

**DEPARTMENT OF PLANT BIOLOGY AND
BIOTECHNOLOGY**

UG SYLLABUS

Restructured from the Academic Year 2012 – 2013

LOYOLA COLLEGE

(Autonomous)

College Conferred with Potential for Excellence by UGC

Re-accredited at A⁺ Level by NAAC

Chennai – 600 034

MISSION STATEMENT OF THE DEPARTMENT

The Department of Plant Biology and Biotechnology rechristened from Department of Botany in tune with the current developments, aims at producing graduates well versed in fundamentals of Plant Biology and in the applied areas of Biotechnology enabling them to apply for higher studies in life sciences. It also imparts skill based training in Mushroom cultivation and Bio-fertilizer production so that our graduates are employable or become entrepreneurs by themselves.

DEPARTMENT OF PLANT BIOLOGY AND BIOTECHNOLOGY B. Sc., Plant Biology and Plant Biotechnology LOYOLA COLLEGE (AUTONOMOUS) CHENNAI 600 034

Sem.	Sub. Code	Title of the paper	Category	Hr/Wk	Cr
I	PB 1508	Algology and Bryology	MC	3	3
	PB 1509	Mycology	MC	3	3
	PB 1510	Practical –I (Algology, Bryology and Mycology)	MC	3	3
	CH 1100	Chemistry for Biologists-I	AR	4	3
	CH 1101	Chemistry Practical for Biologists-I	AR	2	1
			Total Contact hours and credits		15
II	PB 2504	Pteridophytes, Gymnosperms and Paleobotany.	MC	3	3
	PB 2506	Cell Biology and Evolution	MC	3	3
	PB 2507	Practical – II (Pterido. Gymno and Paleo.& Cell Biology and evolution)	MC	3	3
	AZ 2104	Animal Diversity	AR	4	3
	AZ 2105	Animal Diversity Lab Course	AR	2	1
			Total Contact hours and credits		15
III	PB 3510	Microbiology	MC	3	3
	PB 3511	Plant Anatomy	MC	3	3
	PB 3512	Practical III (Microbiology and Plant Anatomy)	MC	3	3
			Total Contact hours and credits		09
	PB 4510	Angiosperm Taxonomy and Economic Botany	MC	3	3
	PB 4511	Embryology of Angiosperms	MC	3	3
	PB 4512	Practical IV (Ang. Taxon, Eco. Bot., and Embryology)	MC	3	3
			Total Contact hours and credits		09
V	PB 5411	Phytochemicals (OR)	ES	3	2

	PB 5412	Agriculture and Horticulture			
	PB 5413	Bioinstrumentation & Biostatistics (OR)	ES	3	2
	PB 5414	Phytogeography and Forestry			
	PB 5521	Plant Physiology	MC	3	3
	PB 5522	Genetics and Plant Breeding	MC	3	3
	PB 5523	Plant Diseases and Management	MC	3	3
	PB 5524	Ethnobotany and Herbal Sciences	MC	3	3
	PB 5525	Practical V (Pl. Phy & Genetics)	MC	3+3	6
	PB 5526	Practical VI (Plant Diseases and Management & Ethno. and Herbal Sci.)	MC	3+3	6
		SELF STUDY PAPER	SSP	-	2
		Total Contact hours and credits		30	30
VI	PB 6612	Plant Biotechnology	MS	3	4
	PB 6613	Microbial Technology	MS	3	4
	PB 6614	Ecology and Environmental Biotechnology	MS	3	4
	PB 6615	Practical VII (Plt. Biotech., Micro. Tech & Eco. & Env. Bio.Tech.)	MS	3+3	8
	PB 6655	Mushroom Cultivation and Bio-fertilizer Production	SK	15	15
			Total Contact hours and credits		30

PB 1508 – ALGOLOGY & BRYOLOGY

SEMESTER: I
CATEGORY: MC

CREDITS: 3
NO. OF HOURS / WEEK: 3

Objectives:

1. To provide knowledge on the structure and reproduction of certain selected algal and bryophyte forms besides giving an overview.
2. To introduce students to basics of algal biotechnology and economic importance of both groups.

Unit I: Algae - Overview

A general account and classification of Algae – distribution - range of thallus organization – pigmentation- flagellation- reserve food – Reproduction(vegetative-asexual-sexual) ; Lifecycle patterns – -salient features of algal divisions (Harold C Bold) – phylogeny - Fossil algae.

Unit II: Algae -Type Study

Structure and reproduction with reference to the following algal forms – *Anabaena, Chlorella, Volvox, Chara, Ectocarpus, Sargassum, Polysiphonia and Gracilaria*. (excluding the developmental stages).

Unit III: Algae - Applications

Algal biotechnology: single cell proteins (SCP): *Spirulina* as single cell protein-production and harvesting of algal biomass – factors affecting biomass production.

Cyanobacterial inoculants (BGA): Isolation, preparation of starter culture, mass cultivation, field applications and crop response.

Economic importance of algae: Algae as food and fodder, use of algae in agriculture and space research, commercial products of algae: Agar Agar, Alginates, Carrageenin, diatomite, mucilage, minerals and elements - Algae in medicine and biofuels.

Unit IV: Bryophytes - Overview

General account of habit, distribution - classification - characteristics of *Hepaticopsida, Anthocerotopsida* and *Bryopsida* – methods of reproduction: vegetative, asexual and sexual- life cycle pattern - fossil bryophytes - phylogeny - economic importance.

Unit V: Bryophytes - Type Study

A detailed study of the range of vegetative and reproductive structure - life cycle of liverworts (*Marchantia*); hornworts (*Anthoceros*) and mosses (*Funaria*) (excluding the developmental stages).

TEXT BOOKS :

1. Srivastava, H.N. 1999. Algae. Pradeep publications, Meerut.
2. Sharma, O.P. 2004. A Textbook of Algae. Tata McGraw- Hill publishing Company Limited, New Delhi.
3. Bilgrami, K.S. and Saha, L.C. 2012. A Textbook of Algae. CBS Publishers & Distributors Pvt. Ltd., New Delhi.
4. Pandey, S.N., Misra, S.P., and Trivedi, P.S. 1997. A text book of Botany, Vol. II, Vikas Publishing House Pvt. Ltd.
5. Dubey, R.C. 2009. A Textbook of Biotechnology. S. Chand & Company Ltd. New Delhi.

BOOKS FOR REFERENCE

1. Bold, H. C. 1982. Morphology of Plants - Wiley Eastern Ltd.
2. Gangulee & Khar, 1980. College Botany Vol. II Tata Mc Graw Hill, New Delhi.
3. Sporne, 1967. Bryophytes - Hutchinson & Co, London.

PB 1509 MYCOLOGY

SEMESTER: I
CATEGORY: MC

CREDITS: 3
NO.OF HOURS/ WEEK: 3

Objectives:

1. To provide knowledge on the structure and reproduction of certain fungal forms besides giving an overview.
2. To introduce students to basics of fungal biotechnology and clinical mycology.

Unit I: General characters of fungi

Habit, nutrition types, cell structure, mycelium – its modifications- Reproduction: vegetative, asexual, sexual, para-sexual; fruiting bodies of sexual and asexual, Life cycle patterns. Salient features of fungal classes (Alexopolus, 1962).

Unit II: Fungal forms

Structure and reproduction with reference to the following fungal forms (no developmental stage) *Albugo, Rhizopus, Aspergillus, Saccharomyces, Neurospora, Peziza*

Unit III: Fungal forms

Structure and reproduction with reference to the following fungal forms (no developmental stages) *Puccinia, Polyporus and Colletotrichum*. Lichens : Types, structure, reproduction and economic importance.

Unit IV: Fungal Applications

Baker's yeast, YAC vector, penicillin production and Mycorrhiza : Types, identification and importance. Economic importance of fungi in general.

Unit V: Clinical mycology

Structure, reproduction, diagnoses and control measures of the following: Dermatophytoses : (*Trichophyton*); Systemic mycoses (*Candida*), Fungal toxins.

TEXT BOOKS :

1. Vashista, B.R. 2000. Fungi, Chand & Co. New Delhi
2. Harold C. Bold, 1982. Morphology of plants. Wiley- Eastern Ltd.
3. Sathyanarayana, U. 2010. Biotechnology; Books and allied (P) Ltd. Kolkatta.
4. Sundararaj, T. 2000. Microbiology Laboratory Manual, IBMS, University of Madras, Taramani, Chennai.

BOOKS FOR REFERENCE

1. Gangulee and Khar, 1980. College Botany Vol. II, Tata Mc Graw Hill, New Delhi.

PB 1510 PRACTICAL I (Algology & Bryology and Mycology)

SEMESTER:I
CATEGORY:MC

CREDITS:3
NO.OF HOURS /WEEK:3

1. Morphological study of the following algal forms - *Anabaena*, *Chlorella*, *Volvox*, *Chara*, *Ectocarpus*, *Sargassum*, *Polysiphonia* and *Gracilaria*.
2. Algal Biotechnology : Cultivation of algae in - Chu 10 medium (Demonstration only).
3. Morphological study of the following bryophyte forms - *Marchantia*, *Anthoceros*, and *Funaria*.
4. Morphological study of the following fungal forms *Albugo*, *Rhizopus*, *Aspergillus*, *Saccharomyces*, *Neurospora*, *Peziza*, *Puccinia*, *Polyporus* and *Colletotrichum*.
5. Study of economically important products obtained from algae, bryophytes and fungi.
6. Photographs and permanent slides related to clinical mycology.
7. Field visit / trip to collect algal specimens - algae herbaria (5 numbers) to be submitted.
8. Visit to algal and fungal biotechnology laboratories.

CH-1100: CHEMISTRY FOR BIOLOGISTS -I

(Offered to students of Advanced Zoology and Plant Biology and Biotechnology)

SEMESTER:I
CATEGORY: AR

CREDITS:3
NO. OF HOURS / WEEK: 4

Objective:

To enable the students to understand the concepts of chemistry.

Unit 1: Handling of chemicals and Data analysis (15 h)

- 1.1 *Storage and handling of chemicals:* Handling of acids, ethers, toxic and poisonous chemicals. Antidotes, threshold vapour concentration and first aid procedure.
- 1.2 *Errors in chemical analysis:* Accuracy, precision. Types of error-absolute and relative errors. Methods of eliminating and minimizing errors.

1.3 *Separation techniques*—Solvent extraction. Principle of adsorption and partition chromatography, column chromatography, thin layer chromatography (TLC), paper chromatography and their applications.

Unit 2: Chemical bonding (15 h)

2.1 *Ionic Bond*: Nature of Ionic bond. Structure of NaCl, KCl and CsCl. Factors influencing the formation of ionic bond.

2.2 *Covalent Bond*: Nature of covalent bond. Structure of CH₄, NH₃, H₂O based on hybridisation.

2.3 *Coordinate Bond*: Nature of coordinate bond. Coordination complexes. Werner's theory. Geometrical and optical isomerism in square planar and octahedral complexes. Mention of structure and functions of chlorophyll and hemoglobin

2.4 *Hydrogen Bond*: Theory and importance of hydrogen bonding. Types of hydrogen bonding. Hydrogen bonding in carboxylic acids, alcohol, amides, polyamides, DNA and RNA.

2.5 *van der Waal's forces*: Dipole – dipole and dipole - induced dipole interactions.

Unit 3: Volumetric analysis (10 h)

3.1 *Methods of expressing concentration*: normality, molarity, molality, ppm.

3.2 *Primary and secondary standards*: preparation of standard solutions

3.3 *Principle of volumetric analysis*: end point and equivalence points.

3.4 *Strong and weak acids and bases* - Ionic product of water , pH, pK_a, pK_b. Buffer solutions - pH of buffer solutions. Mention of Henderson equation & its significance.

Unit 4: Kinetics (10 h)

4.1 *Chemical Kinetics*: Rate, rate law, order and molecularity. Derivation of rate expressions for I and II order reactions.

4.2 *Catalysis*-Homogeneous and heterogeneous catalysis. Enzyme catalysis, enzymes in biological system and in industry.

Unit 5: Chemistry of biomolecules (10 h)

5.1 *Fats* – Occurrence and composition. Hydrolysis of fats.

5.2 *Vitamins* – Source, provitamin, properties and classification. Structure and function of vitamin A, C, D, K and E

5.3 *Hormones* – Thyroxin, adrenaline and sex hormones (structure and functions only)

Text Books:

1. R. Gopalan, S. Sundaram, *Allied Chemistry*, Sultan Chand and Sons, 1995.
2. U. Sathyanarayana, *Biochemistry*, Books and allied (p) Ltd, 1999.
3. B.R.Puri and L.R.Sharma, *Principles of physical chemistry*, Shoban Lal Nagin Chand and Co. 33rd ed., 1992.

References:

1. D.A. Skoog, D.M. West and F.J. Holler, *Analytical Chemistry: An Introduction*, 5th ed., Saunders college publishing, Philadelphia, 1990.
2. G.C. Hill, J.S. Holman, *Chemistry in Context*, ELBS, 1998
3. W.R. Kneen, M.J.W. Rogers, P. Simpson, *Chemistry – Facts, patterns and principles*, ELBS, 1999.

CH-1101: CHEMISTRY PRACTICAL FOR BIOLOGISTS -I

(Offered to students of Advanced Zoology and Plant Biology and Biotechnology)

SEMESTER: I
CATEGORY: AR

CREDITS: 1
NO. OF HOURS / WEEK: 2

Objective:

To enable the students to understand the concept of organic analysis.

Organic Analysis:

- a) Detection of N, S and halogens
- b) Test for aliphatic and aromatic nature.
- c) Test for saturation and unsaturation.
- d) Nature and identification of the following functional groups
 - i) Carboxylic acid
 - ii) Phenols
 - iii) Aldehydes
 - iv) Ketones
 - v) Carbohydrates
 - vi) Primary amines
 - vii) Amides

Text Books:

1. N.S. Gnanapragasam and G. Ramamurthy, *Organic chemistry – Lab manual*, S. Viswanathan Co. Pvt. Ltd., 2002.
2. J.N. Gurtu and R. Kapoor, *Advanced Experimental Chemistry (Organic)*, S. Chand and Co., 1987.

PB 2504 - PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

SEMESTER : II
CATEGORY: MC

CREDITS:3
NO. OF HOURS / WEEK: 3

Objectives:

1. To provide knowledge on the comparative studies of steles, sporangia and gametangia in eusporangiate and leptosporangiate groups.
2. To impart knowledge on morphology, anatomy and reproduction of selected Gymnosperms. This course also includes the study of a few representative fossil forms.

Unit I: Pteridophytes A

General characters of Pteridophytes - Homospory and Heterospory – Apospory and Apogamy – Classification (Reimer's 1954) – General structure and ontogeny of eusporangium, leptosporangium and gametangia – life cycle of homosporous and heterosporous Pteridophytes – general survey of divisions: Psilophyta – Lycophyta – Sphenophyta and Filicophyta – stellar system in Pteridophytes – heterospory and seed habit – origin of Pteridophytes.

Unit II: Pteridophytes B

Study of the structure and reproduction in the following forms (no developmental aspects): Sporophyte (morphology, anatomy and reproduction) and gametophyte (structure, sex organs and mature embryo) of *Psilotum*, *Lycopodium*, *Equisetum*, *Adiantum*, *Azolla* and *Marsilea* – Economic importance of Pteridophytes – Indian contribution of Pteridology.

Unit III: Gymnosperms A

General characters – Concept of pro-gymnosperms – Classification (Bierhorst): Characters up to classes only – distribution – salient features of pteridosperms – *Bennettitales*, *Cycadales*, *Cordaitales*, *Coniferales* and *Gnetales* – Affinities and differences with other major vascular plant groups – evolutionary tendencies among Gymnosperms.

Unit IV: Gymnosperms B

Detailed study of structure and reproduction (no developmental aspects) of *Cycas*, *Pinus* and *Gnetum* – comparative anatomy and developmental morphology of gymnosperms – economic importance – Indian contribution to Gymnosperms.

Unit V: Paleobotany

Introduction – fossils – process of fossilization (preservation) – theories of fossilization – types of fossils: unaltered (coal, ice embedded fossils and embedded in Amber) and altered (compression, petrifications, impressions, moulds and casts) – techniques to study fossils – determination of the age of fossils – geological time scale – Father of Indian Paleobotany (Birbal Sahni) and his contribution. Fossils of the nonvascular plants (bacteria, fungi, algae and bryophytes). Fossils of the vascular plants: Pteridophytes: *Rhynia*, *Lepidodendron*, *Calamites*. Gymnosperms: *Williamsonia*.

TEXT BOOKS:

1. Pandey, S.N., Misra, S.P and Trivedi, P.S. 1970. A text book of Botany (Vol II).Vikas Publishing House Pvt. Ltd. Delhi.
2. Reddy, S.M. 1996. University Botany – 1. New age international Pvt. Ltd. Publishers.

3. Srivastava, H.N. 2004. Gymnosperms. Pradeep Publications, Jalandar.

BOOKS FOR REFERENCE:

1. Arnold. 1947. An introduction to Paleobotany. Mc Graw-Hill Book Company. Inc. USA.
2. Sporne, K.R. 1967. The morphology of gymnosperms. Hutchinson & Co. London.
3. Sporne, K.R. 1975. The morphology of Pteridophytes. Hutchinson & Co. London.
4. Pandey, B.P. 1998. College Botany Vol II S. Chand and Company Ltd. New Delhi.
5. Vashishta, P.C. 1999. Pteridophytes. S. Chand and Company Ltd. New Delhi.
6. Vashishta, P.C. 1999. Gymnosperms. S. Chand and Company Ltd. New Delhi.

PB 2506 –CELL BIOLOGY AND EVOLUTION

SEMESTER: II
CATEGORY: MC

CREDITS: 3
NO. OF HOURS / WEEK: 3

Objectives :

1. To make the student to understand the organization of prokaryotic and eukaryotic cell, structure and function of organelles. The student is also given information on cell division.
2. To give an insight into evolution of organisms.

Unit I: Introduction

History, microscopy: Light, dark field, phase contrast, fluorescent, SEM and TEM. Cell Theory – Structure of prokaryotic and eukaryotic cell. Cytoplasm and its properties.

Unit II: Organelles

Structure and function of cell wall, plasma membrane, ribosomes, Endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, lysosomes, peroxisomes and cell inclusions - Organization of nucleus: nuclear envelope, nucleoplasm and nucleolus.

Unit III: Chromosome

Chromosomal nomenclature- chromatids, centromere, telomere, satellite, secondary constriction. Organization of chromosomes- Nucleic acid and histones- types and classification. Lampbrush chromosomes and polytene chromosomes- Karyotype and idiogram.

Unit IV: Cell division

Cell cycle: G₀, G₁, S and G₂ phases – mitosis: open and closed mitosis – amitosis - meiosis.

Unit V: Evolution

Origin of life- theories of organic evolution: Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism, Mutation theory and synthetic theory- speciation and isolating mechanisms. Molecular evolution.

TEXT BOOKS

1. Verma, P.S and V.K. Agarwal, V.K. 2004. Cell Biology, Genetics Molecular Biology, Evolution and Ecology. S. Chand and Co. New Delhi.
2. Karp, G. 2012. Cell and Molecular Biology. John Wiley and sons, New York.
3. Roy, S.C and De, K. 1997. Cell Biology, New Central Book Agency (P) Ltd. Calcutta.

BOOKS FOR REFERENCE:

1. Cooper, G. M 1997. The cell – A molecular Approach, ASM Press Washington
2. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Kaiser, A., Krieger, Scott and Darnell, J. 2007. Molecular Cell Biology. W.H. Freeman. New York.
3. De Robertis E.D.P. and De Robertis E.M.F. 2006. Cell and Molecular Biology, 8th Edition. Lippincott Williams and Wilkins, Philadelphia.

PB 2507 – PRACTICAL II

SEMESTER:II
CATEGORY:MC

CREDITS:3
NO. OF HOURS / WEEK: 3

Pteridophytes, Gymnosperms and Paleobotany

1. Comparative study of morphology, anatomy and soral organization in *Psilotum*, *Lycopodium*, *Equisetum*, *Adiantum*, *Azolla* and *Marsilea*.
2. Morphological and anatomical studies of the genera mentioned for detailed study: *Cycas*, *Pinus* and *Gnetum*.
3. Comparative study of wood anatomy of *Cycas*, *Pinus* and *Gnetum*.
4. Field trip to study fossils.
5. Field trip to an out station to study the flora.
6. Study of economically important Pteridophytes and Gymnosperms and their products.
7. Submission of photographs of at least 10 different Pteridophytes and Gymnosperms.

Cell Biology & Evolution

1. Study of organelles / inclusions.
2. Microscopy.
3. Mitosis (squash)
4. Meiosis (smear)
5. Polytene chromosomes.
6. Measurement of cell dimensions.
7. Spotters on Evolution.

AZ 2104- ANIMAL DIVERSTIY

SEMESTER	: II	CREDITS	: 03
CATEGORY	: AR	NO. OF HOURS / WEEK	: 04

Objectives: To observe the organization, functional morphology and diversity of representative invertebrates and chordates.

UNIT I

Structure, organization and life history of *Entamoeba histolytica* and *Plasmodium vivax*, *Obelia geniculata*.

UNIT II

Structure, organization and life history of ***Taenia solium***, Nematode parasites of man - ***Ascaris*, *Hirudinaria***.

UNIT III

Structure, organization and life history of ***Penaeus indicus*, *Pila globosa***, Star fish.

UNIT IV

Organization of Frog, Calotes, Pigeon and Rat.

UNIT V

Types of chordata eggs; extra embryonic membranes and their functions in chick, placentation in mammals.

SUGGESTED READING

1. Ekambaranatha Ayyar and T.N.Ananthkrishnan, 2008. A manual of Zoology Vol.I & II (Part 1,2) S.Viswanathan, Chennai.
2. Barnes,R.D 2001. Invertebrate Zoology, W.B.Saunders.
3. Verma, P.S., Agarwal, V.K and Tyagi B.S. 1995. Chordate embryology, S.Chand, New Delhi.
4. Berril, N.J. 1971. Developmental Biology, Mc Graw Hill, New York.

AZ 2105- ANIMAL DIVERSITY LAB COURSE

SEMESTER	:	II	CREDITS	:	01
CATEGORY	:	AR	NO. OF HOURS / WEEK	:	02

Objectives: *To observe the organization, functional morphology and diversity of representative invertebrates and chordates*

Unit I: MAJOR DISSECTION

Cockroach: Digestive system, Nervous system. Freshwater mussel: Digestive system
Prawn: Nervous system. Frog: Arterial system, venous system

UNIT II: MINOR DISSECTION

Earthworm: Lateral hearts. Cockroach: Reproductive system

UNIT III: MOUNTING

Cockroach: Mouth parts, salivary apparatus. Earthworm: Body setae. Prawn: Appendages. Frog:
Hyoid apparatus: Brain.

UNIT IV: SPOTTERS

Representatives from each phylum based on structural organization and phylogeny.

UNIT V: RECORD

Submission of certified laboratory record is mandatory.

SUGGESTED READING

1. Lai, S.S. 2005. A Text Book of Practical Zoology: Invertebrate, Rastogi, Meerut.
2. Ekambaranatha Ayyar and T.N.Ananthakrishnan, 2008 A manual of Zoology Vol.I & II (Part 1,2)
S.Viswanathan, Chennai.
3. Barnes, R.D 2001 Invertebrate Zoology, W.B.Saunders, London.

PB 3510 - MICROBIOLOGY

SEMESTER:III
CATEGORY:MC

CREDITS:3
NO. OF HOURS / WEEK:3

Objectives :

- 1. To provide information on the classification, growth, morphology and genetics of microbes and the recent advances in the field of microbiology. The role of microbes as beneficial and as pathogens is also studied.*
- 2. To understand the applied aspects of microbiology in dairy industries, pharmaceuticals, food and waste water.*

Unit I: Introduction

History-place of microorganisms in the living world-major characteristics of microorganisms-Classification-characterization- microscopic examination-staining.

Unit II: Morphology and fine structure of bacteria

Size, shape and arrangement of bacterial cells -ultra structure - cultivation of bacteria: nutritional types-culture media-physical conditions-reproduction: mode of cell division-Growth: normal growth curve-Quantitative measurement of bacterial growth. Pure cultures: methods of isolation-maintenance and preservation.

Unit III: Microbial physiology and Genetics

Microbial enzymes and their application -Energy production: anaerobic-fermentation-aerobic respiration - photosynthesis (basic aspects only)-Bacterial recombination: conjugation – transduction – transformation.

Unit IV: Viruses

General characteristics – structure - composition and classification–cultivation-replication – Bacteriophages: morphology & structure of T4 and λ phage -classification- viral vaccines: Rabies and HIV.

Unit V: Applied microbiology

Microbial flora- rhizosphere - Biogeochemical cycles-N, C, P, S- VAM fungi- importance, Aquatic microbiology –domestic wastes and sewage: water purification-bacteriological evidence of pollution-techniques. BOD - municipal treatment process.

Food microbiology: microbial flora-microbial spoilage-preservation-fermented foods

Industrial microbiology: major classes of products – Production of Lactic acid- Vinegar- Alcohol- Penicillin.

TEXT BOOKS:

1. Pelczar, Chan and Kreig, 1993. Microbiology – 5th edition, Tata Mc Graw-Hill Co Ltd. New Delhi.
2. Ananthanarayanan, R and Panicker, C.K.J. 2002. Text book of Microbiology. VI Edition, Orient Longman, Chennai

BOOKS FOR REFERENCE:

1. Buge, E. 1992. Modern Microbiology – Principles and Application – WMC Brown Publishers.
2. Volk Wesley and Wheeler, 1980. Basic Microbiology – J.B. Lippincott and Co. Philadelphia, USA.
3. Perry, J.J. and Staley, J.T. 1997. Microbiology: Dynamics and Diversity, Saunders College Publishing – USA.
4. Powar, C.B. and Dagainawala, 1991. General Microbiology Vol I and II – Himalaya Publishing house, Bombay.
5. Prescott, Haley, Klein, 1993. Microbiology-WCB Publishers, England, II Edition

PB 3511 – PLANT ANATOMY

SEMESTER: III
CATEGORY:MC

CREDITS:3
NO. OF HOURS / WEEK:3

Objective : *To make the student to become familiar and to understand the plant cell, tissues, and internal structures of stem, root and leaves.*

Unit I: Plant cell structure and tissues

Plant cell structure – nature of plant cell wall.

Tissue and tissue systems - meristematic tissue, permanent tissue and secretory cells

Unit II: Morphogenesis and Differentiation

Morphogenesis in plants -Differentiation of stem, root and leaf - Vascular bundles and Vascular cambium.

Unit III: Organization of meristems

Meristems – types of meristems: apical, intercalary and lateral; primary meristem and secondary meristem.

Apical meristems – theories on organization of meristems – apical cell theory, Tunica-Corpus theory and histogen theory.

Unit IV:Anatomy of stem and root

Structure of Dicot stem – primary and secondary structure; Structure of Monocot stem; Nodal anatomy.

Structure of Dicot root– primary and secondary structure; Structure of monocot root.

Unit V:Anatomy of leaf and anomalous secondary growth

Leaf anatomy – dorsiventral and isobilateral; Stomatal types

Anomalous secondary growth – *Bignonia, Aristolochia, Boerhaavia* (dicot stem) *Dracaena* (monocot stem).

TEXT BOOKS

1. Vashishta, P.C. 1997. Plant Anatomy, Pradeep Publications.
2. Fahn, A.1992. Plant Anatomy. Pergamon Press

BOOKS FOR REFERENCE:

1. Esau, K. 1990. Plant Anatomy. Wiley Eastern Pvt Ltd New Delhi.

**PB 3512 - PRACTICAL - III
(MICROBIOLOGY AND PLANT ANATOMY)**

**SEMESTER: III
CATEGORY:MC**

**CREDITS:3
NO. OF HOURS / WEEK:3**

MICROBIOLOGY

1. Principles of Microscopy – microbial photographs.
2. Model preparation – shape & arrangement of bacteria.
3. Sterilization: moist heat – dry heat- radiation- filtration.
4. Preparation of culture media.
5. Pour plate- spread plate, streak plate-serial dilution – hanging drop.
6. Microbial examination of different habitats.
7. Smear preparation – Gram staining, endospore staining, capsular staining and fungal staining, IMVIC test.
8. Industrial products as mentioned in theory.
9. Microbial enzyme screening: amylase, protease, lipase, cellulase.
10. Visit to microbiological lab/ microbe based industry.

ANATOMY

1. Tissue types
2. Organization of Apical meristems.
3. Anatomy of dicot stem (*Tridax*) and monocot stem (*Brachiaria*) – Primary structure.
4. Anatomy of dicot root (bean) and monocot root (*Canna*) – Primary structure.
5. Anatomy of dicot stem (Neem) – Secondary structure.
6. Anatomy of dorsiventral leaf (mango) and isobilateral leaf (grass).
7. Stomatal types
8. Anomalous secondary growth - *Bignonia*, *Aristolochia*, *Boerhaavia* (dicot stem) *Dracaena* (monocot stem).
9. Nodal anatomy.
10. Maceration of wood samples to study tracheids and vessels – micrometry.

PB 4510 - ANGIOSPERM TAXONOMY AND ECONOMIC BOTANY

SEMESTER: IV
CATEGORY:MC

CREDITS:3
NO. OF HOURS / WEEK:3

Objectives:

1. To know the basic principles involved in classification, naming and identification of angiospermic plants.
2. To expose the students to the diagnostic features of selected families and to know the economically important plant products and their utilization.

Unit I: Taxonomy- fundamentals

Taxonomy: Definition, Objectives, Importance, Scope - Conceptual bases of plant classification with the following: Linnaeus, Bentham & Hooker, Engler and Prantl - taxonomic hierarchy - Sources of taxonomic characters: Morphology, Anatomy, Embryology, Cytology, Palynology and Phytochemistry – Botanical keys: Construction of dichotomous keys – Indented and bracketed keys.

Unit II: Nomenclature and Herbarium techniques

Plant nomenclature: history and development, major provisions of the International Code of Botanical Nomenclature (ICBN). Effective and Valid publication, Rule of Priority and its typification – author citation- rejection and retention of names – Herbarium techniques – Modern trends in Plant taxonomy: Biosystematics, numerical taxonomy, cladistics and molecular taxonomy.

Unit III: Type studies - I

Detailed study of the diagnostic characteristics and economic importance of the following Angiospermic families: Dicotyledones: Polypetalous: *Annonaceae*, *Rutaceae*, *Caesalpinaceae*, *Capparidaceae*, *Anacardiaceae*, *Cucurbitaceae*.

Unit IV: Type studies - II

Detailed study of the diagnostic characteristics and economic importance of the following Angiospermic families: Gamopetalae: *Rubiaceae*, *Apocynaceae*, *Solanaceae*, *Acanthaceae*, *Lamiaceae* - Monochlamydeae: *Amaranthaceae*, *Euphorbiaceae*- Monocot: *Orchidaceae*, *Poaceae*.

Unit V: Economic Botany

A brief study of the following economic plants products with their botanical name, family, uses and morphology of the useful parts of any five cereals, millets, pulses, beverages, narcotics, spices, condiments, essential oils, medicinal plants, fibre and timber yielding plants.

TEXT BOOKS:

1. Rao K.N. and Krishnamurthy, K.V., 1994. Angiosperms. S. Viswanatham & Co.
2. Pandey, B.P., 1992. Economic Botany. S. Chand & Co, New Delhi.
3. Gurcharan Singh, 2005. Plant Systematics (2nd ed.) Theory and Practice. Oxford and IBH Publishing Co. Pvt. Ltd.,

BOOKS FOR REFERENCE :

1. Pandey B.P. 2000. Simplified course in Botany. S. Chand and Company Ltd. New Delhi.
2. Mitra J.N. Mitra D and Chowdhuri S.K. 1990. Studies in Botany (vol.I) Mont Library, Calcutta./
3. Narayanaswami R.V. Rao K.N. and Raman, A 2000. Outlines of Botany. S. Viswanathan and Co. Chennai.
4. Verma V. 1998. A text book of Economic Botany. Emkay Publications. New Delhi.

PB 4511 – EMBRYOLOGY OF ANGIOSPERMS

SEMESTER: IV
CATEGORY: MC

CREDITS: 3
NO. OF HOURS/WEEK: 3

Objectives: *This course enables the students to understand the lifecycle of angiospermic plant development and the various processes that are involved.*

Unit I: Microsporangium and pollen grains

Introduction – Life cycle of Angiosperms- Flower and its parts – Structure and development of anther – Microsporangium – Microsporogenesis – Microspores – Ultrastructure of pollen grain – Types of pollen grains – Palynology – Pollen morphology – NPC system – Branches of Palynology – Applications of palynology.

Unit II: Megasporangium and female gametophyte

Megasporangium – Development of ovule – Types of ovules – Structure of the ovule – Megasporogenesis – Female gametophytes – Development of embryo sac – Structure of mature embryo sac – Types : Polygonum, Allium and Peperomia types (structure and development) – Haustorial behavior of embryo sac – Nutrition of embryo sac.

Unit III: Pollination and fertilization

Pollination : Self and cross pollination – Contrivances for self and cross pollination – mode of cross-pollination – Anemophily, Hydrophily, Entomophily, Zoophily. Male gametophyte (Pollen tube formation) – Pollen germination. Fertilization: Syngamy – double fertilization and triple fusion – post fertilization changes.

Unit IV: Endosperms and embryogeny

Endosperms: types – Ruminant endosperm, Mosaic, Oily, Composite – development and function– Endosperm haustoria – Cytology - Functions – Embryogeny : development of embryo in dicot (*Capsella*) and monocot (*Luzula*) – Suspensor.

Unit V: Polyembryony and Apomixis

Polyembryony – Types of polyembryony – Adventive polyembryony – Causes of polyembryony – Significance of polyembryony. Apomixis – Formation of seed and fruit. Parthenocarpy – Types of parthenocarpy – Induction of parthenocarpy – Applications.

TEXT BOOKS

1. Annie Ragland, 2009. Developmental Botany, Saras Publications, Nagercoil.
2. Singh, V., Pande, P. C. and Jain, D. K., 1997. Embryology of Angiosperms, Rastogi Publications, Meerut.
3. Ganguly, A. K. and Kumar, N.C., 2008. Developmental and Experimental Embryology of Angiosperms. Emkay Publications, Delhi.
4. Bhojwani, S. S. and Bhatnagar, S. P., 2009. The Embryology of Angiosperms, Vikas Publishing House Pvt. Ltd., New Delhi.

BOOKS FOR REFERENCE

1. Maheswari P, 1971. An Introduction to the Embryology of Angiosperms. Tata McGraw Hill Publishing Co., Ltd., New Delhi.
2. Swamy, B. G. L. and Krishnamurthy, K.V., 1980. From flower to fruit. Tata McGraw Hill

Publishing company Ltd., New Delhi.

3. Dwivedi, J. N., 1988. Embryology of Angiosperms. Rastogi and Co. Meerut.
4. Pandey, B. P., 1995. Embryology of Angiosperms. S Chand & Co. New Delhi.

PB 4512 PRACTICAL - IV
ANGIOS.TAXONOMY, ECO. BOTANY AND EMBRYOLOGY

SEMESTER: IV
CATEGORY: MC

CREDITS: 3
NO. OF HOURS / WEE: 3

Taxonomy

1. Study of diagnostic characters mentioned in the theory syllabus (1 material / family)
Dicotyledons: Polypetalae: *Annonaceae, Rutaceae, Caesalpinaceae, Capparidaceae, Anacardiaceae, Cucurbitaceae.* Gamopetalae: *Rubiaceae, Apocynaceae, Solanaceae, Acanthaceae, Lamiaceae.*
Monochlamydeae: Amaranthaceae, Euphorbiaceae **Monocotyledons:** *Orchidaceae* and *Poaceae.*
2. Submission of 15 herbarium sheets (1 material from each family). Herbarium sheets to be submitted during the model practical examination.
3. Use of dichotomous key in the classification of the given specimens.
4. Economically important plant products of the families mentioned in unit III and unit IV of the theory syllabus.

Economic Botany:

1. Economically important plant products mentioned in unit V of the theory syllabus.
2. Submission of 5 economically important products with information on binomial, vernacular name and nature of product.

Embryology of Angiosperms

1. T.S of Anther at various stages of development
2. Structure of pollen grains using whole mounts (*Catharanthus, Hibiscus, Acacia, Grass*)
3. Pollen viability test using *in-vitro* germination (*Crinum/Catharanthus*)
4. Types of ovules (Permanent slides)
5. Isolation of pollinium (*Calotropis*)
6. L. S. of monocot embryo (Maize)
7. L.S. of oily endosperm (*Ricinus*)
8. Perisperm (*Piper*)
9. Embryo mounting (*Tridax*)

PB 5411 PHYTOCHEMICALS

SEMESTER: V
CATEGORY: ES

CREDITS: 2
NO. OF HOURS/WEEK: 3

Objective: *The main objective is to provide an overview of the plant derived natural products for their occurrence, sources, basic chemistry and therapeutic applications.*

Unit I: Introduction

Plant natural products - History- general significance- classification- list of floral sources- general detection, extraction and characterization procedures.

Unit II: Glycosides and Flavonoids

Glycosides: Classification, therapeutic value, chemical properties & tests for identification.

Flavonoids: Sources, classification, biogenesis, extraction, isolation, identification and therapeutic applications.

Unit III: Anthocyanins and Coumarins

Anthocyanins : Sources, classification, extraction, isolation, identification and therapeutic applications.

Coumarins: Sources, classification, biosynthesis - furanocoumarins and pyranocoumarins: pharmacological properties and photo-toxicity.

Unit IV: Lignans, Terpenes, Volatile oils and Saponins

Lignans and Neolignans: classification, natural sources and pharmacological applications.

Terpenes: Classification, biosynthesis, origin of 5-carbons isoprene unit, head to tail coupling and tail-to-tail coupling of isoprene units - Volatile Oils: Classifications, sources, medicinal and non-medicinal uses - Saponins : Sources, classification, physical and biological properties)

Unit V: Carotenoids and Alkaloids

Carotenoids: Sources, biogenesis, classification and therapeutic values.

Alkaloids: Classification, distribution in nature, localization, nomenclature, physico - chemical properties, extraction, detection, isolation, purification, biosynthetic origin and pharmacological activities.

TEXT BOOKS

1. Agarwal, O. P. 2002. Organic chemistry – Chemistry of organic natural products. Vol. II. Goel publishing house , Meerut.
2. Farooqui, A. A. and Sreeraman, B. S. 2001. Cultivation of medicinal and aromatic crops. Universities Press.
3. Harborne, J. B. 1998. Phytochemical methods – a guide to modern techniques of plant analysis 3 rd edition, Chapman and Hall.
4. Yesodha, D., Geetha, S and Radhakrishnan, V. 1997. Allied Biochemistry. Morgan publications, Chennai.

BOOKS FOR REFERENCE:

1. Gurdeep Chatwal, 1980. Organic chemistry of natural products. Vol. I. Himalaya Publishing house.
2. Kalsi, P. S. and Jagtap, S., 2012. Pharmaceutical medicinal and natural product chemistry. N.K. Mehra for Narosa Publishing House Pvt. Ltd. New Delhi.

PB 5412 AGRICULTURE AND HORTICULTURE

SEMESTER: V
CATEGORY : ES

CREDITS: 2
NO. OF HOURS/WEEK : 3

Objectives:

1. To expose the students to the basic principles of agriculture and agricultural practices.
2. To provide the students a theoretical knowledge of horticulture so as to establish home gardens scientifically.

Unit I: Agriculture in India

Introduction to Agriculture, Green revolution and its Impact. Classification, Types of cropping pattern: Kharif, Rabi and Ziad crops. Soil factors: types of Indian soil, Physical, chemical and biological properties. Mineral and organic constituents of soils and their role in maintaining soil productivity. Essential plant nutrients and other beneficial elements in soils and plants. Use of fertilizer. Role of Nitrogen and phosphorus based fertilizers. Organic farming and Biofertilizers.

Unit II: Basic practices of crop production

Preparation of soil: Seed bed/ field preparation, ploughing, harrowing – Sowing: types of sowing, transplanting - Adding manure and fertilizers - Irrigation: resources, types of Irrigation- Protecting crops from weeds: Weeds, their characteristics, dissemination and association with various crops. Control measures: intercultivation, chemical and biological methods. Diseases in crops and general control measures - Harvesting and post-harvest technology and storage methods.

Unit III: Cultivation of crops

Agronomic practices (varieties, climatic condition, soil, field preparation, manuring, seed sowing, watering, application of fertilizers, irrigation, crop protection and harvesting followed in paddy, legumes, sugarcane, Banana and Mango.

Unit: IV: Horticulture Introduction

History of gardening in India – famous gardens in India. Garden implements and accessories. **Nursery structure:** Store house, potting and packing shed, nursery beds, mist chamber, propagating frames, hot beds, green house and glass house. Nursery management: Vegetative propagation – cuttage, layerage, graftage cultivation of plants by pot method. Bonsai plants.

Unit V: Garden features and operations.

Garden and its components: Fencing hedge, borders, flower beds, edgings, lawn, steps, drives and paths, water garden, rockery, shrubbery and carpet bedding. Terrace gardening, roof gardening and Garden adornments. **Routine garden operations:** Soil sterilization, seed sowing, prickling, planting and transplanting, shading pinching, deshooting, disbudding, defoliation, staking, pruning, wintering, clipping, mulching and topiary. Cultural practices of rearing rose and jasmine. Cut flowers and its importance. Methods to prolong cut flowers life.

TEXT BOOKS

1. Kumar Arvind, 2006. Concepts of Tropical Agriculture. Eastern Books Corporation. India.
2. Panda, S.C. 2005. Agronomy. Agrobios. Jodhpur.
3. Shovan Ray (Ed). 2007. Handbook of Agriculture in India. Oxford University Press. New Delhi.
4. Randhawa, G.S. and Amitabha Mukhopadhyay, 1986. Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.

5. George Acouaah, 2002. Horticulture Principles and Practices. 2nd edition. Pearson Education (Singapore) Pvt. Ltd.,

BOOKS FOR REFERENCE:

1. Shovan Ray (Ed). 2007. Handbook of Agriculture in India. Oxford University Press. New Delhi.
2. Edmund, Senn and Andrews, 1981. Fundamentals of Horticulture. Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. Percy Lancaster, 1979. Gardening in India. Mohan Makhijani and Rekha Printers, New Delhi.

BIOINSTRUMENTATION AND BIOSTATISTICS

SEMESTER: V
CATEGORY:ES

CREDITS:2
NO. OF HOURS / WEEK: 3

Objectives:

1. To understand working principle of various instruments used in biological studies.
2. To provide details on the application of statistical methods in biology.

Unit I: pH and Centrifugation

pH meter: Principles and instrumentation, Centrifugation : Principles, types of centrifuges, types of rotors, application. Sonication, Freeze drying.

Unit II: Spectrophotometry

Spectrophotometric techniques, Instrumentation: ultraviolet and visible spectrophotometry (single and double beam, double wavelength spectrophotometers) Infrared spectrometers - Plasma atomic emission spectroscopy - Luminometry and densitometry – principles and their applications - Mass Spectroscopy- principles of analysis, application.

Unit III: Chromatography

Chromatographic techniques: Principle and applications – Column - thin layer - paper and gas chromatography - Gel filtration - Ion exchange and High performance liquid chromatography - Examples of application for each chromatographic system - Basic principles of electrophoresis.

Unit IV: Biostatistics

Collection and presentation of data: Statistical methods - Basic statistics - measures of dispersion - Probability - simple correlation - linear regression analysis.

Unit V: Biostatistics

Fundamentals of normal - binomial and poison distribution - Population and samples –methods of sampling - analysis of variance - Computer application in biostatistics - MS Excel and SPSS .

Suggested Readings:

1. Bajpai, P.K. 2006. Biological Instrumentation and methodology. S. Chand & Co. Ltd.
2. K. Wilson and J. Walker Eds. 2005. Biochemistry and Molecular Biology. Cambridge University Press.

3. K. Wilson and KH Goulding. 1986. Principles and techniques of Practical Biochemistry. (3 edn) Edward Arnold, London.
4. Sharma A.K. 2005. Text Book Of Biostatistics I, Discovery Publishing House.
5. Annadurai, B. 2007. Text Book of Biostatistics. New Age International.
6. Gurumani, N. 2010. An Introduction to Biostatistics (2nd Edn). MJP Publishers.

PB 5414 –PHYTOGEOGRAPHY AND FORESTRY

SEMESTER: V
CATEGORY: ES

CREDITS: 2
NO. OF HOURS/WEEK: 3

Objective:

To introduce the students to the essential basics of phytogeography and forestry of India.

UNIT I:Phytogeography.

Phytogeography: Types of plant distribution: Continuous distribution; cosmopolitan, circumpolar, circumboreal or circumaustral, and pantropical; Discontinuous distribution; Theory of land-bridge, theory of continental drift, theory of polar oscillations or Shifting of poles, glaciations. Centers of origin and diversity of plants; Methods of dispersal, migrations and isolation; Theory of area and theory of tolerance. Factors influencing plant distribution; Migration of floras, and Evolution of floras. Floristic regions of the world: Vegetation Zones in relation to latitudes and altitudes; a brief account of the phytochoria of the Indian subcontinent; Endemics: Neo and relics.

Unit II: Deforestation and forest protection

Destructive forces: Shifting cultivation, fire losses and bad grazing practices. Destructive agencies: insect-pests and disease. Forest protection: Forest enemies, poaching, encroachment, improper management, damages by animals, birds, parasitic plants and climatic factors. Biological and chemical control. General forest protection against forest fire and grazing. Afforestation, reforestation and effect of wild animals on forest regeneration. Role of tribals in forest preservation. Sanctuaries, National parks, Reserve forests, Sacred groves and Biosphere reserves.

Unit III: Silviculture

General silvicultural principles; ecological and physiological factors influencing vegetation; natural and artificial regeneration of forests; nursery techniques; seed technology collection, storage, pre-treatment and germination; establishment and tendings. Silvicultural systems-clear felling, uniform, shafter-wood, selection, coppice and conversion systems. Social forestry-objectives, scope, necessity; agro-forestry; extension forestry: recreation forestry; people's participation.

Unit IV: Forest Mensuration, Management and Utilization

Methods of measuring-diameter, girth, height and volume of trees; form factor; volume estimation of stand: sampling methods; yield calculation; current annual increment; mean annual increment; sample plots; yield and stand tables; scope and objectives of forest inventory; aerial survey and remote-sensing techniques. Forest management-objectives and principles; techniques; sustained yield relation; normal forest; growing stock; regulation of yield-methods of application; working plans-preparation and control. Forest utilisation: Logging and extraction techniques and principles; transport, storage and sale. Minor and major forest product : definition and scope. Collection, processing and disposal of minor and major forest products.

Unit V: Forest Economics, Policies and Legislation

Fundamental principles of forest economics; Cost-benefit analysis; estimation of demand and supply; assessment and projection of market structures; role of corporate financing; socio-economic analyses of

forest productivity and attitudes. ; Indian Forest Policy of 1894 and 1952; National Commission on Agriculture-report on forestry; Constitution of Wasteland Development Board, Indian Council of Forestry Research and Education. Forest laws; necessity; general principles; Indian Forest Act, 1927; Forest Conservation Act, 1980; Wild-life (Protection) Act, 1972.

TEXT BOOKS

1. McManus B. Collins and Fred M White, 1981. *Elementary Forestry*. Reston Publishing Company, Inc., Reston, Virginia.
2. MacDonald, G. 2003. *Biogeography: Introduction to Space, Time and Life*. John Wiley & Sons, Inc.
3. Sagreiya, K.P., 1967. *Forests and Forestry*. National Book Trust, India.

BOOKS FOR REFERENCE

1. Dwivedi, A.P., 1993. *A Text Book of Silviculture*. International Book Distributors, Dehra Dun.
2. Lal, J.B., 2003. *Tropical Silviculture: New Imperatives: New Systems*, International Book Distributors, Dehra Dun.
3. Longman, K.A. and Jenik, J., 1987. *Tropical forest and its Environment*: ELBS, 2nd edn. London.
4. Shanmughavel, P., 2003: *Techniques in Forestry*, Pointer, Jaipur.
5. Simmons, I. G. 1979. *Biogeography: Natural and Cultural*. Edward Arnold Ltd.
6. Tiwari, K.M. and Singh, R.V., 1984. *Social Forestry Plantations*. Oxford & IBH Publishing Co., New Delhi.

PB 5521 - PLANT PHYSIOLOGY

SEMESTER:V
CATEGORY:MC

CREDITS:3
NO. OF HOURS / WEEK:3

Objectives:

1. To provide an insight into the physico-chemical organization and the functional aspects of plants.
2. To orient the students to understand effectively the concepts on morphogenesis and ultimately plant biotechnology.

Unit I: Plant and Water relations

Water – Properties and its relation to plants. Movement of water from soil to plants- Imbibition, Diffusion, Osmosis, Plasmolysis and Diffusion Pressure Deficit (DPD). Mechanism of water absorption and ascent of sap. Stomatal physiology– Transpiration, Guttation and Antitranspirants.

Unit II: Mineral nutrition and absorption in plants

Essential and non-essential elements, determination of essentiality of mineral elements, general functions of essential elements: specific role and deficiency symptoms. Soilless growth or hydroponics, aeroponics. Absorption and translocation of solutes – active & passive uptake, Donnan's potential.

Unit III: Photosynthesis

Photosynthesis: Definition and its significance. Photosynthetic requirements – chloroplast and its pigments, Absorption of light energy, Excitation of atom or molecules- fluorescence and phosphorescence, Quantum requirements and yield. Red drop and Emerson's enhancement effect, quantosomes, action spectrum – mechanism of photosynthesis: light reaction, photophosphorylation and production of assimilatory power, dark reaction or path of carbon in photosynthesis, C₃ & C₄ pathway. CAM pathway, glycolate pathway, Rubisco and essential fundamentals of translocation of organic solutes.

Unit IV: Respiration and nitrogen assimilation

Glycolysis, Krebs cycle and generation of ATP synthesis through oxidative electron transfer chain (Cytochrome system), chemiosmotic regeneration of ATP, Gluconeogenesis, photorespiration.

Sources of nitrogen – plants/soil, nitrogen assimilation and recycling, symbiotic nitrogen fixation in legumes, amino acid synthesis, reductive and transamination process. Relation between carbon and nitrogen metabolism.

Unit V: Plant Growth and Development

Growth: definition and kinetics- Hormonal regulation of plant growth and development Auxin, Gibberellic acid, Cytokinin, Ethylene and abscisic acid- Bioassay and mode of action. Physiology of flowering: Photoperiodism – Vernalization – dormancy of seeds, methods of breaking dormancy, mechanism of germination of seeds – Basics of signal transduction in plant.

TEXT BOOKS :

1. Devlin, O.P. 1974. Plant Physiology, Affiliated East West Press Pvt. Ltd.
2. Jain, V.K. 2005. Text Book of Plant Physiology, S. Chand & Company Ltd., New Delhi

BOOKS FOR REFERENCE:

1. Noggle, G.R. & Fritz, G. 1976. Introductory Plant Physiology, Prentice – Hall, India
2. Taiz Zeiger, Plant Physiology, II edition, 2002, Sinauer Associates, Inc Pub Sunderland, Massachusetts
3. Salisbury, F.B. & Ross, S. 1974. Plant Physiology, Prentice – Hall, India

PB 5522 – GENETICS AND PLANT BREEDING

SEMESTER:V

CREDITS:3

CATEGORY:MC

NO. OF HOURS / WEEK:3

Objectives:

1. To understand the principles of genetics and transfer of hereditary characters.
2. To make the student to understand the mechanisms of gene expression and its regulation.
3. To understand the process of crop improvement and hybridization.

Unit I: Basic concepts of genetics

History; branches of genetics and application of genetics. Mendelism Mendel's laws- law of segregation and law of independent assortment. Monohybrid crosses and its modification (incomplete dominance, codominance, heterodominance, lethal genes and pleiotropism)- Dihybrid cross.

Unit II: Gene interaction and Sex linked inheritance

Complementary genes, supplementary genes, epistatic genes, duplicate genes – polygenic gene interaction - sex linked inheritance : haemophilia and colour blindness in man - Sex determination in plants - Multiple alleles - cytoplasmic inheritance – linkage and crossing over – chromosome mapping- Genetic recombination: *Neurospora* tetrad formation.

Unit III: Molecular Genetics

Genetic material in prokaryotes and eukaryotes. DNA as the genetic material ; structure and organisation of DNA; Supercoiling of DNA. Replication of DNA ; semiconservative model of replication. Gene and its organization; the genetic code; cistron, recon and muton. Transcriptional and post transcriptional modifications; translation; Regulation of gene expression.

Unit IV: Chromosomal aberrations and Gene Mutations

Chromosomal aberrations: duplication, deletion, inversion, translocation; Examples of chromosomal aberrations: Down syndrome and Klinefelter's syndrome. Mutation and its significance - Addition, deletions, substitutions: transitions and transversions. Mutagens – physical and chemical agents- Transposable elements in plants - DNA repair: proof reading – mismatch repair, excision repair, dark reactivation, recombinational repair and SOS- repair mechanisms.

Unit V: Plant breeding

Principles and objectives of Plant Breeding: Importance of plant breeding in India. Domestication and centres of origin of cultivated plants - Plant introduction - Selection methods: mass. Pure line and clonal selection and their importance. Hybridization: types, selection of parents; Methods-emasculation, bagging – heterosis – polyploidy and its role in plant breeding – Genetic erosion: reasons and preventive methods.

TEXT BOOKS :

1. Chahal, G.S. and Gosal, S.S. 2002. Principles and procedures of plant Breeding. Narosa Publishing House. New Delhi.
2. Singh, B.D. 2005. Plant Breeding, principles and methods (7th Revised and enlarged edition). Kalyani publishers, New Delhi.
3. George M. Malacinski, 2005. Freifelder's Essentials of Molecular Biology. 4th edition. Narosa Publishing House, New Delhi
4. Gupta, P.K. 2007. Genetics - Classical to modern. Rastogi Publications, Meerut, India.
5. Sambamurty, A.V.S.S., 2005. Genetics- second edition. Narosa publishing House, New Delhi.

BOOKS FOR REFERENCE :

1. George W. Burns, 1969. The Science of Genetics. An introduction to heredity. The Macmillan company. New York.
2. Karp, G. 1996. Cell and Molecular biology. John Wiley and sons Inc. New York, Singapore.
3. Gardener, J, Simmons, H.J and Snustad, D.P. 1991. Principles of Genetics (8th edition), John Wiley & Sons, New York.
4. Daniel Sundarraj and Thulasidas, G. 1972. Introduction to cytogenetics and Plant Breeding (III Edn.) Popular Book Depot. Madras.
5. Darbeshwar Roy, 2012. Plant breeding - A biometrical Approach. Narosa Publishing House, New Delhi.

PB 5523 - PLANT DISEASES AND MANAGEMENT

SEMESTER:V
CATEGORY:MC

CREDITS:3
NO. OF HOURS / WEEK:3

Objectives:

1. To study about the plant diseases with special reference to southern India.
2. To understand the diseases, symptoms, causal organisms – etiology of the diseases and control measures.

Unit I: Plant Diseases

Introduction, Concept, importance, history, classification, diagnosis and identification – Koch's postulates. Basic concepts of infection: Inoculum, inoculum potential, predisposition, penetration,

infection, invasion, growth, reproduction and dispersal – Methods of infection: Mechanical forces and chemical weapons (enzymes, toxins and growth regulators). Pathogenic impacts: changes in the host (morphological, anatomical, physiological and biochemical).

Unit II:

Environmental impacts on disease development and epidemics Light, temperature, humidity and soil. Defence mechanisms: *Innate*: surface structures – structure of natural openings – inhibitors – suberised, lignified tissue – gum deposition – phenols – phenolic glycosides. *Induced*: hypersensitivity – histological – cork – abscission – biochemical: phenols and phytoalexins. Fundamental concepts on cross protection and induced resistance.

Unit III: Symptomatology

Study of the following diseases with reference to their incitants, symptom manifestation and control measures.

a) Fungal diseases:

- | | |
|------------------------------------|---------------------------|
| 1. Damping off of Mustard seedling | 6. Rust of wheat |
| 2. Club root of cabbage | 7. Blast of Rice |
| 3. Powdery mildew of cucurbits | 8. Wilt of tomato |
| 4. Ergot of Rye | 9. Tikka of Groundnut |
| 5. Smut of Sorghum | 10. Red rot of Sugar cane |

Unit IV: Symptomatology

Study of the following diseases with reference to their incitants, symptom manifestation and control measures.

- a) Bacterial diseases : Bacterial blight & Citrus canker.
- b) Mycoplasmal disease: Little leaf of brinjal.
- c) Viral diseases : Tobacco Mosaic Virus (TMV) & Tungro disease of Rice.
- d) Nematode disease : Root knot disease of Potato.
- e) Insect disease: Galls.
- f) Other parasitic diseases of plants : *Cuscuta*.

Unit V: Plant disease control

Concepts on prophylaxis.

Exclusion: Legislation – plant quarantine principles.

Eradication – crop rotation, field sanitation, elimination of alternate hosts, soil treatment and seed treatments.

Management strategies: chemical, environmental and – Disease forecasting.

Microbial antagonists: Bacterial, Fungal and viral (mode of action, mass production and field application). Engineered resistance against fungal, viral and bacterial pathogens.

TEXT BOOKS :

1. Mehrotra. R.S. 1980. Plant pathology. Tata McGraw Hill, New Delhi.
2. Rangaswamy, G. 1975. Diseases of crop plants in India. 2nd Edn. Prentice Hall, India

BOOKS FOR REFERENCE :

1. Bilgrami, K.S. and Dube, H.C. 1976. A text book of modern plant pathology. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Pandey B.P. 1989. A text book of plant pathology, pathogen and plant diseases. S. Chand and Company Ltd., New Delhi.

3. Mukerji, K.G. & Bhasin, J. 1972. Plant diseases of India – A source book. Tata McGraw Hill, New Delhi.

PB 5524 - ETHNOBOTANY AND HERBAL SCIENCES

SEMESTER: V

CREDITS:3

CATEGORY:MC

NO. OF HOURS / WEEK:3

Objectives:

1. To know the elementary treatment of various morphological, anatomical and biochemical parameters used in the identification and utilization of medicinal plants in general.
2. To provide an overview of ethnobotany, methods of herbal preparation, tribal medicine and their importance in present day drug research.

Unit I: Ethnobotany I

Introduction, origin and basic notion of ethnobotanical study - Ethnobotany as an emerging science and its scope - Ethnobotany in India: Areas and recent studies - Methodologies of ethnobotanical research: Field work, Literature, Herbaria and Musea and other aspects of ethnobotany. Importance of ethnobotany in Indian systems of medicine (Siddha, Ayurveda and Unani), Role of AYUSH, NMPB, CIMAP and CARI.

Unit II: Ethnobotany II

Basic knowledge of tribes in India with special reference to Tamil Nadu - Todas, Irulas and Paliyars. Tribal economy - Schemes of state forests department for tribal development - Tribal knowledge towards disease diagnosis, treatment, medicinal plants, plant conservation and cultivation.

Unit III: Pharmacognosy

Introduction - history of Pharmacognosy - definitions and terms - Basic concepts: Preparation of drugs for commercial market - Organoleptic evaluation of drugs - Microscopic evaluation of drugs - Physical evaluation of drugs - Active and inert constituents of drugs - Classification of drug plants - individual drugs - drug adulteration.

Unit IV: Organoleptic Study

Detailed organoleptic study of *Adhatoda vasica*, *Andrographis paniculata*, *Azadirachta indica*, *Coriandrum sativum*, *Datura metel*, *Eclipta alba*, *Emblica officinalis*, *Ocimum sanctum*, *Phyllanthus amarus*, *Ricinus communis*, *Vinca rosea* and *Zingiber officinale*. Plants in primary health care: common medicinal plants: *Tinospora*, *Acorus*, *Ocimum*, *Turmeric* and *Aloe*. Intellectual Property Rights (IPR) - Export potential of herbs.

Unit V: Herbal Preparations

Collection of wild herbs - Capsules - compresses - Elixirs - Glycerites - Hydrotherapy or Herbal bath - Herbal oils - Liquid extracts or Tincture - Poultices - Salves - Slippery elm slurry and gruel - Suppositories - Teas. Outline of occurrence, isolation, identification tests, therapeutic effects and pharmaceutical application of alkaloids, terpenoids, glycosides, volatile oils, tannins and resins.

TEXT BOOKS :

1. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.
2. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
3. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.
4. Sharol Tilgner, N. D. 1999. Herbal medicine - From the heart of the earth. Edn. 1, Printed in the USA by Malloy Lithographing Inc.

BOOKS FOR REFERENCE :

1. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.
2. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizoms drugs. Bulletin No.1 Ministry of Health, Govt. of India.
3. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.
4. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.
5. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today& Tomorrow's printers and publishers, New Delhi.

PB 5525 PRACTICAL V

(Plant Physiology, Genetics and Plant Breeding)

SEMESTER: V
CATEGORY:MC

CREDITS:6
NO. OF HOURS / WEEK:6

Plant Physiology

1. Potato osmoscope.
2. Determination of water potential by Dye method.
3. Determination of osmotic pressure.
4. Determination of relative water content.
5. Transpiration
6. Estimation of chlorophyll and carotenoids.
7. Separation of leaf pigments by paper chromatography.
8. Wilmott's Bubbler on photosynthesis using different light and carbon di oxide concentration.
9. Estimation of carbohydrates, protein and total lipids
10. Respiroscope- Demonstration
11. Separation of leaf pigments by column chromatography - Demonstration.
12. Plant growth regulators- Demonstration.

Genetics and Plant Breeding

1. Biometry.
2. Problems on Mendelian Genetics.
Monohybrid cross and modification.
Dihybrid and modification.
- 3 Mapping of chromosomes.
- 4 Chi square analysis.
- 5 Percent seed germination study.
- 6 Seed viability test using tetrazolium salt.
- 6 Demonstration on emasculation.
7. Spotters related to plant breeding
- 7 Chromosomal abnormality study using onion root tip.
- 8 Visit to plant breeding station.

PB 5526 - PRACTICAL VI

(Plant Diseases and Management; Ethnobotany and Herbal sciences)

SEMESTER: V
CATEGORY: MC

CREDITS:6
NO. OF HOURS / WEEK:6

Plant Diseases and Management

1. Study on the incitants, symptoms of locally available fungal, bacterial and viral diseases.
2. Preparation of PDA, NA and Nutrient Broth.
3. Isolation of plant pathogens from infected tissues and verification (Demonstration).
4. Evaluation of fungicide: Slide germination technique and inhibition zone technique.
5. Estimation of flavonoids and phenols in diseased and healthy plants.
6. Spotters: Botanicals, Microbial pesticides; Predators and parasites; Chemicals (Organic and inorganic).
7. A survey of plant diseases in and around Chennai – Specimen collection and Herbarium preparation (10).

Ethnobotany and Herbal Sciences

Organoleptic studies of plants mentioned in the theory in the following aspects.

1. Morphological studies of vegetative and floral parts.
 2. Microscopic preparations of root, stem and leaf.
 3. Stomatal number and stomatal index.
 4. Vein islet number.
 5. Palisade ratio.
 6. Fibres and vessels (maceration).
 7. Starch test.
 8. Proteins and lipid test.
 9. Determination of the percentage of foreign leaf in a drug composed of a mixture of leaves.
 10. Dimensions of Calcium oxalate crystals in powdered crude drug.
- Preliminary phytochemical tests for alkaloids, terpenoids, glycosides, volatile oils, tannins & resins.
Any 5 herbal preparations.

PB 6612 - PLANT BIOTECHNOLOGY

SEMESTER: VI
CATEGORY:MS

CREDITS:4
NO. OF HOURS / WEEK:3

Objectives:

1. *To understand the fundamental aspects of plant tissue culture and molecular biology of plants for the production of transgenics.*
2. *To understand the concepts of modern technology pertaining to large scale production of agricultural products.*

Unit I: Plant Tissue Culture

Definitions, scope & history of plant tissue culture. Importance of plant tissue culture & biotechnology. In vitro culture techniques: Sterilization methods, Culture media – composition, types of medium and role of hormones in *in-vitro* culture. Inoculation, Incubation and Acclimatization. Callus, single cell and suspension culture and its significance.

Unit II: Plant Tissue Culture

Organ culture: Anther, Embryo & Meristem culture. Organogenesis, somatic embryogenesis and artificial seeds. Somatic Hybridization: Isolation, fusion and protoplast culture. Somoclonal Variation & cryopreservation.

Unit III: Plant Molecular Biology

Organisation and function of Plant nuclear genome(*Arabidopsis thaliana*), Genetic transformation of plants by *Agrobacterium*: Genetic organization of Ti plasmids Functions encoded by integrated T- DNA. Molecular mechanism involved in transformation of plants by *Agrobacterium tumefaciens*.

Unit IV: rDNA Technology

Restriction enzymes, Cloning Vectors, gene library, cDNA library molecular probes. Molecular techniques: Electrophoresis, Southern, Northern, Western & Slot blots. Polymerase Chain Reaction. Gene delivery system: Particle gun bombardment, microinjection, electroporation. Plant Viruses, *Agrobacterium* mediated gene transfer (Biological). DNA sequencing.

Unit V: Crop Improvement and Transgenic plant

Crop improvement in terms of yield and quality. Molecular markers (RFLP, RAPD and DNA finger printing) in crop improvement program. Transgenic plants resistant to insect. Biosafety and bioethics.

TEXT BOOKS:

1. Gupta, P. K. 1994. Elements of Biotechnology. Rastogi Publications. Meerut.
2. Ignacimuthu, S., 2003. Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
3. Kalyan Kumar De., 1997. Plant Tissue Culture – New Central Book Agency (P) Ltd., Calcutta.
4. Mascarenhas A.F., 1991. Hand book of Plant Tissue Culture. Indian Council of Agricultural Research. New Delhi.

BOOKS FOR REFERENCE :

1. Grierson, D and Convey, S.N., 1988 . Plant Molecular Biology Published in the USA by Chapman and Hall, New York.
2. Dubey, R.C.1993. Text Book of Biotechnology. S. Chand & Company Ltd., New Delhi.
3. Ignacimuthu, S.1997. Plant Biotechnology . Oxford Publishing Co. Pvt. Ltd., New Delhi.
4. Trivedi P.C. 2001. Algal Biotechnology .
5. Rashid, A. 2009. Molecular physiology and Biotechnology of Flowering plants. Narosa Publishing House Pvt. Ltd., New Delhi.

PB6613 - MICROBIAL TECHNOLOGY

SEMESTER: VI

CREDITS:4

CATEGORY:MS

NO. OF HOURS / WEEK:3

Objectives: To provide information on the fundamentals of the fermentation process, strain improvement and culture, and the use of different microorganism for the production of a variety of industrial products.

Unit I: Introduction to fermentation technology

Chronology and components of fermentation processes - A general account on microbial biomass, enzymes, metabolites and recombinant products - Range of fermentation processes - Transformation

processes. Isolation, preservation, optimization and improvement of industrially important microorganisms.

Unit II: Fermentor and Media

Fermentor - basic functions - body construction - aerators, agitators (impellers and spargers) - asepsis - containment - valves and steam traps - types of fermentors.

Substrates for media preparation - Medium formulation – Sterilization of medium.

Steps and Methods in recovery of products.

Unit III: Food dairy, beverages

Single cell proteins (SCP)- SCP as food and feed – mass cultivation of *Spirulina* – Mycoprotein - . Yogurt and cheese production. Alcoholic beverages – Beer and wine fermentation.

Unit IV: Pharmaceutical and related industries

Antibiotics- sources and types- production of Penicillin and Streptomycin. Production of insulin and Hep B vaccine. transformation of steroids. Vitamins- Production of vitamin B₁₂

Unit V: Enzymes, Amino acids, Organic acids and other products

Microbial enzymes- Production and application of amylase, protease, and lipase. Microbes used for amino acid production- production of L- glutamic acids - Organic acids: citric acid, acetic acid production - Bioplastics and Exopolymer production - Biofertilizers and biofuels.

TEXT BOOKS:

1. Crueger F and Anneliese Crueger, 2000. Biotechnology: Industrial Microbiology Panima publishing Corporation, New Delhi.
2. Stanley, P. F., Whittaker, A. and Hall, S.J., 1995. Principles of Fermentation technology I Edn, Pergamon Press, UK.
3. Balasubramanian, D., Bryce, C. F. A., Dharmalingam, K., Green, J. and Kunthala Jayaraman, 1998. Concepts in Biotechnology, COSIST Publications, India.
4. Adams, M.R. and Moss, M.O., 1995. Food Microbiology New Age International Publishers, New Delhi
5. Casida, L. E. Jr. 1996. Industrial Microbiology New Age International Publishers, New Delhi

BOOKS FOR REFERENCE:

1. Alexander N. Glazer and Hiroshi Nikaido, 1994. Microbial Biotechnology: Fundamentals of Applied microbiology. W.H. Freeman and Co., New York.
2. Satyanarayana U. 2010. Biotechnology, Books and Allied (P) Ltd. Kolkata.

PB 6614 – ECOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY

SEMESTER:VI
CATEGORY:MS

CREDITS:4
NO. OF HOURS / WEEK: 3

Objectives :

1. To give an insight into ecology, environmental pollution and microbial processes in the environment.
2. To provide knowledge on the use of microbes for a safe environment and in the treatment of hazardous waste using biotechnological processes.

UNIT I: Ecology- Basic Principles

Introduction to ecology – ecological principles – structural concepts – ecological factors – physical, chemical, biotic and edaphic factors.

Ecosystem : concepts – types, structure and function - productivity and energy flow – food chains, food web and ecological pyramids – Gene ecology - basic concepts, ecotype, ecophenes, ecads – Microbial communities: Diversity, structure and development- Biodiversity and conservation.

UNIT II: Environment

The environment - air, water and soil. Pollution and its causes: Air pollution, water pollution (heavy metal pollution and thermal pollution) soil pollution (pesticide pollution) (outline only). Nonconventional energy resources- biogas production, methane and hydrogen production - Recycling of waste products- composting and silaging.

UNIT III: Bioremediation

Introduction to bioremediation – types of bioremediation – factors influencing bioremediation – bioremediation mechanisms – microbes in bioremediation – Bioremediation techniques: *ex situ* and *in situ* bioremediation –Phytoremediation - Types of reactors used in bioremediation.

UNIT IV: Treatment of Polluted water and effluents

Biological treatment of sewage - characteristics of sewage and objectives in sewage treatment- Biological treatment: attached growth system- Biofilm kinetics - Trickling filters – Rotating biological contactors – Suspended growth system: Activated sludge process - Anaerobic digestion- Tertiary treatment: nitrogen and phosphorus removal- disinfection - removal of heavy metals and pesticides by biosorption - Removal of oil spills by microbes.

UNIT V: Treatment of Polluted Soil and air

Soil pollution by xenobiotics. Degradation of xenobiotics- pathways of phenol, pentachlorophenol and polychlorinated biphenyl degradation. Pollution by radionuclides - uptake of radionuclides from polluted sites.Purification of polluted air using biofilters - Future prospects.

TEXT BOOKS:

1. Dubey, R.C. 2004. A text book of Biotechnology. S. Chand & Company Ltd. New Delhi.
2. Joseph, C, Daniel .1996. Environmental aspects of microbiology. British Sun Publication.
3. Sharma ,P.D. 2005. Environmental Microbiology. Narosa Publishing House Pvt. Ltd. New Delhi.
4. Sharma , P.D. 2009. Ecology and Environment. Rastogi Publications, Meerut- New Delhi.
5. Agarwal, V.P., 1988. Forests in India. Oxford & IBH Publishing Co. Pvt. Ltd.
6. Rajendran, P and Gunasekaran, P. 2007. Microbial Bioremediation. MJP Publishers. A unit of Tamil Nadu, Book House, Chennai.

BOOKS FOR REFERENCE:

1. Raina, M. Maier, Ian L. Pepper, Charles P. Gerba , 2000. Environmental Microbiology. Academic Press. UK.
2. Alexander N. Glazer and Hiroshi Nikaido, 1994. Microbial Biotechnology: Fundamentals of Applied microbiology W.H. Freeman and Co., New York.
3. Special Issue on Bioremediation & Biodegradation. *Indian Journal of Experimental Biology*, September 2003. Vol.41(9). National Institute of Science Communication and Information Resources, CSIR, New Delhi.
4. Prabodh K. Maiti and Mait, P., 2011. Biodiversity: Perception, peril and preservation. PHI Learning Private Limited, New Delhi.
5. Rana, S.V.S., 2010. Environmental Biotechnology. Rastogi Publications, Meerut, India.
6. Alan Scragg, 1999. Environmental Biotechnology. Pearson Education Limited.

PB 6615 - PRACTICAL – VII**(PLANT BIOTECHNOLOGY, MICRO. TECHNOLOGY AND ECO. & ENV. BIOTECH.)****SEMESTER: VI**
CATEGORY:MS**CREDITS:8**
NO. OF HOURS / WEEK:6**PLANT BIOTECHNOLOGY****Basic Techniques in tissue culture:**

1. Preparation of MS and Modified White's Medium.
2. Embryo culture.
3. Preparation of Murashige and Skoog's Medium.
4. Meristem Culture.
5. Preparation of Nitsch Medium.
6. Anther Culture.
7. Isolation of Protoplast from leaves (mechanical method)

Molecular Techniques

8. Extraction and separation of Plant protein by SDS-PAGE.(In batches)
9. Extraction and separation of plant DNA by agarose gel electrophoresis (In batches)

MICROBIAL TECHNOLOGY

1. Sterilization, media preparation.
2. Screening of microbes for various products (Enzymes).
3. Demonstration of Fermentor operation.
4. Batch culture Technique a) Still culture & b) Shake culture.
5. Growth measurement in batch fermentation.
6. Cultivation yeast – biomass production.
7. Ethanol production.
8. Wine fermentation.
9. Citric acid production.
10. Glutamic acid production.
11. Visit to Biotech Industries.

ENVIRONMENTAL BIOTECHNOLOGY

1. Vegetation analysis – Quadrat and line transect method
2. Estimation of Dissolved oxygen.
3. Estimation of BOD.
4. Determination of net primary productivity.
5. Potability of water (MPN Technique).
6. Determination of acidity of water.
7. Determination of alkalinity of water.
8. Determination of hardness of water.
9. Field visit to sewage treatment plant.

SKILL BASED COURSE

PB6655 MUSHROOM CULTIVATION AND BIO-FERTILIZER PRODUCTION

SEMESTER:VI

CREDITS:15

CATEGORY: SK

NO. OF HOURS/WEEK:15
(Theory: 6; Practical: 9)

Objectives:

1. To help the students to learn mushroom cultivation, bio-composting and biofertilizer production through hands- on- experience.
2. To enable the students to become self- employed/ entrepreneur.

Unit I: Mushroom Biology

Morphology - classification: edible and poisonous mushrooms. Life cycle of Basidiomycetes fungi- Breeding and Genetic improvement of mushroom strains. Medicinal and Nutritional value of mushrooms.

Unit II: Mushroom cultivation Techniques

Cultivation conditions for tropical and temperate countries. Isolation, spawn production, growth media, spawn running and harvesting of mushrooms (*Volvariella* spp., *Pleurotus* spp., *Agaricus* spp., *Calocybe* spp., and *Lentinus* spp). Diseases / contamination; Post Harvest Technology: Freezing, drying, freeze drying and canning..

Unit III: Economics of Mushroom Cultivation

Economics of the production of oyster mushroom, milky mushroom and paddy straw mushroom cultivation : Infrastructure facilities, expenditure on fixed assets, plant and machinery, cost of the project, recurring expenditure , interest and depreciation of the expenditure, cost of production and profit. Entrepreneurship in mushroom cultivation.

Unit IV: Composting Technique

Introduction- history of composting – compost - composting processes - microbiology of composting - fate of pathogens - ingredients in composting - various methods of composting: vermi- composting and home composting - steps in composting.

Unit V: Bio-fertilizers and their Production

Introduction - Types: Microbes as biofertilizer, Green manure, importance of macronutrients ;Biofertilizers vs Chemical fertilizers; Nitrogen fixers – types and examples; Phosphate solubilizers – role of bacteria and Mycorrhizae - Mass cultivation and Application of the following biofertilizers:

- i) *Rhizobium*
 - ii) *Azospirillum*
 - iv) Cyanobacteria
 - v) Mycorrhizae
- Quality control; Challenges and opportunities; Biofertilizer Entrepreneurship

PRACTICAL

Mushroom Cultivation

1. Training on sterilization techniques (Glass wares, Medium, and Laboratory).
2. Microscopical observation of Mushrooms.
3. Media preparation; Isolation and purification of mushroom fungus
4. Spawn preparations
5. Cultivation of mushroom – conditions for cultivation of mushroom
6. Spawn running for *Pleurotus* spp and *Calocybe* spp.
7. Harvesting and preservation.
8. Determination of nutritional value: Proteins, sugars, lipids, crude fiber and ash contents.
9. Composting of solid waste generated in mushroom cultivation.

Biofertilizer Production

1. Isolation and mass cultivation of the following
 - i. *Rhizobium*
 - ii. *Azospirillum*
 - iii. Blue green alga (*Anabaena* /*Nostoc*)
2. Packaging of biofertilizers with carrier material.
3. Isolation and morphological characterization of mycorrhiza from soil.
4. Isolation and culture of Phosphate solubilising microbes.

Evaluation:

(i) I and II CA theory tests with other components	: 100
(ii) Internship (10 days each); report preparation and viva	: 100
(iii) Regular lab assessment – practical and record	: 100
Average Total	: 100

TEXT BOOKS

1. Nita Bahl, 2002. Hand Book on Mushroom Cultivation. 4th Edition, Vijay Primlani for Oxford & IBH Publishing Co., Press, New York, New Delhi.
2. Biswas, S, Datta, M and Nagachan, S.V. 2012. Mushrooms- A manual for cultivation. PHI Learning Private Limited, New Delhi.
3. Krishnamoorthy, 1999. Hand Book of Mushroom Cultivation. TNAU Publications, Coimbatore, TN, India.
4. SubbaRao, N. S., 1988, Biofertilizers in agriculture. Oxford & IBH Publishing Company, New Delhi.
5. SubbaRao, N. S., 1977, Soil microorganisms and Plant Growth. Oxford & IBH Publishing Company, New Delhi.
6. SubbaRao, N. S., 1998, Biofertilizers in agriculture and forestry. India Book House Ltd. New Delhi.

BOOKS FOR REFERENCE

1. Chang, T.S. and Hayes, W.A. 1978. The Biology and Cultivation of Edible Mushrooms. Academic Press, New York.
2. M.C. Nair, C. Gokulapalan and Lulu Das, 1997. Topics on Mushroom Cultivation. Scientific Publishers, Jodhpur, India.