THE AMERICAN COLLEGE, MADURAI

Department of Undergraduate Botany

B.Sc. – Botany Programme (CBCS) 2020-2021 onwards

Semester	Part	Course No.	Course Title	Hr.	Cr.	Marks
1	I	***12XX	TAM/HIN/FRE	3	2	30
	II	ENG1201	Conversational Skills	3	2	30
	IIIC	BOT1551	Ethnoecology	5	5	75
	IIIC	BOT1453	Learning Basic Skills In Biology(LBSB)	4	4	60
	IIIC	BOT1455	LAB I (Ethnoecology and LBSB)	4	4	60
	IIIS	CHE13XX	Chemistry for Botanist -1(theory)	3	3	45
	IIIS	CHE11XX	Chemistry for Botanist -1(lab)	2	1	15
	IVE	***12XX	Basic Tamil/Adv.Tamil/Non-Major	3	2	30
	IVLS	***12XX	Life Skill -1	3	2	30
	V	***11XX	NCA/NCN/NSS/PED/SLP		-	
			Total	**30**	**25**	
2	I	***12XX	TAM/HIN/FRE	3	2	30
	II	ENG1202	Reading and Writing Skills	3	2	30
	IIIC	BOT1552	Genetics and Plant Breeding	5	5	75
	IIIC	BOT1454	Evolution & Phycology	4	4	60
	IIIC	BOT1456	LAB II (Phycology &Genetics)	4	4	60
	IIIS	CHE13XX	Chemistry for Botanist – 2(theory)	3	3	45
	IIIS	CHE11XX	Chemistry for Botanist – 2 (lab)	2	1	15
	IVE	***12XX	Basic Tamil/Adv.Tamil/Non-Major	3	2	30
	IVLS	***12XX	Life Skill -2	3	2	30
	V	***11XX	NCA/NCN/NSS/PED/SLP		1	
			Total	**30**	**25+1**	
3	I	***22XX	TAM/HIN/FRE	3	2	30
	II	ENG2201	Study Skills	3	2	30
	IIIC	BOT2531	Microbiology and Phycology	5	5	75
	IIIC	BOT2533	Archegoniatae	5	5	75
	IIIC	BOT2335	Genetics and Plant Breeding	3	3	45
	IIIC	BOT2637	LAB III (Micro+Arche +Genetics)	2+2+2	6	90
	IIIS	ZOO2349	General Zoology-I	3	3	45
	IIIS	ZOO2151	Lab in General Zoology-I	2	1	15
	V	***21XX	NCA/NCN/NSS/PED/SLP			
			Total	**30**	**27**	
4	I	***22XX	TAM/HIN/FRE	3	2	30
	II	ENG2202	Career Skills	3	2	30
	IIIC	BOT2552	Mycology and Pathology	5	5	75
	IIIC	BOT2444	Cell Biology	4	4	60

	IIIC	BOT2436	Anatomy and Reproductive Biology of Angiosperms (ARBA)	4	4	60
	IIIC	BOT2638	LAB IV (Myco+Cellbio+ARBA	6	6	90
	IIIS	ZOO2350	General Zoology II	3	3	45
	IIIS	ZOO2152	Lab in General Zoology II	2	1	15
	V	***21XX	NCA/NCN/NSS/PED/SLP		1	
			Total	**30**	**27+1**	

Semester	**Part**	**Course No.**	**Course Title**	**Hr.**	**Cr.**	**Marks**
5	IIIC	BOT 3631	Plant Systematics	6	6	90
	IIIC	BOT3633	Biochemistry	6	6	90
	IIIC	BOT3535	Analytical Techniques and Research Methodology	5	5	75
	IIIC	BOT3637	LAB – V (Systematics + Biochem)	3+3	6	90
	IVLS	***32XX	Life Skill - 3	3	2	30
	IVEVS	BOT 3200	Environmental Studies	4	2	30
				30	**27**	
6	IIIC	BOT3832	Plant Biotechnology (Lab cum Theory)	5+3L	8	75+45
	IIIC	BOT3434	Entrepreneurial Botany	4	4	60
	IIIC	BOT3536	Bioresource Management	5	5	75
		BOT3538	Botany Project			
	IIIC	BOT3642	Plant Physiology (Lab cum Theory)	4+2L	6	60+30
	IVLS	***32XX	Life Skill IV	3	2	30
	IVVE	VAL32XX	Value Education	4	2	30
			Total	**30**	**27**	

Supportive Courses

Semester	Part	Course No.	Course Title	Hr.	Cr.	Marks
1	IIIS	BOT1357	Plant Biology I (theory)	3	3	45
1	IIIS	BOT1159	Plant Biology I (lab)	2	1	15
2	IIIS	BOT1358	Plant Biology II (theory)	3	3	45
2	IIIS	BOT1160	Plant Biology II (lab)	2	1	15
3	IIIS	BOT2345	Botany for Chemists- I (theory)	3	3	45
3	IIIS	BOT2147	Botany for Chemists – I (lab)	2	1	15
4	IIIS	BOT2346	Botany for Chemists- II(theory)	3	3	45
4	IIIS	BOT2148	Botany for Chemists – II (lab)	2	1	15

*__Life Skill Courses__

Semester	Part	Course No.	Course Title	Hr.	Cr.	Marks
1	IVLS	BOT1251	Mushroom Culture Technology	3	2	30
2	IVLS	BOT1252	Nursery and Gardening	3	2	30
5	IVLS	BOT3239	Medicinal Botany	3	2	30
6	IVLS	BOT3240	Biofertilizers and Bio-Pesticide	3	2	30

***Non Major Courses**

Semester	Part	Course No.	Course Title	Hr.	Cr.	Marks
1	IVE	BOT1253	Food and Nutrition	3	2	30
2	IVE	BOT1254	Plant Wonders	3	2	30

Add- on courses

Semester	Course No.	Course Title	Hr.	Cr.	Marks
1	BOT 121V	Edible Mushrooms	2	2	30
2	BOT 122V	Gardening techniques	2	2	30
3	BOT 221V	Plant Propagation	2	2	30
4	BOT 222V	Organic farming	2	2	30
5	BOT 321V	Plantation Crops	2	2	30
6	BOT 322V	Skills in Biology	2	2	30

* All Job oriented courses

PROGRAMME SPECIFIC OUTCOMES (PSOs) FOR UNDERGRADUATES

1. Identify the diversity of nature to pursue his own career opportunity without disturbing the ecological balances.
2. Subscribe to the idea of climate conscious approaches while dealing with development activities
3. Probe new avenues in plant biology and pursue research.
4. Explore suitable biotechnological approaches to develop the bio-entrepreneurship.
5. Employ themselves in bio-based industries that offer Green jobs.
6. Evaluate and manage bioresources without bias and profiteering motives.
7. Get back to the community as leaders and do such things that will appreciate the diverseness and togetherness in harmony with nature.
8. Draw from biotic associations in nature insights on to manoeuvre positive and negative influences that are essential for communal co living and societal interferences.
9. Learn from plants the idea of adaptations and acclimatization to entrain themselves to remain steadfast rather than running away from difficult situations.
10. Translate the idea of grand unification of life to draw lessons of pluralism and inclusivity.

COURSE OUTCOME (CO) VS PROGRAM SPECIFIC OUTCOME (PSO) – UG BOTANY

Course code	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10
BOT1551		√			√		√	√	√	√
BOT1453	√	√				√	√	√		√
BOT1455	√	√	√			√		√		√
BOT1552		√	√			√			√	
BOT1454	√	√	√				√		√	√
BOT1456	√	√	√				√		√	√
BOT2551	√			√			√			
BOT2553	√						√			√
BOT2355	√					√	√		√	
BOT2657	√		√	√	√	√	√		√	
BOT2552	√		√			√		√	√	√
BOT2454				√	√					√
BOT2456	√								√	√
BOT2658	√		√	√	√	√		√	√	√
BOT 3651	√					√				√
BOT3653			√	√	√	√				
BOT3555				√	√	√				
BOT3657	√		√	√	√	√		√		
BOT 3259	√	√				√	√	√	√	√
BOT3852			√			√			√	
BOT3454	√	√		√	√	√		√	√	
BOT3656	√	√				√		√	√	
BOT3558	√			√	√	√		√		√
BOT1357	√			√				√		
BOT1159	√			√				√		
BOT1358	√			√				√	√	
BOT1160	√			√				√	√	
BOT2359	√			√						√
BOT2161	√			√						√
BOT2360				√	√	√				
BOT2162				√	√	√				
BOT1251	√		√	√						
BOT1252	√	√		√						
BOT3251	√	√		√	√	√				
BOT3252	√		√	√						
BOT1253	√		√	√						
BOT1254		√		√			√			√
BOT121V	√			√	√					
BOT122V	√			√	√					
BOT221V	√			√	√					
BOT222V	√	√		√	√					√
BOT321V	√								√	√
BOT322V			√	√	√					

MAPPING OF PROGRAMME SPECIFIC OUTCOMES (PSOs) WITH POS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	Total
PSO1	5	4	3	5	5	4	5	3	5	4	42
PSO2	4	4	3	4	4	5	4	3	4	5	40
PSO3	4	5	4	4	4	5	4	3	4	4	41
PSO4	4	4	3	3	4	4	4	3	4	5	38
PSO5	5	4	4	4	5	4	4	4	4	4	42
PSO6	5	5	4	4	5	5	5	4	4	4	45
PSO7	3	4	4	4	5	4	4	3	4	4	39
PSO8	5	5	4	3	3	5	3	2	5	5	40
PSO9	5	5	4	3	3	4	4	2	4	4	38
PSO10	5	5	4	4	4	4	3	3	4	4	40
Mean 405/100 =4.05											

BOT1551 ETHNOECOLOGY 5 Hr./5 Cr.

Preamble: This course is designed for the fresher as an introduction to the ecology of their own community and landscape. The study material is prepared to introduce the basics of ethnoecology and its components with reference to Madurai. The course is aimed at giving proper explanation for the better understanding of their surroundings. Furthur to understand the local knowledge on agriculture, natural resources management and traditional practices of the local community in their day to day life. After the completion of this course the student will be able to understand and appreciate the evolution of mankind and their tradition.

COURSE OUTCOME

At the end of the course, students will be able to

i. understand the climatological changes and apply his knowledge in taking suitable initiatives to protect and conserve life support systems
ii. analyse the origin of human race and learn their habitat, cultural practices and occupation and identify the invasive and native plant species.
iii. relate sangam literature and landscapes and learn about the importance of sacred groves.
iv. assess the extent of environmental degradation in urban Madurai and join the initiatives of city administration in developing and ensuring a clean and green Madurai.
v. quantify the natural wealth and resources by using appropriate field methods to maintain the environmental serenity and take efforts to enhance the ecological elegance.

Unit I: Climate and Geography (15 hr)

Global, regional and local climatic conditions (overview) -Altitudinal Zonation and forest types of Tamilnadu- Significance of Forests and Grasslands- Climate Change.

Unit II: Human Ecology (15 hr)

Origin of human race ethnic communities of the world – Migration of human population – Occupation and culture - Local ethnic communities - Population explosion - Impact on Animal and Plant population; Native, exotic, and invasive species of plants - Vavilovian centres of Origin.

Unit III: Ecological History (15 hr)

Sangam Literature and landscapes - Sacred Groves, Nandavanam - Plants and Animals of socio-religious importance – Geography of Western Ghats & Eastern Ghats - Cultural ecology of Madurai .

Unit IV: Urban Madurai (15 hr)

Urbanization and Tourism- Sources of water – Vaigai - Irrigation practices- Land use- ecological conflicts- Agrobiodiversity - Monoculture - Waste management - Smart city.

Unit V: Vegetation and Floristic Elements (15 hr)

Analysis of local species diversity - Field ecology: Quadrat (frequency, density and abundance) Transect (belt and line)- Study of air microflora.

TEXT BOOKS

1. Pushpendra K. Karhana 2004. Agriculture Science " A complete study package" Arihant Publishers (ISBN- 13 ; 978-8183482875)

2. Krishnamurthy, K.V. 2003. A text Book on Biodiversity (principles and Practice), Science Publishers, USA. (ISBN 1578083257, 9781578083251)

REFERENCES

1. Anonymous, 2011. Handbook of Agriculture, Indian council of Agricultural Research Krishi Anusandhan Bhavan -I Pusa, New Delhi- 110012 (ISBN NO: 81-7164-050-8)

2. Prathipal Singh, 2010. Introduction to biodiversity. Ane books Pvt. Ltd. New Delhi. (ISBN 978-1-8052-185-0)

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	
CO 1	5	5	4	5	5	5	29
CO 2	5	5	4	5	3	3	25
CO 3	5	5	4	4	3	3	24
CO 4	5	5	5	5	5	5	30
CO 5	5	5	5	5	5	5	30
							118/30
							3.9

BOT 1453 LEARNING BASIC SKILLS IN BIOLOGY 4 Hr. /4Cr.

PREAMBLE:

This is a unique course which aims to equip students to develop a basic understanding in biology and self-learning skills to comprehend and communicate with clarity and authenticity. It will also teach soft skill to the fresher in Botany who will be mostly from semi urban background of Madurai and give them the confidence to maneuver their linguistic and cognitive limitation. The course will also provide a gateway to the students and open their thinking and sensitivities to learn and appreciate in science and help to harbour and nurture innovative ideas in day to day life.

COURSE OUTCOME

At the end of the semester, students will be able to

i. see the growth of botanical studies from an exploratory standpoint that they shall be entrained to appreciate the idea of conceptualizing a botanical thought that no less sooner they will acquire skills to build their own cognitive capabilities by resorting to perform appropriate and suitable experiments

ii. acquaint themselves with the contours of communications and equip themselves adequately with the reading writing, listening skills and master the ability to make graphical and pictorial presentations of their ideas to get groomed as a budding botanist

iii. familiarize themselves with the scientific conventions of making scientific measurements, data collections and data interpretations that a professional training needed to initiate original scientific discoveries and pursue career in leading scientific discourses later in life.

iv. find themselves nurtured with personality development and leadership traits to set proper goals, develop problem solving abilities, plan and schedule events that they may eventually emerge as mangers and custodians of nature.

v. turn confident in hiring the services of the emerging frontiers of computational technology and ICT tools to emerge as an updated, informed, tech-savvy, skilled learner and a technician that he shall be vested with a competitive edge to compete with his peers in effectively realizing their dreams and ambitions of life

Unit I. History of Natural Sciences (10 hr)

Insights on botanical edifice - Contributions of Indian Botanists- S.R. Kashyap (Bryology) – Birbal Sahni (Paleobotany) – P.Maheswari (Embryology) M.S. Swaminathan (Plant Breeding) – Jagadish Chandra Bose (Biophysics).

Contributions of Naturalists of International Acclaims – Charles Darwin (Evolution) GJ Mendel (Genetics) Louis Pasteur (Microbiology) Watson and Crick (Cell Biology).

Unit II. Communication in Biology (20 hr)

Observational Skills: Inputs from Class lectures- Seminars- Field Visits; Serendipity in science (Penicillin Invention, Newton Law); Communication and Presentation skills- Verbal and nonverbal - use of scientific words- photographs- cartoons- tables and graphs – common barriers and impediments in communication.

Reading and Comprehension skills: Academic reading tips, making notes while reading.

Writing Skills : Purpose of writing (Class room, Examination, Scientific Publication)- logical sequence- botanical terms, interpretation of results and inferences- experimental records - Mnemonics.

Unit III: Quantitative Biology (10 hr)

Units and measurement - International system of Units (SI)- Seven basic units - Distance (Meter)- Mass (Kilogram)- Time (seconds)- Electric Current (Ampere)- Temperature (Kelvin) Quantity (Mole) - Luminous intensity (Candela). Fundamental measurement- Volumetric and gravimetric Measurements- Tool and Techniques- Constants and standards- Principles of Calibration and Minimizing error – Collection, Processing and preservation of data.

Unit IV : Soft Skills (10 hr)

Personality and Leadership Traits- Intra personal skills- self confidence- Goal setting- Problem solving abilities- Reflective thinking and strategic planning- Time management and effective planning.

Unit V: Computer in Biology (10hr)

Basic Computing and Arithmetic logic skill – Computer - Software & Hardware - Exploring MS office - Basics of networking and Internet applications - Smartphone and its application in biology.

TEXT BOOKS

1. Sanjay Kumar, Pushp Lata (2015) Communication skills 2nd edition. Oxford University Press. India. ISBN: 978-0199457069

2. Dinesh Maidasani(2008) Learning computer fundamentals, MS office and Internet and Web technology. Laxmi Publication. India. ISBN: 8131804062

REFERENCES

1. Adir J, (1997) Effective communication, Pan Book. U.K. ISBN 0330347861
2. Ghosh (2012) Managing soft skills for personality development, Mc Graw Hills India ISBN 978-0-07-107813-9
3. Jones A., Reed R & Weyers (2012), J. Practical skills in Biology, Pearsons review. ISBN 978- 1408245477.

Course outcome	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	Total
CO1	5	5	5	3	2	1	21
CO2	5	5	5	5	4	4	28
CO3	5	5	5	5	5	3	28
CO4	5	5	5	5	5	5	30
CO5	5	5	5	5	5	5	30
Total	25	25	25	23	21	18	137
							137/30 = 4.5

BOT 1455 **4Hr./4Cr.**

ETHNOECOLOGY AND LEARNING BASIC SKILLS IN BIOLOGY- LAB 1

This is a basic course for those who have freshly joined in the field oriented biology courses. The primary objective of this course is to inculcate quantitative thinking and critical analysis among students. It is designed to promote systematic observation skills to promote documentation of the facts that are observed in the field. While studying the basic field ecology concepts students will be given a chance catalog the field information and data with precision and accuracy. At the end of this course students will know to enumerate, tabulate, rank, measure, estimate both qualitative and quantitative information collected aat the study area. They will be also trained to present given information with clarity and accuracy to their class and any other relevant forums.

Students will be able to
i. learnt to appreciate the college campus diversity.
ii. observe various ecological spots.
iii. experiment the use of measuring instruments and landscaping.
iv. acquire hands on training with the use of computer softwares.
v. visit agricultural fields to appreciate ecology of irrigation field.

Learning Basic skills in Biology

Visual documentaries:

1. National scientists.
2. International scientists.

Skill Assessment:

3. Observational and Interpretation Skills
4. Oral Presentation skills (Group wise presentation)
5. Report writing
6. Personality development
7. Time Management – 80:20 Rule

Fundamental Measurement:

8. Physical measurements
9. Volumetric apparatus & Gravimetric apparatus

Exploring with computers:

10. MS Word & Excel, Power Point Presentation
11. Data mining – Scientific web sites
12. Use of Smart phones in Biology.

Ethnoecology

1. Enumeration and description of trees at the American college campus.
2. Observation of structural modifications and adaptations of plants grown in different ecosystem.
3. Raunkier's biological and leaf spectrum.
4. Floristic studies in temples and parks.
5. Vegetation mapping in a nearby forest area (quadrat study 1x1, 10x10m)
6. Botanical elements of heritage (historical)sites.
7. Sacred groves in Madurai (any one site)

8. Importance of irrigation and traditional water management in Madurai;
9. Survey of traditional crops in Madurai.
10. Archeological sites and remains excavated (Keezhadi)
11. Madurai smart city- conservation strategies and waste management
12. Basic Landscape Mapping (application of GPS and GIS)

REFERENCES

1. Bendre, A.M.Kumar (2006) A text book of Practical Botany. (Vol I and II).Rastogi publication New Delhi. ISBN 81-7133-852-6
2. Jones A., Reed R & Weyers (2012) J. of Practical skills in biology, Pearsons Review. ISBN 978-1408254477.
3.Sundararajan, S. (2000) Practical manual of Angiosperm Taxonomy. Anmol publication. New Delhi. (ISBN 81-261-0687-5)

Course outcome	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	Total
CO1	5	5	5	3	2	1	21
CO2	5	5	5	5	4	4	28
CO3	5	5	5	5	5	3	28
CO4	5	5	5	5	5	5	30
CO5	5	5	5	5	5	5	30
Total	25	25	25	23	21	18	137
							137/30 = 4.5

BOT 1357 PLANT BIOLOGY I 3Hr./3Cr.

PREAMBLE:

This course is designed for zoology major students as a supportive course to enable them to understand the world of plants. It gives an overall view on diversity in structure, organization and evolutionary trend in the plant kingdom. Plants are broadly divided into non-vascular and vascular plants and from each group a plant will be taken for a detailed study. The course also has a lab component, in which students will experiment and learn more about the type specimens. At the end of the course the students would have accomplished the basic understanding of the plant kingdom.

COURSE OUTCOME

At the end of the course, the students will be able to

i. look at plants on earth with a geological and geographical perspective and recognize their placing in the five kingdom classification, an arrangement in which algae can be shown as the progenitor of the plant world with a special emphasis on its own ecological and economic potential
ii. describe the general characters of bryophytes, classify liverworts, hornworts and mosses as the structure and reproduction of *Riccia* and
iii. the alternation of generation in mosses are scrutinized in the process of highlighting the ecological and economic importance of the group
iv. present pteridophytes as first land plants and explain their general character and life cycle with morphology and reproduction of *Pteris* as a case study to illustrate the nifty-gritty and diversity of ferns and explore their ecology and evolutionary significance
v. describe and characterize gymnosperms as the constituents of the early forests of planet earth keeping a closer watch on *Pinus,* explaining its external and internal morphology, reproduction and seed formation and use the study to find the feasibility of cashing on industrial and domestic utilities
vi. trace the origin of flowering plants, defining a flower and a fruit and gain an overview on the Bentham and Hooker's classification to deal with floral biology and study the significance of fruits and seeds.

SYLLABUS

UNIT I: Introduction: (9 hr)

Geological timescale -Five kingdom classification – evolution of plants -co-evolution-biological diversity.

UNIT II: Non – vascular plants: (9 hr)

General characters of algae **–** occurrence, and structure of alga (*Caulerpa*) - economic importance of algae- General characters of Bryophytes and morphology of *Riccia* - economic importance of Bryophytes.

UNIT III: Lower Vascular plants: (6 hr)
Non-flowering plants – General characters of Pteridophytes – morphology of ferns (*Pteridium aquilinum*)- economic importance of ferns

UNIT IV: Primitive seed plants: (6 hr).
General characters of Gymnosperms–morphology and reproductive structures of *Pinus* – economic importance of gymnosperms

UNIT V: Flowering plants: (15 hr)
Bentham and Hookers classification (up to series level) -Diagnostic characters of Malvaceae (Polypetalae)-Solanaceae (Gamopetalae)- Euphorbiaceae (Monochalamydeae) - Poaceae (Monocotyledons) with a species from each family as an example.

TEXT BOOKS

1. Pandey, B. P. 2005. *College Botany*, Vol I. (5th ed.) S. Chand & Company New Delhi. ISBN 81-219-0593-1
2. Pandey, B. P. 2009. *College Botany*, Vol II. (7^{th} ed.) S. Chand & Company New Delhi. ISBN 81-219-0601-6

REFERENCES

1. Vashishta, P. C. 2001. *Pteridophyta* (Vascular Cryptogams). S. Chand & Company, New Delhi. ISBN 81-219-0828-0
2. Vashishta,P. C. 2009. *Gymnosperms*. S. Chand & Company, New Delhi. ISBN 81-219-2618-1
3.Vashishta, B.R., A. K. Sinha & A. Kumar 2005. *Bryophyta*. S. Chand & Company, New Delhi.ISBN 81-219-0463-3
4. Bhattacharyya, B. 2005. *Systematic Botany*. Narosa Publishing House, Chennai. ISBN 81-7319-542-0

	K1 (Recall)	K2 (Understanding)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1	4	5	5	3	2	1	20
CO2	4	5	5	3	2	1	20
CO3	4	5	3	3	2	1	19
CO4	4	5	4	3	2	1	19
CO5	3	4	5	4	4	2	22
Total	19	24	22	16	12	6	100
							100/30= 3.33

BOT 1159 PLANT BIOLOGY- I (LAB) 2Hr./1Cr.

At the end of the lab course, the students will be able to

i. identify the diverseness of various plant forms in their own habitats in day to day life and do comparative study of structure and reproduction of thallus forms to higher plants.
ii. to distinguish species in a selective ecosystem with the knowledge he acquired about the anatomical variations among the lower plant forms which differentiates terrestrial plants from aquatic habitats.
iii. categorize the tissue organization in thallophytes, pteridophytes and gymnosperms.
iv. classify the flowering plants by investigating the floral structures of the given plant and identify the family to which the particular plant belongs to.
v. describe the economic importance of plants with specific attention to the plant produces from which he is benefited in life.

1. Algae – *Caulerpa* as example vegetative and reproductive structure
2. Bryophytes – Riccia (gametophyte and sporophyte structure)
3. Pteridophytes – morphological and anatomical structure of sporophyte and sorus organization
4. Gymnosperms – Morphological features of Pinus (Stem, needle and cones)
5. Gymnosperms – Anatomical features of Pinus (male and female cones)
6. Angiosperms – Morphology of vegetative and reproductive structure of Malvaceae *(Hibiscus rosa-sinensis* as example)
7. Morphology of vegetative and reproductive structure of Solanaceae (*Datura metel* as example)
8. Morphology of vegetative and reproductive structure of Euphorbiaceae (*Euphorbia cyathophora* as example)
9. Morphology of vegetative and reproductive structure of Poaceae (*Oryza sativa* as example)
10. Economic botany – plants used as food and medicine
11. Field trip to nearby areas such as Alagar Hills or Sirumalai

REFERENCES

1. Sundararajan, S. 2003. Practical manual of plant morphology. Anmol publication New Delhi. (ISBN 81-261-1403-7)
2. Bendre, A. M., A. Kumar, 2006. A text book of practical botany. Vol I. Rastogi Publication New Delhi. (ISBN 81-7133-809-7)
3. Bendre, A. M., A. Kumar, 2006. A text book of practical botany. (Vol I and II) Rastogi Publication New Delhi. (ISBN 81-7133-852-6)
4. Sundararajan, S. 2000. Practical manual of Angiosperm Taxonomy. Anmol publication New Delhi. (ISBN 81-261-0687-5)

BOT 1251 MUSHROOM CULTURE TECHNOLOGY (LIFE SKILL) 3Hr. /2Cr.

PREAMBLE:

As a two credit course offered to the first year student of any major, it will be taught as life skill course. Skill development is being recognized as the priority of higher education in any said branch of science. This course is designed to motivate fresh students to learn the science of cultivating mushrooms. It is an introductory level course and designed to help the students to grow mushrooms in simple and cheap substrates like hay and organic debris and other locally available substratum. The nutritive and economic potential of mushrooms will be taught with illustration. Demonstration and field visit components may help the students to get hands on experience. At the end of the course the students will develop skills in commercial cultivation, harvest and marketing. It is taught as a lab cum theory course which will span 4 hours per week. This course is also designed to carter to the need of young entrepreneurs who would like to start a food based industry.

COURSE OUTCOME

At the end of the course, the students will be able to

i. List different varieties of mushroom, distinguish between edible and non edible, and classify them.
ii. characterize, compare the cultivating mushroom and trace the lifecycle.
iii. experiment the cultivation procedure, design new culture technique, analyze the pest and factors affecting growth of mushroom.
iv. develop technologies for harvesting, packaging and acquire knowledge to avail loan from banks
v. Summarize uses of mushroom and create new recipes for marketing.

SYLLABUS

Unit I. Introduction (9 hr)

Mushroom a type of fungi –Characteristics features of fungi – Differences between fungi and other organisms. mushroom classification – History of mushroom cultivation – Naming of mushroom – Popular mushroom – Edible and poisonous mushrooms – Institutes cultivating mushroom – Varieties available in Tamil nadu.

Unit II. Morphology and Taxonomy of Mushroom: (9 hr)

Morphological characters and taxonomical position of Agaricus - Pleurotus – Volvariella – Shiitake –life cycle of any one species – Spore collection – fruiting body.

Unit III. Cultivation of Mushroom: (9 hr)

Tray method for large cultivation – Packet method for small scale cultivation – outdoor mushroom cultivation Pure culture of spores – compost making – spawn types and spawning – casing of soil – Time interval for water sprinkling – Pest identification and control – environmental control.

Unit IV. Harvesting and Packaging : (9 hr)

Manual harvesting method – Asepsis –Packing – Labeling –Marketing –Shelf life of mushrooms – Budget.

Unit V. Uses of Mushroom: (9 hr)

Economic value of various mushrooms – Food and Dietary Component –Medicinal value – Mushroom recipes.

TEXT BOOKS:

1. Tripathy D.P 2005. Mushroom cultivation. Oxford and IBH publishing co. pvt.Ltd.New Delhi. ISBN 8120416449

2. Nita Bahl. 2000. Handbook on mushrooms, Oxford &IBH publishing pvt. Ltd. India. ISBN 9788120413993

REFERENCES:

1. Kaul T.N. 2002. Biology and conservation of mushrooms.Oxford and IBH publishing co.pvt.Ltd. New Delhi. ISBN 81-204-1513-2.

2. Stamets P and Chilton J. S 1985. The mushroom cultivator, Richmond publishing company. U.K. ISBN 096-1079-80-0.

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	Total
CO1	5	5	5	5	4	1	25
CO2	5	5	4	4	4	4	26
CO3	5	5	5	5	5	5	30
CO4	5	5	5	5	5	5	30
CO5	5	5	5	3	3	5	30
							141/30=4.7

BOT 1253 FOOD AND NUTRITION (NME) 3Hr./ 2Cr.

PREAMBLE:

Human perspective towards food keeps changing, taking advantage of this, global marketers introduce food varieties in the market every year. In general, foods preferred by consumers is determined by the media and the advertisement agencies. Hence, Today's youth and children are attached towards a variety of packaged, preserved fast food. Enough cautions are posed by health advisors about these junk foods, but still awareness id poor about healthy foods among the educated too. There is a need for a scientific analysis of the food colorants and preservatives. They would be able to choose healthy foods and avoid junk foods and further they would be able to carry this knowledge to their family and friends.

COURSE OUTCOME

At the end of the course, the students will be able to

i. comprehend the idea of defining food as a concept, classify foods, identify palatable nutritious meal, traditional and ethnic food and get idea on dealing with food security and hunger

ii. identify the carbohydrate, protein, fat, mineral and vitamin source of food.

iii. gain a knowledge on the types of food preservative -significance of sweeteners, emulsifiers and probiotics -methods of coloring it with suitable colorants, adding flavor

iv. adulteration, know the methods of checking food quality in the light of legal implications and food laws that the flipside of consuming low quality food on human health is realized

v. acquire the needed skills from the dietary point of view to classify food, define balanced diet, and do BMI calculations for carrying out comparative analysis of food types for securing gainful employment in food industry.

SYLLABUS

UNIT I: Food facts: **(9 hr)**

Concept of food- Brief history of food and agriculture- Cuisines and culture- Classification of foods-(Western foods, Indian food, continental foods, Ethnic foods, Junk foods, Fast foods)- F-Famous food recipes of Madurai

UNIT II. Nutrition of food: (9 hr)

Carbohydrates - Protein – Fats - Vitamins – Minerals - Fibres – water – Deficiency disease.

UNIT III: Food preservatives and additives (9 hr)

Food preservatives- types- expiry date- Artificial sweeteners- Emulsifiers –Probiotics -Enzymes- Microbes in food industry. Food colorants- Types- Food flavors- Types- advantages and limitations of food additives and preservatives

UNIT IV: Food Adulteration(9 hr)

Adulterants- types of adulteration- simple tests in identifying adulteration in food stuffs- Impact on health- case study. Food policies and laws.

UNIT V: Know your food(9 hr)

Balance diet and choice of food – BMI calculation – Nutritional requirements based on age, body mass and gender- role of dieticians- Master Health Checkup Programs - Comparative analysis of Cooked food Vs Raw food - vegetarian food Vs non vegetarian food- prevention of loss of nutrients.

TEXT BOOKS

1. Srilakshmi, B. 2006. Nutrition science.2nd edition New age international publishers, ISBN 81-224-1633-0
2. Sumathi R.M 2007. Fundamentals of food, Nutrition and Diet therapy, New age International Publication ISBN 81-22419828

REFERENCES

1. Anita Tull 1996. Food and Nutrition Oxford University press, U.K. ISBN: 01-98327668
2. Annie Fredrick 2006. Text book of Food and Nutrition, Lotus Press ISBN: 8193820735
3. Sanjeev R. 2014. Ayurvedic science of Food and Nutrition, Springer Publication ISBN: 978-1-9627-408245477.

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	5	5	5	5	2	2	24
CO2	5	5	5	5	5	2	27
CO3	5	5	4	3	2	1	20
CO4	5	5	5	3	3	2	23
CO5	5	5	5	5	3	3	26
	25	25	24	21	15	10	120
							120/30=4

SEMESTER -II

BOT 1552 GENETICS AND PLANT BREEDING 5Hr./5Cr.

PREAMBLE:

The course introduces the basics of genetics dealing with inheritance of characters, about principles pertaining to plant breeding and crop improvement.

Starting from the basic rules drawn from Mendel's experiments, the idea of chromosomal theory of inheritance will be introduced that will lay foundations and students will be able to study applied studies, with real time examples. It will help them to understand DNA as the genetic material. The unit on population genetics will brief about the mutations, genetic drift and chances for speciation. Basics of plant breeding and traditional methods in crop improvement will be discussed citing regional examples. Discussion on plant breeding and crop improvement will not be exhaustive, but the content would suffice the learner to apprentice the need for breeding, conservation and management of genomes of useful plant stocks.

Students should be able to understand the science of inheritance of characters and reasons behind the variations noticed in the population. He should be able to appreciate the importance of plant resources, need to develop hybrid varieties and conserve them for the future generation.

COURSE OUTCOME

At the end of the course, the students will be able to

i. Conceptualize the laws governing our inheritance, compare and contrast the allelic and genic and polygenic interaction.
ii. Acquire knowledge about chromosome organization and recognize sex and sex linked inheritance.
iii. Formulate hardy Weinberg law, assess the effect of mutagens and appreciate the traits in humans.
iv. distinguish between qualitative and quantitative traits, expertise in various methods of breeding.
v. Represent the right of farmer and breeder, adapt strategies to develop resistant varieties and gain knowledge and practical experience in the activities of breeding and conservation centres.

SYLLABUS

Unit I: Fundamentals of genetics (15 hr)

Mendel's history and experiment- laws of inheritance- Allelic interaction -Gene interactions- (Duplicate dominant, epistatis, complementary gene)- multiple allele inheritance (human blood group)- polygenic inheritance (ear length in Maize)- Sex linked inheritance (color blindness).

Unit II: Chromosomal structure and inheritance(15 hr)

Chromosome organization – types of chromosomes, sex chromosome- Sex determination in human, animals and plants (*Melandrium*)- sex linked inheritance- chromosomal aberration-, linkage and mechanism of crossing over.

Unit III: Population genetics (15 hr)
Hardy-Weinberg Law- penetrance and expressivity- spontaneous and induced mutation, mutagens- genetic drift and erosion- Introduction to speciation- human traits- Pedigree and family tree.

Unit IV: Plant breeding (15 hr)
Objectives – Qualitative and quantitative characters- Conventional methods of selection - Self pollinated crops - Cross pollinated crops - Hybridization types - Procedure of hybridization - hybrid vigour.

Unit V: Crop improvement (15 hr)
Crop improvement for resistant, tolerant and high yielding varieties. Traditional breeding programmes in Rice- Plant genetic resources of India- Germplasm centres. Sugarcane breeding institute (Coimbatore) - Tamil Nadu Rice Research Institute (Aduthurai) - Coconut Research Station (TNAU, Aliyarnagar) - Institute of Forest Genetics and Tree Breeding (Coimbatore) - National Research Centre for Banana (Tiruchirappalli).

TEXT BOOKS

1. Ahluwalia,K.B. (2009). Genetics, 2edn. New Age International Publishers. ISBN 978-81- 224-2390-7
2. Chahal, G.C and Gosal,S.S (2002) Principles and Procedures of Plant Breeding. Narosa Publishing House. ISBN 81-7319-374-6

REFERENCES

1. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition. ISBN 0470388250
2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2007). Concepts of Genetics. Pearson Education. 7 th edition. ISBN 813170811X
3. Sinnott,E.W., Dunn,L.C. and Dobzhansky,T. (2004).Principles of Genetics. Tata Mc Graw Hill. ISBN : 0-07-099-413-7.
4. Hayward,M.D, Bosemark,N.O, Romagosa,T(eds) Plant Breeding Principles and prospects Springer publication. ISBN 9780412433900
5. George Acquaah, (2012) Principles of plant genetics and breeding.2 nd edition.Wiley Blackwell Publishers. ISBN 9781118313695

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	5	5	4	4	4	4	26
CO2	5	5	4	4	4	4	26
CO3	5	5	5	5	5	5	30
CO4	4	4	5	5	3	5	26
CO5	5	5	4	3	5	3	25
							133/30=4.4

BOT 1454 EVOLUTION AND PHYCOLOGY 4Hrs./4Cr.

PREAMBLE:

The course provides an overview of formation and conditions of early earth, emergence of life forms and evolution process. Students will be inducted into the plant kingdom starting from algae as the simplest autotrophs and evolutionary trends. They will be able to comprehend the characteristics features of the major groups of algae, and their economic importance will be assessed.

COURSE OUTCOME:

At the end of the course, the students will be able to
i. understand formation of earth and explain the earliest environment conditions..
ii. analyze emergence of life and general theories on evolution.
iii.illustrate the evolutionary links from algae to vascular plants.
iv.formulate the characteristic features, life cycle patterns of major classes of algae.
v. assess the applications and economic potential of algae

SYLLABUS:

Unit I : Genesis of life(12 hr)
Earth formation – Geological time scale – emergence of life - Miller and Urey experiment – basic theories on evolution – Origin of Species – contributions of Darwin and Lamarck – tree of life – evolution of human.

Unit II : Origin of plants: (12 hr)
Life forms – Five kingdom classification – evolutionary history of plants – fossils – Stromatolites – oxygenic photosynthesis - prokaryotic algae – endosymbiosis – chloroplast and membranes – vascularization – evolutionary trends from algae to land plants.

Unit III: Overview of algae: (12 hr)
Characterization and classification of Algae: pigments, storage reserves, cell wall, flagella, eyespot and pyrenoids - thallus construction – reproduction – Outline of classification (Smith, 1955) – Salient features of Cyanophyceae, Chlorophyceae, Phaeophyceae and Rhodophyceae – Contributions of Indian algologists.

Unit IV: Type study of algae: (12 hr)
Cyanophyceae (*Anabaena*) – Chlorophyceae (*Chara*, *Oedogonium*) – Phaeophyceae (*Sargassum*) – Rhodophyceae (*Gracilaria*).

Unit V: Applied Phycology: (12 hr)
Mass cultivation: SCP (*Spirulina*) –marine algae Mariculture (*Kapphaphycus*) - diatomaceous earth – algae as food, Agar agar (*Gracilliaria, Gelidiella*), Carrageenans, Alginates - biofertilizers, biofuel – Docosahexaenoic acid (DHA), Seaweed Liquid Fertilizer – algal blooms – symbiotic association (Azolla, Lichens).

TEXT BOOKS

1. Kumar, H.D.(1988). Introductory Phycology. East West Press. India. ISBN: 81-859-3896-2
2. Sharma,O.P. (2007). Textbook of algae. Tata McGraw Hill, India. ISBN 0-07-451928.

REFERENCE BOOKS

1. Bold, H.C and Wyne. M.J. (1978). Introduction to the algae: Structure and reproduction. Prentice-Hall. ISBN 0134777867
2. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition. ISBN: 9780521141444
3. Morris, I. (1971). An Introduction to Algae. Hutchinson University Library. ISBN: 0-090-80713-8
4. Raven, P.H., Evert, R.F and Eichhorn, S.E. (2013). Biology of plants. 8th Ed. W.H. Freeman Publishers, ISBN: 1464113513.
5. Smith, G.M. (1971). Cryptogamic Botany Vol.1. Algae and Fungi. Tata McGraw – Hill book company. 2nd Edn. ISBN :0070995761.
6. Stewart, W.N and Rothwell G.W. (2010). Paleobotany and the Evolution of Plants. Cambridge University Press. 2nd Edn. ISBN 10:0521126088
7. Willis,K.J and McElwain.J.C (2002). The Evolution of Plants. Oxford University Press.ISBN: 0198500653

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	Total
CO1	5	5	5	5	4	1	27
CO2	5	5	5	5	5	1	26
CO3	5	5	5	3	2	1	21
CO4	5	5	4	3	2	1	20
CO5	5	5	5	4	4	4	27
Total							121
							121/31=4.0

BOT 1456 GENETICS AND PLANT BREEDING AND EVOLUTION AND PHYCOLOGY (LAB-II) 2Hr/2 Cr.

The students will be able to

i.verify mendel's laws, test the purity of gametes, identify the interaction between alleles and distinguish various gene interaction, identify different blood group in human, familiarize with polygenes which influences quantitative traits, determine sex of animals, categorize human traits as dominant and recessive and perform probability test for gene inheritance.
ii.test viability of seed, experiment with emasculation techniques and familiarize with different hybridization techniques by visiting plant breeding stations.
iii. interpret the formation of earth, emergence of life and theories on evolution process.
iv. investigate the habitat and diversity of cyanobacteria and higher algal forms during the field study and draw a comparative analysis of thallus structure and life cycle patterns of important forms.
v. identify the different types of lichens and preserve algal specimens

Genetics and Plant Breeding

1. Verification of Mendel's law – I (Monohybrid ,test and back crosses)
2. Verification of Mendel's law - II (Dihybrid cross)
3. Gene interactions – problem solving
4. Study of Mendelian traits in human
5. Barr bodies & Giant chromosome - Chironema
6. Blood grouping- multiple alleles
7. Probability test – beads/coin/dice
8. Chromosome mapping
9. Drosophila experiment
10. Collection and submission of local rice / vegetable cultivars
11. Determination of seed viability
12. Method of emasculation – pollen dusting and bagging
13. Visits - Cotton, millet, sugarcane research centres (Coimbatore), Banana Research Centre (Trichy), National facilities - NBPGR, ICRISAT.

Reference

1. Gardner,E.J.,Simmon,M.J and Snustad .D.P. (1991) . Principles of Genetics. John Willey and Son (Asian) Ltd. Singapore. ISBN:0-471-50487-4
2. Stansfield,W.D. (1991). Theory and problems of Genetics. 3rd ed. McGraw Hill Inc. ISBN 0-07-060877-6
3. Chahal,G.C and Gosal,S.S (2002) Principles and procedures of Plant breeding. Narosa Publi. House. ISBN 81-7319-374-6

Evolution and Phycology

1. Formation of earth - documentary & discussion
2. Darwinism: Galapagos Island – documentary & discussion
3. Fossils – Stromatolites and Diatoms

Morphology and reproductive structures of

4. *Cyanophyceae – Nostoc*, *Anabaena* and *Oscillatoria* movement
5. *Chlorophyceae – Chlamydomonas, Volvox*
6. *Chlorophyceae - Oedogonium*, *Caulerpa*, *Chara*
7. *Phaeophyceae – Sargassum*, *Dictyota*
8. *Rhodophyceae – Batrachospermum*, *Gracilaria*
9. Algal cultivation Race way (*Spirulina)* – Demo
10. Marine algal cultivation (Mariculture) – Demo
11. Lichens – types and uses
12. Collection and preservation of algae

Reference books

1. Bendre, A. M., A. Kumar, 2006. A text book of practical botany. Vol I. Rastogi Publication New Delhi. (ISBN 81-7133-809-7)
2. Pandey, B. P. 2005. *College Botany*, Vol I. (5th ed.) S. Chand & Company New Delhi. ISBN 81-219-0593-1

BOT 1358 PLANT BIOLOGY II 3Hr./3Cr.

PREAMBLE:

This course gives an overview of life process happening inside plants and this will broaden the understanding of the students on various functional events including water and mineral uptake, transport of photosynthates, growth & development and nitrogen fixation. The course also has a lab component to have a hand on experience of verifying the theory under natural setting. At the end of the course students will be able to appreciate the plant as the only system, which is equipped to capture light energy and convert it into chemical energy.

COURSE OUTCOME

At the end of the course, the students will be able to

i. look at plant as a functionally self-contained entity and use the understanding on mechanics and structures for water and mineral uptake, transport and utilization in their cells and tissues as model system to create and fabricate machines, filters and devices of human utility modeled on the inputs they have received from this course

ii. understand the translocation of food and sap, regulation water and food transport , ventilating mechanism with a role for stomatal apparatus, and process of liquid loss from hydathodes and lenticels that the heat release and hydraulic components of plant function can be analyzed for adoption in designing relevant production and processing units required for industrial and environmental applications

iii. look at chloroplast as photovoltaic battery involved in thermodynamic functions that the light trapping, transfer and transduction processes are elucidated as functions initiated by chlorophyll form from the biophysical viewpoint and the role of phytochromes and cryotochromes are interpreted as environmentally regulated switches with precision ad sensitivity.

iv. critically look at the paradox of nitrogen as a common as well as scarce resource to plants and evaluate the nitrogen cycle and the prokaryotic process nitrogen fixation that serves as source of nitrogenous input and look at nitrate reduction and amino acid synthesis that form the hub of nitrogen metabolism.

v. gain an overview of plant growth & development in outline, study plant growth promotion and regulation by auxins, gibberellins and cytokinins besides ABA and ethylene that they may acquire the prowess of commercially manipulating plant development to their own advantage.

SYLLABUS

UNIT I Water relations: (9 hr)

Pipeline systems in plants- Water potential- Guttation- Imbibition- Osmosis-, Active transport- Passive transport - Carrier mediated transport- Tissue organization of xylem and phloem – role in conduction.

UNIT II Ventilating systems: **(9 hr)**
Stomata- hydathodes- transpiration- evaporation- convection- photorespiration.

UNIT III Photobiology: **(9 hr)**
Photosynthetic pigments- Photosynthetic electron transport- exploring the path of carbon in photosynthesis –photoperiodism – phytochrome- cryptochromes – photomorphogenesis.

UNITIV Nitrogen metabolism: **(9 hr)**
Nitrogen sources – symbiotic and asymbiotic nitrogen fixation- Nitrogen fixing Organisms – Use of biofertilizers.

UNITV Growth and development (9 hr)
Plant hormones, growth promoters-auxin, gibberelin, cytokinins – growth inhibitors- ethylene, ABA- Plant Movements - nastic and tactic movements.

TEXT BOOKS

1. Srivastava. H. S. 2005. *Plant physiology*. Rastogi Publications, Meerut. ISBN 81-7133-785-6
2. Ghosh. M. S. 1996. *Plant physiology*. (Ist Central Edition) New Central Book Agency (P) Ltd. ISBN 81-7381-478-3.

REFERENCES

1. Bidwell. R. G. S. 1975. *Plant physiology*. Macmillan Publishing Co. INC. New York. ISBN-0-02-309430-3

2. Williams. M. B. 1984. *Advanced Plant Physiology*. Pitman Publishing New Zealands Ltd. Wellington.ISBN-0-273-02306-3

3. Salisbury. F. B. & Ross C.W. 1992. *Plant Physiology*. Fourth Edition. Eastern Press. Bangalore. ISBN-981-243-853

4. Sinha. R. K. 2004. *Modern plant physiology*. Narosa Publishing house New Delhi. ISBN 81-7319-333-9

	K1 (Recall)	K2 (Understanding)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1	4	5	4	3	2	1	19
CO2	4	5	3	3	1	1	17
CO3	4	4	4	5	3	2	22
CO4	4	4	4	5	3	1	21
CO5	4	4	4	5	5	2	24
Total	20	22	23	21	14	8	103
							103/30= 3.4

BOT 1160 PLANT BIOLOGY II (LAB) 2Hr./1Cr.

At the end of the course, the students will be able to

i. investigate the movement of food and water through the specialized tissues ,intercellular translocation in plants with the influence of environmental factors.
ii. analyse the external factors which brings changes in the physiology of plants through live experiments**.**
iii. **e**quip himself to calculate the duration, rate of reaction and measurements of various physiological reactions.
iv. explore the movements in plants with response to different stimuli and analyse the role of microbes in fixing atmospheric nitrogen which the plants cannot able to do.
v. apply the knowledge of growing plants in soilless environment with the supplement of mineral nutrients.

1. Ascent of sap (Ringing and Girdling experiment)
2. Osmosis using potato osmoscope
3. Plasmolysis using Onion peel & *Tradescantia* leaf.
4. Measurement of (DPD) Diffusion Pressure Deficit using potato tubers.
5. Transpiration using potted plant & bell jar, cobalt chloride method to compare the transpirational rates
6. Evolution of O_2 during photosynthesis using Wilmott bubbler counter.
7. Effect of different wavelength of light during photosynthesis
8. Measurement of growth using auxanometer
9. Phototropism & Gravitropism using potted plants
10. Use of biofertilizer to promote root nodule
11. Methods of studying plants nutrition – Hydroponics
12. Symbiotic nitrogen fixation – sectioning of legume root nodule

REFERENCES

1. Kumar B. 2006. *A Text book of practical botany*. Rastogi Publication. Meerut. ISBN 81-7133-809-7
2. Santra. S.C.. Chatterjee.T. P.& Das A. P. 2005. *College Botany-Practical.* Vol-I. New Central Book Agency (P) Ltd. India ISBN-81-7381-357-4.

BOT 1252 NURSERY AND GARDENING (LS) 3 Hr./2Cr.

PREAMBLE:

This course is designed for students who have passion for collecting plants and adopting them at safe and protected areas. The course is envisaged in such a way to develop fine skills in planning for various types of gardens with specific theme ad purpose. Landscaping is also added in order to enhance the scope of the course. It is a course where there is no need any perquisites except love and passion for plants and intelligent special perception. At the end of this course student is expected to use the given space in an intelligent manner and transform it as a thematic garde .

COURSE OUTCOME

At the end of the course, the students will be able to

i. Identify the varieties of plants maintained in a nursery, forecast the risk of climatic factors affecting nursery plants, create facilities of his own.
ii. Develop seed storage strategies, track the pest and evolve the right method to control them.
iii. Specialize himself in cultivation technique and manage the nursery.
iv. Categorize the plants, select right choice of the plant for different gardens and develop himself as a entrepreneur
v. Recognize the various types of parks and gardens in his locality, appreciate the role of parks in society thereby conserving it.

SYLLABUS

UNIT 1: Nursery development (9 hr)

Definition –Objectives and Scope for nursery –role of nursery curator– Facilities needed(land –soil - water- climate-special growing structure-manure/fertilizer – pesticide – pots – polybags - labour- transport)-steps in raising nursery - factors affecting nursery plants- varieties of plants sold in nursery and trade.

UNIT II: Propagation by seeds: (9 hr)

Seed storage - seed viability – seed treatment methods -seed sowing – germination and seedling stage- soil mixture –transplanting – watering – control of pest in nursery.

UNIT III: Vegetative propagation and maintenance: (9 hr)

Cutting- layering –budding –grafting –collecting season – planting methods – treatments for propagating materials – propagules – growing in special structures – hardening – pruning – cleaning – fertilizing.

UNIT IV: Nursery plants: (9 hr)

Ornamental plants (flowering) Crotons (non flowering) - medicinal plants – arboreal varieties – climbers – fencing plants – Ornamental palms – Orchids – Gymnosperms – ferns – Cacti – Bonsai.

UNIT V: Gardens and Parks: (9 hr)

Definition - Objectives and scope – Types of garden – landscape gardening –- water garden- ornamental gardening in homes – Kitchen garden - Components of garden/ parks – choice of the plants for garden components – Rockery – Role of gardener - Benefits of garden – Popular parks and gardens –Role of parks in well being of human and environment.

TEXT BOOKS

1.Kumar, N., 2017, Introduction to Horticulture, Med tech publishers, India. ISBN 9386479834
2. Sadhu, M.K., 1989, Plant propagation, New Age International publishers. India. ISBN 8122400655

REFERENCES:

1. Agarwal, P.K.1993, Hand Book of Seed Technology, Dept. Of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi. ISBN 8120409949
2. Bose T.K. Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi. ISBN 9788120402294
3.Edmond Musser, Andrews. 1997. Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.ISBN 9780070189782
4.Janick Jules. 1979. Horticultural Science. (3rd Ed), W.H.Freeman and Co., San Francisco, USA.ISBN 0716717425

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	3	3	4	4	4	4	22
CO2	3	3	3	4	4	34	21
CO3	4	4	4	4	4	4	24
CO4	4	4	4	4	4	4	24
CO5	5	4	4	4	4	5	26
	19	18	19	19	19	20	117
							117/30=3.9

BOT 1254 PLANT WONDERS (NME) 3 Hr./2Cr.

PREAMBLE:

This course is aimed to impart knowledge on plants to non science students. It introduces the microscopic to giant Angiosperms of the plant kingdom. Students will learn about different groups of plant, basic plant processes and their contributions to the human being. Uniqueness of plants in terms of size, shape, habitat and their associations will be highlighted. They will develop a desire to further explore the plant kingdom and also to conserve plants.

COURSE OUTCOME

At the end of the course, the students will be able to

i. relate plants and civilization, identify plants as source of food, fuel, energy.
ii. acquire knowledge about various life forms of plant, able to benefit from the uses of plants
iii. describe the amazing plants, utilize plants as fertilizer
iv. rank the plants according to their magnitude, identify the indicators of pollution and minerals
v. discover plants in various extreme environment, discuss the plant's adaptation.

UNIT I Plant as resource: (9 hr)

Plants and civilization: Difference between plants and animals – Plants and man-Plants as source of food, energy, fuel and medicine - Plants in protection of environment.

UNIT II Plant groups: (9 hr)

Unique characters and Importance of - Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

UNIT III Plants of curiosity(9 hr)

Sensitive plants (*Mimosa pudica*)- Aromatic plants(*Tagetus*)- fertilizing plants(*Tephrosia purpurea*) –camaouflage plants (*Corydalis hemidicentra*) – stinky plants(*Titan arum*) Biolumenscing plants – model plants- dancing plants- seed dispersing plants

UNIT IV Amazing plants(9 hr)

Tallest, largest, oldest and smallest plant -magnitudes in size, flowers, leaves and fruits – Epiphytes(*Vanda*) – Parasites(*Cuscuta*) – Orchids(*Bulbophyllum*) – Insectivores*(Nepenthes*) pollution indicators - mineral indicators

UNIT V Extreme plants and their adaptation: (9 hr)

Plants thriving in space (*chlorella*) – volcanoes(hawaiian *argyroxiphium*)- ocean(-sea weed) – swamps(mangroves -*Avicennia*) –desert (*Saguaro cactusti*) – alpine (Junipers) – tundra (arctic lichen) .

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1. Pandey B.P. 2005 Collage Botany : Vol I, 5th edn. S.Chand &Company LTD. New Delhi. ISBN -81-219-0593-1

2. Raven PH Evert RF and Eichhorn SE 2013. Biology of plants. VIIIth Ed. W.H. Freeman Publishers, 1464113513.
3. Santna, S.C..Chatterjee, T.P and A.P. Das 2004 Collage Botany Practical (Vol II) New Central Book Agency (P) Kolkatta. ISBN -81-7381-320-5
4. Starr,C. 2007. Biology : concepts and applications. VI edn. ISBN 81-315-0284-8.

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	4	5	5	3	3	4	24
CO2	5	5	5	5	3	2	25
CO3	5	5	5	3	2	2	22
CO4	5	5	3	3	2	2	20
CO5	5	5	5	2	2	2	21
							112/30=3.7

BOT 2531 **Microbiology and Phycology** **5Hr./5Cr.**

Pedagogy	Hours	Lecture	Dept. resources	Field /Indus. /Lab	Subject experts	ICT Virtual learning	Peer teaching	Super special models
	75	65	6	2	-	2	-	-

PREAMBLE:

This course provides an overview of the diversity of microbial life forms to the students. Structure and functions of selected prokaryotic organisms and algae will be dealt in detail.

The course introduces students to monera and protista of the five kingdoms, and proceeds with the milestones in the history of microbiology and phycology and contributions of eminent scientists. Viruses will be dealt separately with emphasise on the diseases caused by them to plants and animals. The variations and pigmentation characteristics of prokaryotic, photosynthetic cyanobacteria will be dealt. Pitching discussions on selected forms in the cyanobacterial link between the heterotrophs and autotrophs will be explored.

Students will be able to comprehend the life and processes of prokaryotic organisms from viruses to algae the earliest photosynthetic forms. Besides evolution and conservation aspects, commercial aspects of members will add the utility value of the course.

COURSE OUTCOME At the end of the Semester Students will be able to	Unit	Hrs P/S
CO1: Analyze the origin and diversity of life forms through the contributions of pioneering scientists in order that the role played by microbes in day to day life is understood.	1	10
CO2: Assess the characteristics and classification of viruses and use the knowledge in identifying and interpreting the diseases	2	10
CO3: Distinguish the characteristics, classification, growth, reproduction of bacteria and Cyanobacteria and find out agronomic significance.	3	25
CO4: Recognize the major groups of algae as a unique entity of biota and to know their life cycle and affinities.	4	15
CO5: Catalogue harmful and beneficial microbes and find out ways of effective commercialization.	5	15

SYLLABUS

Unit I:Introduction

Classification of life forms: Five kingdom and 3 domain- the advent of microbiology, (A. V. Leeuwenhoek, L.Pasteur and Robert Koch) and phycology (F E *Fritsch* and MOP Iyengar) - diversity based on habitat.

Unit II:Viruses

Viruses: Discovery, DNA virus (T-phage), lytic and lysogenic cycle- RNA virus (HIV) - comparison of plant and animal viruses – common human viral diseases.

Unit III: Bacteria and Cyanobacterium

Prokaryotic organisation:morphotypes, structure; nutritional types. A brief Introduction to Bergeys system of classification. Growth curve and measurements, Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction).

Cyanobacteria - Exomorphic variations, pigmentation, biological nitrogen fixers, Reproduction and adaptations.

Unit IV: Algae

General characteristics, major groups of algae - life-cycles of Caulerpa (Chlorophyta), Sargassum (Phaeophyta) and Gracilaria (Rhodophyta).

Unit V: Economic Importance

Harmful and beneficial microbes: microbial products –antibiotics(Streptomycin), vaccines (Rabies) and fermentation products - food spoilage. Biofertilizers & biopesticides, Agar, Carrageenan - Diatomite – Biofuel - large scale cultivation of algae.

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Text books

1. Dubey,R C and Maheswari,D.K .(2013) A Textbook of Microbiology, S.Chand & Comp. ISBN 81-219-2620-3
2. Kumar, H.D.(1988).Introductory Phycology. East West press.ISBN: 81-859-3896-2
3. Sharma,O.P (2007).Textbook of algae. Tata McGraw Hill, India ISBN 0-07-451928.

Reference books

1. Pelczar, H.J. E.C.S. Chan and N.R. Kreig. (1993). Microbiology concepts and applications. Tata McGraw Hill Inc. ISBN 0-07-049234-4
2. Prescott, L.M., Harley J.P., Klein D. A. (2008). Microbiology.McGraw Hill, India.6th edition. ISBN 0071267271
3. Bold, H.C and Wyne. M.J. (1978). Introduction to the algae: Structure and reproduction. Prentice-Hall. ISBN 0134777867
4. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition. ISBN: 978-0-521-14144-4
5. Ion Morris. (1971). An Introduction to the Algae. Hutchinson University Library. London. ISBN: 0-090-80713-8

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Three domains of life	2	Lecture and discussion
	Whittaker's five kingdoms	2	Lecture and discussion
	Brief History of microbiology – Leuwenhoek, Pasteur and Koch	2	Lecture and ppt
	Algalogy- Fritch and M.O.P. Iyengar	2	Lecture and ppt

	Distribution of forms in nature	2	Lecture and videos
UNIT II			
	Viruses –the link and the passage to life	2	Lecture and ppt
	Characterization of viral particle	2	Lecture and ppt
	Lytic and lysogenic cycle	3	Lecture and videos
	Types of viruses- variations in genome and capsids (Phage and HIV)	2	Lecture and ppt
	Common plant, animal and human viruses	1	Lecture, ppt and discussion
UNIT III			
	Prokaryotic organization of the bacterium	3	Lecture and chart
	Types, classification, Selected Bergy's entries	6	Lecture and ppt
	Growth, Nutrition and reproduction of Bacteria	6	Lecture and ppt
	Cyanobacteria: Morphotypes and pigmentation	6	Lecture and live specimens
	ecological significance of Blue Greens	4	Lecture and lab visit
UNIT IV			
	Characterization with notes on structure and reproduction	4	Lecture and charts
	Classification of algae	3	Lecture and chart
	Green algae - *Caulerpa*	3	Lecture, chart and museum specimens
	Brown algae - *Sargassum*	3	Lecture, chart and museum specimens
	Red algae - *Gracilaria*	2	Lecture, chart and museum specimens
UNIT V			
	Negative influence and harmful microbes	2	Lecture and discussion
	Beneficial microbes	2	Lecture and ppt
	Microbial Products including antibiotics, vaccines, fermented foods	4	Lecture and product samples
	Agroutility: Mass culture, Biofertilizers & Biopesticides	4	Lecture and agroproduct samples
	Industrial inputs: diatomaceous earth and phycocolloids	3	Lecture and agroproduct samples

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1	5	5	5	5	4	3	27
CO2	5	5	5	5	5	1	26
CO3	5	5	5	3	2	1	21
CO4	5	5	4	3	2	1	20
CO5	5	5	5	4	4	4	27
	25	25	24	20	17	10	121
							121/30 = 4.0

BOT 2335 GENETICS AND PLANT BREEDING 3Hr./3Cr.

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	45	25	5	10	5

Preamble:

The course introduces the basics of genetics dealing with inheritance of characters, about principles pertaining to plant breeding and crop improvement.

Starting from the basic rules drawn from Mendel's experiments, the idea of chromosomal theory of inheritance will be introduced that will lay foundations and students will be able to study applied studies, with real time examples. It will help them to understand DNA as the genetic material. The unit on population genetics will brief about the mutations, genetic drift and chances for speciation. Basics of plant breeding and traditional methods in crop improvement will be discussed citing regional examples. Discussion on plant breeding and crop improvement will not be exhaustive, but the content would suffice the learner to apprentice the need for breeding, conservation and management of genomes of useful plant stocks.

Students should be able to understand the science of inheritance of characters and reasons behind the variations noticed in the population. He should be able to appreciate the importance of plant resources, need to develop hybrid varieties and conserve them for the future generation.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
UNIT 1 CO1: Conceptualize the laws governing our inheritance, Compare and contrast the allelic and genic and polygenic interaction.	1	9
UNIT 2 CO2: Acquire knowledge about chromosome organization and recognize sex and sex linked inheritance.	2	9
UNIT 3 CO3: Formulate hardy Weinberg law, assess the effect of mutagens and appreciate the traits in humans.	3	9

UNIT 4 CO4: distinguish between qualitative and quantitative traits, expertise in various methods of breeding.	4	9
UNIT 5 CO5:Represent the right of farmer and breeder, adapt strategies to develop resistant varieties and gain knowledge and practical experience in the activities of breeding and conservation centres.	5	9

SYLLABUS

Unit I: Fundamentals of genetics

Mendel's experiment, laws of inheritance. Allelic interaction -Gene interactions- (dominant epistatis, complementary gene), multiple allele inheritance (human blood group), and polygenic interactions (ear length in Maize). Sex linked inheritance (color blindness).

Unit II: Chromosomal structure and inheritance

Chromosome organization – types of chromosomes, sex chromosome, Sex determination in human, animals and plants (*Melandrium*),sex linked inheritance, chromosomal aberrations, linkage and mechanism of crossing over.

Unit III: Population genetics

Hardy-Weinberg Law, penetrance and expressivity, spontaneous and induced mutation, mutagens, genetic drift and erosion. Introduction to speciation, human traits,Pedigree and family tree.

Unit IV: Plant breeding

Objectives - Qualitative and quantitative characters. Conventional methods of selection and hybridization . Traditional breeding programmes in Rice.

Unit V: Crop improvement issues

Farmer's and breeder's rights. Crop improvement for resistant, tolerant and high yielding varieties. Plant genetic resources of India- Germplasm centres.

References:

1. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition. ISBN 0470388250
2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2007). Concepts of Genetics. Pearson Education. 7 th edition. ISBN 813170811X
3. Sinnott,E.W., Dunn,L.C. and Dobzhansky,T. (2004).Principles of Genetics. Tata Mc Graw Hill. ISBN : 0-07-099-413-7.
4. Singh,B.D. (2014). Plant Breeding- Principles and methods. Kalyani Publishers.
5. Ahluwalia,K.B. (2009). Genetics, 2edn. New Age International Publishers. ISBN 978-81- 224-2390-7
6. Chahal, G.C and Gosal,S.S (2002) Principles and Procedures of Plant Breeding. Narosa Publishing House. ISBN 81-7319-374-6

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Gregor J. Mendel and his experiments with Garden Pea	2	Short film
	Three laws of inheritance	2	Animated videos
	Interactions of genes	3	OHP, problem solving

	and alleles		
	Polygenic interactions and multiple allele inheritance	2	Visual aid
	Sex linked inheritance	2	Power point
UNIT II			
	Chromosomal theory of inheritance	2	Animated video
	Types of chromosome	2	Slide show
	Sex Determination	1	Chalk and board
	Chromosomal aberrations	2	Chalk and board, OHP
	Linkage and crossing over	2	Chalk and board
UNIT III			
	Hardy –Weinberg law	2	Chalk and board
	Penetrance and Expressivity , human traits	1	Picture
	Mutagens and mutations	2	Lecture
	Genetic drift and gene erosion	1	Video
	Pedigree and family tree, Speciation	1	Group discussion
UNIT IV			
	Agronomically useful traits	1	Tabulating in OHP
	Traditional methods of field selection	2	Video,lecture
	Controlled hybridization	2	Video,lecture
	Ploidy and mutation breeding	2	Lecture
	Landmarks in Rice breeding	1	Protocol
UNIT V			
	Breeding for resistance and tolerance	2	Lecture
	High yielding varieties of crops	1	Listing using OHP
	Farmer’s and breeder’s right	1	Document
	Centres for PGR in India	1	Video/visit to any agricultural college
	Germplasm centres	5	Video/visit to any agricultural college

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	5	5	4	4	4	4	26
CO2	5	5	4	4	4	4	26
CO3	5	5	5	5	5	5	30
CO4	4	4	5	5	3	5	26
CO5	5	5	4	3	5	3	25
							133/30=4.4

BOT 2533 ARCHEGONIATAE 5Hr./5Cr.

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	75	60	-	10	5

PREAMBLE: This course will help the student to understand the evolutionary process in plant kingdoms which will commence from algal form. It seeks to give a account plants of plant adaptations from aquatic condition to a colonized terrestrial habitat. The changes in morphological, anatomical and reproductive structures that propel plant evolution will be investigated. In nutshell the course will trace evidences of plant evolution from extinct and extant plants.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
CO1: comprehend the evolution of morphology of various group of plants, their ever changing life cycle pattern and the sex organs in plants	1	15
CO2: understand the salient features of liverworts "the amphibious plants" on earth with their adaptive features of the three major groups and its ecological significance	2	15
CO3: evaluate the rise of vascular plants through learning the classification and features of primitive land plants which exhibit the important character of seed bearing nature called heterospory	3	15
CO4: correlate and analyze the relationship between the ferns and the true land plants "the gymnosperms" and which proceed to the study of angiosperms.	4	15
CO5: justify the rise of green plants from their single cell ancestors by studying the historical evidence of fossils through ages.	5	15

SYLLABUS

Unit I: Morphological and life-cycle changes of typical land plants: General adaptations to terrestrial habitats (morphological and anatomical characters for heterotrichous habit) - evolution of plant sex organs:- (Antheridium, Oogonium with respect to sterile protective covering, archegonium, ovule).

Unit II. Bryophytes: Classification and Salient features; Introduction to Hepaticopsida, Anthocertopsida and Bryopsida, Morphology, anatomy and reproduction of Riccia, Anthoceros and Funaria. Ecological importance.

Unit III. Pteridophytes: Classification and Salient features; Introduction to Lycopsida, Sphenopsida and Filicopsida, Heterospory and seed habit. Morphology, anatomy and reproduction of Lycopodium

Unit IV. Gymnosperms: Classification and Salient features; Introduction to Cycadopsida, Coniferopsida, Gnetopsida, Morphology, anatomy and reproduction of *Pinus* . Economic importance.

Unit V: Evolution of land plants: Paleoclimatic changes across the Geological time zones. Fossilization and fossil types (Impression, compression, Petrifaction, cast, coal ball) - mega extinction - Origin of angiosperm.

References:

1. Muller,W,H. (1979). Botany: A functional approach, Collier Mac Millan ISBN 0-02-979440-4
2. Rashid,A.(1998). An Introduction to Bryophytes, Vikas Publishers Co. New Delhi.
ISBN: 81-259-0569-3
3. Rashid,A.(1982). An Introduction to Pteridophyta, Vikas Publishers Co. New Delhi. ISBN: 81-259-0709-2
4. Vasishta, P. C. (2006). Gymnosperms. S. Chand & Company New Delhi. ISBN 81-219-2618-1
5. Willis,K.J and McElwain.J.C (2002). The Evolution of Plants. Oxford University Press. ISBN 0-19-850065-3
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7. Pandey, B. P. (2009). College Botany, Vol II. 7th Edn., S. Chand & Company New Delhi. ISBN 81-219-0601-6

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT 1			
	Adaptations to colonize land	3	Chalk and talk & ICT
	Vegetative plant body	3	Chalk and talk & ICT
	Sexual reproduction and life cycle changes	3	Chalk and talk & ICT
	Syngamy leading to embryo formation	3	Chalk and talk & ICT
	Elaboration of sporophytic phase	3	Chalk and talk & ICT
UNIT 11			
	Salient features of Classification of bryophytes	3	Chalk and talk & ICT
	Distribution and ecology of liverworts, hornworts and mosses	3	Chalk and talk & ICT
	Structure and reproduction of *Riccia*	3	Chalk and talk & ICT
	Structure and reproduction of *Anthoceros*	3	Chalk and talk & ICT
	Structure and reproduction of *Funaria*	3	Chalk and talk & ICT

UNIT III			
	Characterization of Pteridophytes and sub grouping	3	Chalk and talk & ICT
	Lycpodium –the type study	3	Chalk and talk & ICT
	Stelar evolution	3	Chalk and talk & ICT
	Heerospory and seed habit in *Selaginella*	3	Chalk and talk & ICT
	Ferns and economic uses	3	Chalk and talk & ICT
UNIT IV			
	Diagnostic Features and Classifications of Gymnosperms and its major taxa	3	Chalk and talk & ICT
	Cycads	3	Chalk and talk & ICT
	Conifers with *Pinus* as type specimen	3	Chalk and talk & ICT
	Gnetopsids	3	Chalk and talk & ICT
	Wood, seeds and economic importance	3	Chalk and talk & ICT
UNIT V			
	Geological time scale	3	Chalk and talk & ICT, Video
	Paleoclimatic changes	3	Chalk and talk & ICT
	Mega extinctions ad fossilization	3	Chalk and talk & ICT, Video
	Types of fossils , reconstructions	3	Chalk and talk & ICT
	Origin of Angiosperms	3	Chalk and talk & ICT, Video

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	
CO 1	5	5	3	5	5	3	26
CO 2	5	5	3	5	4	2	24
CO 3	5	5	4	4	3	2	23
CO 4	5	5	3	3	5	3	24
CO 5	5	5	3	5	5	3	26
							123/30
							4.1

BOT 2637 LAB III (MICRO+ARCHE +GENETICS) (2+2+2 Hrs)

The students will be able to

CO1 : The students will be able to carry out basic microbiological techniques like sterilization, media preparation and culture methods that they would be independently equipped to explore the microbial world by conducting appropriate experiments.
CO2 : The students will be able to the investigate the habitat of cyanobacteria and other higher algal forms during the field study and daily walk of life that they shall draw comparative analysis of thallus structure and life cycle patterns as when needed.
CO3 understand the algal world
CO4 verify mendel's laws, test the purity of gametes, identify the interaction between alleles and distinguish various gene interaction, identify different blood group in human, familiarize with polygenes which influences quantitative traits, determine sex of animals, categorize human traits as dominant and recessive and perform probability test for gene inheritance**.**
CO5 test viability of seed, experiment with emasculation techniques and familiarize with different hybridization techniques by visiting plant breeding stations.

Microbiology
1. Good laboratory practices and observation of ubiquitous presence of microbes
2. Microscope and Simple Staining techniques
3. Gram staining
4. Media preparation& sterilization techniques
5. Microbial isolation from natural habitat– Serial Dilution
6. Smear, spread and pour plate & streaking techniques
7. Microbial analysis of legume root nodules

Phycology
1. Observation of common Cyanobacteria and algae from field
2. Microscopic green algae - Volvox and Spirogyra
3. Macro Green algae - Caulerpa and Chara
4. Brown algae – Sargassum
5. Red algae : Batrachospermum and Gracilaria
6. Mass Cultivation of Algae – Spirulina

Outstation study:
1. Visit to Aavin dairy – food microbiology & industrial unit
2. Field trip to Rameswaram (CMFRI) – marine algal collection

References:
1. Gunasekaran, P. (2000). Laboratory manual in microbiology, New Delhi
2. Cappuccino, J.G. and Sherman, N.(2002). Microbiology: a laboratory manual 6th ed. Pearson Education Ltd. Singapore.

Archegoniatae
1. Panoramic view of archegoniates : whole mount and charts
2. Liver worts and thalloid bryophytes: vegetative and reproductive features of Riccia
3. A study on mosses based on Funaria /Polytrichum

4. Sudy of Lycopodium-sectional view of stem.
5. Study of Selaginella highlighting heterospory.
6. Ecological adaptations of Equisetum: Study of shoot and strobilus
7. Collection andstudy of locally available pteridophytes,
8. Morphology, rachis,pinna and sori of a fern.
9. Pinus-vegatative and reproductive structures
10. Plant evolution I –activity based learning with Geological time scale
11. Plant evolution II – study of fossils (preferably with a field visit to Ariyalur)
12. Visit to hill station

References:

Bendre, A. M., and Kumar, A. (2006). A text book of practical botany. (Vol I). Rastogi Publication New Delhi. ISBN 81-7133-809-7
Bendre, A. M. and Kumar,A. (2006). A text book of practical botany. (Vol II) Rastogi Publication New Delhi. ISBN 81-7133-852-6

Genetics

1. Verification of Mendel's law – I (Monohybrid ,test and back crosses)
2. Verification of Mendel's law - II (Dihybrid cross)
3. Gene interactions – problem solving
4. Study of Mendelian traits in human
5. Barr bodies & Giant chromosome - Chironema
6. Blood grouping- multiple alleles
7. Probability test – beads/coin/dice
8. Chromosome mapping
9. Drosophila experiment

Plant breeding

10. Collection and submission of local rice / vegetable cultivars
11. Determination of seed viability
12. Method of emasculation – pollen dusting and bagging
13. Visits - Cotton, millet, sugarcane research centres (Coimbatore),
Banana Research Centre (Trichy), National facilities - NBPGR, ICRISAT.

Reference

1. Gardner,E.J.,Simmon,M.J and Snustad .D.P. (1991) . Principles of Genetics. John Willey and Son (Asian) Ltd. Singapore. ISBN:0-471-50487-4
2. Stansfield,W.D. (1991). Theory and problems of Genetics. 3rd ed. McGraw Hill Inc. ISBN 0-07-060877-6
3. Chahal,G.C and Gosal,S.S (2002) Principles and procedures of Plant breeding. Narosa Publi. House. ISBN 81-7319-374-6

BOT 2345 **BOTANY FOR CHEMISTS I** **3Hr./3Cr.**

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	45	35	5	3	2

PREAMBLE: This course is designed for the chemistry students as a major supportive course, hence a basic understanding of plant forms and functions are dealt. A general understanding of the abuse of earth's natural resources particularly hazards that the plants face due to habitat destruction and global climate change will be taught. Chemical composition and the uses of plant nutrient are informed.

COURSE OUTCOME At the end of the semester, students will be able to	Unit	Hrs P/S
CO1: recognize the variations between the plant groups from the lower forms to the higher plants that they would not only know to judiciously use them but also would come forward to save and conserve them subscribing the values they learn from this study	1	9
CO2: view cell as the basic living entity of life and look at it as a fundamental self contained and self regulated structural and functional unit of all organisms and dare venturing into next level learning in biochemistry	2	9
CO3: hold the nucleus as the control centre of the cell account for cytochemical events happening within that they would gain confidence to the perform tasks in molecular biology.	3	9
CO4: develop an comprehensive picture of plant as autotrophic life forms and bio machines performing the feat water cycling, food production, carbon turn over and oxygen replenishment making earth a living planet.	4	9
CO5:see the plant's ability to procure selective elements from their surroundings and use them effectively in making their metabolites so as to support their growth and development and draw inspiration for setting up their production units or industries contemplating on resource utilization and economy showcased in a plant of his or her choice	5	9

SYLLABUS

Unit I An overview of plant groups: Salient features of Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

Unit II Cell as the basic entity: Prokaryotic and eukaryotic cells, endosymbiosis, chemistry of cell wall and plasma membrane, Structure and function of chloroplast and mitochondria.

Unit III Nucleus: Organization – nucleic acids and chromosome – functions of nucleus.

Unit IV Plant – water and plant - carbon relations: Biological significance of water molecule (uptake and conduction). Photosynthesis (light reaction and carbon assimilation). Respiration (Glycolysis, TCA cycle and ETS).

Unit V Plant growth and nutrition: Plant nutrients – NPK (organic and inorganic sources) - deficiency symptoms – plant growth regulators (auxins, cytokinins, gibberellins, ABA and ethylene).

References:

1. Berg, L.R. (1997). Introductory Botany: Plants, People & the Environment. ISBN-13: 978-0030248443
2. Sheeler.P and Bianchi. E.D. (1987). Cell and Molecular Biology . 3rd ed. John . Willey and Son

(Asian) Ltd. Singapore. ISBN: 9814-12-648-9
3. Devlin,R M and Witham,F.H. (1999). Plant Physiology, 4edn. CBS Publishers, New Delhi.
4. Pandey, B. P. (2005). College Botany, Vol I. 5th Edn., S. Chand & Company New Delhi. ISBN 81-219-0593-1
5. Pandey, B. P. (2009). College Botany, Vol II. 7th Edn., S. Chand & Company New Delhi. ISBN 81-219-0601-6
6. Sinha, R.K. (2004). Modern plant physiology. Narosa Publishing House New Delhi. ISBN 81-7319-333-9

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	General Characterization and Overview of plant Groups	2	Lecture, PPT
	Algae as progenitors of plants	2	Lecture, PPT, Charts
	Bryophytes, the amphibians	2	Lecture, PPT
	Pteridophytes, free sporing vascular plants	2	Lecture, PPT
	Seeded plants with and without flowers & fruits	1	Lecture
UNIT II			
	Cell the fundamental unit of life	1	Lecture, PPT, Charts
	Prokaryotic and Eukaryotic Cells	2	Lecture, PPT
	Cell envelopes	2	Lecture, Charts
	Single membraned organelles	2	Lecture, PPT
	Energy Transactions in Plant Cells	2	Lecture, PPT
UNIT III			
	Nucleus the control centre	2	Lecture, PPT
	Nuclear organization	2	Lecture, PPT, Charts
	Nucleic acids, DNA and the RNAs	2	Lecture, PPT, Charts
	Chromosomes, karotypes ad Idiograms	2	Lecture, PPT
	Functions of nucleus	1	Lecture, PPT
UNIT IV			
	Biological importance of	1	Lecture, PPT

	water molecule		
	Plant water relations	2	Lecture, PPT
	Carbon intake and photosynthesis	2	Lecture, PPT
	Carbohydrate breakdown and mitochondrial respiration	2	Lecture, PPT, Charts
	Partitioning of photosynthates	2	Lecture, PPT
UNIT V			
	Mineral Nutrition and Plant Growth	2	Lecture
	NPK (organic and inorganic supplies) and utilization	2	Lecture
	Mineral deficiency and toxicity symptoms	2	Lecture
	Plant Growth Hormones	2	Lecture
	PGRs and Developmental Regulation	1	Lecture, PPT

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	Total
CO1	5	5	5	5	5	3	28
CO2	5	5	5	4	3	2	24
CO3	5	5	5	4	2	2	23
CO4	5	5	5	5	5	5	30
CO5	5	5	5	4	3	2	24
Total	25	25	25	22	18	14	129
						129/30=4.3	

BOT 2147 BOTANY FOR CHEMISTS – LAB I. 2Hr./1Cr.

Students will be able to

CO1 understand the diversity of plant kingdom
CO2 survey trees of the campus
CO3 learn the use instruments to study the basic biochemical parameters of soil
CO4 experience the physiology of plant system
CO5 identify symptoms in plant system

1. Morphology of *Sargassum*, *Riccia*, *Fern* and identification of cryptogams in field
2. Morphology of *Cycas*
3. Angiosperms – morphology of monocot and dicot plant
4. Survey of campus trees.
5. A study on plant cell - Onion peel/ *Tradescantia* ,*Hydrilla&Vernonia* (c.s. of stem)
6. Soil test – pH, temperature, EC, alkalinity, acidity.
7. Plant growth measurement and movement – auxanometer, phototropism.
8. Plant water relations: Potato osmoscope
9. Photosynthesis – DCPIP experiment, starch test
10. Transpiration – Cobalt Chloride paper test, stomatal index
11. Respiration –Kuhns tube, Ganongs respiroscope
12. Collection and submission of plants with mineral deficiency symptoms

References:

1. Bendre, A. M., and Kumar, A. (2006). A text book of practical botany. (Vol I). Rastogi Publication New Delhi. ISBN 81-7133-809-7
2. Bendre, A. M. and Kumar,A. (2006). A text book of practical botany. (Vol II) Rastogi Publication New Delhi. ISBN 81-7133-852-6

BOT 2552 **MYCOLOGY & PATHOLOGY** **5Hr./5Cr.**

Pedagogy	Hours	Lecture	Dept. resources	Field/Indust. /Lab	Subject experts	ICT Virtual learning	Peer teaching	Super special models
	75	61	2	7	-	5	-	-

PREAMBLE:

This course uncovers the eukaryotic and achlorophyllous world of fungal biology, its classification and its biotic interaction. Later part of the course deals with the concept of pathogenesis and host response, citing examples of local disease occurrence and finally deals with conventional and modern methods of disease management. As an outcome of this course student will understand and appreciate the diversity and uniqueness of fungal kingdom and students are expected to identify, diagnose and manage the common disease of important crops.

COURSE OUTCOME At the end of the Semester students will be able to	Unit	Hrs P/S
CO1: Understand the features of fungi and relate this knowledge to the daily walks of life.	1	14
CO2: gain an overview of classification based on structure, reproduction and life cycle patterns to distinguish the major groups of fungi.	2	15
CO3: recall the concepts in pathology to understand the mechanism of pathogenesis in delineating host pathogen interactions.	3	12
CO4: interpret the symptomatology to diagnose fungal, bacterial and viral disease to recommend suitable control measures.	4	16
CO5: understand epidemiology and forecast disease and employ suitable disease management strategies.	5	18

SYLLABUS

UNIT I. Basics of mycology: General features of fungi, reproductive biology, fruiting body and spore print, spore dispersal and dormancy – fungal habitats and mode of nutrition -Economic importance.

UNIT II. Classification of fungi: Alexopoulos and Mims (1979) classification salient features of Gymnomycota (cellular and slime moulds), Mastigomycota (Oomycetes), and Amastigomycota (Ascomycetes and Basidiomycetes) – Fungal associations (lichens, mycorrhiza and endophytes)

UNIT III. Introduction to Pathology: Concept of plant disease – Koch's postulates – Disease tetrahedron – Pathogenesis (enzymes and toxins) –Structural and functional defense in plants. Plant diseases and human civilization.

UNIT IV. Plant diseases: Classification, symptoms and diagnosis – traditional and molecular methods. Case studies: Bacterial disease (Citrus canker), Fungal disease (Rice blast), Viral disease (TMV).

UNIT V. Disease Management: Epidemiology and forecasting – agrometeorology - Disease severity and estimation of crop loss - Plant Quarantine – chemical, cultural and biological methods of disease management (*Pseudomonas fluorescens* and *Trichoderma*) – Integrated disease management.

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Text books

1.Mehrotra RS and Agarwal A. 2003. Plant Pathology. 2nd Edn. Tata McGraw Hills Publi. Co. New Delhi ISBN 0-07-047399-4

2. Sumbali G. 2005. The Fungi. Narosa Publishng House. New Delhi. ISBN 81 -7319-512-9

Reference books

1.Alexopoulos CG and Blackwell M. 1996: Introduction to modern mycology, John Wiley. New York. ISBN 9814-12-612-8

Agrios GN. 2006: Plant pathology. 5th Edn. Elseviers Publication, Academic press. New Delhi. ISBN- 13: 978-81-312-0639-3

Chaube HS and Pundir VS. 2005. Crop disease and their management. Prentice Hall of India Pvt. Ltd. New Delhi. ISBN 81-203-2674-1

Hull.R .2002. Plant Virology. Elsevier Publication. Academic Press. New Delhi. ISBN 0-12-361160-1

Singh RS. 2005. Plant disease. Oxford and IBH publishing. Co. Pvt. Ltd. New Delhi. ISBN 81-204-1658-9

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	General features of fungi	2	Lecture and discussion
	Reproductive biology	2	Lecture and ppt
	Fungal fructifications, Spore and spore dispersal	4	Lecture, specimens and campus visit
	Habitats, nutrition and fungal associations	4	Lecture and campus visit
	Economic importance	2	Lecture and product samples
UNIT II			
	Outline Classification of Alexopoulos and Mims (1979)	5	Lecture and charts
	Wall less fungi (slime and cellular molds)	3	Lecture and videos on molds
	Lower fungi (Oomycetes)	2	Lecture, ppt and slides
	Sac fungi (Ascomycetes)	2	Lecture, specimens and slides
	Rust , smuts and mushrooms (Basidomycetes)	3	Lecture, herbarium and specimens
UNIT III			
	Defining disease (Koch's postulates).	2	Lecture and demonstration
	Disease tetrahedron	2	Lecture
	Enzymes and Toxins in Pathogenesis	3	Lecture and ppt
	Plant defense during host –pathogen interaction	3	Lecture and ppt
	Plant disease and its impact	2	Lecture and videos
UNIT IV			
	Infamous Plant diseases, symptoms, diagnosis	4	Lecture, specimens and videos
	Traditional and modern diagnosis methods	4	Lecture and ppt
	Bacterial disease (Citrus Canker)	2	Lecture and herbarium sheets
	Fungal disease (rice blast)	3	Lecture and herbarium sheets
	Viral disease (TMV)	3	Lecture and herbarium sheets
UNIT V			
	Epidemiology,Agrometerology and forecasting	5	Lecture and web based demonstration

	Disease severity and crop loss calculations	2	Lecture and campus visit
	Plant Quarantine	2	Lecture and videos
	Principles and chemical control methods	4	Lecture and lab visit
	Biocontrol and IPM	5	Lecture and sample products

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1	4	5	4	4	2	2	21
CO2	4	4	4	4	5	3	24
CO3	5	4	4	4	3	3	23
CO4	3	3	4	5	5	2	22
CO5	4	4	4	4	4	5	25
	20	20	20	21	19	15	115
							115/30 = 3.8

BOT2444 **CELL BIOLOGY** **4Hr./4Cr.**

Pedagogy	A	B	C	D	E	F	G
	Course Teacher's Contribution	Department Resources	Field / Industry/ Lab	Subject Experts	ICT Virtual Learning	Peer Teaching	Super-Special method
	50	2	-	2	2	2	2

PREAMBLE:

This course is designed as an introductory course to understand and appreciate the living cells that serves as invisible backbones of all the life forms found in our earth. Architectural significance of organelles and other sub cellular components are highlighted for the students to explore and relate the structure and function of a typical cell. Various modes of cell multiplication mechanisms are also taught to motivate students to learn the basics of normal and abnormal cell division. A few tools and techniques commonly employed in cell biology are introduced to monitor and record the behaviour of a living cell. Students expected to get a holistic picture of life cycle pattern of a cell at the end of the course.

COURSE OUTCOME At the end of the semester, students will be able to	Unit	Hrs P/S
CO1: write a brief resume of cell science, explain the organization of prokaryotic cell, fine structure of an eukaryotic cell and see it as product of endosymbiotic theory which with plastome and the plastids shall be establishing the uniqueness of plant cells	1	11
CO2: demarcate cell surface with cell wall and membranous envelope along with understanding on its molecular anatomy and the colloidal nature of protoplasm that draws a line between life and non-life	2	12
CO3: identify the structural and functional significance that endomembranes offer to the sub cellular compartments and see the vitality of GERL complex and the importance of vacuoles and microbodies as single membrane entities besides the chloroplast and mitochondrion the double membrane structures closely associated with energetic	3	13
CO4: fix cell duplication process in the spread of cell cycle events and distinguish direct, indirect ad reduction division as unique and discrete processes and find a role for cytoskeleton and cytokinesis conferring meaning to multicellularity and development	4	14
CO5:familiarize themselves with the theory and practice of using compound microscope, variants of LM and EM, cell fractionation and density gradient	5	10

centrifugation that cell fractionation is done with precision for pursuing further studies		

SYLLABUS

UNIT I

Cell as a basic unit of life: Cell- Discovery, theory - Organization of prokaryotic and eukaryotic cells, endosymbiotic theory - Unique features of plant cell.

UNIT II

Cell Surface and Matrix: Cell wall organization, plasmodesmata, pit fields, middle lamella- Plasma membrane structure (Unit membrane, Fluid-mosaic models) and functions- Properties of Cytoplasm.

UNIT III

Sub cellular components: Ultrastructure of Chloroplast - Mitochondria- Endoplasmic reticulum, Golgi apparatus, lysosomes, ribosomes, Micro bodies, cytoskeletons, Vacuoles and Ergastic substances (Crystals and raphides).

Nucleus – Membrane, nucleoplasm, chromatin reticulum, chromosome and nucleolus.

UNIT IV

Cell cycle and Cell Division: Cell division in lower forms- binary fission and budding.

Cell cycle, mitosis &meiosis- Abnormal cell cycle (Tumour and Cancer cells).

UNIT V

Microscopy and analytical procedures: Principle and working mechanism of compound and electron microscope – Sample preparation and Isolation of organelles (homogenisation, sub-cellular fractionation), Haemocytometry, Photomicrography.

REFERENCES

1.Gerald Karp (2003), Cell Biology 7 th Edn (international student version) John Willey ISBN :9781118318744

2.Geoffrey M. Cooper (2015), 7th Edn The Cell- A Molecular Approach, ASM publications Washington.

3.Albertis B,Johnson A,Lewis J Raff M, Roberts K and Walter P., 2002 Molecular Biology of cell, 4th Edn. Garland Science Publ. ISBN 0-8153-4072-9.

4.Singh and Tomer , (2015), 10th Edn Cell biology .Rastogi publications.Meerut.ISBN-978-81-7133-969-3

5.P.K.Gupta (2015) 4th Edn, A text book of cell and Molecular Biology. Rastogi publications ISBN-978-93-5078-072-5

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Brief Resume of Cell Science	2	Lecture, Charts, Permanent slides
	Organization of prokaryotic cell	3	Lecture,Charts, Permanent slides
	Fine structure of an eukaryote	3	Lecture, Charts, Permanent slides
	Endosymbiotic theory	2	Lecture, Videos
	Uniqueness of plant cells	1	Lecture, Powerpoint
UNIT II			
	Cell envelope and Cell	3	Lecture, Charts, Permanent

	surface		slides
	Cell wall organization	2	Lecture, Charts, Permanent slides
	Physcio-chemical properties of Plasma membrane	2	Lecture, Power Point
	Membrane models	3	Lecture, Power Point
	Cytosol as a colloid	2	Lecture, Videos
UNIT III			
	Endo membrane system	2	Lecture, Charts
	GERL complex	3	Lecture,Charts
	Vacuoles and Microbodies	2	Lecture, Charts
	Chloroplast	3	Lecture, Charts
	Mitochondrion	3	Lecture, Charts
UNIT IV			
	Cell Cycle	3	Lecture, Charts,Power Point
	Direct divisions	2	Lecture,charts,Power Point
	Mitosis	3	Lecture,charts, Power Point
	Meiosis	4	Lecture,charts, Power Point
	Cytoskeleton and Cytokinesis	2	Lecture
UNIT V			
	Basics of optics (law of distances)	2	Lecture, charts, Power Point
	Compound microscope	2	Lecture, charts
	Modifiactiosn light microscope	2	Lecture, Power Point
	EM	2	Lecture, Power Point
	Cell fractionation and density gradient centrifugation	2	Lecture, Power Point

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	
CO 1	5	5	2	2	2	1	17
CO 2	5	5	2	2	2	1	17
CO 3	5	5	1	2	2	1	16
CO 4	5	5	1	2	2	1	16
CO 5	5	5	5	4	4	2	25
	25	25	11	12	12	6	
							91/30
							3.03

BOT 2436 ANATOMY AND REPRODUCTIVE BIOLOGY OF ANGIOSPERMS (ARBA) 4Hr./4Cr.

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	45	35	5	3	2

Preamble : This course exposes students into the internal structure and organization of plants mostly angiosperms. Anatomy of vegetative and reproductive structure is given emphasis to know the complete changes in internal morphology that happens in the lifecycle of plants. Students will be trained to identify the tissue types and meristems which form the basis of growth. The reproductive organs which give rise to the gametes followed by the development of seed will be taught to the students to understand the essentials of reproduction. Students will also learn the applied part of anatomy and embryology which they can employ after learning the course in various field of their career such as making permanent slides, anatomical structures in printing technology, use of stains and mordant to print textiles, Induction of polyembryony and parthenocarpy in horticulture.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
CO1: recognize different types of cells and tissues in plant anatomy. Integrate the theories on meristem.	1	9
CO2: Conceptualize the primary structures in plant parts, Differentiate between secondary and anomalous structures.	2	10
CO3: Describe the structure of stamen and pistil, appreciate the development of pollen and embryo sac.	3	13
CO4: Identify the agents of pollination, examine the embryo and endosperm in a seed.	4	14
CO5: gain confidence in sectioning, effectively use stains for staining and utilize technology to develop parthenocarpy.	5	14

SYLLABUS

Unit I: Cells and Tissues: Tissues as architectural skeleton of plants - Tissue types – structure and functions – localization of cell – Meristems– theories.

Unit II: Anatomy of vegetative structures: Primary structure of root and stem (Dicot and Monocot) – secondary structure – Anomalous secondary growth — Leaf anatomy – nodal anatomy.

Unit III: Reproductive structures: Stamen and pistil structure – pollen structure-male gametophyte - pollen germination- ovule structure and types – female gametophyte and embryo sac.

Unit IV: **Pollination and fertilization**: Types of pollination- agents of pollination–pollen - pistil interaction, double fertilization – triple fusion- embryo formation -embryo types -endosperm formation and types- seed.

Unit V: **Techniques in anatomy and applied embryology** : Stains used in anatomy- Maceration techniques – procedure for sectioning- permanent slide preparation. Wood anatomy and pharmacognosy -Applied embryology: polyembryony - parthenocarpy.

References:
1. Maheshwari.P (1985) An introduction to the embryology of angiosperm. Tata McGraw Hill. ISBN 0 0709 9434 X
2. Fahn,A (1989) Plant Anatomy. Mac Millan pub. New York. ISBN 008 028030 7.
3. Raghavan V. 1986. Embryogenesis in angiosperms. Cambridge University Press. ISBN 0 5212 6771
4.Esau,K . 2002. Plant Anatomy. John Wiley and sons. ISBN 9 8141 2649 7.
5. Burgess,J. 1985. An introduction to plant cell development. Cambridge University press. ISBN 05213 0273 0.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT 1			
	Plant cells and localization	2	Chalk and board,drawings
	Simple permanent tissues	2	micrographs
	Complex tissues	2	Micrographs, anatomy slide
	Functions of tissues	1	lecture
	Meristem tissues	2	micrographs
UNIT II			
	Internal organization of primary stem	2	Microscope connected TV visualization
	Internal organization of primary root	2	Chart
	Internal organization of leaf	2	Chart
	Secondary Growth	2	Lecture with chart
	Anomalous Secondary Growth	2	Lecture with chart
UNIT III			
	Organs of flower	1	Live specimen
	Organization of a Stamen	2	ICT
	Organization of a Pistil	2	ICT
	Microsporogenesis	2	Video
	Female gametophyte and embryosac	6	Video
UNIT IV			
	Pollination	4	Video
	Pollen –Pistil Interactions	2	Diagrams using chalk and board method
	Syngamy and double fertilization	2	video
	Endosperm	2	OHP
	Embryogenesis and seed development	4	Video
UNIT V			

	stains	2	Live demo of preparation
	Maceration and Micrometry	2	Live demo
	Introduction to Histochemistry	3	Slide show
	Wood Anatomy and Microtomy	3	Live demo
	Applied Embryology	4	Lecture

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	5	5	5	4	3	2	24
CO2	5	5	5	5	3	1	24
CO3	5	5	5	4	2	2	23
CO4	5	5	5	5	5	4	29
CO5	5	5	5	5	4	2	26
	25	25	25	23	17	11	126
126/30=4.2							

BOT2638 LAB IV (MYCO+CELLBIO+ARBA) (2+2+2 Hrs)

The students will be able to

CO1: At the end of the semester students will be able to understand characteristic features and habitats of microfungi. Field studies to analyze macrofungal diversity in the locality and their role in environment.

CO2: Analyze the epidemiology and management of major plant diseases in and around Madurai region. Apply the recent diagnosis methods and practices for effective management of plant diseases.

CO 3: obtain the larger picture of a cell

CO 4: distinguish between different types of cells and tissues, view the difference between shoot and root region through anatomical section, equip in maceration techniques, evaluate the quality of wood.

CO5: identify the different parts of reproductive structure, dissect an embryo from the seed, develop polyembryo seeds, utilize the pattern of placentation design in screen printing.

I - MYCOLOGY & PATHOLOGY (Lab) 2H

1. Observations of *Mucor* and *Rhizopus*
2. Observations of *Pilobolus*
3. Documentation of macro fungi from college campus
4. Documentation of plant diseases – rust, wilt, blast, rot, canker
5. Isolation of fungal plant pathogens
6. Isolation of plant pathogenic bacteria
7. Testing Koch's postulates – (*Rhizoctonia solani*) potted plants
8. Study of endophytes in plants
9. Disease assessment methods – different assessment scales (paddy)
10. Testing antagonistic property – biocontrol agent against pathogens – dual culture assay
11. Mass production and formulation of biocontrol strains
12. In- vitro screening of fungicides against pathogens
13. Disease forecasting – web based model

Visit to TNAU

Submission of summative Report on disease incidence in the state

REFERENCES

Aneja KR. 2009. Experiments in Microbiology, Plant Pathology, and Biotechnology. New Age International Publishers, New Delhi. ISBN 978-81-224-1494-3

Alexopoulos CG and Blackwell M. 1996: Introduction to modern mycology, John Wiley. New York. ISBN 9814-12-612-8

II- Cell Biology (2hrs/week)

1. Light and electron microscope - working principles through models
2. Cytological investigations: animal (mouth swab) and plant cell (Onion peel).
3. Cell inclusions: Starch grains, raphides, Cystolith Cytoplasmic streaming (Hydrilla and Tradescantia)
4. Cytochemistry I: Staining for starch ,reducing sugar, proteins.
5. Cytochemistry II: Staining for lipids, terpenes and secondary metabolites.
6. Cytochemistry III: Chromosome staining

7. Microscopic observation of Chloroplast
8. Cell isolation technique
9. Mitosis: smear technique with onion.
10. Meiosis: Rheo / Tradescantia anther Squash.
11. Chromosomal structure: Satellite and Giant Chromosome.

REFERENCES

Sheeler P and Bianchi ED 1987.Cell and Molecular Biology.3rd ed. John willey and Son (Asian) Ltd. Singapore. ISBN: 9814-12-648-9.

Shanmugam G 1988 Cell biology A laboratory Manual, Macmillan India Limited ISBN 033392 087 2

Santra S.C Chatterjee T.P. Das A.P (1989) College Botany Practical – Volume 1, New central book agency, Kolkatta.

III. PLANT ANATOMY AND REPRODUCTIVE BIOLOGY LAB

1. Examination of plant tissues –types.
2. Anatomy of meristems – shoot tip and root tip
3. C.S. of primary structures (Dicot & monocot stem and root)
4. T.S. of secondary structure of stem and Anamolous secondary growth.
5. Anatomy of leaf (Dicot & monocot) & node.
6. Wood anatomy - any three timber
7. Maceration and micrometry
8. Study of reproductive structure (Stamen and pistil).
9. Pollen types and pollen germination.
10. Ovule structure and placentation.
11. Excision of embryo (*Tridax*) and polyembryony in citrus
12. Endosperm types, aril and haustoria

Submission – Report of group activity

REFERENCES:

1. Johri.B.M 1982. Experimental Embryology of Vascular plants –springer-verlag. Nerlin. ISBN 3 5401 0334 1.

2. Esau,K. 1977. Anatomy of seed plants.Wiley Eastern.Publ. ISBN 04712 4520 8.

3. Raghavan V. 1986. Embryogenesis in angiosperms, Cambridge University press . ISBN 05212 6771

BOT 2346 BOTANY FOR CHEMISTS II (THEORY) 3Hr./3Cr.

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	45	35	5	3	2

PREAMBLE: Plant life is essential for the survival of all animals and human being on earth. This course is aimed to inculcate the chemistry of economically important plants which are intertwining in our day today life and also the course is designed to cater the need of young mind of students who take chemistry as major. This course will kindle the inquisitiveness of the students. After completing this course the students will be able to appreciate the plants in terms of its chemical makeup.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
CO1: locate bioresources that are of potential utility in human welfare as plants yielding food, flavor, beverage, fiber, fuel and medicine besides that which are of socio-cultural significance, and evaluate them for phytochemical value	1	9
CO2: catalogue of secondary metabolites in plants, especially in the context of housing oils, alkaloids, glycosides, terpenoids, steroids and such other constituents that have potential applications in drug discovery	2	9
CO3: cull out plant recourses in the form of useful biopolymers, rubber, Non-alcoholic beverages and alcoholic beverages, wood, wood pulp and fruit pulp that serve as raw material for bio-based industries	3	9
CO4: experiment the idea of *Biotransformation* and *Bioprospecting* in the like of the production health tonic *Jeevani* which is shown as model for benefit sharing agreements and the protection for guarding indigenous & traditional knowledge	4	9
CO5:reflect on the caution, risks ad dangers in trading of bioresources and make an assessment of supply and demand in standalone businesses and trading net works that a fair price is ensured at all times	5	9

SYLLABUS

Unit I. Introduction: Bioresources and human welfare – types of bioresources (food, beverages, fiber, medicine, industrial resources, fuel), food and culture.

Unit II: Chemistry of plant medicine: Brief study of Phytochemicals (secondary metabolites): source, useful part, active principles and uses of the following: Essential oil: menthol, citronella; Alkaloids: curcumin, Morphine and Vincristine; Glycosides – digitalin, steviosides; Steroids – *Dioscorea*; Flavanoids – *Pelargonium; T*erpenoids– cannabinoids (Cannabis) curcuminoids (mustard seed) an outline of drug discovery and design.

Unit III: Plant produce as industrial inputs: Botany and chemistry of Rubber. Pulp woods – grapes - papaya – potato – tapioca. Beverages: Non- alcoholic beverages -– history, botany, chemistry of tea, coffee and cocoa.

Unit IV: Bioprospecting and drug development: Jeevani**,** Artemisin, Noni, Brahmi, Indian Ginseng. Traditional knowledge as marker for bioprospecting: access and benefit sharing. Drug abuse and addiction.

Unit V: **Trade and conservation of resources**: Supply and demand assessment –threats – loss of

resources - sustainable management.

References:

1. Annonymus . The AyurvedicPharmacopia of India Volume-I and IV, Govt. of India, Ministry of Health and Family Welfare, Department of Ayush Page 41.
2. Buchanan, B., Gruissem, W. and Jones, R. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
3. Kochhar, S.L. 2011. *Economic Botany in the Tropics*, MacMillan Publishers India Ltd., New Delhi. 4th edition. (ISBN (13) 978-0230- 63893-8)
4. Kokate C.K. 2014. Practical Pharmacognosy, Vallabhprakashan, New Delhi, 5 th edition
5. Trease G.E. and Evans. W.C. (2002) Pharmacognosy ELBS 15th Edition
6. Verma, V. 2009. *Text book of economic botany* Ane Books Pvt Ltd. New Delhi (ISBN (13) 978-81-8052-167-6)
7. Wallis,T.E. (2003)Test books of pharmacognosy CBS publishers and distributors New Delhi (Latest Edition)
8. Simpson, B B. . and Ogorzaly, M.C. (2000)Economic Botany: Plants in our World 3rd Edition, McGraw Hill Book Company, New Delhi, ISBN-13: 978-0072909388.
9. Hill, a. F. 1937. *Economic botany: a textbook of useful plants and plant products*, mcgraw-hill book company, inc. New york and london 1937.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Bioresources for human welfare	2	Lecture, PPT, Charts
	Plants yielding food	2	Lecture, PPT, Charts
	Plant Beverages	2	Lecture, PPT, Charts
	Fibers and fuel from plants	2	Lecture, PPT
	Plants as medicine and of cultural significance	1	Lecture, PPT
UNIT II			
	Catalogue of secondary metabolites in plants	2	Lecture, PPT, Charts
	Oils from plants	2	Lecture, PPT
	Plant alkaloids	1	Lecture, PPT, Charts
	Glycosides, terpenoids and steroids	2	Lecture, PPT, Charts
	Phytochemicals in drug discovery	2	Lecture, PPT, Charts
UNIT III			
	Biopolymers	2	Lecture, PPT, Charts
	Rubber	1	Lecture, PPT
	Wood and wood pulp	2	Lecture, PPT, Charts
	Fruit pulp & Beverages	2	Lecture, PPT, Charts
	Non-alcoholic beverages	2	Lecture, PPT, Charts

UNIT IV			
	The idea of Biotransformation and Bioprospecting	1	Lecture, PPT
	Benefit sharing arrangements with Jeevani as a case study	2	Lecture, PPT
	Other products with commercial potential	2	Lecture, PPT
	Drug abuse and addiction	2	Lecture, PPT
	Rights ad Protection for guarding Indigenous & Traditional Knowledge	2	Lecture, PPT
UNIT V			
	Caution, risks ad dangers in trading of bioresources	2	Lecture, PPT
	Assessment of supply and demand	2	Lecture, PPT
	Trading net works	2	Lecture, PPT
	Fair play - fair price guarantee	2	Lecture, PPT
	Sustainable utilization	1	Lecture, PPT

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	Total
CO1	5	5	5	5	5	3	28
CO2	5	5	5	4	3	2	24
CO3	5	5	5	5	5	3	28
CO4	5	5	5	5	5	5	30
CO5	5	5	5	5	5	3	28
Total	25	25	25	24	23	16	138
							138/30=4.6

BOT 2148 **BOTANY FOR CHEMISTS II – LAB** **2Hr./1Cr.**

The student will be able to

CO 1: identify the basic importance of plants
CO 2: locate plant diversity in the college campus
CO 3: extract common ingredients of plant like oil
CO 4: familiarize with fermentation technique
CO 5: undrestand the importance of alternate fuels like biogas

1. Identification of plant resources mentioned in syllabus
2. Locating potential plant resources on and off campus
3. Survey of plant based medicines in local market
4. Histo-chemical staining and identification of important phytochemicals
5. Solvent extraction of selected plant ingredients
6. Distillation of essential oil
7. Extraction of bio-fuel from *Madhuca* / *Pongamia*
8. Tea adulteration and testing
9. Homemade chocolate preparation
10. Fermentation - Wine preparation
11. Biogas unit – design and demo
12. Natural dyes – extraction and dyeing of fibres

References:

1. Hill, a. F. 1937. *Economic botany: a textbook of useful plants and plant products*, mcgraw-hill book company, inc. New york and london 1937
2. Trease G.E. and Evans. W.C. (2002) Pharmacognosy ELBS 15th Edition

BOT 3631 **PLANT SYSTEMATICS** **6 Hr./6Cr.**

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	90	-	70	10	10

PREAMBLE: This course is designed to give an introduction on plant systematics to the young minds who study the subject for the first time. The morphology and the history of classification will be an eye opener to the students. Further the on hand study of locally available flora can give them the basic knowledge of plants. This study will further helping the young students to appreciate and enjoy the nature and also lead them towards conservation of plants. After the successful completion of the course, the student will be able to understand and explain the principles of systematics, distinctive features of selected families, recall the economic value of the plants in the cited families

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
CO 1: experience and admire the morphological variations in plants and the contributions of various people in terms classification of plants may pave way to conservation.	1	20
CO 2: engross the importance of rules in the naming of plants and it's importance in the field of taxonomical research and enlightened about other fields of high reputation related to plant systematics.	2	20
CO 3: keep himself amused to know the floral characters and economic importance of select families in the group Polypetalae and their phylogenetic relationship with other plant groups	3	15
CO 4: contemplating upon the floral characters and economic importance of select families of Gamopetalae and their phylogenetic relationship will enlighten further to appreciate and save the nature given chow.	4	15
CO 5: take pleasure in investigating the floral characters and economic importance of select families of Monochlamydeae & Moclootyledonae and their phylogenetic characters which will make them enjoy and formulate the ways to sustain.	5	20

SYLLABUS

UNIT 1. Morphology of plants & History of classification:
Morphology of root, stem, leaf, inflorescence, flower and fruit – History of classification (Theophrastus, Linnaeus, Bentham and Hooker, and Engler and Prantle.)

UNIT 2. Principles of plant taxonomy: Principles of Taxonomy – Minor and Major categories, rules and recommendations – ICBN and ICN – principles of ICN – active principles (priority of publication, typification and effective publication) author citation – naming of plants – rejection of names – dichotomous key – phytography – herbarium techniques – numerical taxonomy – Chemotaxonomy.

UNIT 3. Study of the locally available *Polypetalae* flora: Annonaceae, Leguminosae (Fabaceae, Caesalpiniaceae, Mimosaceae), Rosaceae and Cucurbitaceae with their economic importance and phylogeny.

UNIT 4. Study of the locally available *Gamopetalae* flora: Asteraceae, Sapotaceae, Apocynaceae, Rubiaceae and Lamiaceae with their economic importance and phylogeny.

UNIT 5. Study of the locally available *Monochlamydae* and Monocot flora:
Amaranthaceae, Euphorbiaceae, Orchidaceae , Arecaceae and Poaceae with their economic importance and phylogeny.

TEXT BOOKS

1. Singh, G., 2012. Plant systematics, Third edition. Oxibh publishers, New Delhi. ISBN: 978-8120417632.
2. Pandey, S. N. and Misra, S. P., 2008. Taxonomy of angiosperms. Ane books India, New Delhi. ISBN: 978-8180521768.
3. Verma, B.K., 2011. Introduction to taxonomy of angiosperms, PHI learning private limited, New Delhi. ISBN: 978-8120341142.
4. Lawrence, G.H.M., 1965. Taxonomy of vascular plants. The Macmilan co, New York. ISBN: 978-0023681905.
5. Pandey, B. P., 2001. Taxonomy of angiosperms, S. Chand and co limited. New Delhi. ISBN: 978-8121909327.

REFERENCE BOOKS

1. Gamble, J.S and Fischer, C.E.C., 1957. Flora of the presidency of madras, I –
III, W. C. Adlard and son limited, London. ISBN: 978-1152544420.
2. Jeffrey, C., 1982. An introduction to plant taxonomy. Allied publishers private limited, New Delhi. ISBN: 978-0521287753.
3. Jones Jr, S. B. and Luchsinger, A. E., 1987. Plant systematics. Mcgraw hill book company, New Delhi. ISBN: 978-0070327962.
4. Sambamurty, A. V. S. S., 2005. Taxonomy of angiosperms. I. K. International private limited, New Delhi. ISBN: 978-8188237166.
5. Singh, H.B. and Subramanian, B., 2008. National institute of science communication and information resources, New Delhi. ISBN: 978-8172363307.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT 1			
	Morphology of vegetative parts	5	Chalk and talk with ICT
	Morphology of Reproductive parts and phytography	5	Chalk and talk with ICT
	Understanding the botanical diversity of our country	2	Chalk and talk with ICT, PPT
	History of plant classification through various approaches	5	Chalk and talk with ICT
	Classification through ages	3	Chalk and talk with ICT, PPT
UNIT II			
	ICN (Active principles, recommendations & amendments)	5	Chalk and talk with ICT
	Basics of Nomenclatural rules	5	Chalk and talk with ICT
	Herbarium for plant taxonimical studies	5	Chalk and talk with ICT
	Numerical taxonomy and its principles	5	Chalk and talk with ICT
	Essentials of Chemo& Sero Taxonomy	5	Chalk and talk with ICT
UNIT III			
	Characters of Annonaceae	3	Chalk and talk with ICT
	Leguminosae (*sensu lato*)	3	Chalk and talk with ICT
	Characters of Rosaceae	3	Chalk and talk with ICT
	Characters of Cucurbitaceae	3	Chalk and talk with ICT
	Phylogeny and Economic uses	3	Chalk and talk with ICT
UNIT IV			
	Characters of Asterceae	3	Chalk and talk with ICT
	Characters of Sapotaceae	3	Chalk and talk with ICT
	Characters of Apocynaceae	3	Chalk and talk with ICT
	Characters of Rubiaceae & Lamiaceae	3	Chalk and talk with ICT
	Phylogeny and Economic uses	3	Chalk and talk with ICT

UNIT V			
	Characters of Amaranthaceae	3	Chalk and talk with ICT
	Characters of Euphorbiaceae	3	Chalk and talk with ICT
	Characters of Orchidaceae	3	Chalk and talk with ICT
	Characters of Arecaceae & Poaceae	3	Chalk and talk with ICT
	Phylogeny and Economic uses	3	Chalk and talk with ICT

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	
CO 1	5	5	5	5	3	3	26
CO 2	5	5	5	5	4	3	27
CO 3	5	5	4	4	3	3	24
CO 4	5	5	5	5	3	3	26
CO 5	5	5	5	5	3	3	26
							129/30
							4.3

BOT 3633 **BIOCHEMISTRY** **6Hr./6Cr.**

PEDAGOGY	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	6	4	0	1	1

PREAMBLE: A cognitive and pedagogical exposure of biochemistry is useful for a concrete understanding of biology. The course work envisaged endeavors to provide students a broad based training to look at life as an outcome of interlocked events of simple biochemical reactions, biosynthetic pathways and metabolism which eventually gets expressed as physical and physiological changes. In addition to the theoretical knowledge imparted on the basic rules, emphasis will be placed on the applications and forefront areas of experimental biochemistry. A multidisciplinary approach will provide the learner a good leverage for better comprehension of integrated metabolism.

COURSE OUTCOME At the end of the semester, students will be able to	Hrs P/S
CO1: Picturize the array of molecules in a living cell and understand how different chemicals interact among themselves in establishing the cellular basis of life.	15
CO2: explore the various sources of carbohydrates, structural and functional properties and evaluate its significance	15
CO3: understand lipids as an important source of reserve food and emphasize on their vitality in cell membranes, besides referring to the dietary significance of vitamins	15
CO4: Comprehend proteins and nucleic acids as important heteropolymers offering to heterogeneity as well as specificity to cell functions.	28
CO5: Categorize different enzymes and recognize its role in driving biochemical reactions with specificity and use this knowledge eventually for commercial ventures	17

SYLLABUS

Unit 1. Introduction: An overview of the cell structure and brief survey of major bioconstituents (Atoms – molecules – bonds and bonding – functional groups) – basic principles of thermodynamics – Gibbs free energy – entropy and enthalpy – redox reaction – electron transfer and its significance.

Unit 2. Carbohydrates: Sources of various carbohydrates – classification – physio-chemical and optical properties of monosaccharides – structural and functional significance of sucrose, starch and cellulose.

Unit 3. Lipids: Triglycerides – saturated and unsaturated fatty acids – brief outline on lipid metabolism – β-oxidation and lipid peroxidation – dietary value of lipids and vitamins

Unit 4. Nucleic acids, Amino acids and Proteins: Types of nucleic acids – components – synthesis of purines and pyrimidines in outline – properties, classification and precursors for amino acid biosynthesis – structure and

conformation of proteins – significance of Ramachandran plot – acid-base solubility – properties of proteins.

Unit 5. Enzymes: Enzymes as quaternary proteins – properties –classification and nomenclature – mechanism of action – significance of Km – Michaelis and Menton concept– Enzyme catalysis – coenzymes and cofactors – competitive and non competitive inhibition – allosteric regulation – isoenzymes.

REFERENCE BOOKS

1. Berg, J.M. Tymoczko, J.L. and Stryer, L., 2002. Biochemistry, Fourth edition. W. H Freeman and company, New York. ISBN: 07 1674 9548.

2. Gasser, R.P.H. and Richards, W.G., 1986. Entrophy and energy levels. Oxford university publication, London. ISBN: 10- 0194424111.

3. Lehninger, A.L., Nelson, D.L. and Cox, M.M., 2000. Principles of biochemistry, Fifth edition. CBS publishers and distributors, New Delhi. ISBN: 10: 0716743396.

4. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Weil, P.A., 2009. Harper's illustrated biochemistry, Twenty-eighth edition. Mcgraw hill education, New York. ISBN: 978-0-07-162591-3.

5. Voet, D. and Voet, J.G., 2004. Biochemistry, Third edition. John wiley and sons, New Jersey, United States. ISBN: 10: 047119350X.

6. Zubay, G.L., 1998. Biochemistry, Fourth edition. Brown publishers, Chicago. ISBN: 0-697-21900-3.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Cell as a self contained and circuited biochemical entity	2	Chalk and Talk Presentation Overview of cell -animated videos
	Fundamentals of structure and function of atoms, molecules and functional groups	3	Charts and OHP
	Bonds and Bonding	3	Interactive animations, Illustrations with models
	Basic of thermodynamics	2	Chalk and Talk Presentation
	Introduction to Redox and electron transfer reactions	2	Chalk and Talk Presentation
UNIT II			
	Various Sources and significance of carbohydrates	2	Real time examples
	Classification, structure and metabolic significance	3	Real time examples

	Monosaccharides, Structure, properties, reactions and importance	5	Chalk and Talk OHP
	Disaccharides & polysaccharides: types properties and functions	3	Chalk and Talk OHP
	Biological Importance of Sugars and Polysaccharides	2	Real time examples
UNIT III			
	Classification of lipids	2	Chalk and Talk
	Triglycerides and fatty acids	3	Chalk and Talk OHP
	β oxidation and lipid per oxidation	5	Multimedia teaching
	Dietary values of lipids	3	Visualizing with real-time examples Activity based learning
	Health implications of Vitamins	2	Visualizing with real-time examples
UNIT IV			
	Types and structure of nucleic acids(both DNA &RNA)	6	Chalk and Talk OHP
	Pyrimidine & Purine synthesis	6	Chalk and Talk OHP
	Structure, properties and outline synthesis of amino acids	7	Chalk and Talk OHP
	Classification , Structure and synthesis of proteins in outline	6	Multimedia presentation
	Ramachandran Plot	3	Interactive animations and multimedia teaching, Illustrations with models
UNIT V			
	The idea of an enzyme	2	Chalk and Talk
	Classification and nomenclature	3	Introducing mneomonics for enzymes classification
	Michaleis – Menton concept	5	Interactive animation
	Enzyme catalysis and regulation	5	Multimedia presentation
	Factors affecting enzyme action	2	Interactive animation

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	5	5	5	5	3	2	25
CO2	5	5	5	5	5	2	27
CO3	5	5	5	5	5	2	27
CO4	5	5	5	4	3	1	23
CO5	5	5	5	4	3	3	25
	25	25	25	23	19	10	127
						127/30=4.2	

BOT3535 ANALYTICAL TECHNIQUES AND RESEARCH METHODOLOGY 5Hr./5Cr.

Pedagogy	Hours	Lecture	Dept. resources	Field/Indust. /Lab	Subject experts	ICT Virtual learning	Peer teaching	Super special models
	75	60	-	-	-	13	2	-

PREAMBLE:

This course imparts knowledge on principles of various instruments and gadgets employed in scientific enquiry. Students will learn various qualitative and quantitative techniques. Further students will gain skills to design scientific experiments, data mining, analysis and scientific paper writing.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
CO1: follow the standard and good laboratory practices and observe safety norms at every stage of work and be confident in handling basic science experiments	1	12
CO2: confidently and independently use spectrophotometer and its variants and effectively perform analytical work and do quantitative measurements with accuracy	2	10
CO3: understand how the principle of centrifugation, chromatography, electrophoresis and blotting techniques can be utilized to resolve queries inplant biochemistry	3	20
CO4: design and carry out scientific enquiries doing sampling , surveys, and statistical analysis employing data collection and analysis using suitable statistical tools	4	15
CO5:design and execute science projects recalling the training they had undergone in making scientific observations showcasing skills developed in thesis writing report writing and in making scientific presentations	5	18

SYLLABUS

UNIT I. Basic principles:

Units of measurement, expression of solutions concentration (molarity, molality, normality, percentage, parts per thousand, and ppm) – pH metry (working principle, components and buffers) – electromagnetic spectrum – gravitational force – Good Laboratory Practices (GLP).

UNIT II. Analytical Procedures:

Instrumentation for environmental analysis (sonometer, clinometer, altimeter, barometer, hygrometer, anemometer, lux meter, thermometer, rain gauge and smart phone Apps.) colorimetry and spectrophotometry (working principle, components and applications) – Spectroscopy, UV visible and Mass spectrometry (working principle, components and applications.).

UNIT III. Separation Techniques:

Centrifugation (principle, types of centrifuge and applications) – Chromatography (principle of paper and thin layer) – applications of HPLC, GC–MS, FTIR, NMR – electrophoresis – (principle, agarose and Poly Acrylamide Gel Electrophoresis) – applications of Southern and Northern blotting.

UNIT IV. Scientific experimentation:

Scientific observations – critical thinking – development of scientific thought - research aptitude – defining a research problem, hypothesis testing and experimental design – review of literature (journal references, on line resources.) Collection of primary and secondary data – population and sample – sampling methods (random and non–random sampling) – questionnaire – survey – field note – photo documentation. Model

biological organisms (*Escherichia coli* and *Arabidopsis thaliana*).

UNIT V. Data collection and analysis:

Biostatistics (mean, mode, frequency distribution, standard deviations, standard error) – data processing softwares – thesis writing – format of report, abstract, data presentation (tabulations, graphic representation) – interpretation of results – acknowledgements – MS-word, excel and power point – oral presentation – plagiarism.

REFERENCE

1. Jeyaraman, J., 2011. Laboratory manual in biochemistry, Second edition. New age international private limited, New Delhi. ISBN: 9788122430493.
2. Kothari, C.K., 1985. Research methodology – methods and techniques. Wishwa prakashan publications, New Delhi. ISBN: 81 224 0002 7.
3. Palanivelu, P., 2009. Analytical biochemistry and separation techniques – A laboratory manual, Fourth edition. Twenty first century publications. India. ISBN:
978–8190848909.
4. Plummer, D.T., 1975. An introduction to practical biochemistry, Tata mcgraw hill publishing company limited. New Delhi. ISBN: 9780070994874.
5. Rastogi, V.B., 2011. Fundamentals of biostatistics. Ane books private limited, New Delhi. ISBN: 978 81 8052 2550.
6. Wallwork, A., 2011. English for writing research papers. Springer science publications, New York. ISBN: 9781441979216.
7. Wilson, K. and Walker, J., 2006. Principles and techniques of biochemistry and molecular biology, Sixth edition. Cambridge university press, New York. ISBN: 10 0521 69180.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Fundamentals: Basic lab rules. Preparation of buffers and storage of reagents	3	Lecture, calculations and experimental
	Concentrations of solutions: molal, Molar, Normal solutions	3	Lecture and calculations
	Ionization, Sorenson's concept pH & pOH	2	Lecture and demonstration
	pH measurements and use of Buffers	2	Lecture and demonstration with samples
	Standard and Good Laboratory Practices	2	Lecture and workshop
UNIT II			
	Electromagnetic spectrum	1	Lecture and ppt
	Beer & Lamberts law and basics of colorimetry	2	Lecture and demonstration
	Principle and use of Spectrophotometer	3	Lecture and ppt
	Introduction to Spectroscopy	2	Lecture
	UV Vis. and Mass Spec. applications	2	Lecture and experimental
UNIT III			

	Principles of Centrifugation	2	Lecture and demonstration
	Types and uses of Chromatography	3	Lecture and experimental
	Applications of GC MS, HPLC, FTIR, NMR	5	Lecture and e resources
	Electrophoresis (agarose & PAGE)	5	Lecture and videos
	Blotting Techniques (Southern and Northern)	5	Lecture and videos
UNIT IV			
	Scientific Observations and Critical Thinking	3	Lecture and discussion
	Hypothesis framing and testing. Framing research problem.	3	Lecture and assignment
	Literature review – Journal and online resources	3	Lecture, library visit and online resources.
	Data collection: sampling and survey techniques. Methods of field studies.	3	Lecture and project
	Model organism for molecular analysis *(Arabidopsis thaliana*)	3	Lecture and web based demonstration
UNIT V			
	Data analysis –Measures of central tendency , range and deviations	3	Lecture and project
	Statistical and Data Processing Softwares	5	Lecture and demonstration
	Compilation of Dissertation and Thesis writing	3	Lecture and library visit
	Scientific manuscript preparation and publication procedures	4	Lecture and ppt
	Skills to make scientific presentations	3	Lecture and ppt

…

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1	4	4	5	4	2	2	21
CO2	3	4	5	4	3	3	22
CO3	3	4	4	5	3	3	22
CO4	2	3	3	4	4	5	21
CO5	2	3	4	4	4	5	22
	14	18	21	21	16	18	108
						108 /30 = 3.6	

BOT 3637 LAB V (PLANT SYSTEMATICS AND BIOCHEMISTRY) 6Hr./6Cr.

Students will be able to

CO1: appreciate the plant kingdom
CO2: differentiate the various forms of plant diversity
CO3: learn the economic importance of plants
CO4: have hands on experience with biochemical instruments
CO5: extract secondary metabolites from plants

Plant Systematics 3h/wk

The lab course is aimed at giving on hand experience to the students. The students will be encouraged to observe and understand the various vegetative and reproductive structures of the plant.

1. Introduction: Various plant parts
2. Morphology of vegetative parts
3. Morphology of flowers and fruits
4. Phytography (description of plants)
5. Key construction (Indented and bracketed key)
6. Identification of plants up to family level using dichotomous keys used in the floras
7. Polypetalae I Annonaceae, Leguminosae (Fabaceae, Caesalpiniaceae, Mimosaceae),
8. Polypetalae II Rosaceae & Cucurbitaceae
9. Gamopetalae I Asteraceae, Asclepiadaceae,
10. Gamopetalae II (Convolvulaceae, Acanthaceae & Lamiaceae)
11. Monochlamydeae (Amaranthaceae, Euphorbiaceae.)
12. Monocots : Orchidaceae, Arecaceae, & Poaceae
13. Economic botany
14. Taxonomic problems

Further students are encouraged to participate in Field trips arranged by the Course Teacher to nearby botanically rich areas to study plants in their natural habitat.

Suggested places for field study:
Alagar Hills, Karungalakudi, Sathuragiri, Kodaikanal, Kuttupatti, Sirumalai .

REFERENCES

1. Gamble, J.S. and Fischer, C.E.C., 1957. Flora of the presidency of madras, I – III, W. C. Adlard and son limited, London. ISBN : 978-1152544420.
2. Lawrence, G.H.M., 1965. Taxonomy of vascular plants. The macmilan co, New York. ISBN: 978-0023681905.
3. Matthew, K. M., 1995. An excursion flora of central tamilnadu, Oxford press, New Delhi. ISBN: 978-905410286.

Biochemistry 3h/wk

This laboratory session is to train the student to quantitatively and qualitatively analyse biomolecules and metabolites besides providing knowledge about the principles and knowhow of using various instruments**.**

1. pH metry
2. Colorimetry - Verification of Beer – Lambert's law
3. Spectrophotometer- Determination of λ-max.
4. Qualitative test for carbohydrates
5. Quantitative estimation of carbohydrates by Anthrone's method
6. Qualitative test for proteins and amino acids

7. Quantitative estimation of protein by Lowry's method
8. Qualitative test for lipids and estimation of oil in seeds
9. Separation of amino acids using paper chromatography.
10. Separation of pigments using thin layer chromatography.
11. Enzyme activity (Catalase / Peroxidase)
12. Isolation of chloroplast for electron transport studies.
13. Estimation of PS II activity (DCPIP reduction method)

REFERENCE BOOKS

1. Cooper, T.G., 1991. The tools of biochemistry. John wiley and sons, New York. ISBN: 0-471 17116-6.
2. Jeyaraman, J., 1998. Laboratory manual in biochemistry. New age international publishers limited, New Delhi. ISBN: 0852264283.
3. Plummer, D.T., 2003. An introduction to practical biochemistry, Third edition. Tata Mcgraw hill publishing company limited, New Delhi. ISBN: 0-07-0994870

BOT 3239 **MEDICINAL BOTANY** **3Hr./2Cr.**

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT	Field work
	45	30	2	7	3	3

PREAMBLE:

This course will provide knowledge on botanical and therapeutic value of selected locally available and easily cultivable herbs. The students will be introduced to a few systems of medicines such as Siddha, Ayurveda, Unani and Homeopathy. Students will learn domestic usage of medicinal plants and be apprised about scope for documentation of folk medicinal knowledge, collection, marketing and sustainable utilization of medicinal plants.

COURSE OUTCOME At the end of the semester, students will be able to	Unit	Hrs P/S
CO1: Quote the names of physicians and literature related to Indian medical practices. Distinguish various medical practices.	1	7
CO3: identify medicinal plants, describe its morphology, add medicinal knowledge about locally available plant.	3	15
CO4 do cultivation practices of certain medicinal herbs, learn processing, storing and packing of medicinal produce.	4	7
CO5: practice preparation techniques of siddha medicines, commercialize the products.	5	9

SYLLABUS

UNIT 1. Introduction to medical practices in India: History – Literatures and physicians of ancient period. – Ayurvedha – Siddha – Unani-Homeopathy – Allopathy.

UNIT 2. Ethnobotany and Folk lore medical practices: Ethnic communities in Tamil Nadu and their medicinal plant usage – patented products (Kani Tribe) – popular folklore medicines – methods of documenting the ethnobotanical knowledge – AICRPE.

UNIT 3. An overview of selected medicinal plants: Morphology, family, vernacular and botanical name, useful part and active principles phytotherapeutics.

I. Root (*Asparagus racemosus & Gloriosa superba)*

II. Leaf (*Aloe vera, Azadirachta indica)*

III. Bulb(*Allium cepa, Allim sativum)*

IV. Rhizome(*Zingiber officianale, Curcuma longa)*

V.Fruit (*Solanum nigrum, Solanum xanthocarpum)*

VI. Seed(*Trigonella foenum graceum.Cuminum cyminum)*

VII. Oil seed (*Cocus nucifera, Ricinus communis)*

UNIT 4. Cultivation and processing of medicinal plants: Propagules (Seed, leaf, stem, root, rhizome and bulbs) – cultivation methods – harvesting – processing – packaging – storage.

UNIT 5. Good Manufacturing Practices: Choornam – legiyam – thailam – parpum– kasayam– herbal concoction – Processing of medicinal plants – medicinal plants in commercial products – list of commercial outlets.

REFERENCES

1. Akerele, O., Heywood, V. and Synge, H., 1991. The conservation of medicinal plants. Cambridge university press. Cambridge. ISBN: 0521112028.

2. Chevallier, A., 1996. The encyclopedia of medicinal plants. D.K publishing, Michigan. ISBN: 0-789-41067-2.

3. Cunningham, A.B., 2001. Applied ethnobotany- people, wild plant use and conservation. Earth scan publications limited, London. ISBN: 1853836974.

4. Singh, M., 2009. Medicinal plants of india. New central book agency, New Delhi. ISBN: 8173815933.

5. Mathur, N., 2010. Medicinal plants of india. RBSA publishers, New Delhi. ISBN: 8- 176114995.

6. Wallis, T.E., 1997. Textbook of pharmacognosy, Fifth edition. CBS publishers, New Delhi. ISBN: 0700012915.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Systems of medicinal practice and local health traditions in India	2	lecture
	Siddha practitioners and literature of the south	1	Photo, literature, lecture
	Ayurveda practitioners and literature of the south	1	Physicians photo, pictures related in curing disease,lecture
	Unani practitioners and literature of the south	1	Lecture, photos of physicians, slide show showing medicines used
	Homeopathy and Allopathy practitioners and literature of the south	2	PPT, lecture
UNIT II			
	Ethnic communities	2	Lecture, documentary films
	Patenting the products	1	Internet videos
	Popular folklore medicine	1	Slide show, lecture and sample specimen
	Conserving Indigenous knowledge	1	Lecture
	AICRPE	1	lecture
UNIT III			
	Traditional medicine from root	3	Live specimen,photos, lecture
	Traditional medicine from leaf	3	Live specimen, lecture,photos
	Traditional medicine from Bulb and rhizome	3	Live specimen, lecture,photos
	Traditional medicine from fruits and vegetables	3	Live specimen, lecture,photos
	Traditional medicine from seeds and oil seeds	3	Live specimen, lecture,photos
UNIT IV			
	Propagules for cultivation	1	Live specimen, photos
	Cultivation methods	2	Field work
	Picking and harvesting procedures	1	Online videos
	Processing and	2	Live demo,lecture

	preparation of formulation		
	Packaging and Storage	1	Visit to organic shop
UNIT V			
	Preparation of legiyam,parpam	2	Videos,lecture
	Preparation of thailam,kasayam	1	Videos,lecture
	Preparation of beauty products	1	Videos,lecture
	marketing	2	lecture
	Commercial outlets and trade of TM preparations	2	Visit to outlets

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	Total
CO1	5	5	5	1	1	1	18
CO2	5	5	5	5	3	5	28
CO3	5	5	5	5	4	5	29
CO4	5	5	5	5	2	5	27
CO5	5	5	5	5	3	5	28
						129/30=4.3	

BOT 3200 **ENVIRONMENTAL STUDIES** **4Hr./2Cr.**

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	60	45	-	10	5

PREAMBLE: The course presents an overview on the components of environment. Students will learn about the fragility and delicate balance between the interactive variables of habitat. Various causes of pollution with special reference to anthropogenic influences will be investigated. Learners will have an opportunity to get sensitized about local and global environmental issues and strategies to manage them.

COURSE OUTCOME At the end of the Semester, the Students will be able to	Unit	Hrs P/S
CO1: look at the nature differently so that one can appreciate and take efforts to conserve it in order to use the resources wisely and sustainably	1	15
CO2: comprehend the relationship between the Ecosystem and the Community better and also have a better insight on the population	2	10
CO3: cope up with all kinds of pollution and the treatment of pollutants through the study of several worst case scenarios of different degrees.	3	15
CO4: understand better the ever changing climates and its effect on the elements of an ecosystem so that effective combating measures could be taken in a swift manner	4	10
CO5: formulate proper environmental policies on conservation of nature and energy through phytoremediation in order to create a green and clean environment	5	10

SYLLABUS

UNIT 1. Living Earth: Elements of Nature – Biotic, abiotic and climatic factors – lithosphere – atmosphere – hydrosphere – biosphere – renewable and nonrenewable energy resources (types – utilization – generation – solar – wind – hydro – wave – nuclear – biomass –fossil fuel.)

UNIT 2. Ecosystem, Community and Population ecology: Structure – **t**ypes – pyramids–food web – food chain – succession (hydrosere) – Clement's classification of community – attributes of population.

UNIT 3. Pollution: Pollution and its types – sources – effect – control (air –noise – space – water – land – thermal – biomedical and e-waste) – treatment of pollutants (reduce/ reuse/ recycle techniques) – episodes of concern (Ennore oil slick, Bhopal gas tragedy, Pacific gyre,
Fukushima nuclear plant disaster)

UNIT 4. Climate change and natural disasters: Factors affecting global climate (green house effect, ozone depletion, acid rain) – disasters (occurrence – reasons – types – measurement – monitoring –management strategy) – participatory management – earthquake – volcanic eruption – floods – cyclones – tsunami – forest fire.

UNIT 5. Environmental policies: Future energy – environmental movements – national environmental issues – Indian environment policies – environment education – phytoremediation – aforestation and reforestation – social and agroforestry.

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UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Elements of nature	3	Chalk and talk, PPT
	Earth as a biosphere	3	Chalk and talk, PPT
	Renewable rsources	3	Chalk and talk, ICT
	Non renewable depleting resources	3	Chalk and talk, ICT
	Inadvertent effects of byproducts and wastes	3	Chalk and talk. ICT
UNIT II			
	Synecological approaches	2	Chalk and talk, ICT
	Clement's classification of community	2	Chalk and talk, ICT
	Ecological Succession	2	Chalk and talk, ICT
	Structure of an ecosystem	2	Chalk and talk, ICT
	Dynamics and functioning of model ecosystem (pond)	2	Chalk and talk, ICT
UNIT III			
	Types and classification of Pollutants and Pollution	3	Chalk and talk, ICT, PPT
	Air pollution –Photo Chemical Smog and Bhopal Gas Tragedy	3	Chalk and talk, ICT
	Water pollution- Oil Slick and Eutrophication	3	Chalk and talk, ICT
	Radioactive Pollution – Fukushima Nuclear Plant Disaster	3	Chalk and talk, ICT
	Treatment and mitigation of pollutants	3	Chalk and talk, ICT
UNIT IV			
	Major threats and concerns on climate change	2	Chalk and talk, ICT
	Global Warming and Green House Effect	2	Chalk and talk, ICT
	Ozone Depletion and Acid Rain	2	Chalk and talk, ICT
	Tools and Techniques of Environmental Monitoring	2	Chalk and talk, ICT

	Preemptive Measures and Disaster management strategies	2	Chalk and talk, ICT
UNIT V			
	Ecological Movements	2	Chalk and talk, ICT, PPT
	National and international polices and consultations	2	Chalk and talk, ICT
	Phytoremediation	2	Chalk and talk, ICT
	Afforestation and Social Forestry	2	Chalk and talk, ICT
	Environmental education for proactive engagements	2	Chalk and talk, ICT, PPT

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	
CO 1	5	5	5	5	4	4	28
CO 2	5	5	4	5	3	3	25
CO 3	5	5	4	4	4	4	25
CO 4	5	5	5	5	5	4	29
CO 5	5	5	5	5	5	5	30
							137.30
							4.5

BOT3832 **PLANT BIOTECHNOLOGY** **5T+3L/8Cr.**

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	75	60	5	5	5

PREAMBLE:

This course opens up the vistas of molecular biology and its application in genetic engineering. Students will learn the purpose and the art of tissue culture for propagation and genetic transformation of plants. Students will analyze the wet lab data at dry lab. They will explore the practical issues involving fermentation industries and nitty-gritty of making marketable plant based products. On completion of the course students will appreciate the art of fermenting foods and beverages.

COURSE OUTCOME At the end of the semester, students will be able to	Unit	Hrs P/S
CO1: realize the potential of the *in vitro* technique and capitalize on the knowledge to take up jobs and employment in plant tissue culture industries or starting their own plant production and plant propagation units to propagate and market elite planting stocks	1	15
CO2: apply their understanding on DNA techniques , plasmids, vectors, Ti plasmids to vocationally use them in r DNA processes that they take up gainful employment in plant genetic engineering laboratories within and outside the country.	2	15
CO3: hire the experience gained in handling biological data bases to access genomic and proteomic data vested with NCBI, EMBL, DDBJ and other leading molecular biology research centers and lab that show themselves ready for job ready for contemporary innovations and breakthroughs.	3	15
CO4: benefit from identification and characterization of potential microbes to pursue strain development, designing culture equipments and fermentors suitable enough to produce a host of fermented products for SSI and MSI commercial entrepreneurial ventures	4	15
CO5: try their luck in making useful secondary metabolites from plants, biotransformation and cell immobilization, SCP, plant vaccines and marketable enzymes, biofuels and gm crops with due consideration of issues of bioethics and biosafety that shall launch many agrobiotechnological initiatives using the skilling	5	15

SYLLABUS

Unit 1. Tissue culture as a tool for plant biotechnology: Objectives and goals – historical perspective – laboratory design and equipments– MS Media composition and supplementation – explants selection, sterilization, inoculation –induction of callus – organogenesis – somatic embryogenesis and hardening – micro propagation – artificial seeds – protoplast isolation, culture and fusion – haploid plants.

UNIT 2. Basics of rDNA technology : Central Dogma – DNA structure, variations and organization – replication – transcription, translation and protein synthesis – mutations – principles of recombinant DNA technology – pGEMT vector – restriction mediated and PCR based cloning – *Agrobacterium* mediated gene transfer.

Unit 3. Elements of bioinformatics: *In silico* assistance in sequencing biomolecules – online nucleotide and protein databases (EBI and NCBI) and tools (BLAST,FASTA ,ClustalW and PHYLIP)

Unit 4 : Fundamentals of Fermentation Technology: Potential microorganisms – culture and characterization – strain development – batch and continuous culture – media formulation – growth kinetics – fermented products – food (curd, yoghurt, dhokla, miso, sauerkrauts , sausages , vinegar and cheese) – beverages (wine, beer) – types of fermenters – design – control and scale-up – upstream and downstream processing – introduction to bioreactors.

UNIT 5. Marketable products and bio-applications: Secondary metabolites production – immobilisation –

Single Cell Protein(SCP) – enzymes – planticcines – biofuels – GM crops – terminator seed technology – bioremediation – bioethics and biosafety.

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LAB IN PLANT BIOTECHNOLOGY **3L**

1. Sterilization
2. Media preparation
3. Callus culture
4. DNA Extraction and agarose gel electrophoresis
5. DNA Quantification
6. Restriction Digestion of DNA
7. Introduction to databases
8. Usage of tools-BLAST, ClustalW analysis
9. Growth curve of *Escherichia coli*
10. Production of primary metabolites-catalase, amylase
11. Wine/Beer production
12. Production of acetic acid and lactic acid
13. Biodiesel production-*Jatropha*

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT 1			
	Plant tissue culture as component and a tool	3	Chalk and Talk Presentation
	Aseptic procedures	3	Chalk and Talk Presentation
	Micropropagation	3	Multimedia presentation
	Patterns f regeneration in cultures	3	Multimedia presentation
	Tissue culture applications	3	Chalk and Talk Presentation
Unit II			
	DNA; techniques for sequencing	3	Multimedia presentation
	Plasmids , Vectors and Genes of interest	3	Multimedia presentation, Illustrations with models
	r-DNA technology in outline	3	Multimedia presentation
	Restriction mediated PCR cloning	3	Multimedia presentation
	Agrobacterium Technology	3	Multimedia presentation
Unit III			
	Introduction to Biological Data bases	3	Practice through online and offline applications
	Institutions of pre eminence : NCBI, EMBL, DDBJ	3	Practice through online and offline application
	Bioinformatic Tools : (BLAST, FASTA, Clustal W, PHYLIP)	3	Practice through online and offline application
	In silico assistance in sequencing	3	Practice through online and offline application
	Protein data bases and proteomics	3	Practice through online and offline application
Unit IV			
	Identification and characterizations of potential microbes	3	Chalk and Talk Presentation
	Strain Development	3	Chalk and Talk Presentation
	Fermentor designs	3	OHP
	Cultures and controls in fermentation	3	Chalk and Talk Presentation
	Fermentation products commercial interest	3	Real time examples
Unit V			
	Useful Secondary Metabolites from Plants	3	Chalk and Talk Presentation

	Biotransformation and cell immobilization	3	Chalk and Talk Presentation
	SCP, Plant Vaccines and marketable enzymes	3	Chalk and Talk Presentation
	SWOC of Biofuels and GM crops	3	Chalk and Talk Presentation
	Issues of Bioethics and biosafety issues	3	Chalk and Talk Presentation

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	5	5	5	5	5	2	27
CO2	5	5	5	5	3	2	25
CO3	5	5	5	5	5	5	30
CO4	5	5	5	5	5	5	30
CO5	5	5	5	5	4	3	27
	25	25	25	25	22	17	139
139/30=4.6							

BOT 3434 **ENTREPRENEURIAL BOTANY** **4Hr/4Cr**

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	60	50	3	2	5

PREAMBLE:

This course is designed to help students gain the know-how on contemporary opportunities in business situations and develop skills needed to successfully convert them into entrepreneurial ventures. The basics of entrepreneurship as a concept and the fundamentals training they may require to meet their livelihoods will be explored. On completion learners will be able to develop ideas that will lead them to start their own business and enable them to be professionally competent.

Objectives:

1. To provide an understanding the essentials of entrepreneurship.
2. To introduce organizations and agencies that can backup entrepreneurial initiatives.
3. To expose students to various business opportunities emerging around the study of plants.
4. To encourage students to built proposals and projects to become an entrepreneur.

COURSE OUTCOME At the end of the semester, students will be able to	Unit	Hrs P/S
CO1: pragmatically asses the scope of using the knowledge gained in learning Botany for gainful applications by starting own business ventures.	1	12
CO2: evaluate the feasibility designing projects of their own in the model of the various case studies they have investigated in this course.	2	12
CO3: work out the breakeven of small scale business ventures and evaluate the feasibility of value additions in the project the break grounds for achieving cost effectiveness	3	12
CO4: tap agencies that can possibly provide full or partial support to kick start their projects that stabilize the same for making their livelihood	4	12
CO5: assess the market worth of their entrepreneurial exercise and clearly rate the viability considering the opportunities and risks matching it with that of their peers and competitors on real time basis.	5	12

SYLLABUS

Unit 1. Introduction: Need – definition and concept – Types and characterization – entrepreneurial values – motivation and barriers – entrepreneurship as innovation, risk assessment and solutions.

Unit 2. Bioventure: Industry – overview of *Spirulina*, *Pleurotus sajor-caju*, *Ganoderma*, *Lentinusedodes*, drumstick and coconut – Straight Vegetable Oil (SVO) and Pure Plant Oil (PPO) - methods and marketing – fresh and dry flowers for aesthetics.

Unit 3. Value added products: Canning of fruits – process and equipment – fruit and vegetable based products (squash) – ready to serve (RTS) (syrup, pulp, paste, ketchup, soup, vegetable sauces, jam and jellies) –bio-fuel production – Bamboo and cane based products – virgin coconut oil, jasmine oil production – nutraceuticals – standards and quality management.

Unit 4. Organizations and agencies: TIIC, DIC, NABARD, MICROSTAT, DBT – case study – sarvodaya – SIDCO – Micro Small and Medium Enterprises – support structure for promoting entrepreneurship – various government schemes.

Unit 5. Entrepreneurial opportunities: Understanding a market and assessment – selection of an enterprise – business planning –mobilization of resources – Break Even Analysis – project proposal (guidelines, collection of information and preparation of project report) – steps in filing patents – trademarks and copyright – Intellectual Property Rights – export and import license.

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UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Learn the concept of entrepreneurship	3	Lectures, PPT
	Types and Characterization	3	Lectures, PPT
	Innovative ideas of entrepreneurship	2	Lectures, PPT
	Risk assessment	2	Lectures, PPT
	Motivation& barriers of the concept	2	Lectures, PPT
UNIT II			
	Industrial approach	3	Lectures, PPT
	Plant based examples	3	Lectures, PPT
	Oil based extraction	2	Lectures, PPT, Real time examples
	Marketing methods	2	Lectures, PPT, Real time examples
	Flowers as aesthetics	2	Lectures, PPT, Real time examples
UNIT III			
	Preservation Process	3	Lectures, PPT, Videos
	Vegetable &Fruits based products	3	Lectures, PPT
	Biofuel production	2	Lectures, PPT
	Oil extraction and production	2	Lectures, PPT
	Standards and quality management	2	Lectures, PPT
UNIT IV			
	Government	3	Lectures, PPT

	organizations		
	Micro scale industries	3	Lectures, PPT, Local visits
	Small scale industries	2	Lectures, PPT, Local visits
	Other supports for promoting entrepreneurship	2	Lectures, PPT
	Government schemes	2	Lectures, PPT
UNIT V			
	Understanding the market	3	Lectures, PPT
	Planning and mobilisation of resources	3	Lectures, PPT
	Preparing project proposals	2	Lectures, PPT, Real time examples
	Patents, trademarks and copyrights	2	Lectures, PPT, Real time examples
	IPR and obtaining license	2	Lectures, PPT, Real time examples

Bloom's Taxonomy

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	5	5	5	4	3	2	24
CO2	5	5	5	4	3	1	23
CO3	5	5	5	5	5	3	28
CO4	5	5	5	5	4	3	27
CO5	5	5	5	5	5	5	30
	25	25	25	23	20	14	132
132/30=4.4							

BOT3536 **BIORESOURCE MANAGEMENT** **5Hr./5Cr.**

Pedagogy	A	B	C	D	E	F	G
	Course Teacher's Contribution	Department Resources	Field /Industry/ Lab	Subject Experts	ICT Virtual Learning	Peer Teaching	Super-Special method
	65	3	2	-	3	2	-

PREAMBLE:

This course is framed to cater the need of non major students about the Bioresources and its conservation of Indian subcontinent. Current status of our country's wealth is given a greater emphasis. *In situ* and *ex situ* methods of conservation are being taught to create a holistic approach in natural resources management. The course is designed to create leadership abilities among students and transform them as stewards of our natural resource.

COURSE OUTCOME At the end of the semester, students will be able to	Unit	Hrs P/S
CO1: classify landscapes and waterscapes using geological and geographic inputs and analyze the current status of mineral resources of our country	1	15
CO2: identify fresh water and marine aquatic resources and wet land ecosystem and develop appropriate techniques for water shed management and water resource management	2	15
CO3: analyze the biological wealth of our country as a potential resource and integrate its use with the need for conservation	3	15
CO4: understand agriculture as a main resource of food production and assess the Indian and international strategies for food management	4	15
CO5: develop strategy for conservation, policies specific to Indian scenario and effectively manage the resources.		

SYLLABUS

UNIT 1. Geology of India: Introduction of Geology – types of rocks – geographical position and boundaries – soil types in India – pedology – soil as natural capital – ecosystem services of soil – mineral sources – mining and its impact – depletion of minerals – conservation strategies.

UNIT 2. **Water, Wetlands and Marine resources:**Watershed management – raining pattern – harvesting and storage – indigenous and remote sensing techniques – fresh water and wetland ecosystems located in India – global and national statistics of water resources – an overview of ecosystem services of wetlands – types of marine ecosystems – marine resources (production, status, dependence, issues and challenges for resource supply, threats and prospects.)

UNIT 3. Phytogeography: Mega diversity countries – biodiversity hotspots- endemism biogeographical realms – flora and fauna – forest types (Champion and Seth 1968) – Eastern and Western Ghats (physiography, distribution maps, diversity of plants and animals.) – desert ecosystem.

UNIT 4. Food, Agriculture and Forestry: Native seeds and agricultural implements – land use patterns – ancient and modern agriculture –Food (sources,sustainable usage, shortage and management,food storage methods merits and demerits.) Public distribution system (FAO, IBPGR, NBPGR.) – timber and Non timber forest produce (NTFP).

UNIT 5. Conservation and Management: Heritage sites of UNESCO – Man and Biosphere Reserve (MAB) program – national parks – wildlife sanctuaries – botanical gardens – field gene bank – cryopreservation – reintroduction – silviculture.

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UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Geological and geographic dimensions	3	Lecture, PPT
	Rocks and mineralization	3	Lecture, videos
	Pedology and soils in India	3	Lecture, ppt
	Mining and Quarries	3	Lecture, videos
	Regulation and Conservation	3	Lecture, ppt
UNIT II			
	Aquatic resources	2	Lecture,
	Water Shed Management	4	Lecture, ppt
	Wet land ecosystems	2	Lecture, documentary
	Marine resources	3	Lecture, videos
	Water Resource management	4	Lecture, ppt
UNIT III			
	Bio geographical zones of India	3	Lecture, ppt,charts
	Mega diversity zones	3	Lecture, ppt
	Hot spots	3	Lecture, ppt
	Forest Types (Champion, 1968)	3	Lecture, charts
	Eastern and western Ghats	3	Lecture, videos
	Extreme habitats		Lecture,ppt
UNIT IV			
	Agricultural land use	3	Lecture, ppt
	Food Security	3	Lecture, ppt
	Food storage and PDS	3	Lecture,videos
	Forest Resources	3	Lecture,videos

	Indian and international management strategies	3	Lecture,ppt
UNIT V			
	UNESCO	3	Lecture, ppt
	Heritage sites	3	Lecture, ppt
	MAB program	3	Lecture, ppt
	National park and Wild life protection	3	Lecture, ppt
	Ex situ preservation strategies & reintroduction	3	Lecture, ppt

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO 1	5	4	4	5	3	2	23
CO 2	4	4	4	5	4	4	25
CO 3	5	5	4	5	3	3	25
CO 4	4	4	5	4	3	2	22
CO 5	5	5	5	4	3	3	25
	23	22	22	23	16	14	120/30
							4

BOT 3538 **Botany Project** **5Cr./5hr.**

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	75	-	-	-	-

PREAMBLE:

Botany Project work is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation or difficult problem. A project work may be given in lieu of an elective paper (Bio-resource Management). Interested students will get an opportunity to carryout research project at the department laboratories.

Every year, based on the faculty availability a few areas will be identified and informed well in advance. Eligible students will be asked to make a list of three areas according to his/ her ranked choice. According to his/ her ranked choice of the area, project will be allotted. In the case of competition for a specific project the cumulative credential of first four semesters would be considered for project allotment. At the end of the research work students will be encouraged to create fact sheets and posters to report their findings.

COURSE OUTCOME At the end of the semester, students will be able to	Unit	Hrs P/S
CO1: gain an hands-on experience of personally designing and executing a research enquiry based on accepted scientific norms	1	-
CO2: gather basic information, details and preliminary data based on which his/ her research will be positioned	2	-
CO3: garner skill is making scientific observations that ability to collect and collate meaningful information will be fortified	3	-
CO4: galvanize arguments based on the strength of drawn from the statistical tools and tests used for analyzing the data	4	-
CO5:garnish his/her findings in the approved format that even the little original information honestly generated in the study will be added on the exciting body of knowledge known to the scientific community	5	-

	K1 (Recall)	K2 (Understanding)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1	5	5	5	4	3	2	24
CO2	5	5	5	3	3	2	23
CO3	5	5	5	5	4	2	26
CO4	5	5	5	5	3	3	26
CO5	5	5	5	5	5	4	29
Total	25	25	25	22	18	13	128
						128/30= 4.2	

BOT 3642 **Plant Physiology (Theory Cum Lab)** **4+2L Hr./6Cr.**

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	60	40	5	10	5

Preamble: This course explores the knowledge on life processes exclusive to plants. Students learn intricate details on water transport, transpiration and the uptake of nutrients of plants. It also facilitates them to have a deeper insight on energy generation and utilization mechanisms. Eventually learners understand the music of 'plant growth' from the notations of 'chemical regulators'.

COURSE OUTCOME At the end of the semester, students will be able to	Unit	Hrs P/S
CO1: characterize water physical and chemical nature. Experiment with plants to prove conduction of water and photosynthesis.	1	14
CO2: tabulate macro and micro nutrients needed by plants, observe nitrogen fixers and their role, enrich the soil using minerals	2	15
CO3: distinguish between photosynthetic and non photosynthetic pigments in plants, evaluate the efficiency of photosynthesis in plants	3	10
CO4 describe glycolytic pathway and subsequent pathway leading to the synthesis of ATP, assess the respiratory quotient of various substrates	4	8
CO5: experiment with hormones to evaluate the efficacy of hormones in improving the growth of plants, observe rhythmic movements and responses in plants	5	13

SYLLABUS

Unit 1. Plant-Water relations:

Characteristics of water molecule – Diffusion, osmosis, Imbibition– diffusion pressure deficit–guttation–— transpiration–factors affecting transpiration – transport of water -translocation and descent of sap –components of xylem and phloem– girdle experiment

Unit 2. Mineral nutrition:

Essential elements – macro and micronutrients – transport of ions across membrane – active and passive transport – deficiency symptoms and toxicity– nitrogen metabolism and phosphate solubilization.

Unit 3. Photosynthesis:

Photosynthetic pigments –Non photosynthetic pigments - PS I and PS II– reaction centres –antenna pigments – light dependent and independent reactions (C3, C4 and CAM) – C2 cycle – factors affecting photosynthesis.

Unit 4. Respiration:

Glycolysis – Krebs cycle- electron transport system – oxidative phosphorylation– pentose phosphate pathway–respiratory quotient.

Unit 5. Growth Physiology:

Introduction to plant growth –seed germination – physiological role and assays of auxins, gibberellins, cytokinin, abscissic acid, ethylene – photoperiodism and vernalization – photo morphogenesis – phytochromes – LDP, SDP and day neutral plants – Biorhythms and plant movements –senescence –plant response to abiotic stresses.

TEXT BOOKS

1. Sinha, R. K., 2004. Modern plant physiology. Narosa publishing house, New Delhi. ISBN: 81-7319-333-9.

REFERENCES

1. Bidwell, R. G. S., 1975. Plant physiology. Macmillan publishing co. inc., New York. ISBN: 0-02-309430-3.
2. Salisbury, F. B. and Ross, C.W., 1992. Plant physiology, Fourth edition. Eastern press, Bangalore. ISBN: 981-243-853.
3. Srivastava, H. S., 2005. Plant physiology. Rastogi publications, Meerut. ISBN: 81-7133-785-6.
4. Williams, M. B., 1984. Advanced plant physiology. Pitman publishing, New Zealand. ISBN: 0-273-02306-3.
5. Ghosh, M. S., 1996. Plant physiology, First central edition. New central book agency private limited, New Delhi. ISBN: 81-7381-478-3

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Soil-plant water continuum	4	Diagram using chalk
	Soil water and Absorption	2	Science videos
	Ascent of Sap	2	Experiment and lecture
	Transpiratory regulation	3	lecture
	Distribution of photosynthates	3	Schematic representation and chalk and board method
UNIT II			
	Soil-nutrient Profile	2	Tabular column, lecture
	Macronutrients	4	Slide show
	Micronutrients and Deficiency Symptoms	4	Slide show
	Nitrogen up take	3	on line videos
	Phosphate solubilization	2	sample specimen from TNAU, lecture
UNIT III			
	Plastids as photosynthetic machinery	2	slide show, lecture
	Light harvest and energy transduction	2	animated videos
	Carbon assimilation	2	PPT, lecture
	C_2 cycle	2	PPT, lecture
	Factors regulating photosynthesis	2	lecture
UNIT IV			
	HMP pathway in cytosol	2	schematic sketch in board
	TCA cycle in mitochondrial matrix	2	schematic sketch in board, slide show
	ETS	2	schematic sketch in board

	Pentose phosphate path way	1	schematic sketch in board,lecture
	RQ and alienate oxidase	1	lecture, experiment
UNIT V			
	Growth process	2	
	Growth curves and growth measurements	3	instruments, live demo
	PGRs	4	commercial sample of hormones,experiment
	Photoperiodic responses	2	diagrams, photos
	Aging and senescence	2	lecture

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	Total
CO1	5	5	5	4	4	2	25
CO2	5	5	5	4	4	5	28
CO3	5	5	2	4	4	5	25
CO4	5	5	5	4	4	5	28
CO5	5	5	5	4	4	5	28
						134/30=4.4	

PLANT PHYSIOLOGY (LAB)

CO1: experiment on diffusion and plasmolysis, observe influence of temperature on permeability of membrane
CO2: measure the photosynthetic and respiratory rate of plants.
CO3: differentiate between C3 and C4 plants, calculate the stomata in plant leaf
CO4: evaluate the effect of various hormones on growth of plants, measure the growth attributes.
CO5: observe various movements exhibited by plants in response to stimuli.

1. Experiment on imbibition, diffusion and plasmolysis
2. Demonstration of osmosis using potato osmoscope.
3. Determination of water potential.
4. Influence of temperature over permeability of membrane.
5. Transpiration measurement by photometer, Cobalt chloride
6. Oxygen evolution in photosynthesis (Thistle funnel experiment/ wilmott's bubler).
7. Calculation of stomatal index and stomatal frequency of mesophytes and xerophytes.
8. Characterization of C3 and C4 plants.
9. Demonstration of respiration using Ganong's respiroscope and repirometer.
10. Measurement of growth and biomass – auxanometer, scale, weighing balance
11. Auxin, giberellin and ethylene response on plants
12. mineral nutrient efficiency using hydroponics
13. Phototropic and geotropic movements in plants.

REFERENCES:

1. William, G H., 2009. Introduction to plant physiology. John wiley, New Jersey, United States. ISBN: 9780123741431.
2. Nobel, P.S., 1990. Physiochemical environmental plant physiology. Academic press, United States. ASIN: B0043KK4KY.
3. Taiz, L., 2015. Plant physiology, Sixth edition. Sinauer associates, United States. ISBN: 978- 1-60535-255-8.
4. Bajracharya, D., 1999. Experiments in plant physiology. Narosa publishing house, New Delhi. ISBN-13: 978-8173193101, ISBN-10: 817319310X

BOT3240 **BIOFERTILIZERS AND BIOPESTICIDES** **3Hr./2Cr.**

Pedagogy	Hours	Lecture	Peer Teaching	GD/VIDEOS/TUTORIAL	ICT
	45	40	3	-	2

PREAMBLE:

Through this course the non biology students will come to know the importance of eco-friendly approaches in agriculture. By enrolling in this course students will primarily know about the common agriculture practices and will able to appreciate the use of natural methods of providing nutrition and controlling pests and herbs. They will further learn about the regulations governing the organic farming.

COURSE OUTCOME At the end of the semester, students will be able to	Unit	Hrs P/S
CO1: understand the ancient agricultural practices and protect the environment from the recent indiscriminate, avaricious anthropogenic onslaughts that the extent of damage done is at least be mitigated.	1	9
CO2: assess the advantages of organic farming with as an alternative to use of anthropogenic chemicals that biofertilizers and natural means of crop protection including the advocacy of IPM can ensure profitable farming.	2	8
CO3: analyse the various forms of microbes as suppliers of organic nutrients, including nitrates, phosphates enriching the soil that would eventually have a bearing on the methods of cultivation with enhanced nitrogen supply.	3	10
CO4: apply the knowledge of using biopesticides without harming the co- living microbiota and life forms in the ecosystem that the use crop protection chemicals can be avoided to safe guard environment.	4	9
CO5:use the acquired knowledge needed to prepare eco friendly commercial formulations meeting national and international standards and regulations and float newer entrepreneurial ventures	5	9

SYLLABUS

Unit 1. Introduction to Agriculture: Domestication of plants – early agricultural practices – shifting cultivation – settled cultivation– major cultivated crops in India (rice, wheat, soya, maize and brinjal) – industrialization and consequences– green revolution – indiscriminate use of agrochemicals.

Unit 2. Organic farming: Principles and practices of organic farming – organic matter management in agricultural fields – crop rotation – plant health – sustainable agriculture– supplementation of NPK as bioresource – vermicomposting – green manure – terrace and kitchen garden– value addition in organic products – government policies.

Unit 3. Biofertilizers: Scope, application, types – mass cultivation of Biological nitrogen fixers – Blue green algae – *Rhizobium, Azolla* – Phosphate solubilizing bacteria (*Pseudomonas fluorescens)* – Mycorrhiza – cost-benefit analysis.

Unit 4. Biopesticides: History – comparative study of bio and synthetic pesticides – mass production and economics of microbial biopesticides (case study on *Trichoderma*, *Pseudomonas fluorescens*, *Bacillus thuringiensis (Bt)* – plant pesticides (a case study on Neem.)

Unit 5. Commercial formulation: Types of formulation – dry and liquid product – shelf-life, Stabilization, Methods of field application, certification – Bureau of Indian Standards (BIS) –biopesticide regulations (national and international with special emphasis on European Union.)

REFERENCE BOOKS

1. Dubey, R.C., 2014. A textbook of biotechnology. S. Chand and co private limited, New Delhi. ISBN: 81–219–2608–4.
2. Lakshmana, H.C. and Channabasava, A., 2014. Biofertilizers and biopesticides. Pointer publishers, Jaipur. ISBN: 8171327753.
3. Himadri, P. and Dharamvir, H., 2007. Biofertilizers and organic farming. Gene–tech books, New Delhi. ISBN: 978–8189729202.
4. Hegazi, N. I., Fayez, M. and Hamza, M., 2013. Biofertilizers for organic farming. Academic publishing, Egypt. ISBN: 978–3659336157.
5. Dilip, N., 2016. Organic farming for sustainable agriculture. Springer publishing, New Delhi. ISBN: 978–3319268019.

UNITS	TOPIC	LECTURE HOURS	MODE OF TEACHING
UNIT I			
	Crop loss in Indian Agriculture	2	Lecture with Map
	Domesticated plants of India	2	Lecture with videos
	Native food crops	1	Lecture with live specimens
	Major cultivated crops	1	Lecture with Map
	Green Revolution : positive and negative fallouts	3	Lecture and Group discussion
UNIT II			
	Soil nutrient profile	1	Lecture
	NPK and organic content	1	Lecture and field visit inside campus
	Vermicompost , mulching and green manure	2	Lecture and videos
	Bagged cultivation	2	Visit to labs
	Features of organic farming	3	Lecture and peer teaching
UNIT III			
	Biological nitrogen fixation – types and significance	2	Chalk and talk
	BGA, *Rhizobium* and *Azolla* for soil enrichment	3	Lecture and Agriculture fields
	Mycorrhizal types and uses	2	Chalk and talk
	Phosphate solubilization and PGPB	2	Lecture and OHP
UNIT IV			

	Need for alternates to synthetic agrochemicals	2	Lecture and Peer teaching
	Types and uses of selected biopestcides	1	Lecture with Live specimens
	Mass production	3	Audiovisual aid
	Bt-a case study	1	Chalk and talk
	Plant pesticides	2	Lecture with Real samples
UNIT V			
	Commercial formulation –SLF	2	Lecture with PPT
	Shelf life and stabilization	2	Chalk and talk
	Methods of field application	2	AudioVisual aid and visit to agriculture fields
	BIS certification	1	Chalk and talk
	National and international regulation	2	Invited Talks/Guest Lectures

	K1 (Recall)	K2 (Understanding)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1	2	4	4	5	1	1	17
CO2	2	4	5	3	2	4	20
CO3	2	4	5	3	2	4	20
CO4	2	4	4	5	3	4	22
CO5	3	4	5	3	3	1	19
Total	11	20	23	19	11	14	98
							98/30= 3.2

UG ADD ON COURSES

BOT 121V **EDIBLE MUSHROOMS** **2 Hr./ 2 Cr.**

PREAMBLE

As a two credit course offered to the first year student of any major, it will be taught as life skill course. Skill development is being recognized as the priority of higher education in any said branch of science. This course is designed to motivate freshers to learn the science of cultivating mushrooms. It is an introductory level course and designed to help the students to grow mushrooms in simple and cheap substrates like hay and organic debris and other locally available substratum. The nutritive and economic potential of mushrooms will be taught with illustration. students will develop skills in commercial cultivation, harvest and marketing. This course is also designed to carter to the need of young entrepreneurs who would like to start a food based industry.

COURSE OUTCOME

At the end of the course, the students will be able to

i. List different varieties of mushroom, distinguish between edible and non edible, and classify them.
ii. characterize, compare the cultivating mushroom.
iii. experiment the cultivation procedure, design new culture technique, analyze the pest and factors affecting growth of mushroom.
iv. summarize uses of mushroom and create new recipes for marketing.
v. obtain training from agricultural institutes

Unit I. Introduction:

Mushroom Characteristics –history of mushroom cultivation – Naming of mushroom – Popular mushroom – Edible and poisonous mushrooms

Unit II.Edible mushrooms

Morphological characters and taxonomical position of Agaricus - Pleurotus – Volvariella – Shiitake – Psilocybe

Unit III. Cultivation of Mushroom:

Tray method for large cultivation – Packet method for small scale cultivation – facilities required – cultivation procedures - Budget

Unit IV. Harvesting and processing:

Harvesting and packaging -– Food and Dietary value –Medicinal value – Mushroom recipes.

Unit V. Research Institutes: – Institutes cultivating mushroom –collection of spawn- Varieties available in Tamilnadu –Mushroom culture training

Economic value of various mushrooms – Food and Dietary Component –Medicinal value – Mushroom recipes.

TEXT BOOKS:

1. Tripathy D.P 2005. Mushroom cultivation. Oxford and IBH publishing co. pvt.Ltd.New Delhi. ISBN 8120416449

2. Nita Bahl. 2000. Handbook on mushrooms, Oxford &IBH publishing pvt. Ltd. India. ISBN 9788120413993

REFERENCES:

1. Kaul T.N. 2002. Biology and conservation of mushrooms.Oxford and IBH publishing co.pvt.Ltd. New Delhi. ISBN 81-204-1513-2.

2. Stamets P and Chilton J. S 1985. The mushroom cultivator, Richmond publishing company. U.K. ISBN 096-1079-80-0.

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	5	5	5	5	4	1	25
CO2	5	5	4	4	4	4	26
CO3	5	5	5	5	5	5	30
CO4	5	5	5	5	5	5	30
CO5	5	5	5	3	3	5	30
							141/30=4.7

BOT 122V GARDENING TECHNIQUES 2 Hr./2Cr.

PREAMBLE:

This course is designed for students who have passion for collecting plants and adopting them at safe and protected areas. The course is envisaged in such a way to develop fine skills in planning for various types of gardens with specific theme ad purpose. Landscaping is also added in order to enhance the scope of the course. It is a course where there is no need any perquisites except love and passion for plants and intelligent special perception. At the end of this course student is expected to use the given space in an intelligent manner and transform it as a thematic garde .

COURSE OUTCOME

At the end of the course, the students will be able to

i. identify and distinguish various gardens of the world.
ii. classify various gardens of Indian styles.
iii. create different types of garden and planning the design of garden .
iv. perform the different propagation techniques for garden plant cultivation.
v. categorize the various plant varieties planted in a garden

SYLLABUS

UNIT I: Introduction to Gardens: (6 hr)

Definition - Objectives and scope – Types of garden – formal garden- informal garden – British garden - Mughal garden- French garden –Japanese garden - Hanging garden- Vertical garden – medicinal garden.

UNIT II: Gardens in India: (6 hr)

Landscape garden –rock garden -water garden- ornamental garden – Kitchen garden –Terrace garden – Popular Indian Gardens

UNIT III: Creating Garden: (6 hr)

Components of garden – choice of the plants for garden –Facilities required – Planting plants - Role of gardener - Benefits of garden

UNIT IV: Practices involved in gardening(6 hr)

Cutting- layering –budding –grafting –collecting season – planting methods – treatments for propagating materials – propagules – growing in special structures – hardening – pruning – cleaning – fertilizing.

UNIT V: Garden plants: (6 hr)

Ornamental plants (flowering) Crotons (non flowering) - medicinal plants – arboreal varieties – climbers – fencing plants – Ornamental palms – Orchids – Gymnosperms – ferns – Cacti – Bonsai.

TEXT BOOKS

1.Kumar, N., 2017, Introduction to Horticulture, Med tech publishers, India. ISBN 9386479834

2. Sadhu, M.K., 1989, Plant propagation, New Age International publishers. India. ISBN 8122400655

REFERENCES:

1. Agarwal, P.K.1993, Hand Book of Seed Technology, Dept. Of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi. ISBN 8120409949

2. Bose T.K. Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi. ISBN 9788120402294

3.Edmond Musser, Andrews. 1997. Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.ISBN 9780070189782

4.Janick Jules. 1979. Horticultural Science. (3rd Ed), W.H.Freeman and Co., San Francisco, USA.ISBN 0716717425

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	3	3	4	4	4	4	22
CO2	3	3	3	4	4	34	21
CO3	4	4	4	4	4	4	24
CO4	4	4	4	4	4	4	24
CO5	5	4	4	4	4	5	26
	19	18	19	19	19	20	117
							117/30=3.9

BOT 221V **PLANT PROPAGATION** **2Hrs./2Cr.**

PREABMBLE:

The course provides an overview of plant propagation that include methods of propagating by seeds, bulbs, divisions, layers, cuttings, budding, grafting, and micropropagation. The knowledge and information on timing, technique, and material for making cuttings, environmental conditions, and media requirements for rooting cuttings of ornamental plants, fruit trees, shrubs, and flowering plants will be gained. Various propagation structures, soils, and fertilizer requirements will be considered.

COURSE OUTCOME:

At the end of the course, the students will be able to	**Unit**	**Hrs P/S**
CO1 : acquire knowledge of plant propagation technique and its application	1	6
CO2: get vast information on various plant growing structures	2	5
CO3: create skills in the art of plant propagation by vegetative cuttings.	3	7
CO4: create skills in the art of plant propagation by seeds	4	5
CO5: update the technique of plant propagation using micropropagation	5	7

tool.		

SYLLABUS:

Unit I Basics of plant propagation: Scope and importance - government schemes for developing of nurseries – Role of NGO - establishment of nursery - site selection - tools and implements - preparation of nursery beds, transplanting techniques - plant propagation material.

Unit II Plant growing structures: Shade net - Mist chamber - greenhouse - glasshouse - polyhouse - cold frames - hot beds – nursery beds – soil media – pot mixture and containers - manures and manuring – crop health management.

Unit III Vegetative propagation : Stock-scion relationship – Cutting (stem, root, leaves) - Layering (Air, Mound, Ground) – Budding (T- Budding, Patch, Chip budding) – Grafting (tongue, cleft, Approach, side, Veneer) - Raising clonal nursery - factors influencing rooting of cuttings - root stock influences - hardening – Propagation of ornamental plants by rhizomes, corms tubers, bulbs and bulbils – Indoor plants – *Anthuriam, Adenium.*

Unit IV Seed propagation: Seed selection- seed viability – sowing - germination - dormancy – seed treatments -– seed dressing – raising seed beds – seedling vigour – measures for pest and disease control during storage and godown sanitation- Seed Certification and Quality Control – Seed production of medicinal plants- Aromatic plants - Hybrid seed Production.

Unit V Micro propagation: Micro propagation – protocol - media composition - sterilization techniques - explants - shoot multiplication - root formation - acclimatization and hardening - constraints and problems - packing, transport and marketing - establishment of commercial tissue culture units - status of micro propagation in India and globe - nursery certification – marketing of propagative plant materials.

Text books

Adams, C.R. and M. P. Early. 2004. Principles of horticulture. Butterworth – Heinemam, Oxford University Press.

Bansil.P.C. 2008.Horticulture in India.CBS Publishers and Distributors, New Delhi.

Hartmann &Kester's Plant Propagation: Principles and Practices, 9th Edition. 2018. F. Davies, R. Geneve and S.B. Wilson.(Required, ISBN-13: 978-0134480893).

Kumar, N.1997. Introduction to Horticulture, Rajalakshmi Publication, Nagercoil.

Reference books

Beyl, C.A. and R.N. Trigiano. 2015. Plant Propagation Concepts and Laboratory Exercises, 2nd edition.

CRC Press, Boca Raton, FL. Dirr, M.A. and C.W. Heuser, Jr. 2006. The Reference Manual of Woody Plant PropagationFrom Seed to Tissue Culture, 2nd edition. Timber Press, Inc., Portland, OR. Kyte, L.,

Bhattacharjee.S.K. 2006. Amenity Horticulture, Biotechnology and Post harvest technology. Pointer publishers. Jaipur

Chadha, K.L. 2001, Handbook of Horticulture, ICAR, New Delhi.

Chandra, R. and M. Mishra. 2003. Micropropagation of horticultural crops. International Book Distributing Co., Lucknow.

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	3	3	4	4	4	5	23
CO2	3	3	5	4	4	4	23
CO3	4	3	4	4	3	5	23
CO4	4	4	4	4	3	4	23
CO5	4	4	5	4	5	5	27
	18	17	22	20	19	23	
							119/30=3.97

BOT 222V ORGANIC FARMING 2hr/2 Cr.

PREAMBLE: To understand the basic principles of organic farming and its practices. It helps to work with natural system rather than seeking to dominate them. The course encourage the students to enhance the biological system involving microorganisms, soil flora and fauna, plants and animals in maintaining the long term fertility of the soil. This course enables the students to develop their skills in organic farming and ensure field experiences. The organic farming involves the use of renewable resources and allow the agricultural producers an adequate returns and satisfaction from their work including safe drinking water.

Course Outcome:

At the end of the course the student will be able to

i. understand basic principles of organic farming.

ii. classify different organic manures in managing soil fertility.

iii. formulate biofertilizers and biopesticides with locally available resources.

iv. determine the techniques in compost making.

v. analyze social responsibility in organic agriculture.

Unit 1: Overview of organic farming (6hrs)

Origin and principles –Ancient agricultural practices- Indian Agriculture–Pre and Post Green Revolution - types of farming: organic, integrated and mixed farming system –zero budget farming - Advantages.

Unit 2: Soil fertility (6hrs)

Soils types in India-Components - physical, chemical and biological –Depletion of soil nutrients - Soil reclamation and enrichment - organic manures: farmyard manure (FYM) sheep and goat, oil-cakes, sludge and sullage manure.

Unit 3: Biofertilizers and Biopesticides (6hrs)

Introduction –Scope of biological control- Storage and shelf life-Methods of application - Formulation of Panchakavya, Dasakavya - *Azolla* (cultivation) - VAM production – Green manure supplement - Fieldpest management (entomopathogenic fungus and plant extracts) Chemical pesticides Vs biopesticides –*Trichoderma viride, Pseudomonas fluorescens,* Neem formulations

Unit 4: Organic compost and Crop growth management (6hrs)

Composting – importance and methods- microbes in composting -type and amount of compost - Vermicompost preparation – Value addition of FYM and VAC (Vuon-Ao-chuong)– Soil dependent cropping (crop rotation, intercropping, monoculture) - Stress management (soil pH, temperature, nutrients) water management (irrigation methods) - Rain water harvesting

Unit 5: Standardization and Application (6hrs)

History and development of organic standards and certification process - organic standards setting processes - conformity assessment processes (international verification processes) - key challenges for the future of organic regulation- market potential of organic products - Social responsibility in organic agriculture.

Text books

1. Bansal M. “Basic principles of organic farming”,India,2017

2 Kristensen, P., Taji, A. and Reganold, J., "Organic Agriculture: A Global Perspective", CSIRO Press, Victoria, Australia, 2006.

3.Subashini Sridhar, S.Arumugasamy, H,Saraswathy, K.Vijayalakshmi. (2002). "Organic vegetable gardening".

4. Maliwal P.L., (2020) " Principles of Organic farming".

5. Lampkin Nicolas. (1990). "Organic Farming", The University of Wisconsin - Madison. Farming Press.

References

1 Joshi, M., Setty, T.K.P. and Prabhakarasetty. (2006). "Sustainability through Organic farming", 1st edition, Kalyani Publishers, Ludhiana, India.

2 Bavec, F. and Bavec, M. (2007). "Organic Production and Use of Alternative Crops", CRC Press, Boca Raton, FL.

3. Dhaliwal,G.S. and Arora.R, (2006). Principles of insect pest management, Kalyani publisher, New Delhi.

Mapping of course outcomes with Bloom's Taxonomy

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	Total
CO1	5	5	5	4	4	5	28
CO2	5	5	5	4	4	5	28
CO3	5	5	5	4	4	5	28
CO4	5	5	5	4	4	5	28
CO5	5	5	5	4	4	5	28
	25	25	25	20	20	25	113
							140/30 = 4.6

BOT321V PLANTATION CROPS 2Hr/2Cr

PREAMBLE

This add-on course is designed as an topping to UG curriculum offered in the college to Botany majoring and other department students as an optional will help students to understand and appreciate the high-value attached with commercial crops which in turn serve earning foreign exchange to the country and at the same time provide the livelihood for sizable population of rural poor and masses at the semi urban back drop. This course is aimed to inculcate the know-how of growing and cultivating economically important crops that are intertwining in our daily life. It will kindle in young minds the inquisitiveness towards probe the wealth of nature in lesser known context. After completing this course the students will beable get a holistic picture of plantation crops.

COURSE OUTCOME

At the end of the certificate course, the students will be able to

CO1: recognize the important plantation crops that contribute to the commercial side of the agricultural economy.

CO2: appreciate how these crops help to conserve and foster ecological balance and at the same time offer the livelihood to the rural masses.

CO3: develop a comprehensive idea to rear plantation crops in India at diverse agro-climatic profile.

CO4: analyse and develop strong market intelligence and harness the potential to provide a competitive edge to the Indian farmers.

CO5: familiarise themselves and put into practice the knowledge gained using the produce harvested/gathered from plantation crops that they may eventually take entrepreneurial ventures advocating and promoting value added products

SYLLABUS:

Unit I: Plantation Crops: Importance – plantation crops vs major agricultural, horticultural and fruit crops – plantation crops status in India – Topographical data – scope and economic value – research potential.

Unit II: Tea: Origin and distribution– area and production – soil – climate – varieties –vegetative propagation –establishment– pruning –manuring– harvesting (plucking) – processing and manufacturing of tea –classification, grading – packing – marketing.

Unit III: Coffee and Cocoa: Coffee–origin and distribution- soil and climate requirement- varieties– establishment – planting – pruning –manuring– plant protection – processing – grading and packing. Cocoa – origin and distribution – climate and soil – varieties – propagation – plantation establishment –manuring and irrigation – pruning – plant protection – harvesting, processing (fermentation) and yield.

Unit IV: Arecanut, Coconut and Palmyra: Arecanut:Importance–climate and soil, cultivars selection and raising of – varieties – seedling index – establishment –manuring- irrigation – plant protection – harvesting, processing and yield. Coconut: origin and distribution – composition and

uses of coconut – climate and soil – cultivars and hybrids–establishment of coconut plantation – manuring– irrigation – plant protection – harvest and yield – post harvest processing – value addition. Palmyra: origin and distribution – soil and climate requirement –economic importance – varieties – propagation and planting–irrigation – leaf pruning and ablation – plant protection – diseases and disorders – harvesting, processing and yield – edible and commercial products.

Unit V: Cashewnut andRubber: Origin and distribution –importance– climate and soil–varieties and propagation– seed, clonal and budding – establishment and management –irrigation–manuring– plant protection– harvesting, yield, processing and grading.Rubber: origin and distribution – climate and soil – propagation – polyclonal seedlings – planting and after care –manuring– plant protection – harvesting (tapping, marking and bark renewal) – yield – processing of latex- commercial products.

Textbooks

1. Dashora, L. K., Abhay, D., &Lakhawat, S. S. (2006). *Production technology of plantation crops, spices, aromatic and medicinal plants*. Agrotech Publishing Academy.
2. Kumar, N. J. B. M. (2006). *Introduction to spices, plantation crops, medicinal and aromatic plants*.Oxford and IBH Publishing.
3. Shanmugavelu, K. G., &MadhavaRao, V. N. (1979). Spices and plantation crops. *Spices and plantation crops.*
4. Shanmugavelu, K. G., Kumar, N., & Peter, K. V. (2002). *Production technology of spices and plantation crops*.Agrobios.

References

1. Carr, M. K. (2012). *Advances in irrigation agronomy: plantation crops*. Cambridge University Press.
2. Chakraverty, A., Mujumdar, A. S., &Ramaswamy, H. S. (Eds.). (2003). *Handbook of postharvest technology: cereals, fruits, vegetables, tea, and spices* (Vol. 93). CRC press.
3. Dhillon, B. S., &Tyagi, R. K. (Eds.). (2005). *Plant genetic resources: horticultural crops*. Alpha Science Int'l Ltd..
4. Kulkarni, S., & Hedge, Y. R. (2002). *Diseases of plantation crops and their management*.Agrotech Pub.Academy.

	K1 Recall	K2 Understand	K3 Apply	K4 Analyze	K5 Evaluate	K6 Create	
CO1	4	4	4	4	3	3	22
CO2	4	4	4	4	4	4	24
CO3	4	4	5	4	3	3	23
CO4	4	4	4	4	3	3	22
CO5	4	4	5	4	4	4	25
	20	20	22	20	17	17	116
116/30=3.87							

BOT 322V SKILLS IN BIOLOGY 2Hr./2Cr.

PREAMBLE: This is an add on course designed for an undergraduate student who is completing the regular course work so as to enable him to seek employment. The syllabus is prepared to introduce personal and job skills in biology and also help him to find a meaningful role. The course is aimed to give overall basic skills in biology. Further the content will focus mainly on the working lab condition where it is opted. After the completion of this course the student will be able to apply the acquired skills to find employment.

COURSE OUTCOME

At the end of the course, the students will be able to

i. handle tasks in identifying plants in field for vocational purpose
ii. spot common diseases of plants and recommend solution
iii. employ skills acquired in cut flower industry and take up commercial ventures.
iv. utilize locally available plant resources to deal with health issues.
v. take up technical positions for career in emerging and upcoming frontiers in drug development.

Unit 1: Field botany (6hr)

Identification of plants based on their characters - collection of plants, herbarium techniques (collection, pressing, poisoning, drying, mounting, incorporation) - storage of plants – maintenance-herbarium ethics – Remote sensing (GPS, GIS) – Density of plants, mapping - Ecology of water, air and soil.

Unit 2: Crop care management (6hr)

Identification of microbes and symptoms - ICT tools – identification of pest disease and symptoms - nutritional deficiency - isolation of microbes (plant affected parts/soil/water) - recommendation of biofertilizers - types of biofertilizers - mass production - quality analysis - field survey.

Unit 3: Floral aesthetics (6hr)

History - Basic Principles of art in flower arrangement - basic elements of flower arrangement (line, shape, texture, colour) - types of flower arrangement (circular, conical, crescent, vertical, horizontal,

Hogarth curve) - Conditioning cut flowers and foliage - Bouquet making - packaging & storage - Flowers carpets.

Unit 4: Pharmacognosy and folk medicines (6hr)

Identification of bioactive compounds – Pharmacognosic inventory - Quantitative and qualitative analysis, Good harvesting and manufacturing practices (GMP) - compound extraction, isolation, characterization – In vivo studies – Experimental studies on animals – Pharmocodynamics and pharmocokinetics - ethical clearance

Unit 5: Biocomputing (6hr)

Drug development software and databases - Structural Bioinformatics in Drug Discovery – Molecular docking - Phylogenetic Analyses software - UPGMA - Aligroove, Mesquite, Dendroscope - Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Drug targeting, drug delivery.

Textbooks

1. Agrios G.N. (2005). Plant Pathology, 5th edition. Vikas publications. New Delhi.

2. Harborne, (1998). Phytochemical methods, Chapman and Hall, Publ. ISBN 0 4125 7270 2.

3. Nalwa, H. S. (2002). Nanostructured Materials and Nanotechnology, Academic Press.

4. Pradeep, T. (2012). A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education Pvt. Ltd.

5. Sadasivam. S and A. Manickam. (2008). Biochemical methods for Agricultural Sciences, 2nd edn., New Age International Pub. Ltd., ISBN 978–81–224–2140–8

6. Suresh kumar, P., Varalakshmi, D. and Pullaih, T. (2016). Textbook of Pharmacognosy, Publisher: CBS Publishers & Distributors.

References

1. Packer, J. (1998). The Complete Guide to Flower Arranging, Publisher:Dorling Kindersley, ISBN13:9780751305890.

2. Prescott and Dunn's Industrial Microbiology. (2004). CBS Publ., ISBN: 81 2391 0010.

3. Singh, G. (2007). Plant systematics theory and practices. Oxford and IBH Publishing Co. ISBN 81-204-1652

4. Sundararajan, S. (2000). Practical manual of Angiosperm Taxonomy. Anmol publication New Delhi. (ISBN 81-261-0687-5).

5. Watson, J.D. et al. (2004). Molecular Biology of Gene 5th Edn. Pearson Edu. ISBN 0-321-22368-3.

Mapping of course outcome with bloom's taxonomy

	K1 (Recall)	K2 (Understand)	K3 (Apply)	K4 (Analyze)	K5 (Evaluate)	K6 (Create)	
CO 1	5	5	5	4	3	2	**24**
CO 2	5	5	5	4	4	2	**25**
CO 3	4	5	5	3	3	5	**25**
CO 4	4	4	5	5	4	3	**25**
CO 5	4	4	5	5	4	5	**27**
							126/30
							4.2