## 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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**1. VIRUSES** **(8 lectures)**

Discovery, living & non-living characterization, general structure with special reference to bacteriophage multiplication of phage (Lytic and lysogenic cycle), TMV.

**2. BACTERIA** **(8 lectures)**

Discovery, general characteristics, mycoplasma,
cell structures and reproduction (vegetative, asexual and parasexual) Economic importance of bacteria.

**3. ALGAE** **(8 lectures)**

General characteristics; Classification proposed by Fritsch,1955, Economic importance of algae.

**4. CYANOPHYTA** **(5 lectures)**

General characteristics of Cyanobacteria, ultrastructure of Cyanophycean cell morphology and life cycle of *Nostoc, Spirulina* as SCP.

**5. CHLOROPHYTA** **(6 lectures)**

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

**6. CHAROPHYTA** **(2 lectures)**

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

**7. XANTHOPHYTA** **(3 lectures)**

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

**8. PHAEOPHYTA** **(6 lectures)**

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

**9. RHODOPHYTA** **(6 lectures)**

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

**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. 4th edition.
4. Prescott, L.M., Harley J.P., Klein D.A. (2005), Microbiology, McGraw Hill, India. 6th edition.
5. Kumar, H.D. (1999). Introductory Phyology, affiliated East-West Press, Delhi.
6. Pelczar, M.J, (2001) Microbiology, 5th 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** **Time: 3 hours**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**BIOMOLECULES**

**1. Carbohydrates:** Nomenclature and classification, Role of monosaccharides, disaccharides, oligosaccharides and polysaccharides. **(4 lectures)**

**2. Proteins :**Structures of amino acids; Protein structure – primary, secondary, tertiary and quaternary; biological roles of proteins. **(6 lectures)**

**3. Lipids**: Types and function. **(4 lectures)**

**4. 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. **(4 lectures)**

**5. ENZYMES** **(4 lectures)**

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

**5. THE CELL** **(4 lectures)**

Differences between prokaryotic and eukaryotic cell.

**6. CELL WALL, PLASMA MEMBRANE & NUCLEUS** **(8 lectures)**

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

**7. CELL ORGANELLES** **(12 lectures)**

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

8. **CELL DIVISION** **(8 lectures)**

Mitosis and Meiosis.

**Suggested Readings**


1. Campbell, MK (2012) Biochemistry, 7th ed., published by Cengage Learning.
2. Camphell, PN and Smith AD (2011) Biochemistry illustrated, 4th ed., Published by Churchill Livingstone.

3. Tymoezko JL, Berg JM and Stryer L (2012) Biochemistry; A short course, 2nd 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, 5th ed. W.H. Freeman and Company.
6. Karp, G.(2010), Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
7. Hardin, J., Becker, G., Skliensmith, L.J, (2012), Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
8. Cooper, G.M, and Hausman, R.E. 2009 The Cell: A Molecular Approach, 5th 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, 7th 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.

**Examination** **F.M.40** **Time- 3 hrs**

1. Preparation of temporary slides of any one algae included in the syllabus -10
2. Biochemical test of carbohydrates or protein - 5
3. Spotting 2x5 - 10
4. Viva -07
5. Class record & collection - 8

## 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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

1. Definition, General characteristics and Classification by Ainsworth (1973),

   Application of fungi in food industry (Fermentation, Organic acids, enzymes, antibiotics); IPM and Biopesticides. . **(10 lectures)**

2. **MASTIGOMYCOTINA** **(4 lectures)**

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

3. **ZYGOMYCOTINA** **(2 lectures)**

Generalcharacteristics and Life Cycle of *Mucor*

4. **ASCOMYCOTINA** **(10 lectures)**

General characteristics and life cycle of *Peziza*.

5. **BASIDIOMYCOTINA** **(8 lectures)**

General characteristics and life cycle of *Puccinia*.

6. **DEUTEROMYCOTINA** **(4 lectures)**

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

7. **SYMBIOTIC ASSOCIATIONS** **(4 lectures)**

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

8. **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. White rust of crucifer
5. Little leaf of Brinjal

**Suggested Reading**


1. Agrios, G.N. 1997 Plant Pathology, 4th edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W, Blackwell, M.(1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore, 4th edition.
3. Webster, J. and Weber, R.(2007), Intoduction to Fungi, Cambridge University Press, Cambridge, 3rd 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 :Archegoniatae
## (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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

### 1. BRYOPHYTES (20 lectures)

General characteristics and life cycle of

1. *Marchantia*
2. *Anthoceros*
3. *Sphagnum*
4. Evolution of Sporophyte in Bryophytes ( Progressive and Retrogressive)
5. Economic importance of bryophytes.

### 2. PTERIDOPHYTA (20 lectures)

A) General characteristics of Pteridophytes

B) 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 with reference to *Selaginella*

E) Stelar evolution.

### 3. GYMNOSPERMS (20 lectures)

General characteristics of gymnosperms

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

1. *Pinus*
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 MeGraw 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 $2x\ 2^{1/2}$ - 05
3. Spotting – 5x2 -10
4. Viva - 07
5. Class records, collection & models - 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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**1. INTRODUCTION AND SCOPE OF PLANT ANATOMY**

**TISSUES (08 lectures)** Classification of tissues: Simple and complex tissues and secretary tissues.

**STEM** **(10 lectures)**

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

**LEAF** **(6 lectures)**

Structure of dicot and monocot leaf.

**ROOT** **(8 lectures)**

Structure of dicot and monocot root.

**VASCULAR CAMBIUM** **(12 lectures)**

Normal secondary growth in Dicot stem, Anomalous secondary growth in *Boerhaavia* and *Dracaena*.

**PERIDERM** **(4 lectures)**

Development and composition of periderm, Lenticels and rhytidome. Sapwood, Heartwood, early & late wood, tyloses.

**ADAPTIVE AND PROTECTIVE SYSTEMS** **(8 lectures)**

Mechanical tissues- types and distribution, 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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**1. CEREALS** **(6 lectures)**
Wheat & Rice.

**2. LEGUMES** **(6 lectures)**
Arhar, Pea, Gram &Moong

**3. SPICES** **(8 lectures)**
Fennel, saffron, clove, black pepper.

**4. BEVERAGES** **(6 lectures)**
Tea,coffee

**5. OIL AND FATS** **(8 lectures)**
Groundnut, Linseed and Brassica and coconut.

6. **DRUGS-YIELDING PLANTS** **(6 lectures)**
*Rauvolfia, Azadirachta, Ocimum,* Brahmi*, Emblica, Aloe*

**7. PLANT DRUG ABUSE** **(6 lectures)**
*Opoids*, C*ocaine and Cannabinoid*

**8. TIMBER PLANTS** **(8 lectures)**
Teak, Shisham & Sal.

**9. FIBRES** **(4 lectures)**
Cotton & Jute.

**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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**MENDELIAN GENETICS & ITS EXTENSION (16 lectures)**

Mendel's laws of inheritance, Incomplete dominance and co-dominance, Epistatis, Complementary and Duplicate genes, multiple factor and brief idea of polygenic inheritance, pleiotropy.

**EXTRACHROMOSOMAL INHERITANCE (12 lectures)**

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

**LINKAGE AND CROSSING OVER (12 lectures)**

Mechanism and significance of Linkage and crossing over, Interference and co-incidence,sex linkage ( colour blindness, haemophilia)

**VARIATION IN CHROMOSOME NUMBER & STRUCTURE**
**(10 lectures)**

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

**GENE MUTATION (10 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 8th edition.
2. Snustad, D.P. and Simmons, M.J. (2010) Principles of Genetics, John Wiley & Sons, Inc., India. 5th edition.
3. Klug, W.S., Cummings, M.R., Speneer. C.A. (2012). Concepts of Genetics. Benjamin Cummings, USA. 10th 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., 10th edition.

**PRACTICAL** **40 MARKS**

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.

**PRACTICAL EXAMINATION** **F.M. 40**

1. Prepare a temporary slide of *Boerhaavia* stem/ *Dracaena* stem -08
2. Identification of 5 plants of economic botany. ( only botanical name and Family Name) -10
3. Spotting 2x5 - 10
4. Viva-voice - 06
5. Record, collection & Models - 06

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

**FM- 40** **Time- 3hrs**

**Instructions:-** All questions will be of MCQ type .Total questions 40. Total marks= 40 x 1 = 40 marks.

**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, Shisham

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

Spices- Clove, Black peeper, 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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**1. Nucleic Acids (6 lectures)** Historical perspective: DNA as the carrier of genetic information (Griffith's Hershey & Chase)

**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, heterochromatin – Constitutive & Facultative heterochromatic. Polytene and Lampbrush chromosome.

**3. Replication of DNA (8 lectures)**

Mechanism of DNA replication, Enzymes involved in DNA replication

**4. Central Dogma and Genetic Code (6 lectures)**

General account of Central dogma and genetic code.

**5. Mechanism of Transcription (8 lectures)**

Transcription in prokaryotes.

**6. Translation (10 lectures)**

Process of translation in Prokaryotes, Proteins involved in translation.

**7. Regulation of Gene expression (8 lectures)**

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

## Core Course IX :Plant Ecology
## (Credits : Theory-4, Practical -2)

### THEORY
### Lectures: 60

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

1. **Introduction** **(6 lectures)**

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

2. **Soil** **(6 lectures)**

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

3. **Biotic interaction** Positive and negative interactions.

4. **Plant Communities** **(6 lectures)**

Analytic and synthetic characters, Mechanism of succession – Hydrosere & Xerosere,

5. **Ecosystem** **(8 lectures)**

Basic concept, component of ecosystem, types of ecosystem, Grassland and Pond ecosystem, Food chain , Food web, and Ecological pyramid.

6. **Functional aspect of Ecosystem**

Energy flow and biogeochemical cycle- Phosphorus, carbon and nitrogen.

7. **Enviropnmental pollution**

Air pollution, Water pollution, noise pollution – Cause, effect & control, green house effect, biomagnifications, eutrophication, ozone hole, ozone depletion.

8. **Phytogeography**- Vegetation of India with special reference to Jharkhand.

## 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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**1. Taxonomic Aids (10 lectures)**

Herbarium and botanical gardens, E-flora, Documentation, Floral monographs.

**2. Taxonomic Hierarchy (8 lectures)**

Concept of species, Genus and family

**3. Botanical nomenclature (12 lectures)**

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

**4. System of classification (12 lectures)**

Basic idea of Artificial, Natural & Phylogenetic system of classification, Bentham and Hooker's system of classification, Hutchinson's system of classification.

**5. Study of following families (18 lectures)**

1. Ranunculaceae
2. Fabaceae
3. Apocyanaceae
4. Lamiaceae
5. Asclepiadaceae
6. Cyperaceae
7. Verbenaceae
8. Euphorbiaceae
9. Poaceae

**PRACTICAL** **- 40 marks**

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.

**PRACTICAL 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)

## PAPER – BIOFERTILIZER

**Full Marks:40 (20 marks of MCQ and 20 marks Project)** **Time- 3hrs**

**Instructions:-** All questions will be of MCQ type .Total questions 20. Total marks= 20 x 1 = 20marks . TEN(10) marks will be on internal assessment.

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

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

**2** Cyanobacteria ( blue gren algae), Azolla and Anabaena association, Nitrogen fixation, Factors affecting growth, heterocyst.

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

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

**Note:-** Prepare model Q.5 –to be supplied to the setter as well as students.

**Suggested Readings:-**


1. Dubey, R.C. – 2005, Atext 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.

# 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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**1. ANTHER** **(4 lectures)**
Anther wall: structure and function, microsporogenesis.

**2. POLLEN BIOLOGY** **(6 lectures)**
Microgametogenesis & Palynology and scope (a brief account).

**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.

**4. POLLINATION AND FERTILIZATION** **(8 lectures)**
Pollination types and significance, path of pollen tube in pistil; double fertilization and triple fusion.

**5. ENDOSPERM (8 lectures)** Types, development, structure, morphological nature and functions.

**6.EMBRYO** **(8 lectures)**
Development of dicot embryo and monocot embryo

**7. SEED** **(8 lectures)**
Structure, importance and dispersal mechanisms.

**8.POLYEMBROYONY & APOMIXES (8 lectures)**

Introduction, classification; causes & application.

**Suggested Readings**


1. Bhojwani, S.S and Bhatnagar, S.P.(2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi 5th 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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

### 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, antitanspirants, mechanism of stomatal movement.

### 2. MINERAL NUTRITION (10 lectures)

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

### 3. TRANSLOCATION IN THE PHLOEM (10 lectures)

Mechanism of Translocation in phloem.

### 4. PLANT GROWTH REGULATORS (16 lectures)

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

### 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. 4th edition.
2. Taiz, L., Zeiger, E., Møller, I.M and Murphy, A (2015). Plant Physiology and development. Sinauer Associates Inc. USA 6th 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 – 08
3. Spotting( 2x5 ) -10
4. Class records, charts, models. – 06
5. Viva-voice -06

## DISCIPLINE SPECIFIC ELECTIVE (DSE)

## PAPER I- PLANT BREEDING

**Full Marks:60** **Time- 3 hrs**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**UNIT 1**: Introduction and objectives.

**Unit 2**:- Methods of Crop Improvement, Introduction, Selection,Hybridization.

**UNIT 3:-** Inbreeding,Inbreeding Depression,Heterosis.

**Unit 4:-** Role of Mutation,Polyploidy,Distant Hybridization,Role of Biotechnology in crop improvement.

**Suggested Readings:-**


1. Singh ,B.D (2005), Plant breeding; principles and Methods,Kalyani Publishers, 7th edition.

## PAPER-II - Natural Resource Management

**FM:60** **TIME- 3HRS**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**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.

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)** **40 MARKS**

1. Emasculation

2. Cyanobacteria- Study with the help of Photographs.

3. Artificial hybridization

4. Identification of Plants included in the syllabus with reference to scientific name and preparation of flower bud.

EXAMINATION – FULL MARKS- 40

| | |
|---|---|
| 1. Emasculation | 08 |
| 2. Aritificial Hybridization | 05 |
| 3. Study of Cyanobacteria ( with Photographs) – | 05 |
| 4. Spotting- 5 specimens for identification- with scientific names. | 5X2= 10. |
| 5. Viva- Voice | 06 |
| 6. Records/ projects | 06 |

# 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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**1. CONCEPTS OF METABOLISM (10 lectures)**

Introduction, anabolic, catabolic and amphibolic pathway.

**2.CARBON ASSIMILATION (14 lectures)**

Historical background, photochemical reactions, photosynthetic electron transport, PSI, PSII, red drop Emerson effect, Quantum Yield, $CO_2$ reduction, Photophosphorylation, $C_3$, $C_4$ Cycle, photorespiration.

**3. CARBON OXIDATION (12 lectures)**

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

**4.LIPIDS METABOLISM (12 lectures)**

Introduction, saturated & unsaturated fatty acid, β-oxidation of fatty acids/lipids.

**5. NITROGEN METABOLISM (12 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 6th 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 any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

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, Cyropreservation , 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 $O_2$ is evolved during photo synthesis
3. Experiment Showing that $CO_2$ is essential for photo synthesis. -
4. Experiment Showing that light is essential for photo synthesis.
5. Preparation of culture media
6. Study of anther, embryo, endosperm culture, micro propagation and somatic hybridization through photographs.
7. Photographs from biotechnology

**Practical exam F.M.- 40 Time- 3hrs**

1. Effect of $CO_2$ or light is essential for photo synthesis or $O_2$ 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 Netherlsands.
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, 5th edition.
4. Snustad, D.P. and Simmons, M.J (2010). Principles of Genetics. John Wiley and Sons, U.K. 5TH 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** **Time- 3hrs**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

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

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

**3.** Environmental impact assessment-

**4**. Sources, classification of waste

**5**.Impact of waste accumulation.

**6.** Need for management of waste.

**7.** Safe disposal of waste.

**8.** Legal provision of waste management.

**9.** Swacchh bharat Abhiyaan- Your suggestions

## SUGGESTED READINGS:-


1. Ecology & Environment
   Sharma , P.D.- Rastogi Publication- Meerut.

## DISCIPLINE SPECIFIC ELECTIVE (DSE)
## INDUSTRIAL MICROBIOLOGY

**FM- 60** **Time- 3hrs**

In all eight questions of equal value (15 marks each) will be set, out of which examinee shall have to answer any four questions. However, Q. No. 1 will be compulsory, consisting of ten multiple choice questions/ fill in the blanks type. Three questions will be short answer type, having six questions each of five marks, out of which the candidate has to answer any three. Rest four questions will be of long answer type.

**1.** Biogas- Process & Importance- Need, Merit & scope

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

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

**4.** Microbes in Agriculture Biological fixation, Mycorrhizae, Isolation of root nodule bacteria.

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

## 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. 9th 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. N ew Delhi.

**PRACTICAL – FM-40**

1. Study of Plant Community/ Vegetation of College Campus by Quadrate 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 |