

B. Sc., Botany

Syllabus 2017 - 2018 onwards



Since 1951

DEPARTMENT OF BOTANY
Jamal Mohamed College (Autonomous)
College with Potential for Excellence
Re-Accredited (3rd Cycle) with 'A' Grade by NAAC
(Affiliated to Bharathidasan University)
Tiruchirappalli – 620 020

JAMAL MOHAMED COLLEGE (Autonomous), Tiruchirappalli-620 020

B. Sc. Botany– Course Structure under CBCS

(Applicable to the candidates admitted from the academic year 2017 -2018 onwards)

SEM	Course Code	Part	Course	Course Title	Ins. Hrs /Week	Credits	Marks		
							CIA	ESE	Total
I	17U1LT1/LA1/LF1 /LH1/LU1	I	Language – I		6	3	25	75	100
	17UCN1E1	II	English - I		6	3	25	75	100
	17UBO1C1	III	Core – I	Plant diversity (Algae, Fungi and Archegoniate)	5	5	25	75	100
	17UBO1C2P		Core – II	Laboratory Course for Core I	3	2	20	80	100
	17UCH1A1		Allied – I	Inorganic and Organic Chemistry	5	4	25	75	100
	17UCH1A2P		Allied – II	Volumetric Analysis - Practical	3	2	20	80	100
	17UCN1VE	IV	Value Education	Value Education	2	2	-	100	100
TOTAL					30	21			700
II	17U2LT2/LA2/LF2/ LH2/LU2	I	Language – II		6	3	25	75	100
	17UCN2E2	II	English – II		6	3	25	75	100
	17UBO2C3	III	Core – III	Plant Anatomy and Embryology	6	5	25	75	100
	17UBO2C4P		Core – IV	Laboratory Course for Core III	3	2	20	80	100
	17UCH2A3		Allied – III	Bioorganic Chemistry	4	3	25	75	100
	17UCH2A4P		Allied – IV	Organic Analysis - Practical	3	2	20	80	100
	17UCN2ES	IV	Environmental Studies	Environmental Studies	2	2	-	100	100
TOTAL					30	20			700
III	17U3LT3/LA3/LF3/ LH3/LU3	I	Language– III		6	3	25	75	100
	17UCN3E3	II	English – III		6	3	25	75	100
	17UBO3C5	III	Core– V	Cytology, Genetics and Evolution	4	4	25	75	100
	17UBO3C6P		Core– VI	Laboratory Course for Core V	3	2	20	80	100
	17UZO3A5		Allied– V	Animal Structure and Function	4	3	25	75	100
	17UZO3A6P		Allied– VI	Invertebrata and Chordata - Practical	3	2	20	80	100
	17UBO3N1	IV	Non Major Elective- I		2	2	-	100	100
17UCN3S1	Skill Based Elective – I		Soft Skills Development	2	2	-	100	100	
TOTAL					30	21			800
IV	17U4LT4/LA4/LF4/ LH4/LU4	I	Language– IV		6	3	25	75	100
	17UCN4E4	II	English– IV		6	3	25	75	100
	17UBO4C7	III	Core– VII	Plant Molecular Biology	5	5	25	75	100
	17UBO4C8P		Core - VIII	Laboratory Course for Core VII	3	2	20	80	100
	17UZO4A7		Allied– VII	Commercial Zoology	5	3	25	75	100
	17UZO4A8P		Allied– VIII	Animal Physiology and Commercial Zoology-Practical	3	2	20	80	100
	17UBO4N2	IV	Non Major Elective - II		2	2	-	100	100
17UCN4EA	V	Extension Activities	NCC, NSS, etc.	-	1	-	-	-	
TOTAL					30	21			700
V	17UBO5C9	III	Core – IX	Biochemistry and Biophysics	6	5	25	75	100
	17UBO5C10		Core – X	Plant Systematics and Economic Botany	5	5	25	75	100
	17UBO5C11		Core – XI	Plant Physiology	5	5	25	75	100
	17UBO5C12P		Core - XII	Laboratory Course for Core IX, X & XI	5	5	20	80	100
	17UBO5M1 A/B	IV	Major Based Elective – I#		5	4	25	75	100
	17UBO5S2 A/B		Skill Based Elective - II**		2	2	-	100	100
	17UBO5S3 A/B		Skill Based Elective – III**		2	2	-	100	100
17UBO5EC1		Extra Credit Course - I	Medicinal Botany	-	*4	--	*100	*100	
TOTAL					30	28			700
VI	17UBO6C13	III	Core– XIII	Microbiology and Plant Pathology	5	5	25	75	100
	17UBO6C14		Core– XIV	Plant Biotechnology	5	5	25	75	100
	17UBO6C15		Core - XV	Plant Ecology and Phytogeography	5	5	25	75	100
	17UBO6C16P		Core - XVI	Laboratory Course for Core XIII, XIV & XV	5	5	20	80	100
	17UBO6M2 A/B		Major Based Elective - II#		5	4	25	75	100
	17UBO6M3 A/B		Major Based Elective- III#		4	4	25	75	100
	17UCN6GS	V	Gender Studies	Gender Studies	1	1	-	100	100
17UBO6EC2		Extra Credit Course - II	Wood science and Technology	-	*4	--	*100	*100	
TOTAL					30	29			700
GRANDTOTAL					180	140			4300

****Skill Based Electives**

SEMESTER	COURSE CODE	COURSE TITLE
V	17UBO5S2A	Biofertilizer Technology
	17UBO5S2B	Food Microbiology
	17UBO5S3A	Greenhouse Technology
	17UBO5S3B	Remote Sensing

#Major Based Electives

SEMESTER	COURSE CODE	COURSE TITLE
V	17UBO5M1A	Biostatistics and Bioinformatics
	17UBO5M1B	Enzyme Technology
VI	17UBO6M2A	Industrial Botany
	17UBO6M2B	Seed Science and Technology
	17UBO6M3A	Horticulture and Plant Breeding
	17UBO6M3B	Silviculture

* Not Considered for Grant Total and CGPA.

SEMESTER I : CORE I

Plant Diversity (Algae, Fungi, and Archegoniate)

Course Code: 17UBO1C1

Maximum Marks: 100

Hours/Week: 5

Internal Marks: 25

Credits: 5

External Marks: 75

Objectives:

To acquire knowledge on classification, structure, reproduction and life cycle of lower plants with an evolutionary link.

Unit I: Algae

15 Hrs

General Characteristics, distribution and classification of algae (F.E. Fritsch, 1985). Structure, reproduction and life cycle of the following genera: *Oscillatoria*, *Volvox*, *Oedogonium*, *Caulerpa*, *Chara*, *Diatoms* (Navicula), *Ectocarpus* and *Polysiphonia*. #Economic importance of algae in agriculture and industry#.

Unit II: Fungi

15 Hrs

General Characteristics and classification of fungi (Alexopoulos and Mims 1979). Structure, reproduction and life cycle of the following genera: *Albugo*, *Rhizopus*, *Saccharomyces*, *Penicillium* and *Puccinia*. *Lichens – Usnea*. Plant pathology: Tikka disease of Ground nut, Citrus canker, Little leaf of Brinjal. #Economic importance of fungi and lichens#.

Unit III: Bryophytes

15 Hrs

General characteristics and classification (Rothmaler, 1951), Structure, reproduction and life cycle of the following genera: *Marchantia*, *Anthoceros* and *Polytrichum* (Development stages not required), Economic importance of bryophytes.

Unit IV: Pteridophytes

15 Hrs

General characteristics and classification (Sporne, 1962), Structure, reproduction and life cycle of the following genera: *Lycopodium*, *Equisetum* and *Marsilea*. Stellar evolution, heterospory, seed habit and #Economic importance of pteridophytes#. Paleobotany: Fossil types, methods of fossilization, Geological timescale – brief study of *Rhynia*, *Lepidodendron* and *Lepidocarpon*.

Unit V: Gymnosperms

15 Hrs

General characteristics and classification (Sporne, (1965), Structure, reproduction and life history of the following genera – *Pinus* and *Gnetum*. #Economic importance#. A brief study of the fossil gymnosperm -*Williamsonia*.

#-----# Self-study portion

Text Books (T.B.):

1. Vashishta BR and Sinha AK. Botany for Degree students Algae, S. Chand Publishing Company, 2011.
2. Vashishta BR Sinha AK and Singh VP. Botany for Degree students Fungi, S.Chand Publishing Company, 2011.
3. Vashishta BR. Sinha AK and Kumar A. Botany for Degree students Bryophyta, S. Chand Publishing Company, 2011.
4. Rashid A. An introduction to Pteridophyta, Vikas Publishing House, 1999.
5. Vashishta BR Sinha AK and Kumar A. Botany for Degree students Gymnosperms, S. Chand Publishing Company, 2011.

Unit I	:	T.B. 1
Unit II	:	T.B. 2
Unit III	:	T.B. 3
Unit IV	:	T.B. 4
Unit V	:	T.B. 5

SEMESTER I : CORE II

Laboratory Course for Core – I

Course Code: 17UBO1C2P

Maximum Marks: 100

Hours/Week: 3

Internal Marks: 20

Credits: 2

External Marks: 80

Objective:

To enable the students to identify the different organisms by morphological and anatomical studies.

1. Study of vegetative and reproductive structures of the types prescribed in the theory syllabus by temporary preparations and permanent slides:

Algae: *Oscillatoria, Volvox, Oedogonium, Caulerpa, Chara, Diatoms (Navicula), Ectocarpus and Polysiphonia*

Fungi: *Albugo, Rhizopus, Saccharomyces, Penicillium and Puccinia; Usnea.*

Bryophytes: *Marchantia, Anthoceros and Polytrichum*

Pteridophytes: *Lycopodium, Equisetum and Marsilea.*

Gymnosperms: *Pinus and Gnetum*

2. Study of fossil forms through permanent slides
3. Field visit (minimum three days) and submission of report.

SEMESTER II : CORE III

Plant Anatomy and Embryology

Course Code: 17UBO2C3

Maximum Marks: 100

Hours/Week: 6

Internal Marks: 25

Credits: 5

External Marks: 75

Objectives:

- To appreciate the variations in the internal structure of plants
- To understand the role of cell structure in plant development
- To comprehend the developmental stages in plants

Unit I: Meristematic and Permanent tissues

18 Hrs

Meristems –classification, types -apical, lateral and intercalary. Apical meristems – theories on organization of meristems -Apical cell, Histogen and Tunica – Corpus theory - Quiscentcentre. #Simple tissues – Parenchyma, Collenchyma and Sclerenchyma#.

Unit II: Epidermal and Complex tissue systems

18 Hrs

Epidermal tissue system: Structure of epidermal cells, Stomata and its types. Secretory tissues: salt glands, nectaries, resin ducts and laticifers. Complex tissue system: xylem and phloem, Types of vascular bundles, #Stele – concept and types#.

Unit III: Structure of plant organs

18 Hrs

Primary and secondary structure dicot and monocot stem and root, structure of dicot and monocot leaf. Annual rings, heart and sapwood, periderm formation and lenticels. Anomalous secondary growth in dicot (*Bougainvillea*) and monocot (*Dracaena*) stem. #Nodal anatomy- uni, tri and multilacunar nodes#

Unit IV: Embryology

18 Hrs

Structure and development of anther, microsporogenesis, development of male gametophyte, pollen morphology, Ovule structure and types, megasporogenesis, development of monosporic (*Polygonum*), bisporic (*Allium*) and tetrasporic (*Adoxa*) types of embryosacs. # Pollination and Fertilization (outlines)#

Unit V: Embryology

18 Hrs

Endosperm- types and functions. Development of dicot (*Capsella*) and monocot embryo (Grass). Apomixis, Apospory, Parthenogenesis and Polyembryony. Seed: seed coat anatomy, classification of seeds, #Importance of seeds and reserve materials of the seed#.

#-----# Self-study portion

Text Book (T.B.):

1. Pandey SN and Chadha A. Plant Anatomy and Embryology, Vikas Publishing House Pvt. Ltd., Noida, 2009.

Reference Books:

1. Eames AJ and Mc Daniels LH. An Introduction to Plant anatomy, Tata-McGraw-Hill Publishing Co.Pvt.Ltd., Bombay, 1979.
2. Esau K. Plant Anatomy, (2nd Edition) Wiley Eastern Ltd., New Delhi, 1980.
3. Bhojwani SS and Bhatnagar SP. The Embryology of Angiosperms (4th revised edition), Vikas Publishing House / Sangam Books, 1999.

Unit I, II, III, IV, V : T.B. 1

SEMESTER II : CORE IV

Laboratory course for Core - III

Course Code: 17UBO2C4P

Maximum Marks: 100

Hours/Week: 3

Internal Marks: 20

Credits: 2

External Marks: 80

Objective:

- To observe internal organization of plant body.

Anatomy:

Preparation of Transverse Sections of the following plant parts to observe and record the internal structure:

1. Monocot (*Grass*) and Dicot (*Tridax*) stem.
2. Monocot (*Canna*) and Dicot (*Tridax*) root.
3. Monocot (*Grass*) and Dicot (*Hibiscus*) leaf.
4. Normal secondary thickening in Dicot (*Azadirachta indica*) stem.
5. Anamalous secondary thickening in Dicot (*Bougainvillea*) stem.
6. Anamalous secondary thickening in Monocot (*Dracaena*) stem.
7. Nodal anatomy – unilacunar (*Catharanthus roseus*), trilacunar (*Azadiracta indica*) and multilacunar (*Chenopodium album*).

Embryology:

1. T.S. of anther young and mature (*Datura*).
2. Isolation of Endosperm (*Cucumis*).
3. Types of ovule (Permanent slide).
4. Embryo Sac (Permanent slide).
5. T.S of anther (Permanent slide).
6. L.S. of ovule (Permanent slide).
7. Dicot Embryo Dissection (*Tridax* flower).

SEMESTER III : CORE V

Cytology, Genetics and Evolution

Course Code: 17UBO3C5

Maximum Marks: 100

Hours/Week: 4

Internal Marks: 25

Credits: 4

External Marks: 75

Objective:

- To inculcate the structure and function of cells and organelles.
- To impart knowledge on chromosomes and their aberrations.
- To enlighten Mendelian inheritance, their deviations and the concepts of evolution.

Unit I: The Cells

12Hrs

Ultrastructure of pro- and eukaryotic cells. Ultrastructure of cell wall and cell membranes, their chemical composition. Cytoplasm. Structure and functions of nucleus, mitochondria, chloroplasts, endoplasmic reticulum, golgi complex and #ribosomes#.

Unit II: Chromosomes

12 Hrs

Structure, chemical composition, types. Heterochromatin, Chromosomal aberrations (deletions, duplications, inversions and translocations), Aneuploidy - (monosomy, nullisomy, trisomy and haploids). Polyploidy – autopolyploids - allopolyploids. Cell division - amitosis, #mitosis# and meiosis.

Unit III: Genetics

12 Hrs

Introduction – Mendel's laws and principles – Deviation from Mendelian ratio – Lethality – Multiple factor hypothesis. Incomplete dominance – complementary factor – Epistasis – Multiple alleles – physical basis of heredity. Linkage and crossing over – Sex linkage in plants - Cytoplasmic inheritance – Sex determination – #sex linked inheritance in plants#.

Unit IV: Gene action

12 Hrs

Introduction, One gene one enzyme hypothesis, one cistron one polypeptide hypothesis – Modern concept of genes - cistron, muton and recon. Genetic code, Mutation – spontaneous and induced, causes and consequences. #Mutagens – types and their effects#, molecular mechanism of mutation.

Unit V: Evolution

12 Hrs

Introduction – Germplasm theory – #Lamarckism# - Neo-Lamarckism – Darwinism - mutation theory of de vries - Natural selection - variation – speciation - species concept - isolating mechanisms - and Hardy-Weinberg law.

#-----# Self-study portion

Text Books (T.B.):

1. Verma, PS and Agarwal VK. Cytology, S. Chand & Co., NewDelhi, 2008.
2. Sundarajan S. Cytology, Anmol Publications PVT. Ltd. New Delhi,2004.
3. Verma PS and Agarwal VK Genetics, S. Chand & Co., Pvt. Ltd., New Delhi 2009.
4. Arumugam and Meyyan, RP. Genetics and Evolution, Saras Publication, Nagercoil, India, 2015.

Reference Books:

1. Gardner EJ and Shusted DP. Principles of Genetics (7th Edition), John Wiley &sons, NY Chichester, Brisbane, Toronto, Singapore, 1984.
2. Gupta PK. Genetics, Rastogi Publishers, Meerut, India, 2000.
3. Meyyan RP. Genetic and Evolution, Saras Publication, Nagarcoil, India, 2015.
4. Sinott EW Dunn LC and Dobshansky J. Principles of genetics 5th Edn, McGraw Hill Publishing Co., N.Y., Toronto, London, 1985.
5. Shukla RS and Chandel PS. Cytogenetic, Evolution and Plant Breeding, S. Chand & Co., NewDelhi, 1996.
6. Verma PS and Agarwal VK. Concept of Evolution, S. Chand & Co., New Delhi, 1999.

Unit I	:	T.B. 1
Unit II	:	T.B. 2
Unit II and IV	:	T.B. 3
Unit V	:	T.B. 4

SEMESTER III : CORE VI

Laboratory Course for Core - V

Course Code: 17UBO3C6P

Maximum Marks: 100

Hours/Week: 3

Internal Marks: 20

Credits: 2

External Marks: 80

Objective:

- To observe plant cell structure through temporary mounts.
- To impart knowledge of genetics and evolution through problem solving and fossil records.

Cytology

1. Study of the structure of cell organelles through electron micrographs and standard publications.
2. Study of structure of plant cell through temporary mounts.
2. Study of cell inclusions (non-living)
3. Cytochemical tests for starch, sugars and proteins
4. Study of stages of mitosis using cytological preparation of onion root tips.

Genetics and Evolution

1. Working out problems related to Genetics theory
2. Modification feet in birds
3. Modification of beaks in birds
4. Study of geological time scales
5. Study of fossils and living fossils

SEMESTER III : NON MAJOR ELECTIVE - I

Edible Mushroom Cultivation

Course Code: 17UBO3N1

Maximum Marks: 100

Hours/Week: 2

Internal Marks: 00

Credits: 2

External Marks: 100

Objectives:

- To understand the biology of mushrooms and to develop skills in mushroom cultivation

Unit I: Mushrooms

6 Hrs

Importance, habitat, collection, morphology – vegetative and fruit body - identification - edible and poisonous mushrooms. #Mushroom cultivation in India#.

Unit II: Biological Importance:

6 Hrs

Nature, medical and nutritional values of mushrooms, Composting: importance in waste recycling. Farm and the lay out- culture room, harvesting room. #Storage: Short term and long term storage methods#.

Unit III: Spawn and spawning: Spawn and spawning:

6 Hrs

Strains, containers, quantity of spawn to be used, spawning techniques, compost preparation, casing. Cultivation of button, paddy straw and #oyster mushrooms.#

Unit IV: Crop management:

6 Hrs

Air temperature, humidity, ventilation, air-bed ratio, watering, disposal of used compost and recycling, cropping period, insects and pests, #insecticides and their use#. Post harvesting: Picking, grading, packing.

Unit V: Economics of cultivation

6 Hrs

Cost economics – Permanent medium scale mushroom farm. Value added products food value, pickles, Dry powder. Mushroom recipes: #Soup, Pulao#. sanitation, Marketing.

#-----# Self-study portion

Text Books (T.B.):

1. Nita Bahl, Hand book of Mushroom, Oxford and IBH Publishing Co. Pvt. Ltd. 2005.

Unit I, II, III, IV, V : T.B. 1

SEMESTER IV : CORE VII

Plant Molecular Biology

Course Code: 17UBO4C7

Maximum Marks: 100

Hours/Week: 5

Internal Marks: 25

Credits: 5

External Marks: 75

Objectives:

- To understand the organization and molecular mechanisms of cell
- To gain knowledge on prokaryotic and eukaryotic gene regulation

Unit I:DNA

15 Hours

Introduction to molecular biology - DNA as genetic material (Griffith's experiment) - Central dogma of life - DNA content of the cell - C-value paradox Introduction - types of replication - Dispersive, Conservative and Semi-conservative - Messelson and Stahl's Experiment - General features - mechanism of replication in Prokaryotes and eukaryotes - DNA repair system: Photo-reaction, dark excision, #Mismatch repair systems#.

Unit II: RNA and Protein

15 Hours

RNA as genetic material – in TMV – RNA transcription – Initiation, elongation and termination – Structure and functions of rRNA, mRNA and tRNA - Comparison of RNA and DNA as genetic material – Genetic code – Wobble's hypothesis – Translation – Protein synthesis – Initiation, elongation and termination – post translational modifications - #Ribozyme concept#.

Unit III: Molecular systems

15 Hours

Model systems – Bacteria – DNA transfer – competence - preparation of competent cells - principle and applications of bacterial transformation, conjugation, transconjugation, triparental conjugation and transduction – #horizontal gene transfer#.

Unit IV: Regulation of expression

15 Hours

Gene regulation - Prokaryotes - *Lac* operon model - Initiation, Elongation and suppression and termination - Gene regulation in prokaryotes and eukaryotes – Differences - #Role of repetitive DNA# - typical structure and regulation of eukaryotic ribosomal DNA.

Unit V: Plant gene regulation

15 Hours

Expression - cell differentiation – tissue specificity of genes – # environmental regulation # - cis-acting elements – coordination of expression – promoters and enhancers – transcription factors in plants – Helix-turn-helix, zinc-finger and Leucine zipper models – Role of histones and their modifications – Modulation of gene expression in plants (TGS, PTGS and RNAi)

#-----# Self-study portion

Text Books (T.B.):

1. Ajoy Paul. Text Book of Cell and Molecular Biology, Books and Allied (P)Ltd, 2007.
2. Freifelder D. Molecular Biology (2nd edition) Narosa Publishers, New Delhi. 1994.
3. Buchanan BB Gruissem W Jones RL. Biochemistry and Molecular biology of Plants, IK International Publishers, New Delhi. 2000.

Unit I : T.B.1

Unit II : T.B.1

Unit III : T.B.2

Unit IV : T.B.3

SEMESTER IV : CORE VIII

Laboratory Course for Core - VII

Course Code: 17UBO4C8P

Maximum Marks: 100

Hours/Week: 3

Internal Marks: 20

Credits: 2

External Marks: 80

Objective:

- To impart the knowledge on basic principles of techniques in molecular biology
 - To develop the skills in techniques molecular biology
1. Isolation of genomic DNA from onion bulbs by salt-detergent method.
 2. Isolation genomic DNA from bacteria
 3. Quantitative estimation DNA by CTAB method
 4. Quantitative estimation of RNA
 5. Isolation of total DNA from cheek cells salt-detergent method.
 6. Isolation of plasmid DNA (Demonstration only).
 7. Agarose Gel Electrophoresis (Demonstration only).
 8. Construction of plasmid vector restriction map.
 9. Spotters related to various phenomena of molecular biology

SEMESTER IV : NON MAJOR ELECTIVE - II

Landscape gardening

Course Code: 17UBO4N2

Maximum Marks: 100

Hours/Week: 2

Internal Marks: 00

Credits: 2

External Marks: 100

Objectives:

- To understand the basic principles of landscape gardening.
- To get familiarized with common ornamental and flowering plants.

Unit I: Garden designing

6 Hrs

Introduction - formal gardening - informal gardening - planning - designing – principles in laying out a garden – #parts of modern garden#.

Unit II: Garden components

6 Hrs

Establishment of garden - lawn making - green houses (simple, commercial, and conservatories) - indoor gardening - kitchen garden – indoor garden – #rockery and water gardens# – bonsai

Unit III: Soil and fertilizer

6 Hrs

Soil and climatic factors – irrigation (normal and special types) - fertilizers (organic and inorganic) - #fertilizer application#.

Unit IV: Propagation and plant protection

6 Hrs

Plant propagation methods – cutting, layering, grafting, budding- micropropagation-plant protection-causative agents and control measures- #integrated pest management#.

Unit V: Floriculture

6 Hrs

Economic flowers - cultivation of jasmines, rose, #Gerbera# – cut flowers and cut flower industry in India-flower arrangement and dry decorations.

#-----# Self-study portion

Text Books (T.B.):

1. Kumaresan V. Horticulture and Plant Breeding (First edition), Saras publications, Nagercoil,2009.
2. Kumar N. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil, India, 1977.

Reference Books:

1. Edmond JB, Sen TL, Andrews FS, Halfacre RG. Fundamentals of Horticulture (Fourth edition). Tata McGraw Hill Publishing Co., New Delhi, 1979.
2. Jitendra Sing. Basic Horticulture.Kalyani Publishers, Hyderabad, 2002.

Unit I, II, III, IV and V: T.B. 1

SEMESTER V : CORE - IX

Biochemistry and Biophysics

Course Code: 17UBO5C9

Maximum Marks: 100

Hours/Week: 6

Internal Marks: 25

Credits: 5

External Marks: 75

Objective:

- To learn the fundamentals of chemical and physical aspects of biology

Unit I: Carbohydrates

18 Hrs

Carbohydrates: importance, classification, structure of mono, di, oligo and polysaccharides. Amino acids and proteins: importance, classification and structure. Enzymes: nomenclature, classification, mode of action, km value, #isoenzymes#.

Unit II: Lipids and Nucleic acids

18 Hrs

Lipids: importance, classification, structure and properties. Fatty acids – nomenclature and types. Biosynthesis of fatty acids. Secondary metabolites: A general account of biosynthesis and function of phenols, alkaloids, flavonoids and #terpenoids#.

Unit III: Biochemical techniques

18 Hrs

Centrifugation, Chromatography - Paper, thin layer and column; Colorimetry and general account of spectrophotometry, Electrophoresis - principle, SDS-PAGE, applications; #General account of isotopic tracer techniques#.

Unit IV: Atoms, chemical bonds, pH and Buffers

18 Hrs

Structure of atoms, chemical bonding - electrovalent, covalent, noncovalent and coordinate bonds. pH - pH scale, Bronsted-Lowry concept, pH meter and its electrodes. Buffers - Henderson-Hasselbach equation, #biological buffer systems#.

Unit V: Bioenergetics

18 Hrs

Energy and work. Laws of Thermodynamics and explanation. Energy transductions in biological systems. Redox potential, Redox couples, ATP bioenergetics.

Photobiology: Dual nature of light, #characteristics of solar radiation#, solar energy. Efficiency of atoms - absorption spectra in molecules, energy states, De-excitation.

#-----# Self-study portion

Text Books (T.B.):

1. Jain JL. Jain S and Jain N. Fundamentals of Biochemistry. S. Chand and Company Ltd., New Delhi, 2008.
2. Narayanan P. Essentials of Biophysics, New Age International Publishers (P) Ltd., New Delhi, 2000.

Reference Books:

1. Stryer L. Biochemistry, W. H. Freeman and Co., New York, 1989.

Unit I, II, III, IV : T.B. 1

Unit V : T.B. 1, 2

SEMESTER V : CORE - X

Plant Systematics and Economic Botany

Course Code: 17UBO5C10

Maximum Marks: 100

Hours/Week: 5

Internal Marks: 25

Credits: 5

External Marks: 75

Objectives:

- To impart knowledge on taxonomy and its significance.
- To familiarize the students with plants having immense economic importance.

Unit I: Morphology of angiosperms

15 Hrs

Part of a plant body - leaf morphology (types, stipules, venation, phyllotaxy) – structure of a flower- floral diagram and floral formula - inflorescence and its types - #fruits and its types#.

Unit II: Systems of classification

15 Hrs

Introduction-types of classification-artificial (Brief account of Linnaeus classification), natural –Bentham and Hooker (Detailed account) and Phylogenetic (Brief account Engler and Prantl)-Plant nomenclature-binomial, ICBN-Rules of ICBN-Taxonomy in relation to cytology and phytochemistry-#Herbarium techniques#-BSI

Unit III: Families of angiosperm

15 Hrs

Study the following families based on Bentham and Hooker's system of classification - Annonaceae, Rutaceae, Capparidaceae, Anacardiaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Myrtaceae, Cucurbitaceae, #Apiaceae#.

Unit IV: Taxonomical families

15 Hrs

Rubiaceae, Asteraceae, Apocynaceae, Asclepiadaceae, #Solanaceae#, Acanthaceae, Lamiaceae, Euphorbiaceae, Orchidaceae, Poaceae

Unit V: Economic Botany

15 Hrs

Study of the following groups of plants based on their uses with special reference to the botanical name, family and morphology of the useful part: Cereals - Rice, Wheat; Pulses - Green gram, Black gram; Sugar yielding plants - Sugarcane; Fruits-Mango and Banana; Beverages-Tea, Coffee; Oil yielding plants - Ground nut, coconut, gingelly; Timber yielding plants - Teak wood and Jack wood; Fibre yielding plants - Coir, Jute, Cotton; #Rubber yielding plant - Para rubber#; Processing of tea – Processing of coffee – Extraction of eucalyptus oil and sandal wood oil

#-----# Self-study portion

Text Books (T.B.):

1. Annie Ragland, Kumaresan. Angiosperms. Saras Publication, Nagcoil, 2013.
2. Ashok Bendra, Ashok Kumar. Economic botany. Rastogi publications, Meerut, 1980.

Reference Books:

1. Gamble JS. Flora of the presidency of Madras. Vol. I,II& III. Bishensingh Mahendrapal singh, India, 1956.
2. Lawrence GHM. Taxonomy of Vascular plants. Oxford & IBH Publishing company (P) Ltd, New Delhi, 1982.
3. Sambamurty AVSS. Taxonomy of Angiosperms. I.K. International Pvt. Ltd., 2005.
4. Sivarajan V. Principles of plant taxonomy. Oxford and IBH, 1999.
5. Subramanium NS. Modern Plant taxonomy. Vikas publishing house, New Delhi, 1995.

Unit I, II, III, IV, V : TB 1

SEMESTER V : CORE - XI

Plant Physiology

Course Code: 17UBO5C11

Maximum Marks: 100

Hours/Week: 5

Internal Marks: 25

Credits: 5

External Marks: 75

Objectives:

- To provide an insight into the functional aspects of plants.

Unit I: Water relations

15Hrs

Water - Importance to plant life, structure and properties, diffusion, imbibition and osmosis; Absorption of water - active and passive mechanism, Transpiration - types, significance, mechanism of transpiration; Ascent of sap - #path of ascent of sap#, mechanism - vital theories, root pressure theory, physical force theories, transpiration pull.

Unit 2: Mineral nutrition

15Hrs

Absorption of mineral salts: Mechanism - ion exchange, passive and active absorption, carrier concept; Mineral nutrition - Major and minor elements, general functions, deficiency symptoms of essential elements

Nitrogen metabolism - role of nitrogen in plants, sources of nitrogen, conversion of nitrate to ammonia, biological nitrogen fixation - mechanism, #formation of root nodules in leguminous plants#.

Unit III: Photosynthesis

15Hrs

Definition, significance, photosynthetic apparatus, photosynthetic pigments and absorption of light energy, Red drop and Emerson's enhancement effects, Two pigment systems, primary photochemical reactions, dark reaction (Calvin cycle), C4 pathway, photorespiration, #Crassulacean acid metabolism (CAM)#.

Translocation of organic solutes - path of translocation, mechanism of translocation through phloem.

Unit 4: Respiration

15Hrs

Mechanism - glycolysis, anaerobic respiration, Krebs cycle, electron transport system and oxidative phosphorylation, #Cyanide resistant respiration#, pentose phosphate pathway and its significance.

Unit V: Growth and Development

15Hrs

Definition, phases and kinetics of growth. Physiological effects of phytohormones - Auxins, Gibberellins, Cytokinins, ABA and Ethylene. Physiology of flowering - photoperiodism, role of phytochrome in flowering; #Vernalization#. Physiology of senescence and ageing.

#-----# Self-study portion

Text Books (T.B.):

1. Jain VK. Fundamentals of Plant Physiology (14th revised edition), S. Chand & Company Ltd, New Delhi, 2012.

Reference Book:

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

Unit I, II, III, IV, V : T.B.1

SEMESTER V : CORE - XII

Laboratory Course for Core IX, X & XI

Course Code: 17UBO5C12P

Maximum Marks: 100

Hours/Week: 5

Internal Marks: 20

Credits: 5

External Marks: 80

Objectives:

- To develop skills in design and performance of physiology and biochemical experiments, collection, analysis and interpretation of experimental data.
- To develop practical skills in identifying common angiospermic plants.

Biochemistry and Biophysics

1. Colorimetric estimation of sugars/starch
2. Colorimetric estimation of proteins
3. Gravimetric estimation of lipids
4. Separation of plant pigments / amino acids by paper chromatography.
5. Measurement of pH of a solution using pH meter

Plant systematics and Economic Botany

1. Identifying the following:
 - a) Inflorescence - simple raceme, spike, corymb, head, simple cyme, cyathium and hypanthodium
 - b) Fruits - simple (fleshy) – berry, drupe, pepo, hesperidium; Indehiscent – Nut. Dry - legume, capsule (loculicidal). Aggregate
2. Preparation of floral formula from floral description.
3. Identifying the families mentioned in the theory syllabus by noting their vegetative and floral characters.
4. Students must describe the floral parts, draw the L.S. of the flower, floral diagram and write the floral formula.
5. Study of the finished products of plants mentioned in the theory syllabus of economic botany with special reference to their morphology, botanical name and family.
6. Prepare herbarium specimen of 20 plants with field notes.
7. Conduct field work for a minimum of 3 days under the guidance of a teacher and submit field report.

Plant physiology

1. Determination of osmotic pressure of Onion/Rheo leaf.
2. Effect of light intensity on transpiration using Ganong's Potometer.
3. Determination of stomatal frequency and estimation of transpiration rate.
4. Determination of photosynthetic rate in water plants under different CO₂ concentrations.
5. Measurement of oxygen evolution under different coloured lights using Wilmott's bubbler.
6. Measurement of respiration rate using germinating seeds/flower buds with simple respiroscope.

Biostatistics and Bioinformatics

Course Code: 17UBO5M1A

Maximum Marks: 100

Hours/Week: 5

Internal Marks: 25

Credits: 4

External Marks: 75

Objectives:

- To learn about the statistical applications in biology.
- To learn the basics and applications of information technology in biology

Unit I: Biostatistics

15 Hrs

Definition - sampling techniques – data – types, collection, approximation, classification and tabulation - logarithms. - Frequency distribution – Diagrammatic and graphical representation of data (Line, Bar, Histogram, Frequency Polygon, Curve, #Pie chart#).

Unit II: Measures of central tendency

15 Hrs

Mean, median and mode - Measures of dispersion – range, variance, standard deviation – Theories of probability – Students t-test, chi square test for goodness of fit #statistical error #.

Unit III: Bioinformatics

15 Hrs

Bioinformatics - an overview - definition and history; Internet in bioinformatics; Biological databases: sequence database - nucleic acid and #protein databases#. Online tools for Botanical identification of plants (brief introduction to BIOTIK, MANGROVE)

Unit IV: Biological databases

15 Hrs

Structure database – PDB; specialized database, literature database; file formats of genbank, Swissprot, PDB, NCBI data model, #data retrieval using *entrez*#.

Unit V: Biological Sequence analysis

15 Hrs

Pair wise sequence comparison - Sequence queries against biological databases - BLAST and FASTA - Multiple sequence alignments – Phylogenetic alignment. Protein structure visualization tools - RasMol, # Swiss PDB Viewer#.

#-----# Self-study portion

Text Books (T.B.):

1. Khan IA and Khanum A. Fundamentals of Biostatistics. Vikas Publications, Hyderabad, 1994.
2. Gurumani N. An introduction to Biostatistics, MJP Publication. 2005.
3. Prakash S. Lohar. Bioinformatics, MJP Publishers, Chennai, 2009.
4. Sundaralingam R and KumaresanV. Bioinformatics, Saras Publications, Nagercoil, 2015.

Unit I : T.B.1
 Unit II : T.B. 2
 Unit III, IV, V : T.B.3, 4.

Enzyme Technology

Course Code: 17UBO5M1B

Maximum Marks: 100

Hours/Week: 5

Internal Marks: 25

Credits: 4

External Marks: 75

Objective:

To learn the basics applications enzyme technology

Unit I: Enzymes and Applications

15 Hrs

Nature of enzymes – Nomenclature – Commercial classification – Commercial applications of enzymes - Industrial enzyme applications.

Unit II: Enzyme kinetics

15 Hrs

Simple enzyme kinetics – Michaelis Menten's approach – Brigg's-Haldane approach – enzyme catalysis – Mechanism of catalysis – Isoenzymes.

Unit III: Enzyme and Cell immobilization

15 Hrs

Basis and need for immobilization – Physical method – Micro-encapsulation – Plant cell growth - immobilization (tobacco cells).

Unit IV: Biosensors

15 Hrs

Classification of Microbial sensors and measurement procedures – Enzyme electrode – Maintenance and applications of microbial sensors.

Unit V: Bioreactors

15 Hrs

Models (Batch or Phy-flow fermenter) – continuous stirred tank reactor – Fed Batch reactors - Industrially important reactors – Fermenter design.

Text Books (T.B.):

1. Manjula P and Dawn SS. Bio and Enzyme Engineering. Scitech Publications (India) Pvt. Ltd., Chennai, 2004.
2. Stryer L. Biochemistry, W. H. Freeman & Co., New York, San Francisco, 1989.
3. Prema D. Essential Enzymology. Akaram Publications, Thanjavur, 2009.

Biofertilizer Technology

Course Code: 17UBO5S2A	Maximum Marks: 100
Hours/Week: 2	Internal Marks: 00
Credits: 2	External Marks: 100

Objective:

- To impart knowledge on biofertilizer production and its significance.

Unit I: Introduction 6 Hrs

General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, #Actinorrhizal symbiosis#.

Unit II: Bacterial biofertilizer 6 Hrs

Azospirillum, isolation and mass multiplication – #carrier based inoculant#, associative effect of different microorganisms. Azotobacter – classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication.

Unit III: Blugreen algal biofertilizer 6 Hrs

Cyanobacteria (blue green algae), Azolla and Anabaena azolla association, nitrogen fixation, factors affecting growth, blue green algae and #Azolla in rice cultivation#.

Unit IV: Mycorrhizal biofertilizer 6 Hrs

VA-Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – #isolation and inoculum production of VAM#, and its influence on growth and yield of crop plants.

Unit V: Organic farming 6 Hrs

Bulky organic manures, Green manuring and organic fertilizers, recycling of biodegradable municipal, agricultural and Industrial wastes – #biocompost making methods#, types and method of vermin composting – field Application.

#-----# Self-study portion

Text Books (T.B.)

1. Motsara MR. Bhattacharya P and Srivastava B. Biofertilizer technology, marketing and usage, Fertilization Development and consultation organization, New Delhi, 1995.
2. Arun Sharma K. Biofertilizers for sustainable agriculture, Agrobios, Jodhpur, 2004.

Reference Books:

1. Vayas SC Vayas S and Modi HA. Bio-fertilizers and organic Farming, Akta Prakashan, Noida, 1998.
2. Sathe TV. Vermiculture and Organic Farming. Daya publishers, 2004.

Unit I, II, III, IV : T.B. 1
Unit V : T.B. 2

Greenhouse Technology

Course Code: 17UBO5S3A

Maximum Marks: 100

Hours/Week: 2

Internal Marks: 00

Credits: 4

External Marks: 100

Objectives:

- To understand the basic details about organization and functioning of greenhouses.
- To familiarize with crop management in greenhouse condition.

Unit I: Fundamentals of greenhouse technology

6 Hrs

Introduction - scope – classification of greenhouses - construction of greenhouse - heating unit - cooling unit - #environmental control (light and temperature)#.

Unit II: Fertilizer application

6 Hrs

Root media for greenhouses - fertilizers – organic and inorganic – #liquid fertilizers# – application of fertilizers - nutrient deficiencies and toxicities

Unit III: Water in the greenhouses

6 Hrs

Irrigation system in green houses – #drip irrigation# – micro irrigation - water quality, water sanitation

Unit IV: Plant protection in greenhouses

6 Hrs

Diseases of greenhouse plants (bacterial, fungal, nematodes and viral diseases) – management of pest and diseases – #integrated pest management#.

Unit V: Applications of greenhouse technology

6 Hrs

Importance of greenhouse technology – net houses – poly houses – low cost greenhouses - #micropropagation and greenhouse planting of tissue culture transplants# – advantages and disadvantages of greenhouse technology.

#-----# Self Study Portion

Text Books (T.B.) and web links:

1. Sheela VL. Horticulture. MJP Publishers, Chennai, 2011.
2. Introduction to soil science: <http://www.agrimoon.com/wp-content/uploads/Introduction-to-soil-science.pdf>
3. Role of greenhouse technology in agricultural engineering: <http://scialert.net/fulltext/?doi=ijar.2006.364.372&org=10>
4. Greenhouse applications: http://www.linde-gas.com/en/products_and_supply/fumigants/carbon_dioxide_in_agriculture/greenhouse_applications/index.html

Reference Books:

1. Prasad S, Kumar U. Green House Management for Horticultural Crops. Agrobios India, 2012.
2. Pant V, Nelson. Green House Operation and Management. Bali Publication, 1991.
3. Dubey RC. A text book of Biotechnology. S. Chand and Company, 2006.

Unit I, II, III, IV, V : T.B. 1

Medicinal Botany

Course Code: 17UBO5EC1

Maximum Marks: 100

Hours/Week: 0

Internal Marks: 00

Credits: 4

External Marks: 100

Objective:

- To impart basic knowledge on medicinal plants and their therapeutic importance.

Unit I: Pharmacognosy

Introduction – Traditional alternative systems of medicines (Ayurveda, Unani, Homeopathy, Siddha, Aromatherapy, Naturopathy and Yoga) - organised drugs (leaves, fruits, barks, underground drugs) - unorganised drugs (gums and mucilages, resins and resin combinations, dried juices, latices and plant extracts)

Unit II: Collection and processing of herbal drugs

Collection – harvesting – processing (drying, dressing, packing, storage and preservation) – cultivation of medicinal plants and aromatic plants in India - ergastic substances of plants (reserve foods, excretory products and secretory products)

Unit III: Adulteration of crude drugs and its detection

Adulterants – types of adulteration (substandard varieties, inferior drugs, artificially manufactured substances, exhausted drugs, vegetative matter, harmful adulterants and powders) - drug evaluation: organoleptic and microscopic methods (diagnostic characters of leaves, stomata, trichomes, calcium oxalate crystals) – quality control of herbal drugs.

Unit IV: Phytochemical compounds

Brief description, bioactive compounds and medicinal uses of Aloe, Senna (glycosides) – Amla, Arjuna (tannins) – Black pepper, Cassia (terpenoids) – Asafoetida, Ginger (resin) – Vinca, Rawolfia (alkaloids)

Unit V: Nutraceuticals, rejuvenating drugs and marine drugs

Nutraceuticals (antioxidants, PUFA, probiotics, prebiotics, dietary fibers) - rejuvenating drugs – adaptogens – brief account of marine drugs.

Text Books (T.B.):

1. Kokate CK, Purohit AP, Gokhale SB. Pharmacognosy. NiraliPrakashan Publication, Pune, 2014.
2. Chopra RN Chopra IC Handa KL and Kapur LD. Indigenous drugs of India. Academic Publishers, 1994.

Unit I, II, III, IV, V : T.B. 1

SEMESTER VI : CORE - XIII

Microbiology and Plant Pathology

Course Code: 17UBO6C13

Maximum Marks: 100

Hours/Week: 5

Internal Marks: 25

Credits: 5

External Marks: 75

Objective:

- To learn about the various aspects of microbiology.
- To learn about the basic aspects of plant pathology.

Unit I: Fundamentals

15Hrs

History and scope of microbiology. Microscopy - principles and applications of bright field, dark field, phase contrast and electron microscopy (TEM & SEM). Classification of microorganisms - Haeckel's three kingdom concept, Whittaker's five kingdom concept and outline of Bergey's Manual of Systematic Bacteriology (9th edition). General features of Archaeobacteria, Eubacteria, Cyanobacteria, Mycoplasmas, Rickettsiae, Chlamydias, #Actinomycetes#.

Unit II: Bacteria

15Hrs

Morphology - cell size, shape and arrangement. Brief outline of capsule, flagella, axial filaments and pili. Cell wall – composition and characteristics. Structures internal to the cell wall – cytoplasm, ribosomes, mesosomes and nucleus. Bacterial growth curve. #Principle and methods of sterilization#- physical (moist heat, dry heat, filtration, pasteurization, tyndallisation, radiations) and chemical (alcohols, aldehydes, phenols, halogens and hypochlorites).

Unit III: Viruses

15Hrs

History, morphology - shape, size, structure – helical viruses (naked and enveloped viruses), icosahedral (naked and enveloped) viruses, complex viruses, #General characteristics of plant and animal viruses#. Classification of viruses, Viral multiplications (Lytic cycle, Lysogenic cycle).

Unit IV: Plant pathology

15Hrs

Definition, history, importance of plant diseases. Epidemiology and forecasting of plant diseases, common terminologies relevant to plant pathology, Koch's postulates. Classification of plant diseases, symptoms of plant diseases; Fungal, bacterial and #viral diseases#.

Unit V: Plant diseases

15Hrs

Study of the following plant disease: Tikka disease of ground nut, Early blight of potato, Root Rot & wilt disease, Loose smut of wheat. Bacterial blight of paddy. Leaf curl of tomato, #Bunchy top of banana#.

#-----# Self-study portion

Text Books (T.B.):

1. Dubey RC and Maheshwari DK. A text book of Microbiology, S. Chand & company Ltd.,2010.
2. Mehrotra RS. Text book of plant pathology, Tata McGraw Hill publishing company, New Delhi, 2000.
3. Pandey BP. Plant pathology, S.Chand & company Ltd.2011.

Reference Books:

1. Ananthanarayan Paniker's. Text Book of Microbiology(9th Edition), Universities press (India), Hyderabad, 2015.
2. Pelczar MH Chan ECS and Krieg NR. Microbiology, Tata McGraw Hill Publishing co., Ltd, New Delhi, 1993.
3. Joanne M. Prescott Microbiology (8th Edition), 2011.
4. Mehrotra RS. Text book of Plant Pathology, Tata McGraw Hill publishing company, New Delhi, 2000.

Unit I, II, III	:	T.B. 1
Unit IV, V	:	T.B. 2

SEMESTER VI : CORE - XIV

Plant Biotechnology

Course Code: 17UBO6C14

Maximum Marks: 100

Hours/Week: 5

Internal Marks: 25

Credits: 5

External Marks: 75

Objectives:

To acquire basic knowledge in biotechnology and plant tissue culture.

Unit I: Plant tissue culture

15 Hrs

History of biotechnology, Biotechnology in India and global trends, #Achievements of modern biotechnology#. Laboratory organization, Sterilization, Media preparation, Totipotency, Explants, Direct and indirect organogenesis. Protoplast isolation and fusion, cell suspension culture.

Unit II: Biomass and Bioenergy

15 Hrs

Fossil fuel derivatives of biomass, Sources and utilization of biomass, Production of alcohol from biomass, process of biogas production, hydrogen as biofuel from biomass, energy rich crops, petroleum plants, #SCP production from biomass#. Biosorption by algae, fungi and higher plants.

Unit III: Transformation vectors and their applications

15 Hrs

Agrobacterium based vectors – binary and co- integrated, pBR³²², pUC¹⁹, Ti plasmid, Ri plasmid, Yeast plasmid vectors. GUS and GIF assays, Marker assisted selections - #Herbicide and antibiotic resistant markers#.

Unit IV: Metabolic engineering of plants

15 Hrs

Metabolic engineering of carbohydrates, lipids, biodegradable plastics, proteins, oleosin, partition technology, production of lysosomal enzymes, production of antibodies (Plantibodies), #edible vaccines#.

Unit V: Applications of plant biotechnology

15 Hrs

Applications of plant biotechnology in agriculture, improvement of hybrids, production of disease resistant, stress resistant plants, transfer of nif genes to eukaryotes, transgenic plants for crop improvements, #Nutritional quality enhancements#.

#-----# Self-study portion

Text Books (T.B.):

1. Satyanarayana U. Biotechnology, Books and Allied Pvt Ltd., 2007.
2. Dubey RC. A text book of Biotechnology, S. Chand Publishing House, 2010.
3. Slatter A, Scott N and Fowler M. Plant Biotechnology, Oxford University Press, I Pub, 2004.

Unit I and V: T.B. 2

Unit II, III and IV: T.B. 1, 3

SEMESTER VI : CORE - XV

Plant Ecology and Phytogeography

Course Code: 17UBO6C15

Maximum Marks: 100

Hours/Week: 5

Internal Marks: 25

Credits: 5

External Marks: 75

Objectives:

- To impart the knowledge on the interaction of plants and animals with the environment
- To know about the hazards of pollution and the importance of keeping environment clean
- To acquire knowledge on the types of vegetation.

Unit I: General ecology

15 Hours

General Ecology – Approaches to the study of Ecology, Autecology – Synecology, Plant environment – climatic, edaphic and Biotic factors (interference on Plant habitat by animals – Grazing and browsing, by humans – deforestation, Agriculture), #Allelopathy#.

Unit II: Ecosystem concept

15 Hours

Ecosystem concept – components abiotic-biotic-autotrophic producers & heterotrophic consumers, biomass-ecological pyramids, Productivity – primary, secondary and gross; food chain – food web and energy flow – #pond ecosystem#.

Unit III: Vegetational studies

15 Hours

Vegetation – Units of vegetation – formation, association, consociation, society – Development of vegetation: Migration – colonization, ecesis, Methods of study of vegetation (Quadrat and transect). #Plant succession – Hydrosere and xerosere#. Ecological classification of Plants; Morphological and anatomical features of plants and their correlation to the habitat.

Unit IV: Pollution

15 Hours

Pollution and its control: Air pollution, Radiation pollution, Noise pollution, Thermal pollution-Soil pollution: Industrial, agrochemicals (insecticides, pesticides, fungicides, herbicides). Water pollution – Industrial effluents. #Marine pollution#.

Unit V: Phytogeography

15 Hours

Phytogeography-Approaches to Phytogeography – Climate of India & its climatic zones, Botanical regions (provinces) of India – Vegetational types of Tamil Nadu: Evergreen, deciduous, scrub & Mangrove, Continuous and discontinuous distribution. Endemism. *In situ* and *ex situ* conservation. #Application of remote sensing in conservation#.

#-----# Self-study portion

Text Books (T.B.):

1. Shukla and Chandel PS. Plant ecology and soil science, Chand and company Ltd, 1998.
2. Verma V. Plant ecology, Ane books Pvt Ltd, 2011.
3. Sharma, P D. Ecology and Environment. Rastogi Publications. 2011.

Reference Book:

1. Arora MP. Ecology, Himalaya Publishing House, 2004.

Unit I, II, III : T.B.1, 3
Unit IV, V : T.B. 2

SEMESTER VI : CORE - XVI

Laboratory Course for Core XIII, XIV & XV

Course Code: 17UBO6C16P	Maximum Marks: 100
Hours/Week: 5	Internal Marks: 20
Credits: 5	External Marks: 80

Objectives:

Microbiology: Preparation of culture media, cleaning of glassware and methods of sterilization.

1. Isolation of bacteria from soil and water samples by serial dilution and plating methods.
2. Demonstration of ubiquitous nature of microorganisms.
3. Enumeration of bacteria.
4. Gram staining techniques.

Plant Pathology:

Study of morphological and internal part of following infected plants.

1. Tikka disease of ground nut
2. Early blight of potato
3. Loose smut of wheat
4. Bacterial blight of paddy
5. Leaf curl of tomato
6. Bunchy top of banana

Plant Biotechnology: Plant tissue culture media preparation.

1. Explant selection and culture.
2. Isolation of total genomic DNA from leaf tissues (Demonstration)
3. Isolation of plasmid DNA from *E.coli* (Demonstration)

Plant Ecology and Phytogeography:

1. Study of morphological and anatomical features of hydrophytes and xerophytes.
2. Study of morphological features of epiphytes, parasites and halophytes.
3. Determination of minimum size of the quadrat by species area curve method.
4. Random sampling – frequency, estimation.
5. Determination of soil and water pH from different environment.
6. Estimation of Carbonate, bicarbonate.
7. Estimation of Chloride.
8. Estimation of Total dissolved solids.
9. Observation of charts, book diagrams and materials from internet pertaining to phytogeographical syllabus.

SEMESTER VI : MAJOR BASED ELECTIVE – II#

Industrial Botany

Course Code: 17UBO6M2A

Maximum Marks: 100

Hours/Week: 5

Internal Marks: 25

Credits: 4

External Marks: 75

Objectives:

- To understand the basic details about industrial techniques related to plant sciences.
- To familiarize with the techniques providing employment opportunities to undergraduate botany students.

Unit I: SCP and seaweed industry

15 Hrs

Single cell protein (SCP)-algal single cell protein-*Spirulina* mass cultivation and its applications-*Chlorella* mass cultivation and its applications-mass production of bacterial SCP - #mass production of *Yeast*# - seaweed mass cultivation and their applications

Unit II: Biofuel Technology

15 Hrs

Introduction to biofuels-bioethanol-industrial production of bioethanol-uses of bioethanol-biodiesel-manufacture of biodiesel-uses and advantages of biodiesel-biogas production-uses of biogas-biohydrogen-#biohydrogen production and its uses#.

Unit III: Mushroom cultivation

15 Hrs

Nutritive value of edible mushrooms-medicinal values of mushrooms-poisonous mushrooms-morphology of common edible mushrooms-cultivation of paddy straw mushroom-cultivation of oyster mushroom-cultivation of white button mushroom-storage of mushrooms-#recipes of mushrooms#.

Unit IV: Fermentation technology

15 Hrs

Introduction to fermentation technology-stages of fermentation-designing of bioreactors-formulation and sterilization of medium-isolation and selection of microorganism-production of stock culture-inoculum development-culture of microorganism in bioreactor-fermentation processes-upstream process, downstream process-#important fermentation products#.

Unit V: Medicinal plant industry

15 Hrs

Preparation and processing of cosmaceutical agents (peppermint oil, lavender oil, Lemon grass oil) and natural pesticides (neem and pyrethrum) -#Cultivation and post-harvest technology of *Vinca rosea*, *Gloriosa superbam*#.

#-----# Self-study portion

Text Books(T.B.):

1. Kumaresan V. Biotechnology. Saras Publication, Nagercoil, 2013.
2. Annie Ragland and Kumaresan. Angiosperms. Saras Publication, Nagercoil, 2013.
3. Kokate, CK Purohit AP and Gokahale. Phamacognosy, NiraliPrakasan, 2002.

Reference books:

1. Hema Sane et al. Text book of industrial botany. Vision Publication, India, 2013.
2. Dubey RC. A Text book of Biotechnology, Chand Publication, New Delhi, 2006.

Unit I, II, III, IV : TB 1
Unit V : TB 2, TB.3

SEMESTER VI : MAJOR BASED ELECTIVE – II#

Seed Science and Technology

Course Code: 17UBO6M2B	Maximum Marks: 100
Hours/Week: 5	Internal Marks: 25
Credits: 4	External Marks: 75

Objectives:

To learn the principles and technology of seed production and use

Unit I: Seed Production

15 Hrs

General system of seed multiplication. Seed production agencies. Identification of seed production areas and factors affecting it. Compact area approach in seed production. Principles and methods of seed production of varieties and hybrids of cereals like paddy, sorghum, pearl millet and maize; pulses like chickpea, pigeon pea, green gram, black gram; oilseeds like groundnut, sesame, sunflower and castor; fibre crops like cotton and jute; vegetables crops like tomato, brinjal, okra and chilli.

Unit II: Seed Processing

15 Hrs

Principles of seed processing. Seed drying principles and methods. Precleaning, grading, treatment, pelleting and packaging. Seed invigoration and enhancement treatment and their applications. Seed processing machines like cleaner cum grader, specific gravity separator, indented cylinder, seed treater, weighing and bagging machines, their operation and maintenance. Seed quality maintenance during processing.

Unit III: Seed Quality Control

15 Hrs

Seed legislation - Seeds Act 1966, Seed Rules 1969 and New Seed Bill 2004, Seed Law Enforcement. Seed certification – history, concept, organization, phases and minimum certification standards. Field inspection principles and methods. Inspection at harvesting, threshing and processing. Pre-and post-quality testing or genetic purity. Seed Certification Schemes, concepts and procedures. Seed Testing concepts and objectives, its role in seed quality control.

Unit IV: Seed Storage

15 Hrs

Requirements and types of seed storage. Factors affecting seed storage and role of moisture, temperature, RH and moisture equilibrium. Viability nomographs. Seed deterioration causes and methods of control. Physiological, biochemical and molecular changes in seed ageing. Seed drying and Packaging needs. Storage structures. Methods of stacking and their impact. Short and medium term storage. Controlled storage.

Unit V: Seed Health**15 Hrs**

Significance of seed health. Mode and mechanism of transmission of microorganisms - fungi, bacteria and viruses. Procedures for seed health test and rules. Externally and internally seed - borne pathogens, mode of infection, development and spread, methods of detection of seed borne diseases. Important seed-borne diseases of cereals, oilseeds, pulses, fibre crops, vegetables and their control measures. Use of pesticides, botanicals, mycotoxins for seed treatments. Carry over infestation, principles of fumigation and safe use of fumigants.

Text Books (T.B.):

1. Vanangamudi K. Seed science and Technology, New India Publishing Agency, 2014.
2. Basra A. Handbook of Seed Science and Technology Paperback, CRC press, 2008

SEMESTER VI : MAJOR BASED ELECTIVE – III#

Horticulture and Plant Breeding

Course Code: 17UBO6M3A

Maximum Marks: 100

Hours/Week: 4

Internal Marks: 25

Credits: 4

External Marks: 75

Objective:

- To understand the basic principles and applications of horticulture and plant breeding.

Unit I: Basics of horticulture

12 Hrs

Introduction and values of horticulture - classification – kinds of soil and soil fertility - organic, inorganic and biofertilizers - methods of application - irrigation systems - common garden pests and diseases - #methods for controlling pest and diseases#.

Unit II: Propagation methods

12 Hrs

Plant propagation methods - cutting, layering, grafting, budding, stock and scion relationship, micropropagation - uses of plant growth regulators in horticulture - cultivation practice -coconut, banana and #mango#.

Unit III: Principles of landscape gardening

12 Hrs

Gardening - planning, designing and establishment of a garden – garden types - components – lawn making - kitchen garden - indoor garden – cultivation of commercial flowers - rose, jasmines, Gerbera – Ikebana - #Bonsai#.

Unit IV: Basics of plant breeding

12 Hrs

Introduction – conventional and nonconventional methods – selection methods (mass selection, pure line selection and clonal selection) – hybridization techniques – #heterosis# – inbreeding depression

Unit V: Mutation breeding, ploidy breeding and seed certification

12 Hrs

Mutation breeding - #gamma garden# - ploidy breeding (autopolyploids, allopolyploids) – detailed account on seed certification.

#-----# Self-study portion

Text Books (T.B.):

1. Kumaresan V. Horticulture and Plant breeding. Saras Publication, Nagercoil, 2009.
2. Kumar N. Introduction to Horticulture. Rajalakshmi Publications, Nagarcoil, 1994.
3. Singh BD. Plant breeding (10th edition), Kalyani publishers New Delhi, 2015.

Reference Books:

1. Edmond JB, Sen TL, Andrews FS, Halfacre RG. Fundamentals of Horticulture (Fourth edition). Tata McGraw Hill Publishing Co., New Delhi, 1979.
2. Jitendra Sing. Basic Horticulture. Kalyani Publishers, Hyderabad, 2002.
3. Singh P. Essential of plant breeding(6th edition). Kalyani Publishers, India, 2015.

Unit I : TB 1, TB 2
Unit II, III, IV, V : TB 1

Silviculture

Course Code: 17UBO6M3B

Maximum Marks: 100

Hours/Week: 4

Internal Marks: 25

Credits: 4

External Marks: 75

Objectives:

To understand the principles of growing and cultivation of trees

Unit I: Principle

12 Hrs

Silviculture and its place in forestry. Stand establishment, intermediate operations and their effects on growth and yield. Control of understorey and overstorey vegetation. Silviculture of pure and mixed stands.

Unit II: Silviculture of economically important species

12 Hrs

Tropical Species: *Acacia nilotica*, *A. auriculiformis*, *A. mangium*, *Albizia lebbek*, *Azadirachta indica*, *Melia azedarach*, *Prosopis juliflora*, *P. cineraria*, *Pithecelobium dulce*, *Bombax ceiba*, *Ceiba pentandra*, *Casuarina equisetifolia*, *Santalum album*, *Shorea robusta*, *Tectona grandis*, *Tamarindus indica*, *Terminalia arjuna*, *T. chebula*, *Dalbergia sissoo*, *D. latifolia*.

Unit III: Silviculture of economically important species

12 Hrs

Sub-tropical and temperate: *Pinus roxburghii*, *P. kesiya*, *P. wallichiana*, *P. gerardiana*, *Cedrus deodara*, *Abies pindrow*, *Picea smithiana*, *Quercus spp*, *Rhododendron spp*, and *Alnus nepalensis*.

Unit IV: Forest mensuration

12 Hrs

Scope, importance and units of measurement. Measuring instruments and procedures for tree and stand measurement. Stem form factor and form quotient. Tree and log volume estimation with empirical formulae, tables and forest inventory. Grading of forest products. Stump and stem analysis. Inventory planning, sampling size, frequency and probability proportional to area. Computer analysis of inventory data.

Unit V: Agroforestry

12 Hrs

Farming systems - monoculture, multiple cropping, agro-and farm-forestry. Agroforestry systems - perspectives, classification, national and global importance, benefits and limitations. Land use systems in shifting cultivation, taungya and plantations. Choice of species and management practices for live fences, hedgerows, protein "banks", alley cropping, windbreaks and shelterbelts, hill-slope and terrace cultivation, watersheds and woodlots. Diagnosis and design of agroforestry systems.

Text Books (T.B.) and Web link:

1. Indian Forest Management Hand Book, 53 IAM 9-H, 2012
2. <https://www.bia.gov/cs/groups/xnifc/documents/text/idc-022536.pdf>

Wood science and Technology

Course Code: 17UBO6EC2

Maximum Marks: 100

Hours/Week: 0

Internal Marks: 00

Credits: 4

External Marks: 100

Objectives:

- To provide basic information about importance of wood.
- To acquaint the students with the physical characteristics and strength properties of wood.
- To understand seasoning and preservation of wood for better utilization.
- To acquaint the students with knowledge on wood technology.

Unit I: Identification and chemistry of wood

Physical and anatomical features of wood. Pores or vessels, different types of wood rays, non porous woods- sapwood and heart wood- wood parenchyma, resin and gum canals. Chemical constituents of wood: cellulose, hemicelluloses and lignin - Wood extractives: tannins, polyphenols, volatile oils, resins, gums and waxes.

Unit II: Developmental anatomy of woody plants

Characteristics of woody plants. Soft wood and hard wood- process of wood formation. organization of cell wall, reaction wood- cambium, kinds, arrangement, shape and size of cambial initials- Wood rays- wood parenchyma- resin and gum canals

Unit III: General properties of wood

Physical properties of wood- color, weight, odor, lustre, wood density, specific gravity, moisture content; Thermal properties -conductivity and diffusivity; Mechanical properties - stress-strain relation in wood, elastic properties, plasticity. Vibration properties-compression, tensile strength, abrasion, brittleness and hardness.

Unit IV: Seasoning and preservation of wood

Principles of wood seasoning - objectives of seasoning, forms of moisture, diffusion of bound water. Effect of temperature, relative humidity, species, grain direction and thickness of timber on rate of drying- Classification of timbers according to their seasoning characteristics - Stacking of timbers for air seasoning- Agents responsible for wood deterioration. Fungi, bacteria, insects. Wood preservation: basic principles, preservative chemicals.

Unit V: Wood technology

Composite wood - plywood, laminated wood, core board, sandwich board, fibre board, particle board-Improved wood-Compressed wood, Impregnated wood, Compregnated wood, Heat stabilized wood-Chemically modified wood, densified wood

Text Book (T.B.):

1. Shrivastave MB. Wood technology. Vikas Publishing House Pvt Ltd. New Delhi, 2000.

Reference Books:

1. Brown HP. Manual of Indian Wood Technology, International Books and periodicals supply service, New Delhi, 1985.
2. Higuchi T. Biochemistry and Molecular Biology of Wood, Springer, 1997.
3. Panshin AJ and de Zeeuw C. Textbook of Wood Technology. McGraw-Hill Book Company, New York, 1980.
4. Wilson K and White DJB. The Anatomy of Wood: Its Diversity and Variability. Stobart and son Ltd., 1986.

SEMESTER III: ALLIED BOTANY V

Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms

Course Code: 17UBO3A5

Hours/Week: 4

Credits: 3

Maximum Marks: 100

Internal Marks: 25

External Marks: 75

Objective:

- To impart basic knowledge about diversity of lower, vascular cryptogams and seed plants.

Unit I: Algae

12 Hrs

General characteristics - Classification by Fritsch, General characteristics of major divisions - Thallus organization - Detailed study of the genera: *Oscillatoria*, *Volvox*, *Oedogonium* and *Ectocarpus* - #Economic importance of algae#.

Unit II: Fungi

12 Hrs

General characteristics; Classification by Alexopoulos (1979). Detailed study of structure, reproduction and life cycle of *Albugo*, *Peziza* and *Puccinia*. #Economic importance of Fungi#. Lichens – *Usnea*.

Unit III: Bryophytes

12 Hrs

General characteristics, Classification based on Rothmaler (1951), vegetative structure and reproductive methods - Detailed study of the genera: *Marchantia*, *Anthoceros* and *Funaria*. #Economic importance of bryophytes#.

Unit IV: Pteridophytes

12 Hrs

General characteristics - Classification by Reimer (1954). Stelar evolution - Detailed study of the genera – *Lycopodium*, *Equisetum* and *Adiantum*. #Economic importance#.

Unit V: Gymnosperms

12 Hrs

General characteristics, distribution, classification by Sporne (1962). A detailed study of the genera: *Cycas* and *Pinus*. #Economic importance of gymnosperms#.

#-----# Self-study portion

Text Books (T.B.):

- Pandey BP. College Botany - Volume I. S. Chand and Company Ltd., New Delhi, 2010.
- Vasishta BR Sinha AK and Adarsh Kumar. Botany for degree students Bryophyta, S. Chand and Company Ltd., New Delhi, 2011.
- Vasishta BR Sinha AK and Anil Kumar, Botany for degree students Pteridophyta, S. Chand and Company Ltd., New Delhi, 2010.
- Vasishta PC Sinha AK and Anil Kumar, Botany for degree students Gymnosperms, S. Chand and Company Ltd., New Delhi, 2006.

Reference Books:

1. Vasishta BR Sinha AK and Singh VP. Botany for degree students Algae, S. Chand and Company Ltd., New Delhi, 2010.
2. Vasishta BR and Sinha AK. Botany for degree students Fungi, S. Chand and Company Ltd., New Delhi, 2010.
3. Rashid A. An introduction to Bryophyta, Vikas Publishing House (P) Ltd., New Delhi, 1998.
4. Vashista PC. Botany for Degree Students Pteridophyta, S.Chand and Co., New Delhi, 1997.
5. Srivastava HN. Gymnosperms, Pradeep Publications, Jalandhar, India, 1998.

Unit I	:	T.B.1
Unit II	:	T.B.2
Unit III, IV, V	:	T.B.1

SEMESTER III: ALLIED BOTANY VI

Laboratory Course for Allied Botany V

Course Code: 17UBO3A6P
Hours/Week: 3
Credits: 2

Maximum Marks: 100
Internal Marks: 20
External Marks: 80

Objectives

- To develop skills in handling and observing the specimens of lower vascular cryptogams and seed plants.
1. Study of parts of compound and dissecting microscope.
 2. Micro-preparation and observation of permanent slides of specimens of following genera: *Oscillatoria*, *Volvox*, *Oedogonium*, *Ectocarpus*
 3. Micro-preparation and observation of permanent slides of specimens of following genera: *Albugo*, *Peziza*, *Puccinia*, *Usnea*, *Lycopodium*, *Equisetum*, *Adiantum*, *Cycas*, *Pinus*.

SEMESTER IV: ALLIED BOTANY VII

Angiosperm Taxonomy, Anatomy, Embryology and Plant Physiology

Course Code: 17UBO4A7

Hours/Week: 5

Credit : 3

Maximum Marks: 100

Internal Marks: 25

External Marks: 75

Objectives:

- To enable the students to understand the morphology and classification of angiosperms.
- To enable the students to understand internal structure of vegetative and reproductive parts of angiosperms.
- To introduce the basics of plant physiology.

Unit I: Angiosperm taxonomy

15 Hrs

Morphology - Parts of a plant – Stem, Leaf and their modifications – Simple and compound leaves - Phyllotaxy - Inflorescence - Racemose, Cymose, Mixed and Special types - Terminology of floral parts, diagram and formula. Systems of Classification: Artificial (Linnaeus system) - Natural (Bentham and Hooker's system). Plant Nomenclature - Brief accounts of ICBN- Herbarium Technique - #Important herbaria in India#.

Unit II: Angiosperm families

15 Hrs

Study of the general characteristics and economic importance of Annonaceae, Rutaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Rubiaceae, #Apocyanaceae#, Euphorbiaceae, Orchidaceae and Poaceae.

Unit III: Anatomy

15 Hrs

Meristematic tissues: Classification of meristems – Apical meristem – Shoot apex and Root apex organizations (Apical cell theory and Histogen theory). Simple Permanent tissues - Parenchyma, Collenchyma and Sclerenchyma. Complex permanent tissues – Xylem, phloem and cambium. #Primary structure of stem and root in dicots# and monocots.

Unit IV: Embryology

15 Hrs

Structure and development of Anther - Microsporogenesis – microgametophyte development – Structure and types of Ovule - megasporogenesis - megagametophyte development (*Polygonum* type). Endosperm: Nuclear, Cellular, Helobial and Ruminant types. Fertilization, brief account on Apomixis, #Polyembryony#.

Unit V: Plant physiology

15 Hrs

Water - structure and properties, diffusion, imbibition and osmosis. Absorption of water - active and passive absorption. Transpiration: Types and factors affecting transpiration. Photosynthesis: apparatus, pigments – light (z-scheme) and dark reaction (Calvin cycle). Respiration - glycolysis and Krebs's cycle. Plant growth regulators – Auxins, Gibberellins, Cytokinins, Ethylene and #ABA#.

#-----# Self-study portion

Text Books (T.B.):

1. Rao KN Krishnamurthy KV and Rao GS. Ancillary Botany, ViswanathanPvt Ltd., 1983.
2. Pandey SN and Chadha A. Plant Anatomy and Embryology, Vikas Publishing House Pvt Ltd. New Delhi, 2009.
3. Jain VK. Fundamentals of Plant Physiology (14th Ed), S. Chand and Company Ltd, New Delhi, 2012.

Reference Books:

1. Jeffrey C. An Introduction to Plant Taxonomy, Cambridge University Press, 1982.
2. Pandey BP. Taxonomy of Angiosperms, S. Chand & Co. Ltd., New Delhi, 1999.
3. PijushRoi. Plant anatomy, New central book agency (P) Ltd., Kolkata, 2006.
4. Bhojwani SS and Bhatnagar SP. Embryology of Angiosperms, Vikas Publishing House (P) Ltd., New Delhi, 1994.

Unit I, II	:	T.B. 1
Unit III, IV	:	T.B. 2
Unit V	:	T.B. 3

SEMESTER IV: ALLIED BOTANY VIII
Laboratory Course for Allied Botany VII

Course Code: 17UBO4A8P

Hours/Week: 3

Credit : 2

Objectives

Maximum Marks: 100

Internal Marks: 20

External Marks: 80

- To develop skills to describe, classify and identify angiosperms.
- To prepare, observe and understand internal structure of vegetative and reproductive parts of angiosperms.
- To enable the students to observe the basics of physiology experiments.

Angiosperm morphology and taxonomy:

1. Parts of a plant (*Amaranthus*, Grass)
2. Phyllotaxy (*Annona*, *Psidium*, *Quisqualis*, *Nerium*, *Allamanda*, and *Mollugo*)
3. Compound leaves (*Azadirachta*, *Butea*, *Albizzia*, *Moringa*, *Gynandropsis*)
4. Parts of flower (*Tribulus*)
5. Racemose inflorescence (*Crotalaria*, *Mangifera*, *Caesalpinia*, *Achyranthes*, *Cocos*, *Allium*, *Tridax*)
6. Cymose inflorescence (*Jasmine*, *Clerodendron*, *Hamelia*, *Heliotropium*, *Mollugo*)
7. Mixed and special (*Ficus*, *Leucas*, *Euphorbia cyathophora*, *Ocimum*, *Zizyphus*)
8. Description and identification features for the families (Annonaceae, Rutaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Rubiaceae, Apocynaceae, Euphorbiaceae and Poaceae, Orchidaceae).

Anatomy:

Micro preparation of plant parts to observe and record the internal structure.

1. Dicot stem (*Tridax* flower axis).
2. Monocot stem (Grass stem).
3. Dicot root (*Tridax* root)
4. Monocot root (Grass root).

Embryology:

1. T.S. of anther (*Datura*).
2. L.S. of ovule (Permanent slide).
3. Types of ovules- orthotropous and anatropous (Permanent slide).
4. Dicot embryo dissection (*Tridax*).

Plant physiology: (Demonstration of the following spotters)

1. Ganong's photometer
2. Light screen experiment, Willmot's bubbler
3. Lever auxonometer