

**M.Sc. Botany
Courses Offered**

Semester	Subject Code	Title of the Paper	Hours per Week	Credits
I	PB1711	Core I: Plant Diversity I – Algae, Fungi, Lichens and Bryophytes	6	4
	PB1712	Core II: Microbiology, Immunology and Plant Pathology	6	4
	PB1713	Core III: Developmental Botany	6	4
	PB1714 PB1715	Elective I: (a) Marine Biology (b) Cell Biology	6	5
	PB17P1	Practical I: Plant Diversity I – Algae, Fungi, Lichens and Bryophytes, Microbiology, Immunology and Plant Pathology and Developmental Botany	6	-
II	PB1721	Core IV: Plant Diversity II - Pteridophyta, Gymnosperms and Palaeobotany	6	4
	PB1722	Core V: Research Methodology	6	4
	PB1723	Core VI: Biochemistry and Biophysics	6	4
	PB1724 PB1725	Elective II: (a) Medicinal Botany and Pharmacognosy (b) Medicinal Plants and Ethnobotany	6	5
	PB17P1	Practical I: Plant Diversity I – Algae, Fungi, Lichens and Bryophytes, Microbiology, Immunology and Plant Pathology and Developmental Botany	-	5
	PB17P2	Practical II: Plant Diversity II- Pteridophyta, Gymnosperms and Palaeobotany, Research Methodology and Biochemistry and Biophysics	6	5
	LST172	Life Skill Training (LST) – I	-	1
III	PB1731	Core VII - Taxonomy of Angiosperms and Economic Botany	6	4
	PB1732	Core VIII: Genetics and Molecular Biology	6	4
	PB1733 PB1734	Elective III: (a) Forestry (b) Horticulture and Plant Breeding	6	5
	PB17P3	Practical III: Taxonomy of Angiosperms and Economic Botany, Genetics and Molecular Biology	4	-
	PB17PR	Project	8	4

IV	PB1741	Core IX: Plant Physiology and Metabolism	6	4
	PB1742	Core X: Environment and Conservation Biology	6	4
	PB1743	Core XI: Applied Biotechnology	6	4
	PB1744 PB1745	Elective IV: (a) Industrial Microbiology (b) Biostatistics and Bioinformatics	6	5
	PB17P3	Practical III: Taxonomy of Angiosperms and Economic Botany, Genetics and Molecular Biology	-	4
	PB17P4	Practical IV: Plant Physiology and Metabolism, Environment and Conservation Biology and Applied Biotechnology	6	5
	LST174	Life Skill Training (LST) – II	-	1
	STP171	Summer Training Programme	-	1
		TOTAL	120	90

Semester I
Core I: Plant Diversity I – Algae, Fungi, Lichens and Bryophytes
Sub. Code: PB1711

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	90	100

Objectives

1. To understand the diversity, life cycle patterns and major evolutionary trends of algae, fungi, lichens and bryophytes.
2. To develop the skill for identifying cryptogams.

Unit I

General characters of algae including similarities and diversities; Classification of algae by Fritsch (1954); Thallus organization in algae; Life-cycle patterns and alternation of generations. Detailed study on occurrence, habitat, structure, reproduction and life history of Cyanophyceae and Chlorophyceae

Unit II

Detailed study on occurrence, habitat, structure, reproduction and life-history of Xanthophyceae, Bacillariophyceae, Phaeophyta, Rhodophyceae, Fossil algae; Economic importance - Role of algae in soil fertility; Algal blooms; symbiotic associations; nitrogen fixation; Pollution indicators; SCP.

Unit III

General characters of fungi; Classification of fungi proposed by **C.J Alexopoulos and C.W Mims (1979)**; Homothallism and Heterothallism in fungi; Parasexuality in fungi; An overview and life history of Zygomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes. Economic importance of fungi.

Unit IV

General account of Lichens; Classification by Miller (1984); Structure, nutrition and reproduction of the three major groups – Crustose, Foliose and Fruticose; Economic importance of Lichens.

Unit V

Classification, Distribution, Origin (including fossil evidence), Primitive and advanced features of Bryophytes; Evolution of gametophytes and sporophytes; Ecological adaptations; Economic importance. A comparative study of the morphological and anatomical features of Polytrichales, Bryales, Marchantiales, Jungermanniales and Anthocerotales.

Reference Books

1. Bilgrami, K.S., & Sinha, L.B. (2004). *A Text Book of Algae*. New Delhi: CBS Publication and Distributors.
2. Cavers, F. (1988). *The Interrelationships of the Bryophyta*. New Delhi: Technico Publishing Pvt. Ltd.
3. Chapman, V.J., & Chapman, D.J. (1960). *The Algae*. London: Elbs and Macmillian Pvt. Ltd.
4. Chopra, R.N., & Kumar, P.K. (2004). *Biology of Bryophytes*. London: Wiley Eastern Ltd.
5. Fritsch, F.E. (1972). *The Structure and Reproduction of Algae*. Vol I and II, London: Cambridge University Press.
6. Kumar, H.D. (2004). *Introductory Phycology*. New Delhi: Affiliated East Press.
7. Peter George. (2010). *Hand Book of Bryophyta*. New Delhi: Rajat Publications.

8. Prem Puri, P. (1981). *Bryophytes*. New Delhi: Atma Ram and Sons Publishing Company.
9. Rashid, A. (1999). *An Introduction to Bryophyta*. New Delhi: Vikas Publishing House Pvt. Ltd.
10. Robert Edward Lee, T. (2008). *Phycology*. London: Cambridge University Press.
11. Sharma, O.P. (1986). *Text Book of Algae*. New Delhi: Tata McGraw Hill Publishing Co.
12. Vashishta, B.R., Sinha, A.K., & Singh, V.P. (1960). *Algae*. New Delhi: Chand and Company Ltd.

Semester I
Core II: Microbiology, Immunology and Plant Pathology
Sub. Code: PB1712

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	90	100

Objectives

1. To provide an understanding of microorganisms and the role they play in health and disease.
2. To acquire advanced training in microbiology and related areas and develop skills in the critical analysis and interpretation.

Unit I

General properties of bacteria; Morphology and fine structure of Bacteria; Classification of bacteria as per Bergey's Manual of Systematic Bacteriology; Bacterial Nutrition; Bacterial Growth curve; Sterilization and disinfection; Culture media and its types; Methods of isolation - Pure culture; Identification of bacteria.

Unit II

General properties of Viruses; Classification and nomenclature; Structure of virus; Cultivation of virus; Morphology of bacteriophages; life cycle – Lytic cycle and Lysogenic cycle; General properties of Actinomycetes and Mycoplasma; General characteristics of antimicrobial drugs; Antibacterial drugs – Sulfonamides, Penicillins; Drug resistance.

Unit III

Microbial flora of soil - Significance of soil microorganisms. Microbial flora of municipal water and its Purification; Bacteriological examination of drinking water; Microbial flora of milk - Pasteurization of milk - Phosphatase Tests for grading milk sample; Food spoilage by bacteria – *Clostridium botulinum*, *Salmonella sps*, *Shigella sps*, *Staphylococcus sps*.

Unit IV

Immunity – Definition and its types; Properties of Antigens; Antibodies – Basic structure and its types; Strength of Antigen - Antibody interactions; Agglutination reactions; Precipitation reactions; Cytokines - Properties and attributes; Monoclonal antibody production; Immunodiffusion; ELISA; Immune response during bacterial (Tuberculosis), parasitic (Malaria) and viral (HIV) infections.

Unit V

Classification of plant diseases - Symptoms - Infection process - Host parasite interaction - Defense mechanisms in plants; Disease control methods - Physical, chemical, Cultural and Biological - Integrated disease management. Detailed study of the plant diseases- Citrus cancer, White rust disease, Blast of rice, Red rot of Sugercane, Little leaf of Brinjal.

Reference Books

1. Sharma, P.D. (2000). *Microbiology and Plant Pathology*. Meerut: Rastogi Company.
2. Singh, R.S. (1988). *Introduction to Principles of Plant Pathology*. New Delhi: Oxford IBH Publishing Company.
3. Dubey, R.C., & Maheswari, D.K. (2000). *A Text book of Microbiology*. New Delhi: S. Chand and Co. Ltd.
4. Prescott, P., Harley, H., & Klein, K., (2003). *Microbiology*. New York, NY: McGraw Hill Publishers.
5. Rangaswami, G. (1988). *Diseases of Crop Plants in India*. Delhi: Prentice Hall of India Pvt. Ltd.
6. Michael J. Pelczar, J.R., Chan, E.C.S., & Noel R. Krieg. (1998). *Microbiology*. New Delhi: Tata McGraw Hill Publishing Company.
7. Ananthanarayan, R., & Jayaram Paniker, C.K. (2005). *Textbook of Microbiology*.

Hyderabad: Orient Longman Publication.

8. Gerard, J., Tortora, A., Berdell, R., Funke, M., & Christine Case, L. (2002). *Microbiology: An Introduction* (8th Ed.). New York, NY: Pearson Education, Inc.
9. Lansing, M., Prescott John, P., Harley, L., & Donald A Klein. (1999). *Microbiology* (4th ed.). New York: McGraw Hill International Editions.

Semester I
Core III: Developmental Botany
Sub. Code: PB1713

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	90	100

Objectives

1. To understand the process by which plants grow and develop and also encompasses the biology of regeneration, sexual reproduction, metamorphosis, and the growth and differentiation of cells in the adult organism.
2. To become an expert in molecular and cellular aspects of development by using metabolomics and advanced microscopy techniques and create a better understanding of processes underlying developmental botany.

Unit I

Introduction to Developmental Botany- Nuclear- Cytoplasmic interaction- Division- Differentiation- Polarity and Symmetry, organization of Shoot Apical Meristem (SAM) and Root Apical Meristem (RAM); vascular cambium- origin, structure and seasonal activity.

Unit II

Xylem, Phloem and their elements- primary and secondary structures, phylogenetic trends and specialization of xylem and phloem. Secondary growth- Periderm- structure- development of lenticels, Anomalous secondary growth- Bougainvillea, Bignonia, Achyranthes and Dracaena.

Unit III

Wood anatomy- physical, chemical and mechanical properties. Defects in wood- natural defects, knots and defects due to diseases. Reaction wood- Tension and Compression wood- Durability of wood. Ontogeny of dicot and monocot leaves. Differentiation of epidermis with special reference to stomata and trichomes.

Unit IV

Microsporogenesis- Pollen morphology- pollen wall- pollen development- pollen dimorphism- pollen storage, pollen allergy. Microsporogenesis- Pollen- Pistil interaction- structure of style- stigma and significance. Megasporogenesis. Different types of embryo sac development- fertilization- barriers of fertilization- self- incompatibility- types, physiology and biochemistry, methods to overcome self-incompatibility.

Unit V

Fertilization- changes, physiological and biochemical changes during maturation. Seed- seed coat development and specialization. Endosperm- types- haustoria. Embryogenesis and organogenesis of dicot and monocot embryos- Apomixis- Polyembryony- parthenocarpy.

Reference Books

1. Bhojwani, S.S., & Bhatnagar, S.P. (2000). *The Embryology of Angiosperms*. New Delhi: Vikas publishing House.
2. Davis, C.L., & John Willey. (1965). *Systematic Embryology of Angiosperms*. New Delhi.
3. Erdtman, G. (1969). *Hand book of Palynology*. New York, NY: Hafuer Publication Co.
4. James, A.J. (1960). *Morphology of Angioperms*. New York, NY: McGraw Hill Publishing Company Ltd.

5. Maheswari, A. (1950). *An Introduction to the Embryology of Angiosperm*. New York, NY: McGraw Hill Publishers.
6. Nair, P.K.K. (1970). *Pollen Morphology of Angiosperms*. Delhi: Scholar Publication, London and Vikas Publication.
7. Lars Hennig, A., & Claudia Kohler, K. (2011). *Plant Developmental Biology: Methods and Protocols*. London: Humana Press.
8. Paul, M., Wassarman., & Elsevier. (2016). *Essays on Developmental Biology*. New York, NY: McGraw Hill Publishing Company Ltd.

Semester I
Elective I (a): Marine Biology
Sub. Code: PB1714

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	5	90	100

Objectives

1. To make the students realize the potentiality of marine environment.
2. To provide self employment opportunity in producing marine products.

Unit I

Classification of marine habitat – pelagic – neritic and oceanic province, benthic – zonation – shore environment – muddy, rocky and sandy, waves and tides, deep sea bottom – pelagic deposits. Characteristics of marine habitat – physical parameters – temperature, illumination, specific gravity, pressure and buoyancy, ocean current. Chemical constituents – major and minor constituents, deep sea nodules. Plate tectonics – earthquakes and tsunami.

Unit II

Marine biodiversity – phytoplankton – characteristics, sampling and measuring. Marine bacteria, marine fungi, seaweeds and sea grasses; Energy relationship – primary production, grazing food chain, detritus chain and energy balance sheet. Green house effect, Carbon pump.

Unit III

Marine products – Production and uses of Agar-agar, Alginates, Carrageenan; Marine lipids; Marine pharmacology – Bioactive compounds from marine organisms; Sea grasses – structure, reproduction and ecological roles.

Unit IV

Culture of micro algae – Open pond method, Photobioreactors, Batch culture, Continuous culture; Maintenance of culture – Stock culture and Sub culture; Commercial cultivation of seaweeds; Marine pollution – thermal pollution, oil pollution, heavy metal pollution, radioactive pollution; Eutrophication.

Unit V

Mangroves - Structure, Reproduction and ecological roles; Present status of mangroves with special reference to Pitchavaram; Salt marsh plants – Structure, Adaptations and ecological roles; Restoration of mangroves; Coral reefs – Formation, Types, Ecology, Species interaction and economic importance.

Reference Books

1. Cliton J Dawes. (1981). *Marine Botany*. New York, NY: Wiley - Intersciences Publication John Wiley and sons.
2. Dring, M.J., & Edward Arnold, A. (1982). *The Biology of Marine Plants*. New York, NY: John Wiley and sons.
3. Kumudranjan Naskar, D., & Rathindrandath, A. (1999). *Ecology and Biodiversity of Indian Mangroves Vol. I & II*. Delhi: Daya Publishing House.
4. Michael, P. (1986). *Ecological Methods for Field and Laboratory Investigations*. New Delhi: Tata McGraw – Hill publishing company Ltd.
5. Raymond, P. (1980). *Plankton and Productivity*. Michigan: University Press.
6. Sinha, P.C. (1998). *Marine Pollution*. New Delhi: Anmol publications Pvt. Ltd.
7. Warren, W.B. (1971). *Biology and Water Pollution Control*. London: Toronto, Saunders Company, Philadelphia.

Semester I
Elective I (b): Cell Biology
Subject Code: PB1715

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	5	90	100

Objectives

1. To enable the students to have a understanding of cellular components of plants.
2. To gain an insight into the uses of plant cell in industry and how these cells can be manipulated and used in the research/industrial work place.

Unit I

Introduction - The cell theory, Origin and development of cell biology as a separate branch; Structure and organization of prokaryotic and eukaryotic cells; Specialized cell types; Plasma membrane - Structure, models and functions of plasma membrane, ATPases, Receptors, Carriers, Channels and Pumps; Vacuole structure and function, Vacuolar ATPases, Transporters.

Unit II

Cytoskeleton - Microtubules and Microfilaments, their role in cell division and motility ; Intermediate filaments- role in providing strength; Chemical foundation - Macromolecules - Structure, shape and information, Noncovalent interactions in relation to function of nucleic acids and proteins; Biochemical energetic - Types of energy- thermal, electrical and radiant energy; Interconvertibility of energy; Laws of thermodynamics as applicable to biological systems.

Unit III

Chloroplast and Mitochondria - Structure and function, genome organization; Nucleocytoplasmic interactions; RNA editing; Other organelles - Structure and functions of endoplasmic reticulum, golgi apparatus, lysosomes, functions of microbodies and peroxisomes.

Unit IV

Cell wall - Structure and functions, Cell wall architecture, Biogenesis and Growth; Plasmodesmata structure and function; Plasmodesmata in comparison with gap junctions of animal cells.

Unit V

Tools in cell Biology - Microscopy: Working principles of Light microscopy, Scanning electron microscopy, Transmission electron microscopy; Preparation of specimens for Microscopy: Freeze fracture and Freeze etching techniques; Subcellular fractionation - Principles of centrifugation. Spectroscopic techniques - principles and applications of UV-visible, ESR, Nuclear magnetic resonance, Spectrofluorimetry, Circular dichroism (CD).

Reference Books

1. 1. Alberts, B., Bray, D., Lewis, J., Ralf Roberts, K., & Watson, J.D. (1999). *Molecular Biology of the Cell*. New York, NY: Garland Publishing Inc.
2. Avers, C.J. (1986). *Molecular Cell Biology*. New York, NY: Addison Wesley Publishing Company.
3. De, D.N. (2000). *Plant Cell Vacuoles: An Introduction*. Australia: CSIR Publication, Collingwood.
4. Kleinmith, L.J., & Kish, V.M. (1995). *Principles of Cell and Molecular Biology* (2nd ed.). New York, NY: Harper Collins College Publishes.
5. Krishna Murthy, K.V. (2000). *Methods in Cell Wall Cytochemistry*. Florida: CPC Press, Boca Raton.
6. Lodish., Berk, A., Zipursky, S.L., Matsdaira, P., Baltimore, D., & Darnell, J., (2000). *Molecular Cell Biology* (4th ed.). New York, NY: W.H. Freeman and Co.

Semester II
Core IV: Plant Diversity II - Pteridophyta, Gymnosperms and Palaeobotany
Sub. Code: PB1721

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	90	100

Objectives

1. To understand the diversity, life cycle and major evolutionary trends of non-flowering plants.
2. To develop the skill for identifying vascular cryptogams.

Unit I

Origin and evolution of vascular plants; Stelar evolution; Telome theory; Apogamy and apospory; Economic importance of Pteridophytes. Classification of pteridophytes by G.M.Smith

Unit II

Range of thallus structure, reproduction and evolution of gametophytes and sporophytes of the following orders: *Psilotales*, *Lycopodiales*, *Selaginellales*, *Isoetales*, *Equisetales*.

Unit III

Ophioglossales, *Osmundales*, *Filicales* and *Salviniales*. Sporangial development - Eusporangiate and Leptosporangiate types, heterospory and origin of seed habit and soral evolution.

Unit IV

Affinities and evolution of gymnosperms; Classification of gymnosperms (K.R. Sporne, 1965); General characters - morphological, reproductive characters, phylogeny and interrelationship of the orders - *Cycadales*, *Ginkgoales*, *Coniferales* and *Gnetales*.

Unit V

Geological time scale; Methods of fossilization and determination of the geological age of fossils, carbon dating. A brief study of the following fossil Pteridophytes: *Rhynia*, *Lepidodendron*, *Sphenophyllum* and *Calamites*. A brief study of the following fossil Gymnosperms: *Lyginopteris*, *Cycadoidea*, *Pentaxylon* and *Cordaites*.

Reference Books

1. Johri, R.M., Sneha Lata., & Kavita Tyagi. (2012). *Text Book of Gymnosperms*. New Delhi: Wisdom Press.
2. Ernest., Gifford., Foster. (1996). *Morphology and Evolution of Vascular Plants*. New York, NY: W.H. Freeman and Company.
3. Meyan, V. (1987). *Fundamentals of Palaeobotany*. London: Chapman and Hall.
4. Rashid, A. (1985). *An Introduction to Pteridophyta*. New Delhi: Vikas Publishing House Pvt. Ltd.
5. Shukla, A.C., & Misra, S.P. (1982). *Essentials of Palaeobotany*. New Delhi: Vikas Publishing House Pvt. Ltd.
6. Sundara Rajan, S. (2009). *Introduction to Pteridophyta*. New Delhi: New Age International Publishers.
7. Vashishta, B.R., Sinha, A.K., & Kumar. (2005). *Botany for Degree Students – Pteridophyta*. New Delhi: Chand and Co.
8. Vashishta, P.C., Sinha ,A.K., & Anil Kumar. (2007). *Botany for Degree Students: Gymnosperms*. New Delhi: S. Chand and Co.

Semester II
Core V: Research Methodology
Sub. Code: PB1722

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	90	100

Objectives

1. To introduce the students the systematic, theoretical analysis of the body of methods and principles associated with a branch of knowledge which encompasses concepts such as paradigm, theoretical model, phases and quantitative or qualitative techniques involved in plant science which will enable them to pursue various research activities.
2. Acquire and enhance specific laboratory skills including microscopy, spectrophotometry, tissue culture, organelle isolation, chromatography, bioassays to formulate original questions about plants into empirically testable hypotheses, collect and analyze data obtained from original research, and translate and apply experimental data to advance the field and solve real-world problems.

Unit I

Research- Objectives of research, Types of research, Significance, Literature collection- Index card, reference card and Abstract card. Literature citation- Different systems of citing references- Name year system, Citation sequence system and Alphabet number system. Research report, components of a project report, tables, figures, foot note, thesis format, journal format- appendices, e- journal and e- book. Role of supervisors/ Guides in research.

Unit II

Microscopy – Principle, Instrumentation and uses of Light Microscope, Dark-Field Microscope, Phase contrast Microscope, Fluorescent Microscope, Electron Microscope – SEM and TEM, Confocal Microscope; Micrometry; Photomicrometry.

Unit III

Spectrophotometer - Principle, Instrumentation and uses of UV-Vis Spectrometry, Atomic Adsorption Spectrometry, Nuclear Magnetic Resonance Spectrometry, Flame Photometer. Chromatography – Affinity Chromatography, Ion exchange chromatography and High Performance Liquid Chromatography.

Unit IV

Centrifugation – Principles of sedimentation, Types of rotors, Differential centrifugation, Density gradient centrifugation, Ultracentrifuge.

Electrophoresis – Agarose gel electrophoresis (AGE), Sodium Dodecyl Sulphate-Polyacrylamide Gel Electrophoresis (SDS-PAGE).

PCR – Principle and technique.

Cryobiology – Lyophilization and its application in Biology.

Unit V

Data collection and Analysis of data – Mean, Medium, Mode, Standard deviation,

Standard error, Student 'T' test, Chi – square test, Correlation, Regression, ANOVA, SPSS.

Reference Books

1. Jayaraman, J. (1972). *Techniques in Biology*. Madras: Higginbothams Pvt. Ltd.
2. Khan, I. A., & Khannum, A. (1994). *Fundamentals of Biostatistics*. Hyderabad: Vikas Publishing.
3. Khan, J.A. (2008). *Research Methodology*. New Delhi: A.P.H Publishing Corporation.
4. Kothari, C.R. (2004). *Methodology: Methods and Techniques*. Research New Age International Publishers Ltd.
5. Kothari, C. R. (1991). *Research Methodology: Methods and Techniques*. New Delhi: Wiley Eastern Ltd.
6. Michael T. Madigan., John M. Martinko., & Jack Parker. (2003). *Brock Biology of Microorganisms* (10th ed.). USA: Pearson Education International.
7. Ranjit Kumar, A. (2011). *Research Methodology: a step by step guide by beginners* (3rd ed.). London: SAGE Publications Ltd.
8. Sree Ramulu, V. S. (1988). *Thesis Writing*. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
9. Thomas, A. Scruggs., & Margo, A. (2006). *Mastropiere, Applications of Research Methodology*. London: Elsevier Ltd., JAI Press.

Semester II
Core VI: Biochemistry and Biophysics
Sub. Code: PB1723

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	90	100

Objectives

1. To provide an advanced understanding of the core principles of biochemistry and their experimental basis.
2. To deepen and extend the knowledge and understanding of the scientific method and process.

Unit I

Introduction - Biological processes – Carbohydrates - structure and properties of Monosaccharides - ring structure – Oligosaccharides - sucrose and maltose, Polysaccharides - starch, cellulose, pectin and agar - Glycosidic linkage formation.

Unit II

Structure and properties of amino acids and proteins - classification - Peptide bond formation - Biologically important peptides - Denaturation and renaturation of proteins - purification of proteins.

Unit III

Lipids- Classification- Structure and properties- Triglycerides, compound lipids- phospholipids- cholesterol. Structure- Biosynthesis of DNA and RNA. Secondary metabolites- Alkaloids, Glycosides, Steroids and Terpenoids. Vitamins.

Unit IV

Enzyme - Nomenclature and classification - IUB system – properties - Active site - Mechanism of enzyme action (Fisher's Lock and Key model and Koshland's Induced fit model) - Activation energy. Enzyme regulation - activators and inhibitors - coenzymes. Isoenzymes

Unit V

Properties of light - Different components of Electromagnetic radiation. Emission – Excitation - Fluorescence and Phosphorescence – Action and absorption spectrum- Bioluminescence. Laws of Thermodynamics, Concept of free energy, Redox potential, Coupling of chemical reactions. High energy compounds in biology - significance.

References Books

1. Lehninger. (2008). *Principles of Biochemistry*. Delhi: CBS publishers and distributors.
2. Conn and Stumpf . (2009). *Outlines of Biochemistry* (5th ed.). New York, NY: John Wiley & Sons.
3. Pamela, C., Champe., Richard A. Harvey., Lippincott's Williams., & Wilkins. (1994). *Lippincott's Illustrated Reviews: Biochemistry* (2nd ed.). A Wolters Kluwer Company.
4. Thomas M. Devlin., WILEY – LISS. (2002). *Text book of Biochemistry with Clinical Correlations* (5th ed.). John Wiley & Sons, Inc. Publications.
5. Alexander, J., Ninfa and David P., Ballou. (1998). *Fundamental Laboratory Approaches for Biochemistry and Biotechnology*. Maryland: Fitzgerald Science Press, Inc. Bethesda.
6. Jeremy, M., Berg., John L. Tymoczko., & Lubret Stryer. (2002). *Biochemistry* (5th ed.). New York, NY: Freeman and Compay.
7. Robert K. Murray., Daryl K. Granner., Peter A. Mayes., & Victor W. Rodwell. (2003). *Harper's Illustrated Biochemistry* (26th ed.). New Delhi: McGraw Hill.
8. Mahesh., S. (2003). *Biotechnology, Molecular Biology and Biophysics*. New Delhi: New Age International publishers.
9. Jain., Sunjay Jain., & Nitin Jain. (2012). *Fundamentals of Biochemistry*, New Delhi: S. Chand and Company Pvt Ltd.

Semester II
Elective II (a): Medicinal Botany and Pharmacognosy
Sub. Code: PB1724

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	5	90	100

Objectives

1. To study about different medicinal systems.
2. To help our students extract active phytoconstituents from medicinal plants.

Unit I

Medicinal Botany – Definition – Aim and Scope – History – Importance – Present status and future prospects of medicinal crops; Traditional systems of medicine – Siddha, Ayurveda and Unani; Conservation of Medicinal plants – in situ and ex situ; Herbal gardens; IPR.

Unit II

Study of the following plants with reference to their habitat, systematic position, morphology, useful parts, cultivation of *Aloe vera*, *Ocimum*, *Zingiber*, *Catharanthus roseus*, *Phyllanthus amarus*, *Embllica* and *Azadirachta*.

Unit III

Methods of extraction of oil in the following plants – Eucalyptus, Cymbopogon, Rose and Santalum. Extraction procedures for active principles – Withanolides, Hyocyanine, Vinblastine.

Unit IV

Pharmacognosy – Definition, Classification of drugs – Morphological, Taxonomical, Pharmacological and Chemical; Collection and Processing of crude drugs – Antichemical, Phytochemical, Antimicrobial and Chemical.

Unit V

Screening and WHO standardization of crude drugs (WHO guidelines); Physicochemical (Ash and Extraction values); Fluorescence analysis – Qualitative and Quantitative analysis; Basic chromatographic and Spectroscopic analysis of crude drugs.

Reference Books

1. Bhattacharjee, S.K. (2004). *Handbook on Medicinal Plants*. Jaipur: Pointer Publishers.
2. Faroqi, A. A., & Sreeramu, B.S. (2001). *Cultivation of Medicinal and Aromatic Crops*. Universities Press.
3. Joshi, S.G. (2000). *Medicinal plants*. New Delhi: Oxford and JBH Company Private Ltd.
4. Kokate, K., Purohit., & Gokhale. (1999). *Pharmacognosy*. Nirali Publications.
5. Sharma, P., & Etal, C. (2000). *Database on Medicinal Plants Used in Ayurveda*, Ministry of Health and Family Welfare.
6. Srivastava, A.K. (2006). *Medicinal Plants*. Dehradun: International Book Distributors.
7. Evans, W.C. (1997). *Pharmacognosy*. Harcourt Brace and Company Asios Pvt., Ltd.

Semester II
Elective II (b): Medicinal Plants and Ethnobotany *

Sub. Code: PB1725

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	5	90	100

Objectives

1. To learn the different systems of indigenous medicines.
2. To know specific plant taxa that are examples of global ethnobotanical phenomena.

Unit I

Ethnobotany - Introduction, concept, scope and objectives; Ethnic groups and Ethnobotany; Major and minor ethnic groups of Kanyakumari and their life styles; Forest Vs. Ethnic groups; Methodology of Ethnobotanical studies - (a) Field work (b) Herbarium (c) Ancient Literature (d) Archaeological findings (e) Temples and sacred places (f) Protocols.

Unit II

Plants and Tribal Medicine: Significance of the following plants in Ethno-medical practices (along with a brief note on their habitat and morphology) - (a) *Curculigo orchoides* (b) *Costus speciosus* (c) *Gloriosa superba* (d) *Butea monosperma* (e) *Wrightia tinctoria* (f) *Pongamia pinnata*; Medico-ethnobotanical research in Kanyakumari District.

Unit III

Different systems of indigenous medicine (Traditional medicine, Ayurveda, Siddha, Unani), Homeopathy and Allopathy, Role of Phytomedicine in modern systems of medicine; Classification of drugs; analytical methods – drug adulteration, drug evaluation, anatomical and phytochemical analysis of crude drugs.

Unit IV

Phytopharmaceuticals - Drugs of alkaloids, coumarins, volatile oils, tannins, resins and gums; Natural pesticides, antibiotics, allergens and poisonous plants; Economic potential of phytomedicine; potential drug yielding plants and their marketing avenues.

Unit V

Preliminary screening, fractionation and separation of different groups of biodynamic compounds and biological evaluation; IPR and patenting of active principles.

Reference Books

1. Cotton, C.M. (1997). *Ethnobotany, Principles and Applications*. New Delhi: John Wiley and sons.
2. Faulks, P.J. (1958). *An introduction to Ethnobotany*. London: Moredale Pub. Ltd.
3. Jain, S.K. (1990). *Contributions of Indian Ethnobotany*. Jodhpur: Scientific publishers.
4. Jain, S.K. (1981). *Glimpses of Indian Ethnobotany*. New Delhi: Oxford and I B.H.
5. Jain, S.K. (1995). *Manual of Ethnobotany*. Jodhpur: Scientific Publishers.
6. Jain, S.K. (1989). *Methods and Approaches in Ethnobotany*. India: Society of Ethnobotanists, Lucknow.
7. Kokate, C.K., Purohit, A.P., & Gokhale, S.P. (2000). *Pharmacognosy*. Chennai: Nirali Prakasan Publishing Company.
8. Martin, G.J. (1996). *Ethnobotany, A Methods Manual*. London: Chapman and Hall.
9. Rama Rao, N., & Henry, A.N. (1996). *The Ethnobotany of Eastern Ghats in Andhra Pradesh*, India: Howrah, Botanical Survey of India.
10. Trease, G.E., & Evans, W.C. (2005). *Pharmacognosy*. New York, NY: Saunders Publishing Pvt. Ltd.

Semester II
Practical I
Sub. Code: PB17P1
(Plant Diversity I – Algae, Fungi and Bryophytes;
Microbiology, Immunology and Plant Pathology; Developmental Botany)
(To be conducted during Semester – II)

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	5	90	100

Algae: Collection and Microscopic Identification of fresh water algae

Gleocapsa, Anabaena, Oscillatoria, Microcystis, Chlorella, Cladophora, Oedogonium

Micropreparation and specimen identification:

Caulerpa – Rhizome, *Ulva* – Thallus,, *Padina* - Thallus, *Chara* – Sex organs, *Cladophora* – Sex organs, *Codium* – Thallus, *Hypnea* –Thallus, *Gelidium* – Morphology, *Dictyota* – Thallus, *Vaucheria* – Thallus and sex organs, *Turbinaria* – Receptacle.

Fungi: Observation and study of fungi under natural habitat

Aspergillss, Mucor , Penicillium, Peziza - Apothecium , *Lichens* – Foliose thallus , *Fruticose-Usnea* – Thallus, Apothecium

Bryophytes: Micropreparation and specimen identification:

Porella - Stem, *Anthoceros* - Thallus, *Plagiochasma*, *Sphagnum* –Stem, *Polytrichum* – Stem, Leaf, Sporophyte.

Microbiology

1. Sterilization of glasswares.
2. Streaking techniques.
3. Simple staining.
4. Gram's staining.
5. Indole production test.
6. Methyl red test.
7. Voges – Proskauer test.
8. Citrate utilization test.

Developmental Botany

1. Study on ovary, ovules and their modifications.
2. Organization of anthers and pollens, pollen wall patterns, pollen germination and pollen tube growth.

Semester II
Practical II
Sub. Code: PB17P2
(Plant Diversity – II - Pteridophyta, Gymnosperms and Paleobotany; Research Methodology and Biochemistry and Biophysics)

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	5	90	100

Pteridophyta: Micropreparation and specimen identification:

Psilotum - Synangium, *Lycopodium* – Cone, *Selaginella* – Cone, Pteris – rachis, sporophyll, *Pteridium* - rachis *Adiantum* – rachis, sporophyll,, *Gleichenia* - rachis, *Marsilea* –Sporocarp, *Azolla* – Habit, *Salvinia* –Habit, Isoetes – Root, Sporophyll,

Gymnosperms

Anatomy and wood structures of *Gnetum* – Leaf, Stem, *Araucaria* - Stem, Cone
Cupressus – Cone, *Podocarpus* - Cone, *Ovule*, *Cryptomeria* – stem, cone

Research Methodology

1. Problems in Biostatistics
2. Microtome
3. Photomicrography
4. Gel moulding in Agarose gel electrophoresis.
5. Visiting different laboratories and report submission.

Biochemistry and Biophysics

1. Determination of pKa value of acetic acid
2. Determination of isoelectric point of amino acid
3. Estimation of protein
4. Estimation of free amino acid
5. Separation and determination of Rf value of amino acid.
6. Separation of photosynthetic pigments
7. Determination of saponification value of oil
8. Determination of Km value – Nitrate reductase
9. Qualitative analysis of secondary metabolites
10. Estimation of iodine value in any two vegetable oils

Semester III
Core VII: Taxonomy of Angiosperms and Economic Botany
Sub. Code: PB1731

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	90	100

Objectives

1. To be familiar in identifying the botanical name of plants.
2. To enable the students to get knowledge of modern trends in taxonomy of Angiosperms.

Unit I

Aim and scope of plant taxonomy – Systems of angiosperm classification; Linnaeus, Bentham and Hooker and Engler and Prantle; Merits and demerits of these classification; Taxonomic literatures – floras, revisions, manuals, monographs and check lists; Identification and preparation of intended keys and bracketed keys; Herbarium techniques – Types and functions of herbarium; Digital Herbarium.

Unit II

Botanical nomenclature – ICN, Principles and Role of ICN, Rules – principle of priority, rejection of names, limitations in the principle of priority, typification, author citation, effective and valid publications; Numerical taxonomy – principles, character coding, measurement of resemblance-cluster analysis, current trends in biosystematics; Cladistics – phylogenetic approach of classification, species concept; Molecular markers as taxonomic tools – RAPD, RFLP, AFLP, ISSR.

Unit III

Objectives and importance of systematic botany; systematic position, salient features, distribution, description and economic importance of Capparidaceae, Polygalaceae, Caryophyllaceae, Tiliaceae, Zygophyllaceae.

Unit IV

Systematic position, salient features, distribution, description and economic importance of Rhamnaceae, Sapindaceae, Passifloraceae, Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae, Bignoniaceae.

Unit V

Systematic position, salient features, distribution, description and economic importance of Verbenaceae, Nyctaginaceae, Aristalochiaceae, Casuarinaceae, Orchidaceae, Commelinaceae, Araceae, Cyperaceae.

Reference Books

1. Davis, P.H. and V.M. Heywood. (1983). *Principles of Angiosperms Taxonomy*. London: Olive and Byod Publishers.
2. Gurcharan Singh. (2004). *Plant Systematics*. New Delhi: Oxford & IBH Publishing Company Ltd.
3. Nair, R. (2010). *Taxonomy of Angiosperms*. Hyderabad: A.P.H. Publishing Corporation.
4. Pandey, B.P. (2004). *Taxonomy of Angiosperms*. New Delhi: S. Chand and Company.
5. Sambamurty A. V. S. S. (2005). *Taxonomy of Angiosperms*. New Delhi: I.K. International Pvt. Ltd.

6. Sharma O.P. (1996). *Plant Taxonomy*. New Delhi: Tata McGraw Hill Publishing Company Limited.
7. Sivarajan V.V. (1996). *Introduction to the principles of Plant Taxonomy* New Delhi: Oxford and IBH Publishing Company Limited.
8. Vahishta P.C. (1989). *Taxonomy of Angiosperms*, New Delhi: S.Chand and Co.

Semester III
Core VIII: Genetics and Molecular Biology
Sub. Code: PB1732

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	90	100

Objectives

1. To understand the organization and regulation of genes with its consequences.
2. To acquire advanced training with opportunities to get employability in genetics and molecular biology laboratories.

Unit I

Contribution of Johann Gregor Mendel, T.H. Morgan, Karl Landsteiner; Mendel's law of heredity – Monohybrid and Dihybrid cross; Gene interaction – Dominant epistasis (12: 3:1), Recessive epistasis (9:3:4), Duplicate recessive genes (9:7), Duplicate dominant genes (15:1); Sex determination in plants - theories of sex determination; Sex linked characters; Mutation – Types of mutation, Detection of mutation.

Unit II

DNA- types (A, B, C & Z), Watson and Crick model of DNA, viral DNA, bacterial DNA, Mitochondrial and Chloroplast DNA; Dissociation and re-association kinetics of DNA; cot value and its significance; DNA replication of prokaryotes and eukaryotes; Genetic diseases – Sickle cell anemia, Cystic fibrosis, Duchennes muscular dystrophy.

Unit III

Damage and DNA repair mechanism – photo reactivation – excision repair - mismatch repair; Genetic recombination - generalised and site specific; Lysogenic and lytic cycle; Bacterial Transformation ,Transduction and Conjugation; Cloning vectors- plasmids, cosmids, phages, plasmids – characters of plasmids, types, copy number; pBR322, pUC9, MI3, BAC, YAC, shuttle vectors, advantages of cloning vectors.

Unit IV

RNA – types; Transcription - Initiation, elongation, termination, post transcriptional events; Genetic code, Wobble hypothesis; Translation – steps in translation; Molecular tools for studying genes – Autoradiography, Liquid Scintillation counting, Phosphorimaging.

Unit V

Fine structure of the gene; Transposons – Tn3, Tn5; Operon concept – lac operon, trp operon, Steps in gene cloning; Pros and Cons in gene cloning, Construction of genomic library; Construction of cDNA library; Gene silencing; Human Genome Project.

Reference Books

1. Benjamin Lewin. (2000). *Genes VII*. New York: Oxford University Press.
2. Bernard R. Glick and Jack J. Pasternack. (1996). *Molecular Biotechnology*
 - a. (4th edition): *Principles and Manipulation of Recombinant DNA*, New Delhi: Panima Publishing Corporation.
2. Brown T.A. (2001). *Essential Molecular Biology Volume 2*. New York: Oxford University Press.
3. Brown, T.A. (2002). *Genomes* (Second Edition). New York: BIOS Scientific Publishers Ltd.
4. Edward I. Alcamo. (2001). *DNA Technology* (Second Edition). New York: Academic Press.
5. Freifelder.(1990). *Molecular Biology*. New Delhi: Narosa Publishing House.
6. Robert F. Weaver (2002). *Molecular Biology* (Second Edition). New York. McGraw Hill Higher Education.
7. Daniel L. Hartl and Elizabeth W. Jones. (2002). *Essential Genetics: A Genomics Perspective* (Third Edition). Sudbury: Jones and Bartlett Publishers.

Semester III
Elective III (a): Forestry
Sub. Code: PB1733

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	5	90	100

Objectives

1. To enable the students to have a broad knowledge about forest, forest management, and forest products.
2. To prepare the students to involve in tree plantings and to provide and improve wildlife habitat.

Unit I

Forest – definition, role of forest; forest as a balanced ecosystem; types and distribution of (Champion and Seth’s classification). Forest types in Tamilnadu – evergreen forest, deciduous and scrub jungle.

Unit II

Forest management and conservation; regeneration; tending operations; sustainable utilization of forest resources – forest organizations. Forest mensuration and remote sensing – methods of measuring diameter, girth, height, and volume of trees, geographic information systems for management (GIS).

Unit III

Forest utilization – harvesting, conservation, storage and disposal of wood in forest; major and minor forest products; forest based industries – paper and pulp industry, resin tapping and turpentine manufacture. Forest education in India.

Unit IV

Forest degradation – damage caused by fire, climatic factors and injuries by insects, plants, animals, and diseases, activities of man including encroachment and shifting cultivation; measures to protect the forest damage caused by various factors;

Unit V

Agroforestry – objectives, advantages and disadvantages, energy plantations; recreational forestry- role of botanical gardens, zoos, national parks and sanctuaries in recreation/conservation of wild life; Social forestry.

Reference Books

1. Kasturi Reddy. (2010). *Biodiversity and Land Conservation*. New Delhi: Pacific Publication N-187, ShivajiChowk. Sadatpur Extension.
2. RanaS.V.S . (2009). *Essential of Ecology and Environmental Science* (IV Edition). New Delhi: PHI learning Private Ltd.
3. Rao M.K. *Environemntal and Climate Change*. (2011).Delhi: Manglam Publications.
4. Shukla R.S.& Chandel P.S. (2006). *A Text Book of Plant Ecology*. Ram Nagar, New Delhi: S. Chand and Company Ltd.
5. Trivedi, P.R. Trivedi and Gurdeep Raj.(2002). *Environmental Ecology*. New Delhi: Akashdeep Publishing House.
6. Tyler Miller G. (2004). *Environmental Science*. Singapore: Thomson Brooks/cole,

Semester III
Elective III (b): Horticulture and Plant Breeding
Sub. Code: PB1734

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	5	90	100

Objectives

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

Unit I

Introduction – divisions of horticulture – propagation of horticultural crops- seed propagation. Seed storage – germination – characteristics of good seeds – pure seeds and seed treatment. Asexual propagation – advantages and disadvantages. Methods – cuttings, layering, grafting, and tissue culture.

Unit II

Fruit Culture: Orchard cultivation – establishment of orchard – location and site selection planning – layout – planting methods – clean culture, cover crops, intercrops. Cropping and fruit set – unfruitfulness – causes and prevention – harvest – marketing and storage of fruits. Special techniques – ringing, notching, smudging, deblossoming, thinning, trimming and pruning. Vegetable culture – growing of vegetables and greens. Kitchen garden – site, layout and choice of plants.

Unit III

Importance and principles of ornamental garden making – layout and components of ornamental gardening. Lawns, topiary and pergolas. Indoor gardening and care of indoor plants. Floriculture, cultivation of commercial and cut flowers (Rose, Gerbera, Gladiolus, Anthurium, Carnation).

Unit IV

Plant breeding – objectives, methods of crop improvement, simple and honored methods of selection, hybridization, gene recombination, success and failure, methods of hybridization (pedigree and back cross); genetic basis of heterosis and production of hybrid seeds. plant Introduction and acclimatization; mutation breeding – types and mode of mutagens, mutagen treatment and selection of mutants, introduction of mutation through tissue culture, significance of induced mutation in breeding, breeding for resistance to disease and insect pest.

Unit V

Plant breeders' rights – methods of multiplication of seed, seed certification, labeling, legislation intellectual property right in relation to crop plants (both agricultural and horticultural plants). Molecular approaches to crop improvement – gene cloning, molecular markers, application of markers in breeding. Breeding on rice, cotton, and sugar cane.

Reference Books

1. Manibhusan Rao. (1991). *Text book of Horticulture*. New Delhi: Mac Millan India.
2. Sheela V. (2011). *Fundamentals of Horticulture*. Chennai: MJP Publications.
3. Shukla. R. S. Chandel. (1996). *Cytogenetics, Evolution and plant breeding*. New Delhi: Chand. S. c. Ltd.
4. Edmund Senn – Andrew – Halfacre. (1977). *Propagation of horticultural crops*. New Delhi: Tata McGraw – Hill.
5. Chopra. (2004). *Approaches for Incorporating Drought and Salinity Resistance in Crop Plants*. New Delhi: Salish Book Enterprise.
6. Kader, A.A. (2002). *Post-Harvest Technology of Horticultural Crops*. New Delhi: UCANR

Publications.

7. Kumar, N. (2006). *Breeding of Horticultural Crops: Principles and Practices*. New Delhi: Publishing Agencies.
8. Singh, D and Manivannan, S. (2009). *Genetic Resources of Horticultural Crops*. Lucknow: IBDC Publishers.
9. Chahal G. S. and S. S. Gosal. (2002). *Principles and Procedures of plant breeding*. New Delhi: Narosa publishing House.

Semester IV
Core IX: Plant Physiology and Metabolism
Sub. Code: PB1741

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	90	100

Objectives

1. To facilitate the study of integrated activities in plants.
2. To evaluate the stress related mechanism of plants.

Unit I

Physico-chemical properties of water - water potential; Mechanism of absorption of water - active and passive transport - Apoplast and symplast concept. Transpiration - Stomatal mechanism. Antitranspirants. Ascent of sap – SPAC; Mineral nutrition - criteria for essentiality. Macro and micro nutrients, their role and deficiency symptoms. Absorption of solutes - passive, active diffusion and facilitated diffusion. Hydroponics – Nutrient Film Technique (NFT).

Unit II

Properties of light - Interaction between radiant energy and phosphorescence; Photosynthetic apparatus and thylakoid organization; Two pigment systems - Light harvesting systems. Reaction center, P680, P700, water oxidation complex, electron transport system - cyclic - non cyclic - photophosphorylation ;photosynthetic carbon reduction pathways in C3, C4 and CAM plants. Photorespiration and its significance.

Unit III

Respiration - Glycolysis – Anaerobic (Fermentation) and Aerobic (Kreb’s cycle); Electron transport system and oxidative phosphorylation - mechanism - Energetics - Respiratory inhibitors - Cyanide resistant respiration; Integration of metabolic pathways.

Nitrogen Metabolism – Sources of nitrogen. Biological nitrogen fixation – symbiotic and asymbiotic; Nitrate and Ammonia assimilation (GS-GOGAT pathway).

Unit IV

Plant growth regulators and elicitors: Physiological effect and mechanism of action of auxin, gibberellins, cytokinins, ethylene, abscissic acid, morphactins, brassinosteroids.

Photomorphogenesis – phytochrome mediated photoresponses. Physiology of flowering; Fruit ripening.

Unit V

Physiology of senescence and abscission; Biological clock; Stress physiology – biotic and abiotic stress- salinity stress, drought stress, water stress, freezing stress, radiation stress, and heavy metal stress. Stress proteins in plants – stress resistance mechanism.

Reference Books

1. Bidwell, R.G.S.(1974). *Plant physiology*. New York: Macmillan Publishing Company.
2. Devlin, R.M. and F.H. Witham.(1983). *Plant Physiology*.U.S.A: Willard Grant Press.
3. Hall, D.O and Rao. K.K. (1994). *Photosynthesis* (Fifth Edition).U.K:Cambridge University Press.
4. Hess, D. (1981).*Plant Physiology*.New Delhi: Narosa Publishing House.
5. Jain, V.K. (2004). *Fundamentals of Plant Physiology*.New Delhi:S. Chand and Company Ltd.
6. Noggle, G.R. and Fritz G.J.(2002).*Introductory Plant Physiology*. New Delhi: Prentice Hall India.
7. Salisbury, F.B. and Ross. C. (1991).*Plant Physiology*. Belmont: Wadsworth Publishing Company.

Semester IV
Core X: Environment and Conservation Biology
Sub. Code: PB1742

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	90	100

Objectives

1. To impart basic knowledge about the environment and its allied problems.
2. To acquire skills to help the concerned individuals in identifying and solving environmental problems.

Unit I

Habitat Ecology - Freshwater and Marine water ecology (ecosystems); Wetlands and their Characteristics – Classification of Wetlands and Examples; Succession - Causes of succession, Types of succession; Process of succession; Concept of Climatic Climax; Hydrosere; Xerosere; Applications of ecology.

Unit II

Structure of Ecosystem; Productivity of ecosystem; Food chains in ecosystem; Ecological Pyramids; Energy flow in ecosystem; Biogeochemical cycle – Water cycle, Gaseous cycle (Carbon cycle, Oxygen cycle, Nitrogen cycle); Sedimentary cycle ; Ecological Genetics of Population – Ecads, Ecotypes, Ecoclines, Ecospecies; Population Ecology - Characteristics of a population; Population Structure – Population Dispersal and interactions among population;

Unit III

Phytogeography: Definition and Principles of Phytogeography; Distribution – Wides, Endemics and Discontinuous species; Theories of Discontinuous distribution; Factors affecting distribution of species; Climate of India; Vegetation of India; Global environment changes – Global warming and Ozone depletion; Bioremediation, Biofueling, Biofilm and Biocorrosion, Carbon sequestration method, Carbon trading.

Unit IV

Current practices in conservation: Habitat or Ecosystem Approaches - Species-based Approaches - Social Approaches: Chipko Movement – In-situ conservation: Afforestation, Social Forestry, Agroforestry, Botanical gardens, Zoos, Biosphere Reserves, National Parks, Sanctuaries, Protected Area Network, Sacred Groves and Sthalavrikshas – Ex-situ conservation: Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks.

Unit V

Status and protection of species in National and International levels – Role of CITES and IUCN – Convention on Biological Diversity (CBD) – Nagoya Protocol – Man and Biosphere Programme (MAB) – Policies implemented by MoEF for biodiversity conservation – Salient features of Biological Diversity Act 2002 – Ecosystem restoration.

Reference Books

1. Ambasht R.S. (1974). *A Text Book of Plant Ecology* (3rd Edn). Varanasi, India: Students' Friends & Co.
2. Chapman, J.L. and Reiss, M.J. (1999). *Ecology: Principles and Applications* (2nd Ed). New York: Cambridge University Press.
3. Chawla, S. (2011). *A text book of Environment & Ecology*. New Delhi: Tata McGraw-Hill.
4. Good, R. (1974). *The Geography of Flowering Plants*. London: Longman's Publication.
5. Odum E.P. Gray, W. Barrelet Thomas. (2004). *Fundamentals of Ecology* (5th Edition). Asia Pvt. Ltd.
6. Sharma, P.D. (2005). *Ecology and Environment*. New Delhi: Rastogi Publications.
7. Rana, S.V.S. (2008). *Energy, Ecology and Environment*. I.K. International Publishing House

Pvt. Ltd.

8. Yadav.P.R, Shubhrata R. Mishara. (2004).*Environmental Biology*. New Delhi: Discovery Publishing House.
9. Subrahmanyam N.S. and Sambamurty A.V.S.S. (2011).*Ecology* (2nd Edition). New Delhi: Narosa Publishing House.
10. Shukla. R.S and Chandel P., S. (2012).*A Textbook of Plant Ecology including Ethnobotany and Soil Science*. New Delhi: Chand and Company Pvt. Ltd.
11. Verma. P.S and Agarwal. V.K. (2008). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. New Delhi: Chand and Company Pvt. Ltd.

Semester IV
Core XI: Applied Biotechnology
Sub. Code: PB1743

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	4	90	100

Objectives

1. To apply the knowledge of biotechnology in different fields to produce high value products.
2. To develop skill to get employment in biotechnology laboratories and industries.

Unit I

Restriction enzymes - Nomenclature, classification and properties; Types of cloning vectors - Plasmids, Cosmids, ssDNA phages, Ti plasmid; Yeast vectors -YIP, YEP, YRP and YAC ; shuttle vectors; Construction of genomic library; Construction of cDNA library.

Unit II

Plant tissue culture – laboratory organization; sterilization of explants; MS media composition and preparation of media; Meristem culture; suspension culture; protoplast culture and somatic hybridization; production of haploid plants; somatic embryogenesis; synthetic seed production; Transgenic plants – Bt cotton, Golden rice.

Unit III

Industrial Biotechnology – Fermentor design; Batch culture; Continuous culture; Fed batch culture; Immobilization of enzymes; Production of ethanol, acetic acid, citric acid, Penicillin and Vitamin B₁₂.

Unit IV

Biosensors – Principle, types and applications; Biochips; Biosafety – possible dangers of GEOs; biosafety guidelines; physical and biological containments; Intellectual property rights; Process of patenting application; Farmer’s Rights and plant breeder’s Rights.

Unit V

Edible vaccines, Plantibodies; Gene therapy – types of gene therapy, production of monoclonal antibodies and its application; Production of DNA vaccine; Production of subunit vaccine; Nanotechnology – nanomaterials, Synthesis of nanodrugs.

Reference Books

1. Olsen R.C and Christopher. (1992). *Computer assisted Drug Design*. Washington D.C: Americal Chemical Society.
2. Dodds, J.H. and L.W. Roberts. (1995). *Experiments in plant Tissue Culture*. London: Cambridge University Press.
3. Freifelder.(1990).*Molecular Biology*. New Delhi:Narosa Publishing house.
4. Grierson and Covery, S.N. (1988).*Plant Molecular Biology* (II Edn).New York: Blackie Publishing Pvt. Ltd.
5. Bernard R.Glick and Jack.J.Pasteunack. (1996). *Molecular Biotechnology: Principles and Manipulation of Recombinant DNA* (4th edition). New Delhi: Panima Publishing Corporation.
6. Narayanaswamy. (1994). *Plant Cell and Tissue Culture*. New Delhi:Tata McGraw Hill Publishing Company.
7. Murray Moo Young. (1992). *Plant Biotechnology, Comprehensive Biotechnology series*. Pergamon Press.
8. Peter F. Stanbury, Allan Whittaker, Stephen J Hall, Elsevier. (1984). *Principles of Fermentation Technology*. United States.

Semester IV
Elective IV (a): Industrial Microbiology
Sub. Code: PB1744

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	5	90	100

Objectives

1. To know the relevance of microorganisms in the production of some useful human products.
2. To enhance the ability of students to culture and genetically manipulate microorganisms of industrial importance.

Unit I

Screening and Production medium – Introduction, history and development of industrial microbiology, scope of industrial microbiology; Screening techniques – Primary screening and Secondary screening; Strain development; Preservation of microorganisms; Characteristics of an ideal production medium; Raw materials used in fermentation medium.

Unit II

Fermentation Process – Basic structure of a fermentor; Batch culture; Continuous culture; Semi continuous culture; Fed batch culture; Growth kinetics of microorganisms; Classification of fermentation process; Sterilization of equipment, media and air.

Unit III

Types of fermentor – Bubble column reactor, Airlift fermentor, Fluidized bed reactor, Tower fermentor; Immobilization – Methods of immobilization, Different types of immobilized enzyme reactors; Solid – Liquid separation methods; Liquid – liquid extraction; Physical, Chemical and enzymatic methods of cell disruption.

Unit IV

Microbial production of food – Production of single cell protein (SCP); Production of Bakers yeast; Production of bread, Production of wine; Production of beer; Production of whisky, Production of sauerkraut; Preparation of cheese.

Unit V

Production of useful products – Antibiotics – Penicillin, Streptomycin; Organic acids - Citric acid, Acetic acid; Enzyme - Amylase enzyme; Solvents - Ethyl alcohol; Amino acid - Glutamic acid; Vitamin – Vitamin B₁₂.

Reference Books

1. Patel, A.H. (1999). *Industrial Microbiology*. New Delhi: Macmillan India Ltd.
2. Pelczar, M.H. and Cahn, E.C.S. (1993). *Microbiology*. New Delhi: Tata-McGraw Hill Publishing Co. Ltd.
3. Power and Daginawala (1994). *General Microbiology*. New Delhi: Himalayan Publishing House.
4. Ringo, J. (2004). *Fundamental Genetics*. United Kingdom : Cambridge University Press.
5. Salle, A.J. (1974). *Fundamental Principles of Bacteriology*. New Delhi :Tata-McGraw Hill Publishing Co. Ltd.
6. Schlegel, H.G. (1993). *General Microbiology (7th Edition)*.United Kingdom: Cambridge University Press.
7. Starr, M.P. (1981). *The Prokaryotes: A Handbook on Habitat, Isolationand Identification of Bacteria, Vols. I & II*. Berlin: Springer Verlag.
8. Trevan, M.D. (1987). *Biotechnology: The Biological Principles* New Delhi: Tata-McGraw Hill Publishing Co. Ltd.
9. Trevan, K. (1991). *Biotechnology*. New Delhi: Wiley Eastern Ltd.

Semester IV
Elective IV (b): Biostatistics and Bioinformatics
Sub. Code: PB1745

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	5	90	100

Objectives

1. To enable the students to analyze the biological data.
2. To introduce the students about the exploration 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, co-efficient of variation and standard error, Skewness and Kurtosis.

Unit II

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 III

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 IV

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

Unit V

Genomics and Proteomics – types – Softwares in Bioinformatics – Sequence analysis softwares- Molecular Visualization softwares – Prediction softwares – Docking softwares- RasMol-PASS-Drug Designing-Chemoinformatics - Pharmacoinformatics.

Reference Books

1. Attwood T.K and Pary Smith D.J. (2006). Introduction to Bioinformatics. Pearson Education.
2. Gurumani N. (2005). An Introduction to Biostatistics (2nd Edition). Chennai: M.J.P Publishers.
3. Jin Xiong. (2006). Essential Bioinformatics. Cambridge University Press.
4. Rastogi, S.C., Namita Mendriata and Parag Rastogi. (2005). Bioinformatic methods and applications (4th edition). PHI Learning Pvt Ltd.
5. Murthy C.S.V. (2004). Bioinformatics (1st edition). Himalaya Publishing House.
6. Palanisamy, S and Manoharan, M. (1994). Statistical methods for Biologists (2nd edition). Palaniparamount Publishers.
7. Satguru Prasad. (2003). Fundamentals of Biostatistics (4th edition). Emkay Publishers.
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**Semester III
Practical III
Sub. Code: PB17P3**

(Taxonomy of Angiosperms and Economic Botany, Genetics and Molecular Biology)

No. of Hours per Week	Credits	Total No. of Hours	Marks
4	4	90	100

Objectives

1. To learn the taxonomical terminology, morphology, structure and functions of various parts of plants.
2. To have broad knowledge on genetics problems and to carry out molecular biology experiments and interpret the results.

Taxonomy of Angiosperms

1. Assigning plants to their respective families.
2. Technical description of floral parts with reference to families prescribed.
3. Identification of modification and economically important products from the members of the families prescribed in the syllabus (Botanical name, common name, morphology of the useful part-family and uses).
4. Preparing intended keys and bracketed keys for the locally available plants.
5. Field trip, Submission of field note book, with a report on the field trip.
6. Preparation of 5 herbaria of the locally available weed.

Genetics and Cell Molecular Biology

1. Genetics Problems – Monohybrid cross, Dihybrid cross.
2. Genetics Problems – Interaction of genes.
3. Isolation of DNA (Demo)
4. Agarose gel electrophoresis (Demo)
5. Estimation of DNA by UV- Spectrophotometric method.
6. PCR (Demo)

Semester IV
Practical IV
Sub. Code: PB17P4
(Plant Physiology and Metabolism, Environment and Conservation Biology and Applied Biotechnology)

No. of Hours per Week	Credits	Total No. of Hours	Marks
6	5	90	100

Objectives

1. To understand the methodology involved in environment and conservation biology.
2. To learn the physiochemical analysis of plant materials in the context of plant physiology.
3. To achieve skills in practical aspects regarding plant tissue culture.

Plant Physiology

1. Hill reaction – Ferricyanide / DCPIP by isolated chloroplast with reference to light and time.
2. Determination of osmotic potential by plasmolytic methods.
3. Estimation of Carotenoids
4. Determination of stomatal index and stomatal frequency by cellulose acetate film method.
5. Estimation of Proline (stress and unstressed plants)
6. Membrane permeability based on temperature, detergent and pH
7. Effect of age (C3 and C4 plants)

Environment and Conservation Biology

1. Determination of Dissolved oxygen
2. Determination of Total Dissolved solids.
3. Determination of Chemical Oxygen Demand
4. Determination of Salinity
5. Preparation of activated carbon from waste materials
6. Identification of Planktons in the water.
7. Students should be aware of the common environmental problems, their consequences and possible solutions (Submit a report).

Applied Biotechnology

1. Preparation of media and Sterilization
2. Callus culture
3. Immobilization of yeast cells
4. Anther culture
5. Synthetic Seed preparation
6. Fermentor (Demo)
7. Isolation of amylase producing microorganism from soil sample
8. Isolation of lactic acid producing bacteria from milk
9. Wine preparation