Holy Cross College (Autonomous), Nagercoil

Kanyakumari District, Tamil Nadu.

Accredited with A$^+$ by NAAC - IV cycle – CGPA 3.35

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF BOTANY

SYLLABUS FOR POSTGRADUATE PROGRAMME

TEACHING PLAN

EVEN SEMESTER 2025- 2026

Vision

To impart knowledge with professional zeal and devotion for plant science.

Mission

Providing student – centered and profession- oriented higher education that bestows academic environment to create intellectuals with scientific temperament, in the context of global issues and environmental challenges.

Programme Educational Objectives (PEOs)

PEOs	Upon completion of M. Sc. Botany Programme, the graduates will be able to:	Mapping with Mission
PEO1	apply scientific and computational technology to solve social and ecological issues and pursue research.	M1, M2
PEO2	continue to learn and advance their career in industry both in private and public sectors.	M4 & M5
PEO3	develop leadership, teamwork, and professional abilities to become a more cultured and civilized person and to tackle the challenges in serving the country.	M2, M5 & M6

Programme Outcomes (POs)

POs	Upon completion of M.Sc. Botany Programme, the graduates will be able to:	Mapping with PEOs
PO1	apply their knowledge, analyze complex problems, think independently, formulate and perform quality research.	PEO1 & PEO2
PO2	carry out internship programmes and research projects to develop scientific and innovative ideas through effective communication.	PEO1, PEO2 & PEO3
PO3	develop a multidisciplinary perspective and contribute to the knowledge capital of the globe.	PEO2
PO4	develop innovative initiatives to sustain ecofriendly environment	PEO1, PEO2
PO5	through active career, team work and using managerial skills guide people to the right destination in a smooth and efficient way.	PEO2

PO6	employ appropriate analysis tools and ICT in a range of learning scenarios, demonstrating the capacity to find, assess, and apply relevant information sources.	PEO1, PEO2 & PEO3
PO7	learn independently for lifelong executing professional, social and ethical responsibilities leading to sustainable development.	PEO3

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Program Specific Outcomes (PSO)	
On successful completion of the M.Sc. Botany programme, the students are expected to	
PSO1	familiarize with the fundamental, advanced and emerging concepts in Botany.
PSO2	understand the role of plants and their interactions with other organisms in variousecosystems.
PSO3	identify the potency of plant resources in contemporary research and visualize futurethrust areas in Botany.
PSO4	design scientific experiments independently and to generate useful information toaddress various issues in Botany.
PSO5	acquire basic knowledge on principles and applications of laboratory instruments andadequate skills to handle them.
PSO6	choose and apply appropriate tools, techniques, resources, etc. to perform variousexperiments in Botany.
PSO7	carryout scientific experiments independently or in collaboration with inter-disciplinary or multidisciplinary approaches.
PSO8	disseminate knowledge on conservation of biodiversity and protection of environment.
PSO9	awareness on the sustainable utilization of plant/microbial resources following thebioethical norms.
PSO10	demonstrate proficiency in communicating with various stakeholders like students,teachers, scientists and society.

SEMESTER – II

PG BOTANY

TEACHING PLAN –EVEN SEMESTER

Department : Botany
Class : I M.Sc. Botany
Title of the Course : Taxonomy of Angiosperms and Economic Botany
Semester : II
Course Code : BP232CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232CC1	2	3	-	-	4	5	75	25	75	100

Learning Objectives

1. To be familiar with the basic concepts and principles of plant systematic.
2. To develop a suitable method for correct characterization and identification of plants.

Course Outcomes

On completion of this course, the students will be able to:		
1	recollect the basic concepts of morphology of leaves, flowers. identify the types of compound leaves, inflorescence and fruits describe their characteristic features	**K1, K2 K3**
2	explain the principles of taxonomy. summarize the taxonomic hierarchy. define binomial nomenclature. group activity – construct key preparation	**K1, K2 K5, K6**
3	explain the various types of classification. distinguish its advantages and disadvantages construction of floral formula and floral diagram.	**K1, K2 K3, K4**
4	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.	**K1, K2 K3, K4**
5	illustrate and explain the characteristic features and list out the economic importance of the families.	**K1, K2 K3, K5**

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**1**	Botanical exploration and contribution with special reference to India by William Roxburgh, J.D. Hooker, Robert Wright, Nathanial Wallich and Gamble, J.S.	2		K1(R)	Brainstorming	Participative learning Brainstorming	E-content – MS Word	Oral test
	2	Principles of classification as proposed – Artificial – Linnaeus	3	2	K1(R)	Brainstorming	Participative learning Brainstorming	Interactive PPT	Oral test
	3	Natural – Bentham and Hooker	2		K2(U	Integrative teaching	Participative learning Describing using charts	Youtube videos	Slip test

	4	Phylogenetic system - Hutchinson, Modern – Takhtajan.	3		K2(U	Context based	Experiential learning Powerpoint presentation	Interactive ppt	Formative Assessment
	5	Botanical gardens and herbaria of world, preparation and maintenance of Herbarium, Botanical survey of India – its organization and role.	3		K2(U	Inquiry based approach	Participative learning Assignments	E-Content-MS Word	Surprize test
II	**1**	Modern trends in taxonomy, chemotaxonomy, numerical taxonomy, biosystemics.	2		K3(Ap)	Constructivism	Participative learning Skit and role play, Describing using charts	Self prepared videos,	Formative assessment
	2	ICBN uninominal systems- genesis binomial nomenclature, importance and principle.	3	**2**	K3(Ap)	Collaboration	Problem solving methodologies Group discussion	E-content – external links	Quiz questioning in classroom
	3	Important articles, typification.	2		K4(An)	Cooperative learning	Problem solving methodologies Lateral thinking	Lecture Clips	Oral presentation
	4	principles of priority, effective and valid publication, author citation, recommendations	3		K4(An)	Simulation	Participative learning Student administration	Interactive PPT	Online Assignment

		and amendents of code.							
	5	Glossories and dictionaries, Taxonomic literature (Index Kewensis)	3		K4(An)	Context based	Participative learning Analyze problem situations, Group discussion	Youtube videos	Multiple choice questions, CIA
III	**1**	Polypetalae – Nympheaceae, Sterculiaceae.	**3**	**3**	K4(An)	Lecture	Participative learning Student administartion		Student presentation
	2	Portulaceae, Rhamnaceae	**3**		K4(An)	Lecture method	Describing visual images	Youtube videos	Class test, assignments
	3	Vitaceae, Sapindaceae.	**3**		K3(Ap)	Demonstrative	Experiential learning Basic and advanced lab experiments	O lab	Formative assessment
	4	Combretaceae, Turneraceae.	**3**		K3(Ap)	Flipped classroom	Experiential learning Making model	Virtual lab simulations	Google forms

IV	**1**	Gamopetalae – Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae.	2	**2**	K2(U	KWL(what do you know/want to know/what did you learn)	Participative learning Student presentation	Powerpoint presentations	Oral presentation, Class test
	2	Bignoniaceae, Convolvulaceae, Acanthaceae, Verbenaceae.	3		K4(An)	Simulation	Participative learning Analyse problem situations	Lecture clips	Slip test, oral test
	3	Monochlamydeae – Nyctaginaceae, Aristolochiaceae, Casuarinaceae.	2		K4(An)	Simulation	Participative learning Using visual images	MS word	Online assignment
	4	Monocots – Orchidaceae, Amarylidaceae,	3		K5(Ev)	Integrative learning	Experiential learning Powerpoint presentation	Interactive PPT	Presentation
	5	Lilliaceae, Commelinaceae, Cyperaceae.	3		K5(Ev)	Simulation	Experiential learning Powerpoint presentation	Interactive PPT	CIA, class test
V	**1**	General account on utilization of selected crop plants: (i) Cereals (rice and wheat) – (ii) Pulses (red gram	2	**2**	K3(Ap)	Context based	Participative learning Preparing and demonstrating exhibits	-	Quiz questioning in classroom

		and black gram).							
	2	(iii) Drug yielding plants (*Withania somnifera* and *Coleus aromaticus*) (iv) Oil yielding plants (Groundnut, sunflower). (v) Sugar yielding plants (sugarcane and sugar beet).	3		K3(Ap)	Context based	Participative learning Describing using charts	MS Word	Multiple choice questions
	3	(vi) Spices and condiments (cardamom, cinnamon). (vii) Commercial crops - fibre (jute).	2		K3(Ap)	Simulation	Participative learning Chart presentation	Online vise os	Presentation, CIA
	4	(viii) Timber (Teak and red sanders wood), (ix) Resins and gums (Asafoetida and gum arabic) – (x) Essential oils (lemon grass and menthol).	3		K3(Ap)	Integrative learning	Participative learning Chart presentation, Model making		Online assessment
	5	(xi) Beverages (tea, coffee), (xii) Plants used as avenue trees for shade, pollution control and aesthetics	3		K5(Ev)	Inquiry based learning	Participative learning Chart presentation	Lecture clips	Oral test, Summative assessment

		(xiii) Energy plantation - uses of Casuarina.							

ourse Focussing on Employability/ Entrepreneurship/ Skill Development : Employability

ctivities (Em/ En/SD): Field Visit

ourse Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Environment Sustainability

ctivities related to Cross Cutting Issues : -

ssignment : Botanical gardens and herbaria of world

eminar Topic: Energy plantation - uses of Casuarina.

ample questions

art A

Who is known as the "Father of Indian Botany" for his major botanical explorations in India? **(**K1, CO 1)

What is chemotaxonomy and how does it help in plant classification? **(**K2, CO 2)

Apply any one diagnostic morphological feature to identify a member of the family Portulaceae**. (**K3, CO 3)

Analyze the floral characters and identify one feature that distinguishes Oleaceae from Boraginaceae**. (**K4, CO 4)

Evaluate and state which among the two—rice or wheat**—**is more suitable for cultivation under water-logged conditions, giving one reason. **(**K5, CO 5)

Part B

1. Describe the contributions of William Roxburgh, J.D. Hooker, and Nathaniel Wallich to botanical exploration in India. **(**K1, CO 1)
2. Explain numerical taxonomy and biosystematics, highlighting how each contributes to modern plant taxonomy. **(**K2, CO 2)
3. Using floral characters, classify a given specimen into its appropriate family among Sterculiaceae, Vitaceae**. (**K3, CO 3)
4. Analyze and differentiate the key morphological and reproductive characters of Acanthaceae**,** Scrophulariaceae, and Bignoniaceae. **(**K4, CO 4)
5. Evaluate the economic significance of drug-yielding plants (Withania somnifera and Coleus aromaticus). **(**K5, CO 5)

Part C

. Explain the major systems of plant classification: Artificial (Linnaeus), Natural (Bentham & Hooker). Add a note on the role and organization of the Botanical of India. **(**K1, CO 1)

2. Describe the key components of the International Code of Botanical Nomenclature (ICBN), including typification, principles of priority, effective and valid public and author citation. **(**K2, CO 2)
3. Apply systematic criteria to compare and analyze the families Nymphaeaceae, Rhamnaceae, Combretaceae, and Turneraceae based on their morphological, floral, reproductive characters. **(**K3, CO 3)
4. Discuss their diagnostic floral structures, ovary position, inflorescence patterns, fruit types, and vegetative adaptations. **(**K4, CO 4)
5. Evaluate the relative importance of different categories of economic plants—sugar-yielding plants (sugarcane, sugar beet), spices and condiments (cardamom, cinnamon). **(**K5, CO 5)

Head of the Department **Course Instructor**

Dr. W. Vincy

Teaching Plan – EVEN SEMESTER

Department : Botany
Class : I M.Sc. Botany
Title of the Course : CORE COURSE IV: PLANT ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Semester : II
Course Code : BP232CC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232CC2	2	3	-	-	4	5	75	25	75	100

Objectives

1. Learn the importance of plant anatomy in plant production systems (Knowledge).

2. Classify meristem and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants (Skill).

Course outcomes

Course outcomes: CO	On completion of this course, the students will be able to:	
CO1	Learn the structures, functions and roles of apical *vs* lateral meristems in monocot and dicot plant growth.	K1& K2
CO2	Study the function and organization of woody stems derived from secondary growth in dicot and monocot plants.	K1&K4
CO3	Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K2& K6
CO4	Understand the various concepts of plant development and reproduction.	K3& K6
CO5	Profitably manipulate the process of reproduction in plants with a professional and entrepreneurial mindset.	K5

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I									
	1	Morphological and physico-chemical changes;Plasmodesmata-types of pits – growth of cell wall – formation of intercellular spaces.	3	3	K2(U)	Lecture using Chalk and talk ,Introductory session,	Brainstorming questions, MCQ, Online Quiz, Essay	Self prepared videos	Assignments
	2	Meristems: Classifications: Theories of shoot and root apices, Cytological zonation in shoot apex.	3		K2(U)	Lecture using Chalk and talk ,Introductory session,	Brainstorming questions, MCQ	Interactive PPT	Slip Test
	3	Vascular Cambium: Composition and organization – multiplicative and additive divisions.	3		K2(U)	Lecture using Chalk and talk ,Introductory session,	Essay Short summary, Discussion,	MS word	Oral Test

	4.	Xylem: Primary and secondary xylem – tracheary elements and vessels – vesselless dicots – xylem rays and axial parenchyma of angiosperm	2		K2(U)	Lecture using Chalk and talk ,Introductory session,	Self Prepared Videos	PPT	Surprise Test
	5.	Dendrochronology – grain, texture and figure in wood; reaction wood; ring porous and diffuse porous wood	2		K2(U)	Lecture using Chalk and talk ,Introductory session,	Debating / Presentations	Interactive ppt	Formative Assessment
	6.	Phloem: Ultra structure and ontogeny of sieve tube elements and companion cell. Evolution of tracheary elements.	2		K2(U)	Lecture using Chalk and talk ,Introductory session,	Online assignment	MS-Word	Slip test

II									
	1	Structure, organization and activity of phellogen. Polyderm and Rhytiderm – wound periderm.	3	4	K1(U)	Lecture using you tube videos, Group discussion	Experiential learning Powerpoint presentation	External links	Group Discussion
	2	Normal secondary thickening in Dicots; Anomalous secondary growth in Dicots (Amaranthaceae, Aristolochiaceae, Bignoniaceae, Piperaceae, Nyctaginaceae) and arborescent	3		K1(U)	Lecture using you tube videos, Group discussion	Participative learning Assignments	Interactive PPT	Home work
	3	Monocots. Primary thickening in palms; Ontogeny of leaf, Structure and types of Stomata; Leaf abscission;	3		K1(U)	Lecture using you tube videos, Group discussion	Describing visual images.	You Tube Videos	Dictation

		Major nodal types; Kranz anatomy and its significance.							
	4	Microtechnique: Principle of killing and fixation, dehydration and rehydration of botanical specimens. Stains: Principle of double staining (fast-green and light green) of free hand sections;	3		K1(U)	Lecture using you tube videos, Group discussion	Flipped classroom, Group discussion	PPT	Creative Writing
	5	Protocol for serial sectioning of paraffin wax impregnated specimens; Mounting and mounting media.	3		K1(U)	Lecture using you tube videos, Group discussion	Participative learning Preparing and demonstrating exhibits	MS Word	Quiz
III									

	1	Structure and developme nt of Anther; Ultrastruct ure and physiology of anther tapetum; Male gametophy te;	**1**	4	K 3(Ap)	Peer tutoring, Lecture using videos, Demons tration,	Evaluation through short test, MCQ, True/False,	Youtu be videos	Google forms
	2	Palynology : Morpholog y and ultrastructu re of pollen wall, pollen kitt, pollen analysis, pollen storage, pollen sterility and pollen physiology .	**2**		K1(K)	Lecture using Chalk and talk Brainstor mihg	Simple definitions , Observati on note, Dictation	PPT	Student presentati on
IV									
	1	Structure and developme nt of Megaspora ngium; Types of ovules, Endotheliu m,	4	4	K4(A n)	Lecture using Chalk and talk ,Demonst ration,	Short summary or overview, panel discussion, Peer review	Self Prepar ed Videos	Students Presentati on

		obturator and nucellus..							
	2	Megasporogenesis: Female gametophyte: Structure, types, haustorial behavior and Nutrition of embryo sacs	5		K5(E)	Demonstration, PPT, Review	Evaluation through short test, MCQ, True/False,	Interactive E-Book	Creative Writing
	3	Fertilization: Double fertilization and triple fusion; Endosperm: Development of endosperm, types, physiological efficiency of endosperm haustoria and functions; Ruminate endosperm.	5		K2(U)	PPT, Review, you tube videos	Suggest idea/concept with examples,	Youtube Videos	Brain Storming
	4	Embryogeny: Development of	4		K 3(Ap)	Lecture using Chalk and talk	Oral presentation,	PPT	Seminar Presentation

Course on			monocot (Grass) and dicot (Crucifer) embryos.				,Introductoryssession,	observation notes			Focussing
	V										
		1	Causes of Polyembryony, classification, induction and practical application.	5	3	K2(U)	Mind mapping, Peer tutoring, PPT, Review	Evaluation through short test, MCQ, problem solving	External Links	Group Discussion	
		2	Apomixis and its significance. Seed and Fruit development and role of growth substances.	4		K 3(Ap)	Lecture using videos, Demonstration,	Oral presentation, observation notes,	Interactive E-Book	Open Book Test	
		3	Parthenocarpy and its importance.	5		K1(K)	Mind mapping, Peer tutoring, Problem solving	Assignments, slip test, home work- flow chart	Self Prepared videos	Home Work	

Employability/ Entrepreneurship/ Skill Development : Skill Development

Activities (Em/ En/SD): Preparation of Permanent Slide, Model making of secondary thickening in dicots.

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Environment Sustainability

Activities related to Cross Cutting Issues :-

Assignment : Structure and development of Anther / online (Google classroom, Nearpod)

Seminar Topic: Causes of Polyembryony, classification, induction and practical application

Sample questions (minimum one question from each unit)

Part A

1. What are the fibres that are associated with phloem? (K1, CO1)

a. Surface Fibres b. Wood Fibres c. Hard Fibres d. Bast Fibres

2. The tree's age may be established using the ---------- methods (K1, CO1)

3. What causes the cork tissue to form? (K1, CO1)

a. Periderm b. Periblem c. Phelloderm d. Phellogen

4. Pits with a border can be located in ----------(K1, CO1)

5.Exine is made up of _____ (K2, CO2)
a. vascular strands b. sporopollenin c parenchyma d.meristematic cells

6.. The point of attachment between Ovule body and funicle is called_____ (K3, CO3)

7. In ____ type of Ovule embryo sac become horse shoe shaped (K4, CO4)

8. Polyembryony was 1st reported by ____ in ___ (K5, CO5).

Part B

1. Draw and describe the different types of stele which you have studied (K1, CO1).

2. Write a note on the different stomatal types according to Metcalfe and Chalk (K2, CO2).

3. Describe the structure and development of anther in a flower? (K3, CO3).

4. Role of sporopollenin in pollination – justify(K4, CO4).

5. Sketch the types of endosperm formation (K5, CO5).

Part C

1. Write a note on the structure of 'Plasmodesmata'. State it's important functions (K1, CO1)

2. Describe the anomalous secondary growth in Bignonia sp, Boerhavia sp, with diagrams (K2, CO2).

3. Write in detail about Types of Ovule (K3, CO3).

4. Give an account of structure and organization of a typical embryo sac of angiosperm? (K4, CO4)

5. What is Polyembryony? Write a brief account on Classification of Polyembryony and its significance (K5, CO5).

Head of the Department **Course Instructor**

Hanna Jeeja Alexander

SEMESTER – II

TEACHING SEMESTER **PLAN –EVEN**

Department : **Botany**
Class : **I M.Sc. Botany**
Title of the Course : **CORE COURSE V: ECOLOGY, PHYTOGEOGRAPHY, CONSERVATION BIOLOGY & INTELLECTUAL PROPERTY RIGHTS**
Semester : **II**
Course Code : **BP232CC3**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232CC3	2	3	-	-	4	5	75	25	75	100

Learning Objectives

1. To analyze and comprehend the fundamental ideas of plant ecology as a scientific study of environment (Knowledge).
2. To study the plant communities and plant succession stages (Skill).

Course Outcomes

On	completion of this course, the students will be able to:	
CO1	understand the scope and importance of population ecology, plant communities and ecosystem ecology.	K1 & K2
CO2	understand the applied aspect of environmental botany.	K1 & K4
CO3	spot the sources and pollution and seek remedies to mitigate and rectify them.	K2 & K6
CO4	identify different plant communities, categorize plant biomes and identify threatened, endangered plant species and create awareness program in protection of biodiversity.	K3 & K6
CO5	analyze insight into the vegetation types, species interaction and their importance and the factors influencing the environmental conditions.	K5

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

nit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**1**	Ecological principles: Introduction– History, scope, concepts.	2		K1(R)	Brainstorming	Participative learning Brainstorming	E-content – MS Word	Oral test
	2	Diversity of plant life; growth form, life form.	3	2	K1(R)	Brainstorming	Participative learning Brainstorming	Interactive PPT	Oral test
	3	Basic concepts of population ecology– population dynamics –	2		K2(U	Integrative teaching	Participative learning Describing using charts	Youtube videos	Slip test

		Regulation of population density.							
	4	Basics concepts of community – characteristics, composition, structure, origin and development	3		K2(U	Context based	Experiential learning Powerpoint presentation	Interactive ppt	Formative Assessment
	5	Community dynamics – trends of succession.	3		K2(U	Inquiry based approach	Participative learning Assignments	E-Content-MS Word	Surprize test
I	**1**	Ecosystem ecology and resource ecology: Introduction– kinds – major types – functional aspects of ecosystem: food chain and food web, energy flow, laws of thermodynamics. productivity – primary and secondary productivity – gpp & bpp.	2		K3(Ap)	Constructivism	Participative learning Skit and role play, Describing using charts	Self prepared videos,	Formative assessment

	2	**Resource Ecology:** Energy resources; renewable and non-renewable.	3	**2**	K3(Ap)	Collaboration	Problem solving methodologies Group discussion	E-content – external links	Quiz questioning in classroom
	3	**Soil**: Formation, types and profile - erosion and conservation, Water resources – conservation and management.	2		K4(An)	Cooperative learning	Problem solving methodologies Lateral thinking	Lecture Clips	Oral presentation
	4	**Environment Deterioration:** Climate change - Greenhouse effect and global warming, ozone depletion and acid rain.	3		K4(An)	Simulation	Participative learning Student administration	Interactive PPT	Online Assignment
	5	Waste management - Solid and e-waste, recycling of wastes. Eco-restoration/remediation ecological foot prints - carbon foot print - ecolabeling - environmental auditing	3		K4(An)	Context based	Participative learning Analyze problem situations, Group discussion	Youtube videos	Multiple choice questions, CIA

II	1	**PHYTOGEOGRAPHY:** Phytogeographical Zones - Vegetation types of India and Tamil Nadu,	3	3	K4(An)	Lecture	Participative learning Student administartion		Student presentation
	2	Distribution: Continuous, Discontinuous and Endemism. Theories of discontinuous distribution: Continental drift, Ageand area hypothesis.	3		K4(An)	Simulation	Describing visual images	Youtube videos	Class test, assignments
	3	Geographical Information System (GIS)	3		K3(Ap)	Demonstrative	Experiential learning Basic and advanced lab experiments	O lab	Formative assessment
	4	Principles of remote sensing and its applications.	3		K3(Ap)	Flipped classroom	Experiential learning Making model	Virtual lab simulations	Google forms
V	1	Biodiversity and conservation ecology: definition, types of biodiversity – values of biodiversity – hot spots – threats to biodiversity: habitat loss.	2	2	K2(U	KWL(what do you know/want to know/what did you learn)	Participative learning Student presentation	Powerpoint presentations	Oral presentation, Class test

	2	Poaching of wild life – Invasion of exotic species, man and wild life conflicts	3		K4(An)	Simulation	Participative learning Analyse problem situations	Lecture clips	Slip test, oral test
	3	Endangered and endemic plant species of India,	2		K4(An)	Simulation	Participative learning Using visual images	MS word	Online assignment
	4	Red list categories of IUCN	3		K5(Ev)	Integrative learning	Experiential learning Powerpoint presentation	Interactive PPT	Presentation
	5	Biotechnology assisted plant conservation- *in situ* and *ex situ* methods.	3		K5(Ev)	Simulation	Experiential learning Powerpoint presentation	Interactive PPT	CIA, class test
y	**1**	Intellectual Property Rights – Introduction, Kinds of Intellectual Property Rights- Patents, Trademarks, Copyrights, Trade Secrets.	2	**2**	K3(Ap)	Context based	Participative learning Preparing and demonstrating exhibits	-	Quiz questioning in classroom

	2	Need for intellectual property right, Advantages and Disadvantages of IPR.	3		K3(Ap)	Context based	Participative learning Describing using charts	MS Word	Multiple choice questions
	3	International Regime Relating to IPR – TRIPS, WIPO, WTO, GATTS.	2		K3(Ap)	Simulation	Participative learning Chart presentation	Online videos	Presentation, CIA
	4	IPR in India genesis and development. Geographical Indication – introduction, types.	3		K3(Ap)	Integrative learning	Participative learning Chart presentation, Model making		Online assessment
	5	Patent filing procedure for ordinary application	3		K5(Ev)	Inquiry based learning	Participative learning Chart presentation	Lecture clips	Oral test, Summative assessment

urse Focussing on Employability/ Entrepreneurship/ Skill Development : Skill Development

ctivities (Em/ En/SD): Eco Trip

ourse Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Environment Sustainability

ctivities related to Cross Cutting Issues : -

ssignment : Forest Laws/ online

eminar Topic: Vegetation of Tamilnadu

ample questions

art A

1. The study of interactions between organisms and their environment is called_____.**(K1, CO 1)**
   a) Taxonomy

b) Ecology
c) Physiology
d) Evolution

2. Which statement best explains the difference between a food chain and a food web**?(K2. CO2)**
a) A food chain shows only producers, while a food web shows only consumers.
b) A food chain represents a single pathway of energy flow, whereas a food web shows interconnected feeding relationships.
c) A food chain includes decomposers, while a food web excludes them.
d) A food chain is found only in aquatic ecosystems, while food webs occur on land.

3. Which of the following correct term denotes why the Shola forests of South India exhibit high endemism?(**K3, CO3)**
A. They occur in regions with uniform rainfall throughout the year
B. They are remnants of ancient vegetation isolated by climatic and geographical barriers
C. They have the highest rate of forest regeneration in India
D. They are located in areas with continuous species distribution
4. Abbreviate IUCN_____(K**4,C04)**
5. How many products got GI tags till now**?(K5,CO5)**
a.370 b. 729 c. 624 d. 399

Part B

1. Define population ecology and explain any two basic concepts related to population dynamics**.(K1,CO1).**
2. Explain primary and secondary productivity in an ecosystem. **(K2,CO2).**
3. Explain the Age and Area hypothesis **(K3, CO3)**
4. Enlist the IUCN categories. **(K4,CO4).**
5. Comment on geographical indication**.(K5,CO5)**

Part C

1. Describe the characteristics and structure of a plant community**.(K1,CO1).**
2. Explain the process of soil formation.(**K2,CO2)**
3. Assess the role of Geographical Information System (GIS) and remote sensing in vegetation mapping**.(K3, CO3)**
4. Summarize the role of biotechnology assisted plant conservation- *in situ* and *ex situ* methods**.(K4, CO4)**
5. Explain the Patent filing procedure for ordinary application**.(K5, CO5)**

Head of the Department **Course Instructor**

Dr. J. Celin Pappa Rani

SEMESTER – II

Department : **Botany**
Class : **I M.Sc. Botany**
Title of the Course : **CORE LAB COURSE-II: Lab Course (For Core III, IV & V)**
Semester : **II**
Course Code : **BP232CP1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232CP1	-	2	3	-	4	5	75	25	75	100

Pre-requisite

Theoretical understanding of plant taxonomy, ecology and phytogeography, plant anatomy and embryology as well as basic laboratory skills for the relevant core course.

Learning Objectives

1. Understand and develop skill sets in plant morphological, floral characteristics and artificial key preparation.
2. Expedite skilled workers to carry out research in frontier areas of plant science.

Course Outcomes

On completion of this course, the students will be able to:		
CO1	to gain recent advances in plant morphological and floral characteristics.	**K1**
CO2	understand about different floral characteristics and artificial key preparation which employed for plant identification and conservation.	**K2**
CO3	recall or remember the information including basic and advanced in relation with plant anatomy and embryology.	**K4 & K5**
CO4	apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	**K3**
CO5	know about different vegetation sampling methods.	**K3**

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**1**	**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.	2		K1(R)	**Experimental learning**	Hands-on Specimen Observation		Identification and drawing of Specimens
	2	Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family. Solving nomenclature problems.	3	2	K1(R)	**Experimental learning**	**Sectioning of the Specimens**		Sectioning Skill, Identification and drawing of Specimens
II	**1**	**ANATOMY** Study of shoot apex of *Hydrilla*	2		K3(Ap)	Experimental learning	Hands on Specimen observation	https://www. Shoot apex Hydrilla.org	Identification & Drawing of Specimens

	2	Observation of cambial types.	3	**2**	K3(Ap)	Experimental learning	Sectioning of the specimen	https://www.Fascicularcambium.org	Identification & Drawing of Specimens
	3	Sectioning and observation of nodal types	2		K4(An)	Experimental learning	Sectioning of the specimen	https://www.nodes.org	Identification & Drawing of Specimens
	4	Study of anomalous secondary growth of the following: STEM- *Nyctanthus, Bouerhhavia, Bignonia, Piper betal* and *Mirabilis*.	3		K4(An)	Experimental learning	Sectioning of the specimen	https://www.nodes.org	Identification & Drawing of Specimens
	5	Observation of stomatal types by epidermal peeling	3		K4(An)	Experimental learning	Sectioning of the specimen	https://www.Stomata types.org	Identification & Drawing of Specimens
III	**1**	**EMBRYOLOGY** Observation of T.S. of anther.	**3**	**3**	K4(An)	Experimental learning	Observation of Permanent Slide	https://www.anther.org	Identification & Drawing of Specimens
	2	Observation of ovule types.	**3**		K4(An)	Experimental learning	Observation of Permanent Slide	https://www.ovules.org	Identification & Drawing of Specimens

	3	Observation of mature embryo sacs.	**3**		K3(Ap)	Experimental learning	Observation of Permanent Slide	https://www.embryosac.org	Identification & Drawing of Specimens
	4	Dissection and observation of embryos (globular and cordate embryos).	**3**		K3(Ap)	Experimental learning	Hands on Specimen observation	https://www.Embryo types.org	Sectioning skill, Identification & Drawing of Specimens
	5	Study of pollen morphology				Experimental learning	Observation of Permanent Slide	https://www.Male gametophyte.org	Identification & Drawing of Specimens

IV	**1**	**ECOLOGY** 1. Determination of the quantitative characters of a plant community by random quadrat method (abundance, density, dominance, species diversity, frequency) in grazing land, forests. 2. Estimation of above ground and below ground biomass in a grazing land employing minimum size of quadrat. To determine soil moisture, porosity and water holding capacity of soil collected from varying depth at different locations.	2	**2**	K3(Ap)	Demonstrative			
	2	Determination of pH of soil and water by universal indicator (or) pH meter.	3		K3(Ap)	Demonstrative	Experiential learning Advanced lab experiments		Observation note
	3	Determination of dissolved oxygen. Estimation of carbonate. Estimation of bicarbonate	2		K3(Ap)	Demonstrative	Experiential learning Advanced lab experiments		Observation note

V	**1**	Phytogeography, conservation biology & Intellectual property rights Mapping of world vegetation Mapping of Indian vegetation. Remote sensing – Analyzing and interpretation of Satellite photographs Vegetation/ weather.	2	**2**	K3(Ap)	Context based	Experiential learning Models and Charts	-	Quiz questioning in classroom	Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability, Skill Development** Activities (Em / En /SD): **Hands on Training on Sectioning of**

Plant Species.

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): **Environmental Sustainability**

Environment Sustainability activities related to Cross Cutting Issues**: Field visit to study the habitat (Hill station)**

Sample Questions

1. Preparation of artificial keys**.(K3, CO1)**
2. Observation of mature embryo sacs.(**K3, CO1**)
3. Observation of cambial types. .(**K3, CO1**)
4. Sectioning and observation of nodal types.(**K3, CO2)**
5. Dissection and observation of embryos (globular and cordate embryos)(**K3, CO2)**
6. Determination of the quantitative characters of a plant community by random quadrat method (abundance, density, dominance, species diversity, frequency) in grazing land, forests. .(**K3, CO5)**
7. Determination of pH of soil and water by universal indicator (or) pH meter**.(K3,CO4)**
8. Determination of dissolved oxygen. **.(K3,CO4)**
9. Estimation of carbonate. **.(K3,CO4)**
10. Estimation of bicarbonate..(**K3,CO5)**

Head of the Department **Course Instructor**

Dr.W.Vincy

Teaching Plan – EVEN SEMESTER

Department : Botany
Class : I M.Sc. Botany
Title of the Course : ELECTIVE COURSE IV: a)- RESEARCH METHODOLOGY, COMPUTER APPLICATIONS & BIOINFORMATICS
Semester : II
Course Code : BP232EC4

CourseCode	L	T	P	S	Credits	Inst.Hours	Total Hours	Marks		
								CIA	External	Total
BP232EC4	2	2	-	-	2	4	60	25	75	100

Objectives

1. To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner (Knowledge).
2. To provide an overview on modern equipments that they would help students gain confidence to instantly commence research careers and/or start entrepreneurial ventures (Skill).

Course outcomes: CO	On completion of this course, the students will be able to:	
CO1	Realize the need of centrifuges and chromatography and their uses in research	K1 & K2
CO2	Learn the principles and applications of electrophoresis.	K2 & K3
CO3	Construct the phylogenetic trees for similar characteristic feature of plant genomes and study *de novo* drug design through synthetic biology.	K5 & K6
CO4	Understand the concept of pairwise alignment of DNA sequences using algorithms.	K3 & K4
CO5	Interpret the features of local and multiple alignments.	K4 & K5

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I									
	1	Literature collection and citation: bibliography — bibliometrics (scientometrics) : definition-laws — citations and bibliography .	4	3	K2(U)	Lecture using Chalk and talk ,Introductory session,	Brainstorming questions, MCQ, Online Quiz, Essay	Self prepared videos	Assignments
	2	*biblioscape— plagiarism— project proposal writing — dissertation writing – paper presentation (oral/poster)	4		K2(U)	Lecture using Chalk and talk ,Introductory session,	Brainstorming questions, MCQ	Interactive PPT	Slip Test
	3	E-learning tools-monograph — introduction and writing-Standard operating procedure (SOP) – introduction and preparation.	4		K2(U)	Lecture using Chalk and talk ,Introductory session,	Essay Short summary, Discussion,	MS word	Oral Test

	4.	Research Institutions - National and International.			K2(U)	Lecture using Chalk and talk ,Introductory session,	Self Prepared Videos	PPT	Surprise Test
II									
	1	Basic principles and applications of pH meter, UV-visible spectrophotometer, centrifuge, lyophilizer,	3	4	K1(U)	Demonstration, Integrative teaching	Experiential learning	External links	Group Discussion
	2	chromatography-TLC, Gas chromatography with mass spectrum (GC/MS), and HPLC-	3		K3(Ap)	Inquiry based approach	Powerpoint presentation	Interactive ppt	Formative Assessment
	3	Scanning Electron microscopy-Agarose gel Electrophoresis —	3		K4(An)	Lecture using you tube videos, Group discussion	Participative learning Assignments	Interactive PPT	Surprize test

	4	Polyacrylamide Gel Electrophoresis – Polymerase chain reaction	3		K4(An)	Discussion forum (google classroom, mentimeter)	Describing visual images.	You Tube Videos	Online Assignment
	1	Basic principles and applications of pH meter, UV-visible spectrophotometer, centrifuge, lyophilizer,	**1**		K1(U)	Lecture using you tube videos, Group discussion	Flipped classroom, Group discussion	PPT	Quiz questioning in classroom
III									
	1	Introduction to computers and Bioinformatics. Types of hardware and software operating systems.	4	4	K2 (U)	Discussion forum (google classroom, mentimeter, Whatsapp poll)	Evaluation through short test, MCQ, True/False,	Youtube videos	Multiple choice questions, CIA
	2	Fundamentals of networking, operation of networks,	4		K4(An)	Group discussion, Experimental demonstration	Simple definitions, Observation note, Dictation	PPT	Class test, assignments

		telnet, ftp, www, Internet.							
	3.	Biological Research on the web: Using search engines, finding scientific articles.	4		K5 (Ev)	Flipped classroom, Group discussion	Creative writing, Quiz, slip test	Interactive ppt	Google forms
IV									
	1	Public biological databases,	4	4	K4(An)	K5(Ev)	PPT & you tube Videos, Computational techniques	Self Prepared Videos	Students Presentation
	2	Searching biological databases.	4		K5(E)	K4(An)	Interactive PPT presentation,	Interactive E-Book	Creative Writing
	3	Use of nucleic acid and protein data banks.	4		K2(U)	K3(Ap)	Lecture using Chalk and talk , E- content(M.s-word	Youtube Videos	Brain Storming
V									
	1	NCBI, EMBL, DDBJ, SWISSPORT,	4	3	K3(Ap)	Discussion forum (google classroom, mentimeter)	Evaluation through short test, MCQ, problem solving	External Links	Quiz questioning in classroom

	2	Protein prediction and Gene finding tools.	4		K4(An)	Review, Lecture using Interactive PPT Videos	Oral presentation, observation notes,	Interactive E-Book	Multiple choice questions
	3	Techniques in Bioinformatics- BLAST, FASTA, Multiple Sequence Analysis **.**	4		K5(Ev)	Lecture using PPT & youtube Videos, Computational techniques	Assignments, slip test, home work- flow chart	Self Prepared videos	Presentation, CIA

Course Focussing on Employability/ Entrepreneurship/ Skill Development : **Skill Development**

Activities (Em/ En/SD): **Compare different nucleotide sequence using gen bank, Bioinformatics tools, Visit Library for Literature collection .**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): **Professional Ethics**

Activities related to Cross Cutting Issues :-

Assignment : **chromatography- TLC, Gas chromatography with mass spectrum (GC/MS), and HPLC (online)**

Seminar Topic: **NCBI, EMBL, DDBJ, SWISSPORT**

Sample questions (minimum one question from each unit)

Part A

1. Why literature collection is important in research? (K1, CO1)
2. Define Citation.(K1, CO1)
3. Electron microscope can give a magnification up to ----------(K2, CO2)
   a. 400,000X b. 100,000X c. 15,000X d. 100X.

4. An UV-Vis spectrophotometer measures the intensity of light transmitted through a sample compared to a reference measurement of the incident light source – State True or False (K2, CO2).
5. Abbreviate : APA (K1, CO1)
6. Name any two best search engines (K3, CO3).
7. PSI BLAST is better than BLAST – State True or False (K4, CO4)

Part B

1. Evaluate the importance of e-journal and e – book in research (K1, CO1)
2. Justify the role of supervisors towards research scholars, while performing research (K1, CO1).

3. Write notes on the principle and uses of Affinity chromatography (K2, CO2).

4. List out the applications of lyophilization (K2, CO2).

5. Deduct the protocol for performing Multiple Sequence Alignment (K3, CO3).
6. How DDBJ acts as biological database in collecting DNA sequences? (K5, CO5).

Part C

1. Consider that you are doing research in a science field. Explain how you will prepare a research report (K1, CO1).
2. Explain your own view and perspective opinion about research (K1, CO1).

3. Justify the role of agarose gel electrophoresis in separating DNA fragments (K2, CO2).

4. Evaluate the role of PCR in making million copies of specific DNA (K3, CO3).

5. Explain the Protein sequence databases with suitable examples.(K5, CO5)

Head of the Department **Course Instructor**

Hanna Jeeja Alexander

SEMEESTER II

Department : **Botany**
Class : **I M.Sc. Botany**
Title of the Course : **SKILL ENHANCEMENT (SEI) NURSERY AND GARDENING**

Semester : **II**
Course Code : **BP232SE1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232SE1	2	-	-	-	2	2	30	25	75	100

Learning Objectives

1. To recognize the importance of nursery and gardening (Knowledge).
2. To develop skills necessary to manage a wholesale nursery (Skill).

Course outcomes

On completion of this course, the students will be able to:		
1	Recognize the basic process required for growing and maintaining plants in nurseries.	**K1**
2	Explain the different methods of plant propagation and various gardening styles.	**K2**
3	Apply techniques for effective hardening of plants and computer applications for creative gardening.	**K3& K6**
4	Compare and contrast cultivation of different vegetables and growth of plants in nursery and gardening.	**K4**
5	Develop new strategies to enhance growth and quality of nursery	**K5 &**

	plants.	**K6**

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	1	Nursery: Definition,objectives and scope and building up of infrastructure for nursery, planning and seasonal activities -	2	1	K1(R)	Brainstorming	Participative learning Brainstorming	Iterative PPT	Oral test
	2	Planting - direct seeding and transplants.	3		K1(R)	Lecture method	Participative learning Using charts	O LAB	Quiz, Class test
II	1	Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion	3	1	K2(U)	Integrative teaching	Participative learning Preparing and demonstrating exhibits	Youtube videos	Online assignment

	2	Seed production technology - seed testing and certification.	2		K2(U)	Context based	Participative learning Brainstorming		Oral presentation
III	1	Vegetative propagation: Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings	2	1	K3(Ap)	Demonstrative	Experiential learning Hands on training through skill based course	Demonstrative videos	Observation note
	2	Hardening of plants - green house - mist chamber, shed root, shade house and glasshouse	3		K3(Ap)	Cooperative learning	Experiential learning Hands on training through skill based course	Interactive PPT	Observation note
IV	1	Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer	2	1	K2(u)	Inquiry based learning	Experiential learning Powerpoint presentation	Youtube videos	Formative assessment, CIA
	2	home gardening - parks and its components - plant materials and design – computer	3		K4(An)	Computational thinking	Problem solving Using computational techniques	Demonstrative videos	Online Assignment, CIA

		applications in landscaping.							
V	1	Gardening operations: Soil laying, manuring, watering, management of pests and diseases and harvesting.	2	1	K3(Ap)	Blended learning	Participative learning Using visual images and charts	O lab	Quiz questioning , Online Assignment
	2	Sowing/raising of seeds and seedlings: Transplanting of seedlings.	1		K3(Ap)	Demonstrative	Experiential learning Demo- field	Video clips	Observation note, class test
	3	Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.	3		K3(Ap)	Experiential learning	Experiential learning field Projects		Observation note, Class test

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Course Focussing on Employability/

Entrepreneurship/ Skill Development : Skill Development

ctivities (Em/ En/SD): Field visit

ourse Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Environment Sustainability

ctivities related to Cross Cutting Issues : -

ssignment : Vegetative propagation/ online

eminar Topic: Transplanting of seedlings**.**

ample questions

art A

Which of the following is ***not*** an objective of a plant nursery? **(K1, CO 1)**
a. Production of high-quality planting material
b. Conservation of plant biodiversity
c. Raising seedlings for research and education
d. Increasing post-harvest life of fruits
Seed dormancy is best defined as____ **(K2, C02)**
a. The rapid germination of a seed
b. A temporary failure of a viable seed to germinate
c. The permanent loss of seed viability
d. The rapid loss of moisture in seeds
Air layering is also known as_____.**(K3, CO3)**
What is gardening?(K2, CO4)
a. The practice of cultivating and nurturing plants
b. The art of designing outdoor spaces
c. The study of plant species
d. The process of harvesting crops?**(K3, CO3)**

First pesticide used by man is____ **(K5,CO5)**
a. Rotenone b. Thuricide c. Pyrethrin d. Pheromone

Part B

1. Enlist the components of Nursery. **? (K1, CO 1)**
2. Describe any six causes of seed dormancy.**(K2,CO2).**
3. Comment on glass house. **(K3, CO3)**
4. Integrate the various types of gardening**. (K4, C04)**
5. Write short note on pest and disease management **(K3,CO5)**

Part C

1.Write detailed account on planting techniques **(K1,CO1).**
2.Explain the seed certification (**K2,CO2)**
3.Summarize various methods of Vegetative propagation **(K3, CO3)**
4.Explain the components, construction of home gardening **(K4, CO4)**
5.Explain the cultivation methods of different vegetables: lady's finger, onion, garlic, tomatoes **(K5, CO5)**

Head of the Department

Course Instructor

Dr. J. Celin Pappa Rani

SEMESTER – II

ELECTIVE COURSE III: a) BIOSTATISTICS

TEACHING PLAN –EVEN SEMESTER

Department : Botany
Class : I M.Sc. Botany
Title of the Course : Biostatistics
Semester : II
Course Code : BP232EC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP232EC1	2	2	-	-	2	4	60	25	75	100

Learning Objectives

1. To provide the student with a conceptual overview of statistical methods.
2. To emphasis on usefulness of commonly used statistical software for analysis, research, and experimentation.

Course Outcomes

On completion of this course, the students will be able to:		
CO1	create and interpret visual representations of quantitative information, such as graphs or charts.	**K5 & K6**
CO2	solve problems quantitatively using appropriate arithmetical, algebraic, or statistical methods	**K3 & K5**
CO3	know the latest version using in statistical tools and apply the tools to interpret the results	**K2**
CO4	develop their competence in hypothesis testing and interpretation.	**K4**
CO5	understand why biologists need a background in statistics.	**K1**

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

nit	**Module**	**Topic**	**Teaching Hours**	**Assessment Hours**	**Cognitive level**	**Pedagogy**	**Student Centric Method**	**E-Resources**	**Assessment/ Evaluation**

									Methods
I	1	**INTRODUCTION TO STATISTICS** Introduction to biostatistics, basic principles, variables.	3	4	K1(U)	Brainstorming	Participative learning Brainstorming	Interactive PPT	Oral test
	2	Collection of data, sample collection and representation of Data - Primary and Secondary	4		K1(U)	Brainstorming	Participative learning Power Point presentation	Interactive PPT	Slip test
	3	Classification and tabulation of Data – Diagrams, graphs and presentation.	3		K1(U)	Brainstorming	Participative learning Using charts	Ms word	Online assessment
II	1	**DESCRIPTIVE STATISTICS** Mean, median and mode for continuous and discontinuous variables.	4	4	K3(Ap)	Integrative teaching	Experiential learning Assignments	Animated videos	Online assignment
	2	Measures of dispersion: Range of variation, standard deviation	3		K3(Ap)	Simulation	Experiential learning	Demonstrative videos	Quizquestioning

							Using visualimaes		
	3	standard error and coefficient variation.	4		K3(Ap)	Collaboration	Participativelearning Seminar		Presentation
II		**PROBABILITY** Basic principles - types - Rules of probability - addition and multiplication rules.	5	3	K4 (Ev)	Reflective thinking	Experiential learning Exhibits	Video clips	Formative assessment
		PROBABILITY DISTRIBUTION Patterns of probability distribution; binomial - Poisson and normal.	5		K4 (Ev)	Simulation	Experiential learning Role play	Demonstrative videos	Homework
V		Chi-square test for goodness of fit; Null hypothesis, level of Significance - Degrees of Freedom.	3	2	K3(Ap)	Constructivism	Experiential leaning Making models	Virtual lab vist	Student presentation

		Student ‘t’ test – paired sample and mean differences ‘t’ tests. ANOVA. Basic introduction to Multivariate Analysis of Variance (MANOVA).	2	2	K3(Ap)	Constructivism	Experiential leaning Making models	Virtual lab vist	Student presentation
V		Correlation - types of correlation - methods of study of correlation - testing the significance of the coefficients of correlation.	3	2	K4(An)	Blended learning	Experentalleraning - Advanced lab experiemnts	E book	Observation note
		Regression and types. Sampling and experimental designs of research- Randomized block design and split plot design.	2	2	K4(An)	Blended learning	Experentalleraning - Advanced lab experiemnts	E book	Observation note

se Focussing on Employability/ Entrepreneurship/ Skill Development : Skill Development

ctivities (Em/ En/SD): SD

ourse Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Environment Sustainability

ctivities related to Cross Cutting Issues : -

ssignment : methods of study of correlation

eminar Topic: Randomized block design and split plot design.

ample questions

Part A

1. Data collected directly from the original source is called _____ data.(K1, CO 1)

2. The measure of dispersion that shows how much each value deviates from the mean is called _____..(K2, CO2)
3. The probability distribution in which the mean and variance are equal is called the _____ distribution. .(K3, CO 3)
4. In a chi-square test, the value used to compare the calculated χ^2 with the tabulated value depends on the _____ of freedom. .(K4, CO4)
5. When both variables move in opposite directions, the type of correlation observed is called _____ correlation. .(K5, CO5)

Part B

1. Define primary and secondary data. Explain any three methods of primary data collection.**(**K1,CO1)
2. Explain the difference between mean, median, and mode for continuous variables. How does each measure help in understanding the nature of the dataset? .(K2, CO 2)
3. Explain the addition and multiplication rules of probability with suitable examples. .(K3, CO 4)
4. Apply the concept of the *paired sample t-test* to explain how you would test whether a training program significantly improves student performance. .(K4, CO 4)
5. Evaluate the suitability of randomized block design (RBD) and split plot design for agricultural experiments. .(K5, CO5)

Part C

1. Describe in detail the basic principles of biostatistics. Explain the types of variables, methods of data collection, classification and tabulation of data, and the use of diagrams and graphs in data presentation. (K1, CO 1)
2. Describe the various measures of dispersion—range, standard deviation, standard error, and coefficient of variation. (K2, CO2)
3. Describe the characteristics and applications of the binomial**,** Poisson**,** and normal probability distributions. (K3, CO 3)
4. Explain how you would use Chi-square test for goodness of fit**,** Student's t-test.(K4, CO4)
5. Critically evaluate the use of correlation, regression, and experimental designs (RBD and split plot design) in biological research .(K5, CO 5)

Head of the Department **Course Instructor**

Dr. W. Vincy

II M.Sc BOTANY

TEACHING PLAN –EVEN SEMESTER

Department : Botany
Class : II M.Sc. Botany
Title of the Course : PLANT PHYSIOLOGY AND METABOLISM
Semester : IV
Course Code : BP234CC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
BP231CC2	4	2	-	5	6	90	25	75	100

Objectives

1. To acquire knowledge on the functional aspects of plants
2. To understand the biophysical and biochemical processes of plants

Course Outcomes

CO	Upon completion of this course,the students will be able to:	PSO Addressed	Cognitive level
CO- 1	Relate understand properties and importance of water in biological system, nutrients and its translocation.	PSO-1	K1 &K3
CO- 2	demonstrate the importance of light in plant growth and the harvest of energy.	PSO-2	K3 & K4
CO- 3	explain the energy requirement and nitrogen metabolism.	PSO-3	K3 & K5
CO- 4	compare the various growth regulators that influence plant growth.	PSO-3	K2
CO- 5	discuss the senescence and plant response to environmental stress.	PSO-3	K1 & K3

Teaching plan

Total Contact hours: 90 (Including lectures, assignments and tests)

nit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**1**	Water Relations: Physical and chemical properties of water –Components of water Potential.	2		K1(R)	Brainstorming	Participative learning Brainstorming	E-content – MS Word	Oral test
	2	Plasmolysis - water absorption by roots – Apoplast and Symplast concept - water transport through the xylem	3	2	K1(R)	Brainstorming	Participative learning Brainstorming	Interactive PPT	Oral test
	3	Transpiration and evapotranspiration - stomatal structure and function – mechanism of stomatal opening and closing.	2		K2(U	Integrative teaching	Participative learning Describing using charts	Youtube videos	Slip test
	4	Mineral nutrition – essential nutrients – macro and micro nutrients – deficiencies and plant disorders.	3		K2(U	Context based	Experiential learning Powerpoint presentation	Interactive ppt	Formative Assessment

	5	Absorption of solutes – translocation of solutes – pathways and mechanisms.	3		K2(U	Inquiry based approach	Participative learning Assignments	E-Content-MS Word	Surprize test
I	**1**	Photosynthesis: The physical nature of light – the absorption and fate of light energy – absorption and action spectra-photoreceptors.	2		K3(Ap)	Constructivism	Participative learning Skit and role play, Describing using charts	Self prepared videos,	Formative assessment
	2	Ultrastructure and biochemical compartmentation of Chloroplast	3	**2**	K3(Ap)	Collaboration	Problem solving methodologies Group discussion	E-content – external links	Quiz questioning in classroom
	3	Photosynthetic Electron Transport and Photophosphorylation (cyclic and noncyclic)	2		K4(An)	Cooperative learning	Problem solving methodologies Lateral thinking	Lecture Clips	Oral presentation
	4	Photosystems and reaction centres - Light Harvesting complexes - Photosystem I & II and Oxidation of Water.	3		K4(An)	Simulation	Participative learning Student administration	Interactive PPT	Online Assignment
	5	Carbon metabolism: C3, C4 and CAM pathways and their distinguishing features -	3		K4(An)	Context based	Participative learning Analyze problem situations, Group discussion	Youtube videos	Multiple choice questions, CIA

		photorespiration and its significance.							
II	**1**	An overview of plant respiration – Glycolysis.	**3**	**3**	K4(An)	Lecture	Participative learning Student administartion		Student presentation
	2	TCA cycle– Electron Transport – oxidative phosphorylation and ATP synthesis	**3**		K4(An)	Lecture method	Describing visual images	Youtube videos	Class test, assignments
	3	Chemios motic Theory - Pentose Phosphate Pathway– Respiration and its significance in crop improvement.	**3**		K3(Ap)	Demonstrative	Experiential learning Basic and advanced lab experiments	O lab	Formative assessment
	4	Nitrogen fixation (Biological - symbiotic and non-symbiotic).	**3**		K3(Ap)	Flipped classroom	Experiential learning Making model	Virtual lab simulations	Google forms
V	**1**	Growth and development – Phases of plant growth – growth types- Growth	2	**2**	K2(U	KWL(what do you know/want to know/what did	Participative learning Student presentation	Powerpoint presentations	Oral presentation, Class test

		Substances.				you learn)			
	2	Auxins, gibberellins, cytokinins, abscisic acid, ethylene, brassino steroids	3		K4(An)	Simulati on	Participative learning Analyse problem situations	Lect ure clips	Slip test, oral test
	3	physiological effect and mechanism of action in agricultural and horticultural crops	2		K4(An)	Simulati on	Participative learning Using visual images	MS word	Online assignment
	4	–Photoperiodism – Classification of plants and mechanism of flowering – Phytochrome and their action on flowering – Vernalization.	3		K5(E v)	Integrati ve learning	Experiential learning Powerpoint presentation	Inter activ e PPT	Presentation
	5	Biological rhythms and movements. Seed dormancy and causes and Seed germination and their biochemical changes.	3		K5(E v)	Simulati on	Experiential learning Powerpoint presentation	Inter activ e PPT	CIA, class test

y	**1**	Plant senescence –Types and Mechanism of senescence-	2	**2**	K3(Ap)	Context based	Participative learning Preparing and demonstrating exhibits	-	Quiz questioning in classroom
	2	Abscission: Morphological and biochemical changes – Significance.	3		K3(Ap)	Context based	Participative learning Describing using charts	MS Word	Multiple choice questions
	3	Fruit ripening-Biochemical, Physiological changes and control of fruit ripening.	2		K3(Ap)	Simulation	Participative learning Chart presentation	Online vise os	Presentation, CIA
	4	Plant response to environmental stress: Biotic	3		K3(Ap)	Integrative learning	Participative learning Chart presentation, Model making		Online assessment
	5	Abiotic stress – Water, temperature, light and salinity-	3		K5(Ev)	Inquiry based learning	Participative learning Chart presentation	Lecture clips	Oral test, Summative assessment

se Focussing on Employability/ Entrepreneurship/ Skill Development : Skill Development

ctivities (Em/ En/SD): SD

ourse Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): Environment Sustainability

ctivities related to Cross Cutting Issues : -

ssignment : mechanism of flowering

eminar Topic: Abiotic stress – Water

ample questions

Part A

1. The movement of water through the cell wall continuum is called the _____ pathway. (K1 CO1)
2. The pigment–protein complexes that capture and transfer light energy in photosynthesis are called _____ complexes. (K2 CO2)
3. During oxidative phosphorylation, ATP is synthesized as protons move back into the mitochondrial matrix through the enzyme _____. (K3 CO3)
4. The photoreceptor that analyzes changes in red and far-red light and regulates flowering is called _____. (K4 CO4)
5. The hormone commonly used to delay senescence and extend shelf life of leafy vegetables is _____. (K5 CO5)

Part B

1. Define water potential and its components. Describe plasmolysis and explain what happens to a plant cell when placed in a hypertonic solution. (K1 CO1)
2. Explain the differences between cyclic and non-cyclic photophosphorylation. (K2 CO2)
3. Apply your understanding of glycolysis, TCA cycle, and electron transport to explain how inhibitors of any one of these pathways would affect ATP production in plants. (K3 CO3)
4. Analyze the roles of auxins, gibberellins, and cytokinins in plant growth.(K4 CO4)
5. Evaluate the role of abiotic stresses (water, temperature, light, salinity) in accelerating plant senescence. (K5 CO5)

Part C

1. Describe in detail the processes involved in water relations of plants and the mechanism of stomatal opening and closing. (K1 CO1)
2. Compare the C3, C4, and CAM pathways, highlighting their distinguishing features and the significance of photorespiration. (K2 CO2)
3. Discuss the role of the Pentose Phosphate Pathway and evaluate how efficient respiration supports crop improvement. (K3 CO3)
4. Analyze plant growth and development by discussing: phases and types of growth, physiological effects and mechanisms of action of growth substances. (K4 CO4)
5. Evaluate the significance of senescence, abscission, fruit ripening, and stress responses in overall plant performance and crop yield. (K5 CO5)

Head of the Department **Course Instructor**

Dr. W. Vincy

Teaching Plan – EVEN SEMESTER

SEMESTER -IV

Department : Botany

Class : II M.Sc. Botany

Title of the Course : BIOCHEMISTRY AND APPLIED BIOTECHNOLOGY

Semester : IV

Course Code : BP234CC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP234CC2	4	2	-	-	**5**	**6**	**90**	**25**	**75**	**100**

Objectives:

1. To study the fundamentals and significance of Plant Biochemistry
2. To know the structure and properties of plant biomolecules

Course Outcomes

CO	Upon completion of this course, the students will be able to:	PSO Addressed	Cognitive level
CO- 1	knowledge on the fundamentals and significance of Plant Biochemistry	PSO-1	K1 (K)
CO- 2	understanding on the structure and properties of plant biomolecules.	PSO-2	K2 (U)
CO- 3	explain the role of enzymes in plants.	PSO-3	K3 (AP)
CO- 4	compare and contrast the methods of transgenic plants production and natural plants.	PSO-3	K4 (AN)
CO- 5	discuss and develop skills for effective utilization of microbial/plant enzymes and their role in biological cells	PSO-3	K5 & K6(C & E)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I									
	1.	Atomic structure: chemical bonds - ionic bond, covalent bond, coordinate covalent bond, hydrogen bond,	4	3	K2(U)	Lecture using Chalk and talk Mind mapping,	Evaluation through short test, MCQ, True/False,	Self prepared videos	Assignments
	2.	Hydrogen ion concentration (pH), buffers.	4		K 3(Ap)	Interactive PPT Demonstration	Simple definitions, Online quiz, slip test	Interactive PPT	Presentation
	3.	Thermodynamics principle, First Law of Thermodynamics a) energy (b) Enthalpy	5		K1(K)	Group Discussion, Lecture using videos	Short essays, MCQ, True/False	MS word	Quiz

	4.	(ii) second law of thermodynamics (a) entropy (c) free energy, redox potential.	5		K4(An)	Group Discussion, Mind mapping Peer teaching	Differentiate between various ideas, Map knowledge	PPT	Seminar Presentation
II									
	1.	Classification of carbohydrates; Structure and properties of monosaccharides,	4	3	K2(U)	Lecture using Chalk and talk ,Introductory session,	Concept explanations, class test	External links	Group Discussion
	2.	Oligosaccharides, Polysaccharides – Glycoproteins..	4		K 3(Ap)	Mind mapping, Peer tutoring, PPT,	MCQ, True/False, online quiz(mentimeter)	Self Prepared videos	Home work
	3.	Protein and Amino acids: Structure, Classification and properties; Peptides - Structure	4		K1(K)	Lecture using videos, Demonstration, Interactive PPT	Suggest idea/concept with examples,	Lateral thinking	Brainstorming

		: Primary, secondary, Ramachandran plot, tertiary and quaternary structures							
	4.	Classification of Lipids: Structure and properties of fatty acids,	3		K4(An)	Interactive PPT Flow Chart	Differentiate between various lipids, Open book test	PPT	MCQ
	5.	Phospholipids, glycolipids, lipoproteins, cholesterol - structure and functions.	3		K5(E)	Lecture using Chalk and talk PPT,	Slip test, Oral Presentation	MS Word	Dictation
III									
	1	Enzymes - Classification and nomenclature chemical nature of	6	4	K 3(Ap)	Peer tutoring, Lecture using videos, Demonstration,	Evaluation through short test, MCQ, True/False,	Youtube videos	Google forms

		enzymes –							
	2	factors affecting enzyme action – Michaelis – Menton constant, Secondary	6		K1(K)	Lecture using Chalk and talk Brainstormihg	Simple definitions, Observation note, Dictation	PPT	Student presentation
	3	Metabolites: Structure, classification and properties of alkaloids, steroids, terpenoids, flavonoids. Glycosides - their chemical nature and role.	6		K4(An)	PPT, Interactive e-book, Interrogative Learning	Creative writing, Quiz, slip test	Interactive ppt	Formative Assessment
IV									
	1	Transgenic plants - pest resistance, herbicidal resistance	4	4	K4(An)	Lecture using Chalk and talk ,Demonstration,	Short summary or overview, panel discussion, Peer review	Self Prepared Videos	Students Presentation

	2	Disease resistant, abiotic and biotic stress tolerant, in improving crop yield, food quality- Golden rice	5		K5(E)	Demonstration, PPT, Review	Evaluation through short test, MCQ, True/False,	Interactive E-Book	Creative Writing
	3	Edible vaccines, Cytoplasmic male sterility and fertility restoration, terminator Seed technology	5		K2(U)	PPT, Review, you tube videos	Suggest idea/concept with examples,	Youtube Videos	Brain Storming
	4	Antisense technology for Delayed fruit ripening,	4		K 3(Ap)	Lecture using Chalk and talk ,Introductorysession,	Oral presentation, observation notes	PPT	Seminar Presentation
V									
	1	Fermentation techniques- Types.	5	3	K2(U)	Mind mapping, Peer tutoring,	Evaluation through short test, MCQ,	External Links	Group Discussion

		Industrial Production of enzymes-amylase, protease & lipase and their applications.				PPT, Review	problem solving		
	2	Immobilization for enzymes production. Antibiotic – Penicillin Production	4		K 3(Ap)	Lecture using videos,Demonstration,	Oral presentation, observation notes,	Interactive E-Book	Open Book Test
	3	Amino acid - Glutamic acid production. Bioreactors for culturing Plant cells and production of Secondary metabolites,	5		K1(K)	Mind mapping, Peer tutoring, Problem solving	Assignments, slip test, home work- flow chart	Self Prepared videos	Home Work
	4	Super bug and its role in biodegra	4		K4(An)	PPT, solving problems, Research	Observation notes, class test, Mind map	Ms-word	Home work

		dation. Bioreme diation - *In situ* and *Ex situ*.				projects			

Course Focussing on Employability/Entrepreneurship/Skill Development: **Employability**

Activities (Em/ En/SD): Model Making

Course Focussing on Cross Cutting Issues (Professional Ethics/Human Values/Environment Sustainability/ Gender Equity): Environment Sustainability

Activities related to Cross Cutting Issues: Poster Presentation, Album making,

Assignment : Protein and Amino acids: Structure, Classification and properties

Seminar Topic: Super bug and its role in biodegradation. Bioremediation - *In situ* and *Ex situ*.

Sample questions

Part : A

1. Which of the following bonds is formed by the sharing of a pair of electrons donated by only one atom? (K1, CO1)

a) Ionic bond

b) Covalent bond

c) Coordinate covalent bond

d) Hydrogen bond

Answer: c) Coordinate covalent bond

2. A solution with pH = 3 has which characteristic?(K1, CO1)

a) Neutral

b) Strongly basic

c) Slightly acidic

d) Strongly acidic

Answer: d) Strongly acidic

3. The First Law of Thermodynamics states that:(K1, CO1)

a) Energy can be created but not destroyed

b) Entropy of the universe is constant

c) Energy cannot be created or destroyed, only transformed

d) Free energy always increases

Answer: c) Energy cannot be created or destroyed, only transformed

4. Which carbohydrate is correctly classified as polysaccharide?(K2, CO2)

a) Glucose

b) Sucrose

c) Lactose

d) Glycogen

Answer: d) Glycogen

5. The α-helix and β-pleated sheet represent which level of protein structure?(K1, CO1)
a) Primary
b) Secondary
c) Tertiary
d) Quaternary
Answer: b) Secondary
6. Which lipid has a four-ring fused structure?(K1, CO1)
a) Glycolipid
b) Phospholipid
c) Fatty acid
d) Cholesterol
Answer: d) Cholesterol
7. The Michaelis–Menten constant (Km) represents:(K2, CO2)
a) Maximum reaction velocity
b) Substrate concentration at half Vmax
c) Enzyme concentration
d) Inhibitor binding rate
Answer: b) Substrate concentration at half Vmax
8. Golden Rice is genetically engineered to produce:(K3, CO3)
a) Vitamin C
b) β-Carotene (pro-vitamin A)
c) Iron
d) Vitamin D
Answer: b) β-Carotene (pro-vitamin A)
9. Immobilized enzymes are mainly used because they(K5, CO5)
a) Cannot be reused
b) Decrease enzyme stability
c) Increase efficiency and allow repeated use
d) Require high cost with no advantages
Answer: c) Increase efficiency and allow repeated use
10. In situ bioremediation refers to:(K5, CO5)
a) Treatment of pollutants away from the site
b) Treatment at the contamination site itself
c) Bioremediation using only fungi
d) Bioremediation using only plants
Answer: b) Treatment at the contamination site itself

Part-B

1. Describe the process of ionic bonding and give an example.(K1, CO1)

2. Explain the role of hydrogen bonds in water's properties.(K1, CO1)
3. Discuss the importance of buffers in biological systems.(K1, CO1)
4. Describe the concept of enthalpy and its significance in biological reactions.(K1, CO1)
5. Explain the Second Law of Thermodynamics and the concept of free energy. Describe in situ and ex situ bioremediation techniques.(K1,CO1)
6. Discuss the role of a superbug in biodegradation.(K5,CO5)
7. Describe the production and applications of industrial enzymes such as amylase, protease, and lipase.(K5, CO5)
8. Explain the process of immobilization in enzyme production.(K5, CO5)

Part: C

1. Compare and contrast ionic, covalent, coordinate covalent, and hydrogen bonds, with examples.(K1, CO1)
2. Explain the pH scale and the role of buffers in maintaining pH stability in biological systems.(K1, CO1)
3. Discuss the First and Second Laws of Thermodynamics with respect to biological systems, including the role of entropy and free energy.(K1, CO1)
4. Explain bioremediation in detail, discussing both in situ and ex situ methods and the role of engineered organisms (like superbugs) in biodegradation and environmental cleanup.(K5, CO5)
5. Discuss different fermentation techniques and the industrial production of enzymes, including applications in biotechnology and bioreactors for culturing plant cells and secondary metabolites.(K5, CO5)
6. Describe various applications of transgenic plants in agriculture, including pest and disease resistance, abiotic stress tolerance, Golden Rice, and edible vaccines.(K4, CO4)

Head of the Department **Course Instructor**

Dr. Hanna

Jeeja Alexander

Teaching Plan

Department : Botany
Class : II M.Sc. Botany
Title of the Course : CORE LAB COURSE IV: CORE COURSE VIII AND IX

Semester : III
Course Code : BP234CP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP234CP1	-	-	6	-	5	6	90	25	75	100

Learning Objectives:

1. Extract biomolecule of diverse nature from different sources so that they will be able to assess the metabolic profile of their source material.
2. Recognize the role that water plays in several physiological processes in plants.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	perform quantitative tests for all major macro molecules and file a report of chemical profile of a plant cell.	**K1**
2.	understand the structure and properties of various enzymes.	**K2**
3.	apply the fundamentals of water and its relation to plants.	**K3**
4.	compare the role of pigment in photosynthetic mechanism and related events of plants.	**K4**
5.	evaluate the theory and practical skills gained during the course and create idea to seek for suitable job in relevant industries.	**K5 & K6**

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I									
	1.	**PLANT PHYSIOLOGY :** 1. Determination of osmotic potential by plasmolytic method. 2. Determination of water potential using gravimetric method. 3. Determination of water potential using dye method (Chardakov's method).	10	3	K2(U)	Experimental learning	Hands-on Specimen Observation		Demonstration of Experiments
	2.	1. Effect of Monochromatic light on apparent photosynthesis. Effect of CO_2 concentration on	8		K 3(Ap)	Experimental learning	Hands-on Specimen Observation		Demonstration of Experiments

		apparent photosynthesis.							
II									
	1.	**PLANT PHYSIOLOGY** 1. Effect of temperature on protoplasmic membrane. 2. Separation of chloroplast pigments using paper chromatographic technique. Estimation of chlorophyll content using Arnon's method.	18	3	K2(U)	Experimental learning	Hands-on Specimen Observation	-	Demonstration of Experiments
III									
	1	**BIOCHEMISTRY** 1. Rice coleoptile growth test for Indole Acetic Acid. 2. .	6	4	K 3(Ap)	Experimental Learning	Observation of experiment & Interpret	-	Demonstration of Experiments
	2	Effect of auxin on root initiation	6		K1(K)	Experimental Learning	Observation of experiment & Interpret	-	Demonstration of Experiments

	3	Experiments to show the heribicidal action of Auxin (2-4,D).	6		K4(An)	Experimental Learning	Observation of experiment & Interpret	Youtube videos	Demonstration of Experiments
IV									
	1	**BIOCHEMISTRY** Estimation of Proline content.	4	4	K4(An)	Experimental Learning	Observation of experiment & Interpret	MS Word	Demonstration of Experiments
	2	Determination of Relative Water content	5		K5(E)	Experimental Learning	Observation of experiment & Interpret	Physiology online book	Demonstration of Experiments
	3	Estimation of Glycine betaine content	5		K2(U)	Experimental Learning	Observation of experiment & Interpret	-	Demonstration of Experiments
V									
	1	**APPLIED BIOTECHNOLOGY** Isolation of genomic DNA.	5	3	K2(U)	Experimental Learning	Observation of experiment & Interpret	-	Demonstration of Experiments
	2	Electrophoresis of nucleic acid .(Demo)	4		K 3(Ap)	Experimental Learning	Observation of experiment & Interpret	-	Demonstration of Experiments
	3	Preparation of competent *E.coli* cells. (Demo)	5		K1(K)	Experimental Learning	Observation of experiment & Interpret	-	Demonstration of Experiments
	4	Transformation and recovery of plasmid clones.(Demo)	4		K4(An)	Experimental Learning	Observation of experiment & Interpret	-	Demonstration of Experiments

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability, Skill Development**

Activities (Em / En /SD): **Hands on Training on Sectioning of Plant Species.**

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): **Environmental Sustainability**

Environment Sustainability activities related to Cross Cutting Issues**: Field visit to Microbiology Lab**

Sample Questions

1. Determination of osmotic potential by plasmolytic method**.(K3, CO1)**
2. Determination of water potential using gravimetric method. **.(K3, CO1)**
3. Determination of water potential using dye method (Chardakov's method). **.(K3, CO2)**
4. Effect of Monochromatic light on apparent photosynthesis. **.(K3, CO2)**
5. Effect of CO_2 concentration on apparent photosynthesis**.(K3, CO3)**
6. Effect of temperature on protoplasmic membrane. **.(K3, CO3)**
7. Estimation of chlorophyll content using Arnon's method. **.(K3, CO4)**
8. Estimation of Proline content. **.(K3, CO4)**
9. Estimation of Glycine betaine content. **.(K3, CO5)**
10. Determination of Relative Water Content.**(K3, CO5)**

Head of the Department **Course Instructor**

Dr. J. Hanna Jeeja Alexander

M.Sc. BOTANY

Teaching Plan
Department : Botany
Class : II M.Sc. Botany
Title of the Course : ELECTIVE COURSE VI a) - FORESTRY AND WOOD TECHNOLOGY

Semester : III
Course Code : BP234EC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP234EC1	4	-	-	-	3	4	60	25	75	100

Objectives

To study various aspects of Forest Botany.

To raise student awareness of the need to create a sustainable way of living and the current Global issues with forestry caused by human interference.

Course outcomes

Course outcomes:	On completion of this course, the students will be able to: CO	PSO addressed	Cognitive level
CO 1	gain knowledge on various aspects of forest botany	PSO -1	**K1**
CO2	understand the importance and of different forests.	PSO -1	**K2**
CO3	apply the ecological significance of forests in creating it	PSO -2	**K3**
CO4	analyse the dynamics of the forest.	PSO -2	**K4**
CO5	describe and concentrate on various Indian forests laws and acts.	PSO-4	**K5 & K6**

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
1	1	Introduction and scope of Forest Botany - Merits of combining traditional Botany and Forestry practices.	1	2	K1(R)	Introductory session	Participative Learning-Brainstorming	Lecture videos	MCQ, Quiz
	2	Forest and gene conservation - Forest and ecosystem -	1		K2(U)	Lecture using Chalk and talk,	Participative Learning-brainstorming	Youtube videos	Google forms
	3	Forest and civilization. Geographical history of the forest vegetation - natural vs. artificial.	2		K1(R)	Reflective thinking	Participative learning-Flipped classroom,	Interactive PPT	Class test
	4	Special emphasizes on social forestry, Industrial forestry and multi-purpose forestry.	2		K3(Ap)	Integrative learning	Experiential learning Field visit	O lab	Quiz questioning in classroom
	5	Preservation of natural forestry - Pollution control.	1		K4(An)	Inquiry based approach	Participative learning – solving problems	Interactive PPT	I CIA

II	**1**	Forest genetics, Forest physiology, Forest ecology – strong interrelationships.,	2	**2**	K1(R)	Brainstorming	Participative learning brainstorming	Demonstrative videos	Essay questions ,Home work
	2	Seedlings, leaves, bark branching pattern architectural models of trees.	2		K1(R)	Demonstrative	Experiential learning - demonstration	Simulative videos	Class t test
	3	Major and minor forest products, use and misuse of forests by man,	2		K3(Ap)	Collaboative learning	Participative learning Exhibits- forest products	YouTube videos	Slip test
	4	Direct And Indirect Forest Wealth, Forest Policies, Forest Protection Through Peoples Committee.	2		K4(An)	Integrative learning	Participative learning Seminar	E-content MS Word	Qui questioning in classroom
III	**1**	**Silviculture:** concept and scope of study, forest in general form, composition,	2	**2**	K1 (U)	Lecture method	Participative learning Brainstorming	E-content MS Word	Summative examination
	2	classification of world forests and Indian forests.	2		K2(R)	Flipped classroom	Participative learning G Group discussion	Animated videos	Home work
	3	Classification based on its quality density, tolerance, crown; water cycles of forest.	2		K4(An)	Group discussion	Group discussion		Multiple choice questions

	4	Photosynthetic processes in forest: nitrogen and mineral nutrition in forests.	3		K4(An)	Demonstartive	Participative learning Demonstartion using charts		Assignments
IV	**1**	**Seed dynamics in forest:** seed production, dissemination, germination, establishment and mortality.	3	**3**	K4(An)	Lecture method	Experientiallearning Power point presentation	Interactive PPT	Google forms
	2.	Growth of trees in general terms – height, diameter, volume, growth of stands	3		K4(An)	Blended learning	Paicipative learning Seminar	Animated videos	Online assignment
	3.	gross increment, net increment, stand reaction to varies types of cuttings.	3		K4(An)	Simulation	Problem solving Lateral thinking	Econtent- MS Word	Oral test
V	**1**	**Measurement:** definition, direct measurements, direct and indirect estimate.	3	**3**	K5(Ev)	Inquiry based approach	Participative learning Using visuali mages	Econtent- PPT	Slip test
	2.	Measurement of volume – common units, different methods and procedures of volume measurements. Measurement of age: direct estimate.	3		K5(Ev)	Computational thinking	Using computational hardware	Econtent- PPT	Oral presentation

	3.	Progress to be achieved in social forestry, industrial forestry and multiple forestry. Forest Laws- Indian Forest Act, 1927; Forest conservation Act. Wild Life Protection Act, 1972.	3		K5(Ev)	Context based, Case study method	Participative learning Analyse problem situations	Virtual field tours	Online assignment
	4.	Forest Laws- Indian Forest Act, 1927; Forest conservation Act. Wild Life Protection Act, 1972.	3			Context based	Participativel earning Group Discussion	Interactive E book	Summative examination

Course Focussing on Employability/ Entrepreneurship/ Skill Development : **Skill Development**
Activities (Em/ En/SD): Model making
Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): **Environment Sustainability**
Activities related to Cross Cutting Issues : **-**
Assignment **: Forest Laws/ online**
Seminar Topic: **Silviculture**

Sample questions

Part A

1. Agroforestry the definition implies that___ **(K1,CO1)**

a. Agroforestry normally involves two or more species of plants at least one of which is a woody perennial
b. An agroforestry system always has two or more outputs
c. The cycle of an agroforestry system is always more than one year
d. All of the above

2. The primary forest product is _____(**K2, CO2)**

3. Which one is the major objective of coppicing? **(K3, CO3)**

a. Collection of fire wood. b Emergence of new shoot.
c. Production of green manure. d. None of the above.

4. Which of the following method is used to check varietal purity**?(K4, CO4)**

a.Germination test b. Grow out test
c. Viability test d. Vigour test5.

5. Social forestry means_____ **(K5, C05)**

a. It is forestry of people by the people and for the people

b. The forestry in which the efforts aimed at raising and managing trees for the benefits of rural people

c. Both (a) & (b)

d. None of these

Part B

1. What is the significance of integrating traditional botany and forestry practices**?(K1, CO1)**
2. Forest genetics, Forest physiology, Forest ecology – comment its strong interrelationships**.(K2, CO2)**
3. Explain photosynthetic process in forest **(K3, CO3)**
4. Write short note on Seed dynamics in forest **(K4, CO4)**
5. List out the progress to be achieved in industrial forestry and multiple forestry (**K5, C05)**

Part C

1. Explain social forestry and its role in conservation**. (K1, CO1)**
2. Summarize the Major and minor forest products **. (K2, CO2)**
3. Write an account on world forest**. (K3, CO3)**
4. Explain stand reaction to varies types of cuttings**.(K4, CO4)**
5. Describe the Indian Forest Act of 1927, the Forest Conservation Act, and the Wild Life Protection Act of 1972**.(K5, C05)**

Head of the Department **Course Instructor**

Dr. J. Celin Pappa Rani

SEMESTER IV

ELECTIVE COURSE VII: a) INDUSTRIAL BOTANY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP234EC4	**4**	**-**	**-**	**-**	**3**	**4**	**60**	**25**	**75**	**100**

Department : Botany
Class : II M.Sc. Botany
Title of the Course : ELECTIVE COURSE VII a) – Industrial botany
Semester : III
Course Code : BP234EC4

Learning Objectives:

1.To learn the applied aspects of industrial application of algae, fungi, bacteria, plants, molecular biology and recombination technology.

2. To acquire knowledge on *in vitro* cultivation techniques to develop protocols targeted towards commercialization.

Course outcomes

On the successful completion of this course, the students will be able to:		
1.	understand the basics of algae in industrial applications.	**K1**
2.	demonstrate and to recollect the uses in fungi in industries.	**K2**
3.	use bacterial role in industries.	**K3**
4.	compare and contrast the use of plants in industries.	**K4**
5.	discuss and develop skills for working in industries specializing in biomolecules.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate; **K6** - Create

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	1	Algae in industries: Fertilizer industry-Seaweeds	3	4	K1(U)	Brainstorming	Participative learning Brainstorming	Interactive PPT	Oral test
	2	Pharmaceutical industry – antibiotics, agar, carageenin, alginin, diatomate earth	4		K1(U)	Brainstorming	Participative learning Power Point presentation	Interactive PPT	Slip test
	3	mineral industry, fodder industry	3		K1(U)	Brainstorming	Participative learning Using charts	Ms word	Online assessment
II	1	Fungi in industries: Beneficial use of yeast.	4	4	K3(Ap)	Integrative teaching	Experiential learning Assignments	Animated videos	Online assignment
	2	Fermentation of alcohol, preparations of enzyme, organic acid preparation.	3		K3(Ap)	Simulation	Experiential learning Using visualimaes	Demonstrative videos	Quizquestioning
	3	Cheese production, protein manufacture, vitamins, fats.	4		K3(Ap)	Collaboration	Participativelearning Seminar		Presentation

III		Plant products: Fibres and Fibre-Yielding Plants, wood and cork, tannins and dyes, rubber, fatty oils	5	3	K4 (Ev)	Reflective thinking	Experiential learning Exhibits	Video clips	Formative assessment
		Vegetable fats, sugars and starches, pulp and paper, gums and resins.	5		K4 (Ev)	Simulation	Experiential learning Role play	Demonstrative videos	Home work
IV		Bacteria in industry: Food industry, dairy products, bioleaching, biogas production, bioremediation	5	4	K3(Ap)	Constructivism	Experiential leaning Making models	Virtual lab vist	Student presentation
V		Recombinant plants: Tissue culture: Micropropagation, somatic seeds, cell culture.	5	4	K4(An)	Blended learning	Experientalleraning - Advanced lab experiemnts	E book	Observation note

Course Focussing on Employability/ Entrepreneurship/ Skill Development : **Skill Development**
Activities (Em/ En/SD): Role play
Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): **Environment Sustainability**
Activities related to Cross Cutting Issues : **-**
Assignment : Fibres and Fibre-Yielding Plants **/ online**
Seminar Topic: Seeweeds- fertilizer industry

Sample questions

Part A

1. Agar agar is obtained from_____.(**K1, CO1)**
2. Which of the following is obtained by fermenting milk?(**K2,C02**)
   a. Gundruk
   b. Cheese
   c. Sinki
   d. Kombucha
3. Commercial Rubber is produced from_____.(**K3, CO3)**
4. Name the major organism employed in biogas production_____. **(K4,C04)**
5. A totipotent cell means _____**(K5, CO5)**
   a.An undifferentiated cell capable of developing into a system or entire plant.
   b. An undifferentiated cell capable of developing into a complete embryo

c.An undifferentiated cell capable of developing into an organ
d. Cells which lack the capability to differentiate into an organ or system.

Part B

1. Enlist the antibiotics obtained from seaweeds **(K1, CO1)**
2. Comment on beneficial use of yeast.(**K1, CO 2**)
3. Write short note on sugars and starches (**K3, CO3**)
4. List the beneficial bacteria in food industry **(K4, CO4)**
5. Write short note on cell culture **(K5, CO5)**

Part C

1. Summarize the source, production process of diatomite earth**.(K1, CO1)**
2. Explain the process of organic acid preparation.(**K2, CO2**)
3. Write a detailed account on pulp and paper production. (**K3, CO3**)
4. Microorganism assist in Bioremediation- Explain (**K4, CO4**)
5. Elaborate the process of Micropropagation. **(K5, CO5)**

Head of the Department **Course Instructor**

Dr. J. Celin Pappa Rani

Department : Botany

Class : II M.Sc. Botany
Title of the Course : SKILL ENHANCEMENT COURSE III: PROFESSIONAL COMPETENCY IN BIOLOGY
Semester : III
Course Code : BP234SE1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
BP234SE1	4	-	-	-	2	4	60	25	75	100

Learning Objectives:

1. To understand the concept of agronomy and sustainable agriculture.
2. To learn the mechanism underlying the shift from vegetative to reproductive phase.

Course outcomes

Course outcomes:	On completion of this course, the students will be able to: CO	PSO addressed	Cognitive level
CO 1	learn about the structure of atoms, molecules, and chemical bonds.	PSO -1	**K1**
CO2	demonstrate both the theoretical and practical knowledge in cell biology and molecular biology.	PSO -1	**K2**
CO3	explain and use the methods of recombinant technology.	PSO -2	**K3**
CO4	compare and contrast the physiological functions and metabolism.	PSO -2	**K4**
CO5	discuss and develop skills for effective comprehension and communication.	PSO-4	**K5 & K6**

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	1	Molecules and their interaction relevant to biology: Structure of atoms, molecules, and chemical bonds.	2	3	K1(R)	Lecture method	Experientaillearning Powerpoint presentation	Interactive PPT	Oral test
	2	Composition, structure, and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids, and vitamins).	2		K2(U)	Reflective thinking	Experientaillearning Making models		Slip test, I CIA
	3	Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).	2		K1(R)	Cooperative learning	Participative learning Brainstorming	Youtube videos	Online Assignment
	4	Principles of catalysis, enzymes and enzyme kinetics,	2		K3(Ap)	Context based	Participative learning Using charts	Animated videos	Class test
	5	Enzyme regulation, mechanism of enzyme catalysis, isozymes	1		K4(An)	Context based	Participative learning Using charts	Animated videos	Class test, I CIA
II	1	Cellular organization: Membrane structure and function	2	1	K1(U)	Simulatiom	Participative learning Using Models		Quiz questioning

	2	Structure of model membrane, lipid bilayer, and membrane protein diffusion, osmosis;	2		K1(U)	Experie ntial learning	Participative learning Using working Models	Animated videos, Virtual images	I CIA
	3	ion channels; active transport; membrane pumps; mechanism of sorting and regulation of intracellular transport; electrical properties of membranes.	2		K2(R)	Experie ntial learning	Participative learning Using working Models	Virtual lab resources	Online assignmen t
	4	Structural organization and function of intracellular organelles (cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast,	2		K3(Ap)	Constru ctivism	Participative Learning Participating and demonstrating exhibits	O lab, structural videos	Oral Presentati on
	5	Organization of genes and chromosomes: Operon, unique and repetitive DNA.	2		K3(Ap)	Integrati ve teaching	Experiential Learning- Preparing videos	Youtube Videos	Presentati on
III	1	FUNDAMENTAL PROCESSES: DNA replication, repair, and recombination: Unit of replication, enzymes involved, replication	2	2	K4(Ev)	Blended learning	Experiential Learning- making models	Interactive videos	Multiple choice questions
	2.	origin and replication fork, the fidelity of replication, extrachromosomal replicons, DNA damage and repair	1		K4(An)	Blended learning	Experiential Learning- making models	Simulative videos	Assignme nts. Open book test, oral test, CIA

		mechanisms, homologous and site-specific recombination.							
	3.	Protein synthesis and processing: Ribosome, the formation of initiation complex, initiation factors and their regulation,	1	2	K2(U)	Flipped classroom	Participative learning Describing visual images	E-books	Preparation of question bank by the students
	4.	elongation and elongation factors, termination, genetic code, aminoacylation of tRNA,	2		K2(U)	Flipped classroom	Participative learning Describing visual images	O Labsss	Preparation of question bank by the students
IV	1	Cell communication and cell signaling: Host-parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells,	2		K 3(Ap)	Lecture method	Experiential learning Powerpoint presentation	Interactive PPT	Google forms
	2.	Alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.	3		K 3(Ap)	Lecture method	Experiential learning Powerpoint presentation	Virtual lab	Online quiz assessment
	3.	Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer, and the cell cycle, virus-induced cancer,	2		K 4(Ev)	Embodied learning	Lateral thinking	Interactive videos	Summative examination, Quiz, CIA

		metastasis, interaction of cancer cells with normal cells, apoptosis.							
V	1	Basic concepts of development: Potency, commitment, specification, induction, competence, determination, and differentiation; morphogenetic gradients; cell fate and cell lineages.	3	2	K1(R)	Lecture method	Participative learning Brainstorming	Animated videos - Potency	Formative assessments
	2.	Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy	3		K1(R)	Context based	Participative learning Using charts	Online articles	Online assignment
	3.	Transition to flowering, floral meristems and floral development in Arabidopsis and Antirrhinum.	3		K 2(U)	Simulation	Participative learning Using charts	O LAB	Online assignment
	4.	Programmed cell death, aging, and senescence	2		K4 (An)	Cooperative learning	Experietial learning Powerpoint presentation	Interactive PPT	Brainstorming, formative assessment

Course Focussing on Employability/ Entrepreneurship/ Skill Development : **Skill Development**
Activities (Em/ En/SD): Model making
Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): **Environment Sustainability**

Activities related to Cross Cutting Issues : -
Assignment : Programmed cell death, aging, and senescence/ **online**
Seminar Topic: Apoptosis.

Sample questions

Part A

1. Which type of bond is primarily responsible for stabilizing the secondary structure of proteins? **(K1 C01)**

2. a) Ionic bond b) Hydrogen bond c) Covalent bond d) Hydrophobic interaction

2. The lipid bilayer structure of cell membranes is primarily stabilized by_____(**K2, CO1)**

a) Hydrophobic interactions b) Hydrogen bonds c) Covalent bonds d) Ionic bonds

3.During DNA replication, which enzyme is responsible for unwinding the DNA double helix? (**K2,C03**)

a) DNA polymerase b) Helicase c) Ligase d) Primase

4.In protein synthesis, the process of forming a peptide bond between two amino acids occurs at_____.(**K3, CO4**)

a) The nucleus b) The ribosome c) The Golgi apparatus d) The endoplasmic reticulum

5.The tumor suppressor gene that plays a critical role in preventing cancer development by regulating the cell cycle is_____.(**K4, CO5**)

a) TP53 b) MYC c)RAS d) BCL-2'

Part B

1. Describe the role of Van der Waals interactions in the stabilization of biomolecular structures.(**K1, CO1**)
2. Write short note on osmosis.(**K2, CO2**)
3. Comment on DNA repair mechanism. (**K3, CO3**)
4. Outline the main stages of translation in protein synthesis.(**K4, CO4**)
5. Briefly define the concept of morphogenetic gradients in developmental biology.(**K5, C05**)

Part C

1. Discuss the composition, structure, and function of carbohydrates. (**K1, CO1**)
2. Describe the structure and function of the lipid bilayer in cell membranes (**K2, CO2)**
3. Explain the processes involved in DNA replication (**K2, C03**)
4. Enlist the pathogen-induced diseases in animals and plants (**K4, CO4**)
5. Analyze the process of programmed cell death. (**K5, CO5**)

Head of the Department **Course Instructor**

Dr. J. Celin Pappa Rani