

ST. MARY'S COLLEGE (AUTONOMOUS), THOOTHUKUDI

Master of Science (Botany)

Course Structure (w.e.f. 2017-18)

Semester - I

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max .Marks		
					CIA	ESE	Total
Core I	17PBOC11	Plant Diversity	6	5	40	60	100
Core II	17PBOC12	Microbiology and Plant pathology	6	5	40	60	100
Core-III	17PBOC13	Anatomy and Embryology	6	5	40	60	100
Elective I	17PBOE11	Molecular Biology and rDNA Technology/Stem cell science	6	5	40	60	100
Practical I	17PBOCR1	17PBOC11, 17PBOC12, 17PBOC13	6	3	40	60	100
			30	23	200	300	500

Semester - II

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core IV	17PBOC21	Biochemistry and Biophysics	6	5	40	60	100
Core V	17PBOC22	Taxonomy of Angiosperms	6	5	40	60	100
Core-VI	17PBOC23	Research Methodology	6	5	40	60	100
Elective II	17PZOE21	Applied Biology/ Health and Nutrition	6	4	40	60	100
Practical II	17PBOCR2	17PBOC21, 17PBOC22, 17PBOC23	6	3	40	60	100
Self Study (Compulsory)	17PBOSS1	Herbal and Ethno Botany		2		100	100
			30	22+2	200	400	600

Semester - III

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core VII	17PBOC31	Plant Physiology	6	5	40	60	100
Core VIII	17PBOC32	Bio Diversity and Conservation	6	5	40	60	100
Core-IX	17PBOC33	Biostatistics and Bioinformatics	6	5	40	60	100
Practical III	17PBOCR3	17PBOC31, 17PBOC32, 17PBOC33	6	3	40	60	100
Project	17PBOP31	Dissertation	6	5	40	60	100
Self Study (optional)	17PBOSS2	Forestry		2		100	100
			30	23 + 2	200	300+100	500 + 100

Semester - IV

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core X	17PBCC41	Marine Biology	6	5	40	60	100
Core XI	17PBOC41	Plant Biotechnology	6	5	40	60	100
Core-XII	17PBOC42	Plant Ecology	6	5	40	60	100
Elective III	17PBOE41	Horticulture and Nursery management / Bionanotechnology	6	4	40	60	100
Practical IV	17PBOCR4	17PBOC41& 17PBOC42,	4	2	20	30	50
Practical V	17PBCCR1	17PBCC41	2	1	20	30	50
			30	22	200	300	500

Self Study 2+2

90+4

SEMESTER I			
Core I – Plant Diversity			
Code: 17PBOC11	6 Hrs/week	Hrs/Semester : 90	Credit :5

Objectives:

- To have a broad knowledge about the major groups of plants and their characteristics.

Unit I : **Algae**
 Classification of algae by F.E.Fritsh (1954). General characteristics. Range of thallus structure, vegetative, asexual, sexual reproduction and life cycle patterns of Cyanophyceae, Chlorophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae.

Unit II : **Fungi**
 Classification of Fungi by Alexopoulos and Mims (1979). General characteristics. Diversity of somatic, reproductive and fruiting structures in different groups of fungi: Myxomycetes, Zygomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. Heterothallism and Parasexuality in fungi.

Unit III : **Bryophyta**
 Classification of Bryophytes by Rothmaler (1951). General characteristics. Morphological, anatomical structure, vegetative, sexual reproduction and life cycle pattern of Marchantiales, Jungermaniales, Anthocerotales, Sphagnales and Polytrichales. Spore dispersal mechanism in bryophytes.

Unit IV : **Pteridophyta**
 Classification of Pteridophytes by Smith (1955). General characteristics. Life cycle pattern in homosporous and heterosporous pteridophytes. Morphological, anatomical structure, asexual and sexual reproduction of Psilotales, Lycopodiales, Selaginellales, Isoetales, Equisetales, Ophioglossales and Filicales. Heterospory and seed habit. Stelar evolution in pteridophytes. Telome concept.

Unit V : **Gymnosperms**
 Classification of Gymnosperms by K.R.Sporne (1965). General characteristics. Morphological, anatomical structure and reproduction of Cycadaceae, Ginkgoaceae, Podocarpaceae, Araucariaceae, Ephedraceae, Welwitschiaceae and Gnetaceae.

Algae

Reference books:

1. Bilgrami, K.S. and L.B. Sinha, 2004. A Text Book of Algae. CBS Publication and distributors, New Delhi.
2. Fritsch, F.E. 1972. The structure and reproduction of algae. Vol. I & II. Cambridge University Press.
3. Kamat, N.D 1982. Topics in Algae. Saikripa Prakasam, Aurangabad.
4. Robert Edward Lee, 2008. Phycology. Cambridge University Press
5. South, G.R. and Whittick, 1987. Introduction to phycology, Blackwell Scientific Publications London.
6. Vashishta, B.R, A.K. Sinha. and V.P. Singh. 2007. Algae. S.Chand and Co., Ltd., New Delhi

Fungi

Reference books :

1. Alexopoulos and Mim's, 1983. Introductory mycology, Wiley Eastern Ltd. Hyderabad.
2. Johri R.M., Snehlata & Kavita Tyagi 2010. Text Book of Fungi .Dominant Publishers & Distributors Pvt.Ltd.
3. Smith, G.M. 1988. Cryptogamic Botany Vol.I Mc-Graw Hill Book Company New York.
4. Vashishta, B.R and A.K. Sinha. 2007. Fungi. S. S. Chand and Co Ltd. New Delhi.

Bryophyta

Reference books :

1. Cavers, F. 1964. Inter relationship of the Bryophyta. Dawsons of pall mall. London.
2. Peter George 2010. Hand Book of Bryophyta. Rajat Publications .New Delhi.
3. Rashid, A. 1999. An introduction to Bryophyta. Vikas Publishing House Pvt. Ltd.
4. Watson, E.V. 1971. Structure and life of Bryophytes. Hutchinson University Library, London.
5. Vashishta, B.R, A.K. Sinha. and V.P. Singh. 2006. Bryophyta. S.Chand and Co. Ltd., New Delhi.

Pteridophyta

Reference books:

1. Bower, F.D. 1988. Vol. I & 2. Primitive land plants. Arihant Publishers Jaipur.
2. Pandi, S.N., P.S. Trivedi, S.P. Misra, 2006. A text Book of Botany Vol. II. Vikas Publishing House Pvt. Ltd.
3. Parihar, N.S. 1967. An introduction to Embryophyta, Pteridophyta. Central Book Depot Publications in Botany, Allahabad.
4. Rashid, A. 1985. An introduction to Pteridophyta, Vani Educational Books.
5. Sundara Rajan S. 2009. Introduction to Pteridophyta. New Age International Publishers. New Delhi
6. Vashishta, P.C., A.K. Sinha and Anil Kumar, 2008. Botany for degree students – Pteridophyta. S.Chand & Co., New Delhi.

Gymnosperms :

Reference books :

1. Chamberlain, C.J. 1986. Gymnosperms. Structure and evolution. CBS Publishers & Distributors, Delhi.
2. Johri R.M., Sneh Lata and Kavita Tyagi 2010. Text Book of Gymnosperms. Wisdom Press, New Delhi
3. Sporne, K.R. 1974. The morphology of Gymnosperms. B.I. Publications Pvt. Ltd.,
4. Vashishta, P.C., A.K. Sinha and Anil Kumar, 2007. Botany for degree students- Gymnosperms. S.Chand & Co., New Delhi.

Practical

2Hrs/Week

- **Algae :** *Nostoc, Ulva, Padina, Turbinaria, Hypnea.*
- **Fungi:** *Xylaria, Polyporus, Agaricus.*
- **Bryophyta :** *Plagiochasma, Anthoceros, Sphagnum, Polytrichum.*
- **Pteridophyta :** *Selaginella, Isoetes, Adiantum, Pteris.*
- **Gymnosperms :** *Cycas, Araucaria, Podocarpus, Gnetum*

Submission - Record Note Book

Bottle specimens/herbarium specimens (any five)

SEMESTER I			
Core II – Microbiology and Plant pathology			
Code:17PBOC12	Hrs/week: 6	Hrs/Semester : 90	Credits: 5

Objectives:

- To study the growth characteristics of microorganisms enabling the learner to identify microorganisms by themselves.
- To understand the basic principles related to plant diseases.

Unit I Classification of bacteria - Bergey's major groups. Early development of microbiology-contributions of Leeuwenhoek, Robert Koch and Louis Pasteur. Isolation, pure-culture, nutritional requirement, measurement of growth, continuous culture, synchronous culture. Cultural characteristics of bacteria. Ultra structure of bacteria. Antimicrobial components : mode of action of penicillin, gramicidin, streptomycin and sulfonamides

Unit II Morphology and nature of virus particles, Purification and quantitative assay of plant viruses, Infection and replication with reference to Gemini virus, CaMV and bacteriophage. Antiviral chemotherapeutic agents. General account of mycoplasma and rickettsiales.

Unit III Types of food spoilage. Methods of food preservation. Milk micro flora and their significance, water microflora and their significance. Micro flora of soil and their role in soil fertility and carbon sequestration, rhizosphere microflora and mycorrhiza.

Unit IV Introduction: components of disease (disease pyramid), causes of disease, classification of diseases, stages in the development of disease (disease cycle), general symptoms of plant diseases caused by fungi, bacteria and viruses. Dissemination of plant pathogens, Integrated disease management

Unit V Detailed study of the following: damping off of seedlings, tikka disease of groundnut, wilt of cotton, blight of potato (early and late), downy mildew of grapes, ergot of rye, citrus canker and bunchy top of banana.

Books for Reference:

1. Abbas A.K. and A.H. Lichtmann. 2003. Cell and Molecular Immunology. Saunders, Philadelphia.
2. Dubey, R.C and D.K Maheshwari, 2003. A text book of microbiology. S.Chand and company, New Delhi.
3. Caldwell DR 2005. Microbial Physiology and Metabolism Wm.C.Brown publishers. Lnc.

4. Kumar H D and Swati Kumar 2008, Modern concepts of Microbiology. Vikas Publications. New Delhi.
5. Pelczar H. and R. Reid, 1998. Microbiology – Concepts and Applications Tata Mc Grow Hill Publishing company P.Ltd. New Delhi.
6. Pelzar M J . ECS Chan and Noel R Krig. 2010. Tata Mc Grow Hill Puplishing company P.Ltd. New Delhi.
7. Prasad T V S., 2011 Soil Microbiology. Dominant Publishers and distributors. New Delhi
8. Prescott. L.M., J.P. Harley and D.A.Klein 2002. Microbiology. Mc Graw hill, New York.
9. Agrios, G.N., 1997. Academic Press, Plant Pathology, London.
10. Mehrotra, R.S. &A.Agarwal, 2003. Plant Pathology. Tata McGraw Hill Publishing Company, New Delhi.
11. Rangaswami, G. 1988. Diseases of crop plants. Prentice-Hall International, London.
12. Sharma, P.D. 2006. Plant Pathology. Narosa Publishing House Pvt. Ltd., New Delhi.

Practical

Hrs / week: 2

A

1. Methods of sterilization, media preparation
2. Light microscopic observation of bacteria- wet mount, simple and differential staining– Gram's staining, Hanging drop technique to observe mobility
3. Study on production of acid and gas
4. Effect of temperature, pH, salinity, disinfectants, radiation on the growth of bacteria.
5. Milk bacteriology : Enumeration of bacteria found in milk- SPC method. Testing the quality of milk -Dye-reduction test (Resazurin and Methylene blue).
6. Bacterial analysis of water for coli forms - MPN
7. Enumeration of soil bacteria by serial dilution technique (any three soil types).
8. Effect of antibiotics on the growth of bacteria. -Determination of MIC
9. Study of infected specimen prescribed in the syllabus

B

1. Record of brief life history of scientist related to microbiology
2. Drawing the electron microscopic structure of viruses-T₄, CaMV.
3. Drawing the electron microscopic structure of mycoplasma

Submission - Record Note Book

SEMESTER-I			
Core III – Anatomy and Embryology			
Code:17PBOCI3	Hrs/week:6	Hrs/Semester : 90	Credits :5

Objectives:

- To know about structure and functions of reproductive organs associated with seed development.
- To study the internal morphology of Angiosperms.

Unit: I Meristem- classification, shoot apical meristem and root apical meristem. Simple permanent tissues- parenchyma, collenchyma and sclerenchyma. Epidermal tissue system- Functions and types: Anomocytic, anisocytic, diacytic and paracytic. Trichomes - Stinging hairs, glandular hairs and peltate hair.

Unit: II Complex permanent tissues- Components of xylem - Tracheids, Fibres, vessels, parenchyma. Wood anatomy: Xylem- Primary xylem, secondary xylem. tyloses-reaction wood, heart wood and sap wood, growth rings. Phloem- components, sieve elements, fibres, parenchyma. Cambium - origin, structure and function-seasonal activity of the cambium.

Unit: III Secondary growth in dicot stem- *Polyalthia*, *Boerhaavia*, *Achyranthus*, *Antigonan*, dicot root -*Azadirachta*. Aerial root - *Tinospora* and *Vanda*. Dicot leaf - Dorsiventral and isobilateral leaf and monocot leaf.

Unit: IV Microsporogenesis - development of male gametophyte, megasporogenesis development of female gametophytes-pollination and fertilization-pollen-pistil interactions-pollen germination, pollen tube growth and pollen tube discharge, mechanism of nuclear fusion-compatibility vs incompatibility-self-incompatibility, methods to overcome incompatibility.

Unit: V Embryogenesis and seed formation-polyembryony, apomixes-causes of apomixes, diplospory, apospory, significance of apomixes. Parthenocarpy-genetical, natural and induced parthenocarpy. Triple fusion and endosperm formation. Types of endosperm.

Books for Reference:

1. Bhojwani S S, S. P. Bhatnagar 2000. The Embryology of Angiosperms McGraw Hill
2. Catherine Easu, Plant Anatomy 1972. 2nd Edition . Wiley Eastern Private Ltd.
3. Chandurkar P. 1977. Plant Anatomy Oxford and IBH
4. Fahn A. 1990. Plant Anatomy Pergamon Press

5. Maheshwari P 1971 An introduction to the Embryology of Angiosperms Tata McGraw Hill Publishing Co New Delhi
6. Pandey S N A Chadha. 2009. Plant Anatomy and Embryology Sangam Books Ltd
7. Pandey B P 1978 Plant anatomy S Chand Co
8. Elezabeth G. Cutter, 1978- 2d ed., Plant Anatomy, Reading, Mass: Addison - Wesley Pub.Co.

Practical

Hrs / week: 2

Anatomy

- Examination of different cells and tissue types
- Examination of Structural detail and identification of wood of some common Indian timbers (any two)
- Study of the internal structure of root (any two) and stem (any two).
- Double staining technique to study the stem and root prescribed in the syllabus.
- Study of leaf anatomy.

Embryology

- Pollen germination and pollen tube growth.
- Dissection of dicot embryo(globular, cordate and mature stage).

Submission - Record Note Book

SEMESTER I			
Elective I– Molecular Biology and r DNA Technology			
Code:17PBOE11	Hrs/week: 6	Hrs/Semester : 90	Credits:5

Objectives:

- To upgrade the knowledge about the latest concepts of prokaryotic and eukaryotic genome and expression.

Unit I: Chemistry of genetic material –DNA double helical structure-Watson and crick model, alternative models. DNA replication- Semiconservative mechanisms-molecular mechanism of initiation of DNA replication in *E. coli*, λ phage and PBR322, elongation, termination. DNA replication in Eukaryotes- initiation, cis and transacting elements, elongation and termination. DNA modification, DNA damages and repair mechanism , DNA repair and genetic diseases in human – Bloom’s syndrome, Xeroderma pigmentosum.

Unit II: Organisation of genetic material –packaging of DNA-nucleosome model at molecular level; chromosome DNA content and C value paradox; repetitive DNA- satellite DNA, selfish DNA, split gene, overlapping genes, pseudogene; Genetic code- properties, codon assignment, wobble hypothesis; Regulation of gene expression in prokaryotes- General aspects of gene regulation, transcriptional regulation- inducible and repressible system, positive and negative regulation; operon concept- lac operon and tryp operon, relative positions of promotor and operator, master switches; Regulation of translation- protein synthesizing apparatus, molecular mechanism of translation, role of translation factors, feedback inhibition, mRNA half life.

Unit III: Regulation of gene expression in eukaryotes – transcriptional control- initiation, multiple RNA polymerases, transcription factors; core elements; auxiliary elements - enhancers and silencers in transcription. pre initiation complex, elongation- elongation factors and termination-role of termination factors, nucleosome remodeling. Post transcriptional processing - RNA modification, splicing and RNA editing. Translation regulation - molecular mechanisms, initiation, elongation and termination, role of translation factors. Difference between prokaryotic and eukaryotic gene regulation. Regulation of gene expression in plant cells by light.

Unit IV Outline of genetic engineering –Enzymes used in rDNA technology, exonuclease, endonuclease, restriction endonuclease, S_i nuclease, DNA

ligase, reverse transcriptase and alkaline phosphatase. Cloning vectors – plasmids – pBR³²², shuttle vectors, M¹³ Bacteriophage vector, Cosmids, Ti plasmid. Isolation of genes from genomic and cDNA library.

Unit V Gene transfer methods- vector mediated (*Agrobacterium*), direct gene transfer (physical and chemical). Screening and identification of recombinants. Mobile genetic elements – Is elements and transposons in maize and Bacteria. DNA sequencing – Maxam and Gilbert method, Dideoxy nucleotide method, Messing's shot gun method. DNA chips. Hybridization techniques – Southern, Northern and Western blotting. DNA amplification – PCR, RFLP, RAPD and finger printing.

Books for Reference

1. David Preifelder, 2006. Molecular Biology. Narosa publishing House, Madras, New Delhi.
2. Gupta, R.K. 2006. Genetics. Rastogi publications.
3. Benjamin Lewin, 2004. Genes VII. Pearson Prentice Hall.
4. Channarayappa, 2006, Molecular Biology. Principles and Principles and practices. Universities Press (India), Pvt. Ltd. 3.5.819. Hyderabad, 500 029.
5. Nicholl DST, 2001. An Introduction of genetic engineering. Cambridge University press.
6. Old R.N. and Primrose, S.B. 2004. Principle of gene manipulation. Blackwell scientific publication, USA.
7. Power C. B. 2007. Genetics Vols. I and II. Himalaya publishing House. Kundanal chandak. Industrial Estate. Ghat Road. Nagpur- 440 018.
8. Robert H. Tamarin. 2006 Principles of Genetics. Tata Mc. Graw - Hill publishing company Ltd., New Delhi.
9. Sathyanarayana, U. 2006. Biotechnology. Book and Allied (P). LTD. Kolkatha.
10. Singh, B.D. 2005. Genetic Kalyani publishers, Chennai.

SEMESTER I			
Elective I– Stem cell science			
Code:17PBOE11	Hrs/week: 6	Hrs/Semester : 90	Credits:5

Objectives

1. To acquaint students of biology with the latest development in biotechnology.
2. To understand the pros and cons of stem cell technology.

Unit I : Stem cells - definition; unique properties – proliferation and differentiation; Potency definitions: totipotent, pluripotent, multipotent and unipotent; basics of early human embryology; History and key stem cell research events.

Unit II : Isolation, culture, identification and assays. Types: unlimited and limited; Embryonic and adult stem cells - bone marrow, cord blood, neural, endothelial, hematopoietic, epithelial, pancreatic, hepatic, glandular, cardiac and gastrointestinal.

Unit III: Stem cells and cloning; germ line stem cells; Recruiting Donors and Banking hES Cells; IPRs and hES Cells.

Unit IV: Genetically engineered stem cells and experimental therapies. Stem cell based therapies: stem cells and repair of heart and nervous system; regeneration strategies.

Unit V: Guidelines for hES cell research - Scientific background of hESC research; Ethical and scientific concerns; Current Regulation of Human Embryonic Stem Cell Research. Future of SC research.

Sources

1. The Natl Academies, USA 2007 Understanding Stem Cells
2. The Natl Academies, USA 2002 Stem Cells and the Future of Regenerative Medicine
3. Stem Cells Info 2008, NIH USA
4. Terese Winslow 2006 Regenerative Medicine, Natl Acad Sci & Engg, USA

Reference Books

1. Stewart Sell 2003 (Ed) Stem Cells Handbook, Humana Press, NY
2. Verma IM and Gage FH 2002 (Ed) Regenerative Medicine, Natl Acad Sci & Engg, USA

SEMESTER II			
Core IV – Biochemistry and Biophysics			
Code:17PBOC21	Hrs/week: 6	Hrs/Semester : 90	Credits:5

Objectives :

- To study the molecular structure of biomolecules.
- To understand various metabolic pathways and their significance.
- To highlight the principles of energy conversion in biological systems.

Unit I : Biomolecules-Structure and properties of carbohydrates: mono-saccharides, disaccharides, polysaccharides and mucopolysaccharides. Biosynthesis and hydrolysis of sucrose and starch. Gluconeogenesis.

Unit II : Amino acids: classification based on R - group, structure and properties. Metabolism of phenylalanine, tyrosine and tryptophan. Proteins: The peptide bond and primary structure. Ramachandran plot. Secondary structure, domain, motif and backbone folding. stabilizing forces in collagen. Tertiary structure and Quaternary structure (haemoglobin).

Unit III : Lipids: classification, structure and properties of simple lipids (triglyceride and wax), compound lipids (phospholipids and glycolipids) and derived lipids.steroids - cholesterol, Terpenes. Biosynthesis and degradation of palmitic acid. Synthesis of purines and pyrimidines.

Unit IV : Enzymes –nomenclature IUPAC 1974. Principles of catalysis, enzyme action, active site, activation energy, enzyme kinetics. Cofactors and inhibitors. Secondary metabolites- structure and properties of alkaloids (colchicine and atropine) and glycosides (cardiac and cyanogenic). Vitamins - A, B,C,D,E and K- sources and deficiency diseases.

Unit V : Dual nature of light, electromagnetic spectrum, phosphorescence and fluorescence. Laws of thermodynamics, concept of enthalpy, entropy and free energy. Redox couple, redox potential, coupled reactions, phosphorylation. High energy compound - ATP.

Books for Reference :

1. Bhutani, S.P. 2009. Chemistry of Biomolecules. Ane Books Pvt. Ltd. New Delhi.
2. Conn, E. E. and P. K. Stumpf, 1987. Outlines of Biochemistry. John Wiley and Sons, Inc.
3. Cox, M. M. and D. L. Nelson. 2008. Principles of Biochemistry. 5th edition. Replika Press Pvt. Ltd., India.
4. David Rawn, 2004. Biochemistry. Panima Publications, New Delhi.
5. Ferrier, D. R. 2014. Biochemistry. 6th edition. Wolters Kluwer (India) Pvt. Ltd.,

New Delhi

6. Gupta, S.N. 2011. Biochemistry. Rastogi Publications, Meerut, India.
7. Lehninger, A. L. 1987. Principles of Biochemistry. CBS publishers and Distributors. Delhi.
8. Nagini, S. 2007. Text Book of Biochemistry. 2nd edition. Scitech Publications (India) Pvt. Ltd., Chennai
9. Salil Bose, 1982. Elements of Biophysics. Jjothi Books, Madurai.
10. Sathyanarayana, U and U. Chakrapani. 2006. Biochemistry. 3rd edition. Arunabha Sen, Books and Allied (P) Ltd., Kolkata.

Practical

Hrs/Week: 2

- Titration of amino acid (glycine)
- Estimation of free amino acid from plant tissues (Ninhydrin method)
- Estimation of total soluble protein from plant tissues (Barfoed's test)
- Separation of amino acids (ascending paper chromatography).
- Separation of photosynthetic pigments (column chromatography).

Absorption spectrum of chlorophyll

- Study of enzyme kinetics and determination of Km value.
- Saponification value of two vegetable oils.
- Qualitative tests for alkaloids, flavonoids, glycosides and phenols.

Submission - Record Note Book

SEMESTER II			
Core V-Taxonomy of Angiosperms			
Code: 17PBOC22	6 Hrs/week	Hrs/Semester : 90	Credit : 5

Objectives:

- To identify the local flora up to the species level.
- To enable the students to get fair knowledge of modern trends in taxonomy of Angiosperms.

Unit I : Definition and objectives-brief history of plant taxonomy – Botanical Nomenclature- need for scientific names, polynomial and binomial nomenclature- ICN principles, names of taxa -genus, species, infraspecific categories, type method, citation, typification, effective and valid publication, retention and rejection of names-, principle of priority, conservation of names . Identification methods: use of floras, manuals and monographs -dichotomous keys (indented and bracketed key), guidelines for constructing dichotomous keys - interactive keys (computer aided).

Unit II : Taxonomic hierarchy- - Ranks in the hierarchical system (order, family, genus, species and infraspecific). Classification: relative merits and demerits of major systems of classifications- Linnaeus, Bentham and Hooker's, Takhtajan and Angiosperm Phylogeny Group (III): Current trends in biosystematics - Phenetics - numerical taxonomy. Phylogenetic-Cladistics,

Unit III : Taxonomic evidences - Morphology, Cytology, Embryology and chemosystematics (Phytochemicals phenols, alkaloids, flavonoids and terpenoids). Molecular systematics (DNA bar coding). Herbarium methodology- Specimen preparation, maintenance, management and functions, general account of National and regional herbaria with special reference to Central National Herbaria, Calcutta (CAL) and Madras Herbarium (MH), Botanical Survey of India, roles of Botanical gardens, National (Tropical Botanical Garden, Trivandrum.) and International (Royal Botanical Garden, Kew).

Unit IV : A detailed study of vegetative and floral characters of the following families: Ranunculaceae, Capparidaceae, Polygalaceae, Tiliaceae, Rhamnaceae, Sapindaceae, Fabaceae, Aizoaceae, Asteraceae, Sapotaceae.

Unit V : Boraginaceae, Solanaceae, Scrophulariaceae, Bignoniaceae, Verbenaceae, Nyctaginaceae, Casuarinaceae, Orchidaceae, Commelinaceae and Cyperaceae.

Reference books:

1. Davis, P.H. and V.M. Heywood, 1983. Principles of Angiosperm Taxonomy, Olive & Boyd, London.
2. Gurcharan Singh, 2004. Plant Systematics – Oxford & IBH Publishing Co., New Delhi.
3. Gurcharan Singh, 2012. Plant Systematics – Oxford & IBH Publishing Co., New Delhi.
4. Harborne, J.B. and B.L. Turner; 1984. Plant chemo-systematics. Academic Press, London.
5. Jeffrey, C.1982. Introduction to plant Taxonomy. Cambridge university Press Cambridge.
6. Johri R.M. and Sneb Lafa, 2005. Taxonomy – Sonali publications, New Delhi.
7. Pandey, B.P.2005. Taxonomy of Angiosperms. S.Chand & Company, New Delhi.
8. Stace C.A., 1989. Plant taxonomy and Biosystematics Edward. Arnold, London.
9. Saxena N.B. and S. Saxena, 2010. Plant Taxonomy. Pragati Prakashan Publishers.
10. Subrahmanyam, N.S. 2007. Modern Plant Taxonomy. Vikas Publishing House Pvt. Ltd. New Delhi.
11. Vashishta P.C., 1989, Taxonomy of Angiosperms, R.Chand & Co., New Delhi.

Practical**2Hrs / Week**

1. Study of wild taxa representing different families and identification to species level.
2. Construction of taxonomic keys (dichotomous).
3. Field trips within and around the campus; compilation of field notes and preparation of herbarium sheets of such plants, wild or cultivated, as are abundant.
4. Training in using floras for identification of specimens described in the class.

Submission - Record Note Book, five herbarium sheets, fifteen photographs and field note book

Semester II			
Core VI – Research Methodology			
Code: 17PBOC23	Hrs/week:6	Hrs/Semester : 90	Credits : 5

Objectives:

- To infuse the practical knowledge of using various instruments into the vast array of techniques in plant science.
- To motivate the students to do research.

Unit I Microscopy - basic principles, components of compound microscope, phase contrast and fluorescent microscopes. Electron microscopy-principle, components, working mechanism and applications of TEM, SEM and Scanning Probe microscope. Micro technique: fixatives, stains, dehydration and embedding – sectioning with rotary microtome and staining. Micrometry – principle and methods of measurement of plant cells.

Unit II pH metry -principle, electrodes, measurement of pH. Spectroscopy- visible and ultraviolet spectrophotometers – Atomic absorption spectrophotometer (AAS). FTIR - principle, working mechanism and its applications. Centrifugations: working principle and applications of clinical centrifuge, high-speed centrifuge, ultra centrifuge and analytical centrifuge.

Unit III Chromatography- types– adsorption and partition chromatography. Principle and applications of Thin layer chromatography, HPTLC, Gas liquid chromatography and High performance liquid chromatography Photomicrography - principle and methods.

Unit IV Electrophoresis - basic principles, electrophoretic mobility, factors, isoelectric focusing, types - vertical and horizontal. Agarose and polyacrylamide gel electrophoresis, detection and recovery of electrophorogram. Gel documentation system. Tracer techniques - nature of radioactivity, patterns of radioactive decay, half life - detection, radiation measurement - Geiger Muller counter, Scintillation counter, Autoradiography and applications of isotopes in biology . X- ray crystallography.

Unit V Research techniques- meaning and objectives, methods and approaches in research. Literature and reference collection. Internet – World Wide Web – search engines and browsing tools – e journals and e books – Manuscript processing – proof correction – thesis and journal format- preparation of full paper, reviews, – bibliometrics.

Books for Reference:

1. Anbalagan, K. 1985. Electrophoresis. Life Science Book house. Madurai.
2. Bryan C. Williams Keith Wilson, 1983. A biologist's guide to practical techniques of practical biochemistry second edition. Edward Arnold publications.
3. Ghatak K. L., 2011, Techniques and methods in Biology, PHI Learning Private Ltd, New Delhi.
4. Guruamni. N, 2006, Research Methodology for Biological Sciences, MJP Publishers, Chennai
5. Gurumani N., 2010. Scientific thesis writing and paper presentation. MJP Publishers, Chennai
6. Jayaraman J., 1985. Laboratory manual in biochemistry, Wiley Eastern Ltd., New Delhi.
7. Johansen, M., 1940. Plant Microtechnique Mc. Graw Hill.
8. Kothari C.R., 2004. Research Methodology – Methods and techniques New age International (P) Ltd., Publishers. New Delhi.
9. Plummer, D., 1987. An introduction to practical Biochemistry, Tata Mc. Graw Hill.
10. Ramadass P. and A. Wilson Aruni. 2009. Research and writing across the disciplines, MJP Publishers, Chennai
11. Rana S.V.S., 2012, Biotechniques Theory And Practice, Rastogi publications, New Delhi.
12. Subramanian, 2005. Biophysics principles and Techniques. MJP Publishers, Chennai.
13. Veerakumari, L., 2004. Biochemistry M.J.P. Publishers, Chennai.
14. Veerakumari, L., 2015. Bioinstrumentation, M.J.P. Publishers, Chennai.
15. Wilson, K. and J. Walker, 1997. Practical biochemistry IV edition, Cambridge university press.

Practical - Hrs/week :2

- Preparation of permanent slides using microtome
- Measurement of plant cells using micrometer
- Thin layer chromatographic separation of amino acids
- Analysis of protein by PAGE
- Analysis of DNA by AGE
- Digital photographic display of anatomical samples/ microscopic samples
- Demonstration-AAS and FTIR
- Exercises in the calculation of citation Index
- Determination of Impact Factor of Author, Article and Journal.

Submission - Record Note Book

Semester II

Elective II– Applied Biology

Code: 17PZOE21

Hrs/week:6 Hrs/Semester : 90

Credits : 4

Objectives

- To explore the scope for self employment opportunity adopting Apiculture, Poultry and Sericulture after their graduation.
- To acquire knowledge on mushroom cultivation.
- To learn the art of culturing earthworm and production of bio-fertilizer through vermi-composting.

Unit I Apiculture

Scope and economics of Apiculture - Bees suitable for bee keeping - bee keeping equipments. Artificial hive - Langstroth hive - Newton's hive. Products of bee keeping - honey, wax, pollen and venom. Relationship between bees and plants. Diseases: Foul brood disease - septicemia, nosema, acarine disease.

Unit II Poultry keeping

Scope - commercial breeds, management of chicks, growers, layers and broilers. Summer management and winter management, Debeaking, Feed stuffs for poultry. Poultry diseases – fowl cholera , ranikhet , aflatoxicosis and coccidiosis.

Unit III Vermicomposting

Scope and importance of vermitechnology – worms suitable for composting. Vermiculture -Vermicomposting process– vermicomposting materials-construction of vermi bed -indoor and outdoor vermicomposting-application of vermicompost -predators and parasites of earthworm. Economics of vermicomposting

Unit IV Mushroom Cultivation

Introduction. Nutritional and medicinal value of edible mushrooms. Poisonous mushrooms. Types of edible mushrooms available in India. Cultivation of oyster mushroom. Post harvesting technology: Freezing, dry freezing, drying, canning and entrepreneurship. Disease management.

Unit V Sericulture

Scope of sericulture - Role of Central Silk Board. Mulberry cultivation - mulberry silkworm - silk gland. Rearing of silkworm - mounting - silk reeling - uses of silk. Diseases of silkworm: pebrine, muscardine, flacherie - grasserie.

Books for Reference

1. Mishra.R.C and Rajesh Grag.1998 Perspectives in Indian Apiculture, Agro Botanica, New Delhi.
2. Root.A.I.1985 Encyclopedia of Bee Culture, International Books and Periodicals Supply Service.
3. Raja Justus.E. 1994 Economics of Bee Keeping Industry, Rawat Publications, New Delhi.
4. Gnanamani.M.R. 2010 Profitable Poultry Farming, J.Hiltone Publication Madurai.
5. Gupta.P.K. 2003 Vermi Composting for Sustainable Culture, Agrobios .
6. Ranganathan.L.S.2006 Vermibiotechnology from Soil Health to Human Health. AGROBIOS (India) Jodhpur.
7. Ganga, G. and J. Sulochana Chetty, 1998. An introduction to Sericulture, Oxford and IBH Publishing Co.Pvt.Ltd., New Delhi.
8. Dubey, R.C. 2008. A text book of Biotechnology, S. Chand & Co Ltd; New Delhi.
9. Kumaresan. V. 2004. A Text Book of Biotechnology, Saras Publication, Nagercoil.

Semester II			
Elective II–Nutrition and Health			
Code: 17PZOE21	Hrs/week:6	Hrs/Semester : 90	Credits : 4

Objectives

- To introduce the students to fundamentals of nutrition, food and health.
- To familiarize them with importance of nutrition during various stages of life.
- To impart knowledge regarding etiology and management of nutritional disorders.

Unit – I Basics of Nutrition

Basic food groups –carbohydrate, protein, lipids, vitamins and minerals - calcium and potassium. Concept of balanced diet –Protein Energy Malnutrition- Iron and iodine deficiency Recommended dietary allowances for Indians — Sedentary, Moderate and Heavy meal- Meal planning – food pyramid.

Unit II Food groups

Selection and nutritional contribution of the following food groups - pulses, cereals, fruits and vegetables, milk and milk products, egg, meat, fish, poultry.

Unit III Nutrition during life cycle

Physiological considerations and nutritional concerns for the following life stages - Infant, Pre school, adolescent, pregnant women, nursing, adult men/ women - old age.

Unit IV Nutrition and fitness

Definition of fitness and health - Nutritional guidelines for health and fitness - diet and benefits of physical activity. Etiology and health complications of over weight and obesity - Weight management.

Unit V Therapeutic Nutrition

Etiology, clinical features and nutritional management of the following - Type I and Type II Diabetes - Hypertension, coronary heart disease -Peptic ulcer and Diarrhoea - Infective hepatitis – B

Books for Reference

1. B. Srilakshmi, Human Nutrition New Age International (p) Ltd. 2009.
2. M.Swaminathan, Essential of Food & Nutrition Vol.I &II, Bappco, Bangalore.1974
3. B.Srilakshmi, Dietetics, New Age International Pvt. Ltd, 2009.
4. Mudambi SR and Rajagopal MY, Fundamentals of Foods, Nutrition and Diet Therapy, New Age International Pvt. Ltd, 2009.
5. Sherman H.C. Chemistry of Food and Nutrition, Agrobios 2010.
6. Blank F.C. A Hand book of Foods and Nutrition Agrobios 2010.

SEMESTER II	
Self Study Course I - Herbal and Ethno Botany	
Code: 17PBOSS1(Compulsory)	Credit: 1

Objective

- To provide the student with an opportunity to explore and exploit the medicinal values of Indian plants.
- To give an overall view of ethno botany, tribal medicines and their importance in present day drug research.

Unit I Introduction- history of pharmacognosy- definition and terms-basic concepts: 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 II 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 Teas. Phytopharmaceuticals: alkaloids, volatile oils, resins and tannins.

Unit III Herbal industry- Market potential of herb-global herbal market-Indian herbal market scenario-manufacturing sectors-(organized and unorganized)- Quality and safety assessment of herbal medicines-Herbal drug regulation in India- WHO on botanicals.

Unit IV Plants in folk religion – *Aegle marmelos*, *Ficus benghalensis*, *Curcuma domestica*, *Cyanodon dactylon* and *Sesamum indicum*. Medicinal uses and their significance – coconut, banana and betel

Unit V 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- Tribal medicines and their role in community herbal gardens-Traditional knowledge in relation to Intellectual Property Rights (IPR).

Books for Reference

1. Gokhale, B., Kokate, C.K., Purohit, A.P. 2004. Pharmacognosy. Nirali Prakashan, Pune
2. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
3. Qadry, J.S. 2005. Pharmacognosy. B.S. Shah Prakashan', Ahemadabad.
4. Jain SK 1981 *Glimpses of Indian Ethnobotany* Oxford & IBH, New Delhi
5. Jain SK 1987 *A Manual on Ethnobotany* Scientific Publisher Jodhpur
6. Jain SK and Mundgal 1999 *Handbook of Ethnobotany* London

SEMESTER III			
Core VII – Plant Physiology			
Code: 17PBOC31	Hrs/week:6	Hrs/Semester : 90	Credits: 5

Objectives:

- To facilitate the study of integrated activities in plants.
- To evaluate the stress related mechanisms of plants.

Unit I Water relations of plants - components of water potentials and their relation. Ascent of sap – theories. Translocation – source sink relationship. Transpiration - stomatal movement, antitranspirants. Inorganic nutrient - ion uptake - passive and active uptake and transport. Mineral nutrition and hydroponics.

Unit II Photosynthesis - recent concepts of thylakoid membrane - electron transport, redox system of chloroplast, photophosphorylation - cyclic, noncyclic, pseudocyclic. Mechanism of photosynthesis OEC (Oxygen evolving complex), C₃ and C₄ cycle, Rubisco, CAM pathway. Photorespiration and its significance.

Unit III Respiration - anaerobic, aerobic respiration. Glycolysis, TCA - cycle, oxidative phosphorylation, mitochondrial electron transport, inhibitors, uncouplers, glyoxylate cycle and cyanide resistant respiration. Pentose Phosphate Pathway (PPP). Sources of nitrogen - nitrogen metabolism - nitrogen fixation - symbiotic and asymbiotic, nitrogenase - biochemistry and mode of action, assimilation of nitrate and ammonia (GS - GOGAT - pathway)

Unit IV Physiological role and mechanism of action of auxin, gibberellin, cytokinin, ethylene, abscissic acid, morphactins and brassinosteroids. Photomorphogenesis - phytochrome mediated photoresponses. Physiology of flowering. Fruit ripening. Physiology of senescence and abscission, Biological clock.

Unit V Stress Physiology – biotic and abiotic stress - salinity, drought, freezing, radiation and heavy metal stress. Stress proteins in plants. Secondary messengers in plants-cAMP, Ca-calmodulin.

Books for Reference :

1. Beevers, L. 1976. Nitrogen metabolism in plants. William clowes & sons Ltd. London.

2. Bidwell, R.G.S. 1979. Plant physiology, Macmillan publishing company, New York
3. Devlin, R.M. 1974. Plant Physiology. Narosa publishing House, New Delhi
4. Jain, V.K. 2004. Fundamentals of Plant Physiology, S.Chand and Co.Ltd. New Delhi.
5. Noggle, G.R. and G.J. Fritz, 2002. Introductory plant physiology. Prentice Hall India, New Delhi.
6. Salisbury, F.B. and C.W. Ross, 2007. Plant Physiology. Thomson Wordsworth.
7. Taiz, L. and E. Zeiger. 1998. Plant Physiology. Sinauer Associates. Publishers Massachusetts, United States of America

Practical

Hrs/ week: 2

- Hill activity - effect of different wave lengths.
- Effect of antitranspirants and determination of stomatal index and frequency (Single leaf method & calcium chloride method)
- Determination of water potential(any one method)
- Membrane permeability studies.(using different solvents and temperature)
- Nitrate reductase activity – any one factor (light conditions/age)
- Determination of amylase activity.
- Determination of peroxidase activity
- Estimation of proline (Under normal and stressed conditions)
- Determination of chlorophyll content during aging/ under different light conditions
- Study on ion uptake.
- Determination of sugar content in fruits during ripening process.

Submission - Record Note Book

SEMESTER III			
Core VIII Biodiversity and Conservation			
Code: 17PBOC32	Hrs/week:6	Hrs/Semester : 90	Credits:5

Objective:

- To create awareness among the students to appreciate the variety in living world and their values.
- To manage and conserve the diversity of biological resource.

Unit I Biodiversity – concepts and scope. Levels of biodiversity - genetic diversity –nature and origin ,measurement based on DNA and chromosome ,molecular marker(RFLP,RAPD).Species diversity,. methods of assessment – diversity indices, species richness, species abundance, species evenness, taxic diversity, species turnover, species /area relationship and spatial pattern. Centers of Plant diversity.

Unit II Methods of analysis of vegetation - floristic , physiognomic and phytosociological. Remote sensing and Geographic Information System (GIS) application in Biodiversity studies . Values and uses of Biodiversity - economic, social, ethical aesthetic, optional and ecosystem services. Endemic plant diversity- endemism- types, endemic plants of India. Hot spots – distribution in India and world.

Unit III Biodiversity – global, national and regional level. Loss of biodiversity – loss of genetic diversity, process responsible for species extinction. Threatening - causes – habitat destruction, over exploitation, introduction of exotics, diseases. Man made causes – pollution, industrialization urbanization and deforestation .IUCN threat categories. Common threatened taxa of India. Red data book.

Unit IV Conservation of biodiversity. Current practices – habitat/ecosystem approaches, species based approaches , social approaches- sacred groves and sthalaviriksha. *In situ* conservation –National park, wild life sanctuaries and Biosphere reserve, afforestation, social forestry, agro forestry. *Ex situ* conservation - field gene bank, seed bank, pollen bank, tissue culture, DNA bank and cryopreservation methods. Green movements – Chipko movement and silent valley movement.

Unit V Organizations associated with biodiversity management, IUCN, WWF, UNEP, BSI, NPBGR, ICAR, WHF. Biodiversity legislations – GATT, TRIPS, CITES, Wild life preservation Act (1972), Indian forest Act (1927), Rio Summit – Agenda- 21, Convention on biological Diversity, Biodiversity Act (2002). Role of indigenous people in conservation. Biopiracy, sustainable development and management of biodiversity.

Books for Reference

1. Agarwal, K.C.2001. Fundamentals of Environmental Biology.S.chand &Co; New Delhi.
2. Dash, M.C.2001. Fundamentals of Ecology(2 nd edition). TATA Mc Graw Hill, New Delhi.
3. Dash, M.C.2004. Fundamentals of Ecology.TATA Mc Graw Hill, New Delhi.
4. Jhoshi, P.C. and Namita joshi . 2004. Biodiversity and conservation.APH Publishing Company, New Delhi
5. Khoshoo, T.K. Environmental concerns and strategies. Ashish Publishing House, New Delhi.
6. Krishnamoorthy, K.v.2004. An Advanced Text Book of Biodiversity oxford and IBH, New Delhi.
7. Odum, E.P. and Gay W. Barrelet, 2004. Fundamentals of Ecology (2 nd edition). TATA Mc Graw Hill, New Delhi .

Practical- Hrs / Week: 2

- Raunkiaers Frequency diagram – Quadrant / Transect method.
- Shannon Weieners Index and Abundance.
- Raunkiaers Biological Spectrum.
- Estimation of primary productivity of any terrestrial ecosystem (biomass method / Chlorophyll method)
- Determination of primary productivity of an aquatic ecosystem (Light / dark bottle method)
- World map showing hotspots.
- India map showing hotspots
- India map showing Biosphere reserves.
- Endangered / Endemic plants lists and photos (any 2).

Scientific Visits: Visit to any nearby place to observe *insitu* conservation of biodiversity - biosphere reserves, national parks, sanctuaries, wet lands, corals and mangroves.

SEMESTER III			
Core IX – Biostatistics and Bioinformatics			
Code: 17PBOC33	Hrs / week: 6	Hrs/Semester : 90	Credits: 5

Objectives:

- To make them analyze the biological data.
- To introduce the students to the explorations of advanced sciences.

Unit I Measures of central tendency: simple arithmetic mean, median and mode - their merits and demerits. Measures of dispersion: range, standard deviation, coefficient of variation and standard error.

Unit II Probability: definition, types (Apriori probability, Aposteriori probability), rules (addition rule and multiplication rule). Theoretical distributions: binomial and normal distribution. Test of significance - steps in tests of hypothesis. Chi-square analysis. Student's t test. ANOVA - assumption and analysis of variance (one way and two way).

Unit III Correlation analysis: definition, types. Methods of correlation- scatter plot diagram, graphic method, Karl Pearson's coefficient of correlation and rank correlation. Regression analysis: definition, types, regression lines and equations.

Unit IV Bioinformatics: definition, scope. Biological databases: Nucleotide databases – NCBI, EMBL, Genbank and DDBJ. Protein databases – PDB, SWISS PROT. Bioinformatics tools – BLAST, FASTA.

Unit V DNA sequence analysis: Global alignment, local alignment, gap penalty alignment, affine gap penalty alignment. Pairwise sequence alignment – dot matrix. Dynamics programming methods - Smith Waterman algorithm, Needleman -Wunsch algorithm. Scoring matrices - PAM and BLOSUM. Multiple sequence alignment – sum of pairs method and progressive method.

Books for Reference:

1. Attwood T.K and D. J. Pary Smith. 2006. Introduction to Bioinformatics Pearson Education, Ltd.
2. Gurumani N. 2005. An Introduction to Biostatistics. 2nd edition. M.J.P. Publishers, Chennai.
3. Jin Xiong, 2006. Essential Bioinformatics. Cambridge University Press.
4. Murthy C.S. V. 2004. Bioinformatics. 1st edition. Himalaya Publishing House.
5. Palanisamy, S. and M. Manoharan, 1994. Statistical methods for biologists. II Edition. Palani paramount publishers.
6. Rastogi, S.C., Namita Mendriata and Parag Rastogi, 2005. Bioinformatics methods and applications. 4th edition. PHI learning Pvt Ltd.
7. Satguru Prasad, 2003. Fundamentals of Biostatistics. 4th edition. Emkay Publications.
8. Veera Bala Rastogi, 2009. Fundamentals of Biostatistics. 2nd e dition. Ane Books Pvt. Ltd. Chennai.

Practical

Hrs / week:2

- Statistical analysis of leaves and fruits - mean, median, mode and standard deviation.
- Graphic representation of data.
- Diagrammatic representation of data.
- Correlation coefficient between length and width of leaves.
- Problem related to chi-square test.
- Study of probability using coin toss.
- Test of significance (Student's t test).
- Practiclas
- **Web browsing**
- Retrieving data from biological database
- Bibliographic searching
- Sequence alignment and similarity searching
- Gene finding
- Protein prediction
- Biomolecular visualization

Submission - Record Note Book

SEMESTER IV			
Self study - Forestry			
Code 17PBOSS2	Hrs/week:6	Hrs/Semester : 90	Credits: 4

Objectives:

- To gain a knowledge on various types of soil and water management.
- To know the significance of forests.

- Unit I** Water - a vital resource, India's water budget. Ground water, rain water, social implications. Forest nursery - Water management and manuring - organic manure - compost. Principles and methods of irrigation - sprinkler, drip, pitcher and irrigation systems.
- Unit II** Scope of forestry, Definition of forest, forest as balanced ecosystem. Forest management - objectives, management of flora - choice of species, salvage - cutting, pruning coppicing.
- Unit III** Social forestry - objectives, Role of social forestry in cottage industry; Agro forestry - techniques and implementation. Energy plantations under social forestry programme - Recreation forestry.
- Unit IV** Conservation of forests. Role of exotics in forestry. Minor forest products. Important forest based industries- Pulp and paper.
- Unit V** Nature and properties of wood: physical, chemical and mechanical. Anatomy of wood, Durability of wood. Defects and abnormalities of wood, wood seasoning and preservation; Defects due to seasoning and machining;

Books for Reference:

1. Anandan Kumaravelan R. 2005. Environmental Science and Engineering Seitechpublication (India) Pvt. Ltd Chennai.
2. Buce J. Zobel, Gerrit Van wyk and Fcr Stahl 1987. Growing exotic forests. A. Wiley- inter science publication John wileys sons. New york.
3. Kasturi Reddy 2010. Biodiversity and land conservation. Pacific publication N-187, Shivaji Chowk. Sadat pur Extension Delhi 110 094
4. Rana. S. V. S. 2009. Essentials of Ecology and Environmental Science. IV edition PHI learning Private Ltd., New Delhi 110011
5. Rao. M. K. 2011. Environment and climate change. Manglam publications Delhi 110053(India)
6. Shukla R.S, Chandel P.S. 2006. A text book of plant ecology. S. Chand and Company Ltd., Ram Nagar, New Delhi 110 055.
7. Trivedi. P. R Trivedi, Gurdeep Raj 2002. Environmental Ecology. Akashdeep publishing house, New Delhi.
8. Tyler Miller. G. 2004. Environmental Science. Thomson Brooks/cole Singapore.

SEMESTER IV			
Core X – Marine Biology			
Code: 17PBCC41	Hrs/week:6	Hrs/Semester : 90	Credits: 5

Objectives

- To make the students realize the potentiality of marine environment
- To understand the marine ecosystem threats and conservation

Unit I Marine Environment – Zonation and Biota

Sea as a biological environment. Classification of marine environment. Plankton – classification (size, life, habitat) and adaptations. Inter-tidal, rocky, sandy and muddy shores – features of the flora, fauna and adaptations. Role of marine micro-organisms (bacteria and fungi) in nutrient cycles (nitrate, phosphate and sulphate)

Unit II Characteristics of Sea Water

Physical properties: waves, tides, currents- types, causes, and their impact on marine organisms. Illumination, temperature, pressure. Chemical properties: nutrients, (major, minor, and trace elements), salinity, pH, density, dissolved gases (oxygen, carbon-di-oxide).

Unit III Marine Ecosystems

Estuaries, salt marshes, mangroves. Coral reef - ecology and types, species interaction, adaptations and importance. Threats and conservation of coastal ecosystems (coral reef and mangroves)

Unit I V Marine Pollution

Sources, effects and control measures of heavy metal, radioactive, oil, and thermal pollutions. Algal blooms-sources and effects. Microbial indicators of pollution. Role of microbes in pollution abatement.

Unit V Wealth of the sea

Living resources: Fishery products- fish meal and fish oil. Natural pearls: formation, ornamental and medicinal importance. Non-living resources: mineral wealth (manganese nodules, beach placers, glauconite and garnet). Bioactive compounds from marine organisms (bacteria, fungi, macro algae and sponges). Phycocolloids: agar-agar and algin.

Books for Reference

1. Tait, R.V. and Dipper F.A (1998) Elements of marine ecology.-4thed. British Library Cataloguing in Publication Data.
2. Gross, G., 1993.Oceanography: A view of the Earth. Sixth edition. Prentice Hall Inc., New Jersey.
3. McCormick, J.M. and J.V.Thiruvathaakal, 1976. Elements of Oceanography. W.B. Saunders Company, Philadelphia.
- 4 .Nybakken, J.W. 1997. Marine Biology – An Ecological Approach. Addison Wesley Longman, Inc. California, 477pp.
5. Olivia J.Fernando 1999.Sea water-Properties and dynamics, Dhanesh Publications, Ponnagam,Thanjavur
6. Russel 1970. Marine Ecology, Academic Press- London and New York
7. Nelson and Smith 1973, Oil pollution and Marine Ecology-Plenum press
8. Benjamin- Cummings, Menlo Park, California.Vijaya Ramesh, K. (2004). Environmental Microbiology.MJP Publishers Chennai.
9. MoshrafuddinAhamed and Basumatary. S.K.(2006). Applied Microbiology. MJP Publishers Chennai
- 10.Daws, C.J.1981. Marine Botany John Wiley and Sons, New York.

PRACTICALS

Hrs / Week : 2

- 1.Determination of acidity
- 2 Determination of salinity
- 3 Determination of alkalinity
- 4 Determination of total hardness
5. Determination of nitrite
6. Determination of phosphate
- 7 .Biochemical test for micro-organisms-IMViC
8. Collection and identification of marine plankton (any three phyto and zooplanktons)
9. Identification and remarks of the following
 - i. Plankton net
 - ii Inter-tidal organisms
 - a. Rocky shore :Sea anemone, *Chiton*
 - b. Muddy shore:*Uca*, *Cerithidia*
 - c. Sandy shore: *Arenicola*, *Murex*
 - ii.Food fishes: *Cybium*,*Sardinella*
 - iii Sea weeds: *Gracilaria*,*Sargassum*,
10. Submission: Record Note Book

Semester IV			
Core XI – Plant Biotechnology			
Code: 17PBOC41	Hrs/week:6	Hrs/Semester : 90	Credits: 5

Objectives:

- To enumerate the role of 21st century science (biotechnology) in increasing productivity of crop plants and to enhance the production of high value metabolites.
- To develop skill to get employment in biotechnology laboratories and industries.

Unit I: Biotechnology-scope. Principles of plant tissue culture: totipotency, differentiation, dedifferentiation, redifferentiation. Establishment of plant tissue culture lab: equipment, culture vessels, pretreatment of explants. Composition of various tissue culture media and their preparation. Establishing callus: dynamics of callus growth, factors influencing organogenesis, embryogenesis and somatic embryos.

Unit II: Micropropagation: stages of micropropagation, factors affecting shoot multiplication, induction of roots. Synthetic seeds: methods of making synthetic seeds and applications. Production of virus free plants. Somoclonal variation: isolation and characterization of variants -molecular basis and induced mutations, applications and limitations. Cell suspension culture and production of secondary metabolites.

Unit III: Production of haploids (anther, pollen and ovule), detection of haploids - morphology and genetic markers, application of haploids. Protoplast isolation and culture. Protoplast fusion-techniques, selection of fused protoplasts, application. Uses of somatic hybrids and cybrids.

Unit IV Biofertilizers: Mass production of *Rhizobium*, *Azospirillum* and Blue Green Algae (BGA), Vesicular Arbuscular Mycorrhizal Fungi (VAM). Single cell protein. Production of antibiotic (Penicillin), organic acid (Citric acid) and vitamin (Vitamin B₁₂). Outline of green synthesis of nanoparticles and their characterization.

Unit V Molecular farming - Nutritional quality and quality of seed protein. Immuno protective drugs. Gene therapy – types of gene therapy, methods of gene therapy, production of antibodies and vaccines, monoclonal antibodies and its application. Biosafety – definition, requirement, biosafety in relation to transgenic research. Intellectual property rights – process of patenting, applications. Farmer’s Rights and plant breeder’s Rights.

Books for Reference:

1. Colin Rattledge and K. Bjon, 2001. Basic biotechnology. Cambridge University
2. Dubey, R.C. 2005. Textbook of Biotechnology. S. Chand & Co. New Delhi
3. George, E.F. and P.D. Sherrington, 1984. Plant propagation by tissue culture. Exegetic Ltd. London.
4. Gupta, P.K. 2000. Elements of Biotechnology. Rastogi publication, Meerut.
5. Kalyan Kumar De. 2004. An Introduction to Plant Tissue Culture. New Central Book Agency, Calcutta.
6. Kumar, H.D. 1993. Molecular biology and Biotechnology. Vikas publishers, New Delhi.
7. Mahesh, 2008. Paddy molecular Biotechnology, New age international, publishers. (p) Limited.
8. Mukhopadhyay S.N, prabhakar Sharma, and Rabindra Narain, 2011. A text book of DNA recombinant technology. Wisdom press. New Delhi.
9. Ramavat, K. G., 2000. Plant Biotechnology, S. Chand & Co., New Delhi
10. Reinort, J and M.M. Yeoman, 1983. Plant cell and tissue culture. Narosa publishing house Delhi.
11. Satyanarayana U. 2006. Biotechnology. Books and Allied (P) Ltd. Kolkatta.
12. Singh, B.D.2005. Biotechnology- Expanding Horizons. Kalyani Publishers, New Delhi.

Practical

Hrs /week: 2

Practical

- Isolation of *Rhizobium*
- Synthesis of nanoparticles
- UV – visible characterization of nanoparticles
- Preparation of synthetic seeds

Set up / pictures / photographs/ demonstration

- Apical meristem culture
- Cell suspension culture
- Protoplast Culture
- Anther Culture

Submission - Record Note Book

SEMESTER IV			
Core XII- Plant Ecology			
Code: 17PBOC42	Hrs/week:6	Hrs/Semester : 90	Credits : 5

Objectives:

- To enhance the understanding of the environment, key ecological issues, concepts and principles of environmental protection to make life on earth more sustainable and beneficial to human.

Unit I Plant and the environment: climatic factors - air, water and temperature; Edaphic factors - types based on texture and colour. Components of soil- soil air, soil water, pH, mineral matter, organic matter, soil profile - soil organisms - reclamation of soil erosions and conservation. Biotic Factors - positive and negative interactions. Structure and function of major ecosystems - terrestrial (Grass land , forest and desert) aquatic (pond).

Unit II Population structure and dynamics: Basic concepts - characteristics of population, size and density, dispersion, age structure, natality, mortality, biotic potential and life table. Population dynamics - theory of population growth , Plant population dynamics, Regulation of population growth, Evolution among population and population interaction.

Unit III Ecological succession - Definitions, Causes of succession and climax, concept, Monoclimax and poly climax theories, Kinds of succession, Hydrosere and Xerosere. Adaptation of plants- hydrophytes, xerophytes and halophytes,

Unit IV Environmental Management Plan (EMP), ecological indicators. Bioremediation - *In situ* and *ex situ* bioremediation of hydrocarbon, dyes, heavy metals and xenobiotics. Biodegradation of pesticides, biodegradable plastics, bio-augmentation. Bio-filtration - mechanism and microorganisms used. Microbial leaching, bio-mining. Ecology in national affairs- carbon trading, carbon sequestration, blue carbon, climate conference, convention and summit.

Unit V Global environment problems - climate change, global warming, UV - B, green house effect - ozone layer depletion, acid rain , nuclear accidents and holocaust. Disaster management – flood, earthquake and landslides. Eco-management, Environmental Impact Assessment (EIA). Sustainable eco-development, environmental education, Environmental protection Act (EPA)1986. Man and Biosphere (MAB)

Books for Reference :

1. Asthana and Meera Asthana, 2001. Environmental problems and solutions. S.Chand and Co. Ltd., New Delhi.
2. Balasubramanian,D; C.F.a. Bryee, K.Dharmalingam, J.Green and K. Jeyaraman, 2005. Concepts in Biotechnology. Universities Press.
3. Dash, M.C.2001.Fundamentals of ecology. Tata McGraw Hill publishing Co. Ltd., New Delhi.
4. Murugesan, A.G.and Rajakumari , 2005. Environmental Science and Biotechnology, theory and Techniques . M.J.P. Publishers, chennai.
5. Sharma, P.D1999.Elements of ecology. Rastogi Publications, Shivaji Road, Meerut.
6. Trivedi P.R, P.L Sharma and KN Sundarshan 1994. Natural environment and Constitution of India, Efficient offset printers, New Delhi.
7. Tyller Miller G., 2004. Environment Science Thompson Brooks/Cole. Singapore.
8. Varshney C.K 1989. Water pollution and management, S.P. Printers, Noida.

Practical

Hrs /week: 2

- Determination of soil pH (at least 3 types of soil)
- Determination of soil texture.
- Determination of soil moisture.
- Determination of soil bulk density.
- Determination of soil porosity.
- Determination of soil organic matter content.
- Estimation of dissolved O₂ in water samples.
- Estimation of BOD in water samples.
- Estimation of COD in water samples.
- Adaptation of plants- hydrophytes,xerophytes and halophytes,

Submission - Record Note Book

SEMESTER IV		
Elective III– Horticulture and Nursery Management		
Code:17PBOE41	Hrs/week:6	Hrs/Semester : 90 Credits : 4

Objectives:

- To learn the techniques and applications of horticulture.
- To motivate the students to get acquainted with nursery management

- Unit I** : Horticulture – definition, divisions and importance. Propagation of horticultural crops – cuttage, layerage, graftage and budding. Seedage – characteristics of good seed, and seed treatment for germination – Transplanting of seedling.
- Unit II** : Plant growing structures – objectives and types – green houses, hot beds, cold frames and conservatory. Establishment and cultivation of orchard. Gardening - outdoor garden –types, principles, designing and garden components.
- Unit III** : Indoor gardening. Terrarium, hanging basket and bonsai. Commercial gardening - cut flowers and economic flowers. Kitchen gardening – selection of site, lay out and choice of plants. Storage and preservation of fruits and vegetables.
- Unit IV** : Nature and scope of nurseries- location and site selection, climate water and soil qualities. Growing media- types of containers, potting mixtures, soil preparation for filed grown plants, , improving soil quality, sanitation and sterilization techniques. Irrigation system- overhead sprinkler, drip and pulse watering. Pest Management- - physical, biological and chemical control of diseases, Nutrient management- fertilizers, manures and growth hormones.
- Unit V** : Management plans: Cost efficiency, work scheduling, labour availability. Marketing strategies: Modifying plant growth- plant uniformity, holding stock, stem sturdier, improving foliage colour, encourage flowering offseason. Selection of marketable plant, developing stock list, clearing surplus stock, surveying customer, terminology

Books for Reference:

1. Choudhri D and Amal Metha 2010. Flower crops cultivation and management Oxford book company . Jaipur
2. Edmund Senn - Andrew – Halfacre. 1977. Fundamentals of Horticulture. Tata Mc. Graw Hill.
3. Hartmann & Kester, 1989 – Plant propagation. Prentice – Hall of India Pvt. Ltd. New Delhi.
4. Mallikarjuna Reddy and Aparna rao 2010. Plant propagation in horticulture. Pacific book international. New Delhi.
5. Kumar, N. 1997. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil, India.
6. Randahawa 1985. Floriculture in India. Allied publishers.
7. Utpal Banerji 2008. Horticulture Mangal Deep Publication. Jaipur

SEMESTER IV			
Elective III– Bionanotechnology			
Code:17PBOE41	Hrs/week: 6	Hrs/Semester : 90	Credits:4

Assurance of learning:

- To acquire the basic knowledge on nanoparticles - their principles and characteristics.
- To learn the tools of generating nanomaterials.
- To comprehend the modern-day applications of nanoparticles.

Unit I Nanoparticles – definition and historical background of nanotechnology. Principles: quantization effects - inverse relationship between size and reactive surface area. Properties: surface effects, the effects of size, shape, surface and bulk composition, and solubility and persistence. Particle characteristics: distribution, organ system effects, including effects on immune and inflammatory systems. Types of nanoparticles: liposomes, albumin-bound, polymeric iron oxide, quantum dot and gold.

Unit II Essentials of nanostructure generation: top-down vs. bottom-up chemical and physical self assembly. Physical, chemical and biogenic synthesis of nanomaterials – biomimetics, green plants, and microorganisms. Role of biomolecules - reducing and/or capping agents: proteins, viruses and carbohydrates.

Unit III Detection and measurement of nanoparticles – physical characterization by UV, FTIR, SEM, FESEM, DLS, X-ray diffraction and Zeta potential.

Unit IV Targeted nanoparticles: active & passive targeting. Application: medicine, manufacturing & materials, delivery vehicles, cancer therapy, tissue engineering, fluorescent biological labels, biological assays, imaging agents, biosensors, manipulation of cells and biomolecules.

Unit V Interactions between nanoparticles and living systems, interaction with cells, exposure of living systems to nanomaterials - toxicity effects. Mediators of the toxicity of particles. Factors influencing the interaction of nanomaterials over mammalian cells: uptake, transport and biodistribution of nanoparticles in living system, toxicity on cellular processes. Overview of EU regulatory aspects.

Reference

1. Barbara Panessa-Warren, 2006 Understanding cell-nanoparticle interactions - making nanoparticles more biocompatible. Brookhaven National Laboratory
2. Bhushan Bharat (Ed.) 2012. Encyclopedia of Nanotechnology, Springer.

4. Chand A, Mirkin, Christof Niemeyer 2007. Nanobiotechnology II: more concept and applications 1st edition Wiley-VCH Publisher.
5. European Commission, SCENIHR, 2006. Modified opinion on the appropriateness of existing methodologies to assess the potential risks associated with engineered and adventitious products of nanotechnologies, European Union
6. Gysell Mortimer, 2011. The interaction of synthetic nanoparticles with biological systems
8. PhD Thesis, School of Biomedical Sciences, Univ. of Queensland.
9. Iseult Lynch, Anna Salvati & Kenneth A. Dawson, 2009 Protein-nanoparticle interactions: What does the cell see? *Nature Nanotechnology* 4, 546 - 547 doi:10.1038/nnano.2009.248
10. Jain K.K. Nanobiotechnology molecular diagnostics: Current techniques and application (Horizon Bioscience) 2006 Taylor & Francis 1st edition.
11. Johan Ach, Ludwig Siep 2007. Nano–Bio–Ethics: Ethical dimension of nanobiotechnology by 1st edition lit ver leg publication.
12. Jain, K. K. 2012. Handbook of Nanomedicine, Springer.
13. Kelsall Robert W, Ian Hamley, Mark Geoghegan, 2004 Nanoscale Science and Technology, Wiley Eastern.
14. Mark Ratner and Daniel Ratner 2002. Nanotechnology: A gentle introduction to the next big idea. Pearson Education Publishers.
15. Michael Kohler, Wolfgang, Fritzsche, 2004 Nanotechnology: Introduction to Nanostructuring Techniques.
16. ORR *ET AL.*, 2010. cellular recognition and trafficking of amorphous silica nanoparticles by macrophage scavenger receptor a. nanotoxicology. published online september 17, 2010. DOI:10.3109/17435390.2010.513836
17. Sharon, M. & Sharon, M 2012. Bio-Nanotechnology- Concepts and Applications, CRC Press.
18. Volker Mailänder and Katharina Landfester 2009 Interaction of nanoparticles with cells. biomacromolecules, 10 (9): 2379 – 2400 DOI: 10.1021/BM900266R
19. Yao N and Zhong Ling Wang, 2005, Hand book of microscopy for nanotechnology kluwer academic publishers.

Online Resources

- 1) <http://ieet.org/index.php/IEET/more/bionanotechnology20141007> Institute of Ethics & Emerging Technologies
- 2) <https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html>
- 3) <http://www.particle-works.com/applications/controlled-drug-release/Applications>
- 4) <https://jnanobiotechnology.biomedcentral.com/articles/10.1186/1477-3155-2-3>
DOI: 10.1186/1477-3155-2-3
- 5) <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3865110/>
- 6) <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/>