

## **UNDERGRAGUATE SYLLABUS BOTANY**

### **Distribution of marks will be as follows:-**

Each Theory paper will consists of 150 marks (two core papers of 75 marks each) consisting of 120 marks (60 each in both the core papers) from end semester, 30 marks (30 marks each in both the core papers)from mid semester and attendance .

Each practical paper will be of 50 marks (25 each in two core papers), out of which 40 marks (20 marks in both core papers) will be end semester and 10 marks (5 marks in each mid semester). The 5% marks on attendance in the subject concerned will be as per regulation (Theory & Practical).

**SEMESTER – I**  
**Core course I : Microbiology and Phycology**  
**(Credits : Theory-4, Practical -2)**

**THEORY**

**Lectures: 60**

**Full Marks: 60**

**Time: 03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1: VIRUSES (8 lectures)**

Discovery, living & non-living characterization, general structure with special reference to bacteriophage and TMV.

**UNIT 2: BACTERIA (8 lectures)**

Discovery, general characteristics, mycoplasma, cell structures and reproduction

**UNIT 3: APPLIED MICROBIOLOGY (4 lectures)**

Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

**UNIT 4: ALGAE (8 lectures)**

General characteristics; Classification proposed by Fritsch.

**UNIT 5: CYANOPHYTA (5 lectures)**

General characteristics, morphology and life cycle of *Nostoc*.

**UNIT 6: CHLOROPHYTA (6 lectures)**

General characteristics; morphology and life cycle of *Volvox and Oedogonium*.

**UNIT 7: CHAROPHYTA (2 lectures)**

General characteristics; morphology and life cycle of *Chara*.

**UNIT 8: XANTHOPHYTA (3 lectures)**

General characteristics; morphology and life cycle of *Vaucheria*.

**UNIT 9: PHAEOPHYTA (6 lectures)**

General characteristics; morphology and life cycle of *Ectocarpus*.

**UNIT 10: RHODOPHYTA (6 lectures)**

General characteristics; morphology and life cycle of *Batrachospermum*.

**UNIT 11: APPLIED PHYCOLOGY (4 lectures)**

Economic importance of algae.

**Suggested readings**

1. Vashishishta, B.R., Singh, V.P., and Sinha A.K.(2014) Botany for Degree Students (Algae) S.Chand& Company Ltd.
2. Gangulee,H.C. and Kar, A.K. 2012, College Botany Volume-II

3. Lee, R.E. (2008), Phycology, Cambridge university Press, Cambridge. 4<sup>th</sup> edition.
4. Prescott, L.M., Harley J.P., Klein D.A. (2005), Microbiology, McGraw Hill, India. 6<sup>th</sup> edition.
5. Kumar, H.D. (1999). Introductory Phyology, affiliated East-West Press, Delhi.
6. Pelczar, M.J, (2001) Microbiology, 5<sup>th</sup> edition, Tata McGraw-hill co, New Delhi.
7. Sharma,P.D.(2014) Microbiology. Rastogi Publication, Meerut

**Core Courses II : Biomolecules and cell**  
**(Credits : Theory-4, Practical-2)**

**THEORY**

**Lectures: 60**

**Full Marks: 60**

**Time:3hrs**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**BIOMOLECULES**

**(22 lectures)**

**Unit 1: Carbohydrates:** Nomenclature and classification, Role of monosaccharides, disaccharides, oligosaccharides and polysaccharides.

**Unit 2: Proteins :**Structures of amino acids; Protein structure – primary, secondary, tertiary and quaternary; biological roles of proteins.

**Unit 3:Nucleic acids:** Structure of nitrogenous bases; Structure and function of nucleotide; types of nucleic acids; structure of B-DNA, Compare with Z- DNA; Types of RNA; structure of tRNA.

**UNIT 4: ENZYMES**

**(6 lectures)**

Definition, History of its discovery, Structure of enzyme: holoenzyme, apoenzyme. Prosthetic group, Cofactors, mechanism of enzyme action. Factors affecting enzyme activity.

**UNIT 5: THE CELL**

**(4 lectures)**

Ultra structure of prokaryotic and eukaryotic cell.

**CELL WALL, PLASMA MEMBRANE & NUCLEUS**

**(8 lectures)**

Chemistry, Structure and Function of plant cell wall, Plasma Membrane and Nucleus.

**CELL ORGANELLES**

**(12 lectures)**

Chloroplast, Mitochondria, Peroxisome, Endoplasmic reticulum, Golgi Apparatus, Lysosomes and Ribosomes: Structure & Functions.

### **UNIT 5: CELL DIVISION**

**(8 lectures)**

Mitosis, Meiosis and cancer.

#### **Suggested Readings**

1. Camphell, MK (2012) Biochemistry, 7<sup>th</sup> ed., published by Cengage Learning.
2. Camphell, PN and Smith AD (2011) Biochemistry illustrated, 4<sup>th</sup> ed., Published by Churchill Livingstone.
3. Tymoezko JL, Berg JM and Stryer L (2012) Biochemistry; A short course, 2<sup>nd</sup> ed. W.H.Freeman.
4. Berg JM, Tymoezko JL, and Stryer L (2011) Biochemistry, W.H.Freeman and Company.
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5<sup>th</sup> ed. W.H. Freeman and Company.
6. Karp, G.(2010), Cell Biology, John Wiley & Sons, U.S.A. 6<sup>th</sup> edition.
7. Hardin, J., Becker, G., Skliensmith, L.J, (2012), Becker's World of the Cell, Pearson Education Inc. U.S.A. 8<sup>th</sup> edition.
8. Cooper, G.M, and Hausman, R.E. 2009 The Cell: A Molecular Approach, 5<sup>th</sup> edition, ASM Press & Sunderland, Washington, D.C, Sinauer Associates, MA.
9. Becker, W.M, Kleinsmith, L.J., Hardin, J. and Bertoni, G.P. 2009 The World of the cell, 7<sup>th</sup> edition, Pearson Benjamin Cummings Publishing, San Francisco.

### **PRACTICAL**

**F.M. – 40**

#### **Microbiology**

1. Structure of Bacteriophage and TMV by photographs.
2. Forms of Bacteria by slides/photographs.
3. Gram staining technique.

#### **Phycology**

4. Study of vegetative and reproductive structures of *Nostoc*, *Volvox*, *Oedogonium*, *Chara*, *Vaucheria*, *Ectocarpus* and *Batrachospermum* by preparing temporary slides and also by permanent slides.
5. Qualitative tests for carbohydrates and proteins.
6. Study of different stages of mitosis and meiosis by preparing temporary slides & also by permanent slides.



**SEMESTER – II**  
**CORE COURSE III: Mycology and Phytopathology**  
**(Credits : Theory-4, Practical -2)**  
**THEORY**

**Lectures: 60**

**Full marks: 60**

**Time:03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1: INTRODUCTION TO TRUE FUNGI (6 lectures)**

Definition, General characteristics and Classification by Ainsworth.

**UNIT 2: MASTIGOMYCOTINA (4 lectures)**

General account and Life cycle of *Synchytrium* and *Phytophthora*.

**UNIT 3: ZYGOMYCOTINA (2 lectures)**

General characteristics and Life Cycle of *Albugo*

**UNIT 4: ASCOMYCOTINA (10 lectures)**

General characteristics and life cycle of *Peziza*.

**UNIT 5: BASIDIOMYCOTINA (8 lectures)**

General characteristics and life cycle of *Puccinia*.

**UNIT 6: ALLIED GROUP (2 lectures)**

General characteristics of Slime molds.

**UNIT 7: DEUTEROMYCOTINA (4 lectures)**

General characteristics and Life cycle of *Alternaria* and *Cercospora*.

**UNIT 8: SYMBIOTIC ASSOCIATIONS (4 lectures)**

Lichen – Occurrence; General characteristics; and types and Economic Importance.

**UNIT 9: APPLIED MYCOLOGY (10 lectures)**

Application of fungi in food industry (Fermentation, Organic acids, enzymes, antibiotics); IPM and Biopesticides.

**UNIT 10: PHYTOPATHOLOGY (10 lectures)**

General symptoms; etiology and control of following diseases-

1. Citrus canker
2. Loose smut of wheat
3. Red rot of sugarcane
4. Early blight of potato
5. White rust of crucifer

**Suggested Reading**

1. Agrios, G.N. 1997 Plant Pathology, 4<sup>th</sup> edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W, Blackwell, M.(1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore, 4<sup>th</sup> edition.
3. Webster, J. and Weber, R.(2007), Introduction to Fungi, Cambridge University Press, Cambridge, 3<sup>rd</sup> edition.
4. Sethi, I.K. and Walia, S.K.(2011). Textbook of Fungi and their Allies, Macmillan Publishers India Ltd.
5. Sharma, P.D, (2011), Plant Pathology, Rastogi Publication, Meerut, India.

**CORE COURSE IV :Archegoniate**  
**(Credits : Theory-4, Practical -2)**

**THEORY**

**Lectures: 60**

**Full marks: 60**

**Time: 03Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1: BRYOPHYTES**

**(20 lectures)**

General characteristics and life cycle of

1. *Marchantia*
2. *Anthoceros*
3. *Sphagnum*
4. Evolution of Gametophyte and Sporophyte in Bryophytes.
5. Economic importance of bryophytes.

**UNIT 2: PTERIDOPHYTA**

**(20 lectures)**

- A) General characteristics of Pteridophytes
- B) Classification, Morphology, Anatomy and Reproduction(developmental stages not included) of
  1. *Rhynia*
  2. *Lycopodium*
  3. *Selaginella*
  4. *Equisetum*
- C) Apogamy and Apospory
- D) Heterospory and Seed habit
- E) Stelar evolution.

### UNIT 3: GYMNOSPERMS

(20 lectures)

General characteristics of gymnosperms

Morphology, Anatomy and Reproduction (Developmental details not to be included) of

1. *Pinus* and
2. *Gnetum*

#### **Suggested Reading**

1. Vashistha, P.C., Sinha, A.K.Kumar, A.(2010), Pteridophyta. S.Chand, Delhi, India.
2. Bhatnagar, S.P. & Moitra, A.(1996), Gymnosperms, New Age International (P) Ltd Publishers, New Delhi, India.
3. Parihar, N.S, (1991), An introduction to Embryophyta : Vol. 1. Bryophyta, Cental Book Deposit, Allahabad.
4. Raven, P.H., Johnson, G.B.Losos, J.B., Singer, S.R. (2005), Biology, Tata McGraw Hill, Delhi.
5. Vander – poorteri 2009 Introduction to Bryophyta, COP.
6. Prasad, C. (2013) An Introduction to Pteridophyta, Emkay Publication, New Delhi, India.

#### **Practical**

**F.M. 40marks**

1. Study of All genus of fungi, Bryophyta, Pteridophytes and Gymnosperm (included in the syllabus) by preparing temporary slides and by permanent slides.
2. Study of different forms of lichen by photographs
3. Identification of disease (included in syllabus)

#### **EXAMINATION**

**F.M. 40marks**

**Time- 3hrs**

1. Preparation of temporary slides of any one genus (included in syllabus)-10
2. Disease identification (Any two disease included in syllabus)
  - a. Name of disease
  - b. Name of host
  - c. Name of agent
3. Spotting –
4. Viva
5. Class records, collection & models

2x 2<sup>1/2</sup> - 05

5x2 -10

- 07

- 08



**SEMESTER - III**  
**Core Course V : Anatomy of Angiosperms**  
**(Credits : Theory-4, Practical -2)**

**THEORY**

**Lectures: 60**

**Full marks: 60**

**Time:03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**INTRODUCTION AND SCOPE OF PLANT ANATOMY**

**(2 lectures)**

**UNIT 1: TISSUES**

**(14 lectures)**

Classification of tissues: Simple and complex tissues and secretory time.

**UNIT 2: STEM**

**(8 lectures)**

Types of vascular bundles: Structure of dicot and monocot stem.

**UNIT 3: LEAF**

**(6 lectures)**

Structure of dicot and monocot leaf.

**UNIT 4: ROOT**

**(8 lectures)**

Structure of dicot and monocot root.

**UNIT 5: VASCULAR CAMBIUM**

**(10 lectures)**

Structure, function and seasonal activity of cambium, Anomalous secondary growth in *Boerhaavia* and *Dracaena*.

**UNIT 6: PERIDERM**

**(4 lectures)**

Development and composition of periderm, Lenticels and rhytidome.

Sapwood, Heartwood, early & late wood, tyloses.

**UNIT 7: ADAPTIVE AND PROTECTIVE SYSTEMS**

**(6 lectures)**

Epidermal tissue system, cuticle, stomata, trichomes, Anatomical adaptation of xerophytes & hydrophytes.

### **Suggested Readings**

1. Dickison, W.C.(2000). Integrative plant Anatomy. Harcourt Academic Press, USA.
2. Fahn. A.(1974), Plant Anatomy, Pergmon Press. USA
3. Mauseth, J.D.(1998), Plant Anatomy. The Berjammin/ Cummings Publisers, USA.
4. Esau. K.(1977). Anatomy of seed plants. John Wiley & Sons. Inc., Delhi.

## **Core Course VI :ECONOMIC BOTANY** **(Credits : Theory-4, Practical -2)**

### **THEORY**

**Lectures: 60**

**Full marks: 60**

**Time: 03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1: CEREALS**

**(6 lectures)**

Wheat & Rice.

**Unit 2: LEGUMES**

**(6 lectures)**

Arhar, Pea, Gram & Moong

**UNIT 3: SPICES**

**(8 lectures)**

Fennel, saffron, clove, black pepper.

**UNIT 4: BEVERAGES**

**(6 lectures)**

Tea

**UNIT 5: OIL AND FATS**

**(8 lectures)**

Groundnut, Linseed and Brassica and coconut.

**UNIT 6: DRUGS-YIELDING PLANTS(6 lectures)**

*Rauvolfia, Azadiracta, Ocimum, Papaver, Emblica, Aloe*

**UNIT 7: PLANT DRUG ABUSE**

**(6 lectures)**

*Opoids, & cocaine.*

**UNIT 8: TIMBER PLANTS**

**(6 lectures)**

Teak, Shisham& Sal.

**UNIT 9: FIBRES**

**(6 lectures)**

Cotton & Jute.

**UNIT 10: SUGAR YIELDING PLANTS**

**(2 lectures)**

Sugarcane.

**Suggested Readings**

1. Kochhar, S.L., (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, GE. (2001), Economic Botany: Principles & Practices, Kluwer Academic Publishers, The Netherlands.
3. Chrispeels. M.J. and Sadava. D.E. (2003). Plants, Genes and Agriculture, Jones & Bartlett. Publishers.

**Core Course VII :GENETICS**  
**(Credits : Theory-4, Practical -2)**

**THEORY**  
**Lectures: 60**

**Full marks: 60**

**Time: 03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1: MENDELIAN GENETICS & ITS EXTENSION (18 lectures)**

Mendel's laws of inheritance, Incomplete dominance and co-dominance, Epistasis, Complementary and Duplicate genes.

**UNIT 2: EXTRACHROMOSOMAL INHERITANCE (8 lectures)**

Cytoplasmic inheritance: Variation in four O'clock plant & infective heredity-Kappa particles in *Paramecium*.

**UNIT 3: LINKAGE AND CROSSING OVER (12 lectures)**

Mechanism and significance of Linkage and crossing over

**UNIT 4: VARIATION IN CHROMOSOME NUMBER & STRUCTURE**

**(8 lectures)**

Deletion, Duplication, Inversion, Translocation, Euploidy, Aneuploidy, origin of *Rhapho-brassica* & *Triticale*.

**UNIT 5: GENE MUTATIONS**

**(8 lectures)**

Types of mutations, Molecular basis of mutations, Mutagens– Physical and chemical, Role of mutation in crop improvement.

**Suggested Readings**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics. John Wiley & sons. India 8<sup>th</sup> edition.
2. Snustad, D.P. and Simmons, M.J. (2010) Principles of Genetics, John Wiley & Sons, Inc., India. 5<sup>th</sup> edition.
3. Klug, W.S., Cummings, M.R., Speneer. C.A. (2012). Concepts of Genetics. Benjamin Cummings, USA. 10<sup>th</sup> edition.
4. Griffiths, A.J.F, Wessler, S.R., Carroll, S.B., Doebley. I. (2010). Introduction to Genetic Analysis. W.H. Freeman and Co., U.S.A., 10<sup>th</sup> edition.

## **PRACTICAL**

**F.M. 40**

1. Study of anatomical details of root, stems and leaf by preparing temporary slide and also by permanent slide or by photographs.
2. Study of anomalous structure of *Boerhaavia* stem and *Dracaena* stem by preparing temporary slide and by permanent slide or by photographs.
3. Study of parenchyma, collenchymes, sclerenchyma and different components of Xylem and Phloem by photographs.
4. Adaptive anatomy- xerophytes and hydrophytes by preparing temporary slides.
5. Testing good fit or not by chi-square method.

## **PRATICAL EXAMINATION**

**F.M. 40**

1. Prepare a temporary slide of *Boerhaavia* stem/ *Dracaena* stem -10
2. Identification of 5 plants of economic botany. ( only botanical name and Family Name) -10
3. Spotting                      2x4                      - 08
4. Viva-voice                      - 06
5. Record, collection & Models                      - 06

**SKILL ENHANCING COURSE SEMESTER III**  
**PLANTS AND HUMAN WELFARE**

**FM- 60**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1:** Utility of Plants in relation to human beings, General introduction & its objectives.

**UNIT 2:** Common name, scientific name, methods of Cultivation and Production and uses of the following-

Cereals – Rice, Wheat, Maize

Pulses- Arhar, Moong, Lentil, Gram.

**UNIT 3:** Common name, scientific name, cultivation, along with the role of climatic factors and uses of the following-

Fibres- Cotton , Jute

Wood- Sal, Teak, Shisam

**UNIT 4:** Common name, scientific name, cultivation and uses of following-

Spices- Clove, Black pepper, Saffron, Coriander.

Medicinal plants- Neem, Amla, Tulsi, Turmeric, Garlic.

**SEMESTER - IV**  
**Core Course VIII : Molecular Biology**  
**(Credits : Theory-4, Practical -2)**

**THEORY**  
**Lectures: 60**

**Full marks: 60**

**Time:03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1: Nucleic Acids** **(2 lectures)**

Historical perspective: DNA as the carrier of genetic information (Griffith's Hershey & Chase)

**UNIT 2: Structure of DNA and RNA** **(14 lectures)**

DNA structure, Watson and Crick Model of DNA, Types of DNA, Organization of DNA of prokaryotes, RNA structure, nucleosome model, Chromatin structure – Euchromatine, heterochromatine – Constitutive & Facultative heterochromatic. Polytene and Lampbrush chromosome.

**UNIT 3: Replication of DNA** **(8 lectures)**

Mechanism of DNA replication, Enzymes involved in DNA replication

**UNIT 4: Central Dogma and Genetic Code** **(6 lectures)**

General account of Central dogma and genetic code.

**UNIT 5: Mechanism of Transcription** **(8 lectures)**

Transcription in prokaryotes and transcription in Eukaryotes.

**UNIT 6: Translation** **(10 lectures)**

Process of translation in Prokaryotes & Eukaryotes, Proteins involved in translation, Inhibitors of protein synthesis.



**UNIT 7: Regulation of Gene expression (4 lectures)**

Regulation of gene expression in Prokaryotes, Operon – inducible system – Lac operon, Repressible system, Tryptophan operon.

**Core Course IX :Plant Ecology and Phytogeography**  
**(Credits : Theory-4, Practical -2)**

**THEORY**

**Lectures: 60**

**Full marks: 60**

**Time: 03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1: Introduction**

**(6 lectures)**

Basic concept, levels of organization, Inter-relationship between the world and the environment.

**Unit 2: Soil**

**(6 lectures)**

Importance, origin, formation, composition; Physical and Chemical and biological components, Soil profile.

**UNIT 3: Water**

**(8 lectures)**

Importance, States of water in Environment, Atmospheric moisture, Precipitation types (rain, fog, snow, hail, des), Hydrological cycle.

**UNIT 4: Plant Communities**

**(6 lectures)**

Analytic and synthetic characters, Species diversity, index, Miche, Mechanism of successin – Hydrosere & Xerosere,

**UNIT 5: Ecosystem**

**(8 lectures)**

Basic concept, component of ecosystem, types of ecosystem, Grass land and Pond ecosystem, Food wave, Food chain and Ecological pyramid.

**UNIT 6: Functional aspect of Ecosystem**

Air pollution, Water pollution, noise pollution – Cause, effect & control, green house effect.

**Core Course X :Systematics**  
**(Credits : Theory-4, Practical -2)**

**THEORY**

**Lectures: 60**

**Full marks: 60**

**Time: 03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1: Taxonomic Aids**

**(18 lectures)**

Herbarium and botanical gardens, E-flora, Documentation, Flor monographs, journals, Single access & multi-access.

**UNIT 2: Taxonomic Hierarchy**

**(8 lectures)**

Concept of species, Genes and family

**UNIT 3: Botanical nomenclature**

**(12 lectures)**

Principles of International code of botanical nomenclature. Typification, anther citation, valid publication.

**UNIT 4: System of classification**

**(8 lectures)**

Bentham and Hooker's system of classification, Hutchinson's system of classification.

**UNIT 5: Study of following families**

**(8 lectures)**

1. Ranunculaceae
2. Solanaceae
3. Apocyanaceae
4. Lamiaceae
5. Poaceae
6. verberaceae

**PRACTICAL****F.M.- 40**

6. Watson and Crick model of DNA, nucleosome model, polytene and Lambrush chromosome by photographs
7. Study of DNA replication mechanism by photographs
8. Photographs establishing nucleic acid as a genetic material.
9. Study of pond-ecosystem, grass land ecosystem, Food wave, Food chain by photographs.
10. Studies of families included in the syllabus
11. Study of water; air and noise pollution by photographs.

**PRATICAL EXAMINATION****F.M. 40**

- |   |    |
|---|----|
| 6. Describe the floral characters of any one family with including floral formula & floral diagram. | 10 |
| 7. Describe the Watson & Crick model of DNA by photographs.   | 08 |
| 8. Spotting (5 X 2 )  | 10 |
| 9. Viva voce  | 06 |
| 10. Class record, collection, model   | 06 |

**Semester: - IV (Skill Enhancement Course)**

**Nursery Technique F.M.- 60**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1:** (6 lectures)  
Nursery – Definition, objectives and scope.

**Unit 2:** (6 lectures)  
Cultivation of ornamental plants like cycas, palm, Aloe vera, Croton & Rhoco.

**UNIT 3:** (8 lectures)  
Cultivation of Flowers like Rose, Hibiscus, Marigold, nerium, Chrysanthemum, Dahlia, orchid.

**UNIT 4:** (6 lectures)  
Cultivation of vegetables like – Potato, onion, Bringal, Lady's finger, Carrot, Radish, Chilli. Storage and marketing procedures.

**UNIT 5:** (8 lectures)  
Preparation of flower beds – Through simple illustrations.

### **Suggested Readings**

5. Bose, T.K. and Mukharjee.D. 1972 – Gardening in India, Oxford and IBH publishing Co., New Delhi
6. Saudhu, m.K. 1989. Plant propagation, Wile Estern ltd. Bangalore.
7. Kumar, n. 1997 – Introduction to Horticulture, Ragalakshmi publication, Nagercoil.

Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi

## **SEMESTER- V**

### **Core Course XI: Reproductive Biology Of Angiosperms** **(Credits : Theory-4, Practical -2)**

#### **THEORY**

**Lectures: 60**

**Full Marks: 60**

**Time:03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

#### **UNIT 1: ANTHER**

**(4 lectures)**

Anther wall: structure and function, microsporogenesis.

#### **UNIT 2: POLLEN BIOLOGY**

**(8 lectures)**

Microgametogenesis & Palynology and scope (a brief account).

#### **UNIT 3: OVULE**

**(10 lectures)**

Structure, Types, Female gametophyte- megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of *Polygonum* type; organization and structure of mature embryo sac.

#### **UNIT 4: POLLINATION AND FERTILIZATION**

**(8 lectures)**

Pollination types and significance, path of pollen tube in pistil; double fertilization and triple fusion.

#### **UNIT 5: ENDOSPERM**

**(6 lectures)**

Types, development, structure and functions.

#### **UNIT 6: EMBRYO**

**(6 lectures)**

Development of dicot embryo and monocot embryo

#### **UNIT 7: SEED**

**(4 lectures)**

Structure, importance and dispersal mechanisms.

#### **UNIT 8: POLYEMBRYONY & APOMIXES**

**(6 lectures)**

Introduction, classification; causes & application.

### **Suggested Readings**

1. Bhojwani, S.S and Bhatnagar, S.P.(2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi 5<sup>th</sup> edition.
2. Shivanna, K.R. (2013). Pollen Biology and Biotechnology, Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
3. Raghavan, V.(2000). Development Biology of Flowering plants, Springer, Netherlands.
4. Johri, B.M. I(1984), Embryology of Angiosperms, Springer- Verlag, Netherlands.

### **Core Course XII: PLANT PHYSIOLOGY** **(Credits : Theory-4, Practical -2)**

#### **THEORY**

**Lectures: 60**

**Full Marks: 60**

**Time:03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

#### **UNIT 1: PLANT WATER RELATIONSHIP (14 lectures)**

Water Potential, water absorption by roots, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap-cohesion-tension theory. Transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement.

#### **UNIT 2: MINERAL NUTRITION (10 lectures)**

Essential and beneficial elements macro and micronutrients, methods criteria for essentiality, mineral deficiency symptoms, roles of essential elements, Hydroponics.

#### **UNIT 3: TRANSLOCATION IN THE PHLOEM (10 lectures)**

Mechanism of Translocation in phloem.

**UNIT 4: PLANT GROWTH REGULATORS****(16 lectures)**

Discovery, chemical nature (basic structure), roles of Auxin, Gibberellins, Cytokinins.

**UNIT 5: PHYSIOLOGY OF FLOWERING****(10 lectures)**

Photoperiodism, florigen concept, vernalization, seed dormancy.

**Suggested Readings**

1. Hopkins, W.G. and Huner, A.(2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4<sup>th</sup> edition.
2. Taiz, L., Zeiger, E., Møller, I.M and Murphy, A (2015). Plant Physiology and development. Sinauer Associates Inc. USA 6<sup>th</sup> edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual, Narosa Publishing House, New Delhi.

**PRATICAL****40 marks**

1. Embryo Dissection
2. Determination of water potential of given tissue (potato tuber) by weight method.
3. Calculation of stomatal frequency from the two surfaces of leaves of a mesophyte.
4. Study of structure of anthers, types of ovules, structure of a mature embryo sac by photographs.
5. To determine the rate of transpiration by Farmer's and Ganong's potometer.

**PRATICAL EXAMINATION****F.M.- 40****Time- 3 hrs**

1. To determine the rate of transpiration by Farmer's photometer/ Ganong's potometer.  
OR  
Embryo Dissection (of dicot embryo) -10
2. Draw a well labeled diagram of a typical mature embryo sac - 10
3. Spotting ( 2x5 ) -10
4. Class records, charts, models. - 08
5. Viva-voice -07



## **DISCIPLINE SPECIFIC ELECTIVE (DSE)**

### **PAPER- BIOFERTILIZER**

#### **Full Marks:60**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

#### **UNIT 1: GENERAL ACCOUNT ABOUT THE MICROBES AS BIOFERTILIZER:-**

- a. Rhizobium- Isolation, Identification, mass multiplication
- b. Azotobacter: Isolation, Identification, and mass multiplication

**UNIT 2:** Cyanobacteria ( blue green algae), Azolla and Anabaena association, Nitrogen fixation, Factors affecting growth.

**UNIT 3:** Mycorrhizal association – a brief account, colonization of VAM, its influence on crop plants.Mycorrhiza as biofertilizer.

**UNIT 4:** Organic farming: Green manuring and Organic fertilizers, Recycling of biodegradable, municipal ,agricultural and industrial wastes,Biocomposting,Method of Vermicomposting – field application.

#### **Suggested Readings:-**

1. Dubey, R.C. – 2005, A text book of Biotechnology – S.Chand Co, New Delhi.
2. Kumaresan , V-2005, - Biotechnology, Saras publication, New delhi.
3. John Jothi Prakash, E. 2004, Outline of Plant –Biotechnology, New Delhi.
4. Sathe, T.V- 2004, Vermiculture and organic –Farming- Daya publication
5. Subha Rao, N.S. – 2000, Soil Microbiology – Oxford and IBH publishers, New Delhi.
6. Vayas, S.C. Vayas, S.Modi, H.A. 1998- Biofertilizer and Organic farming- Akta Prakashan- Nadiad.

## Natural Resource Management

### **FULL MARKS:60**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1:** Natural resources, Definition, types. Sustainable utilization- Concept, approaches, (Economical, Socio- cultural, Ecological).

**UNIT 2:** Land- Soil degradation and management- Water- Fresh water estuaries, wet lands, threats, and management strategies.

**UNIT 3:** a. Biological Resource - Biodiversity- Definition and types, Significance, threat and management.

c. Forest- Definition, Importance and management.

**UNIT 4:** Energy- Renewable and Non renewable sources.

**UNIT 5:** National and International efforts in resource management.

### **PRACTICALS (DSE- I & II)      F.M.- 40**

1. Isolation technique of Rhizobium & Azotobacter
2. Cyanobacteria- study with the help of Photographs.
3. Methods of Organic farming through illustrations (Project work)
4. Identification of Plants included in syllabus with reference to scientific name and preparation of flower bud.

### **EXAMINATION – FULL MARKS- 40**

- |   |          |
|---|----------|
| 1. Isolation technique of <i>Rhizobium/ Azotobacter</i> -           | 10       |
| 2. Study of Cyanobacteria ( with Photographs) –                     | 05       |
| 3. Spotting- 5 specimens for identification- with scientific names. | 5X2= 10. |
| 4. Viva- Voice  | 07       |
| 5. Records/ projects  | 08       |

## **SEMESTER- VI**

### **Core Course XIII: PLANT METABOLISM**

**(Credits : Theory-4, Practical -2)**

#### **THEORY**

**Lectures: 60**

**Full Marks: 60**

**Time:03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

#### **UNIT 1: CONCEPTS OF METABOLISM**

**(6 lectures)**

Introduction, anabolic, catabolic and amphibolic pathway.

#### **UNIT 2: CARBON ASSIMILATION**

**(14 lectures)**

Historical background, photochemical reactions, photosynthetic electron transport, PSI, PSII, CO<sub>2</sub> reduction, red drop Emerson effect, Quantum Yield, C<sub>3</sub>, C<sub>4</sub> Cycle, photorespiration, photophosphorylation.

#### **UNIT 3: CARBON OXIDATION**

**(10 lectures)**

Glycolysis, oxidative decarboxylation of pyruvate, TCA Cycle, anaerobic reactions, mitochondrial electron transport.

#### **UNIT 4: ATP- SYNTHESIS**

**(8 lectures)**

Mechanism of ATP synthesis, substrate level phosphorylation, (oxidative and photophosphorylation).

#### **UNIT 5: LIPIDS METABOLISM**

**(8 lectures)**

Introduction, saturated & unsaturated fatty acid,  $\beta$ -oxidation.

#### **UNIT 6: NITROGEN METABOLISM**

**(8 lectures)**

Biological nitrogen fixation , Reductive amination& Transamination.

#### **Suggested Readings**

1. Hopkins, W.G. and Huner, A.(2008). Introduction to Plant Physiology. John Wiley and Sons.

2. Taiz, L., Zeiger, E., Møller, I.M and Murphy, A (2015). Plant Physiology and development. Sinauer Associates Inc. USA 6<sup>th</sup> edition.
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.

**Core Course XIV : Plant Biotechnology**  
**(Credits : Theory – 4, Practical -2)**

**THEORY**

**Lectures : 60**

**Full Marks : 60**

**Time : 03 Hrs.**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

1. **Plant Tissue Culture** (20 Lectures)  
History : Basic requirement of tissue culture, Technique, Prospect and application , Totipotency, Organogenesis, Embryogenesis, Protoplast Isolation ,micropropagation, Somatic hybridization, anther culture, pollen culture, Cryopreservation , Germplasm Conservation.
2. **Recombinant DNA Technology** ( 25 Lectures)  
Tools, Restriction endonucleases Eco-RI Bam H1, Sal-1, Plasmid, Cloning Vectors; Properties, (pBR-322, Cosmid, Lambda phage, Shuttle vector YEP), Ti- Plasmid, Process and application of r-DNA technology, genomic and c-DNA library, PCR technology, Blotting – Northern and southern, DNA – finger printing .
3. **Application of Bio- technology** (15 lectures)

Pest resistant (Bt-cotton), Transgenic crops with improved quality traits (*Flavr savr* tomato, Golden rice), Impact of transgenic crops on society.

### **Practical**

Full Marks : 40

Time : 03 Hrs.

1. Separation of Pigments by Chromatography method.
2. Experiment Showing O<sub>2</sub> is evolved during photo synthesis
3. Experiment Showing that light is essential for photo synthesis. -
4. Experiment Showing that light is essential for photo synthesis.
5. Study of anther, embryo, endosperm culture, micro propagation and somatic hybridization through photographs.
6. Photographs from biotechnology

### **Practical exam**

**F.M.- 40**

**Time- 3hrs**

1. Effect of CO<sub>2</sub> or light is essential for photo synthesis or O<sub>2</sub> is evolved during photo synthesis -10
2. Study of biotechnological experiments related to the syllabus through photographs -05
3. Spotting -2x5 -10
4. Viva voce -07
5. Practical record and Model -08

### **SUGGESTED READINGS**

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture : Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Gilick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology – Principles and Applications of recombinant DNA. ASM Press, Washington.
3. Bhojwani, S.S. and Bhatnagar, S.P. (2011)., The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi, 5<sup>th</sup> edition.

4. Snustad, D.P. and Simmons, M.J (2010). Principles of Genetics. John Wiley and Sons, U.K. 5<sup>TH</sup> edition.
5. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics : Principles, Techniques and Applications. John Willey & Sons Inc. U.S.A.

## **DISCIPLINE SPECIFIC ELECTIVE SEMESTER VI**

### **ENVIRONMENTAL EDUCATION & WASTE MANAGEMENT**

#### **FM- 60**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1:** Understanding Ecosystems, Population, Community, Components of Ecosystems.

**UNIT 2:** Destruction of Ecosystem due to changing pattern of land use, Migration, Transportation, Urbanization, Industrialization, Environmental Impact Assessment.

**UNIT 3:** Need for management of waste, safe disposal of waste.

**UNIT 4: a.** World Conservation strategy

b. Legal Provisions for waste management

c. Swacchh Bharat Abhiyaan- Your Suggestions.

**UNIT 4: a.** Global warming, Green house effects

b. Consequences of climate change

#### **SUGGESTED READINGS:-**

1. Ecology & Environment

Sharma , P.D.- Rastogi Publication- Meerut.

**DISCIPLINE SPECIFIC ELECTIVE (DSE)**  
**INDUSTRIAL ENVIRONMENTAL MICROBIOLOGY**

**FM- 60**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer four questions. Q. No. 1 will be compulsory, consisting of eight very short answer type questions, each of three marks, out of these short questions, examinee shall have to answer any five short questions.

**UNIT 1:** Biogas- Process & Importance- Need, Merit & scope

**UNIT 2:** Bioremediation, Role of microbes in waste management, Bioremediation of a) Hydrocarbons b) Industrial wastes c) Xenobiotics, Biomining, Bioreactors.

**UNIT 3:** Microbial flora of water- water pollution, sewage, algal bloom. BOD, COD, Eutrophication.

**UNIT 4: a)** Microbes in Agriculture Biological fixation, Mycorrhiza, Isolation of root nodule bacteria.

b) Microbial products of Industrial value- Organic acids, Alcohols, Antibiotics, Downstream processing & uses.

**UNIT 5:** Bioleaching – General account.

**SUGGESTED READINGS:-**

1. Pelzar. M.J. JR. Chen E.C.S. Krieg, N.R (2010) Microbiology- An application based approach, Tata MC Graw Hill Education pvt. Ltd. New Delhi
2. Tortora, G.J. Funke, B.R. Case, C.L. (2007), Microbiology, Pearson Benjamin Cummings, San Francisco, U.S.A. 9<sup>th</sup> edition
3. Dubey, R.C. – 2015, A. Text book of Biotechnology S. Chand & Co. Pvt. Ltd- New Delhi.

4. Ramawat, K.G. & Goyal, Shaily- 2015, Comprehensive Biotechnology- S.chand & Co. New Delhi.

**PRACTICAL – FM-40**

1. Study of Plant Community/ Vegetation of College Campus, by Quadrant method , Measurement of frequency and density.
2. Study of microbial flora of water samples.
3. Project on Waste management for clean, green Campus.
4. Principles and functioning of instrument in Microbiology Laboratory ( any two)
5. Sterilization technique & Preparation of culture media.

**EXAMINATION –**

**F. M.- 40**

**Time- 3 hrs**

- |  |    |
|--|----|
| 1. Study of Plant Community by Quadrat method- frequency & density | 15 |
| 2. Description of one Instrument of Microbiology- Laboratory.      | 05 |
| 3. Spotting – 2 photographs ( from syllabus)                       | 05 |
| 4. Viva voice  | 05 |
| 5. Records/ Project  | 10 |