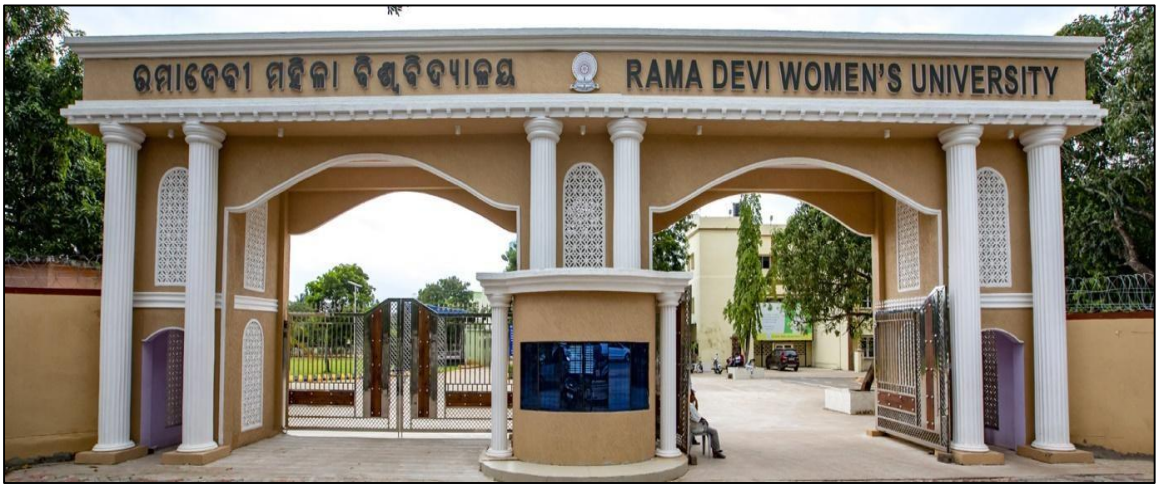
DEPARTMENT OF BOTANY

SYLLABUS OF UG PROGRAMME (B.Sc.)



RAMA DEVI WOMEN'S UNIVERSITY
Vidya Vihar, Bhubaneswar-751022, Odisha
Website: https://rdwu.ac.in

Rama Devi Women's University

DEPARTMENT OF BOTANY

COURSE/ PROGRAMME NAME: B.Sc. BOTANY

(STATE MODEL SYLLABUS FOR UNDERGRADUATE COURSE)

12.10.23
Controller of Examinations
R.D. Women's University
Bhubaneswar

Course Structure of U.G. Botany Honours				
Semester	**Course**	**Course Name**	**Credit**	**Total marks**
Semester-I	AECC-I		4	100
	C-1 (Theory)	Microbiology and Phycology	4	75
	C-1 (Practical)	Microbiology and Phycology	2	25
	C-2 (Theory)	Biomolecules and Cell Biology	4	75
	C-2 (Practical)	Biomolecules and Cell Biology	2	25
	GE -1A (Theory)	Biodiversity (Microbes, Algae, Fungi & Archegoniate)	4	75
	GE -1A(Practical)	Biodiversity (Microbes, Algae, Fungi & Archegoniate)	2	25
Semester-II	AECC-II		4	100
	C-3 (Theory)	Mycology and Phytopathology	4	75
	C-3 (Practical)	Mycology and Phytopathology	2	25
	C-4 (Theory)	Archegoniate	4	75
	C-4 (Practical)	Archegoniate	2	25
	GE -2A (Theory)	Plant Physiology &Metabolism	4	75
	GE -2A(Practical)	Plant Physiology &Metabolism	2	25
Semester-III	C-5 (Theory)	Anatomy of Angiosperms	4	75
	C-5 (Practical)	Anatomy of Angiosperms	2	25
	C-6 (Theory)	Economic Botany	4	75
	C-6 (Practical)	Economic Botany	2	25
	C-7 (Theory)	Genetics	4	75
	C-7 (Practical)	Genetics	2	25
	SEC-1		4	100
	GE -1B (Theory)	Plant Ecology & Taxonomy	4	75
	GE -1B (Practical)	Plant Ecology & Taxonomy	2	25
Semester-IV	C-8 (Theory)	Molecular Biology	4	75
	C-8 (Practical)	Molecular Biology	2	25
	C-9 (Theory)	Plant Ecology & Phytogeography	4	75

	C-9 (Practical)	Plant Ecology & Phytogeography	2	25
	C-10 (Theory)	Plant Systematics	4	75
	C-10 (Practical)	Plant Systematics	2	25
	SEC II		4	100
	GE-2B (Theory)	Plant Anatomy , Embryology & Biotechnology	4	75
	GE-2B(Practical)	Plant Anatomy , Embryology & Biotechnology	2	25
Semester-V	C-11 (Theory)	Reproductive Biology of Angiosperms	4	75
	C-11 (Practical)	Reproductive Biology of Angiosperms	2	25
	C-12 (Theory)	Plant Physiology	4	75
	C-12 (Practical)	Plant Physiology	2	25
	DSE - 1 (Theory)	Analytical Techniques in Plants Sciences	4	75
	DSE - 1 (Practical)	Analytical Techniques in Plants Sciences	2	25
	DSE - 2 (Theory)	Plant Breeding	4	75
	DSE - 2 (Practical)	Practical related to theory	2	25
Semester-VI	C-13 (Theory)	Plant Metabolism	4	75
	C-13 (Practical)	Plant Metabolism	2	25
	C-14 (Theory)	Plant Biotechnology	4	75
	C-14 (Practical)	Plant Biotechnology	2	25
	DSE - 3 (Theory)	Stress Biology	4	75
	DSE-3 (Practical)	Practical related to theory	2	25
	DSE – 4 (Theory+Practical) /Project work**	Industrial & Environmental Microbiology /Project Work** Dissertation	6	100
		Total	**148**	**2600**

PROGRAMME OUTCOMES (POs) OF B.Sc. BOTANY

PO1. Imparting knowledge and understanding: 1. Able to compare and contrast the characteristics, their occurrence, morphological differences, and life cycles of plant diversity ranging from virus, prokaryotic to eukaryotic complex forms. 2. Learn the functional aspects of plants from gene to organ level. 3. Able to explain the ecological interrelation of life on the earth by tracing energy and nutrient flow through the environment in different strata related to the structure of populations, communities and ecosystems. 4. To learn the socioeconomic values of natural resources for a sustainable development of the society. Gain detailed knowledge about the economically important plants.5. The field and the laboratory work enhance the implementation of theoretical knowledge and their intellectual skills to construct and test hypotheses, to plan, conduct and write a report on an independent project.

PO2.Intellectual skills – able to: 1. Think logically and organize tasks into a structured form. 2. Assimilate knowledge and ideas based on wide reading and through the internet. 3. Transfer of appropriate knowledge and methods from one topic to another within the subject. 4. Understand the evolving state of knowledge in a rapidly developing field.

PO3. Practical Skills: 1. Study of plant and microbial diversity. 2. Plant classification and identification, anatomy, and morphology. 3. Study of Plant physiology, plant biochemistry, genetics, plant breeding, etc. 4. Ecological study of the local area.

PO4.Transferable Skills: 1. Use of information technology for accumulation and sharing of data. 2. Dissemination of scientific ideas in writing and orally. 3. Creation of team spirit. 4. Access of E- library resources. 5. Regularity, punctuality, devotion and career planning.

PO5.Interdisciplinary approach: 1. aware of the role of plant science as well as other biological sciences in interdisciplinary research as well as in daily life.

PO6. Scientific Knowledge and problem analysis: 1. Application of principles of basic science in studying. 2. Analyzing problems and phenomena related to biological science.

PO7.Usage of Modern tools:1. Practical application of modern techniques/ instruments in Biochemical and molecular analysis. 2. Use of technology in Biotechnology, *in vitro* culture, microbiology etc.

PO8. The Botanist and society: Apply reasoning informed by the contextual knowledge to assess plant diversity, its importance for society, health, safety, legal and environmental issues and the consequent responsibilities relevant to the biodiversity conservation practice.

PO9.Ethics: 1. Application of moral and ethical principles to mitigate environmental issues and biodiversity conservation. 2. Basic knowledge on environment and sustainable development will

create responsible citizens.

P10. Career Opportunity: 1. Biological Scientists. 2. Plant scientists**.** 3**.** Chemical biologists**.** 4**.** Pursuing higher studies in allied disciplines. 5. Molecular Biologist. 6. Plant physiologist. 7. Indian Forest Service and State Forest Service.

PROGRAMME SPECIFIC OUTCOMES (PSOs) OF B.Sc. BOTANY

1. Students can work in projects in the fields of life sciences and biotechnology.
2. Seminar and projects included in the syllabus will make the student deliver ideas and scientific information with clarity.
3. Application of information of economic and medicinal importance of plants for family and society.
4. Knowledge about origin of crop plants and their propagation will help in conservation of important plants.

SEMESTER I

Environmental Studies and Disaster Management

SEMESTER-1 FOR UNDER-GRADUATE COURSE ARTS, SCIENCE AND COMMERCE

COURSE OUTCOMES (COs)

1. Students understand about problems of environmental pollution and Impact of pollution on human and ecosystem and control measures.
2. Students will learn about increase in population growth and understand the issues of use of resources in proper manner leading to sustainable development.
3. Learn about causes and impacts of Disasters and Case studies of National and Global disasters and risk reduction approaches of Disasters with safety issues in mitigating Industrial disasters.
4. Basic idea about the mode of transmission and course of some communicable and non-communicable diseases and knowledge on the Importance and methods of prevention of epidemics and pandemics

Unit-I (Environment)

The Environment: The Atmosphere, Lithosphere, Hydrosphere, Biosphere.

Ecosystem: Energy flow in the ecosystem

Biogeochemical Cycle: Water Cycle, Carbon Cycle, Nitrogen Cycle

Pollution: Water Pollution, Air Pollution, Soil Pollution, Radiation Pollution, Industrial Pollution, Light Pollution, Sound Pollution.

Environmental Laws: (Water Act 1974, Air act 1981, The Wildlife Protection Act 1972, The Environment Protection Act 1986), The Forest Conservation Act 1980.

Unit-II (Climate Change & Sustainable Development)

Population Ecology: Individuals, Species, Population, Community Human Population Growth, Population Control Methods Urbanization and its effect on society

Climate Change: Cause, Effect, Global Warming, Carbon Footprint and environmental protection

Step taken towards Sustainable Development: Ban of single-use plastic automobile Scrapping Policy, Promotion of Electrical Vehicles

Brief idea on Sustainable Development Goals (SDGs), Agenda 21 of Rio Earth Summit

Unit-III (Disaster Management)

Disaster Management: Types of Disasters (Natural and Man-made and their cause and effect) Vulnerability Assessment and Risk Analysis: Vulnerability to various disasters (Flood, Cyclone, Earthquake, Heat waves and Lightning)

Institutional Framework: Institutional arrangements for disaster management (National Disaster Management Authority (NDMA), State Disaster Management Authority (SDMA), District Disaster Management Authority (DDMA), National Disaster Response Force (NDRF) and Odisha Disaster Rapid Action Force (ODRAF)

Preparedness Measure: Disaster Management Cycle, Early Warning System, Pre-Disaster and Post Disaster Preparedness, Strengthening of SDMA and DDMA, Community Preparedness, Stakeholder Participation, Corporate Social Responsibility (CSR)

Survival Skills: Survival skills adopted during and after disaster Flood, Cyclone, Earthquake, Heat waves and Lightning.

Unit-IV (Public Health Management)

Brief idea on Epidemics and Pandemics, Non-Communicable Diseases with special reference to cardiovascular diseases, Cancer, Hypertension and Obesity and their prevention. Communicable Diseases with special reference to Covid-19, Flu, Hepatitis, AIDS and Tuberculosis and their transmission

Dynamics of Disease Transmission: Mode of transmission (Direct/Indirect), Events after infection: Immunity (Active vrs, Passive, Innate vrs Acquired, Herd Immunity), Incubation Period.

Prevention of Epidemics/Pandemics Disease: Preventing Measures (Quarantine, Sanitization, Personal Protective measures such as Hand Washing and use of protective devices, Vaccination); Control Measures (Surveillance, Isolation, Contact Tracing)

Life Style Management (Diet, Physical Exercise, Yoga and sleeping habit)

Role of Different Sectors in managing Health Disaster: Role of Government (Centre and State), Community, Civil Society, Student mass, NGO

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	5	4	5	5	2	4	5
CO2	5	4	5	4	5	2	4	4	2	5
CO3	5	5	5	2	5	4	5	5	4	5
CO4	5	2	4	2	4	5	5	5	5	5

SEMESTER - I

Core I (C-I): Microbiology and Phycology

Course Outcomes

After reading this paper, students should have:

1. Basic understanding of microbiology, phycology.

2. Observation of microbe in field and laboratories.

3. Gain knowledge about the systematic position the occurrence, distribution, morphology, anatomy, method of reproduction, life history of microbes and algae.

4. Economic importance of microbes and algae.

Unit-I

Introduction to microbial world, microbial nutrition, growth and metabolism.
Viruses:-Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV). Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases.

Unit–II

(i) Bacteria: - Discovery, general characteristics, types- archaebacteria, eubacteria, wallless forms (mycoplasma and spheroplasts), cell structure, nutritional types, reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction). Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).
(ii) Cyanobacteria:-Ecology and occurrence, cell structure, heterocyst, reproduction, economic importance; role in biotechnology. Morphology and life-cycle of Nostoc. General characteristics of prochlorophyceae, Evolutionary significance of Prochloron.

Unit–III

(i) Algae:- General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; and methods of reproduction, classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); Role of algae in the environment, agriculture, biotechnology and industry.
(ii) Chlorophyta:- General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of Chlamydomonas, Volvox, Oedogonium and Coleochaete.

Unit-IV

(i) Charophyta:- General characteristics; occurrence, morphology, cell structure and lifecycle of Chara; evolutionary significance.
(ii) Xanthophyta:- General characteristics; Occurrence, morphology and life- cycle of Vaucheria.
(iii)Phaeophyta:-Characteristics, occurrence, cell structure and reproduction. Morphology and life-cycles of Ectocarpus and Fucus.
(iv)Rhodophyta:-General characteristics, occurrence, cell structure and reproduction. Morphology and life-cycle of Polysiphonia.

PRACTICAL

Microbiology

(i) Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
(ii) Types of Bacteria to be observed from temporary/permanent slides/photographs.
(iii)Examination of bacteria from natural habitat(curd) by simple staining
(iv)Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule (live materials and photographs).
(v) Gram staining.

Phycology

Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Volvox, Oedogonium,Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia,Procholoron, Diatoms through electron micrographs, temporary preparations and permanent slides (based on the availability of materials).

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	4	4	4	2	4	2	5
CO2	5	5	5	5	4	4	4	2	2	5
CO3	5	4	4	5	5	5	2	4	2	5
CO4	5	4	2	4	4	2	2	2	2	5

Core II (C-II): Biomolecules and Cell biology

Course Outcomes

After reading this paper, students should have:

1. Basic knowledge about different biomolecules of plants and analysis of some.

2. Understanding of cell structure, division and function.

3. To know the plants at cellular level i.e. the chemical composition, structural and functional aspects of the biomolecules, structural organization of the cells.

4. Study of the various organelles, their functions and cell division.

Unit-I

(i) Biomolecules and Bioenergenetics: Types and significance of chemical bonds; Structure and properties of water; pH and buffers. Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions.

(ii) Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.
(iii)Carbohydrates: Nomenclature, classification and function of Monosaccharides; Disaccharides, Oligosaccharides and polysaccharides.

Unit –II

(i) Lipids: Definition and major classes of storage and structural lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties.
(ii) Proteins: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quarternary; Isoelectric point; Protein denaturation and biological roles of proteins.
(iii)Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Unit –III

(i) The cell: Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).
(ii) Cell division: Eukaryotic cell cycle, different stages of mitosis and meiosis. Cell cycle, Regulation of cell cycle.

(iii)Cell wall and plasma membrane: Chemistry, structure and function of Plant Cell Wall.

Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.

Unit-IV

(i) Cell organelles: Nucleus; Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.

(ii) Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.

(iii) Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semi-autonomous nature of mitochondria and chloroplast. Endoplasmic Reticulum, Golgi Apparatus, Lysosomes,

PRACTICAL

(i) Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.

(ii) Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo

(iii)Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf.

(iv)Counting the cells per unit volume with the help of haemocytometer. (Yeast/ pollen grains).

(v) Study the phenomenon of plasmolysis and deplasmolysis.

(vi)Study different stages of mitosis and meiosis using aceto carmine and aceto orcine method.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	4	5	5	5	5	4	2	5
CO2	5	2	4	5	5	4	5	2	2	5
CO3	5	4	2	5	4	4	5	4	2	5
CO4	5	5	2	5	4	5	5	2	2	5

GE-1A

Generic Elective Paper I: Biodiversity (Microbes, Algae, Fungi and Archigoniates)

Course Outcomes

After reading this paper, students should have:

1. Have knowledge of viruses and the viral replication cycles.

2. Be able to understand the physiology of and application of bacteria for human welfare.

3. Knowledge of various types of algae and fungi as well as their distribution in nature.

4. Be able to understand the characteristics and uniqueness of lower plants (bryophytes and pteridophytes).

5. Knowledge of the gymnosperm flora and their importance to nature.

Unit-I

Microbes: Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit-II

(i) Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Morphology and life- cycles of the following: *Chlamydomonas, Oedogonium, Nostoc and Fucus, Vaucheria, Polysiphonia*, Economic importance of algae.

(ii) Fungi: Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; TrueFungi-General characteristics, ecology and significance, life cycle *of Rhizopus* (Zygomycota) *Penicillium* (Ascomycota), *Puccnia*, *Agaricus* Basidiomycota); Symbiotic Associations-Lichens.

Unit-III

(i) Bryophytes: General characteristics, adaptations to land habit, Classification, Range of thallus organization, Classification (up to family), morphology, anatomy and reproduction of Marchantia and Funaria (Developmental details not to be included).

(ii) Pteridophytes: General characteristics, classification, early land plants (*Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella, Equisetum* and *Pteris* (Developmental details not to be included). Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes.

Unit-IV

Gymnosperms: General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas, Pinus* and *Gnetum*. (Developmental details not to be included). Ecological and economical importance.

PRACTICAL

1. Gram staining

2. Study of vegetative and reproductive structures of Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus and *Polysiphonia* through temporary preparations and permanent slides.

3. *Rhizopus* and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.

4. *Puccinia* and *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of Agaricus.

5. *Marchantia* and *Funaria*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).

6. *Selaginella*- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m.microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).

7. *Equisetum*- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry) (temporary slides); t.s rhizome (permanent slide).

8. *Cycas*- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).

9. *Pinus*- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m.dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	4	5	5	5	5	4	2	5
CO2	5	2	4	5	5	4	5	2	2	5
CO3	5	4	2	5	4	4	5	4	2	5
CO4	5	5	2	5	4	5	5	2	2	5
CO5	5	4	4	5	5	5	5	4	2	5

SEMESTER – II

AECC-II (MIL Alternative English)

COURSE OUTCOME

On completion of course, students will be able to:

1. demonstrate high-level proficiency in writing and speaking English
2. employ effectively the language of their discipline and devlope skills in organizing and expressing ideas and viewpoints with clarity and coherence in writing and speech
3. formulate and defend original arguments
4. enumerate skills in narration, description, and argumentation.

SYLLABUS:

UNIT 1: Short Story

(i) Jim Corbett-The Fight between Leopards
(ii) Dash Benhur- The Bicycle
(iii) Dinanath Pathy- George V High School
(iv) Alexander Baron- The Man who knew too much
(v) Will f Jenkins- Uneasy Homecoming

UNIT 2: Prose

(i) Mahatma Gandhi- The way to Equal Distribution
(ii) S Radhakrishnan- A Call to Youth
(iii) C V Raman-Water- The Elixir of Life
(iv) Harold Nicolson- An Educated Person
(v) Claire Needell Hollander- No Learning without Feeling

UNIT 3:

(i) Comprehension of a passage and answering the questions

UNIT 4:

(i) Language exercises-test of vocabulary, usage and grammar

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	2	2	2	2	2	4	2
CO2	4	2	2	2	4	4	2	2	2	2
CO3	2	2	2	4	2	4	2	2	4	2
CO4	2	2	2	2	4	2	4	4	2	2

Core III (C-III): Mycology and Phytopathology

Course Outcomes

After reading this paper, students should have:

1. Importance of fungi in industry, agriculture and medicine.

2. Gain knowledge about the Kingdom-Fungi including their systematic status, occurrence, mode of nutrition, structural variations and lifecycle.

3. Study the Lichen, a symbiotic association of fungi with algae, and their economic significance.

4. Gain knowledge about the diseases caused by the viruses, bacteria, and fungi in plants.

Unit-I

(i) Introduction to true fungi: Definition, General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.
(ii) Zygomycota: General characteristics; Ecology; Thallus organisation; Life cycle with reference to *Rhizopus*.
(iii)Ascomycota: General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; life cycle and classification with reference to *Saccharomyces, Aspergillus, Penicillium*, and *Neurospora*.
(iv)Basidiomycota: General characteristics; Ecology and Classification; Life cycle of Puccinia and Agaricus.

Unit-II

(i) Allied Fungi: General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.
(ii) Oomycota: General characteristic; Ecology; Life cycle and classification with reference to *Phytophthora, and Albugo.*
(iii)Symbiotic associations: Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction. Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance.

Unit-III

Applied Mycology: Role of fungi in biotechnology, Mushroom cultivation, Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.

Unit-IV

Phytopathology: Terms and concepts; General symptoms; Geographical distribution of diseases; etiology; symptomology; Host- Pathogen relationships; disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine. Bacterial diseases – Citrus canker and angular leaf spot disease of Cotton.

Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Loose and covered smut.

PRACTICAL

(i) Introduction to the world of fungi (Unicellular, coenocytic /septate mycelium, ascocarp & basidiocarps).

(ii) Rhizopus: study of asexual stage from temporary mounts and sexual structures through permanent slides.

(iii) Aspergillus and Penicillium: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.

(iv) Agaricus: Specimens of button stage and full grown mushroom; sectioning of gills of Agaricus, and fairy rings are to be shown.

(v) Albugo: Study of symptoms of plants infected with Albugo; asexual phase study through section/ temporary mounts and sexual structures through permanent slides.

(vi) Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Viral diseases: Mosaic disease of ladies finger, papaya, cucurbits, moong, black gram,

Fungal diseases: Blast of rice, Tikka disease of ground nut, powdery mildew of locally available plants and White rust of crucifers**.**

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	5	2	2	4	5	2	4	5
CO2	5	5	5	5	4	4	5	4	4	5
CO3	5	5	2	5	4	4	2	2	4	5
CO4	5	4	2	5	4	4	2	4	2	5

- Note related: 1
- From What Related: 2
- Neutral: 3
- Moderately Related: 4

- Highly Related: 5

Core IV (C-IV): Archegoniate

Course Outcomes

After reading this paper, students should have:

1. Evolution of first land plants Geologic time period in earth's history, preservation of plants. Understand the impact of ecological and climate change on plants.

2. Gain knowledge about the Kingdom-Plantae, the land plants, their origin and adaptation.

3. Learn to know about rang of thallus organization, structure, reproduction, evolutionary trends and economic importance in bryophytes, petridophytes and gymnosperms.

4. Able to know palaeobotany- geological time scale, fossils and fossilization processes taking some examples from petridophytes and gymnosperms.

Unit-I

(i) Introduction: Unifying features of archegoniates; Transition to land habit; Alternation of generations. General characteristics; Origin of land plants and Adaptations to land habit;
(ii) Bryophytes : Origin and Classification; Range of thallus organization. Classification (up to family). Reproduction and evolutionary trends in Riccia, Marchantia, Anthoceros and Funaria (developmental stages not included). Ecological and
economic importance of bryophytes.

Unit-II

Pteridophytes: General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of Psilotum, Selaginella, Equisetum and Pteris. Apogamy, and apospory, heterospory and seed habit, telome theory, stellar evolution and economic importance.

Unit-III

Gymnosperms: General characteristics, classification (up to family), morphology, anatomy and reproduction of Cycas, Pinus, Ginkgoand Gnetum.(Developmental details not to be included).Ecological and economic importance.

Unit-IV

Palaeobotany: Geological time scale,fossilsand fossilization process. Morphology, anatomy and affinities of Rhynia, Calamites, Lepidodendron, Lyginopteris, Cycadeoidea and Williamsonnia.

PRACTICAL

(i) Morphology of thallus and anatomy of *Riccia, Marchantia, Anthoceros, Funaria*-
(ii) *Psilotum*- Study of specimen, transverse section of synangium (permanent slide).

(iii) *Selaginella*- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).
(iv*) Equisetum*- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).
(v) Study from permanent slides of *Ophioglossum* (L.S. of spike), *Marselia* (L.S. of sporocarp) and *Lycopodium* (L.S. of strobilus).
(vi) *Pteris*- Morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).
(vii) *Cycas*- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll and meghaspore, T.S root, leaflet
(viii) *Pinus*- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), T.S. Needle, stem, L.S. male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), L.S.of female cone
(ix) *Gnetum*- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)
(x) Study of some fossil slides / photographs as per theory.
(xi) Botanical excursion/study tour.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	4	4	4	5	2	4	2	5
CO2	5	5	4	5	4	5	2	5	4	5
CO3	5	4	4	5	5	5	4	4	4	5
CO4	5	4	2	5	4	2	2	2	4	5

GE-2A

Generic Elective Paper II: Plant Physiology & Metabolism

Course Outcomes

After reading this paper, students should have:

1. Learn about plant physiology and metabolism which includes plant water relations, mineral nutrition and translocation of nutrients.
2. Learn about photosynthesis, respiration in plants. Study about structure and properties of enzymes.
3. Learn about various plant growth hormones and response of plants to light and temperature.
4. Understand plant response to light and temperature. Understand photo periodism and photo morphogenesis.

Unit-I

(i) Plant-water relations: Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.
(ii) Mineral nutrition: Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.
(iii) Translocation in phloem.: Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading

Unit-II

(i) Photosynthesis: Photosynthetic Pigments (Chl a, b, x anthophylls, carotene);Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation.
(ii) Respiration: Glycolysis, anaerobic respiration, TCA cycle; Oxidative Phosphorylation.

Unit-III

(i) Enzymes: Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.
(ii) Nitrogen metabolism: Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit-IV

(i) Plant growth regulators: Discovery and physiological roles of auxins, gibberellins, cyto kinins,
ABA, ethylene.

(ii) Plant response to light and temperature: Photo periodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far-red light responses on photo morphogenesis; Vernalization.

PRACTICAL

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration byexcised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	5	5	5	4	5	2	5
CO2	5	5	5	5	5	5	2	5	2	5
CO3	5	5	5	5	5	5	4	5	2	5
CO4	5	5	5	5	5	5	4	4	2	5
CO5	5	5	4	5	5	5	4	4	2	4

SEMESTER - III

Core V (C-V): Anatomy of Angiosperms

Course Outcomes

After reading this paper, student should have:

1. Internal Organization of plants Primary and secondary growth patterns.

2. Learn the internal structures like cell, tissue, organs of the angiosperms

3. Learn the tissue organization and their structural comparison in leave, roots and stem of both dicot and monocot plants.

4. Normal and anomalous secondary growth of angiospermic plants.

Unit-I

(i) Introduction and scope of Plant Anatomy: Applications in systematics, forensics and pharmacognosy.

(ii) Tissues: Classification of tissues; Simple and complex tissues (no phylogeny); cyto differentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Cell wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances.

Unit-II

(i) Stem: Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cyto-histological zonation); Types of vascular bundles; Anatomy of dicot and monocot stem. Vascular Cambium: Structure, function and seasonal activity of cambium; secondary growth in stem (normal and anomalous).

(ii) Leaf: Anatomy of dicot and monocot leaf, Kranz anatomy.

Unit-III

(i) Root: Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescentcentre; Root cap; Anatomy of dicot and monocot root; Endodermis, exodermis and origin of lateral root. Secondary growth in roots.

(ii) Wood: Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology.

(iii)Periderm: Development and composition of periderm, rhytidome and lenticels.

Unit –IV

(i) Adaptive and Protective Systems Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni-and multicellular, glandular and nonglandular: two examples of each), stomata (classification); Anatomical adaptations of xerophytes and hydrophytes.

(ii) Secretory System: Hydathodes, cavities, lithocysts and laticifers.

PRACTICAL

1. Study of distribution and types of parenchyma, collenchyma and sclerenchyma, Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres, Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
2. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
3. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
4. Root: monocot, dicot, secondary growth.
5. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
6. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy)

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	4	4	5	5	4	2	2	4	4
CO2	5	4	4	5	5	4	2	4	4	4
CO3	5	4	2	5	5	4	2	4	2	4
CO4	5	2	2	4	4	4	2	2	2	2

Core VI (C-VI): Economic Botany

Course Outcomes

After reading this paper, student should have:

1. Gain knowledge about the origin, evolution, domestication of economically important plants which are indispensable for life.

2. Learn about cereals, legumes, sugar, spices, drugs, oils and fat, essential oils, rubber, timber, fiber etc.

3. Learn parts of the plants that are economically important and methods to extract it.

4. Learn about habit and cultivation of economically important plants.

Unit- I

(i) Origin of Cultivated Plants: Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of newcrops/varieties, importance of germplasm diversity.

(ii) Cereals: Brief account of Wheat, Rice and millets.

(iii)Legumes: General account, importance to man and ecosystem.

(iv)Sugars & Starches: Morphology and processing of sugarcane, products and byproducts of sugarcane industry. Potato – morphology, propagation & uses.

Unit-II

(i) Spices: Listing of important spices, their family and part used, economic importance with special reference to fennel, saffron, clove and black pepper Beverages: Tea, Coffee (morphology, processing & uses)

(ii) Drug-yielding plants: Therapeutic and habit-forming drugs with special reference to *Cinchona, Digitalis, Papaver* and *Cannabis.*

(iii)Tobacco: Tobacco (Morphology, processing, uses and health hazards)

Unit-III

(i) Oils & Fats: General description, classification, extraction, their uses and health implications groundnut, coconut, linseed and Brassica (Botanical name, family & uses)

(ii) Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.

Unit-IV

(i) Natural Rubber: Para-rubber: tapping, processing and uses.

(ii) Timber plants: General account with special reference to teak and pine. Fibers: Classification based on the origin of fibers, Cotton and Jute (morphology, extraction and uses).

PRACTICAL

(i) Cereals: Rice (habit sketch, study of paddy and grain, starch grains).

(ii) Legumes: Soya bean/moong bean/black gram, Groundnut, (habit, fruit, seed structure, micro-chemical tests).

(iii) Sugars & Starches: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato (habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, starch grains, micro-chemical tests).
(iv) Spice and Beverages: clove, black pepper ,Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
(v) Oils & Fats: Groundnut, Mustard–plant specimen, seeds; tests for fats in Crushed seeds.
(vi) Drug-yielding plants: Specimens of Digitalis, Papaver andCannabis.
(vii) Woods: Tectona, Pinus/Sal: Specimen, Section of young stem.
(viii) Fiber-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	4	5	4	4	2	4	2	4
CO2	5	5	2	5	4	4	5	4	2	4
CO3	5	5	2	5	2	4	5	2	2	5
CO4	5	5	2	5	2	4	4	2	2	2

Core VII (C-VII): Genetics

Course Outcomes

After reading this paper, student should have:

1. Gain knowledge about the laws of inheritance.

2. Learn about extra chromosomal inheritance, linkage and crossing over.

3. Learn about gene mapping, variation in chromosome structure and number, mutation.

4. Learn fine structure of gene, population and evolutionary genetics.

Unit-I

(i) Mendelian genetics and its extension, Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant

traits, Polygenic inheritance.

(ii) Extrachromosomal Inheritance: Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; Maternal effects-shell coiling in snail; Infective heredity-Kappa particles in Paramecium.

Unit-II

Linkage, crossing over and chromosome mapping: Linkage and crossing over Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage.

Unit-III

(i) Variation in chromosome number and structure: Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy

(ii) Gene mutations: Types of mutations; Molecular basis of Mutations; Mutagens –physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of Transposons in mutation. DNA repair mechanisms.

Unit-IV

(i) Fine structure of gene: Classical vs. molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus.

(ii) Population and Evolutionary Genetics: Gene pool, Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.

PRACTICAL

1. Meiosis through temporary squash preparation.
2. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis.
3. Chromosome mapping using test cross data.
4. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
5. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
6. Blood Typing: ABO groups & Rh factor.
7. Chromosome anomaly : Translocation Ring, Laggards and Inversion Bridge, break etc.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	4	5	5	4	5	4	4	5

CO2	5	5	4	5	5	5	5	2	2	5
CO3	5	5	4	5	5	5	5	2	2	5
CO4	5	5	4	5	5	5	5	4	2	5

SEC-I (Communicative English)

COURSE OUTCOME

On completion of course, students will be able to:

1. build speaking and listening skills and develop a neutral accent and improve general standard of pronunciation

2. learn beyond the conventional syllabus and be prepared to meet challenges while seeking a job.

3. to be able to synthesize knowledge and use it creatively to better understand and improvise themselves

4. be able to communicate effectively through written reports, presentations, and discussions

SYLLABUS:

UNIT 1: Introduction

(i) What is communication?

(ii) Types of communication (Horizontal, Vertical, Interpersonal, Grapevine),

(iii) Uses of Communication, Inter-cultural communication, Communication today:

(iv) Distinct features of Indianisation, alternative texts of language learning, global English and English in the print and electronic media in India.

UNIT 2: The Four Skills and Prospect of new material in language learning

(i) Listening-Passive and active, Speaking effective, intelligibility and clarity

(ii) Methods and techniques of reading such as skimming, scanning and searching for information; Reading to understand the literal, metaphorical and suggested meaning of a passage,

(iii) Identifying the tone (admiring, accusatory, ironical, sympathetic, evasive, indecisive, ambiguous, neutral etc.) of the writer and view-points.

(iv) Cohesive and Coherent writing

UNIT 3: Grammatical and Composition Skills

(i) Doing exercises like filling in the blanks, correcting errors, choosing correct forms out of alternative choices, joining clauses, rewriting sentences as directed, and replacing indicated sections with single words / opposites / synonyms, choosing to use correct punctuation marks, getting to understand and use formal and informal styles, learning to understand the usages of officialese, sexism, racism, jargon.

(ii) Learning to understand information structure of the sentence such as topic-focus relationship; strategies of thematization, postponement, emphasis, structural compression (deletion of redundant parts, nominalization, cleft and pseudo-cleft sentences, elliptical structures etc.). Logical Connectors between sentences. Methods of developing a paragraph, structure of an essay and methods of developing an essay

UNIT 4: Exercises in Written Communication

(i) Précis writing

(ii) Note-taking skills

(iii) Writing reports

(iv) Guidelines and essentials of official correspondence for making enquiries, complaints and replies

(v) Making representations; writing letters of application for jobs; writing CV, writing letters to the editor and social appeals in the form of letters/pamphlets.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	4	4	2	2	2	2	4	2
CO2	2	2	2	2	2	4	2	2	2	2
CO3	4	4	2	4	4	2	2	2	2	2
CO4	4	2	2	4	2	2	2	2	2	4

SEMESTER - IV

Core VIII (C-VIII): Molecular Biology

Course Outcomes

After reading this paper, student should have:

1. Learn the historical perspective and the proof of nucleic acids as genetic material.
2. Structure of DNA and RNA, replication and their organization within the cell.
3. Detailed functions of nucleic acids related to protein synthesis (gene expression).
4. Function of genes.

Unit-I

Nucleic acids : Carriers of genetic information: Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty), Types of genetic material, denaturation and renaturation, cot curves. Organization of DNA and structure of RNA-Prokaryotes, Viruses, Eukaryotes, Fraenkel-Conrat's experiment. Organelle DNA - mitochondria and chloroplast DNA. The Nucleosome -Chromatin structure- Euchromatin, Heterochromatin-Constitutive and Facultative heterochromatin.

Unit-II

(i) The replication of DNA: Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi-conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA, replication of the 5′ end of linear chromosome; Enzymes involved in DNA replication.

(ii) Central dogma and genetic code: Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)

(iii)Processing and modification of RNA: Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I & group II intron splicing,alternative splicing eukaryotic mRNA processing (5′ cap, 3′ polyA tail); Ribozymes, exon shuffling; RNA editing and mRNA transport.

Unit-III

Mechanism of Transcription: Transcription in prokaryotes and eukaryotes;Regulation of transcription in prokaryotes and eukaryotes: Principles of transcriptional regulation; Prokaryotes: Operon concept- Regulation of lactose metabolism and tryptophan synthesis in E.coli. Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing

Unit-IV

Translation (Prokaryotes and eukaryotes): Ribosome structure and assembly; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation,

elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.

PRACTICAL

1. Preparation of LB medium and raising E. coli.
2. Isolation of genomic DNA from E. coli./onion roots
3. RNA estimation by orcinol method.
4. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
5. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)
6. Study of Barr body from buccal smear preparation.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	2	5	5	5	5	4	2	5
CO2	5	5	2	5	5	5	5	4	2	5
CO3	5	5	2	5	5	5	5	4	2	5
CO4	5	5	2	5	5	4	4	2	2	5

Core IX (C-IX): Plant Ecology and Phytogeography

Course Outcomes

After reading this paper, student should have:

1. Know the detailed structure of various ecosystems (abiotic and biotic components) and their functions.

2.Various edaphic factors in relation to plant adaptations.

3.Interrelationships of the living world and the environment.

4. Concepts of Population and community.

Unit-I

(i) Introduction Concept of ecology, Autoecology, Synecology, system ecology, Levels of organization. Inter-relationships between the living world and the environment, the components of environment, concept of hydrosphere and lithosphere and dynamism, homeostasis.
(ii) Light, temperature, wind and fire: Variations; adaptations of plants to their variation.

Unit-II

(i) Soil: Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.
(ii) Water: Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.

Unit-III

Biotic interactions and Population ecology: Characteristics and Dynamics.
Plant communities: Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

Unit-IV

(i) Ecosystems: Structure; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.
(ii) Functional aspects of ecosystem: Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.
(iii)Phytogeography: Principles; Continental drift; Theory of tolerance; Endemism; Phytogeographical division of India; Local Vegetation.

PRACTICAL

1. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper)

2.Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.

3. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.

4. Study of morphological adaptations of hydrophytes, xerophytes, halophyles (two each).

5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).

6. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.

7. Field visit to familiarize students with ecology of different sites

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	2	5	5	5	2	4	5	4
CO2	5	5	4	5	4	4	2	4	5	4
CO3	5	5	4	5	5	4	2	4	5	2
CO4	5	5	4	4	4	4	2	4	5	4

Core X (C-X): Plant Systematics

Course Outcomes

After reading this paper, students should have:

1. Gain knowledge on plant systematic, herbarium and its preparation, e-flora, Taxonomic hierarchy, binomial nomenclature.

2. System of classification, their merits and demerits.

3. Phylogeny of angiosperms

4. Descriptive studies of a number of families of taxonomic importance.

Unit-I

Plant identification, Classification, Nomenclature; Biosystematics. Identification: Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: Single access and Multi-access

Unit-II

Taxonomic hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).Botanical nomenclature: Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.

Unit-III

(i) Systematics- an interdisciplinary science: Evidence from palynology, cytology, phytochemistry and molecular data.

(ii) Systems of classification: Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (up to series) and Hutchinson (up to series); Brief reference of Angiosperm Phylogeny Group (APG III) classification.

Unit-IV

Phylogeny of Angiosperms: Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades). Origin& evolution of angiosperms; co- evolution of angiosperms and animals; methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).

Families of Angiosperms : Descriptive studies of Magnoliaceae, Rosaceae, Rubiacae, Liliaceae, Poaceae, and Orchidaceae

PRACTICAL

(i) Study of vegetative and floral characters of available materials of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Magnoliaceae, Rosaceae, Rubiacae, Liliaceae, Poaceae, and Orchidaceae as per theory syllabus.

(ii) Field visit, plant collection and herbarium preparation and submission. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book)

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	4	5	4	5	2	4	4	5
CO2	5	5	4	5	4	4	2	4	2	4
CO3	5	5	4	5	4	4	2	2	2	4
CO4	5	5	2	5	4	4	2	4	2	4

SEC II (QUANTITATIVE APTITUDE & DATA INTERPRETATION)

COURSE OUTCOME

On completion of this course, students will be able to

1. have a good command over quantitative aptitude and logical thinking.

2. understand various quantitative methods.

3. understand data and draw inference from data.

4. improve their critical thinking skills

SYLLABUS

UNIT I: Whole numbers, Integers, Rational and irrational numbers, Fractions, Square roots and Cube roots, Surds and Indices, Problems on Numbers, Divisibility.

Steps of Long Division Method for Finding Square Roots.

UNIT II: Basic concepts, Different formulae of Percentage, Profit and Loss, Discount, Simple interest, Ratio and Proportion, Mixture.

UNIT III: Time and Work, Pipes and Cisterns, Basic concepts of Time,

Distance and Speed; relationship among them.

UNIT IV: Concept of Angles, Different Polygons like triangles, rectangle, square, right angled triangle, Pythagorean Theorem, Perimeter and Area of Triangles, Rectangles, Circles

UNIT V: Raw and Grouped Data, Bar Graphs, Pie charts, Mean, Median and Mode, Events and Sample Space, Probability.

II. LOGICAL REASONING

UNIT I: Analogy basing on kinds of relationships, Simple Analogy; Pattern and Series of Numbers,

Letters, Figures. Coding-Decoding of Numbers, Letters, Symbols (Figures), Blood relations.

UNIT II: Logical Statements – Two premise argument, More than two premise argument using

connectives.

UNIT III: Venn Diagrams, Mirror Images, Problems on Cubes and Dices.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	4	4	4	2	2	2	2	4
CO2	2	4	2	4	4	2	2	2	2	2
CO3	2	2	2	2	2	2	2	4	2	2
CO4	2	2	2	2	4	2	4	2	2	4

SEMESTER - V

Core XI (C-XI): Reproductive Biology of Angiosperms

Course Outcomes

After reading this paper, student should have:

1. Gain knowledge about reproductive structures and their activities in plants.

2. Know about variations in the structures, developments, functions of reproductive parts of the angiospermic flower and their involvement in the process of reproduction.

3. Learn the types of pollinations and their significance.

4. Fertilization and embryogenesis

Unit-I

(i) Introduction: History and scope.
(ii) Anther: Anther wall: Structure and functions, micro-sporogenesis, callose deposition and its significance.

(iii)Pollen biology: Micro-gametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC system; Palynology and scope (a brief account); Pollen wall proteins;
Pollen viability, storage and germination; Abnormal features: Pseudomonads, polyads, massulae, pollinia.

Unit-II

Ovule: Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Female gametophyte– mega-sporogenesis and mega-gametogenesis; Types and ultra structure of mature embryo sac (Details of Polygonum type).

Unit-III

(i) Pollination and fertilization: Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.
(ii) Self incompatibility: Basic concepts; Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination; Intraovarian and in vitro pollination; Modification of stigma surface.

Unit-IV

(i) Endosperm: development, structure and functions
(ii) Embryo: Types of embryogeny; General pattern of development of dicot and monocot embryo; Suspensor: structure and functions; Embryo- endosperm relationship; Nutrition of embryo; Embryo development in Paeonia.
(iii)Seed: Structure, importance and dispersal mechanisms
(iv)Polyembryony and apomixes: Introduction; Classification; Causes and applications.

PRACTICAL

(i) Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.
(ii) Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs,fresh material), ultrastructure of pollen wall (micrograph); Pollen viability: Tetrazolium test, Germination: Calculation of percentage germination in different media using hanging drop method.
(iii) Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs). Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.
(iv) Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	5	4	5	4	4	2	5
CO2	5	5	4	5	4	5	4	4	2	5
CO3	5	5	4	5	4	5	4	4	2	4
CO4	5	5	2	5	4	5	4	2	2	4

Core XII (C-XII): Plant Physiology

Course Outcomes

After reading this paper, student should have:

1. Knowledge about plant physiology and growth.
2. Gain knowledge about the plant water relationships and Mineral nutrition and their uptake.
3. Plant growth regulators and their physiological roles in plant growth and developments.
4. Physiology of flowering and involvement of phytochromes.

Unit-I

(i) Plant water relationship: Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, trans-membrane pathways, root pressure, guttation. Ascent of sap– cohesion-tension theory. Transpiration and factors affecting transpiration, anti-transpirants, mechanism of stomatal movement.

(ii) Translocation in the phloem: Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model; Phloem loading and unloading; Source–sink relationship.

Unit-II

(i) Mineral nutrition: Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents.

(ii) Nutrient Uptake: Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems,proton ATPase pump and ion flux, uniport, co-transport, symport, and antiport.

Unit-III

Plant growth regulators: Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene. Brassinosteroids and Jasmonic acid.

Unit-IV

(i) Physiology of flowering: Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.

(ii) Phytochrome: Discovery, chemical nature, role of phytochrome in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.

PRACTICAL

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of water potential of given tissue (potato tuber) by weight method.
3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.
4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces).
6. To study the phenomenon of seed germination (effect of light).
7. To study the induction of amylase activity in germinating barley grains
8. To demonstrate suction due to transpiration.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	5	5	5	5	4	2	5
CO2	5	5	2	5	4	5	4	2	2	5
CO3	5	5	5	5	4	5	5	2	2	5
CO4	5	5	4	5	4	5	5	2	2	5

DSE I: Analytical Techniques in Plants

Course Outcomes

After reading this paper, student should have:

1. Knowledge of the principles of microscopy, autoradiography, chromatography, electrophoresis and spectrophotometry.

2. Various methods for cell fractionation.

3. Radioisotopes and their uses.

4. Learn the statistical methods and formulas to represent data and Handling of instruments in laboratory.

Unit-I

Imaging and related techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Flow cytometry (FACS); Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit-II

Cell fractionation: Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2gradient, analytical centrifugation, ultracentrifugation. Radioisotopes: Use in biological research, auto-radiography, pulse chase experiment. Spectrophotometry: Principle and its application in biological research.

Unit-III

Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography;Affinity chromatography. Characterization of proteins and nucleic acids: Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

Unit-IV

Biostatistics: Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit. T-Test and correlation.

PRACTICAL

1. Study of different microscopic techniques for chromosome study
2. Study of PCR Demonstration.
3. To separate chlorophyll by paper chromatography.
4. To separate phytochemicals by thin layer chromatography.
5. To estimate protein concentration through Lowry's methods.

6. To separate proteins using PAGE.
7. To separate DNA (marker) using AGE.
8. Estimation of plant pigments

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	5	5	5	4	5	2	5
CO2	5	5	5	5	5	5	5	5	2	5
CO3	5	5	5	5	5	5	4	5	4	5
CO4	5	5	5	5	5	5	4	5	4	5

DSE II: Plant Breeding

Course Outcomes

After reading this paper, student should have:

1. Basic understanding of Crop improvement.

2. Basic understanding of germplasm and plant genetic resources.

3. Use of breeding techniques for crop improvement

4. Conservation of plant genetic resources

Unit-I

Plant Breeding : Introduction and objectives : Breeding systems: mode of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

Unit-II

Methods of Crop Improvement : Introduction : Centres of origin and domestication of crop Plants, plant genetic resources; Acclimatization; Selection methods; For self pollinated, cross Pollinated and vegetatively propagated plants; Hybridization ; For self, cross and vegetatively propagated plants Procedure, advantages and limitation.

Unit-III

Quantitative inheritance :Concept, mechanism, examples of inheritance of Kernel colour in wheat ,Skin colour in human beings. Monogenic vs Polygenic inheritance.

Unit-IV

Inbreeding depression and heterosis : History, genetic basis of inbreeding depression and heterosis; Applications. Crop improvement and breeding : Role of mutations ; Polyploidy ; Distant hybridization and roleof biotechnology in crop improvement.

PRACTICAL

Practical related to theory

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	5	5	5	5	4	4	5
CO2	5	5	5	5	4	5	5	2	4	5
CO3	5	5	5	5	4	5	5	2	2	5
CO4	5	5	5	5	5	5	5	4	4	5

SEMESTER - VI

Core XIII (C-XIII): Plant Metabolism

Course Outcomes

After reading this paper, student should have:

1. Knowledge about the mechanism of photosynthesis, respiration, synthesis and assimilation of Nitrogen.

2. Gain knowledge on the concept of metabolism and signal induction, carbon assimilation, Carbon oxidation and ATP synthesis.

3. Lipid metabolism: synthesis and breakdown and its significance.

4. Nitrogen metabolism: nitrogen fixation and ammonia assimilation.

Unit-I

(i) Concept of metabolism: Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric ,covalent modulation and Isozymes).
(ii) Mechanisms of signal transduction: Calcium, phospholipids, cGMP, NO.

Unit-II

Carbon assimilation: Historical background, photosynthetic pigments, role of photosynthetic pigments, antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, C3, C4pathways; Crassulacean acid metabolism; Factors affecting CO2 reduction. Photorespiration

Unit-III

(i) Carbon Oxidation: Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle,amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanideresistant respiration, factors affecting respiration.
(ii) ATP-Synthesis: Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photo- phosphorylation), ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers.

Unit-IV

(i) Lipid metabolism: Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluco-neogenesis and its role in mobilisation of lipids during seed germination, α oxidation.
(ii) Nitrogen metabolism: Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and trans-amination.

PRACTICAL

1. Isolation and quantitization of photosynthetic pigments.
2. Experimental demonstration of Hill's reaction.
3. To study the effect of light intensity on the rate of photosynthesis.
4. Effect of carbon dioxide on the rate of photosynthesis.
5. To compare the rate of respiration in different parts of a plant.
6. Demonstration of absorption spectrum of photosynthetic pigments.

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	P3O4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	5	4	5	5	4	2	5
CO2	5	5	5	5	5	5	5	4	2	5
CO3	5	5	4	5	4	4	5	2	2	5
CO4	5	5	4	5	4	5	4	2	2	5

Core XIV (C-XIV): Plant Biotechnology

Course Outcomes

After reading this paper, student should have:

1. Basic understanding of methods of gene transfer, plant tissue culture, genetic engineering and creating genetically modified plants.

2. History of Biotechnology.

3. Study about biosafety issues involved.

4. Gain Knowledge about recombinant DNA technology and their applications.

Unit-I

Plant Tissue Culture: Historical perspective; Aseptic tissue culture techniques, Composition

of media; Nutrient and hormone requirements (role of vitamins and hormones). Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation).

Unit-II

Recombinant DNA technology-I: Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC and briefly PAC, MAC, HAC).Gene Cloning (Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning).

Unit-III

Recombinant DNA technology-II: Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; Probes-oligonucleotide, heterologous, Methods of gene transfer- Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

Unit-IV

Applications of Biotechnology: Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Gentically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.

PRACTICAL

1. a) Preparation of tissue culture (MS) medium.
(b) Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.
2. Study of anther culture.
3. Preparation of artificial seeds.
4. Testing and study of Bt cotton.

5. Isolation of plasmid DNA.
6. Gel electrophoresis (demonstration).

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	5	5	5	5	4	4	5
CO2	5	5	5	5	4	2	2	2	2	5
CO3	5	5	5	5	5	4	5	4	5	5
CO4	5	5	4	5	4	5	5	2	4	5

DSE III: Stress Biology

Course Outcomes

After reading this paper, student should have:

1. Basics of plant stress and its types.
2. Causes of plant stress
3. Stress tolerance.
4. Stress adaptations

Unit-I
Defining Plant Stress : Acclimation and adaptation

Unit-II
Environmental factors :Water Stress ;Salinity Stress, High light Stress; Temperature Stress; Hypersensitive reaction; Pathogenesis related (PR) proteins; Systemic acquired resistance. Mediation of insect and disease resistance by jasmonates

Unit-III
Stress sensing mechanisms in plants : Role of nitric oxide Calcium modulation, Phospholipid signaling

Unit-IV
Developmental and physiological mechanisms that protect plants against environmental stress : Adaptation in plants ; Changes in root : shoot ratio; Aerenchyna development; Osmotic

adjustment; Compatible solute production; Reactive oxygen species Production and scavenging mechanisms.

PRACTICAL

Practical related to theory

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

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CO1	5	5	4	5	4	5	5	4	2	5
CO2	5	5	5	5	4	5	5	2	2	5
CO3	5	5	4	5	4	4	5	2	2	5
CO4	5	5	5	5	4	4	5	2	2	5

DSE IV: Industrial and Environmental Microbiology (Theory+Practical)/Project Work

(If the student is not able to secure 60percent of honors mark then they should appear for DSE-IV paper as mentioned above or they have to submit dissertation work on honors related topics scoring more than 60% of honors marks.)

Course Outcomes

After reading this paper, student should have:

1. Understanding industrial and environmental microbiology.
2. Knowledge about isolation and culture of microbes.
3. Role of microbes in water treatment and agriculture.
4. Importance of microbes in industry, environment and agriculture.

Unit-I

(i) Scope of microbes in industry and environment: Bioreactors/Fermenters and fermentation processes: Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous fermentations. Components of a typical bioreactor, Types of bioreactors- laboratory.
(ii) Microbial production of industrial products: Microorganisms involved, media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying.

Unit-II

Microbial enzymes of industrial interest and enzyme immobilization: Microorganisms for industrial applications and hands on screening microorganisms for casein hydrolysis; starch hydrolysis; cellulose hydrolysis. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase).

Unit-III

Microbes and quality of environment: Distribution of microbes in air; Isolation of microorganisms from soil, air and water.
Microbial flora of water: Water pollution, role of microbes in sewage and domestic waste water treatment systems. Determination of BOD, COD, TDS and TOC of water samples; Microorganisms as indicators of water quality.

Unit-IV

Microbes in agriculture and remediation of contaminated soils: Biological fixation; Mycorrhizae; Bioremediation of contaminated soils. Isolation of root nodulating bacteria, arbuscular mycorrhizal colonization in plant roots.

PRACTICAL

1.Principles and functioning of instruments in microbiology laboratory
2.Hands on sterilization techniques and preparation of culture media
3. Screening microorganisms for industrial use.
4. Mycorrhiza, arbuscular mycorrhizal colonization in plant roots
5. Determination of BOD, COD, TDS and TOC of water samples;
6.Microorganisms as indicators of water quality

MAPPING OF COURSE OUTCOMES WITH THE PROGRAM OUTCOMES:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	5	5	5	4	5	2	4	4	2	5
CO2	5	5	5	4	5	5	4	4	2	5

CO3	5	5	4	5	4	5	5	4	2	5
CO4	5	5	4	5	5	5	5	4	4	5

- Note related: 1
- From What Related: 2
- Nutral: 3
- Moderately Related: 4
- Highly Related: 5