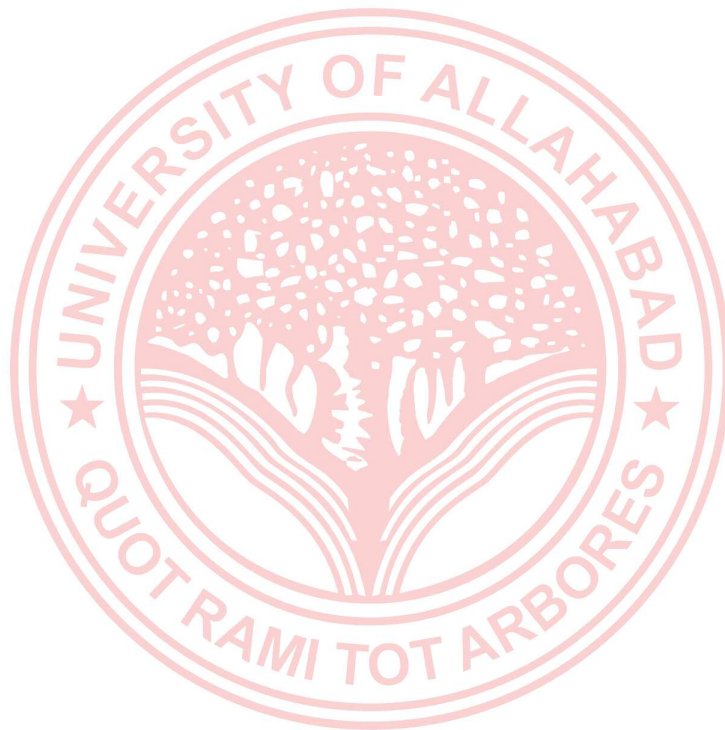


---

# SYLLABUS BOTANY

B.SC. (THREE-YEAR DEGREE COURSE)



DEPARTMENT OF BOTANY  
UNIVERSITY OF ALLAHABAD

---

## About the Department

The Department of Botany was established in **1923**, making it one of the oldest departments of the University. The department has produced notable scholars and administrators known to hold prestigious positions around the world. It is recognized for its academic and research excellence, evidenced by programs like the Special Assistance Programme (**SAP 1976**), COSIST Support Programme (**1990**), and **FIST (2016)**. The department offers a **graduate course in Botany** and **postgraduate courses in Botany and Agricultural Botany**. It currently boasts expertise in research and teaching across multiple areas, including:

- Systematics
- Molecular Biology
- Microbiology
- Virology
- Mycology
- Ecology
- Ethnobotany
- Developmental Biology
- Physiology
- Bioremediation
- Forestry
- Computational Biology
- Biotechnology

This expertise is attributed to the **21 permanent faculties**. Four of the faculty members are counted among the **top 2% of highly cited researchers** in the world, demonstrating successful national and international collaborations, as evidenced by their highly cited research publications and patent profiles.

### Major Focus and Goals

A major focus is to enhance teaching quality by exposing students (undergraduate, graduate, and PhD) to modern biological concepts and techniques, preparing them for global expectations. Concurrently, the department strives to find **sustainable solutions using plants** to address:

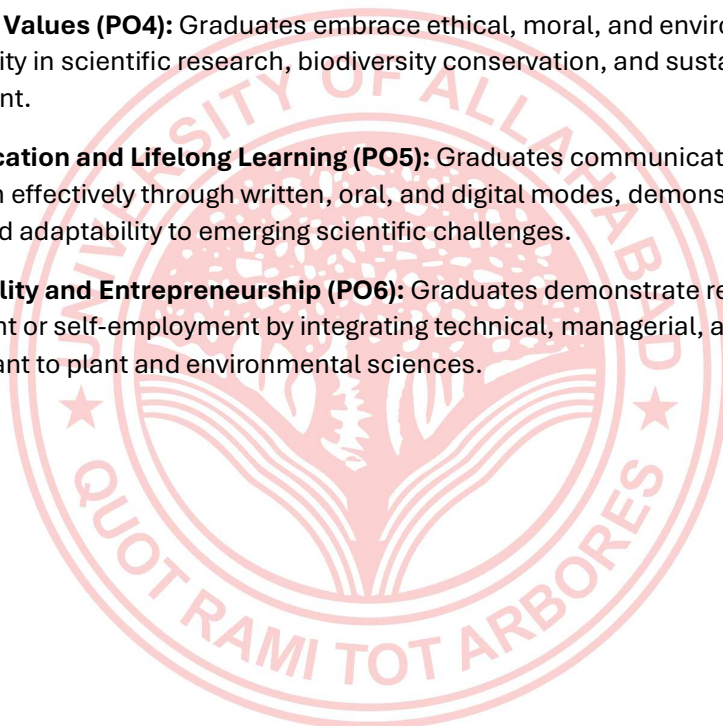
- Higher demands for food
- Efficient land use and freshwater sources
- Remedial efforts to ameliorate the effects of urbanization and industrialization

The department focuses on **combating the adverse effects of climate change, industrialization, and urbanization** on agriculture and public health, aligning with **SDG Goals 2030**.

## Program Outcomes (POs)

The Program Outcomes outline the knowledge, skills, and values graduates are expected to achieve:

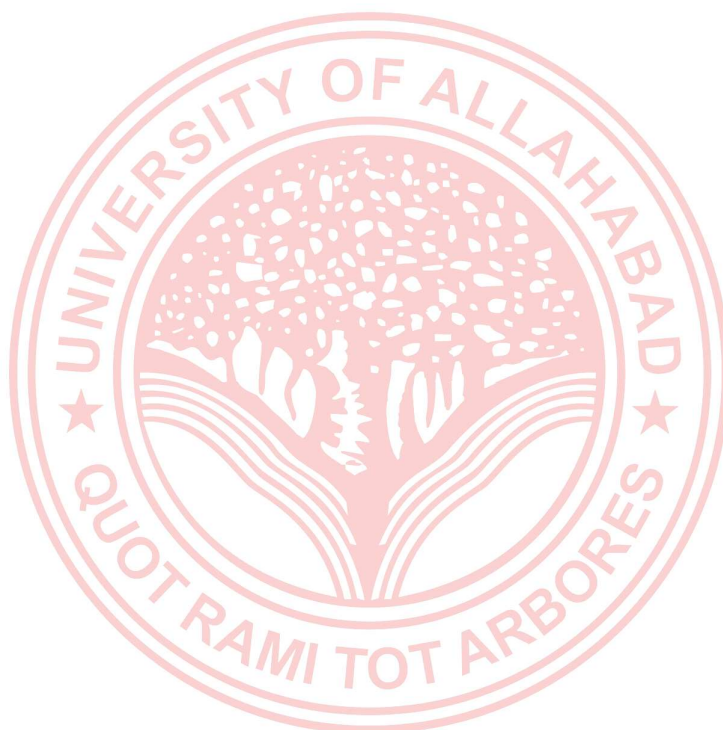
- **Knowledge and Understanding (PO1):** Graduates demonstrate comprehensive knowledge of plant sciences and related disciplines, integrating fundamental and specialized principles across biology, ecology, genetics, and biotechnology.
- **Skills and Application (PO2):** Graduates apply theoretical and practical knowledge to identify, analyze, and solve biological and environmental problems using appropriate laboratory and field methods.
- **Research and Analytical Thinking (PO3):** Graduates employ cognitive, analytical, and technical skills to evaluate evidence, analyze biological data, and generate innovative solutions.
- **Ethics and Values (PO4):** Graduates embrace ethical, moral, and environmental responsibility in scientific research, biodiversity conservation, and sustainable development.
- **Communication and Lifelong Learning (PO5):** Graduates communicate scientific information effectively through written, oral, and digital modes, demonstrating self-directed learning and adaptability to emerging scientific challenges.
- **Employability and Entrepreneurship (PO6):** Graduates demonstrate readiness for employment or self-employment by integrating technical, managerial, and entrepreneurial skills relevant to plant and environmental sciences.



## Program Specific Outcomes (PSOs)

The Program Specific Outcomes are skills and knowledge particular to the Botany B.Sc. program:

- **PSO1:** Explain structure, function, classification, and evolution of plants from algae to angiosperms.
- **PSO2:** Apply experimental and observational methods to study plant physiology, genetics, and ecology.
- **PSO3:** Analyze the role of plants in human welfare, agriculture, and environmental sustainability.
- **PSO4:** Employ modern laboratory and field techniques including microscopy, chromatography, and tissue culture.
- **PSO5:** Demonstrate teamwork, responsibility, and scientific integrity during practical and fieldwork.



# B.Sc. Part I Courses

## Paper I: Fungi, Lichens, Bacteria & Viruses

### Course Details

- **Course Title:** Fungi, Lichens, Bacteria & Viruses
- **Theory Marks:** 34 Marks

### Course Objectives

To introduce students to the **morphology, classification, and life cycles of fungi, lichens, bacteria, and viruses**, emphasizing their ecological and economic importance.

### Course Outcomes (COs)

- **CO1:** Explain morphology, reproduction, and classification of fungi.
- **CO2:** Describe structure and importance of bacteria, viruses, and lichens.
- **CO3:** Evaluate ecological and economic roles of microorganisms.

### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (CO) | PO1  | PO2 | PO3  | PO4  | PO5 | PO6  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---------------------|------|-----|------|------|-----|------|------|------|------|------|------|
| CO1                 | 3    | 2   | 2    | 1    | 1   | 1    | 3    | 1    | 2    | 3    | 1    |
| CO2                 | 3    | 2   | 2    | 1    | 1   | 1    | 2    | 2    | 3    | 2    | 2    |
| CO3                 | 2    | 2   | 3    | 2    | 1   | 2    | 3    | 2    | 3    | 2    | 2    |
| Average             | 2.67 | 2   | 2.33 | 1.33 | 1   | 1.33 | 2.67 | 1.67 | 2.67 | 2.33 | 1.67 |

### Course Content (Units)

#### UNIT - I: Fungi

A general introduction to fungi, including **structure, reproduction, importance, and classification**.  
The life histories of the following genera:

- **Lower Fungi:** *Albugo*, *Phytophthora*, *Mucor*
- **Higher Fungi:**
  - **Ascomycetes:** *Saccharomyces*, *Sphaerotheca*, *Peziza* (*Morchella* for practical only)
  - **Basidiomycetes:** *Ustilago*, *Puccinia*, *Agaricus*
  - **Fungi Imperfecti:** *Cercospora*, *Aspergillus*

#### UNIT - II: Lichens, Bacteria and Plant Viruses

- **Lichens:** Occurrence, general **structure and reproduction** with special reference to *Parmelia*. Economic Importance of Lichens in general.
- **Bacteria: Structure, reproduction, and economic importance.**
- **Viruses: Nature, structure, transmission, multiplication, and economic importance.**

## Suggested Readings

Recommended Indian Textbooks

Authors / Publishers

*Botany for Degree Students – Fungi*

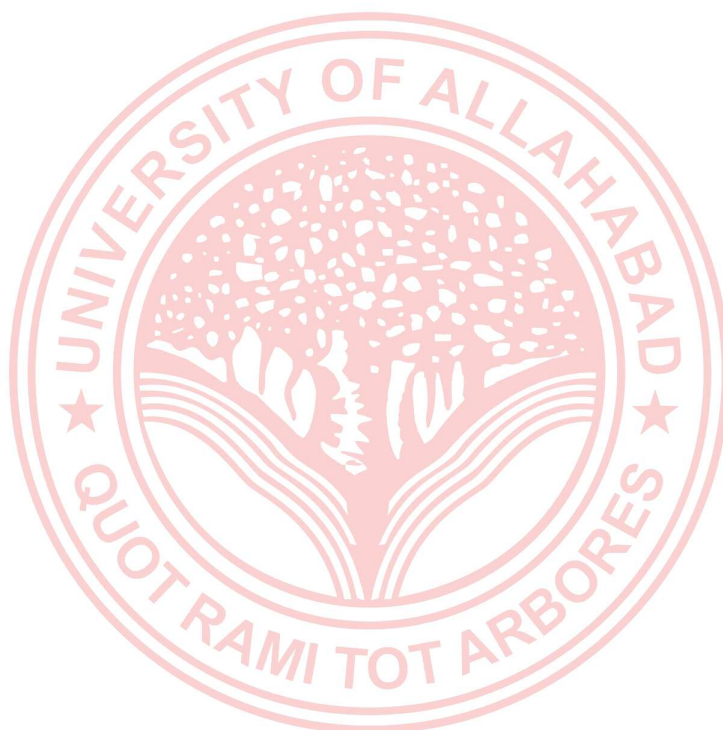
B.R. Vashishta, A.K. Sinha & Adarsh Kumar (S. Chand)

*A Textbook of Microbiology*

K.R. Aneja (New Age)

*Microbiology: Plant Pathogens & Fungal Biology*

C.K. Alexopoulos et al.



## Paper II: Algae and Bryophyta

### Course Details

- **Course Title:** Algae and Bryophyta
- **Theory Marks:** 33 Marks

### Course Objectives

To study the **diversity, structure, and reproduction of algae and bryophytes**, and understand their ecological and economic roles.

### Course Outcomes (COs)

- **CO1:** Classify algae and bryophytes with examples.
- **CO2:** Analyze life cycles and reproductive structures.
- **CO3:** Evaluate ecological and economic importance.

### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (CO) | PO1  | PO2 | PO3 | PO4  | PO5 | PO6  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---------------------|------|-----|-----|------|-----|------|------|------|------|------|------|
| CO1                 | 3    | 2   | 1   | 1    | 1   | 1    | 3    | 1    | 2    | 3    | 1    |
| CO2                 | 3    | 2   | 2   | 1    | 1   | 1    | 2    | 2    | 1    | 2    | 2    |
| CO3                 | 2    | 2   | 3   | 2    | 1   | 2    | 3    | 2    | 3    | 1    | 2    |
| Average             | 2.67 | 2   | 2   | 1.33 | 1   | 1.33 | 2.67 | 1.67 | 2    | 2    | 1.67 |

### Course Content (Units)

#### UNIT - I: Algae

A general Introduction to algae, including their **vegetative structure, reproduction, ecology and economic importance**; broad classification of algae; and study of reproduction and life cycle of the following genera:

- **Cyanophyceae:** *Oscillatoria*, *Nostoc*
- **Chlorophyceae:** *Chlamydomonas*, *Volvox*, *Chlorella*, *Hydrodictyon*, *Oedogonium*
- **Xanthophyceae:** *Vaucheria*
- **Phaeophyceae:** *Ectocarpus*, *Fucus* (*Sargassum* for practical only)
- **Rhodophyceae:** *Batrachospermum*, *Polysiphonia*

#### UNIT - II: Bryophyta

A general account of Bryophytes; the life histories of the following genera:

- **Hepaticopsida:** *Riccia*, *Marchantia*, *Pellia*, *Porella*
- **Anthocerotopsida:** *Anthoceros*

- **Bryopsida:** *Sphagnum*, *Funaria*

## Suggested Readings

Recommended Indian Textbooks

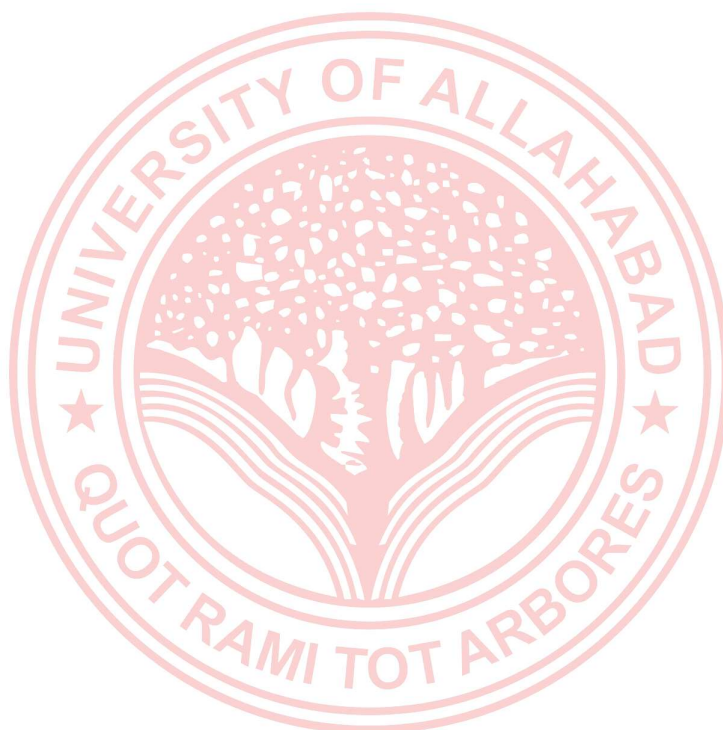
Authors / Publishers

*Botany for Degree Students – Algae*

B.R. Vashishta et al. (S. Chand)

*Botany for Degree Students – Bryophyta* B.R. Vashishta et al. (S. Chand)

*Textbook of Botany Vol. I (Lower Plants)* Pandey, Misra & Trivedi (S. Chand)



## Paper III: Pteridophyta and Gymnospermophyta

### Course Details

- **Course Title:** Pteridophyta and Gymnospermophyta
- **Theory Marks:** 33 Marks

### Course Objectives

To explore the **evolutionary significance, anatomy, and reproductive adaptations of vascular cryptogams and gymnosperms.**

### Course Outcomes (COs)

- **CO1:** Describe salient features of vascular cryptogams and gymnosperms.
- **CO2:** Compare evolutionary trends from pteridophytes to gymnosperms.
- **CO3:** Relate structure to adaptation and phylogeny.

### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (CO) | PO1 | PO2 | PO3  | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---------------------|-----|-----|------|-----|-----|-----|------|------|------|------|------|
| CO1                 | 3   | 2   | 1    | 1   | 1   | 1   | 3    | 1    | 2    | 3    | 1    |
| CO2                 | 3   | 2   | 3    | 1   | 1   | 1   | 2    | 2    | 2    | 2    | 1    |
| CO3                 | 3   | 2   | 3    | 1   | 1   | 1   | 3    | 2    | 2    | 1    | 2    |
| Average             | 3   | 2   | 2.33 | 1   | 1   | 1   | 2.67 | 1.67 | 2    | 2    | 1.33 |

### Course Content (Units)

#### UNIT - I: Pteridophyta

A general account of the **pteridophytes** with special reference to life histories of the following genera:

- **Psilophyta:** *Rhynia*
- **Lycophyta:** *Lycopodium*, *Selaginella*
- **Arthrophyta:** *Equisetum*
- **Filicophyta:** *Marsilea*, *Pteridium*

#### UNIT - II: Gymnospermophyta

Classification and general account of the **gymnosperms** with special reference to the life histories of the following genera:

- **Cycadales:** *Cycas*
- **Coniferales:** *Pinus*

## Suggested Readings

### Recommended Indian Textbooks

### Authors / Publishers

*Botany for Degree Students – Pteridophyta*

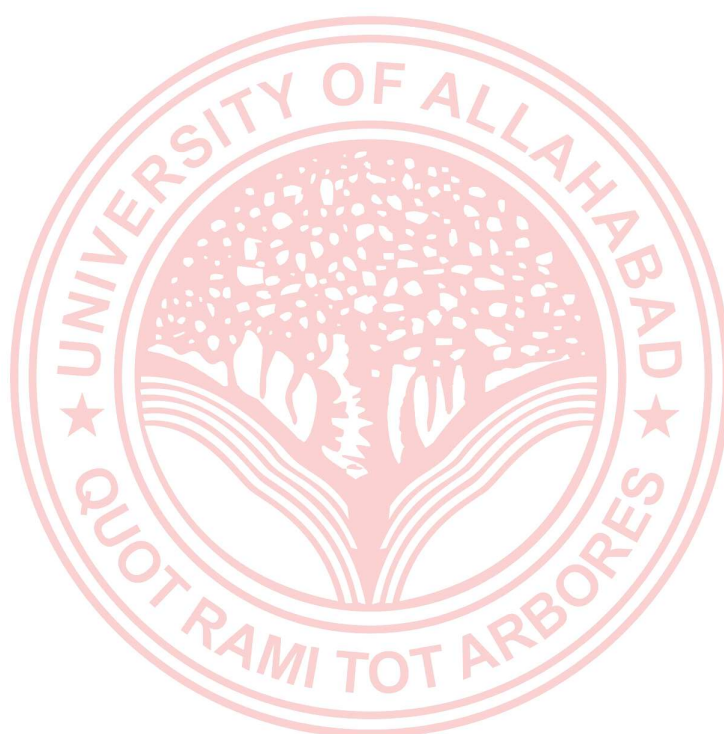
B.R. Vashishta et al. (S. Chand)

*Botany for Degree Students – Gymnosperms*

B.R. Vashishta et al. (S. Chand)

*Textbook of Botany Vol. II (Pteridophyta–  
Gymnosperms)*

S.N. Pandey, S.P. Misra & P.S. Trivedi (S.  
Chand)



## Practical Botany (B.Sc. Part I)

### Course Objectives

To develop fundamental **laboratory skills** including specimen identification, slide preparation, and safe use of microscopes and chemicals. The practical examination is based on the coursework prescribed for Paper I, II and III.

### Course Outcomes (PCOs)

- **PCO1:** Prepare, stain, and observe temporary slides of fungi, algae, bryophytes, and pteridophytes.
- **PCO2:** Identify and classify specimens microscopically and macroscopically.
- **PCO3:** Record and maintain accurate laboratory notes and field data.
- **PCO4:** Demonstrate safe handling of microscopes and chemicals.

### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (PCO) | PO1  | PO2 | PO3  | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|----------------------|------|-----|------|-----|-----|-----|------|------|------|------|------|
| PCO1                 | 2    | 3   | 2    | 2   | 2   | 3   | 3    | 1    | 2    | 3    | 1    |
| PCO2                 | 3    | 3   | 2    | 1   | 2   | 3   | 2    | 2    | 2    | 2    | 1    |
| PCO3                 | 1    | 3   | 2    | 2   | 3   | 2   | 3    | 2    | 2    | 1    | 2    |
| PCO4                 | 1    | 3   | 1    | 3   | 1   | 2   | 2    | 2    | 2    | 2    | 2    |
| Average              | 1.75 | 3   | 1.75 | 2   | 2   | 2.5 | 2.5  | 1.75 | 2    | 2    | 1.5  |

### Course Content (Syllabus Activities)

- Preparation and study of suitable **glycerine mounts and sections of plant materials of cryptogams and gymnosperms** to test knowledge of these groups.
- The **dissection of plants and parts of plants prescribed**, the preparation, staining, mounting and study of given plants (permanent preparations are not required).
- A practical study of plants prescribed in the syllabus.
- Notebooks containing a complete record of laboratory work must be produced at the practical examination.

## B.Sc. Part II Courses

### Paper I: Taxonomy of Angiosperms, Morphology & Anatomy

#### Course Objectives

To provide knowledge of **plant classification systems, morphological diversity, and anatomical structures in angiosperms.**

#### Course Outcomes (COs)

- **CO1:** Apply rules of plant nomenclature and classification systems.
- **CO2:** Describe morphology and anatomy of angiosperms.
- **CO3:** Analyze reproductive structures and embryology.

#### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (CO) | PO1 | PO2 | PO3  | PO4 | PO5 | PO6  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---------------------|-----|-----|------|-----|-----|------|------|------|------|------|------|
| CO1                 | 3   | 2   | 1    | 1   | 1   | 2    | 3    | 1    | 2    | 2    | 2    |
| CO2                 | 3   | 2   | 1    | 1   | 1   | 1    | 2    | 2    | 1    | 2    | 2    |
| CO3                 | 3   | 2   | 3    | 1   | 1   | 1    | 2    | 2    | 2    | 1    | 2    |
| Average             | 3   | 2   | 1.67 | 1   | 1   | 1.33 | 2.33 | 1.67 | 1.67 | 1.67 | 2    |

#### Course Content (Units)

##### UNIT - I: Taxonomy

- **History of plant taxonomy** with special reference to India.
- Brief account of **Bentham & Hooker, Englar & Prantl and Hutchinson's system of classification.**
- Detailed account of the following families: Poaceae (Graminae); Liliaceae, Orchidaceae; Musaceae; Ranunculaceae; Brassicaceae (Cruciferae); Capparidaceae; Papaveraceae; Caryophyllaceae; Malvaceae; Leguminosae; Rosaceae; Apiaceae (Umbelliferae); Myrtaceae; Amaranthaceae; Casuarinaceae; Euphorbiaceae; Asclepiadaceae; Cucurbitaceae; Acanthaceae; Solanaceae; Convolvulaceae; Lamiaceae (Labiateae); Asteraceae (Compositae); Rubiaceae.

##### UNIT - II: Morphology & Anatomy

- Broad outline of morphology and anatomy of **vegetative and reproductive organs of angiosperms.**
- **Cell wall structure; tissue and tissue systems;** morphology and anatomy of root and shoot; **Root-stem transition regions.**

- An account of normal primary structure and **secondary growth** in herbaceous and woody plants.
- **Anomalous secondary growth** as exemplified by stems of *Boerhaavia*, *Chenopodium*, *Pyrostegia (Bignonia)* and *Dracena*.
- Anatomy of leaf; **Leaf abscission**; general morphology of flower and floral parts.

### UNIT - III: Reproductive Structures and Embryology

- A brief history of **anther and ovule**; **Male gametophytes**, *Polygonum* type of embryo sac.
- **Fertilization**, development of embryo sac as exemplified by *Capsella bursapastoris* and *Sagittaria* type.
- An elementary account of the development of **endosperm**; **apomixes and polyembryony**.

### Suggested Readings

| Recommended Indian Textbooks     | Authors / Publishers                  |
|----------------------------------|---------------------------------------|
| <i>Taxonomy of Angiosperms</i>   | V. Singh (S. Chand)                   |
| <i>Plant Anatomy</i>             | P.C. Vasishta or A. Fahn (Pergamon)   |
| <i>Morphology of Angiosperms</i> | S.N. Pandey & P.S. Trivedi (S. Chand) |

## Paper II: Plant Physiology and Plant Ecology

### Course Objectives

To study **physiological processes and ecological principles** governing plant life, communities, and environmental interactions.

### Course Outcomes (COs)

- **CO1:** Explain mechanisms of photosynthesis, respiration, and growth regulation.
- **CO2:** Apply ecological principles to community and ecosystem analysis.
- **CO3:** Evaluate effects of environmental factors on plant functions.

### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (CO) | PO1 | PO2  | PO3  | PO4  | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---------------------|-----|------|------|------|-----|-----|------|------|------|------|------|
| CO1                 | 3   | 2    | 2    | 1    | 1   | 2   | 2    | 2    | 2    | 2    | 2    |
| CO2                 | 3   | 3    | 3    | 3    | 1   | 2   | 2    | 2    | 1    | 2    | 3    |
| CO3                 | 3   | 3    | 3    | 3    | 1   | 2   | 2    | 2    | 2    | 1    | 2    |
| Average             | 3   | 2.67 | 2.67 | 2.33 | 1   | 2   | 2    | 2    | 1.67 | 1.67 | 2.33 |

### Course Content (Units)

#### UNIT - I: Plant Physiology

- **Cell constituents and their microchemical reactions;** physiology of cell.
- **Absorption of materials** in general; ascent of sap; Transpiration.
- **Assimilation of Nitrogen; translocation of plant food materials.**
- Elementary knowledge of growth including turgidity; **movement in plants.**
- **Plant-water relations** (water absorption, transpiration & translocation, salt uptake and translocation).
- **Growth hormones;** movement of hormones; dormancy and its regulation.
- **Vernalization and photoperiodism; phytochrome system.**
- **Enzymes:** classification and mechanism of action.
- **Respiration & photorespiration; Photosynthesis;** synthesis of amino acids; **Lipid metabolism.**

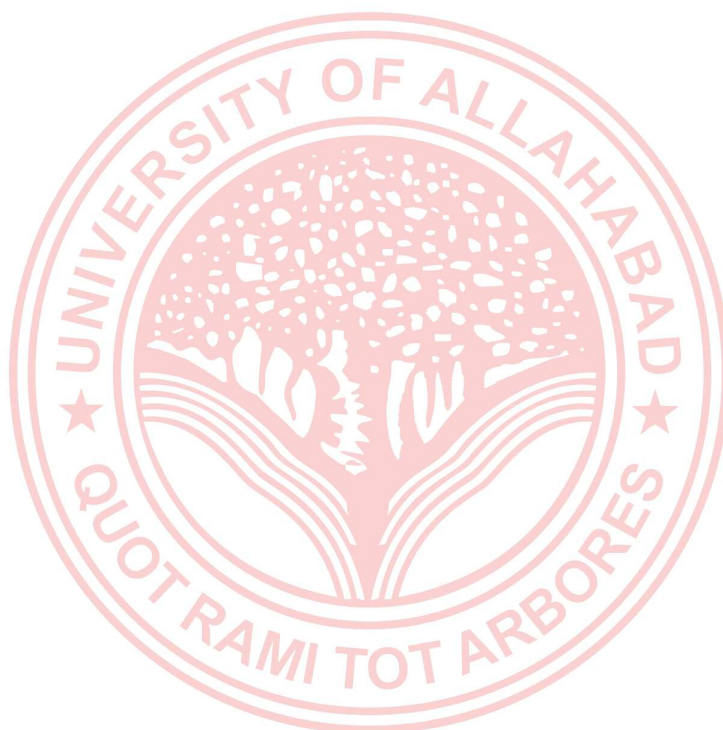
#### UNIT - II: Plant Ecology

- An elementary knowledge of **ecology.**
- **Ecological factors:** climatic, edaphic, phytogeographic and biotic factors.
- **Plant succession.**

- **Plant communities:** hydrophytes, mesophytes, xerophytes, mangroves, epiphytes and parasites.
- **Food chains; ecosystem; pollution;** forest types in India.

## Suggested Readings

| Recommended Indian Textbooks             | Authors / Publishers              |
|------------------------------------------|-----------------------------------|
| <i>Plant Physiology</i>                  | S.N. Pandey & B.K. Sinha (Vikas)  |
| <i>Plant Physiology and Biochemistry</i> | Salisbury & Ross (CBS Publishers) |
| <i>Ecology and Environment</i>           | P.D. Sharma (Rastogi)             |



## Paper III: Cytology, Genetics & Evolution

### Course Objectives

To understand the **cellular and genetic mechanisms underlying heredity, variation, and plant evolution.**

### Course Outcomes (COs)

- **CO1:** Describe structure and function of cellular components.
- **CO2:** Explain Mendelian and molecular genetic principles.
- **CO3:** Evaluate evolutionary theories and genetic variation.

### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (CO) | PO1      | PO2         | PO3         | PO4      | PO5      | PO6         | PSO1        | PSO2        | PSO3        | PSO4     | PSO5     |
|---------------------|----------|-------------|-------------|----------|----------|-------------|-------------|-------------|-------------|----------|----------|
| CO1                 | 3        | 2           | 2           | 1        | 1        | 1           | 3           | 3           | 2           | 2        | 2        |
| CO2                 | 3        | 3           | 3           | 1        | 1        | 2           | 2           | 2           | 1           | 2        | 2        |
| CO3                 | 3        | 2           | 3           | 1        | 1        | 2           | 2           | 2           | 2           | 2        | 2        |
| <b>Average</b>      | <b>3</b> | <b>2.33</b> | <b>2.67</b> | <b>1</b> | <b>1</b> | <b>1.67</b> | <b>2.33</b> | <b>2.33</b> | <b>1.67</b> | <b>2</b> | <b>2</b> |

### Course Content (Units)

#### UNIT - I: Cytology and Genetics

- **Cytology:** General study of **cell and its organelles; chromosomes; cell divisions.**
- **Genetics:** **Mendelism; linkage & crossing-over; gene concept; sex-determination in plants;** cytoplasmic inheritance, **mutation** (Chromosomal & genic); **chromosomal aberrations & polyploidy.**

#### UNIT - II: Molecular Biology

- **Structure of DNA, RNA and Proteins.**
- Role of **nucleic acids in protein synthesis.**
- **Genetic code; mechanism of protein synthesis.**

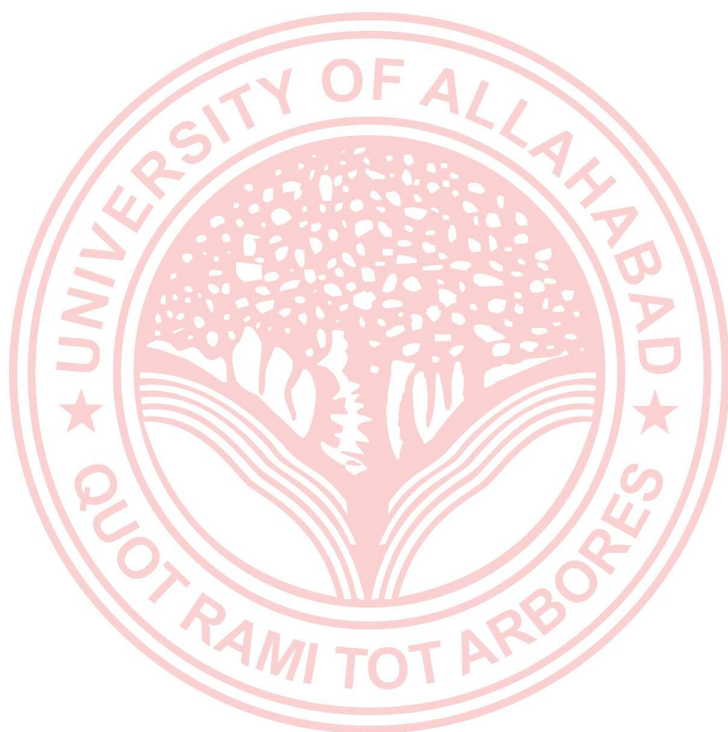
#### UNIT - III: Evolution

- **Origin of life and organic evolution:** evidences, mechanism and theories.

### Suggested Readings

| Recommended Indian Textbooks                    | Authors / Publishers                     |
|-------------------------------------------------|------------------------------------------|
| <i>Cytology and Genetics</i>                    | P.K. Gupta (Rastogi)                     |
| <i>Genetics: A Textbook for Degree Students</i> | Gardner, Simmons & Snustad (Wiley India) |

| Recommended Indian Textbooks  | Authors / Publishers |
|-------------------------------|----------------------|
| <i>Principles of Genetics</i> | B.D. Singh (Kalyani) |



## Practical Botany (B.Sc. Part II)

### Course Objectives

To train students in **dissection, physiological experiments, plant family identification, and ecological field techniques**. The practical examination is based on the coursework prescribed for Paper I, II and III.

### Course Outcomes (PCOs)

- **PCO1:** Perform plant dissection and prepare anatomical slides.
- **PCO2:** Conduct physiological experiments on transpiration, photosynthesis, and respiration.
- **PCO3:** Identify plant families using floral and vegetative characters.
- **PCO4:** Demonstrate statistical and field ecology techniques such as quadrat and frequency analysis.

### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (PCO) | PO1         | PO2      | PO3        | PO4        | PO5      | PO6      | PSO1       | PSO2     | PSO3     | PSO4     | PSO5 |
|----------------------|-------------|----------|------------|------------|----------|----------|------------|----------|----------|----------|------|
| PCO1                 | 2           | 3        | 2          | 1          | 2        | 3        | 3          | 2        | 2        | 2        | 1    |
| PCO2                 | 2           | 3        | 3          | 1          | 2        | 3        | 2          | 2        | 2        | 2        | 2    |
| PCO3                 | 3           | 3        | 2          | 1          | 2        | 3        | 3          | 2        | 2        | 2        | 2    |
| PCO4                 | 2           | 3        | 3          | 3          | 2        | 3        | 2          | 2        | 2        | 2        | 2    |
| <b>Average</b>       | <b>2.25</b> | <b>3</b> | <b>2.5</b> | <b>1.5</b> | <b>2</b> | <b>3</b> | <b>2.5</b> | <b>2</b> | <b>2</b> | <b>2</b> |      |

## B.Sc. Part III Courses

### Paper I: Applied Microbiology, Genetic Engineering, Plant Pathology

#### Course Objectives

To familiarize students with **microbial and molecular techniques** applied in biotechnology and agriculture, including ethical considerations.

#### Course Outcomes (COs)

- **CO1:** Explain basic tools and techniques of genetic engineering.
- **CO2:** Apply microbial and biotechnological principles in agriculture and industry.
- **CO3:** Evaluate ethical issues related to biotechnology.

#### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (CO) | PO1  | PO2  | PO3 | PO4  | PO5  | PO6  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---------------------|------|------|-----|------|------|------|------|------|------|------|------|
| CO1                 | 3    | 3    | 3   | 2    | 2    | 3    | 3    | 3    | 2    | 2    | 3    |
| CO2                 | 3    | 3    | 3   | 3    | 2    | 3    | 2    | 2    | 1    | 3    | 2    |
| CO3                 | 2    | 2    | 3   | 3    | 3    | 2    | 2    | 2    | 2    | 2    | 2    |
| Average             | 2.67 | 2.67 | 3   | 2.67 | 2.33 | 2.67 | 2.33 | 2.33 | 1.67 | 2.33 | 2.33 |

#### Course Content (Units)

##### UNIT - I: Applied Microbiology and Genetic Engineering

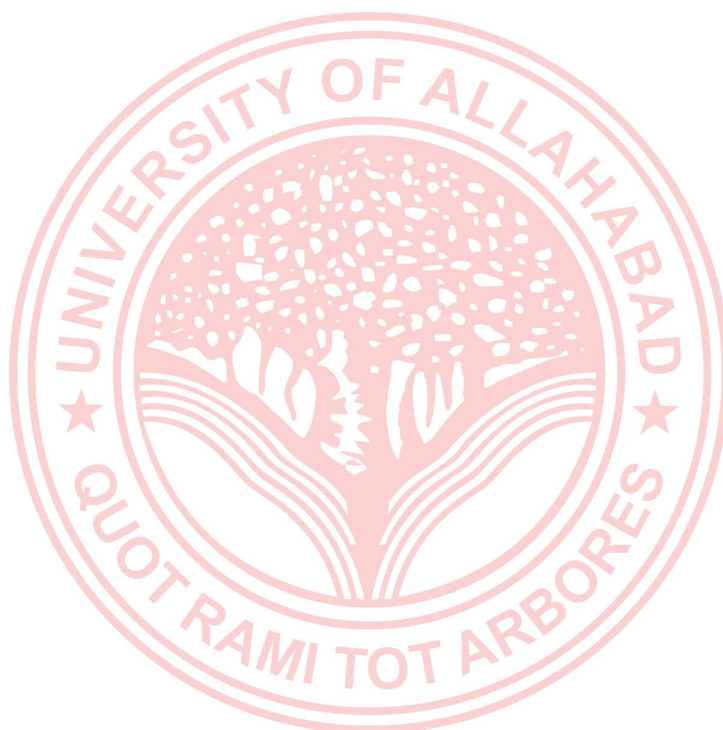
- **Applied Microbiology:** Definition and scope; An elementary knowledge of **soil, water, sewage, milk, food, air, and industrial microbiology**.
- Importance and application of *Penicillium*, *Bacillus*, *Chlorella*, *Streptococcus*, *Lactobacillus*, *Leuconostoc*, *Saccharomyces*, *Aspergillus*, *Clostridium*, and *Claviceps*.
- **Symbiotic and non-symbiotic nitrogen-fixing bacteria;** blue-green algae and mycorrhiza.
- **Genetic Engineering:** Concept & scope; **gene transplant, role of restriction enzymes, endonucleases; plasmids in transferring gene.**
- Application of genetic engineering in medicine, agriculture, industry and environment.

##### UNIT - II: Plant Pathology

- Definition and scope; **disease and disease-causing organisms; symptoms of plant diseases; dissemination of pathogens.**
- Introductory knowledge of **epidemiology and forecasting of plant diseases; host-parasite interaction;** effect of environment on plant diseases.
- Principles of **defence mechanisms and control.**

## Suggested Readings

| Recommended Indian Textbooks      | Authors / Publishers       |
|-----------------------------------|----------------------------|
| <i>Microbiology (Aneja)</i>       | P.K. Gupta (Rastogi)       |
| <i>Introductory Biotechnology</i> | H.S. Chawla (Oxford & IBH) |
| <i>Plant Pathology</i>            | P.D. Sharma (Rastogi)      |



## Paper II: Economic Botany, Applied Plant Anatomy, Marine Biology, Limnology and Plant Breeding

### Course Objectives

To examine **economically important plants, anatomical applications, aquatic ecology, and basic plant breeding techniques.**

### Course Outcomes (COs)

- **CO1:** Identify economically important plants and their uses.
- **CO2:** Apply anatomical and breeding techniques in crop improvement.
- **CO3:** Analyze aquatic and marine plant adaptations.

### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (CO) | PO1 | PO2  | PO3 | PO4  | PO5  | PO6  | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---------------------|-----|------|-----|------|------|------|------|------|------|------|------|
| CO1                 | 3   | 3    | 3   | 2    | 2    | 3    | 3    | 2    | 2    | 2    | 3    |
| CO2                 | 3   | 3    | 3   | 3    | 2    | 3    | 2    | 2    | 3    | 3    | 2    |
| CO3                 | 3   | 2    | 3   | 2    | 1    | 2    | 2    | 2    | 2    | 2    | 2    |
| Average             | 3   | 2.67 | 3   | 2.33 | 1.67 | 2.67 | 2.33 | 2    | 2.33 | 2.33 | 2.33 |

### Course Content (Units)

#### UNIT - I: Economic Botany

Knowledge of **use of plants for human welfare:**

1. Use of plants or plant products belonging to the groups: **algae, fungi, bryophytes and gymnosperms.**
2. Use of plants or plant products belonging to **Angiosperms** with special reference to:
  - **Food plants:** cereals (wheat, rice maize); legumes (Pigeon pea, ground nut, gram); sugarcane and fruits.
  - **Food Adjuncts:** Beverages (Tea and coffee); Spices (*Piper nigrum*, *Capsicum*, *Curcuma*, *Zinziber*, *Crocus sativus*, *coriander sativum*, *syzygium aromaticum*).
  - **Masticatories and fumicatories** (*Piper betel*, *Areca catechu*, *Acacia catechu*, *Nicotiana tabaccum*).
  - **Drug-yielding plants:** Drug narcotics (*Cinchona*, *Aconitum*, *Atropa*, *Artemissia*, *Rauwolfia*, *Cannabis sativa*, *Papawar sominiferum*).
  - **Timber:** Teak, Sal, Shesham.
  - **Fibre:** Cotton, Jute, Sun-hemp, Coir.
  - **Edible oil:** Peanut oil, Coconut, Mustard.

- **Rubber:** *Havea, Ficus*.
- **Tannins:** *Acacia*.
- **Gum:** *Acacia, Sterculia*.
- **Weeds and weed control:** An introduction and definition of weeds; methods of weed control, a basic knowledge of herbicides, their transformation and persistence in soil; some prominent weeds of crop plants and their control.

## UNIT - II: Applied Plant Anatomy and Plant Breeding

- **Applied Plant Anatomy:** Economic aspect of applied plant anatomy in **taxonomy, horticulture, food adulteration, medicinal plants**.
- Wood in present day **archaeology, forensic application**.
- **Plant Breeding:** An elementary knowledge of plant breeding, methods of breeding of **self-pollinated crops, cross-pollinated crops, and asexually propagated crops, parasexuality**.
- Techniques of plant breeding: **emasculation, pollination** etc..

## UNIT - III: Marine Biology and Limnology

- An elementary knowledge of **marine biology and limnology**.
- A general study of morphological and reproductive features of **micro and macrophytes growing in sea water** with special reference to their adaptations.
- A preliminary knowledge of **abiotic** (Physicochemical properties of water) and **biotic** (planktons, periphytons, macrophytes, benthos and decomposes) factors influencing growth of fresh water and marine water flora.

## Suggested Readings

| Recommended Indian Textbooks        | Authors / Publishers   |
|-------------------------------------|------------------------|
| <i>Economic Botany (Verma)</i>      | P.C. Verma (S. Chand)  |
| <i>Applied Botany</i>               | P.C. Verma (S. Chand)  |
| <i>Principles of Plant Breeding</i> | Allard (Wiley Eastern) |
| <i>Environmental Biology</i>        | P.K. Gupta (Rastogi)   |

## Paper III: Palaeobotany, Palynology, Plant Diversification, Morphogenesis and Tissue Culture

### Course Objectives

To provide insight into **plant evolution through fossils and apply tissue culture methods in plant morphogenesis.**

### Course Outcomes (COs)

- **CO1:** Explain fossilization and evolution of plant forms.
- **CO2:** Apply knowledge of morphogenesis and tissue culture techniques.
- **CO3:** Evaluate evolutionary and developmental processes.

### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (CO) | PO1 | PO2  | PO3 | PO4  | PO5  | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---------------------|-----|------|-----|------|------|-----|------|------|------|------|------|
| CO1                 | 3   | 2    | 3   | 1    | 1    | 1   | 3    | 1    | 2    | 2    | 2    |
| CO2                 | 3   | 3    | 3   | 2    | 2    | 3   | 2    | 2    | 1    | 3    | 2    |
| CO3                 | 3   | 2    | 3   | 1    | 1    | 2   | 2    | 2    | 2    | 2    | 2    |
| Average             | 3   | 2.33 | 3   | 1.33 | 1.33 | 2   | 2.33 | 1.67 | 1.67 | 2.33 | 2    |

### Course Content (Units)

#### UNIT - I: Palaeobotany and Palynology

- **Palaeobotany:** An elementary knowledge of Palaeobotany; **geological era; process of fossilization; types of fossils;** methods of fossil study.
- **Form genera and reconstruction of fossil plants.**
- **Palynology:** An introductory knowledge of palynology.

#### UNIT - II: Plant Diversification

- **Evolutionary trends; origin and evolution of different plant groups.**

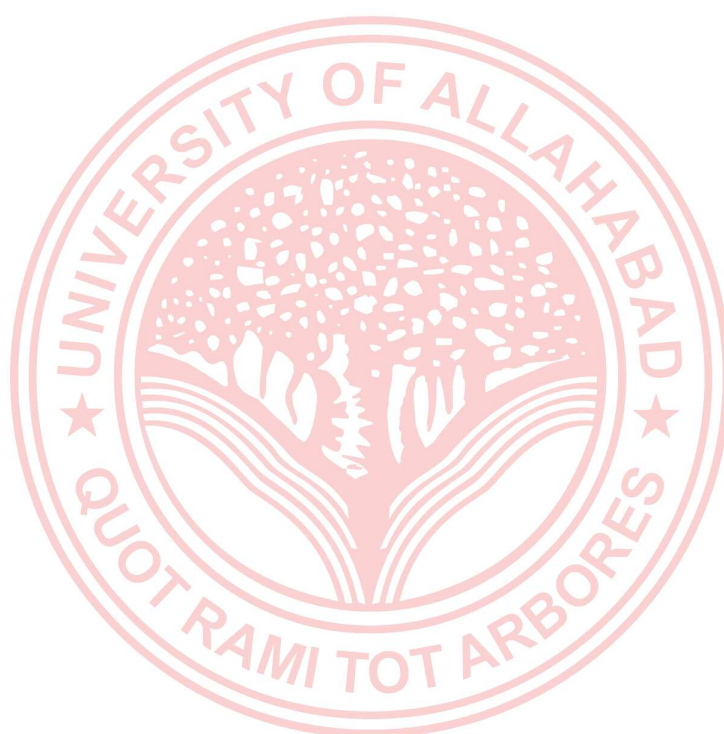
#### UNIT - III: Morphogenesis and Tissue Culture

- **Phenomenon of morphogenesis;** an elementary knowledge of **polarity, symmetry; cellular and tissue differentiation.**
- **Protoplast fusion, methodology and application of tissue culture.**

### Suggested Readings

| Recommended Indian Textbooks | Authors / Publishers             |
|------------------------------|----------------------------------|
| <i>Palaeobotany (Sharma)</i> | A.K. Sharma & P. Sharma (Oxford) |

| Recommended Indian Textbooks                     | Authors / Publishers                         |
|--------------------------------------------------|----------------------------------------------|
| <i>Plant Tissue Culture: Theory and Practice</i> | S.S. Bhojwani & M.K. Razdan (Elsevier India) |
| <i>Plant Morphogenesis</i>                       | S.N. Pandey et al. (S. Chand)                |



## Practical Botany (B.Sc. Part III)

### Course Objectives

To integrate **applied laboratory techniques** including tissue culture, microbial culturing, marine plant study, and scientific reporting. The practical examination is based on the coursework prescribed for Paper I, II and III.

### Course Outcomes (PCOs)

- **PCO1:** Perform tissue culture, microbial culture, and sterilization techniques.
- **PCO2:** Identify economically important plants and their products.
- **PCO3:** Conduct studies on marine and freshwater flora.
- **PCO4:** Prepare fossil slides and pollen diagrams.
- **PCO5:** Prepare scientific reports and present experimental results.

### CO–PO and CO–PSO Mapping Table

Correlation scale: 3 = High, 2 = Moderate, 1 = Low, 0 = No relation

| Course Outcome (PCO) | PO1      | PO2        | PO3      | PO4        | PO5      | PO6        | PSO1     | PSO2       | PSO3       | PSO4     | PSO5       |
|----------------------|----------|------------|----------|------------|----------|------------|----------|------------|------------|----------|------------|
| PCO1                 | 3        | 3          | 3        | 3          | 2        | 3          | 2        | 2          | 2          | 2        | 1          |
| PCO2                 | 3        | 3          | 3        | 2          | 2        | 3          | 2        | 1          | 2          | 2        | 2          |
| PCO3                 | 3        | 3          | 3        | 2          | 2        | 3          | 2        | 2          | 3          | 2        | 2          |
| PCO4                 | 3        | 2          | 3        | 1          | 1        | 2          | 2        | 2          | 2          | 2        | 2          |
| PCO5                 | 3        | 3          | 3        | 3          | 3        | 3          | 2        | 2          | 2          | 2        | 2          |
| <b>Average</b>       | <b>3</b> | <b>2.8</b> | <b>3</b> | <b>2.2</b> | <b>2</b> | <b>2.8</b> | <b>2</b> | <b>1.8</b> | <b>2.2</b> | <b>2</b> | <b>1.8</b> |