A.D.M. COLLEGE FOR WOMEN (AUTONOMOUS),

Affiliated to Bharathidasan University, Tiruchirappalli

(Nationally Accredited with "A" Grade by NAAC – 4th Cycle)

NAGAPATTINAM - 611 001.

DEPARTMENT OF BOTANY

UG SYLLABUS

2024 – 2025 onwards

B.Sc Botany

(For the candidates admitted from the academic year 2024-2025 Onwards)

Programme Educational Objectives (PEO)

PEO 1	To study morphological and anatomical adaptations of plants of various habitats.
PEO 2	To demonstrate techniques of plant tissue culture.
PEO 3	To familiarize with the structure of DNA, RNA.
PEO 4	To carryout experiments related with plant physiology.
PEO 5	To perform biochemistry experiments.

Programme Outcomes (POs)

PO 1	Increase the awareness and appreciation of human friendly algae and their economic importance.
PO 2	Develop an understanding of microbes and fungi and appreciate their adaptive strategies.
PO 3	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
PO 4	Compare the structure and function of cells and explain the development of cells.
PO 5	Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.

Programme Specific Outcomes (PSO)

PSO 1	The students will understand the character and life cycle of algae
PSO 2	Understand the structure of various tissues and their functions
PSO 3	Learn the internal structure of the stem, root and Leaf
PSO 4	The students will understand the plant propagation techniques. Learn about the Various angiospermic plants
PSO 5	Study the mechanism of absorption of water. Acquire knowledge on photosynthesis.

STRUCTURE OF THE UG PROGRAMME - 2024-2025 ONWARDS

Part	Category of Courses	No. of Courses	Hrs	Total Credits
Part I	Language Courses (Tamil/Hindi/French/Arabic/ Sanskrit)	4	24	12
Part II	English Language Courses	4	24	12
Part III	Core Courses (CC) (T – 9, P – 5)	14	70	60
	Minor Course (T – 4 / 5 , P – 2/1)	6	24	16
	Discipline Specific Courses (DSC)	3	10	9
	Project	1	3	3
Part IV	Skill Enhancement Courses (SEC)	4	8	8
	Ability Enhancement Courses (AEC)	3	6	6
	Multi Disciplinary Courses (NME)	2	4	4
	Environmental Studies	1	2	2
	Value Education	1	2	2
	Soft Skill Development	1	2	2
	Summer Internship/Industrial Activity	0	0	2
Part V	Gender Studies	1	1	1
	Extension Activity (NCC/NSS/Sports/Any Other Activities)	0	0	1
	Total	45	180	140

B.Sc., Botany

(For the candidates admitted from the Academic year 2024-2025 Onwards)

SEMESTER–I								
PART	**COURSE TYPE**	**COURSES**	**HOURS**	**CREDITS**	**EXAMD URATION**	**MAX. MARS**		**Total**
						CIA	**EXT**	
Part I	Language Course I	LC I – Tamil I	6	3	3	25	75	100
Part II	English Course I	ELCI –English I	6	3	3	25	75	100
Part III	Core Course I	CC I - Plant Diversity- I	5	4	3	25	75	100
	CPI-Core Practical I	Core Practical – I	3	-	-	-	-	-
	First Minor Course–I	FMC I - Allied Zoology - I	4	3	3	25	75	100
	First Minor Practical I	FMC II - Allied Zoology –II (Practical)	2	-	-	-	-	-
Part IV	Value Education	Value Education	2	2	3	25	75	100
	Skill Enhancement Course I	Basics of Botany	2	2	3	25	75	100
Extra CreditI	Extra Credit I	Professional English for life science – I &II		2	3	-	100	100
	Total			**17+2**	-	-	-	**700**

SEMESTER–II								
PART	**COURSE TYPE**	**COURES**	**HOURS**	**CREDITS**	**EXAMDU RATION**	**MAX .MAR KS**		**Total**
						CIA	**EXT**	
PartI	Language Course II	LC II –Tamil Paper II	6	3	3	25	75	100
Part II	English Course II	ELC II-English Paper II	6	3	3	25	75	100
Part III	Core Course II	CC II - Plant Diversity –II	6	5	3	25	75	100
	Core Practical I	Core Practical – I (Core paper – I & II)	2	3	3	40	60	100
	First Minor Practical I	FMC II - Allied Zoology –II (Practical)	2	2	3	40	60	100
	First Minor Course–II	FMC II - Allied Zoology –III Theory	4	3	3	25	75	100
Part IV	EVS	Environmental Studies	2	2	3	25	75	100
	SECI–Skill Enhancement Course - II	Organic Farming	2	2	3	25	75	100
*Extra Credit II	Extra Credit II	Mushroom Cultivation		2	3	-	100	100
	Total			**23+2**				

SEMESTER–III

PART	COURSE TYPE	COURSES	HOURS	CREDITS	EXAMDURATION	MAX. MARKS		Total
						CIA	EXT	
Part I	Language Course III	LC III - Tamil III	6	3	3	25	75	100
Part II	English Course III	ELC III - English III	6	3	3	25	75	100
Part III	Core Course III	CC III –Plant Anatomy and Embryology	6	6	3	25	75	100
	Core Practical II	Core Practical – II (Core paper - III)	2	-	-	-	-	
	Second Minor Course–II	SMC I - Chemistry–I	4	3	3	25	75	100
	Second Minor Practical – II	SMP I - Chemistry Practical–II	2	-	-	-	-	100
Part IV	Multi Disciplinary Course I	NME I - Bio fertilizer and Bio pesticides	2	2	3	25	75	100
	Skill Enhancement Course III	SEC III - Entrepreneurial Opportunities in Botany	2	2	3	25	75	100
*Extra Credit III	Extra credit III	Mushroom Cultivation		2	3	-	100	100
	Total			**19+2**				

SEMESTER–IV

PART	COURSE TYPE	COURSES	HOURS	CREDITS	EXAMDURATION	MAX. MARKS		Total
						CIA	EXT	
Part I	Language Course IV	LC IV - Tamil IV	6	3	3	25	75	100
Part II	English Course IV	ELC IV - English IV	6	3	3	25	75	100
Part III	Core Course IV	CC IV – Morphology, Taxonomy and Economic Botany	5	5	3	25	75	100
	Core Practical II	CP II - (Core paper – III & IV)	3	3	3	40	60	100
	Second Minor Practical – I	SMP I - Chemistry Practical–II	2	2	3	40	60	100
	Second Minor Course–II	SMC II - Chemistry III	4	3	3	25	75	100
Part IV	Multi Disciplinary Course II	NME II - Horticulture	2	2	3	25	75	100
	Ability Enhancement Course - I	Cultivation of Algae	2	2	3	25	75	100
Extra Credit IV	Extra Credit IV	Computer Literacy		2	3	-	100	100
	Total			**23+2**				

SEMESTER–V

PART	COURSE TYPE	COURSES	HOURS	CREDITS	EXAMDURATION	MAX.MARKS		Total
						CIA	EXT	
Part III	Core Course V	CC V - Cell and Molecular Biology	5	5	3	25	75	100
	Core Course VI	CC VI - Genetics, Biostatistics and Evolution	5	5	3	25	75	100
	Core Course VII	CC VII - Microbiology plant pathology and plant protection	5	4	3	25	75	100
	Core Course VIII	CC VIII - Plant Biotechnology and Bioinformatics	5	4	3	25	75	100
	Core Practical III	CP III - (Core paper – V,VI, VII & VIII)	3	3	3	40	60	100
	Discipline Specific Elective – I	DSE I - Herbal Botany	3	3	3	25	75	100
Part IV	Ability Enhancement Course-II	AEC II - Botanical Garden & Landscaping	2	2	3	25	75	100
	Soft Skill Development	SSD - Soft Skill Development	2	2	3	25	75	100
	Summer Internship/Ind. Training	Internship	-	2	-			
*Extra Credit V	Extra Credit Courses V	Indoor and outdoor gardening (Multidisciplinary)		2	3	-	100	100
	Total			**30+2**				

SEMESTER–VI

PART	COURSE TYPE	COURSES	HOURS	CREDIT	EXAMDURATION	MAX.MARKS		Total
						CIA	EXT	
Part III	Core Course IX	CC IX - Plant Physiology, Biochemistry and Biophysics	6	5	3	25	75	100
	Core Course X	CC X - Plant Ecology, Phytogeography And Environmental Biotechnology	6	5	3	25	75	100
	Core Practical IV	CP – IV (Core paper – IX & X)	3	3	3	40	60	100
	Core Course XI	CC XI - Project	3	3	3	25	75	100
	Discipline Specific Elective –II	DSE II - Agro based Entrepreneurship	3	3	3	25	75	100
	Discipline Specific Elective–III	DSE III - Seaweed Technology	4	3	3	25	75	100
Part IV	Ability Enhancement Course -III	AEC III - Botany studies for competitive Examinations (Same discipline)	2	2	3	25	75	100
	Skill Enhancement Course SEC-IV	SEC IV - Environmental Impact Analysis	2	2	3	25	75	100
Part V	GS	Gender Studies	1	1	3	25	75	100

	Extension Activity	(NCC/NSS/Sports/Any Other Activities)		1	-	-		
Extra credit VI	Extra Credit Courses VI	Culture of Microorganisms (Same Disciplinary)		2		-	100	100
	Total	**No. of Courses –**		**28+2**				

Grand Total – Credit 140 & Extra Credit 12

Semester-I / Core Course - I	PLANT DIVERSITY – I (ALGAE, FUNGI, LICHENS AND BRYOPHYTES)	Course Code:
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	The main objectives of this course are to • To relate the skill and methods in thallophytes and non-flowering plant groups. • Knowledge in Understanding the structural and functional diversity of Lowergroup of plants. • To organize for collection and examination of lower group of plants from various environment. • Justify the concept of lichens and bryophytes as indicator for water and air pollution. • To know about Bryophytes .	
UNIT	**CONTENT**	**HOURS**
UNIT I – ALGAE	Introduction and general characters of algae, Classification (F.E.Fritsch 1945) Criteria used for algal classification, phylogenic classification, Range of thallus, Reproductive diversity and life cycle patterns of Algae, Economic importance of algae	18 Hrs
UNIT II	Ecology of algae, Characteristic feature, thallus organization and reproduction of the principle classes of algae with reference to cyanophyceae- Microcystis, Oscillatoria, Lyngbya – Clorophyceae – chlorella, Hydrodictyon, Zygnema, Caulerpa, Chara and Nitella, Xanthophyceae – Botrydium, Bacillariophyceae – Navicula, Phacephyceae – Ectocarpus, Laminaria, Phodophyceae- Batrachospermum , Polysiphonia.	18 Hrs
UNIT III	General account of fungi, classification of fungi Alexopolous and mims (1979), phylogeny and cell structure, Heterosis, pararsexsuality, heterothallism, Reproduction, phylogeny and inter relationship of principle classes such as myxomycotina – Stemonitis, Mastigomycotina – Phthium, zygomycotina – Pilobolus. Ascomycotina – Penicillium, Basidiomycotina – Puccinia, Dueteromycotina – Fusarium	18 Hrs

UNIT IV	General characters of lichens and its symbionts, types, classification and distribution, thallus structure and reproduction Economic importance and ecological role of Lichens in vitro culture – A detailed study of Parmelia and Usnea	18 Hrs
UNIT V BRYOLOGY	General characters, distribution of Bryophytes (Rothmalar, 1955), Structure, reproduction and life cycle of major group – Marchantiales, Jungermaniales, Anthocerotales and polytrichales. Evolution of gametophyte and sporophyte. Ecological and economic importance of Bryophytes.	18 Hrs

References

1. Classification (F. E, Fritsch 1945). FritschF.E.1945,structureandreproductionofalgae,CambridgeUniversitypress.
2. Chapman,V.J andChapman,D.J.1975.TheAlgae,MacmillanIndiaLtd,Delhi
3. Hale,M.E(Jr)1983,TheBiologyofLichensEdwardArnoldMayland.
4. Bold,H.C&wynne,M.J.1985,Introductiontothealgae,prenticeHallofIndia,NewDelhi
5. Sharma,O.P1998TextbookAlgae,TataMcGrawHil,NewDelhi

Web-Resources:

1. https://nicholls.edu/biol-ds/bio1155/Lectures/Cell%20Biology.pdf
2. https://www.medicalnewstoday.com/article/320878.php
3. https://biologydictionary.net /cell

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Relate the morphology structure of Algae, Fungi, bryophytes and Lichens	PO1
CO2	Apply thep ractical knowledge tounderstanding the diversity of plantforms.	PO1,PO2
CO3	Examine the importance of structural diversity in the evolution of plant forms.	PO1,PO2
CO4	State the ecological and economic importance o fAlgae, Fungi, lichen and bryophytes	PO1, PO2
CO5	Compare the structural organization of gametophytes and sporophytes in different classes of bryophytes	PO1,PO2

Semester-I/Core practical – I	PLANT DIVERSITY – I (ALGAE, FUNGI, LICHEN AND BRYOPHYTE)	Course Code:
Instruction Hours:3	Credits: -	Exam Hours:3
Internal Marks:-	External Marks:-	Total Marks:-

Cognitive Level	**K1–Recalling** **K2-Understanding** **K3-Applying** **K4 – Analyzing** **K5-Evaluating** **K6–Creating**
Course Objectives	**The objectives of this course are** • To characterize the life cycle patterns of majorgroups of plants. • To learn about the practical knowledge on algae • To know about the fungi. • To study about the Parmelia and usnea. • To gaina knowledge on Bryophytes.
UNIT	**CONTENT**
	Algae Cyanophyceae- Microcystis, Oscillatoria, Lyngbya Chlorophyceae -chlorella, Hydrodictyon, Zygnema Caulerpa, chara and Nitella Xanthophyceae-Botrydium, Bacillariophyceae–Navicula Phacephyceae -Ectocarpus, Laminaria. Phodophyeae-Batrachospermum,polysiphonia.
	Fungi Myxomycotina – Stemonitis Mastigomycotina – Pythium Zygomycotina – Pilobolus Ascomycotina – Penicillium Basidiomycotina – Puccinia Dueteromycotina–Fusarium
	Lichens Parmelia Usnea

	Bryophytes Marchantiales Jungermaniales Anthocerotales Polytrichales

References

1. BiswasC.andJohriB.M.(1997).Gymnosperms.NarosaPublishers,NewDelhi.
2. Parihar,N.S.(1976).BiologyandmorphologyofthePteidophytesCentralBook Depot.
3. Sporne,K.R.(1986).ThemorphologyofPteridophytes.Hutchinson UniversityPress.London.
4. Smith, G.M.(1995).ThefreshwaterAlgae oftheUnitedStates,Mc-GrawHill,Newyork.
5. WastonE.V. (1971). Structureandlife ofBryophytes3rdHutchinsonUniversityLibraryLondon.

Web-Resources:

1. https://www.britannica.com/science/chromagraphy
2. https://gurunanakcollege.edu.in/files/science/algae-bryophytes-gungi-plant-pathology-and-lichens.pdf

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Learn about the structure, methods and reproduction of the algae	PO1,PO2,PO6
CO2	Know about the economic importance of algae, fungi and lichens	PO1,PO2, PO6
CO3	Microscopic observation and identification of algae, fungi, lichens and bryophytes	PO1,PO2, PO6
CO4	Know about the structure, life history and Economic importance of algae	PO1,PO2, PO6
CO5	Make use of practical knowledge to comprehend the variety of plant types	PO1,PO2, PO6

Semester- I /Skill Enhancement Corse - I	BASICS OF BOTANY	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**
Course Objectives	**The objectives of this course are to** • To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes. • To understand the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms. • To investigate the classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms. • Enable to learn various cell structures and functions of prokaryotes and eukaryotes and understand the salient features and functions of cellular organelles. • Understanding of laws of inheritance, genetic basis of loci and alleles.

UNIT	CONTENT	HOURS
UNIT I	Systematics : Two Kingdom and Five Kingdom systems - Salient features of various Plant Groups : Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.	6 Hrs
UNIT II	Cell as the basic unit of life - Prokaryotic and Eukaryotic Cell (Plant Cell) - Light Microscope and Electron Microscope Ultra Structure of Prokaryotic and Eukaryotic Cells - Cell Wall - Cell Membrane : Plastids, Ribosomes.	6 Hrs
UNIT III	Structure and Modification of Root, Stem and Leaf - Structure and Types of Inflorescences - Structure and Types of Flowers, Fruits and Seeds.	6 Hrs
UNIT IV	Concept of Heredity and Variation - Mendel's Laws of Inheritance.	6 Hrs

UNIT V	Cell as a Physiological Unit : Water relations -Absorption and movement : Diffusion, Osmosis, Plasmolysis, Imbibition - Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition	6 Hrs

Reference

1. Singh,V.,Pande,P.C andJain,D.K. 2021. A Text Book of Botany.Rastogi Publications,Meerut.
2. Bhatnagar, S.P and AlokMoitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
3. Sharma,O.P.2017. Bryophyta, MacMillanIndiaLtd.Delhi.
4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
5. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II, S.Chand and Co. New Delhi.
6. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.

Web-Resources:

1. https://www.britannica.com/science/tissue-culture
2. https://en.wikipedia.org/wiki/Plant_tissue_culture
3. https://microbeonline.com/animal-cell-culture-introduction-types-methods-applications/

Course outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Students will be able to explain the concept of biodiversity, including its types (genetic, species, and ecosystem diversity), and the importance of preserving biodiversity for ecosystem health and human well-being.	PO1,PO2.PO3
CO2	Students will be proficient in identifying and classifying various plant, animal, and microbial species using taxonomic and phylogenetic methods.	PO1,PO2
CO3	Students will be able to explain the mechanisms of mitosis and meiosis, and their significance in growth, reproduction, and genetic variation.	PO1,PO2.PO3
CO4	Students will learn to identify and describe the external and internal structures of plants, including roots, stems, leaves, flowers, fruits, and seeds.	PO1,PO2,PO3
CO5	Students will explore the biochemical processes of photosynthesis, respiration, and other metabolic pathways crucial for plant growth and development.	PO1,PO2,PO3

Semester-II /Core Course - II	PLANT DIVERSITY –II (PTERIDOPHYTES, GYMNOSPERM AND PALEOBOTANY)	Course Code:
Instruction Hours:6	Credits:5	Exam Hours:3
Internal Marks:25	External Marks:75	Total Marks:100

Cognitive Level	**K1–Recalling** **K2 –Understanding** **K3-Applying** **K4Analyzing** **K5-Evaluating** **K6–Creating**	
Course Objectives	**The objectives of this course are** • To categorize the Pteridophytes by their characteristic features • To rate the stellar evolution, heterospory and seed habit • To state the gymnosperms • To assess the significance geologicaltim escale and carbon dating • To appraise the significan ceandim portance of fossils.	
UNIT	**CONTENT**	**HOURS**
UNIT I	Pteridophytes -general characteristics and classification by Smith (1955). Morphology, structure, reproduction and life-histories of the following genera:-*Lycopodium, Selaginella*	18 Hrs
UNIT II	Morphology, structure, reproduction and life-histories *Equisetum* Marsilea, Stelar evolution in Pteridophytes. Heterospory and seed habit	18 Hrs
UNIT III	Gymnosperms-general characteristics and classification of Gymnosperms by Sporne (1965), Morphology, structure and mode of reproduction and life-histories of the following genera--*Cycas, Pinus* and *Gnetum*	18 Hrs
UNIT IV	Paleo botany- fossils and methods of fossilization-Different types of fossils. Geological time-scale-an elementary knowledge of the computation of the age of fossils-Radio Carbon dating.	18 Hrs
UNIT V	A brief study of the following fossil forms:- *Rhynia, Lepidodendron, Lepidocarpon, Calamites* and *Williamsonia*.	18 Hrs

References

1. Smith. G.M.(1965):Cryptogamic Botany Vol.II(2ndEdn.,)(Bryophytes and Pteridophytes)TataMcGrawHillPublishingCo.,NewDelhi.
2. Sporne. K.R. (1970):The Morphology of Pteridophytes (The Structure of Ferns andAlliedPlants)HutchinsonUniversityLibrary,London.Bierhorst. D.W. (1971):Morphology of Vascular Plants. The MacMillan Co., N.Y. andCollier-MacMillanLtd.,London.
3. Coulter.J.M.andChamberlainC.J.(1964):MorphologyofGymnospermsCentralBookDepot,Allahabad.
4. Sporne.K.R.(1971):TheMorphologyof Gymnosperms(TheStructureandEvolutionofPrimitiveseedPlants)HutchinsonUniversityLibrary,London.
5. Arnold.C.A.(1947):AnIntroductiontoPaleobotanyMcGrawHillBookCo.,N.Y.,Seward.A.C.(1959):PlantLifeThroughtheAgesHafnerPublishingCo

Web resources

1. https://www.pdfdrive.com/biochemistry-books.html

Course Outcomes

CO	On completion of this course, students will be able to	Program outcome
CO1	Compare the classification of pteridophytes	PO1,PO3,PO6
CO2	Measure the evolution of sporophytes, heterospory and seed habit and stellar evolution of pteridophytes	PO1,PO3,PO6
CO3	Understanding about gymnosperms their classification	PO1,PO3
CO4	Illustrate the geological time scale and carbon dating	PO1,PO3,PO6
CO5	Rate the distribution and reconstructed structure of fossils	PO1,PO3,PO6

Semester-II/ Core practical I & II	**PLANT DIVERSITY- I & II (ALGAE, FUNGI, LICHENS, BRYOPHYTES , PTERODOPHYTES, GYNOSPERMS AND PALEOBOTANY)**	**Course Code:**
Instruction Hours:2	**Credits:3**	**Exam Hours:3**
Internal Marks:40	**External Marks : 60**	**Total Marks :100**

Cognitive Level	**K1–Recalling** **K2-Understanding** **K3-Applying** **K4-Analyzin** **K5-Evaluating** **K6–Creating**
Course Objectives	**The objectives of this course are** • Describe habit and habitat of pterodophytes their characteristics and classification • To Describe stellar variation and evolution of stele in pteridophytes • Distinguish and identify the pteridophytes in your surroundings • To know about the distribution and economic importance of pteridophytes • Briefly studied on Gymnosperm
UNIT	**CONTENT**
	Pterodophytes *Lycopodium* – Stem and cone *Selaginella* - Stem and Cone *Equisetum* – Stem and Cone *Marsilea* – Rhizome and Sporocarp
	Gymnosperms Cycas Rachis, Leaflet–T.S; Coralloid root, male cone. Megasporophyll and Microsporophyll. Needle –T.S. Young stem – T.S; Male and Female cone. Stem –Gnetum–T.S, Male and Female Strobilus–Demonstration only. **Paleobotany-Slides**- *Rhynia,Lepidodendron,Lepidocarpon*,*Calamites*and*Williamsonia* **Fossils:** Impression, Compression and petrification.

Semester-II / Skill Enhancement Course II	Organic farming	Course Code:
Instruction Hours:2	Credits:2	Exam Hours:3
Internal Marks:25	External Marks:75	Total Marks:100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• To enable students to gain knowledge on the scope of organic farming and its significance • To impart practical insights sustainable agriculture, green manuring, recycling and composting • To study sustainable agriculture • To know about the importance of bio fertilizers	
UNIT	**CONTENT**	**HOURS**
UNIT I	Soil – physical, chemical properties. Soil pollution – oil, chemicals –fertilizers, pesticide and herbicide, non-degradable solids, biomagnification, consequences of land pollution – damage to soil and crops.	**6 Hrs**
UNIT II	Organic farming – definition, basic concept of organic farming, integrated plant nutrient supply management, integrated insect pest and disease management, integrated soil and water management. Sustainable agriculture practices-crop rotation, mixed cropping.	**6 Hrs**
UNIT III	Management of organic wastes and green manures: Farm manures, Composts, Mulches and pest control, importance of organic manure, importance of green manure, crops of green manure, oil cake. Animal based organic manure–cow dung, vermicomposting-methods, production and utilization.	**6 Hrs**
UNIT IV	Biofertilizers–classification, nitrogen fixers–*Rhizobium*, Cyanobacteria, *Azolla*and Vesicular Arbuscular Mycorrhiza.	**6 Hrs**
UNIT V	Recycling of bio-degradable municipal, agricultural and Industrial wastes – bio compost making methods.	**6 Hrs**

References

1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services.

2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers.
3. SubbaRao N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition.Medtech
4. Vayas,S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming AktaPrakashan, Nadiad.
5. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.

Web Resource

https://www.freebookcentre.net/medical_text_books_journals/microbiology_ebooks_online_texts_download.html

Course Outcomes

CO	**On completion of this course, students will be able to**
CO1	Recognize the different forms of bio fertilizers and their uses
CO2	Explain and interpret the components, patterns, and processes of bacteria for growth in crop production.
CO3	Apply techniques for synthesizing green manure and develop strategies to increase crop yield.
CO4	Analyze and decipher the significance of biofertilizers in soil fertility
CO5	Develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India

Semester-II / Extra Credit Course II	MUSHROOM CULTIVATION	Course Code:
Instruction Hours: 6	**Credits: 2**	**Exam Hours: 3**
Internal Marks	**External Marks- 100**	**Total Marks: 100**

Cognitive Level	**K1-Acquire / Remember** **K2-Understanding** **K3-Apply** **K4-Analyze** **K5-Evaluate** **K6-Create**	
Course Objectives	❖ To learn and develop skills in mushroom cultivation ❖ To understand and appreciate the role of mushrooms in Nutrition, Medicine and health. ❖ To cultivate mushroom cultivation in small scale industry. ❖ To learn about diseases and post harvest technology. ❖ To study new methods and strategies to contribute to mushroom production	
UNIT	**CONTENT**	**HOURS**
UNIT I	Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.	**18 Hrs**
UNIT II	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.	**18 Hrs**
UNIT III	Life cycle of *Pleurotus spp* and *Agaricus spp.*	**18 Hrs**
UNIT IV	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing	**18 Hrs**
UNIT V	Diseases and post harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.	**18 Hrs**

Text Book:

1.Text Book of Womens, Health Lila A.Wallis, 1997

2. Nutrition Science, B.Sri Lakshmi,2008

Reference Books:

1.Essential of food and nutrition,Vol.I and II,Swaminathan.M,2006

2.Food chemistry,L.G.Meyor

3.Food Science,Polter

4.Nutrition Science,B.Sri Lakshmi,2008

5.A text book of Health Worker (ANM),Vol I and II ,A.M .Chacklay.

Web Resources:

1. https://www.elsevier.com/books/women-and-health/goldman/978-0-12-288145-9.

2. **https://www.ebooks.com/en-us/subjects/health-fitness-women-s-health-ebooks/401/.**

Course Outcomes

CO	On completion of this course, students will be able to
CO1	Ensure the students to acquire knowledge on anatomy of female reproductive system and related diseases.
CO2	To understand the concepts of vaccines and genetic complication during the pregnancy.
CO3	To understand acquire knowledge on different types of parturition and vaccination for infants.
CO4	Ensure the students to understand acquire knowledge on diagnosis and treatment in health problem for women
CO5	Ensure the students to understand acquire knowledge on balanced diet and physical activity for women

Semester-III / Core Course III	PLANT ANATOMY AND EMBRYOLOGY	Course Code:
Instruction Hours: 6	**Credits: 6**	**Exam Hours: 3**
Internal Marks -25	**External Marks-75**	**Total Marks: 100**

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Assess classification, Identification, Structure, Function and role of apical to Lateral meristem in plant growth. • To employ the function and organization of woody stem. • Categorize anatomy of stem, root and leaf to their secondary growth. • To assess the process of seed setting. • To illustrate the structure of Micro, Megasporangium and Gametophyte.	
UNIT	**CONTENT**	**HOURS**
UNIT I	Introduction, Scope and importance, History of plant Anatomy, type of cells and tissues, Classification of planttissues, Meristematic tissues, types, structure and function.Epiderma ltissue system, secretary tissues, Development of plant body.	**18 Hrs**
UNIT II	Simple permanent tissues–Parenchyma, Collenchyma and Sclerenchyma, Structure, Composition and function. Complex permanent tissue–xylem, phloem structure, composition and function. Primary structure of Monocot stem,leaf and root.	**18 Hrs**
UNIT III	Stem thickening in Monocot and Dicots. Root thickening of Dicot. Anomalous Secondarygrowth in stem of *Boerhavia, Bignonia, Nyctanthes* and *Dracaena* Structure, function and Seasonal Activity of Cambium, Structure and development of Periderm.	**18 Hrs**
UNIT IV	Structure and development of Microsporangium and male gametophyte. Structure and development of megasporangium. Structureof ovules and its types, development of ovule megasporagenesis. Development of embryosac–Monosporic–*Polygonum* type bisporic – *Allium* type and tetrasporic–*Pepromia* type.	**18 Hrs**
UNIT V	Double fertilizationand Triple fusion. Apomixis, Development of Endosperm, Dicotembryo (*Capsella*type) and Monocot embryo (*Lyzula*type), Poly embryony structure of fruit and seed.	**18 Hrs**

References

1. Tayal,M.S.PlantAnatomy,3rdedition(2012).Rastogipublications,Meerut.
2. Pandey,B.P.(1978).PlantAnatomy,S.Chand&Co.,NewDelhi.
3. Vasishta,F.C.AtextbookofpantAnatomy.PradeepPublications,Jullendar
4. Katherine Esau,(1975).PlantAnatomy,WileyEasternPrivateLtd.,NewDelhi.
5. Johi,B.M.(1984).EmbryologyofAngiosperm, Springlerverlag,Berlin.

Web Resources:

1. https://www.kobo.com/us/en/ebook/fundamentals-of-herbal-medicine-3.
2. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine- natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu.

Course Outcomes

On completion of the course the learner will be able

CO1: Inspect process of compatibility involved in plant reproduction.
CO2:Comply importance and tissues involved in secondary growth of Dicot and Monocot

CO3:State the types of plant growth and compare their structure, function and its process of luxury and plant growth

CO4: Demonstra tean omalous Secondary growth indicot and Monocot.

CO5: Examine fertilization,types of Endosperm, dicot embryo, Polyembryony, Parthenocarpy and Apomixis.

Semester- III / Core Practical III	PLANT ANATOMY AND EMBRYOLOGY	Course Code:
Instruction Hours: 2	Credits: -	Exam Hours: -
Internal Marks : -	External Marks: -	Total Marks: -

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 - Creating**
Course Objectives	The main objectives of this course are to • To provide basic knowledge of plant internal architecture and cellularcomposition and reproduction. • To familiar with the history of microscopy and different parts of compound microscopes. • To learn about different techniques of anatomy like sectioning and staining. • To know mountingedia and mounting techniques. • To explain the common stains for plant cells
UNIT	**CONTENT**
	Anatomy 1. Identifying Stomatal types using leaf peel method *2.* Stem–Primary Structure–*Tridax*, *Zeamaize* 3. Root–Primary structure Bean,Canna indica *4.* Leaf anatomy–*Nerium* 5. Anamalous Secondary growth–*Boerhavia*, *Nyctanthes* and *Achyranthes*.
	Embryology 1. T.S. of anther 2. Variousstages of embryo Sac, Endosperms, Male and Female gametophytes Polyembryony to bestudied bypermanent Slide. 3. Dissection of Embryo –*Tridax,* Dissection of conidia of Calotropis

References

1. Bhojwani,S.S.,Bhatnagar,S.P.,DantuP.K.(2015).EmbryologyofAngiosperms,6thedition.NewDelhi,Delhi:VikasPublicationHousePvt.Ltd.
2. Fahn,A.(1982).Plantanatomy.Oxford,U.K.:PergamonPress.
3. Mauseth, J.D. (1988).Plant Anatomy. San Francisco,California:TheBenjamin/CummingsPublisher
4. CoutlerE.G.,1969.PlantAnatomy–PartICellsandTissues–

EdwardArnold,London.
5. Dickison,W.C.(2000).IntegrativePlantAnatomy,HarcourtAcademicPress,USA.

Web-Resources:

1. https://www.youtube.com/watch?v=6qnSsV2syUE
2. https://www.youtube.com/watch?v=9_h0ZXx1lFw
3. https://slideplayer.com/slide/9431799/

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Understand the scope and importance of Anatomy and Embryology.	PO1
CO2	Understand the normal and anomalous secondary growth in plants and their causes.	PO1
CO3	Perform the techniquesin anatomy.	PO1
CO4	Know fertilization, endosperm and embryogeny.	PO1,PO2

Semester-III / Non Major Elective I	BIO FERTILIZER AND BIO PESTICIDES	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	The main objectives of this course are to • To describe the importance of biofertilizers and their cultivation. • To learn mass cultivation of different biofertilizers. • To identify the types of mycorrhiza and its advantages. • To assess the knowledge about the types of biopesticides and its advantages. • To understand the mechanism and action of biopesticides.	
UNIT	**CONTENT**	**HOURS**
UNIT I	Definition, Classification of fertilizers (Synthetic and Natural fertilizer), organic fertilizers, Biofertilizers – General account and importance, Fertilizers application method (Foliar, seed dressing, soil drenching),Dry and wet formulation.	6 Hrs
UNIT II	Mass cultivation: Bacterial biofertilizers *Azospirillum*, *Azotobacte r*and Rhizobium and Cyanobacterial biofertilizers–*Anabaena and nostoc*.	6 Hrs
UNIT III	Fungal biofertilizers, Mycorrhizal Classification, isolation and its importance, VAM-Inoculum production and its field applications	6 Hrs
UNIT IV	Biopesticides – Definition, types and mass production of biopesticides, methods and application of biopesticides. Methods of quality control and Techniques ofbiopesticides. Advantages of biopesticides and commercialization.	6 Hrs

UNIT V	Mechanism of action and application of biopesticides – viral origin (*NPV*) – fungalorigin (*Trichoderma*)– bacterialorigin (*Pseudomonas* and *Bacillus*).	6 Hrs

References

1. Joshi,S.R.(2018).Biopesticides:ABiotechnologicalApproach.New AgeInternational(P)Ltd.,Publishers.
2. Koul, O. and Dhaliwal, G.S. 2012. Biopesticides and Pest Management.CumpusBooksInternational.
3. SubbaRao,N.S.(2000).SoilMicrobiology.OxfordandIBHPublishingCo.Pvt.Ltd., NewDelhi.
4. Varma,A.andHock,B.(1995).MycorrhizaSpringer–Varlag,Berlin.
5. YaacoVokan(1994).Azospirillum/PlantAssociations.CRCPress,BocaRato n,FL.

Web-Resources:

1. https://www.freebookcentre.net/medical_text_books_journals/microbiology_ebooks_ online_texts_download.html
2. http://www.microbeworld.org

Course Outcomes

CO	**On completion of this course, students will be able to**
CO 1	Understand the importance of biofertilizers.
CO 2	To organize the biofertilizers for mass cultivation parameters.
CO 3	To categorize the type of biofertilizers to be used.
CO 4	To employ the biofertilizers for commercialization.
CO5	Aware the mechanismand action of biopesticides.

Semester-III/ Skill Enhancement Course III	ENTREPRENEURIAL OPPORTUNITIES IN BOTANY	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	K1-Acquire / Remember K2-Understanding K3-Apply K4-Analyze K5-Evaluate K6-Create	
Course Objectives	• Encourage the development of sustainable farming practices, including organic farming, permaculture, and agroforestry, to meet growing food demands while conserving biodiversity • Foster innovation in the creation of new products from plants, such as herbal medicines, natural cosmetics, essential oils, biofuels, and plant-based foods. • Develop businesses that focus on the conservation and restoration of native plant species and ecosystems, promoting ecotourism or reforestation services. • Encourage research and commercialization of biotechnological applications like plant breeding, genetic modification, or tissue culture to improve crop yields, resilience, and quality. • Explore botanical solutions for the health and wellness industry, including herbal supplements, nutraceuticals, and alternative medicine using plant-based treatments.	
UNIT	**CONTENT**	**HOURS**
UNIT I	Introduction to Entrepreneurship, Scope and identification of new ventures using plant resources, Mechanism of product selection and commercialization	**6 Hrs**
UNIT II	Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites.	**6 Hrs**
UNIT III	Production of Biofertilizers, Vermicompost, Spirulina and Azolla cultivation, Mushroom cultivation, Bonsai, Bouquet making,	**6 Hrs**
UNIT IV	Product commercialization and business strategy, Dyes, Cosmetics and Perfumes, Gums and Jute Products.	**6 Hrs**
UNIT V	Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues	**6 Hrs**

References

1. Botany for Gardeners" by Brian Capon
2. Plant Biotechnology and Genetics: Principles, Techniques, and Applications" by C. Neal Stewart Jr.
3. The Botany of Desire" by Michael Pollan
4. The Lean Startup" by Eric Ries
5. Botany: An Introduction to Plant Biology" by James D. Mauseth

Web Resources:

https://www.pdfdrive.com/cosmetology-books.html.

https://www.pdfdrive.com/cosmetology-e57742835.html.

Course Outcomes

CO	On completion of this course, students will be able to
CO1	Relate to how various fields of botany could be understood with an entrepreneurial approach.
CO2	Explain the concept of Entrepreneurial Opportunities in Botany
CO3	Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations.
CO4	Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc.
CO5	Develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing.

Semester-III/ Extra Credit Course III	MUSHROOM CULTIVATION	Course Code:
Instruction Hours: 6	Credits: 2	Exam Hours: 3
Internal Marks	External Marks- 100	Total Marks: 100

Cognitive Level	**K1-Acquire / Remember** **K2-Understanding** **K3-Apply** **K4-Analyze** **K5-Evaluate** **K6-Create**
Course Objectives	❖ To learn and develop skills in mushroom cultivation ❖ To understand and appreciate the role of mushrooms in Nutrition, Medicine and health. ❖ To cultivate mushroom cultivation in small scale industry. ❖ To learn about diseases and post harvest technology. ❖ To study new methods and strategies to contribute to mushroom production

UNIT	CONTENT	HOURS
UNIT I	Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.	**18 Hrs**
UNIT II	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.	**18 Hrs**
UNIT III	Life cycle of *Pleurotus spp* and *Agaricus spp.*	**18 Hrs**
UNIT IV	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing	**18 Hrs**
UNIT V	Diseases and post harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.	**18 Hrs**

Text Book:

1. Text Book of Womens, Health Lila A.Wallis, 1997
2. Nutrition Science, B.Sri Lakshmi,2008

Reference Books:

1. Essential of food and nutrition,Vol.I and II,Swaminathan.M,2006
2. Food chemistry,L.G.Meyor
3. Food Science,Polter
4. Nutrition Science,B.Sri Lakshmi,2008
5. A text book of Health Worker (ANM),Vol I and II ,A.M .Chacklay.

Web Resources:

1. **https://www.elsevier.com/books/women-and-health/goldman/978-0-12- 288145-9.**
2. **https://www.ebooks.com/en-us/subjects/health-fitness-women-s-health-ebooks/401/.**

Course Outcomes

CO	On completion of this course, students will be able to
CO1	Ensure the students to acquire knowledge on anatomy of female reproductive system and related diseases.
CO2	To understand the concepts of vaccines and genetic complication during the pregnancy.
CO3	To understand acquire knowledge on different types of parturition and vaccination for infants.
CO4	Ensure the students to understand acquire knowledge on diagnosis and treatment in health problem for women
CO5	Ensure the students to understand acquire knowledge on balanced diet and physical activity for women

Semester-IV / Core Course–IV	MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY	Course Code:
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The main objectives of this course are to** • Compare the knowledge on classification and nomenclature of plant • To describe the characters off amilies and economic importance of Monocot and Dicot plants. • To employ herbarium preparation, Binomial systemof plants. • To apply typification, authorcitation, rules of naming in plants and modern taxonomy • To discuss the pollination methods and mechanism of seed dispersion in Angiosperms.	
UNIT	**CONTENT**	**HOURS**
UNIT I	Leaf phyllotaxy, leaf Types, shapes and modifications, stem types and modifications (Underground, aerial and sub-aerial). Root types and modifications, inflorescence types, flower and its parts. Fruits classification.	18 Hrs
UNIT II	Introduction to principle of Taxonomy and their importance. Classification–Natural – Bentham & Hooker, phylogenetic – Armen Takhtajan and APG in brief –Merits and Demerits. Plant Nomenclature, ICBN, ICN and Binomial system, preparation, maintenance and importance of Herbarium.	18 Hrs
UNIT III	Study of the following families and their economic importance: Annonaceae, Capparidaceae, Anacardiaceae, Rutaceae, Leguminosae, (Fabaceae, Ceasalpinaceae and Mimosaceae).	18 Hrs

UNIT IV	Study of the following families and their economic importance; Asteraceae, , Rubiaceae, Asclepiadceae, Solanaceae and Lamiaceae, Amaranthaceae, Nyctaginaceae, Aristolochiaceae, Euphorbiaceae – lilliaceae, Commelinaceae and Poaceae.	18 Hrs
UNIT V	Study of binomial, family and morphology useful parts and uses of the following plant products fibre–*Canabis sativum*resin–*Ferule Osafoetida*, Timber–*Terminalia bellerica*, Pulses-*Cajanuscajan*, Oil – *Sesamum indicum*, Spices – *Pipernigrum*.	18 Hrs

References

1. Vasishta,P.C.1994.Taxonomy of Angiosperms,R.S.Chand&Company.
2. Verma, B.K.(2011).Introduction to Taxonomy of Angiosperms. PHILearningPvtLtd. NewDelhi.
3. Sharma,O.P.(1993). Plant Taxonomy Tata McGrawHill.
4. Subramaniyan N.S.Modern PlantTaxonomy.
5. Singh,VandJain,J.Taxonomy of Angiosperms, Rastogi publication, Meerut.

Web-Resources:

1. www.biologydiscussion.com/notes/enzymes-2.notes
2. https://www.britannica.com/science/protein/The-mechanism-of-enzymaticaction
3. https://www.youtube.com/watch?v=oVJ2LJxO6tU

Course Outcomes

CO	**On completion of this course, students will be able to**	**Programme outcome**
CO1	Compare plant groups and recogni zetherole of Herbarium.	PO1
CO2	Assess the importance of Herbaria and Botanical gardens.	PO1,PO2
CO3	Employ the rule of ICBN in Botanical Nomenclature.	PO1,PO3
CO4	Analyze the terms and concepts related to phylogenetic systematics.	PO1,PO3
CO5	Examine the characters of families according to Bentham and Hooker'ssystem of classification.	PO1,PO2,PO6

Semester-IV / Core Practical –II	MORPHOLOGY, EMBRYOLOGY AND ECONOMIC BOTANY	Course Code:
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks :40	External Marks:60	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**
Course Objectives	**The main objectives of this course are to** • To study morphological characters of leaf, stipule, stem and root. • Recognizing the taxonomic traits of the various plant groups. • The objective of this course is to familiarize students with the basic concepts. • Applications of modern techniques used in Cell and Molecular Biology and Genetics, Biostatistics and evolution. • The students will be able to understand the principle and working of statistical estimation.
UNIT	**CONTENT**
	Study of Morphological Characters Leaf, Stipule, Stem and Root, Infloresunce, flower and Fruits.
	A detailed study of following Families Annonaceae, Capparidaceae, Rubiaceae, Anacardiaceae, Rutaceae, Leguminocae (Fabaceae, Ceasalpinceae and Mimosaceae). Asteraceae, Rubiaceae, Asclepiadaceae, Solanaceae and Lamiaceae, Amaranthaceae, Nyctaginaceae, Aristolochiaceae, Euphorbiaceae, Lilliaceae, Commelinaceae and Poaceae. Botanical Tour (2-3 days) to floristicri chareain and around TamilNadu.

References

1. Vasishta,P.C.1994.Taxonomy of Angiosperms,R.S.Chand&Company.
2. Verma, B.K.(2011).Introduction to Taxonomy of Angiosperms.PHI Learning Pvt Ltd. New Delhi.
3. Sharma,O.P.(1993).Plant Taxonomy Tata Mc Graw Hill.

4. Subramaniyan N.S.Modern Plant Taxonomy.
5. Singh,VandJain,J.Taxonomy of Angiosperms, Rastogi publication, Meerut.

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	Compare plant groups and recognize the role of Herbarium.	PO1
CO2	Assess the importance of Herbaria and Botanical gardens.	PO1,PO2
CO3	Employ the rule of ICBN in Botanical Nomenclature.	PO1,PO3
CO4	Analyze the terms and concept tsrelated to phylogenetic systematics.	PO1,PO3
CO5	Examine the characters of families according to Bentham and Hooker'ssystemo fclassification.	PO1,PO2,PO6

Semester-IV/ Non major Elective	Horticulture	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**
Course Objectives	**The objectives of this course are to** • Create a calming and pleasing environment. • Increase humidity levels, which can be beneficial in dry environments. • Support local biodiversity by providing habitats for birds, insects, and other wildlife. • Engage in physical activity through gardening tasks. • Experiment with various gardening techniques and technologies. Promote an understanding of ecological and environmental principles.

UNIT	CONTENT	HOURS
UNIT I	**Introduction:** Importance – History and development of gardening – Hindu style – Buddhist garden – Moghul garden – Japanese garden – British garden.	6 Hrs
UNIT II	**Garden Plant components :** Arboretum – Shrubbery — Topiary – Edge – Hedge – Terrace garden, Flowering annuals and herbaceous perennials – Climbers and creepers – Ornamental palms – Ferns.	6 Hrs
UNIT III	**Garden Non plant components:** Rock garden – Water garden- Fountain- Statue- Arches Pergola- Urns- Tubs.	6 Hrs
UNIT IV	**Landscaping**: Principles of landscaping – Lawn and lawn maintenance – Principles, planning and execution of private garden – Public garden and factory garden.	6 Hrs
UNIT V	**Indoor gardening:** Decorative plants – Bonsai – Principles of flower arrangement – Decoration with indoor plants for conference hall, living room, dining hall and verandah flower arrangement.	6 Hrs

1. GopalSamyIyengar ,1990, Complete Gardening In India ,IBH, India
2. Indoor gardening, Vishnu Swarup, ICAR, New Delhi.
3. Nambison, K.M.P. 1992. Design elements of landscape gardening. Oxford and IBH Publications, New Delhi.
4. Pratibha and P.Trivedi, 1990. Beautiful shrubs, ICAR, New Delhi.
5. 5. Pratibha and P.Trivedi. 1987. Home Gardening. ICAR, New Delhi.

Web-Resources:

1. http://old.noise.ac.in/SecHmscicour/english/LESSON O3.pdf
2. https://study.com/academy/lesson/energy-yielding-nutrients-carbohydratesfat-protein.html.
3. https://www.nhsinform.scot/healthy-living/food-and-nutrition/eatingwell/vitamins-and-minerals.

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Identify suitable indoor plants for various environments and purposes.	PO1,PO5
CO2	Learn techniques for planting, repotting, pruning, and propagating indoor and outdoor plants.	PO1
CO3	Manage indoor environmental factors such as light, temperature, humidity, and air circulation	PO1,PO2
CO4	Assess soil types and conditions, and improve soil health through amendments and composting.	PO1,PO2
CO5	Arrange plants to enhance interior design and create visually appealing displays.	PO1,PO5,PO6

Semester-IV / Ability Enhancement Course -I	Cultivation of Algae	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The main objectives of this course are to** ❖ To impart sufficient information about the culture and cultivation of algae under laboratory and outdoor conditions ❖ To study the media composition for algae cultivation and high value products and its applications. ❖ To know about the important seaweeds and its cultivation practices ❖ To study the SLF production and applications in agriculture crops To understand about the Environment Impact Assessment of algal cultivation	
UNIT	**CONTENT**	**HOURS**
UNIT I	Morphology, life history and mass culture of microalgae: Spirulina, Chlorella, Dunaliella and Botryococcus.	6 Hrs
UNIT II	High value products: Single Cell Protein (SCP), phycocyanin, β-carotene, astaxanthin – biofuel, media composition - scale up - lab to land - raceway ponds and photobioreactor	6 Hrs
UNIT III	Marine macroalgae: Morphology, life history and mass cultivation of Gracilaria, Kappaphycus, Sargassum and Ulva	6 Hrs
UNIT IV	Polysaccharides: agar, carrageen, alginate - economic importance - seaweed as food, feed and Seaweed Liquid Fertilizer (SLF)	6 Hrs
UNIT V	Role of seaweeds in aquaculture: Environment Impact Assessment of algal cultivation.	6 Hrs

Text Book:

1. Laboratory manual in Biochemistry, J. Jayaraman, 2nd edition, NewAge International Publishers, 2011,
2. An Introduction to Practical Biochemistry, David T. Plummer, 3 rd edition, Tata McGraw-Hill Publishing Company Limited, 2001.

Reference Books:

1. Biochemical Methods, S. Sadasivam and A. Manickam , 4h edition, New Age International Publishers, 2016

2. Essentials of Food and Nutrition, Vol. I & II, M.S. Swaminathan.
3. Bowman and Robert M. 2006. Present Knowledge in Nutrition. 9th edition, International Life Sciences Publishers.
4. Indrani TK. 2003. Nursing Manual of Nutrition and Therapeutic Diet, 1st edition Jaypee Brothers medical publishers.
5. Martha H. and Marie A. 2012. Biochemical, Physiological, and Molecular Aspects of Human Nutrition. 3rd edition. Chand ,Publishers.

Web-Resources:

1. https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors
2. http://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf
3. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y
4. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	Cognizance of basic food groups viz. Carbohydrates, proteins and lipids and their nutritional aspects as well as calorific value	PO1,PO5
CO2	Identify and explain nutrients in foods and the specific functions in maintaining health.	PO1
CO3	Classify the food groups and its significance	PO1,PO2
CO4	Understand the effect of food additives	PO1,PO2
CO5	Describe the importance of nutraceuticals and pigments	PO1,PO5,PO6

Semester-V / Core Course–V	CELL AND MOLECULAR BIOLOGY	Course Code:
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	• **The main objectives of this course are to** • To make them understand the plant cell. • To explain the cell structure and organelles. • To discuss the cell division mechanism. • To state the gene expression and regulation. • To learn the regulation of gene expression.	
UNIT	**CONTENT**	**HOURS**
UNIT I	History and introduction of cell, Ultra structure of prokaryotic and eukaryotic cell. Plant cell structure and function, Cell wall-structure, chemistry and functions. Plasma membrane-structure, chemistry and function-Celltheory..	15 Hrs
UNIT II	Structure and functions of mitochondria and chloroplast, Structure and functions of ER, Golgi complex, ribosome and cytoskeletons, Structure and functions of nucleus and nucleolus.	15 Hrs
UNIT III	Cell cycle events of cell cycle, Molecular structure and functions of DNA and RNA. Cell divisions - Mitosis and Meiosis. Genetic regulation of cell cycle in Yeast, Cellular checkpoints, DNA replication, DNA polymerases, eukaryotic system, origin, elongation and termination mechanisms, replication models Cairn's model, linear DNA model, rolling circle model, inhibitors of replication.	15 Hrs
UNIT IV	Expression of genome, Transcription, RNA polymerase. Prokaryotic and eukaryotic transcription, promoters mediated initiation, RNA polymerases I, II and III, elongation and termination, post transcriptional processing, genetic code, Wobble' shypo thesis, el	15 Hrs

	ongation and termination of translation.	
UNIT V	Process of transcriptional regulation, Eukaryotic regulation, response elements, DNA binding domains– promoters, repressors, co activators, co repressors, enhancer elements. DNA repair mechanisms. Post - translational modification of proteins. Protein folding-self-assembly and role of chaperones. Principles of gene regulation: *lac* and *trp*operons of *E. coli*. Gene families and hormonal control in eukaryotes.	15 Hrs

REFERENCES:

1. AjoyPaulTextBookofCellandMolecularBiology,BooksandAllied(P)Ltd,2007.
2. BuchananBBGruissemWJonesRL.BiochemistryandMolecularbiologyofPlants,IKInternationalPublishers,NewDelhi.2000.
3. FreifelderD.MolecularBiology(2ndedition)NarosaPublishers,NewDelhi.1994.
4. VermaPSAgarwalVK.MolecularBiology(Firstedition),S.ChandandCompanyLtd.NewDelhi,(2009).
5. MolecularbiologyofthecellFifthedition-2008.
6. CellandmolecularbiologyRastogipublications,fourthrevisededitionby P.K.Gupta@2015

Web-Resources:

1. https://www.intechopen.com/books/secondary-metabolites-sources-and-applicationanintroductory- chapter-secondary-metabolites
2. https://www.toppr.com/guides/biology/plant-growth-and development/plantgrowth

Course Outcomes

CO	On completion of this course, students will be able to	Program Outcomes
CO1	Describe the ultra-structure and functions of plant cell.	PO1
CO2	Understand the cell cycle and cell division types in plants.	PO1,PO3
CO3	Understand the central dogma of molecular biology	PO1
CO4	Record the mechanism of transcription, translation in prokaryotes and eukaryotes.	PO1,PO2.PO3

Semester-V / Core Course V	GENETICS BIOSTATISTICS AND EVOLUTION	Course Code:
Instruction Hours: 5	Credits: 5	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The objective of this course are to** • To describe the Mendelian principles andMutation and its role in evolution • To compare the linkage and cros sing over • To apply the measures of central tendency and know about the collection and classification of data • To discuss the importance of analysis of variance • To rate the theories of evolution.	
UNIT	**CONTENT**	**HOURS**
UNIT I	Genetics-Monohybrid and Dihybrid cross. Deviation from mendelian ratio: Incomplete dominance (Mono-anddihybrid), lethalfactor, complementary factor andepistasis (dominant), Multiple factor Hypostasis, multiplealleles. Mutations–types mutagens, physical and chemical mutagens. Mutationrate–its role ine volution.Geneunits –Cistron, Recon, Muton, Codon and Operon	15 Hrs
UNIT II	Linkage, crossing over, recombination, cytological proof of crossing over,mapping of genes on the chromosomes, sex linkage-Drosophila (eyecolour), humans (colourblindness) and plants, cytoplasmic inheritance .Changesin chromo some structure, number and behaviour.	15 Hrs
UNIT III	Introduction, Population and sample, variables, Collection of data, Classification and Tabulation of data, Diagrams and Graphs, Frequency distribution. Introduction, Measures of Central tendency – Mean, Median, Mode. Measures of dispersion Range, Co efficient of Range, Standard deviation, Standard error, coefficient of variation.	15 Hrs

UNIT IV	Random and Non – Random sampling, Test of Hypothesis and significance for small and large sample, Chi – square test and Goodness of fit, Analysis of variance (ANOVA – one way).	15 Hrs
UNIT V	Evolutionary concepts. Theories of Lamarck, Charles Darwin and the modern synthetic theories and biological evolution.	15 Hrs

Text Book:

1. Sinnott, E.W., L.C. Dunn and J. Dobshansky (1958): Principles of Genetics (5thEdition)McGrawHillPublishingCo.,N.Y.Toronto,London.
2. Srb, A.M. Owen,R.D. and Edgar, R.S. (1979): General Genetics Eurasia PublishingHouse(P)ltd.,NewDelhi.
3. Palaniyappan, S. (1987): Marabiyal (Genetics-In Tamil) V.K. publishing House,Madras. Ahluwalia, K.B. (1990): Genetics Wiley Eastern Ltd., New Delhi, Bangalore,Bombay,Calcutta,Madras,Hydrabad.
4. Palaniyappan, S. (1987): Marabiyal (Genetics-In Tamil) V.K. publishing House,Madras.Ahluwalia,K.B.(1990):GeneticsWileyEasternLtd.,NewDelhi,Bangalore,Bombay,Calcutta,Madras,Hydrabad.
5. Renganathan,T.K.and Shanmugavel,S.(1996):GeneticsandGeneticEngineeringCommercialOffsetPrinters,Sivakasi,India

Web-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_bt40/preview
2. https://onlinecourses.swayam2.ac.in/cec20_bt05/preview
3. https://youtu.be/8uahFPl6ny8

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Describe the Mendel in principles.	PO1
CO2	Contras the linkage and crossing over.	PO1,PO2
CO3	Acquire knowledge on the different measures of biostatistics.	PO1, PO4
CO4	Understanding sampling methods and test of hypothesis.	PO1,PO2
CO5	Relate on theories of evolution.	PO1,PO3

Semester-V / Core Course VII	MICROBIOLOGY, PLANT PATHOLOGY AND PLANT PROTECTION	Course Code:
Instruction Hours: 5	**Credits: 4**	**Exam Hours: 3**
Internal Marks -25	**External Marks-75**	**Total Marks: 100**

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The objective of this course are to** • To evaluate the structure, reproduction, culture and economic importance of bacteria • To evaluate the structure, reproduction, culture and economic importance of virus. • To know about the factors responsible for the plant diseases • To collect knowledge on the pathogens causing diseases in plants. • To relate the plant protection methods. Column chromatography.	
UNIT	**CONTENT**	**HOURS**
UNIT I	Bacteria–Discovery, general characteristics and cell structure; mode of ntrition – Reproduction. Sterilization techniques, bacterial culture and staining techniques (simple and differential). Economic importance.	12 Hrs
UNIT II	Viruses =Discovery, generalstructure. Symptoms of virus infection inplants; transmission of plant viruses – structure and multiplication of Bacteriophages & TMV; genome organization. Structure and multiplication of viroids. Economic importance.	12 Hrs
UNIT III	Plant Pathology: History–importance – causative organisms and Biotic and Abiotic factors responsible for plant diseases. General symptoms, Pathogenesis, Host–pathogen interaction	12 Hrs
UNIT IV	Study of plant diseases–Symptoms, causative organisms, disease cycleand control measures: (a) Cereals: Rice – blast disease; (b) Vegetables: Brinjal – Little leaf; (c) Fruits:Banana–Bacterial leaf blight, Citrus – Bacterial canker; (d) Oil seeds: Ground nut –Tikka disease;(e)	12 Hrs

	Sugar yielding:Sugarcane–redrot. f. Tubers: Potato – Blight disease.	
UNIT V	Plant Protection–Scope, importance, equipmentused-sprayers–dusters–soilin jector–seed dressing drum; seed treatment–soil sterilization. Methods of plant protection a) Cultural–Tillage, sowing and planting dates, crop rotation and fertilizer. b) Mechanical–Field sanitation. c) Physical–Heatand soil Sterilization. d) Chemical Bactericides, Fungicides, Insecticides, Herbicides. e) Biological–Biological control of pests.	12 Hrs

References

1. Carpenter,P.L.(1967).Microbiology.SaundersCo.,Philadelphia,USA.
2. Stanier,R.Y.,Adelberg,E.A.andIngram,J.L.(1978).GeneralMicrobiologyMacMillan& Co.,NewDelhi.
3. Pelizar,M.J.,Chan,E.C.S.andKrieg,N.R.(1993).Microbiology.TataMcGrawHillPublishingCo.Ltd.,NewDelhi.
4. Dubey,R.C.andMaheshwari,D.K.(2007).ATextbookofMicrobiology.S.ChandandCo. Ltd.,NewDelhi.
5. MicrobiologyThirdEdition-*RichardA.HarveyandCynthiaNauCornelissen*.
6. BapReddy,D.andJoshi,N.C.(1991).PlantProtectioninIndia.AlliedPublishersLtd.,New Delhi.

Web Resources:

1. https://www.amazon.in/Practical-Herbal-Medicine-Handbook- Reference-ebook/dp/B00QR9QLRY.

Course outcome

CO	**On completion of this course, students will be able to**
CO1	Understand the structure, reproduction, culture and economic importance of bacteria
CO2	Understandandthestructure,reproduction,cultureandeconomicimportanceofvirus
CO3	Explain the causes of different plant diseases
CO4	Recognize different plant pathogens
CO5	Explain different plant protection methods.

Semester-V / Core Course VII	CORE COURSE VIII PLANT BIOTECHNOLOGY AND BIOINFORMATICS	Course Code:
Instruction Hours: 5	Credits: 4	Exam Hours: 3
Internal Marks -25	External Marks-75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The objective of this course are to** 1. To comprehend the advances made in the field of plant biotechnology; and bioinformatics 2. To understand how merejum bling of genes results in the creation of new organisms 3. The content of the course contributes for food security and human health towards sustainable agriculture. 4. The aim of this course is to emphasize the integration of computer science, statistics and cellular and molecular instrumentations for developing and applying biological research. 5. This course will make the students to understand basic and advanced principles, concepts, and operations of electrophoresis, spectroscopy and chromatography.	
UNIT	**CONTENT**	**HOURS**
UNIT I	Biotechnology: definition and scope. Tissue culture: sterilization methods,media preparation (MS basal medium); use of different explants types;materials and callus growth; differentiation; subculturing and hardening.	12 Hrs
UNIT II	Plasmids: general features and types; plasmids as vectors - pBR 322, Ti-plasmid; cosmids, phagemids, Lambda-phage; transposons; site directed mutagenesis.	12 Hrs

UNIT III	Steps involved in genetic engineering: generation of desired foreign genes by restriction enzymes and cDNA synthesis; joining DNA molecules; transfer of rDNA molecules into bacteria and plants. Southern and Western blotting. PCR technique.Role of *Agrobacterium* in plant genetic engineering.	12 Hrs
UNIT IV	Importance and application areas: biomass production - food (single cell proteins); bio-fertilizers. Environmental Biotechnology: Waste treatment – solid (compost), Liquid (industrial effluents), sewage treatment (domestic sewage).	12 Hrs
UNIT V	Bioinformatics: History,scope and applications. Types of biological data bases. Nucleic acid databases - Genebank, NCBI, EMBL, DDBJ; Primary protein databases - SWISSPROT, TrEMBL; Secondary protein databases - PROSITE, PROFILES, PRINTS, Pfam; Structural classification databases - SCOP, CATH; Literature databases - PubMed, Medline.	12 Hrs

REFERENCES:

1. Arthur, M.L.(2005).*Introduction to Bioinformatics*(Ed:2).Oxford University Press, New York.
2. Attwood, T.K. and Parrysmith,D.J.(2001).*Introduction to Bioinformatics*. Pearson Education, New Delhi.
3. Chatterji, A.K. (2011).*Introduction to Environmental Biotechnology*. Prentice Hall India Pvt., Ltd., New Delhi.
4. Dubey, R.C. (2013). A Textbook of Biotechnology. S. Chand& Company Ltd., New Delhi.
5. Gupta, P.K. (1994).*Elements of Biotechnology*. Restogi Publications, Meerut.
6. Ignacimuthu, S. (1997).*PlantBiotechnology*.Oxford& IBM Publishing Co., New Delhi.
7. Kalyan Kumar De. (1997).*Plant Tissue culture*. New central Book Agency, Calcutta.
8. Kumar, H.D. (1991).*A Textbook on Biotechnology*.East west press, New Delhi.
9. Parihar, P. (2014).A Textbook of Biotechnology. Argobios Publications, Jodhpur
10. Purohit, S.S. (2003).*Agricultural Biotechnology*. Agrobios Publications, Joshpur.
11. Trevan, M.D., Boffey, S., Goulding, K.H. and Stanbury, P. (1988). *Biotechnology–TheBiologicalPrinciples*.TataMcGrawHillPublishingCo., New Delhi.

Web sources

https://plant-biotech.net/
https://onlinelibrary.wiley.com
www.nipgr.res.in › library_web › free_online_res
www.ncbi.nlm.nih.gov/pmc/articles/PMC5037948/
https://www.amboss.com/us/knowledge/Statistical_analysis_of_data
https://www.nottingham.ac.uk/-sczsteve/Ohlendieck%20and%20Harding%202018.pdf

Course outcomes

CO	**On completion of this course, students will be able to**
CO1	Explain the basics, methodology and applications of plant tissue culture
CO2	Design experiments for functional characterization of plant genes and to identify those suitable¬ for creating agronomically important traits.
CO3	Conceptualize plant transformation, selection of desirable genes for crop improvement, design¬ binary vector and procedure for generating GM crops.
CO4	Explain which type of data is available from the most common public databases like (NCBI, EMBI, UniProt, GenBank, Protein Data Bank, CATH).
CO5	Explain the theories underlying the most common methods for sequence searches and sequence¬ alignments, and in particular knows the principle and main steps for pairwise and multiple sequence alignments.

Semester-V / Core Practical III	CELL AND MOLECULAR BIOLOGY, GENETICS, BIOSTATISTICS, EVOLUTION, MICROBIOLOGY, PLANT PATHOLOGY, PLANT PROTECTION, PLANT BIOTECHNOLOGY AND BIOINFORMATICS	Course Code:
Instruction Hours: 3	**Credits: 3**	**Exam Hours: 3**
Internal Marks :40	**External Marks:60**	**Total Marks: 100**

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**
Course Objectives	The main objectives of this course are to • The objective of this course is to familiarize students with the basic concepts. • Applications of modern techniques used in Cell and Molecular Biology and Genetics, Biostatistics and evolution. • The students will be able to understand the principle and working of statistical estimation. • To study morphological characters of leaf, stipule, stem and root. • Recognizing the taxonomic traits of the various plant groups.
UNIT	**CONTENT**
	CELL AND MOLECULAR BIOLOGY 1. Observation of cells in onion peeling. 2. Observation of cell division in onion root tip and Rheo flower buds. 3. Differential staining methods for characterization of cells. 4. Isolation of total DNA from onion bulbs by using salt and detergent method.
	GENETICS BIOSTATISTICS AND EVOLUTION 1) Monohybrid Experiment 2) Dihybrid Experiment 3) Incomplete Dominance Tabulation of data, Diagrams and Graphs, Standard deviation, Standard error, Chi – Square and one way Anova.
	MICROBIOLOGY, PLANT PATHOLOGY & PLANT PROTECTION Tools and equipment used in microbiology: Spiritlamp, Inoculationloop,

	Hotairoven, Autoclave, Pressure Cooker, Laminar air flow chamber, Incubator. Media preparation, Serial techniques and plating techniques. Types of Bacteria from temporary / permanent slides / photographs; Binary fission, conjugation. Simple and differential staining. Slide preparation of causative organisms in plant disease. Identification of various plant protection appliances mentioned in the syllabus and their working mechanism.
	BIOTECHNOLOGY & BIO INFORMATICS 1. MS media preparation 2. Tissue culture techniques

REFERENCES:

1. Jain VK. Fundamentals of Plant Physiology (14th Ed), S. Chand and Company Ltd, New Delhi, 2012.
2. Jain JL. Jain S and Jain N. Fundamentals of Biochemistry. S. Chand and Company Ltd., New Delhi, 2008.
3. Narayanan P. Essentials of Biophysics, New Age International Publishers (P) Ltd., NewDelhi, 2000.
4. Stryer L. Biochemistry, W. H. Freeman and Co., New York, 1989.
5. Taiz L and Zeiger E. Plant physiology (Second edition). The Benjamin/Cummings publishing company, Inc., California, New York, 1998.

Web-Resources:

1. https://www.youtube.com/watch?v=QNYlX5Ne9lQ
2. https://www.slideshare.net/doctorrao/agglutination-tests-and-immunoassys
3. https://microbenotes.com/introduction-to-precipitation-reaction/

Course Outcomes

CO	On completion of this course, students will be able to	Program outcomes
CO1	The outcomes of this course is to familiarize students with the basic concepts.	PO1,PO2
CO2	Applications of modern techniques used in Cell and Molecular Biology and Genetics, Biostatistics and evolution. To study morphological characters of leaf, stipule, stem and root.	PO1,PO2,PO6
CO3	The students will be able to understand the principle and working of statistical estimation.	PO1,PO2.PO6

Semester-V / Discipline Specific Elective -I	HERBAL BOTANY	Course Code:
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	The main objectives of this course are to • Employ the various Indian system of medicine • Examine the drugs from various parts o fplants • Interpret the application of drugs • Recognize the significance of plants in ethnobotanical practices • To construct the interrelationship of humans and plants.	
UNIT	**CONTENT**	**HOURS**
UNIT I	Brief history of medicinal plants. Indian systems of medicines-Siddha, Ayurvedha and Unani. Classifications of crude drugs, Chemistry of drugs. Drugs from roots (*Rauwolfia*). Drugs form bark (Cinchona). Drugs from wood (*Ephedra*).	9 Hrs
UNIT II	**Drugs from leaves** (Adathoda). **Drugs from flower**, (*Eugenia*). **Drugs from fruits and seeds** (wood apple and Coriander, Underground stem (Ginger).	9 Hrs
UNIT III	A brief account of drugs acting on the central nervous system, drugs used in disorders of gastrointestinal tract and cardiovascular drugs. Cultivation of medicinal plantsin India. Breeding methods appliedto medicinal herbs	9 Hrs
UNIT IV	Significance of the following plantsin ethno botanical practices (along with their habitat and morphology)a) *Azadiracta indica*b) *Ocimum sanctum* c) *Vitexne gundo*.d) *Gloriosa superba*e) *Tribulusterrestris*f) *Pongamiapinnata* and g). *Rauvol fiasepentina*,	9 Hrs

UNIT V	Introduction, concept, scope and objectives. The relevance of ethnobotany in the present context. Major ethnic people in Tamil Nadu. Ethnobotany as a source of drug.a) Reserpineb) Artemisinc) Gugulipidd) Strychnine	9 Hrs

REFERENCE :

1. SanaLoue, Research Ethics: Theory and Practice,
2. Jasan off, S.The Ethics of Invention: Technology and the Human Future
3. RSubramanian, Professional Ethics, Oxford University Press.
4. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing
5. R.R.Gaur,R.Sangal,G.P.Bagaria. A Foundation Course in Human Values and Professional Ethics, Excel Books, Delhi.

1. https://www.britannica.com/science/metabolic-disease/Disorders-of-carbohydrate-metabolism
2. https://www.slideshare.net/MohitAdhikary/gastric-and-pancreatic-function-tests
3. https://onlinecourses.nptel.ac.in/noc20_ge13/preview

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Appreciate the various Indian system of medicine.	PO1,PO3,PO6
CO2	Identify drugs from various parts of plants.	PO1,PO3,PO6
CO3	Restate the knowledge and application of drugs.	PO1,PO3,PO6
CO4	Information on the ethnobotanical practices.	PO1,PO3,PO6
CO5	Manage the significance of ethnobotany.	PO1,PO3,PO6

Semester-V / Ability Enhancement Course – II	BOTANICAL GARDEN AND LANDSCAPING	Course Code:
Instruction Hours: 2	**Credits: 2**	**Exam Hours: 3**
Internal Marks :25	**External Marks: 75**	**Total Marks: 100**

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The main objectives of this course are to** • To know about the fundamental concepts of gardening and landscaping. • To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning. • To illustrate the significance of garden adornments and propagation structures. • To inculcate entrepreneurial skills in students for creative landscaping design using CAD software • To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping	
UNIT	**CONTENT**	**HOURS**
UNIT I	Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden, etc. Special types of gardens, their walk-paths, bridges, constructed features.	6 Hrs
UNIT II	Bioaesthetic planning, definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds	6 Hrs
UNIT III	Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parks and public gardens. Landscape designs, Styles of garden, formal, informal and free style gardens, types of gardens	6 Hrs

UNIT IV	Establishment and maintenance, special types of gardens, Bio-aesthetic planning, ecotourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.	6 Hrs
UNIT V	Computer Aided Designing (CAD) for outdoor and indoorscaping Exposure to CAD (Computer Aided Designing).	6 Hrs

Text Book:

1. Manickam,S.S.(2018).BiochemicalMethods(3rded.).NewageInternationalPvtLtd publishers –

   ISBN 10: 8122421407 / ISBN 13: 9788122421408
2. Plummer,D.T.(n.d.).AnIntroductiontoPracticalBiochemistry.TataMcGraw Hill-ISBN: 97800708416
3. Alan H Gowenlock. 1998. Varley's Practical Clinical Biochemistry, 6th edition, CBS Publishers, India.
4. B. Godkar. 2020. Textbook of Medical Laboratory Technology Vol 1 & 2 Paperback, 3rd edition, Bhalani Publishers.
5. Kanai L Mukerjee. 1996. Medical Lab Technology, Vol I& II, 1st edition, Tata Mcgraw Hill, Pennsylvania.
6. RanjnaChawla. 2014. Practical Clinical Biochemistry Methods and interpretations 58 (Paperback). 4th edition, Jaypee Brothers Medical Publishers, New York.

Reference Books:

1. Singh,S.K.(2005).IntroductoryPracticalBiochemistry(2nded.).AlphaScience International, Ltd- ISBN 10: 8173193029 / ISBN 13: 9788173193026
2. Ashwood, B. a. (2001). Tietz Fundamentals of Clinical chemistry. WB Saunders Company, Oxford Science Publications USA - ISBN 10: 0721686346 / ISBN 13: 978072168634

Web-Resources:

1. https://www.elsevier.com/journals/clinical-biochemistry/0009-9120/guide-for-authors
2. http://rajswasthya.nic.in/RHSDP%20Training%20Modules/Lab.%20Tech/Biochemistry/Dr.%20Jagarti%20Jha/Techniques%20In%20Biochemistry%20Lab.pdf
3. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y
4. https://dspace.cuni.cz/bitstream/handle/20.500.11956/111493/Clinical_biochemistrypdf.pdf?sequence=1&isAllowed=y

Course Outcomes

CO	On completion of this course, students will be able to	Programme outcome
CO1	To know about the fundamental concepts of gardening and landscaping.	PO1,PO2
CO2	To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.	PO1,PO2
CO3	To illustrate the significance of garden adornments and propagation structures.	PO1,PO2,PO3, PO6
CO4	To inculcate entrepreneurial skills in students for creative landscaping design using CAD software	PO1,PO2,PO3
CO5	To create the design	PO1,PO2,PO3, PO6

Semester-V / Extra Credit Courses V	INDOODR AND OUTDOOR GARDENING	Course Code:
Instruction Hours: 6	Credits: 2	Exam Hours: 3
Internal Marks :-	External Marks:100	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The main objectives of this course are to** • Create a calming and pleasing environment. • Increase humidity levels, which can be beneficial in dry environments. • Support local biodiversity by providing habitats for birds, insects, and other wildlife. • Engage in physical activity through gardening tasks. • Experiment with various gardening techniques and technologies. • Promote an understanding of ecological and environmental principles.	
UNIT	**CONTENT**	**HOURS**
UNIT I	**Introduction:** Importance – History and development of gardening – Hindu style – Buddhist garden – Moghul garden – Japanese garden – British garden.	18 Hrs
UNIT II	**Garden Plant components :** Arboretum – Shrubbery — Topiary – Edge – Hedge – Terrace garden, Flowering annuals and herbaceous perennials – Climbers and creepers – Ornamental palms – Ferns.	18 Hrs
UNIT III	**Garden Non plant components:** Rock garden – Water garden- Fountain- Statue- ArchesPergola- Urns- Tubs.	18 Hrs
UNIT IV	**Landscaping**: Principles of landscaping – Lawn and lawn maintenance – Principles, planning and execution of private garden – Public garden and factory garden.	18 Hrs
UNIT V	**Indoor gardening:** Decorative plants – Bonsai – Principles of flower arrangement – Decoration with indoor plants for conference hall, living room, dining hall and verandah flower arrangement.	18 Hrs

REFERENCES

1. GopalSamyIyengar ,1990, Complete Gardening In India ,IBH, India
2. Indoor gardening, Vishnu Swarup, ICAR, New Delhi.
3. Nambison, K.M.P. 1992. Design elements of landscape gardening. Oxford and IBH Publications, New Delhi.
4. Pratibha and P.Trivedi, 1990. Beautiful shrubs, ICAR, New Delhi.

5. 5. Pratibha and P.Trivedi. 1987. Home Gardening. ICAR, New Delhi.

Web-Resources:

1. https://nptel.ac.in/courses/102/103/102103041/
2. https://futureoflife.org/background/benefits-risks-biotechnology/
https://www.sciencedirect.com/topics/neuroscience/genetic-engineering
3. http://www.biologydiscussion.cm/biotechnology/techniquesbiotechnology/important-techniques-of-biotechnology-3-techniques/15683
4. https://iopscience.iop.org/book/978-0-7503-1347-6/chapter/bk978-0-7503-1347-6ch1
5. https://www.slideshare.net/zeal_eagle/fermentation-technology
6. https://www.slideshare.net/zeal_eagle/fermentation-technology
7. https://www.slideshare.net/Chepkitwai/blotting-techniques-6129300

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Identify suitable indoor and outdoor plants for various environments and purposes.	PO1,PO3
CO2	Design garden layouts that suit various purposes, such as aesthetic appeal, food production, or habitat creation..	PO1,PO2,PO3
CO3	Create garden plans that consider soil conditions, climate, and available space	PO1,PO3
CO4	Arrange plants to enhance interior design and create visually appealing displays.	PO1,PO3
CO5	Learn proper watering, mulching, and weeding practices.	PO1,PO3

Semester-VI / Core Corse IX	PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS	Course Code:
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The objective of this course are to** • Differentiation of C3 and C4 pathway to know about the nutrition requirements. • To describe the respiration, nitrogen metabolism and growth regulator. • To compare the structure and classification of carbohydrate and protein • To state the role of enzymes • To state the concept of thermodynamics law	
UNIT	**CONTENT**	**HOURS**
UNIT I	Plant – Water Relations – Water Transport Processes – Diffusion, Osmosis, Water Potential – Transpiration and its Significance, Mechanism of stomatal movement. Mineral Nutrition: Nutrient Uptake and Transport Mechanism. Photosynthesis: Photosynthetic Apparatus, Photochemical reactions, Electron Transport Pathway, Photophosphorylation, Calvin cycle. C4 –pathway, Crassulcean Acid Metabolism, Photorespiration.	18 Hrs
UNIT II	Respiration, Glycolysis, TCA Cycle, Electron Transport system, oxidative Phosphorylation –Anerobic respiration - Nitrogen Metabolism: Biological Nitrogen Fixation, Growth and Development: Physiological Role of Plant Growth Regulators: auxins, Cytokinins, Gibberellins Abscissic Acid and Ethylene. Physiology of Flowering- Photoperiodism and Vernalization. Seed Dormancy and Seed Germination.	18 Hrs
UNIT III	Structure and Classification, of carbohydrates, Structure, Characteristics and Classification of Amino Acids – protein and Non Protein Amino Acid Biosynthesis. Structure of Proteins Primary, Secondary, Tertiary and Quaternary Structure - Lipids: Classification and Structure, Biosynthesis of Fatty Acids, Saturated and Unsaturated Fatty Acids,	18 Hrs

	Oxidation of Fatty Acids.	
UNIT IV	General aspects (Classification, Nomenclature and Structure) Mechanism of enzyme action Michaells Menton Equation and its Significance Kinetics Regulatory mechanisms, Isoenzymes.	18 Hrs
UNIT V	Thermodynamics, Laws- Redox Potential – Redox coupling, Bioenergetics – ATP, Entrophy and Enthalpy Photo Biology: Dual Nature of Light, Characteristics of solar Radiation, Solar Energy, Efficiency of Atoms, Absorption Spectra in Molecules – Energy states and Deexcitation.	18 Hrs

REFERENCES

1. Jain V.K. (1990) Plant Physiology S. Chand & Co New Delhi
2. ar H.D. and Singh H.N. (1990 Plant metabolism)
3. Fang F.K. (1982) Light Reaction path of Photosynthesis Vol. 35 molecular biology, Biochemistry and Biophysics – Springer.
4. Malik C.P. and Srinivastra (1995) Plant Physiology
5. Verman S.K. (1999) Plant Physiology S. Chand & Co, New Delhi
6. Palner J.J. (ed) 1984 the physiology and biochemistry of Plant respiration – Cambridge University Press, U.K.

Web resources

1.https://nptel.ac.in/courses/102/106/102106065/

2 http://www.digimat.in/nptel/courses/video/102106065/L65.html

3 https://www.slideshare.net/sardar1109/bioinformatics-lecture-notes

Course Outcomes

CO	On completion of this course, students will be able to	**Program outcomes**
CO1	Introduce the fundamentals of Bioinformatics and its applications Genome, metabalome & Transcriptome.	PO1
CO2	Classify biological data base and to correlate the different file formats by nucleicacid, protein data base, structural and metabolic database..	PO1,PO2. PO3
CO3	Develop algorithms for interpreting biological data.	PO1,PO2
CO4	Discuss the concepts of sequence alignment and its	PO1.PO2, PO3
CO5	Apply the various tools employedin genomic study and Protein visualization. Analyse the entiregenome by shot gunmethod.	PO1.PO2

Semester-VI / Core Corse X	PLANT ECOLOGY, PHYTOGEOGRAPHYAND ENVIRONMENTAL BIOTECNOLOGY	Course Code:
Instruction Hours: 6	Credits: 5	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The objectives of this course are to** ❖ To recognize the concepts of ecosystem and cyclic flow of elements between organism and environment. ❖ To appraise the knowledge on plant distribution and their conservation. ❖ To state about Autecology and Synecology. ❖ To explain plant succession patterns and its ecological adaptations. ❖ To compare phytogeography vegetational types and phytogeographical regions of India.	
UNIT	**CONTENT**	**HOURS**
UNIT I	Introduction, Scope and History of Ecology Biotic and Abiotic factors and their influence on Vegetation. Basic concepts, Levels of Organization inter-relationship between the living world and the environment.	18 Hrs
UNIT II	Ecosystem concept process and components, Food chain, Food web, Principles function and models of Energy flow, Terrestrial and pond ecosystem. Ecological Pyramids types and function – Biogeochemical cycle (C, N, P).	18 Hrs
UNIT III	Autecology and Synecology, Vegetation, Formation, Association, Consociation, Society, development of Vegetation – Migration, Ecesis – ecads, ectone, colonization – Methods of study in Vegetation (Quadrat and Transect) Plant succession, Hydrosere and Xerosere, Morphological and anatomical feature of Hydrophytes, Mesophytes and Xerophytes	18 Hrs

UNIT IV	Phytogeography: Principles – Vegetation types in India, biogeographical time of India, Tropical rain forest, shoals and deciduous forest, Sand dunes, Mangrove and Scrub jungle, continental drift, Principle of Remote Sensing and its applications. Phytogeographical regions in India. Endemism. In situ and ex situ conservation. Application of remote sensing in conservation.	18 Hrs
UNIT V	Air pollution, Radiation pollution, Noise pollution, Thermal pollution-Soil pollution: Industrial, agrochemicals (insecticides, 90 pesticides, fungicides, herbicides). Water pollution – Industrial effluents. Marine pollution	18 Hrs

Text Book:

1. Singh, J.S., Singh, S.P and Gupta, S (2006). Ecology Environment and Resource conservation, Anamaya Publications, New Delhi.
2. Wilkinson, D.M. (2007). Fundamental Process in Ecology an earth system Approach Oxford.
3. Odum, E (2008). Ecology Oxford and IBH Publisher.
4. Sharma, P.D. (2010).Ecology and Environment, (8th Ed) Rastogi Publications, Meerut.
5. Ambast, R.S. A text book of plant Ecology. Vikas publication, New Delhi.
6. Shukla, R.S. and P.S. Chandel, Plant Ecology and Soil Science, S. Chand and Co.

Web-Resources:

1. https://youtu.be/GkUCmb0cKwo?list=PLCZ9KmODEcu138llVeHClJ4nskArYr1Dg

Course Outcomes

CO	**On completion of this course, students will be able to**	**Programme outcome**
CO1	Compare the concept of ecosystem, biogeochemical cycle and species selection.	PO1,PO2, PO5
CO2	Discuss the environmental deterioration and possible measures for their revival.	PO1,PO2, PO5
CO3	Apply the acquired knowledge about conserve plant species and natural resources in modern techniques.	PO1,PO2, PO5
CO4	Record and register the diversity changes through remote sensing.	PO1,PO2, PO5
CO5	Apply strategies for the conservation of Germplasm.	PO1,PO2, PO5

Semester-VI / Core Practical VI	PLANT PHYSIOLOGY, BIOCHEMISTRY AND BIOPHYSICS, PLANT ECOLOGY, PHYTOGEOGRAPHY AND ENVIRONMENTAL BIOTECNOLOGY	Course Code:
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**
Course Objectives	**The objectives of this course are to** ❖ To determine the chlorophyll, carotenoids and protein. ❖ To estimate the lipid, reducing sugar and amino acids by ninhydrin method. ❖ To understand the separation techniques. ❖ To acquire knowledge on electrophoretic apparatus. ❖ To study about plant ecology and phytogeography.
UNIT	**CONTENT**
	PLANT PHYSIOLOGY 1. Determination of water potential in different tissues. 2. Estimation of chlorophyll a, Chlorophyll b, and total chlorophyll by the Arnon's method. 3. Determination of carotenoids 4. Estimation of protein by Lowry's method 5. Estimation of total phenols Hill reaction – demonstration

	BIOCHEMISTRY 1. Extraction and estimation of lipid 2. Determination of reducing sugars in (grapes) fruit 3. Estimation of amino acids by ninhydrin 4. Separation and identification of amino acids by chromatography 5. Separation of dyes by Paper / TLC methods 6. Extraction of amylase and determination of its activity 7. Determination of peroxidase activity
	BIOPHYSICS 1. Principle and methodology of pH meter, Spectrophotometer, Centrifuge,· Electrophoretic apparatus, permanent slide preparation
	PLANT ECOLOGY AND PHYTOGEOGRAPHY: 1. Study of morphological and structural adaptations in locally available plant forms Hydrophytes – Hydrilla, Xerophytes – Nerium, Mesophytes - Tridax 2. Study of morphological features of epiphytes, Parasites and halophytes. 3. Studies of vegetation by quadrat, Line transect method. 4. Study of phytogeographical regions in India. 5. Determination of soil and water pH.
	BIOTECHNOLOGY 3. MS media preparation 4. Tissue culture techniques

REFERENCES:

1. Taiz L and Zeiger E. Plant physiology (Second edition). The Benjamin/Cummings publishing company, Inc., California, New York, 1998.

2.Jain VK. Fundamentals of Plant Physiology (14th Ed), S. Chand and Company Ltd, New Delhi, 2012.

3. Jain JL. Jain S and Jain N. Fundamentals of Biochemistry. S. Chand and Company Ltd., New Delhi, 2008.
4.Narayanan P. Essentials of Biophysics, New Age International Publishers (P) Ltd., NewDelhi, 2000.
5. Stryer L. Biochemistry, W. H. Freeman and Co., New York, 1989.

Web Resoureses
https://uou.ac.in/sites/default/files/slm/BSCBO-203.pdf
https://uou.ac.in/sites/default/files/slm/BSCBO-303.pdf

CO	**On completion of this course, students will be able to**	**Programme outcome**
CO1	Perform procedure of water estimation, chlorophyll, carotenoid and phenol.	PO1,PO2, PO5
CO2	Estimate the lipid, reducing sugar and amino acids by ninhydrin level.	PO1,PO2, PO5
CO3	Understand the separation techniques.	PO1,PO2, PO5
CO4	Apply the knowledge on electrophoretic apparatus.	PO1,PO2, PO5
CO5	Apply the knowledge on plant ecology and phytogeography.	PO1,PO2, PO5

Semester-VI / Discipline Specific Elective -II	AGRO BASED ENTREPRENEURSHIP	Course Code:
Instruction Hours: 3	Credits: 3	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The objective of this course are to** ❖ Relate to how various fields of botany could be understood with an entrepreneurial approach ❖ Relate to how various fields of botany could be understood with an entrepreneurial approach ❖ Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations ❖ Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc	
UNIT	**CONTENT**	**HOURS**
UNIT I	Introduction to Entrepreneurship, Scope and identification of new ventures using plant resources, Mechanism of product selection and commercialization, General concept about the Govt. formalities, rules & regulation, Entrepreneurship skill development.	12 Hrs
UNIT II	Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, solvents, organic acids, beverages, enzymes, antibiotics	12 Hrs
UNIT III	Production of Biofertilizers, Vermicompost, Establishment of medicinal, herbal and zodiac gardens, Terrace & Kitchen garden, Spirulina and Azolla cultivation, Mushroom cultivation, Bonsai, Bouquet making, Terrarium	12 Hrs
UNIT IV	Product commercialization and business strategy, Dyes, Cosmetics and Perfumes, Gums, Resins & Latex, Areca Leaf Plates, cups & bags, Jute Products.	12 Hrs

UNIT V	Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues, Marketing and public perceptions in product development – Technology licensing and branding concerns.	12 Hrs

REFERNCES:

1. Robin Lowe and Sue Marriott 2009. Enterprise: Entrepreneurship and Innovation: Concepts, Contexts and Commercialization, Routledge Publisher, London, UK.
2. Peter F.Drucker, 2009. Innovation and Entrepreneurship, Harper Collins Publisher, New York, US.
3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.
4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
5. Webster,J andWeber,R.2007.IntroductiontoFungi,3rdEd.CambridgeUniversityPress,

Web resources

1. https://www.brainkart.com/article/Entrepreneurial-Botany_38321/
2.https://www.youtube.com/watch?v=hnBla1FfcLo

CO	**On completion of this course, students will be able to**	**Programme outcome**
CO1	Relate to how various fields of botany could be understood with an entrepreneurial approach	PO1,PO2, PO5
CO2	Relate to how various fields of botany could be understood with an entrepreneurial approach	PO1,PO2, PO5
CO3	Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations	PO1,PO2, PO5
CO4	Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc	PO1,PO2, PO5
CO5	Develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing.	PO1,PO2, PO5

Semester-VI / Discipline Specific Elective - III	SEA WEED TECHNOLOGY	Course Code:
Instruction Hours: 4	Credits: 3	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**
Course Objectives	**Theobjective ofthiscourse areto** ❖ Relate to how various fields of botany could be understood with an entrepreneurial approach ❖ Relate to how various fields of botany could be understood with an entrepreneurial approach ❖ Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations ❖ Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc
UNIT	**CONTENT**
UNIT I	Morphology, life history and mass culture of microalgae: Spirulina, Chlorella, Dunaliella and Botryococcus.
UNIT II	High value products: Single Cell Protein (SCP), phycocyanin, β-carotene, astaxanthin – biofuel, media composition - scale up - lab to land - raceway ponds and photobioreactor
UNIT III	Marine macroalgae: Morphology, life history and mass cultivation of Gracilaria, Kappaphycus, Sargassum and Ulva

UNIT IV	Polysaccharides: agar, carrageen, alginate - economic importance - seaweed as food, feed and Seaweed Liquid Fertilizer (SLF).
UNIT V	Role of seaweeds in aquaculture: Environment Impact Assessment of algal cultivation

Reference

1. KumarH.D.andSingh,H.N.1976.ATextBookofAlgaeAffiliatedEastWestPressPvt.Ltd.,New Delhi,Madras.
2. Kumar,H.D.1990.IntroductoryPhycology,AffiliatedEastWestPress(P)Ltd.,NewDelhi,Madras,Hyderabad, Bangalore.
3. Pandey,B.P.1993.AText bookofBotany-Algae S. Chand&Co.,(P) Ltd.,NewDelhi.
4. Sharma,O.P.1990.TextBookofAlgaeTataMcGrawHill PublishingCo.,Ltd., NewDelhi.

5.Bilgrami,K.S.,andL.C.Saha.1996.ATextBookofAlgae,CBSPublishers&Distributors(P)Ltd.,New Delhi.

CO	**On completion of this course, students will be able to**	**Programme outcome**
CO1	Obtain an in-depth knowledge on culture and mass cultivation of algae and its different methods	PO1,PO2, PO5
CO2	Exploration and recommendation of the commercial potential of algal products.	PO1,PO2, PO5
CO3	Understand the applied facet of algology and acquire a complete knowledge about the cultivation methods in algae.	PO1,PO2, PO5
CO4	Describe the preparation of seaweed liquid fertilizers and their applications in agriculture and horticulture.	PO1,PO2, PO5
CO5	Acquiring the information about algal applications in different industries and agriculture fields in the current scenarion.	PO1,PO2, PO5

Semester-VI / Ability Enhancement Course - III	BOTANY STUDIES FOR COMPETITIVE EXAMINATIONS	Course Code:
Instruction Hours: 2	Credits: 2	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The objective of this course are to** ❖ Relate to how various fields of botany could be understood with an entrepreneurial approach ❖ Relate to how various fields of botany could be understood with an entrepreneurial approach ❖ Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations ❖ Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc	
UNIT	**CONTENT**	**HOURS**
UNIT I	Plant science and its branches . Five kingdom classification. Outline of Kingdom plantae General characters and Economic importance of Algae, Fungi and Lichens.	6 Hrs
UNIT II	General characters and Economic importance of Bryophytes, Pteridophytes and Gymnosperms .Palaeobotany- Types of fossils, Geological time scale ,Fossil beds of Tamil Nadu.	6 Hrs
UNIT III	Root system and shoot system. Modifications (Pneumatophore, Stilt root, Epiphytic root, Cladode, Phylloclade , Pitcher and Phyllode) Parts of a flower - Fruits types(Outline) Parthenocarpy- Pollination – types, Seed dispersal – types, Seed Germination types. Taxonomy –definition. Types of classification- Taxonomic hierarchy, ICN, Binomial nomenclature and BSI. Herbarium and Major Herbaria of the world.	6 Hrs
UNIT IV	Cell –Prokaryotic and Eukaryotic – Cell organelles with functions . DNA and RNA (Basic concepts) -Cell division and its significance - Mitosis and Meiosis (outline) Mendelism – Monohybrid and Dihybrid cross, Sex linked inheritance	6 Hrs

UNIT V	Ecosystem – abiotic and biotic components. Energy flow in an ecosystem, Aforestation, Deforestation- Chipko movement –-Forest Conservation act- Pollution types and effects- Eutrophication, Global warming ,Ozone depletion, Climate change. Biodiversity and types- Hot spots, Mega diversity countries, Conservation – *ex situ* and *in situ* methods. Endangered plants and Red data Book. Rio -Earth summit. Biodiversity Management Policies - IUCN, UNEP, WWF, ICSU, WCMC.	6 Hrs

CO	**On completion of this course, students will be able to**	**Programme outcome**
CO1	Relate to how various fields of botany could be understood with an entrepreneurial approach	PO1,PO2, PO5
CO2	Relate to how various fields of botany could be understood with an entrepreneurial approach	PO1,PO2, PO5
CO3	Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations	PO1,PO2, PO5
CO4	Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc	PO1,PO2, PO5
CO5	Relate to how various fields of botany could be understood with an entrepreneurial approach	PO1,PO2, PO5

REFERENCES:

1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8thEdn., New York.
3. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
4. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
5. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.
6. https://www.amazon.in/BOTANY-COMPETITIVE-EXAMINATIONS-SUNIT-MITRA/dp/9383420898
7. https://www.amazon.in/Botany-Competitive-Examinations-UPSC-Indian-Competive/dp/B08VWB64BC

Semester-VI / Skill Enhancement Course – IV	ENVIRONMENTAL IMPACT ANALYSIS	Course Code:
Instruction Hours: 2	Credits:2	Exam Hours: 3
Internal Marks :25	External Marks:75	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	The objectives of this course are to • Provide insights into the central dogma of molecular biology and explain the mechanism of DNA replication. • Elaborate the mechanism of transcription and reverse transcription. • Highlight the characteristics of genetic code and describe the process of protein synthesis. • Introduce the concept of regulation of gene expression in prokaryotes • Familiarize the different types of mutations and explain the mechanism of DNA repair.	
UNIT	**CONTENT**	**HOURS**
UNIT I	Origin and Development Purpose and aim, core values and principles, History of EIA development, Environmental Management Plan, Environmental Impact Statement, Scope of EIA in Project planning and Implementation	6 Hrs
UNIT II	EIA Process Components of EIA, EIA Methodology- Screening, Scoping, Baseline data, Impact Identification, Prediction, Evaluation and Mitigation, Appendices and Forms of Application	6 Hrs
UNIT III	Techniques of Assessment-Cost-benefit Analysis, Matrices, Checklist, Overlays, Impact on Environmental component: air, noise, water, land, biological, social and environmental factors. EIA Document	6 Hrs
UNIT IV	Main participants in EIA Process Role of Project proponent, environmental consultant, PCBs, PCCs, public and IAA. Public	6 Hrs

	participation.	
UNIT V	Environmental Appraisal and Procedures in India and EIA Methodology, indicators and mitigation, Environmental Audit of different environmental resources, Risk Analysis, Strategic environmental assessment, ecological impact assessment: legislation.	6 Hrs

REFERENCES

1. Veer BalaRastogi, 2008, Fundamentals of Molecular Biology, 1st edition, AnebooksIndia.
2. David Friefelder,1987, Molecular Biology, 2nd edition, NarosaPublishingHouse.
3. Dr.P.S.VermaandDr.V.K.Agarwal,2013,Cellbiology, Genetics,MolecularBiology,EvolutionandEcology,1stedition,S.Chand&CompanyPvt.Ltd.
4. Karp,G.,2010,CellandMolecularBiology:ConceptsandExperiments,6thedition,John
5. Wiley&Sons.Inc.
6. DeRobertis,E.D.P.andDeRobertis,E.M.F.,2010,CellandMolecularBiology,8thedition,
7. LippincottWilliamsandWilkins,Philadelphia.
8. James.D.Watson,2013,MolecularBiologyoftheGene7thedition,BenjaminCummings.
9. GeorgeM.Malacinski,1992,Freifelder'sEssentialsofMolecularBiology,4thedition, NarosapublishingHouse.

Web-Resources

1. www.mednotes.net/notes/biology
2. https://www.onlinebiologynotes.com/repair-mechanism-of mutation/
3. https://teachmephysiology.com/biochemistry/protein-synthesis/dna-translation/

Course Outcomes

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Illustrate the Central Dogma of molecular biology, explain the multiplication of DNA in the cell and describe the types and model of replication.	PO1
CO2	Elaborate the mechanism of transcribing DNA into RNA, discuss the formation of different types of RNA.	PO1
CO3	Decipher the genetic code and summarize the process of translation.	PO1
CO4	Comprehend the principles of gene expression and explain the concept of operon in prokaryotes.	PO1,PO2
CO5	Distinguish the types of mutations and explain the various mechanisms of DNA repair.	PO1,PO2

Semester-VI / Extra Credit Course VI	CULTURE OF MICROORGANISMS	Course Code:
Instruction Hours: 6	Credits: 2	Exam Hours: 3
Internal Marks :-	External Marks:100	Total Marks: 100

Cognitive Level	**K1 –Recalling** **K2 -Understanding** **K3 -Applying** **K4 - Analyzing** **K5 - Evaluating** **K6 – Creating**	
Course Objectives	**The main objectives of this course are to** • To identify and classify microorganisms based on their morphology, biochemical properties, and genetic makeup • To observe how microorganisms grow under various conditions, including temperature, pH, oxygen levels, and nutrient availability. • To isolate and identify pathogenic microorganisms that cause diseases, enabling accurate diagnosis and treatment. • To utilize microorganisms in the production of fermented products, such as alcohol, yogurt, bread, and cheese. • To develop methods for using microorganisms to degrade environmental pollutants, such as oil spills or heavy metals..	
UNIT	**CONTENT**	**HOURS**
UNIT I	Definitions of growth, Batch culture, Continuous culture, generation time and specific growth rate Temperature and temperature ranges of growth pH and pH ranges of growth Effect of solute and water activity on growth Effect of oxygen concentration on growth Nutritional categories of microorganisms	18 Hrs
UNIT II	Passive and facilitated diffusion Primary and secondary active transport, concept of uniport, symport and antiport Group translocation Iron uptake	18 Hrs
UNIT III	Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle	18 Hrs

UNIT IV -	Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction) Fermentation - Alcohol fermentation and Pasteur effect	18 Hrs
UNIT- V	Introduction to biological nitrogen fixation Ammonia assimilation Assimilatory nitrate reduction	18 Hrs

REFERENCES

1. Brock Biology of Microorganisms"Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, David A. Stahl
2. Microbiology: An Introduction"Gerard J. Tortora, Berdell R. Funke, Christine L. Case
3. "Manual of Clinical Microbiology"Karen C. Carroll, Michael A. Pfaller, Marie Louise Landry, et al.
4. "Microbial Physiology"
5. Albert G. Moat, John W. Foster, Michael P. Spector4th Edition (2003)

WEBSOURCES

1. https://www.cdc.gov/lab/resources/microbiology.html
2. https://microbiologysociety.org

CO	**On completion of this course, students will be able to**	**Program outcomes**
CO1	Related the morphology structure of Algae, Fungi, bryophytes and Lichens	PO1
CO2	Apply the practical knowledge to understanding the diversity of plant forms.	PO1,PO2
CO3	Examine the importance of structural diversity in the evolution of plant forms.	PO1,PO2
CO4	State the ecological and economic importance of Algae, Fungi, lichen and bryophytes	PO1, PO2
CO5	Compare the structural organization of gametophytes and sporophytes in different classes of bryophytes	PO1,PO2