- learn the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.

➢gain knowledge on the ecological and economic importance of algae, fungi, lichens and bryophytes.
➢ spark interest in the evolutionary lines of plant development.
➢ study the diversity by describing the morphology and explaining the reproductive processes of algae, fungi and bryophytes.
➢exposethebeneficialandharmfulroles of algae, fungi, lichens and bryophytes.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Relate to the structural organizations of algae and compare the variations and life-cycle patterns in algae.	2[20]	1, 2, 3	R, U, E	F, C
CLO2	Demonstrate both the theoretical and practical knowledge in understanding the phylogeny and diversity of fungi and their importance.	2[20]	1, 2, 3	An, Ap	M, P
CLO3	Relate to the structural organizations of lichens and their uses.	2[20]	1, 2, 3	U, E	F, C
CLO4	Compare and contrast structural variations of gametophytes and sporophytes in bryophytes.	2[20]	1, 2, 3	An, E	M, P
CLO5	Discuss and develop skills for effective conservation and utilization of lower plant groups.	2[20]	1, 2, 3	An, E	C, M

Module	Course description	Hours	% CLO mapping with module	Learning activities	Assessment tasks	Reference
1	**ALGAE - General account**					
1.1	Range of thalli organization	1	1[10]	Lec	Sem	1,2,4
1.2	Algae of diverse habitats	1	1[10]	Lec	Ess	1,2,4
1.3	Life-cycle patterns and alternation of generations	2	1[10]	Lec	Ess	1,2,4

1.4	Salient features of major classes: Cyanophyceae, Chlorophyceae, Charophyceae	3	1[10]	Lec/Int	Sem	1,2,4
1.5	Xanthophyceae, Bacillariophyceae, Phaeophyceae	2	1[10]	Lec	Sem	1,2,4
1.6	Rhodophyceae. Phylogeny and inter-relationships of algae	2	1[10]	Lec	Sem	1,2,4
1.7	Contributions of Indian Phycologists: T.V. Desikachary, V. Krishnamurthy, M.O.P. Iyengar and V.S. Sundaralingam	1	1[10]	Lec	Ess	1,2,4,13
1.8	Structure, reproduction and life histories of the following genera: *Oscillatoria*, *Ulva*	2	1[10]	Lec	Ess	1,2,4
1.9	*Diatoms, Dictyota*	1	1[10]	Lec	Sem	1,2,4
1.10	*Polysiphonia*	1	1[10]	Lec	Ess	1,2,4
2	**FUNGI**					
2.1	General Characteristics, occurrence and distribution.	1	2[10]	Lec	Sem	9,10,12
2.2	Mode of nutrition in fungi	1	2[10]	Lec	Ess	9,10,12
2.3	Classification of Fungi by Alexopoulos and Mims (1979).	2	2[10]	Lec	Ess	
2.4	Phylogeny and inter-relationships of major groups of fungi	1	2[10]	Lec/Int	Sem	
2.5	Salient features of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.	3	2[10]	Lec	Sem	9,10,12
2.6	Heterothallism in fungi, sexuality in fungi, Para sexuality.	1	2[10]	Lec	Sem	9,10,12
2.7	Contributions of Indian Mycologists (C.V.Subramanian)	3	2[10]	Lec	Sem	9,10,12
2.8	Structure, reproduction and life histories of the following genera: *Aspergillus, Polyporus*	2	2[10]	Lec	Ess	9,10,12
2.9	*Plasmodiophora, Rhizopus*	1	2[10]	Lec	Ess	9,10,12
2.10	and *Colletotrichum*	1	2[10]	Lec	Sem	9,10,12
3	**LICHENS**					
3.1	Introduction and Classification (Hale, 1969).	2	3[20]	Lec	Sem	11
3.2	Occurrence and inter-relationship of phycobionts and mycobionts,	1	3[20]	Lec	Ess	11

3.3	Structure and reproduction in Ascolichens	1	3[20]	Lec	Ess	11
3.4	Basiodiolichens	1	3[20]	Lec/Int	Sem	11
3.5	and Deuterolichens.	1	3[10]	Lec	Sem	11
3.6	Structure, reproduction and life history of *Usnea*.	1	3[10]	Lec	Sem	11
4	**BRYOPHYTES**					
4.1	General characters and Classification of Bryophytes by Rothmaler (order level).	1	4[10]	Lec	Sem	3,15
4.2	Distribution, Structural variations of gametophytes and sporophytes in Hepaticopsida	1	4[10]	Lec	Ess	3,15
4.3	Anthoceropsida	1	4[10]	Lec	Ess	3,15
4.4	and Bryopsida.	1	4[10]	Lec/Int	Sem	3,15
4.5	Phylogeny of bryophytes.	1	4[10]	Lec	Sem	3,15
4.6	General characters of major groups - Marchantiales, Jungermaniales, Anthocerotales	1	4[10]	Lec	Sem	3,15
4.7	Sphagnales and Polytrichales.	1	4[10]	Lec	Ess	3,15
4.8	Structure, reproduction and life histories of the following genera: *Targionia, Porella*	2	4[10]	Lec	Ess	3,15
4.9	*Anthoceros*	1	4[10]	Lec	Sem	3,15
4.10	and *Polytrichum.*	1	4[10]	Lec	Ess	3,15
5	**ECONOMIC IMPORTANCE**					
5.1	Algae - Economic importance in Food and feed - Single cell protein	1	5[10]	Lec	Ess	1,2,4
5.2	Industrial products (Agar-Agar, Carrageenan, Alginic acid, Iodine	1	5[10]	Lec	Ess	1,2,4
5.3	biofertilizers, Vitamins and biofuel)	1	5[10]	Lec	Sem	1,2,4
5.4	Medicinal value and Diatomaceous earth.	1	5[10]	Lec	Ess	1,2,4
5.5	Fungi – Economic importance in food, industries and medicine.	1	5[10]	Lec	Ess	9,10,12
5.6	Lichens – economic importance and as indicator of pollution.	1	5[10]	Lec	Ess	11
5.7	Bryophytes – Ecological	1	5[10]	Lec	Sem	3,15
5.8	Industrial	1	5[10]	Lec	Ess	3,15
5.9	Horticultural	1	5[10]	Lec	Ess	3,15
5.10	and medicinal	1	5[10]	Lec	Ess	3,15

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18. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London.

Course Title: Core Course (CC) - 2 Plant Diversity - II

Course type: Theory + Practical

Subject Code: 23PB12

Total hours: 90 Hours/Week: 6 [Th.: 4 + P.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score % : 100 Int.: 40 Ext.: 60
Minimum Pass % : 50 [No min. for Int.]

Course Creator	Expert 1	Expert 2
S. Thampiraj **9385780553** minuthampi17@gmail.c	**Avvai M.S. Vijaya** **9488454201** avvaimsvijaya@gmail.com	**Dr. S. Karuppusamy (Assistant Professor)** **The Madura College, Madurai** **8838841004,** ksamytaxonomy@gmail.com

Objectives: This course enables the students to

- study the classification, distribution, characteristic features, structure, reproduction and life-history of the major types of Pteridophytes, their phylogeny and evolution and economic importance.

- study the structure, anatomy, reproduction and life-history of selected pteridophytes.
- study the classification, distribution, characteristic features, structure, reproduction and life-history of the major types of Gymnosperms and their economic importance.
- study the structure, anatomy, reproduction and life-history of selected Gymnosperms.
- learn the process of fossilization, characteristic features of selected fossils of Pteridophytes and Gymnosperms.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Recall classification, recent trends in phylogenetic relationship, general characters ofPteridophytes.	2[20]	1, 2, 3	R, U, E	F, M
CLO2	Learn the morphological/anatomical organization, life-history of major types of Pteridophytes.	2[20]	1, 2, 3	U, An	F, C
CLO3	Learn the morphological/anatomical organization, life-history of major types of Gymnosperms including economic importance.	2[20]	1, 2, 3	An, E	F, C
CLO4	Understanding the morphology and anatomy of selected Gymnosperms.	2[20]	1, 2, 3	U	F
CLO5	Awareness on fossil types, fossilization and fossil records of Pteridophytes and Gymnosperms.	2[20]	1, 2, 3	U, An	F, M

Module	Course description	Hours	% CLO mapping with module	Learning activities	Assessment tasks	Reference
1	**PTERIDOPHYTES - General account**					
1.1	General characteristics, Classification by K.R. Sporne	2	1[20]	Lec	Ess	1,2,3
1.2	Range of structure of sporophytes and gametophytes	3	1[20]	Lec	Ess	1,2,3
1.3	Life cycles, Apogamy, Apospory and, Heterospory and seed habit	3	1[30]	Lec	Sem	1,2,3
1.4	Stelar evolution	2	1[10]	Lec	Ess	1,2,3
1.5	Economic importance	2	1[20]	Lec	Ess	1,2,3
2	**PTERIDOPHYTES - Study of major groups**					
2.1	Structure, anatomy, reproduct- ion and life histories of the following genera: *Psilotum*	2	2[20]	Lec	Ess	1,2,3
2.2	*Selaginella*	3	2[20]	Lec	Ess	1,2,3
2.3	*Isoetes*	2	2[20]	Lec	Sem	1,2,3
2.4	*Pteris*	3	2[20]	Lec	Ess	1,2,3
2.5	and *Marsilea*	2	2[20]	Lec	Ess	1,2,3
3	**GYMNOSPERMS - General account**					
3.1	General characters, Classificat- ion (K.R. Sporne, 1965).	2	3[20]	Lec/ Sp	Ess	4,5,6
3.2	Morphology and anatomy of vegetative parts	2	3[20]	Lec/ Sp	Ess	4,5,6
3.3	reproduction – organization of male and female cones	3	3[20]	Lec/ Sp	Sem	4,5,6
3.4	development of male & female gametophytes, embryogeny.	3	3[20]	Lec/ Sp	Sem	4,5,6
3.5	Economic importance of Gymnosperms.	2	3[20]	Lec/ Sp	Ass	4,5,6
4	**GYMNOSPERMS - Study of major groups**					
4.1	Structure (Exomorphic and endomorphic), anatomy	2	4[20]	Lec/ Sp	Ess	4,5,6
4.2	reproduction & life histories of the following genera: *Cupressus*	3	4[20]	Lec/ Sp	Ess	4,5,6
4.3	*Araucaria*	2	4[20]	Lec/	Sem	4,5,6

				Sp		
4.4	*Podocarpus*	2	4[20]	Lec/ Sp	Sem	4,5,6
4.5	and*Gnetum*	3	4[20]	Lec/ Sp	Ass	4,5,6
5	**PALEOBOTANY**					
5.1	Geological Time Scale.	2	5[20]	Lec/ Sp	Ess	5,6,8
5.2	Contribution of Birbal Sahni to Paleobotany.	2	5[20]	Lec/ Sp	Ess	5,6,8
5.3	Methods of fossilization and fossil types. Economic importance of fossils – fossil fuels and industrial raw materials and uses.	3	5[20]	Lec/ Sp	Sem	5,6,8
5.4	Study of organ genera: *Rhynia, Lepidocarpon, Calamites*	3	5[20]	Lec/ Sp	Sem	5,6,8
5.5	*Cordaites*and *Lyginopteris*	2	5[20]	Lec/ Sp	Ass	5,6,8

References

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22.Bierhorst, D.W. 1969. Morphology of Vascular Plants. The Macmillan Co., New York.
23.Bierhorst, D.W. 1971. Paleobotany and Evolution. Praeger Publishing Co., U.S.A.
24. Graham, L.E. 1993. Origin of Land Plants. John Wiley & Sons. Inc. New York.

Course Title: Laboratory Course - I (Core paper 3) Covering theory papers I and II

Course type: Practical

Subject Code: 23PBP1

Total hours: 60 Hours/Week: 4 [Pract.: 3 + T.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 36
Total Score % : 100 Int.: 40 Ext.: 60
Minimum Pass % : 50 [No min. for Int.]

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Objectives: This course enables the students to

- learn how to employ the use of instruments, technologies and methodologies related to thallophytes and non-flowering plant groups. study the structure, anatomy, reproduction and life-history of selected pteridophytes.
- enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of algae, and fungi.
- comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.
- develop the technical abilities in staining, sectioning, sterilizing, and characterizing. thallophytes, and other varieties of non-flowering plants.
- compare the structural diversity of fossil and extant plant species.

CLO No.	**Course Outcome** *Upon completion of this course, the students will be able to*	**% of PLO Mapping with CLO**	**CLO & PLO Mapped with GA**	**Cognitive Level (CL)**	**Knowledge Category (KC)**
CLO1	Recall and apply the basic keys to distinguish algae at genus level based on its structural organization.	3[20]	1, 2, 3, 5	R, Ap	M, P
CLO2	Demonstrate practical skills in describing morphological and reproductive structures of fungi and lichens.	3[20]	1, 2, 3, 5	R, Ap	C, P
CLO3	Demonstrate practical skills in describing morphological and	3[20]	1, 2, 3, 5	R, U, Ap	M, P

	reproductive structures of Bryophytes.				
CLO4	Demonstrate practical skills in describing morphological and reproductive structures of Pteridophytes.	3[20]	1, 2, 3, 5	Ap	C, M, P
CLO5	Demonstrate practical skills in describing morphological and reproductive structures of Gymnosperms.	3[20]	1, 2, 3, 5	AN, Ap	P

Module	Course description	Hours	% CLO mapping with module	Learning activities	Assessment tasks	Reference
1	**ALGAE**					
1.1	External morphology and internal structure of the vegetative and reproductive parts of the following: *Oscillatoria*,	3	1[20]	Lec	Sem	1,6,9
1.2	*Scytonema,*	2	1[20]	Lec	Ess	1,6,9
1.3	*Ulva, Diatoms,*	3	1[30]	Lec	Ess	1,6,9
1.4	*Dictyota*	3	1[10]	Lec / Int	Sem	1,6,9
1.5	and *Polysiphonia*.	2	1[20]	Lec	Sem	1,6,9
2	**FUNGI**					
2.1	Study of morphological and reproductive structures of the following: *Plasmodiophora,*	3	2[20]	Lec	Ess	6,7,9
2.2	*Rhizopus,*	2	2[20]	Lec	Ess	6,7,9
2.3	*Polyporus*	2	2[20]	Lec	Sem	6,7,9
2.4	and *Colletotrichum*.	2	2[20]	Lec	Ess	6,7,9
2.5	**LICHENS** Study of morphological and reproductive structures of *Usnea*	3	2[20]	Lec	Ess	6,7,9
3	**BRYOPHYTES**					
3.1	External morphology and internal structure of the vegetative and reproductive organs of the following: *Riccia*,	3	3[20]	Lec	Ess	8,9,10
3.2	*Targionia,*	2	3[20]	Lec	Ess	8,9,10
3.3	*Plagiochasma,*	2	3[20]	Lec	Sem	8,9,10

3.4	*Plagiochasma, Porella*	2	3[20]	Lec	Ess	8,9,10
3.5	and *Pogonatum*	2	3[20]	Lec	Ess	8,9,10
4	**PTERIDOPHYTES**					
4.1	External morphology and internal structure of the vegetative and reproductive organs of the following: *Selaginella*,	3	4[20]	Lec	Ess	3,9,10
4.2	*Isoetes, Pteris*	2	4[20]	Lec	Ess	3,9,10
4.3	and *Marsilea*.	2	4[20]	Lec	Sem	3,9,10
4.4	Fossils: *Rhynia, Lepidodendron*	2	4[20]	Lec	Ess	3,9,10
4.5	*Lepidocarpon, Calamites.*	2	4[20]	Lec	Ess	3,9,10
5	**GYMNOSPERMS**					
5.1	External morphology and internal structure of the vegetative and reproductive organs of the following: *Cupressus*	3	5[20]	Lec	Sem	4,5,9
5.2	*Araucaria,*	2	5[20]	Lec	Ess	4,5,9
5.3	*Podocarpus*	2	5[20]	Lec	Ess	4,5,9
5.4	and *Gnetum*.	3	5[20]	Lec /Int	Sem	4,5,9
5.5	Fossils: *Cordaites* and *Lyginopteris*	3	5[20]	Lec	Sem	4,5,9

References

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10.Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.

Course Title: DSE - 1 Microbiology, Immunology & Plant Pathology

Course type: Theory + Practical

Subject Code: 23PBEA

Total hours: 90 Hours/Week: 6 [Th.: 4 + P.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score % : 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

Course Creator
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Expert 2
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Objectives: This course enables the students to

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

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Recognize the general characteristics of microbes, plant defense and immune cells.	4[20]	1, 2, 6	R, U	F, C
CLO2	Explain the stages in disease development and various defense mechanisms in plants and humans.	4[20]	1, 2, 6, 7, 9	An, E	C, M
CLO3	Elucidate concepts of microbial interactions with plant and humans.	4[20]	1, 2, 6, 7, 9	E	F, P
CLO4	Analyze the importance of harmful and beneficial microbes and immune system	4[20]	1, 2, 6, 7, 9	An	F, C
CLO5	Determine and interpret the detection of pathogens and appreciate their adaptive strategies.	4[20]	6, 7	E	F, M

Module	Course description	Hours	% CLO mapping with module	Learning activities	Assessment tasks	Reference
1	**BACTERIA**					
1.1	General characteristics of bacteria – Fine structure, cell wall and staining properties.	2	1[20]	Lec	Sem	2,3,5
1.2	Outline classification by Bergey's manual, 9th edition 1993.	3	1[20]	Lec/ Ch	Ess	2,3,5
1.3	Bacterial growth – batch culture and continuous culture. Growth Curve. Factors affecting growth.	3	1[20]	Lec	Ass	2,3,5
1.4	Determination of bacterial growth - Direct method: Haemocytometer, Viable plate count; Indirect method: Turbidity.	2	1[20]	Lec/ Ch	Ass	2,3,5
1.5	Reproduction - Fission and sporulation. Genetic recom- bination - Transformation, Transduction and Conjugation	2	1[20]	Lec/ Ch	Ess	2,3,5
2	**VIRUSES**					
2.1	General characters and fine structure.	2	1[20]	Lec	Ch	2,3,9
2.2	Overview of Phycoviruses and Mycoviruses.	3	1[20]	Lec	ESS	2,3,9
2.3	Viruses of Eukaryotes - Plant viruses (TMV).	2	1[20]	Lec/ Ch	ESS	2,3,9
2.4	Bacteriophages- classification, replication of DNA and RNA phages - Lytic and Lysogenic cycle.	3	1[20]	Lec	ESS	2,3,9
2.5	Viroids and prions.	2	1[20]	Lec	Sem	2,3,9
3	**ENVIRONMENTAL MICROBIOLOGY**					
3.1	Soil Microbiology: Importance of Microbial flora of soil.	2	2[20]	Lec	Sem	2,3,5
3.2	Interaction among soil microb- es (positive and negative interactions) and	2	2[20]	Lec	Ess	2,3,5
3.3	with higher plants (rhizosphere and phyllosphere).	3	2[20]	Lec	Ess	2,3,5
3.4	Microorganisms in organic matter decomposition.	3	2[20]	Lec/ Int	Sem	2,3,5
3.5	Microbiology of water and air. Water quality and waste water treatment.	2	2[20]	Lec	Sem	2,3,5
4	**IMMUNOLOGY**					
4.1	Introduction; Immune System; Types of Immunity - Innate and Acquired. Immune Cells - Hematopoiesis, B and T lymphocytes.	2	3[30]	Lec	Ess	10,11

4.2	Antigen: Definition, Properties and types. Antibody: Structure, types and function. Antigen - Antibody interactions: definit- ion, types- Precipitation, Aggl- utination, Complement fixation	3	3[20]	Lec	Ess	10,11
4.3	Immune Response - Humoral and Cell Mediated.	2	4[10]	Lec	Sem	10,11
4.4	Vaccines - types and recombi- nant vaccines.	2	4[10]	Lec	Ess	10,11
4.5	Immunodiagnosis - Blood Grouping, Widal test, Enzyme-Linked Immunosorbent Assay (ELISA), Immunoelectrophor- esis and Immunodiffusion.	3	4[30]	Lec	Ess	10,11
5	**PLANT PATHOLOGY**					
5.1	Classification of plant diseases - Symptomology,Principles of plant infection - Inoculum, ino- culum potential, Pathogenicity.	2	5[30]	Lec/ Sp	Ess	6,7,8
5.2	Disease triangle. Host-parasite interrelationship and interaction.	2	5[10]	Lec/ Sp	Ess	6,7,8
5.3	Causal agents of plant diseases - biotic causes (fungi, bacteria virus, mycoplasma, nematodes, parasitic algae, angiospermic parasites). Role of toxins in disease development.	3	5[20]	Lec/ Sp	Sem	6,7,8
5.4	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.	3	5[20]	Lec/ Sp	Sem	6,7,8
5.5	Principles of disease manage- ment - Physical, chemical and biological methods. Plant quar- antine and legislation. Integr- ated Pest Management system.	2	5[20]	Lec/ Sp	Ass	6,7,8

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Course Title: Discipline Specific Elective (DSE) - 2
Ethnobotany, naturopathy & Traditional Healthcare

Course type: Theory

Subject Code: 23PBEB

Total hours: 90 Hours/Week: 6 [Th.: 4 + T.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

Course Creator	Expert 1	Expert 2
S. Jeeva **9952202112** solomonjeeva@gmail.com	**T.S. Shynin Brintha** **9443452865** shyninb24@gmail.com	**Dr. M. Johnson (Associate Professor)** **St. Xavier's College, Palayamkottai** **9786924334**, ptcjohnson@gmail.com

Objectives: This course enables the students to

- be aware of the importance of the History of ethnobotany, its scope, concept and, sociological and anthropological aspects.
- understand the concept of ethnobotany and the life style and plants used by Indian tribals in their traditional practices.
- evaluate the various research techniques used to gather information on the knowledge of the tribal community.
- transform ethno botanical knowledge to health-care systems.
- use strategies to transform ethno botanical knowledge into goods with value additions.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Recall the History and concept of ethnobotany.	4[20]	1, 2, 9	R	C, M
CLO2	Understand the life style and the plants used in the traditional practices by Indian tribals.	4[20]	1, 2, 9	U, E	C
CLO3	Use various research methologies used to gather information on the knowledge of the tribal community.	4[20]	1, 2, 9	An, E	M, P
CLO4	To apply the ethno botanical knowledge in health-care systems.	4[20]	1, 2, 9	An, Ap	M, P
CLO5	Assess the methods to transform ethnobotanical knowledge into value added products.	4[20]	1, 2, 9	E	C, M, P

Module	Course description	Hours	% CLO mapping with module	Learning activities	Assessment tasks	Reference
1	**ETHNOBOTANY**					
1.1	History of ethnobotany	2	1[20]	Lec	Ess	5,6,19
1.2	Concept, scope, sub dis- ciplines of ethno botany.	3	1[20]	Lec	Ess	5,6,19
1.3	Knowledge of following sociological and anthro- pological terms: culture, values and norms,	3	1[20]	Lec	Ass	5,6,19
1.4	institutions, culture diffusion and	2	1[20]	Lec	Ass	5,6,19
1.5	ethnocentrism.	2	1[20]	Lec	Ass	5,6,19
2	**PLANTS USED BY TRIBALS OF TAMIL NADU**					
2.1	Traditional knowledge of following tribes of Ta -mil Nadu: Irulas, Kanis,	2	2[20]	Lec/Sp	MCQ	5,6,19
2.2	Paliyars, Badagas,	3	2[20]	Lec/Sp	MCQ	5,6,19
2.3	Kurumbers,	2	2[20]	Lec/Sp	MCQ	5,6,19
2.4	Thodas	3	2[20]	Lec/Sp	MCQ	5,6,19
2.5	and Malayalis.	2	2[20]	Lec/Sp	MCQ	5,6,19
3	**SOURCES OF ETHNOBOTANICAL DATA**					
3.1	Primary - archeological sources and inventories	2	3[25]	Lec/Sp	Q	5,6,16
3.2	Secondary - travelogues, folklore and literary sources, herbaria and medicinal texts.	2	3[25]	Lec/Sp	Q	5,6,16
3.3	Methods in ethnobotan- ical research - Prior Info -rmed Consent, PRA techniques, interviews and questionnaire meth- ods, choice of resource persons.	3	3[25]	Lec/Sp	Q	5,6,16
3.4	Folk taxonomy – plants associated with culture and	3	3[15]	Lec/Sp	Q	5,6,16
3.5	socio-religious activities	2	3[10]	Lec/Sp	Q	5,6,16
4	**NATUROPATHIC MEDICINE**					
4.1	Role of plants in naturo- pathy- Importance and relevance of medicinal drugs in India.	2	3[25]	Lec/Sp	Sem	1,2,3
4.2	Disease diagnosis treat- ment, and cure using natural therapies includ- ing dietetics,	3	3[25]	Lec/Sp	Sem	1,2,3
4.3	botanical medicine, hom -eopathy,	2	3[25]	Lec/Sp	Sem	1,2,3

	fasting, exerc- ise, lifestyle counseling, detoxification,					
4.4	and chelation, clinical nutrition, hydrotherapy, naturopathic manipulat- ion and spiritual healing.	2	3[10]	Lec/Sp	Sem	1,2,3
4.5	**Traditional healthcare:** Health practices, appro- aches, knowledge and beliefs incorporating pla - nt, mineral based med- icines, manual techniq- ues and exercises.	3	3[15]	Lec/Sp	Sem	1,2,3
5	**VALUE ADDITION**					
5.1	From folk Taxonomy to species confirmation	2	4[40]	Lec	Ess	6,7,14
5.2	- evidences based on phylogenetic and metabolomic analyses	2	4[40]	Lec	Ess	6,7,14
5.3	Ethno botanical databases and	3	4[10]	Lec	Ess	6,7,14
5.4	Traditional knowledge	3	4[5]	Lec	Ess	6,7,14
5.5	Digital Library (TKDL).	2	4[5]	Lec	Ess	6,7,14

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Semester - II
(Credit Level - 6.0)

List of Courses	Name	Credits	Credit Points	No. of Hours
Core Course (CC - 4)	Cell & Molecular Biology	4	24	6
Core Course (CC - 5)	Plant anatomy & Embryology of angiosperms	4	24	6
Core Course (CC - 6)	Laboratory Course - II	4	24	6
Discipline Specific Elective (DSE - 3)	Research methodology, Computer Application & Bioinformatics	4	24	6
Discipline Specific Elective (DSE - 4)	Organic Farming	4	24	6
Project		2	12	-
	Total	**22**	**132**	**30**

*Internship during the I year vacation

Course Title: Core Course (CC) - 4 Cell & Molecular Biology

Course type: Theory + Practical

Subject Code: 23PB21

Total hours: 90 Hours/Week: 6 [Th.: 4 + P.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score % :100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

Course Creator	Expert 1	Expert 2
S. Thampiraj **9385780553** minuthampi17@gmail.com	**Avvai M.S. Vijaya** **9488454201** avvaimsvijaya@gmail.com	**Dr. S. Karuppusamy (Assistant Professor)** **The Madura College, Madurai** **8838841004,** ksamytaxonomy@gmail.com

Objectives: This course enables the students to

- Enable to learn various cell structures and functions of the cellular organelles of prokaryotes and eukaryotes.
- To understand the cell division and its mechanism and anomalosity.
- To enlighten the students with contributions of the people on molecular biology.
- To comprehend the molecular processes.
- A thorough study of DNA structure, replication, transcription and translation processes.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Recall plant cell (prokaryotic & eukaryotic) structures and explain their functions	8[20]	1, 9, 7	R, U	C
CLO2	Illustrate and explain the structure of various cell organelles.	8[20]	1, 9, 7	R, Ap	F, M, P
CLO3	Explain the structure and functions of nucleic acids and the mechanism of Cell Cycle.	8[20]	1, 9, 7	E	F, M, P
CLO4	Compare and contrast the DNA replication (prokaryotes and eukaryotes), DNA sequencing.	8[20]	1, 9, 7	An, E	F, C
CLO5	Discuss and develop skills for DNA/gene manipulating and the enzymes involved.	8[20]	1, 9, 7	An, E, C	F, C

Module	Course description	Hours	% CLO mapping with module	Learning activities	Assessment tasks	Reference
1	**PROKARYOTIC AND EUKARYOTIC CELL - General account**					
1.1	Structural organization of plant cell - Cell wall - Structure and functions	2	1[20]	Lec	CA	1,3
1.2	Plasma membrane; structure, models (Fluid mosaic model) and functions	3	1[30]	Lec	Ess	1,2,3
1.3	Site for ATPase	3	1[10]	Lec	Ess	1,2,3
1.4	Ion carriers channels and pumps, receptors	2	1[20]	Lec	Ess	1,2
1.5	Plasmodesmata and its role	2	1[20]	Lec	Ess	1,2
2	**CELL ORGANELLES**					
2.1	Chloroplast - structure function and genome organization	2	2[20]	Lec/Sl	Sem	1,3,4
2.2	Mitochondria; structure, function and genome organization	3	2[20]	Lec/Sp	Sem	1,4
2.3	Plant Vacuole - Tonoplast membrane	2	2[20]	Lec/Sp	Sem	1,2
2.4	ATPases transporters as a storage organelle	3	2[15]	Lec/Sp	CA	1,2
2.5	Structure and function of Golgi apparatus, lysosomes, endoplasmic reticulum and microbodies	2	2[25]	Lec/Sp	CA	1,2,4
3	**NUCLEUS**					
3.1	Nucleus - Structure and function, nuclear pore, Nucleosome organization, euchromatin and heterochromatin	2	3[20]	Lec	Ess	2,9,10
3.2	Ribosome- Structure and functional significance. DNA Structure. A, B and Z Forms	2	3[20]	Lec	Ess	8,9,10
3.3	Protein synthesis - transcription, post transcriptional modification, RNA editing and translation	2	3[20]	Lec/Sp	Ess	4,5,6
3.4	DNA damage and repair (Thymine dimer, photoreactivation, excision repair)	2	3[15]	Lec/Sp	Ess	6,7
3.5	Cell cycle - role of cyclin dependent kinases, cytokinesis and cell plate formation	2	3[15]	Lec/Sp	Ess	2,5,9
3.6	Mechanisms of programmed cell death and Apoptosis	2	3[10]			2,7,10
4	**DNA REPLICATION**					
4.1	DNA replication (prokaryotes and eukaryotes)	2	4[20]	Lec/Sp	CA	9,10
4.2	Enzymes involved in DNA replication.	3	4[20]	Lec/Sp	CA	9,10
4.3	DNA sequencing – methods	2	4[20]	Lec/Sp	CA	9,10

4.4	cDNA and genomic library	2	4[20]	Lec/Sl	CA	9,10
4.5	Reverse transcription and overlapping genes	3	4[20]	Lec	CA	9,10
5	**GENE CLONING**					
5.1	DNA/gene manipulating enzymes: endonuclease, ligase, polymerase, phosphatase, transcriptase, transferase, topoisomerase	2	4[25]	Lec	CA	6,7
5.2	Gene cloning: cloning vectors, molecular cloning and DNA libraries	2	4[20]	Lec	Sem	6,7
5.3	Molecular genetic elements, insertion elements, transposons	3	4[15]	Lec	Sem	6,7
5.4	Recombinant DNA. Direct and indirect gene transfer.	3	4[20]	Lec	Sem	6,7
5.5	Detection of recombinant molecule, production of gene products from cloned genes.	2	4[20]	Lec	Sem	6,7

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Course Title: Core Course (CC) - 5 Plant anatomy & Embryology of angiosperms

Course type: Theory + Practical | **Subject Code: 23PB22**

Total hours: 90 Hours/Week: 6 [Th.: 4 + P.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

Course Creator	Expert 1	Expert 2
J. Lohidas **9443483496** lohiscott@yahoo.co.in	**C.P. Ben** **8072230521** ben.christal@gmail.com	**Dr. V. Manimekalai (Associate Professor)** **Sree Parashakti College for Women, Courtallam** **9487762072,** sehimaravi@gmail.com

Objectives: This course enables the students to

- Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants.
- Learn the importance secondary growth and anomalies; nodal anatomy.
- Understand the structure and development of male gametophyte.
- Understand the structure and development of female gametophyte.
- Understand the cause and importance of polyembryony, apomixes and parthenocarpy.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Explain the structures, functions and roles of apical *vs* lateral meristems in plant growth, organization of woody stems.	2[20]	1, 2, 3	R, An	F, C
CLO2	Highlight the importance of secondary growth and anomalies; nodal anatomy and stomatal types. Study the function and derived from secondary growth in dicot and monocot plants.	2[20]	1, 2, 3	An, E	F, M
CLO3	Explain the structure and functions of microsporangium.	2[20]	1, 2, 3	An, U, E	F, C, M
CLO4	Explain the structure and functions of megasporangium.	2[20]	1, 2, 3	An, E	F, C, M
CLO5	Profitably manipulate the process of reproduction in plants with a professional and entrepreneurial mindset.	2[20]	1, 2, 3	R, U, An	C, M, P

Module	Course description	Hours	% CLO mapping with module	Learning activities	Assessment tasks	Reference
1	**TISSUE SYSTEMS**					
1.1	Meristems: Classifications, Theories of shoot and root apices	2	4[20]	Lec	Ess	3,5
1.2	Vascular Cambium: Composition and organization – multiplicative and additive divisions	3	4[20]	Lec	Ess	3
1.3	Xylem: Primary and secondary xylem – tracheary elements and vessels – vesselless dicots – xylem rays and axial parenchyma of angiosperm wood	3	4[20]	Lec	Ess	3
1.4	Dendrochronology – grain, texture and figure in wood; reaction wood; ring porous and diffuse porous wood	2	4[30]	Lec	Ess	3
1.5	Phloem: Ultra structure of sieve tube elements and companion cell	2	4[10]	Lec	Ess	3
2	**SECONDARY GROWTH**					
2.1	Normal secondary thickening in Dicots	2	5[20]	Lec/ Sl	Sem	3,4
2.2	Anomalous secondary growth in Dicots (Aristolochiaceae, Bignoniaceae, Nyctaginaceae)	3	5[30]	Lec/ Sl	Sem	3,4
2.3	Secondary thickening in palms	2	5[20]	Lec/ Sl	Sem	3,4
2.4	Structure and types of Stomata	3	5[20]	Lec/ Sl	Sem	3,4
2.5	Major nodal types - Unilacun- ar, tri and multilacunar	2	5[10]	Lec	Ess	3,4
3	**MICROSPORANGIUM AND MALE GAMETOPHYTE**					
3.1	Structure of Anther	2	1[25]	Lec	Ess	1,2,4
3.2	Ultrastructure and function of tapetum	2	1[25]	Lec	Ess	1,2,4
3.3	Male gametophyte – structure and development	3	1[30]	Lec/ Sl	MCQ	1,2,4
3.4	Palynology: Morphology and ultrastructure of pollen wall, pollen kitt and pollen sterility.	3	1[20]	Lec	Ess	1,2,4
4	**MEGASPORANGIUM AND FEMALE GAMETOPHYTE**					
4.1	Structure and types of ovules	2	2[20]	Lec	Ass	1,2,4
4.2	Anomalous structures associated with ovule - Endo- thelium, obturator and aril	2	2[10]	Lec	Sem	1,2,4
4.3	Megasporogenesis: Female gametophyte: Structure and development (Polygonum type), haustorial behavior and Nutrition of embryo sacs	3	2[20]	Lec	Sem	1,2,4

4.4	Fertilization: Double and preferential fertilization and triple fusion	2	2[20]	Lec	Sem	1,2,4
4.5	Endosperm: Development of endosperm, types, physiol- ogical efficiency of endosperm haustoria and functions; Ruminate endosperm	2	2[10]	Lec	Ess	1,2,4
4.6	Embryogeny: Development of monocot (Grass) and dicot (Crucifer) embryos.	3	2[20]	Lec	CA	1,2,4
5	**POLYEMBRYONY**					
5.1	Causes of Polyembryony, classification, induction and practical application	3	3[30]	Lec	CA	1,2,4
5.2	Apomixis and its significance	2	3[20]	Lec	Ess	1,2,4
5.3	Seed and Fruit development and role of growth substances	4	3[20]	Lec	Ess	1,2,4
5.4	Parthenocarpy and its importance	3	3[30]	Lec	CA	1,2,4

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of Angiosperms. Regency Publications, New Delhi.

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Course Title: CC-6 Laboratory Course - II

Course type: Practical

Subject Code: 23PBP2

Total hours: 60 Hours/Week: 4 [Pract.: 3 + T.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 36
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

Course Creator	Expert 1	Expert 2
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Objectives: This course enables the students to

- Understand and develop skill to identify stages in mitosis and meiosis and interpret the different stages.
- Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants and techniques in staining.
- Understand the structure of anther, ovule, pollen morphology and germination, pollinium and endosperm structure, dissection of embryos at different stages.
- Learn to quantify plant species and estimate the various ecological parameters.
- Know about different vegetation types and their mapping.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	To gain recent advances in cell and molecular biology	3[20]	1, 2, 3	U, An	C
CLO2	Understand the different tissue organization in plants	3[20]	1, 2, 3	U	F, M
CLO3	Recall the structure, types of reproductive organs of plants and pollen germination	3[20]	1, 2, 3	R, E	F
CLO4	Analyze the various parameters that influence diversity of plants	3[20]	1, 2, 3	An	F, C, M
CLO5	Recognize and interpret maps representing the different vegetation types	3[20]	1, 2, 3	An, Ap	F, C

Course description	Hours	% CLO mapping with module	Learning activities	Assessment tasks	Reference
CELL AND MOLECULAR BIOLOGY					
Identification of different stages of mitosis and mitotic index from suitable plant material. (Onion root tips).	3	1[20]	Lec	Sem	1,6,9
Identification of meiosis from suitable plant material. (Tradeschantia/Rheo floral buds).	3	1[20]	Lec	Ess	1,6,9
Localization of nucleus and plant vacuole in Onion peel.	3	1[30]	Lec	Ess	1,6,9
Study of cyclosis in cells of *Hydrilla*	2	1[10]	Lec /Int	Sem	1,6,9
Restriction digestion of DNA samples using restriction endonucleases (RE).	3	1[10]	Lec	Sem	1,6,9
Separation of DNA using AGE	3	1[10]	Lec	Sem	1,6,9
ANATOMY					
Dissection of shoot apex - *Hydrilla*	3	2[20]	Lec	Ess	6,7,9
Observation of cambial types.	3	2[10]	Lec	Ess	6,7,9
Sectioning and observation of nodal types.	3	2[10]	Lec	Sem	6,7,9
Study of anomalous secondary growth of the following: STEM: *Nyctanthus, Aristolochia, Bignonia, Dracaena* ROOT: *Achyranthus*	3	2[20]	Lec	Ess	6,7,9
Observation of stomatal types by epidermal peeling.	3	2[20]	Lec	Ess	6,7,9
Maceration of wood and observation of the components of xylem.	3	2[10]	Lec	Ess	6,7,9
Double staining technique - differentiation of tissue components.	2	2[10]	Lec	Ess	6,7,9
EMBRYOLOGY					
Observation of T.S. of anther.	3	3[20]	Lec	Sem	8,9,10
Observation of ovule types.	3	3[20]	Lec	Ess	8,9,10
Observation of mature embryo sacs.	3	3[20]	Lec	Ess	8,9,10
Dissection and observation of embryos (globular and cordate embryos).	3	3[10]	Lec	Sem	8,9,10
Study of pollen morphology.	3	3[10]	Lec	Sem	8,9,10
Study of *in vitro* pollen germination.	3	3[10]	Lec	Sem	8,9,10
Observation of pollinium structure in *Calotropis*.	3	3[5]	Lec	Ess	8,9,10
Observation of endosperm types.	2	3[5]	Lec	Ess	8,9,10

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3.Panshin, A. J. and C. de Zeeuw. 1980. Textbook of wood technology. Structure, identification and uses of the commercial woods of the United States and Canada. Fourth Edition. New York: McGraw-Hill Book Company.
4.Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.
5.Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.
6.Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.

Course Title: Discipline Specific Elective (DSE) - 3 Research methodology, Computer Applications & Bio-informatics

Course type: Theory

Subject Code: 23PBEC

Total hours: 90 Hours/Week: 6 [Th.: 6 + T.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

Course Creator
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Objectives: This course enables the students to

- To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.
- To provide an overview on modern equipments that they would help students gain confidence to instantly commence research careers and/or start entrepreneurial ventures.
- To develop interdisciplinary skills in using computers in botany to learn about the biological database.
- Students aware with the most recent technologies for sequencing and bioinformatics analysis and is able to apply them to the structural and functional genomics of plants.
- Operate various software resources with advanced functions and its open office substitutes.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Realize the need of centrifuges and chromatography and their uses in research	6[20]	2, 5, 10	R, U	F, C
CLO2	Learn the principles and applications of electrophoresis.	6[20]	2, 5, 10	U, E	C, M
CLO3	Construct the phylogenetic trees for similar characteristic feature of plant genomes and study de novo drug design through synthetic biology.	6[20]	2, 5, 10	C, E	C, P, M
CLO4	Understand the concept of pairwise alignment of DNA sequences using algorithms.	6[20]	2, 5, 10	U, An	C, M
CLO5	Interpret the features of local and multiple alignments.	6[20]	2, 5, 10	An, E	C, M, P

Module	Course description	Hours	% CLO mapping with module	Learning activities	Assessment tasks	Reference
1	**METHODS IN RESEARCH**					
1.1	Methods in research; literature collection	2	1[20]	Lec	Ess	5,11,12
1.2	Citation; bibliography	2	1[20]	Lec	Sem	5,11,12
1.3	Project proposal writing– dissertation writing – paper presentation (oral/poster).	3	1[20]	Lec	Ass	5,11,12
1.4	E-learning tools, monograph	3	1[10]	Lec	Sem	5,11,12
1.5	Plagiarism- Standard operating procedure (SOP)	2	1[20]	Lec	Sem	5,11,12
1.6	Role of R & D institutions	2	1[10]	Lec	Sem	5,11,12
2	**PRINCIPLES AND TECHNIQUES**					
2.1	pH meter	2	2[10]	Lec	Ess	1,11,12
2.2	UV-visible spectrophotometer	2	2[20]	Lec	Ess	1,11,12

2.3	Centrifuge	2	2[10]	Lec	MCQ	1,11,12
2.4	Chromatography- TLC, Gas chromatography with mass spectrum (GC/MS), and HPLC	3	2[20]	Lec	Qui	1,11,12
2.5	Agarose gel Electrophoresis — Polyacrylamide Gel Electrophoresis	3	2[20]	Lec	MCQ	1,11,12
2.6	Principle and applications of SEM and TEM	2	2[20]	Lec	MCQ	1,11,12
3	**BIOINFORMATICS.**					
3.1	Introduction to computers and Bioinformatics	2	2[20]	Lec	Qui	3,4
3.2	Types of hardware, software and Operating systems	3	2[30]	Lec	MCQ	3,4
3.3	Fundamentals of networking, operation of networks, telnet, ftp, www, Internet	2	2[30]	Lec	Qui	3,4
3.4	Biological Research on the web: Using search engines (Google and Pubmed)	3	2[20]	Lec	MCQ	3,4
4	**BIOLOGICAL DATABASES**					
4.1	Public biological databases	2	3[25]	Lec	GD	3,4,7
4.2	Searching biological databases	2	3[25]	Lec	GD	3,4,7
4.3	Use of nucleic acid and protein data banks	3	3[25]	Lec	GD	3,4,7
4.4	NCBI, EMBL, DDBJ, SWISSPORT, PUBCHEM	3	3[25]	Lec	Q	3,4,7
5	**TOOLS AND TECHNIQUES**					
5.1	Protein prediction and Gene finding tools	3	4[20]	Lec	GD	4,7,9
5.2	Techniques in Bioinformatics	2	4[20]	Lec	GD	4,7,9
5.3	BLAST	2	4[10]	Lec	Sem	4,7,9
5.4	FASTA	2	4[30]	Lec	Sem	4,7,9
5.5	Multiple Sequence Analysis.	3	4[20]	Lec	GD	4,7,9

References

1.Veerakumari, L. 2017. Bioinstrumentation. MJP Publisher, India. p578.
2.SreeRamulu, V.S.1988. Thesis Writing, Oxford& IBH Pub. New Delhi.
3.Kothekar, V and T. Nandi. 2009. An introduction to Bioinformatics. Panima publishing crop, New Delhi.
4.Mani, K and N. Vijayaraj. 2004. Bioinformatics – A Practical Approach.1st Edn. Aparna publication, Coimbatore.
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6.Jayaraman, J. 2000. Laboratory manual of Biochemistry, Wiley Eastern Limited, New Delhi 110 002.
7.Pevsner, J. 2015. Bioinformatics and functional genomics. Hoboken, NJ: Wiley-Blackwell.

8.Arthur Conklin W.M and Greg White, 2016. Principles of computer security. TMH. McGraw-Hill Education; 4 edition.
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11.Mishra Shanthi Bhusan. 2015. Handbook of Research Methodology - A Compendium for Scholars & Researchers, Ebooks2go Inc.
12.Narayana, P.S.D. Varalakshmi, T. Pullaiah. 2016. Research Methodology in Plant Science, Scientific Publishers, Jaipur, Rajasthan.

Course Title: Discipline Specific Elective (DSE) - 4 Organic Farming

Course type: Theory

Subject Code: 23PBN1

Total hours: 90 Hours/Week: 6[Th.: 4 + T.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

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Objectives: This course enables the students to
- To study various aspects of organic farming.
- To understand the relevance of organic farming, its advantages and short comings against conventional high input agriculture.
- To know the importance of organic farming in the present scenario and its impact on environment and soil health.
- Awareness on the importance of organic farming in the present scenario and its impact on environment and soil health.
- Expose the students to about quality aspect and grading.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Know various aspects of organic farming	2[20]	1, 2, 3	U	C
CLO2	Understand the relevance of organic farming, its advantages.	2[20]	1, 2, 3	U, E	F, C, M
CLO3	Explain the short comings against conventional high input agriculture.	2[20]	1, 2, 3	An, E	M, C
CLO4	Compare the packaging methods of harvest.	2[20]	1, 2, 3	An	C, M
CLO5	Discuss and develop skills for post-harvest management.	2[20]	1, 2, 3	An, C, E	M, P

Module	Course description	Hours	% CLO mapping with module	Learning activities	Assessment tasks	Reference
1	**AGRONOMY**					
1.1	Organic farming - principles, characteristics, types, significance, scope of organic farming in India.	4	1[25]	Lec	Sem	1,6,8
1.2	Organic farming methods – for cereals, vegetables and fruit crops.	4	1[25]	Lec	Ess	1,6,8
1.3	Initiatives by Government /NGOs for promoting organic farming	4	1[25]	Lec	Ess	1,6,8
1.4	Operational structure of NPOP (National Programme for Organic Production)	3	1[25]	Lec	Ess	1,6,8
2	**SOIL SCIENCE**					
2.1	Organic farming for sustainable agriculture	3	2[20]	Lec	Ess	1,2,5,7
2.2	Manures - compost, methods of composting - Green manuring, vermicompost and biofertilizer	3	2[20]	Lec	Sem	2,4,10
2.3	Harmful effect of non-judicious chemical fertilization	3	2[20]	Lec	Sem	2,4,10
2.4	Quality parameters of organic manures and specifications - Soil fertility in organic farming systems	3	2[20]	Lec	Sem	2,4,10

2.5	Soil enrichment by microbes	3	2[20]	Lec	Sem	2,4,10
3	**FUNDAMENTALS OF ORGANIC FARM MANAGEMENT:**					
3.1	Land management in organic farming	4	3[20]	Lec	Ess	2,5,10
3.2	Water management in organic farming.	3	3[20]	Lec	Ess	2,5,10
3.3	Normal and abnormal seedlings	3	3[20]	Lec	Ess	2,5,10
3.4	Organic insect disease manag -ement Organic pest disease management	3	3[20]	Lec	Sem	4,9
3.5	Preventive and cultural methods for insects and pest control - Identification of different fungal and bacterial biocontrol agents	4	3[20]	Lec	Sem	4,9
4	**POST HARVEST MANAGEMENT**					
4.1	Processing of grapes, wheat, groundnut and sugarcane. Processing, labelling of organic produce - Storage and transport of organic produce	4	4[100]	Lec	Ess	6,8
5	**ORGANIC QUALITY CONTROL STANDARDS**					
5.1	Certification- types, process & procedure and agencies.	3	5[30]	Lec	Ess	3,6,7
5.2	Quality aspect and grading - Packaging and handling.	3	5[30]	Lec	Ess	3,6,7
5.3	Economic considerations and viability of organic products - Export of organic product and marketing	3	5[40]	Lec	Sem	3,6,7

References

1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services.
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6. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh
7. Tolanur, S. 2018. Fundamentals of Soil Science IInd Edition, CBS Publishers, New Delhi
8. Reddy, S.R. 2017. Principles of Organic Farming Kalyani Publishers, New Delhi
9. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.
10. Ahmad Mehraban. 2013. The Basis of Organic Fertilizers, LAP LAMBERT Academic Publishing.

Semester - III

(Credit Level - 6.5)

List of Courses	Name	Credits	Credit Points	No. of Hours
Core Course (CC - 7)	Taxonomy of Angiosperms & Economic Botany	4	24	6
Core Course (CC - 8)	Ecology, phytogeography, Conservation Biology and Intellectual property rights	4	24	6
Core Course (CC - 9)	Laboratory Course - III	4	24	6
Discipline Specific Elective (DSE - 5)	Entrepreneurial opportunities in Botany	4	24	6
Discipline Specific Elective (DSE - 6)	Biotechnology	4	24	6
Project		2	12	-
	Total	**22**	**132**	**30**

Course Title: Core Course (CC) - 7
Taxonomy of Angiosperms & Economic Botany

Course type: Theory + Practical

Subject Code: 23PB31

Total hours: 90 Hours/Week: 6 [Th.: 4 + P.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

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Objectives: This course enables the students to

- To be familiar with the basic concepts and principles of plant systematics.
- To develop a suitable method for correct characterization and identification of plants.
- To understand the importance of taxonomic relationships in research of plant systematics.
- To provide information on various classification systems.

➢To know about the economic importance of plants.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Recollect the basic concepts of morphology of leaves, flowers. Identify the types of compound leaves, inflorescence and fruits Describe their characteristic features	2[20]	1, 2, 3	R, An, E	C. F
CLO2	Explain the principles of taxonomy. Summarize the taxonomic hierarchy. Define Binomial nomenclature. Group Activity – Construction of key (Key preparation)	2[20]	1, 2, 3	E, C	F, M, P
CLO3	Explain the various types of classification. Distinguish its advantages and disadvantages. Construction of floral formula and floral diagram.	2[20]	1, 2, 3	U, E, C	F, M, P
CLO4	Illustrate and explain the characteristic features and list out the economic importance of the families Field trip to local botanical garden and regional botanical garden.	2[20]	1, 2, 3	C, An	F, C, M, P
CLO5	Illustrate and explain the characteristic features and list out the economic importance of the families.	2[20]	1, 2, 3	R, C, An	F, M, P

Module	Course description	Hours	% of CLO mapping with module	Learning activities	Assessment Tasks	Reference
1	**TAXONOMY AND SYSTEMATICS**					
1.1	Contributions to Indian Taxonomy by William Roxburgh, J.D. Hooker, Robert Wright, Nathanial Wallich and Gamble, J.S.	2	2[10]	Lec	Ess	5
1.2	Principles of classification as proposed - Artificial - Linnaeus	2	3[30]	Lec	Sem	1,2
1.3	Natural - Bentham and Hooker	2	3[30]	Lec/Sp	GD	1,2
1.4	Phylogenetic system - Hutchin- son, Modern - A.P.G. IV.	2	3[20]	Lec	Sem	1,2
1.5	Role of Botanical gardens and Botanical survey of India. Preparation and maintenance of Herbarium.	2	2[10]	Lec/Sp	Ass	4
2	**MODERN TRENDS IN TAXONOMY**					
2.1	Modern trends in taxonomy - chemotaxonomy, numerical taxonomy, and Molecular Taxonomy.	3	2[20]	Lec	Ess	1,2,3
2.2	ICN - binomial nomenclature, importance and principle.	3	2[10]	Lec	MCQ	1,2,3
2.3	Typification, principles of priority, effective and valid publication	2	2[20]	Lec/Sp	MCQ	1,2,3
2.4	Author citation, rejection, choice and retention of names.	2	2[30]	Lec	Ess	1,2,3
2.5	Taxonomic literature - Index Kewensis, Floras, Monographs and Revisions.	2	2[20]	Lec/Sp	CA	1,2,3
3	**DICOTYLEDONOUS FAMILIES**					
3.1	**Polypetalae** – Nympheaceae, Sterculiaceae	2	4[10]	Lec/Int	Sem	1,2
3.2	Capparidaceae, Portulaceae	2	4[10]	Lec	Sem	1,2
3.3	Rhamnaceae, Vitaceae	2	4[20]	Lec	Sem	1,2
3.4	Sapindaceae & Combretaceae	2	4[10]	Lec	Sem	1,2
3.5	**Gamopetalae -** Sapotaceae, Oleaceae	2	4[10]	Lec	CA	1,2,3
3.6	Boraginaceae, Scrophulariaceae	2	4[20]	Lec	Ess	1,2,3
3.7	Bignoniaceae, Convolvulaceae	2	4[10]	Lec	Sem	1,2,3
3.8	Acanthaceae & Verbenaceae	2	4[10]	Lec	CA	1,2

						,3
4	**MONOCHLAMYDEAE AND MONOCOTYLEDONOUS FAMILIES**					
4.1	**Monochlamydeae** – Nyctaginaceae, Piperaceae,	2	4[40]	Lec/Sp	GD	1,2 ,3
4.2	Aristolochiaceae & Casuarinaceae	2	4[10]	Lec/Sp	GD	1,2 ,3
4.3	**Monocots** – Orchidaceae	2	4[10]	Lec/Sp	GD	1,2 ,3
4.4	Amarylidaceae, Lilliaceae	2	4[20]	Lec/Sp	GD	1,2 ,3
4.5	Commelinaceae&Cyperaceae	2	4[20]	Lec/Sp	GD	1,2 ,3
5	**ECONOMIC BOTANY**					
5.1	General account on utilization of selected crop plants: (i) Cereals (rice and wheat) – (ii) Pulses (red gram and black gram)	2	5[20]	Lec/Sp	GD	6
5.2	(iii) Drug yielding plants (*Withamniasomnifera*and *Coleus aromaticus)* (iv) Oil yielding plants (Groundnut, sunflower).	2	4[20]	Lec/Sp	GD	6
5.3	(v) Sugar yielding plants (sugarcane and sugar beet), (vi) Spices and condiments (cardamom, cinnamon).	2	4[20]	Lec/Sp	GD	6
5.4	(vii) Commercial crops - fibre (jute), (viii) Timber (Teak and red sanders wood)	2	4[20]	Lec/Sp	GD	6
5.5	(ix) Resins and gums (Asafoetida and gum arabic) – (x) Essential oils (lemon grass and menthol)	2	4[10]	Lec/Sp	GD	6
5.6	(xi) Beverages (tea, coffee), (xii) Energy plantations - uses of *Casuarina.*	2	4[10]	Lec/Sp	GD	6

References

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2.Sharma, O.P. 2017. Plant Taxonomy. (II Edition). The McGraw Hill Companies.

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Course Title: Core Course (CC) - 8
Ecology, Phytogeography, Conservation Biology & IPR

Course type: Theory + Practical

Subject Code: 23PB32

Total hours: 90 Hours/Week: 6 [Th.: 6 + P.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

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Expert 2
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Objectives: This course enables the students to

- comprehend the fundamental ideas of plant ecology scientifically and to analyse the various components present.
- understand the concept of ecosystem and the various components.
- study the distribution of plants and its significance.
- study biodiversity management and conservation.
- enhance the knowledge of the students and equip them in evaluating and protecting invaluable components of nature.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Understand the scope and importance of population ecology and plant communities.	2[20]	1, 2, 3	U	C
CLO2	Understand the applied aspect of ecosystems, their resources and utilization.	2[20]	1, 2, 3	U, E	C, F
CLO3	Explain the distribution of plants and the factors responsible for distribution. GIS and its applications.	2[20]	1, 2, 3	E	C, M
CLO4	Explain biodiversity, its importance, threats to biodiversity and conservation of biodiversity.	2[20]	1, 2, 3	E	M, P
CLO5	Apply Intellectual Property Rights and its various components	2[20]	1, 2, 3	Ap, E	M, P

Module	Course description	Hours	% of CLO mapping with module	Learning activities	Assessment Tasks	Ref.
1	**ECOLOGICAL PRINCIPLES**					
1.1	Introduction – Basicconcepts of population	2	1[10]	Lec	Sem	1
1.2	Ecology population dynamics –Regulation of population density.	3	1[20]	Lec	GD	1
1.3	Basic concepts ofcommunity–characteristics, composition, structure, origin and development	3	1[30]	Lec	GD	1
1.4	Communitydynamics	2	1[10]	Lec	Sem	1
1.5	Trends of succession.	2	1[30]	Lec	GD	1
2	**ECOSYSTEMECOLOGY AND RESOURCE ECOLOGY**					
2.1	Introduction - kinds - major types	2	1[10]	Lec	Ess	1,3,5
2.2	Functional aspects of ecosystem	2	1[20]	Lec	Ess	1,3,5
2.3	Food chain and food web	2	1[20]	Lec	Sem	1,3,5
2.4	Energy flow, laws of thermodynamics.	2	1[20]	Lec	GD	1,3,5
2.5	Productivity–primary and secondary productivity –GPP&BPP.	2	1[10]	Lec	GD	1,3,5
2.6	**Resource Ecology:** Energy resources;	2	1[10]	Lec	Ess	1,3,5

	renewable and non-renewable.					
2.7	**Soil**: Formation, types and profile - erosion and conservation, water resources - conservation and management.	2	1[10]	Lec	Ess	1,3,5
3	**PHYTOGEOGRAPHY**					
3.1	Phytogeographical Zones - Vegetation types of India and Tamil Nadu.	2	2[20]	Lec	GD	4
3.2	Distribution: Continuous, Discontinuous and Endemism.	2	2[20]	Lec	Sem	4
3.3	Theories of discontinuous distribution	2	2[20]	Lec/ Sp	MCQ	4
3.4	Continental drift, Age and area hypothesis	2	2[20]	Lec	Sem	4
3.5	Geographical Information System (GIS) Principles of remote sensing and its applications	2	2[20]	Lec	Sem	6
4	**BIODIVERSITY AND CONSERVATION ECOLOGY**					
4.1	Definition, types of biodiversity – values of biodiversity – Hot spots	2	3[20]	Lec	CA	5
4.2	Threats to biodiversity: habitat loss. Poaching of wild life – Invasion of exotic species	3	3[30]	Lec	Ess	5
4.3	Man and wildlife conflicts	2	3[20]	Lec	CA	5
4.4	Red list categories of IUCN	2	3[10]	Lec	Ess	5
4.5	Plant conservation-*in situ* and *exsitu* methods.	3	3[20]	Lec	CA	5
5	**INTELLECTUAL PROPERTY RIGHTS**					
5.1	Intellectual Property Rights – Introduction	2	4[10]	Lec	Ess	12, 13
5.2	Kinds of Intellectual Property Rights- Patents, Trademarks, Copyrights, Trade Secrets.	2	4[30]	Lec	Ess	12, 13
5.3	Need for intellectual property right, Advantages and Disadvantages of IPR	3	4[20]	Lec	Ess	12, 13
5.4	International Regime Relating to IPR – TRIPS, WIPO, WTO, GATTS.	3	4[20]	Lec	CA	12, 13
5.5	Geographical Indication - Introduction, types.	2	4[20]	Lec	CA	12, 13

References

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 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.
7.Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge
8.University Press. ISBN. 978-1107114234.

9.Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and
10.Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
11.Ahuja, V.K. 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
12.Nithyananda, K.V. 2019. Intellectual Property Rights: Protection and Management. India, In: Cengage Learning India Private Limited.
13.Venkataraman M. 2015. An introduction to Intellectual property rights. Create space Independent Pub.North Charleston, USA.
14.Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
15.Gillson, L. 2015. Biodiversity Conservation and Environmental Change, Oxford University Press, Oxford.

Course Title: CC-9 Laboratory Course - III

Course type: Practical

Subject Code: 23PBP3

Total hours: 60 Hours/Week: 4 [Pract.: 3 + T.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 36
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

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Objectives: This course enables the students to

- Understand and develop skill sets in plant morphological, floral characteristics and artificial key preparation.
- Expedite skilled workers to carry out research in frontier areas of plant science.
- Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants
- Learn the importance of plant anatomy in plant production systems.

- Know about different vegetation sampling methods.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	To gain recent advances in plant morphological and floral characteristics.	3[20]	1, 2, 3, 5	U	C
CLO2	Understand the different floral characteristics and artificial key preparation which employed for plant identification and conservation.	3[20]	1, 2, 3, 5	U, E	F, C
CLO3	Recall or remember the information including basic and advanced in relation with plant anatomy and embryology.	3[20]	1, 2, 3, 5	R	M
CLO4	Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	3[20]	1, 2, 3, 5	R, Ap	C, P
CLO5	Know the different vegetation sampling methods.	3[20]	1, 2, 3, 5	An	C

Course description	Hours	% of CLO mapping with module	Learning activities	Assessment tasks	Reference
TAXONOMY AND ECONOMIC BOTANY OF ANGIOSPERMS					
Preparation of artificial keys. Description of a species, based on virtual herbarium and live specimens of the families mentioned in the theory.	5	1[20]	Lec	Sem	1,3,5
Description of a species, based on virtual herbarium and live specimens of the families mentioned in the theory.	5	1[20]	Lec	Ess	1,3,5
Study the products of plants mentioned in the syllabus	5	1[30]	Lec	Ess	1,3,5

of economic botany with special reference to the morphology, botanical name and family.					
Solving nomenclature problems.	5	1[10]	Lec	Sem	2,4,5
Field trip: A field trip at least 3-4 days to a floristically rich area to study plants in nature and field report submission of not less than 20 herbarium sheets representing the families studied.	5	1[20]	Lec	Sem	---
ECOLOGY					
Determination of the quantitative characters of a plant community by random quadrat method (abundance, density, dominance, species diversity, frequency) in grazing land, forests.	5	4[20]	Lec	Sem	3,6,7
To determine soil moisture, porosity and water holding capacity of soil collected from varying depth at different locations.	5	4[20]	Lec	Ess	3,6,7
Determination of pH of soil and water by universal indicator (or) pH meter.	5		Lec	Ess	4,5
Determination of dissolved oxygen.	5	4[20]	Lec	Ess	3,5,6
Estimation of carbonate	5	4[20]	Lec	Sem	3,6,7
Estimation of bicarbonate	5	4[20]	Lec	Ess	2,3,6
PHYTOGEOGRAPHY, CONSERVATION BIOLOGY &INTELLECTUAL PROPERTY RIGHTS					
Visit to remote sensing laboratory (at Anna University, Regional Meteorological Centre at Numgambakkam).	5	5[100]	Lec/Sp	CA	---

References

1.Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.

2.Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. NiraliPrakashan, 1st Edition. ISBN: 9351642062.

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5.Mann J. Davidson, R. S and J. B. Hobbs, D. V. Banthorpe, J. B. Harborne. 1994. *Natural Products*. Longman Scientific and Technical Essex.

6.Gopalan, C., B. V. Ramasastri and S. C. Balasubramanian. 1985. Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.

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8.Traditional plant medicines as sources of new drugs. P. J Houghton in Pharmacognosy. Trease and Evan's.16Ed.2009.

Course Title: Discipline Specific Elective (DSE) - 5 Entrepreneurial opportunities in Botany

Course type: Theory

Subject Code: 23PBED

Total hours: 90 Hours/Week: 6 [Th.: 4 + T.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

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Objectives: This course enables the students to
➢Understand the different classifications of horticultural crops, nursery management, and use of technology in horticulture.
➢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.
➢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.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Students can acquire knowledge on organic farming and their advantages.	5[20]	1, 2, 6	U, E	F, M
CLO2	Analyze both the theoretical and practical knowledge in understanding various horticultural techniques.	5[20]	1, 2, 6	An, Ap	C, M
CLO3	To develop kitchen garden or terrace garden in their living area.	5[20]	1, 2, 6	C, E	M, P
CLO4	Evaluate the horticultural techniques offered to students in order to develop self employment and economical improvement.	5[20]	1, 2, 6	E	F, C
CLO5	Create and develop skills for mushroom cultivation.	5[20]	1, 2, 6	C	P

Module	Course description	Hours	% of CLO mapping with module	Learning activities	Assessment Tasks	Reference
1	**ORGANIC MANURES AND FERTILIZERS**					
1.1	Organic manures and fertilizers	2	1[20]	Lec	Ess	7,8,9
1.2	Composition of fertilizer, NPK content of various fertilizers.	3	1[20]	Lec	Sem	7,8,9
1.3	Common organic manures bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost.	4	1[20]	Lec/ Sp	GD	7,8,9
1.4	Preparation of compost, aerobic and anaerobic - advantages.	3	1[20]	Lec	Sem	7,8,9
1.5	Vermicompost preparation, vermiwash. Panchakaviyam.	3	1[20]	Lec/ Sp	CA	7,8,9
2	**COMMON GARDEN TOOLS**					
2.1	Common garden tools	2	2[25]	Lec	Ess	7,8,9
2.2	Methods of plant propagation by seeds	2	2[25]	Lec	MCQ	7,8,9
2.3	Vegetative propagation, cutting, grafting, budding and layering	4	2[25]	Lec	MCQ	7,8,9

2.4	Use of growth regulators for rooting	3	2[25]	Lec	Ess	7,8,9
3	**GARDENING**					
3.1	Types of garden for marketing: ornamental, indoor garden, kitchen garden	3	3[20]	Lec	Sem	7,8,9
3.2	Terrace garden, vegetable garden.	3	3[20]	Lec	Sem	7,8,9
3.3	Rockery and artificial ponds	3	3[20]	Lec	Sem	7,8,9
3.4	Ornamental garden designing, garden components flower beds	3	3[20]	Lec	Sem	7,8,9
3.5	Borders, hedges, edges, drives, paths, garden adornments.	3	3[20]	Lec	CA	7,8,9
4	**PACKAGING AND PRESERVATION TECHNIQUES**					
4.1	Packaging of fruits and vegetables	3	4[30]	Lec/ Sp	GD	7,8,9
4.2	Preservation techniques drying, heat treatment, low temperature storage and by chemicals.	3	4[40]	Lec/ Sp	GD	7,8,9
4.3	Preparation of wine, vinegar and dairy products	3	4[30]	Lec/ Sp	GD	7,8,9
5	**MUSHROOMS**					
5.1	Significance of mushrooms	2	5[25]	Lec/ Sp	GD	4,6
5.2	Types of mushrooms (button mushroom, oyster mushroom)	2	5[25]	Lec/ Sp	GD	4,6
5.3	Spawn isolation and preparation. Cultivation	3	5[25]	Lec/ Sp	GD	4,6
5.4	Value added products from mushroom – pickles, candies and dried mushrooms.	3	5[25]	Lec/ Sp	GD	4,6

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1.Chmielewski, J.G. and Krayesky, D. 2013. General Botany 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.

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9.Peter, K.V. 2017. Basic Horticulture.

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12.Ignacimuthu, S.1998. Plant Biotechnology. Tata Mc Graw Hill Ltd., New Delhi.

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14.Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
15.Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

Course Title: Discipline Specific Elective (DSE) -6 Biotechnology

Course type: Theory + Practical

Subject Code: 23PBEE

Total hours: 90 Hours/Week: 6[Th.: 4 + P.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

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Objectives: This course enables the students to
➢Students should be familiar with the basics of genetics and molecular biology.
➢To develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels.
➢To learn the applied aspects of molecular biology and recombination technology, gene insertion and production of recombined new plants.
➢To impart knowledge that leads to comprehensive understanding of the principles, tools and practices of rDNA technology.
➢To enable students to gain basic understanding of rDNA techniques and its applications.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Understand the basics of recombinant DNA technology.	8[20]	1,7, 9	U	F, C
CLO2	Demonstrate and to recollect the production of vitamins.	8[20]	1,7, 9	C, E	C, M

CLO3	Analyze the production of antibiotics.	8[20]	1,7, 9	An	F, M
CLO4	Compare and contrast the recombined organism and natural organisms.	8[20]	1,7, 9	An, E	C, M, F
CLO5	Create and develop skills for rDNA techniques and in producing hybrids varieties.	8[20]	1,7, 9	C, An, Ap	M, P

Module	Course description	Hours	% of CLO mapping with module	Learning activities	Assessment Tasks	Reference
1	**RECOMBINANT DNA TECHNOLOGY**					
1.1	Recombinant DNA technology - Enzymes and vectors.	2	1[20]	Lec	Ess	1,3,5
1.2	Direct gene transfer - Electropor- ation, liposome mediated.	3	1[20]	Lec	Sem	1,3,5
1.3	Indirect gene transfer - Agrobacterium mediated.	4	1[20]	Lec /Sp	GD	1,3,5
1.4	Detection of recombinant molecule.	3	1[20]	Lec	Sem	1,3,5
1.5	Blotting techniques - Southern and Western. Genome library, cDNA library.	3	1[20]	Lec /Sp	Ess	1,3,5
2	**MECHANISM OF RECOMBINATION**					
2.1	Mechanism of recombination - role of recA and recBCD enzymes, chi-sequences	2	2[25]	Lec	Ess	1,3,5 ,
2.2	Site-specific recombination	2	2[25]	Lec	MCQ	1,3,5
2.3	Genetic markers - RAPD, ISSR, AFLP, SCAR and SAT-DNA,	4	2[25]	Lec /Sp	MCQ	1,3,5
2.4	PCRand Cloning techniques.	3	2[25]	Lec	Ess	1,3,5
3	**TRANSGENIC PLANTS**					
3.1	Transgenic Plants - Production of insect resistant (BT Cotton)	3	3[25]	Lec	Sem	3,5

3.2	Herbicide resistant plants (Glyphosate).	3	3[25]	Lec	Sem	3,5
3.3	Strategies for development of Golden Rice and Flavour Savr tomato.	3	3[25]	Lec /Sp	Sem	3,5
3.4	Terminated gene technology and molecular farming for production of pharmaceutical products.	3	3[25]	Lec	Sem	3,5
4	**INDUSTRIAL PRODUCTION**					
4.1	Industrial production of Vitamins and enzymes - Vitamin B12 and alpha amylase.	3	4[30]	Lec /Sp	GD	2,5
4.2	Production of antibiotic medicines: Penicillins and aminoglycosides.	3	4[30]	Lec /Sp	GD	2,5
4.3	Recombinant hormones: insulin (somatotrophin).	3	4[40]	Lec /Sp	GD	2,5
4.4	Vaccines - Hepatitis B vaccine.	2				2,5
5	**GENE SEQUENCING**					
5.1	Gene sequencing methods - Maxum and Gilbert	2	5[25]	Lec /Sp	GD	1,3,5
5.2	Sanger's chain termination method and Automated sequencing.	3	5[25]	Lec /Sp	GD	1,3,5
5.3	Genome - mitochondrial and chloroplast.	3	5[25]	Lec /Sp	GD	1,3,5
5.4	Regulating rDNA technology - patenting, IPR, bio-ethics and safety.	3	5[25]	Lec /Sp	GD	1,3,5

References

1. Neal Stewart, Jr. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications. JohnWiley&sons Inc.
2. Smith. J.K. 1996. Biotechnology – 3 rd Ed. Cambridge Univ. Press, Cambridge.
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5. Abdin, M.Z., Kiran, U., Kamaluddin, M., Ali, A. (Eds.). 2017. Plant Biotechnology: Principles and Applications, Springer publishers.
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10. Smith-Keary, P. 1991. Molecular Genetics. Macmillan Pub. Co. Ltd. London.

Semester - IV
(Credit Level - 6.5)

List of Courses	Name	Credits	Credit Points	No. of Hours
Core Course (CC - 10)	Plant Physiology & Plant Metabolism	4	24	6
Core Course (CC - 11)	Biochemistry & Biophysics	4	24	6
Core Course (CC - 9)	Laboratory Course – IV	4	24	6
Discipline Specific Elective (DSE - 7)	Biostatistics	4	24	6
Discipline Specific Elective (DSE - 8)	Genetics & Plant Breeding	4	24	6
	Total	**20**	**120**	**30**

Course Title: Core Course (CC) - 10 Plant Physiology & Plant Metabolism

Course type: Theory + Practical

Subject Code: 23PB41

Total hours: 90 Hours/Week: 6 [Th.: 4 + P.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

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Objectives: This course enables the students to

- To acquire knowledge on the functional aspects of plants.
- To understand the biophysical and biochemical processes of plants.
- To study the metabolism of plants.
- To learn the plant growth regulations.
- To know the adaptive mechanisms of plants in adverse environmental conditions.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Relate understand properties and importance of water in biological system, nutrients and its translocation	2[20]	1, 2, 3	U, E	C, M
CLO2	Demonstrate the importance of light in plant growth and the harvest of energy	3[20]	1, 2, 3, 5	An, C, E	F, C
CLO3	Explain the energy requirement and nitrogen metabolism.	2[20]	1, 2, 3	E	M, C
CLO4	Compare the various growth regulators that influence plant growth.	2[20]	1, 2, 3	An	F, M
CLO5	Discuss the senescence and plant response to environmental stress.	2[20]	1, 2, 3	U, An, E	F, C, M

Module	Course description	Hours	% of CLO mapping with module	Learning activities	Assessment Tasks	Reference
1	**WATER RELATIONS**					
1.1	Components of water potential - Plasmolysis - water absorption by roots – Apoplast and Symplast concept - water transport through the xylem.	3	1[25]	Lec	Sem	6,12, 13,14
1.2	Mineral nutrition – essential nutrients – macro and micro nutrients – defic- iencies and plant disorders – absorp- tion of solutes – translocation of solutes – pathways and mechanisms	4	1[25]	Lec	GD	6,12, 13,14
1.3	Phloem loading and unloading - translocation of photosynthates – source - sink relationship.	3	1[25]	Lec	Sem	6,12, 13,14
1.4	Transpiration - stomatal structure and function – mechanism of stomatal opening and closing.	3	1[25]	Lec	GD	6,12, 13,14

2	**PHOTOSYNTHESIS**					
2.1	Absorption and action spectra – photoreceptors	1	2[20]	Lec	Ess	6,12, 13,14
2.2	Photosynthetic Electron Transport and Photophosphorylation (cyclic and noncyclic)	3	2[20]	Lec	Ess	6,12, 13,14
2.3	Photosystems and reaction centres - Light Harvesting complexes - Photosystem I & II and Oxidation of Water	3	2[20]	Lec	Sem	6,12, 13,14
2.4	Carbon metabolism: C3, C4 and CAM pathways.	3	2[20]	Lec	GD	6,12, 13,14
2.5	Photorespiration and its significance. Brief account on enzyme RUBISCO	3	2[20]	Lec	GD	6,12, 13,14
3	**RESPIRATION**					
3.1	Respiratory Quotient (RQ), Glycolysis, TCA cycle.	2	3[20]	Lec	GD	6,12, 13,14
3.2	Electron Transport, oxidative phosphorylation, ATP synthesis.	3	3[20]	Lec	Sem	6,12, 13,14
3.3	Chemiosmotic Theory - Pentose Phosphate Pathway.	2	3[20]	Lec	MCQ	6,12, 13,14
3.4	AO respiration, Cyanide resistant respiration.	2	3[20]	Lec	Sem	6,12, 13,14
3.5	Nitrogen fixation (Biological - symbiotic and non-symbiotic), Physiology and Biochemistry of nitrogen fixation.	2	3[20]	Lec	Sem	6,12, 13,14
4	**GROWTH AND DEVELOPMENT**					
4.1	Phases of plant growth – growth types.	2	4[20]	Lec	CA	6,12, 13,14
4.2	Growth hormones – Physiological role, mode of action and applications of Auxins, gibberellins, cytokinins, abscisic acid, ethylene, brassinosteroids.	2	4[20]	Lec	Ess	6,12, 13,14
4.3	Photoperiodism – Classification of plants and mechanism of flowering.	2	4[20]	Lec	CA	6,12, 13,14
4.4	Phytochrome and their action on flowering – Vernalization- Mechanism and its practical application.	3	4[20]	Lec	Ess	6,12, 13,14
4.5	Seed dormancy and causes, methods to break dormancy.	2	4[20]	Lec	CA	6,12, 13,14
5	**STRESS PHYSIOLOGY**					
5.1	Abiotic and biotic – Adaptive mechanism to various stresses (avoidance, escape, tolerance).	2	5[20]	Lec	Ess	6,12, 13,14

5.2	Effects and mechanism of stress on plants – drought, cold, high temperature, UV radiation	2	5[20]	Lec	Ess	6,12, 13,14
5.3	Role of proline and molecular chaperones in stress.	2	5[20]	Lec	Ess	6,12, 13,14
5.4	Senescence and aging – Types and Mechanism of senescence.	3	5[20]	Lec	CA	6,12, 13,14
5.5	Abscission: Morphological and biochemical changes – Significance.	3	5[20]	Lec	CA	6,12, 13,14

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23.Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nd Edition). SpringerVerlag, New York, USA.

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Course title: Core Course (CC) - 11 Biochemistry & Biophysics

Course type: Theory + Practical

Subject Code: 23PB42

Total hours: 90 Hours/Week: 6 [Th.: 4 + P.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

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Objectives: This course enables the students to

- To study the fundamentals and significance of Plant Biochemistry.
- To know the structure and properties of plant biomolecules.
- To learn the fundamental and applications of Plant Biotechnology.
- To study the mechanism of enzyme action and inhibition.
- To expose the students on the fundaments of genetic transformation.

CLO No.	Intended Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Knowledge on the fundamentals and significance of Plant Biochemistry	2[20]	1, 2, 3	R, U	F, C
CLO2	Understanding on the structure and properties of plant biomolecules.	2[20]	1, 2, 3	U	F, C, M
CLO3	Explain the role of enzymes in plants.	2[20]	1, 2, 3	An, E	F, M
CLO4	Compare and contrast the methods of secondary metabolite production	2[20]	1, 2, 3	An, E	F, P, M
CLO5	Discuss and develop skills for effective utilization of plant enzymes and their role in biological cells.	2[20]	1, 2, 3	C, An	F, P, M

Module	Course description	Hours	% of CLO mapping with module	Learning activities	Assessment Tasks	Reference
1	**ATOMIC STRUCTURE**					
1.1	Chemical bonds - ionic bond, covalent bond, coordinate covalent bond, hydrogen bond	2	1[20]	Lec	Ess	1,2,3,7
1.2	Hydrogen ion concentration (pH), buffers.	2	1[20]	Lec	Ess	1,2,3,7
1.3	Henderson-Hasselbalch equation.	2	1[20]	Lec	Ess	1,2,3,7
1.4	Classification of carbohydrates - Structure and properties of monosaccharides, Oligosaccharides	2	1[20]	Lec	MCQ	1,2,3,7
1.5	Polysaccharides – Glycoproteins	2	1[20]	Lec	Qui	1,2,3,7
2	**BIOMOLECULES**					
2.1	Proteins: Structure, Classification and properties, Primary, secondary structure, Ramachandran plot, tertiary and quaternary structures.	3	2[40]	Lec	MCQ	1,2,3,7
2.2	Aminoacids - structure and properties	2	2[20]	Lec	Sem	1,2,3,7
2.3	Lipids: Classification, structure and properties of	3	2[40]	Lec	Ess	1,2,3,7

	fatty acids, phospholipids, glycolipids, lipoproteins, cholesterol					
3	**ENZYMES**					
3.1	Classification and nomenclature chemical nature of enzymes.	4	3[20]	Lec	Ess	1,2,3,7
3.2	Factors affecting enzyme action	2	3[10]	Lec	Sem	1,2,3,7
3.3	Michaelis–Menton constant	2	3[10]	Lec	Ess	1,2,3,7
3.4	Enzyme inhibition, co enzymes, isoenzymes.	2	3[20]	Lec	Ess	1,2,3,7
3.5	Vitamins – classification and properties.	3	3[20]	Lec	Ess	1,2,3,7
4	**SECONDARY METABOLITES**					
4.1	Structure, classification and properties of-alkaloids	3	4[25]	Lec	MCQ	1,2,3,7
4.2	Steroids, terpenoids, flavonoids.	3	4[25]	Lec	Ess	1,2,3,7
4.3	Glycosides	1	4[25]	Lec	CA	1,2,3,7
4.4	Synthesis through mevalonic acid and Shikimic acid pathway.	2	4[25]	Lec	Ess	1,2,3,7
5	**BIOPHYSICS**					
5.1	Thermodynamics principle, First Law of Thermodynamics a) energy (b) Enthalpy.	2	5[20]	Lec	Qui	16, 17
5.2	Second law of thermodynamics (a) Spontaneity and disorder (b) entropy (c) free energy.	2	5[10]	Lec	Sem	16, 17
5.3	Redox potential, dissociation and association constant, activation energy, binding energy.	3	5[10]	Lec	Sem	16, 17
5.4	Free energy and equilibrium constant	2	5[10]	Lec	Sem	16, 17
5.5	Calculation of equilibrium constant and free energy	2	5[10]	Lec	Ess	16, 17
5.6	High energy compounds	1	5[10]	Lec	Ess	16, 17
5.7	Redox reactions, oxidation potential and coupling of chemical reactions.	3	5[10]	Lec	Ess	16, 17
5.8	Electromagnetic spectrum, UV irradiation - applications.	3	5[10]	Lec	Sem	16, 17
5.9	Action and absorption spectrum - Fluorescence, Phosphorescence and Biolumiscence	2	5[10]	Lec	Ess	16, 17

References

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16.Philip Nelson 2003. Biological Physics: Energy, Information, Life, Pennsylvania University.
17.William Bialek 2011. Biophysics: Searching for Principles, Princeton University.

Course Title: CC-12 Laboratory Course - IV

Course type: Practical

Subject Code: 23PBP4

Total hours: 60 Hours/Week: 4 [Pract.: 3 + T.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 36
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

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Objectives: This course enables the students to

- Extract bimolecule of diverse nature from different sources so that they will be able to assessthe metabolic profile of their source material.
- Recognize the role that water plays in several physiological processes in plants.
- To learn the fundamental and applications of Plant Biotechnology.
- Learn about chromatographic techniques.
- Expose the students to gain recent advances in molecular biology.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Perform quantitative tests for all major macro molecules and file a report of chemical profile of a plant cell.	3[20]	1, 2, 3, 5	R, U, E	F, C
CLO2	Analyze the structure and properties of various enzymes.	3[20]	1, 2, 3, 5	An, E	F, M
CLO3	Understand the fundamentals of water and its relation to plants.	3[20]	1, 2, 3, 5	U	F, C
CLO4	Understand the role of pigment in photosynthetic mechanism and related events of plants.	3[20]	1, 2, 3, 5	U, E	F, C
CLO5	Evaluate the theory and practical skills gained during the course and create idea toseek for suitable job in relevant industries.	3[20]	1, 2, 3, 5	E, C	M, P

Module	Course description	Hours	% of CLO mapping with module	Learning activities	Assessment Tasks	Reference
1	**PLANT PHYSIOLOGY**					
1.1	Determination of osmotic potential by plasmolytic method.	4	1[20]	Lec	Ess	1,6,9
1.2	Stomatal index and stomatal frequency	3	1[20]	Lec	Sem	1,6,9
1.3	Chloride ion estimation	3	1[30]	Lec	GD	1,6,9
1.4	Effect of temperature and organic solvent on membrane permeability	4	1[30]	Lec	Ess	1,6,9
2	**PLANT PHYSIOLOGY**					
2.1	Ganong's Respiroscope	3	2[20]	Lec	MCQ	6,7,9
2.2	Absorption spectrum of chlorophyll	3	2[20]	Lec	Sem	6,7,9
2.3	Quantification of chlorophyll a & b.	3	2[30]	Lec	Sem	6,7,9
2.4	Experiment to study the rate of Hill activity of isolated chloroplast by dye-reduction.	4	2[30]	Lec	MCQ	6,7,9
3	**PLANT PHYSIOLOGY**					
3.1	Effect of temperature on protoplasmic	3	3[30]	Lec	GD	8,9,10

	membrane.					
3.2	Estimation of IAA.	3	3[40]	Lec	GD	8,9,10
3.3	Estimation of proline.	3	3[30]	Lec	GD	8,9,10
4	**BIOCHEMISTRY**					
4.1	Separation of chlorophyll pigments using paper chromatography	4	4[25]	Lec	Sem	3,9,10
4.2	Separation of aminoacids using TLC	3	4[25]	Lec	Sem	3,9,10
4.3	Estimation of proteins using Lowry's method	4	4[25]	Lec	MCQ	3,9,10
4.4	Estimation of carbohydrates by Anthrone method	4	4[25]	Lec	Sem	3,9,10
5	**BIOCHEMISTRY**					
5.1	Determination of nitrate reductase acivity.	3	5[30]	Lec	Sem	4,5,9
5.2	Alpha amylase activity in germinating seeds.	3	5[40]	Lec	Sem	6,7,8
5.3	Estimation of phenols	3	5[30]	Lec	Sem	10

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2Palanivelu, P. 2004. Laboratory Manual for an analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.

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12. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge.

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Course Title: Discipline Specific Elective (DSE) - 7 Biostatistics

Course type: Theory

Subject Code: 23PBEF

Total hours: 90 Hours/Week: 6 [Th.: 4 + T.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %:100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

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Objectives: This course enables the students to

- To provide the student with a conceptual overview of statistical methods.
- To emphasis on usefulness of commonly used statistical software for analysis, research, and experimentation.
- To understand and evaluate critically the acquisition of data and its representation.
- To gain the knowledge about the probability and statistical inference are all topics that will be taught in order to obtain knowledge about the graphical representation of data.
- To learn more about how to organize, create, and carry out the distribution of scientific knowledge.

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Create and interpret visual representations of quantitative information, such as graphs or charts	5[20]	1, 2, 6	C, E, An	F, C, P
CLO2	Solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods	5[20]	1, 2, 6	An, E	M, C
CLO3	Know the latest version using in statistical tools and apply the tools to interpret the results	5[20]	1, 2, 6	An, Ap, E	M, F, C
CLO4	Develop their competence in hypothesis testing and interpretation	5[20]	1, 2, 6	C, An, U	M, P
CLO5	Understand why biologists need a background in statistics	5[20]	1, 2, 6	U, E	F, C

Module	Course description	Hours	% of CLO mapping with module	Learning activities	Assessment Tasks	Reference
1	**INTRODUCTION TOSTATISTICS**					
1.1	Introduction to biostatistics and basic principles	3	2[40]	Lec	Ess	1,2,3
1.2	Variables - Collection of data, sample collection, representat- ion of Data - Primary and Secondary	3	3[30]	Lec	Sem	1,2,3
1.3	Classification and tabulation of Data - Diagrams, graphs and presentation.	4	3[30]	Lec/ Sp	GD	1,2,3
2	**DESCRIPTIVE STATISTICS**					
2.1	Mean, median and mode for continuous and discontinuous variables	5	2[50]	Lec/ Int	Ess	1,2,3
2.2	Measures of dispersion: Range of variation, standard deviation and standard error and coefficient variation.	5	2[50]	Lec/ Int	MCQ	1,2,3
3	**PROBABILITY AND PROBABILITY DISTRIBUTION**					
3.1	Basic principles - types - Rules of probability - addition and multiplication rules.	4	4[50]	Lec/ Int	Sem	1,2,3
3.2	Patterns of probability distribution; binomial - Poisson and normal.	4	4[50]	Lec/ Int	Sem	1,2,3
4	**HYPOTHESIS TESTING**					
4.1	Chi-square test for goodness of fit	3	4[25]	Lec/ Sp	GD	1,2,3
4.2	Null hypothesis	4	4[25]	Lec/ Sp	GD	1,2,3
4.3	Level of Significance - Degrees of Freedom	3	4[25]	Lec/ Sp	GD	1,2,3
4.4	Student ‘t’ test – paired sample and mean differences ‘t’ tests	4	4[15]	Lec/ Sp	GD	1,2,3
4.5	ANOVA. Basic introduction to Multivariate Analysis of Variance (MANOVA)	4	4[10]	Lec/ Sp	GD	1,2,3
5	**CORRELATION AND REGRESSION**					
5.1	Correlation - types of correlation - methods of study of correlation - testing the significance of the coefficients of correlation.	5	5[30]	Lec/ Sp	GD	1,2,3
5.2	Regression and types.	4	4[40]	Lec/ Sp	GD	1,2,3
5.3	Sampling and experimental designs of research- Randomized block design and split plot design.	5	4[30]	Lec/ Sp	GD	1,2,3

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13. Zar, J.K. 2011. Biostatistical Analysis, Fourth Edition, Prantice-Hall International, New Jersey, USA.

Course Title: Discipline Specific Elective (DSE) – 8 Genetics & Plant Breeding

Course type: Theory + Practical

Subject Code: 23PBEG

Total hours: 90 Hours/Week: 6 [Th.: 4 + P.: 2] Credits: 4

Pass-out Policy: Min. Contact Hours: 54
Total Score %: 100 Int.: 40 Ext.: 60
Minimum Pass %: 50 [No min. for Int.]

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Objectives: This course enables the students to

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

CLO No.	Course Outcome *Upon completion of this course, the students will be able to*	% of PLO Mapping with CLO	CLO & PLO Mapped with GA	Cognitive Level (CL)	Knowledge Category (KC)
CLO1	Understand the Mendal's Law of inheritance and gene interactions.	8[20]	1, 7, 9	U, E	F, M, C
CLO2	Analyze the various factors determining the heredity from one generation to another.	8[20]	1, 7, 9	An, E	F
CLO3	Explain Gene mapping methods: Linkage maps.	8[20]	1, 7, 9	E, U	F, C
CLO4	Interpret and explain the theories of evolution	8[20]	1, 7, 9	An, Ap	F, C
CLO5	Compare and contrast the genetic basis of breeding self and cross – pollinated crops.	8[20]	1, 7, 9	An, E	F, C, M

Module	Course description	Hours	% of CLO mapping with module	Learning activities	Assessment Tasks	Reference
1	**GENETICS**					
1.1	Mendal's Law of inheritance.	2	1[20]	Lec	Ess	1,3,5, 10
1.2	Gene interactions and modified dihybrid ratios – Complementary Genes and Epistasis.	2	1[20]	Lec	Sem	1,3,5, 10
1.3	Quantitative inheritance – Ear size in corn. Multiple allele inheritance – Self sterility in	3	1[20]	Lec /Sp	GD	1,3,5, 10

	Nichotiana					
1.4	Linkage and Crossing-over	2	1[20]	Lec	Sem	1,3,5, 10
1.5	Extra-Chromosomal Inheritance – maternal inheritance.	3	1[20]	Lec /Sp	CA	1,3,5, 10
2	**GENES**					
2.1	Structure of Gene, Operon. Polycistronic mRNA	3	2[20]	Lec	Ess	2,3,5, 10
2.2	Gene regulation in prokaryotes with reference to Lac operon and trp operon - Regulator, Promotor, Operator and Repressor.	3	2[30]	Lec	MC Q	2,3,5, 10
2.3	Gene Regulation eukaryotes – with special reference to regulation of flowering in *Arabidopsis*	3	2[10]	Lec	MC Q	2,3,5, 10
2.4	Transposable genetic elements: Ac element, transposase, transposon	2	2[20]	Lec	Ess	2,3,5, 10
2.5	Simple transposon, composite transposon, Is element. Transposons in *Zea mays*.	2	2[20]	Lec	CA	2,3,5, 10
3	**MUTATION**					
3.1	Mutation types – Frame-shift mutation, addition, deletion, substitution, inversion, transversion and transition.	3	3[30]	Lec /Sp	Sem	5,6,1 0
3.2	Xeroderma pigmentosum	1	3[10]	Lec	Sem	5,6,1 0
3.3	UV-induced mutation.	1	3[20]	Lec /Sp	Sem	5,6,1 0
3.4	DNA repair mechanism – mismatch mechanism.	2	3[10]	Lec	Sem	5,6,1 0
3.5	Chromosomal aberrations - types	2	3[30]	Lec	CA	5,6,1 0
4	**EVOLUTION**					
4.1	Natural selection – Darwin and theory of evolution.	2	4[25]	Lec /Sp	GD	22,23
4.2	Types of selection, genetic drift, gene flow, adaptation and convergence	3	4[25]	Lec /Sp	GD	22,23
4.3	Origin of genetic variations	2	4[25]	Lec /Sp	GD	22,23
4.4	Gene-environment interaction, population genetics	2	4[15]	Lec /Sp	GD	22,23
4.5	Origin of plants – early vascular plants and seed plants.	2	4[10]	Lec /Sp	GD	22,23
5	**PLANT BREEDING**					
5.1	Objectives of plant breeding, characteristics improved by plant breeding	3	4[25]	Lec /Sp	GD	7,8
5.2	Genetic basis of breeding self and cross – pollinated crops	3	4[25]	Lec /Sp	GD	7,8

5.3	Pure line theory, pure line selection	3	4[15]	Lec /Sp	GD	7,8
5.4	Mass selection and clonal selection methods	3	4[25]	Lec /Sp	GD	7,8
5.5	Hybridization, Genetics and physiological basis of heterosis	3	4[10]	Lec /Sp	GD	7,8

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