

# **SYLLABUS**

**Choice-Based Credit System (CBCS)**

## **Maharaja Ganga Singh University**

**Bachelor of Science (B.Sc.) Botany**

**(Semester) 2024-25**

**Department of Botany**

Undergraduate Programme

**(Effective from Academic Year 2024-25)**

**SCHEME OF EXAMINATION AND**

**COURSES OF STUDY**

**FACULTY OF SCIENCE**

**B.Sc. Examination, 2025**

**BOTANY**

## **Background**

Considering the curricular reforms as instrumental for desired learning outcomes, all the academic Department of Maharaja Ganga Singh University made a rigorous attempt to revise the curriculum of postgraduate programmes in alignment with National Education Policy-2020 and UGC Quality Mandate for Higher Education Institutions-2021. The process of revising the curriculum could be prompted with the adoption of "Comprehensive Roadmap for Implementation of NEP". The roadmap identified the key features of the Policy and elucidated the Action Plan with well-defined responsibilities and indicative timeline for major academic reforms.

The process of revamping the curriculum started with the series of webinars and discussions conducted by the University to orient the teachers about the key features of the Policy, enabling them to revise the curriculum in sync with the Policy. Few research has also been carried out by the faculty members about the assessment, evaluation and significance of the NEP 2020. Proper orientation of the faculty about the vision and provisions of NEP-2020 made it easier for them to appreciate and incorporate the vital aspects of the Policy in the revised curriculum focusing on creating holistic, thoughtful, creative and well-rounded individuals equipped with the key 21st century skills 'for the development of an enlightened, socially conscious, knowledgeable, and skilled nation'.

With NEP-2020 in background, the revised curricula articulate the spirit of the Policy by emphasising upon- integrated approach to learning; innovative pedagogies and assessment strategies; multidisciplinary and cross-disciplinary education; creative and critical thinking; ethical and Constitutional values through value-based courses; 21st century capabilities across the range of disciplines through life skills, entrepreneurial and professional skills; community and constructive public engagement; social, moral and environmental awareness; Organic Living and Global Citizenship Education (GCED); holistic, inquiry-based, discovery-based, discussion-based, and analysis-based learning; exposure to Indian knowledge system, cultural traditions and classical literature through relevant courses offering 'Knowledge of India'; fine blend of modern pedagogies with indigenous and traditional ways of learning; flexibility in course choices; student-centric participatory learning; imaginative and flexible curricular structures to enable creative combination of disciplines for study; offering multiple entry and exit points, alignment of Vocational courses with the International Standard Classification of Occupations maintained

by the International Labour Organization; breaking the silos of disciplines; integration of extra-curricular and curricular aspects; exploring internships with local industry, businesses, artists and crafts persons; closer collaborations between industry and higher education institutions for technical, vocational and science programmes; and formative assessment tools to be aligned with the learning outcomes, capabilities, and dispositions as specified for each course. The University has also developed consensus on adoption of Blended Learning with 10% component of online teaching and 90% face to face classes for each programme.

### **Choice Based Credit System (CBCS)**

The Choice Based Credit System (CBCS), a part of academic reform process to enhance quality of education and facilitate transferability of students from one University/institution to another at the national and international level, provides substantive autonomy to teachers to formulate their own curricula and enable them to introduce innovations in teaching and learning process and upgrade overall quality of higher education. The CBCS provides scope for Comprehensive and Continuous Evaluation (CCE) of students and encourages them to learn. The CBCS provides a cafeteria type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

The grading system is widely regarded as an improvement over the traditional marks system, which is why leading institutions in India and abroad have adopted it. Thus, there's a strong rationale for establishing a consistent grading system. This would facilitate seamless student mobility among institutions within the country and abroad, while also allowing prospective employers to accurately assess students' performances. To achieve the desired standardization in the grading system and the method for calculating the Cumulative Grade Point Average (CGPA) based on students' examination results, the UGC has devised these comprehensive guidelines.

## Outline of Choice Based Credit System

([https://www.ugc.gov.in/pdfnews/8023719\\_guidelines-for-cbcs.pdf](https://www.ugc.gov.in/pdfnews/8023719_guidelines-for-cbcs.pdf))

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement; i. Environmental Science and ii. English/MIL Communication. These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication.

3.2 Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

### 4. Research Component in Under-Graduate Courses

Project work/Dissertation is considered as a special course involving application of knowledge in solving/analysing/exploring a real-life situation/difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

## Marking Scheme:

**For 80 Theory course:** A course will contain 5 units. The question paper shall contain three sections:

**Section A (10 marks):-** shall contain 10 questions two from each Unit. Each question shall be of 1 mark (questions I through V are multiple-choice questions, while questions VI through X will be fill-in-the-blank questions.). All the questions are compulsory.

**Section B (25 marks):-** shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words.

**Section C (45 marks):-** shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

## BOTANY

### Semester I

**Total 6 credits; 150 marks**

Type of Course	Course Code	Title	Credit	Marks (External + Internal)	Hours in a week
Paper I Core course (DCC) (Theory) [BOT-T-1]	BOT-T-1-4.5DCCT12	BOTANY – I	4	100 (80 + 20)	6
Paper II Core course (DCC) (Lab) [BOT-L-1]	BOT-L-1-4.5DCCP12	Lab-1	2	50 (40 + 10)	4
	<b>Total</b>		<b>6</b>	<b>150 (120 + 30)</b>	<b>10</b>

The marks of internal examination should be given on the basis of term tests/regular class tests/seminars/quizzes/artwork/chart or model preparation/student fest/plantation work/science club activities etc.

## Theory Paper

### ALGAE, FUNGI, LICHENS, MICROBES AND PLANT PATHOLOGY

#### Unit-I

**Algae:** General characters, thallus organization, pigments, reserve food material, reproduction and economic importance. Classification with special reference to Fritsch.

General characters, morphology, reproduction and life cycle of:

**Cyanophyta:** *Nostoc*.

**Chlorophyta:** *Volvox*.

**Charophyta:** *Chara*.

**Xanthophyta:** *Vaucheria*.

**Phaeophyta:** *Ectocarpus*.

**Rhodophyta:** *Polysiphonia*.

## Unit-II

**Fungi:** General characteristics, broad classification (**Alexopoulos and Mims, 1979**) and economic importance.

Structure and life history of:

*Albugo, Mucor, Penicillium, Morchella, Puccinia, Ustilago and Alternaria.*

## Unit-III

**Lichens:** General characters, habitat, structure, reproduction (with special reference to *Parmelia* and *Usnea*) and economic importance specially as indicators of environmental pollution.

**Brief history of Microbiology:** Major contributions of Leeuwenhoek, Pasteur, Koch, Metchnikoff, Paul Ehrlich, Edward Jenner, Fleming and Waksman.

## Unit-IV

**Bacteria:** Characteristics, structure, nutrition, reproduction and economic importance. Gram staining.

**Mycoplasma (phytoplasma):** Characteristics, structure and economic importance.

**Viruses:** Nature, structure, multiplication and transmission of plant viruses. AIDS virus.

General account of viroids and prions.

## Unit-V

Principles of Plant Pathology.

Symptoms and control measures of following plant diseases:

White rust of crucifers, green ear disease of bajra, loose and covered smut of wheat, black rust of wheat, citrus canker, little leaf of brinjal and yellow vein mosaic of bhindi.

## PRACTICALS

1. Microscopic preparation and study of the following algal material:  
*Nostoc, Volvox, Chara, Vaucheria, Ectocarpus* and *Polysiphonia*.
2. Microscopic preparation and study of *Albugo, Mucor, Penicillium, Morchella, Puccinia, Ustilago* and *Alternaria*.
3. Gram staining.
4. Field/laboratory study of some locally available plant diseases caused by viruses, mycoplasma, bacteria and fungi:  
White rust of crucifers, green ear disease of bajra, loose and covered smut of wheat, black rust of wheat, citrus canker, little leaf of brinjal, yellow vein mosaic of bhindi.

### Marking Scheme (40 marks):

There shall be a practical examination of four hours duration and the distribution of marks shall be as follows:

		Regular/NC students	Ex-students
1	Identification and slide preparation of algae	5	6
2	Identification and slide preparation of fungi	5	6
3	Bacterial staining	5	6
4	Plant pathology exercise/lichens	5	6
5	Spots – Five (a) Algae (b) Fungi (c) Lichens (d) Plant pathology: Fungi (e) Plant pathology: Bacteria/Virus/Mycoplasma	(2*5=10)	(2*5=10)
6	Viva-voce	5	6
7	Practical record	5	-
8	<b>Total</b>	40	40

**Reference Books:**

1. A Text Book of Botany Vol. I/II– Saxena and Sarabhai, Ratan Prakashan Mandir, Agra.
2. A Text Book of Botany – Singh, Pandey and Jain, Rastogi Publications, Meerut.
3. Algae, Lichens and Bryophyta – Gena, Verma and Chaudhary, Alka Publications, Ajmer.
4. Fungi, Microbiology and Plant Pathology – Gena, Verma and Chaudhary, Alka Publications, Ajmer.
5. A Text Book of Practical Botany I - Bendre and Kumar, Rastogi Publications, Meerut.

**Marking Scheme:**

**For 80 Theory course:** A course will contain 5 units. The question paper shall contain three sections:

**Section A (10 marks):-** shall contain 10 questions two from each Unit. Each question shall be of 1 mark (questions I through V are multiple-choice questions, while questions VI through X will be fill-in-the-blank questions.). All the questions are compulsory.

**Section B (25 marks):-** shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words.

**Section C (45 marks):-** shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

**BOTANY****Semester II****Total 6 credits; 150 marks**

Type of Course	Course Code	Title	Credit	Marks (External + Internal)	Hours in a week
Paper I Core course (DCC) (Theory) [BOT-T-2]	<b>BOT-T-2-</b> 4.5DCCT12	<b>BOTANY – II</b>	4	100 (80 + 20)	6
Paper II Core course (DCC) (Lab) [BOT-L-2]	<b>BOT-L-2-</b> 4.5DCCP12	<b>Lab-2</b>	2	50 (40 + 10)	4
	<b>Total</b>		<b>6</b>	<b>150 (120 + 30)</b>	<b>10</b>



The marks of internal examination should be given on the basis of term tests/regular class tests/seminars/quizzes/artwork/chart or model preparation/student fest/plantation work/science club activities etc.

## **Theory Paper**

# **BRYOPHYTES, PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY**

### **Unit-I**

**Bryophytes:** General characters, classification and economic importance.

Morphology and life history of *Riccia*, *Marchantia*, *Anthoceros* and *Sphagnum*.

### **Unit-II**

**Pteridophytes:** General characters and broad classification. Stellar system, homosporous, heterosporous and origin of seed habit in pteridophytes.

### **Unit-III**

Occurrence, structure and life history of *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum* and *Marsilea*.

### **Unit-IV**

Gymnosperms: General characters, economic importance and broad classification.

Occurrence, morphology, anatomy and life history of *Cycas*, *Pinus* and *Ephedra*.

### **Unit-V**

Geological time scale, types of fossils, process of fossilization and applied aspects of palaeobotany.

Structure of *Rhynia* and *Williamsonia*.

## **PRACTICALS**

1. Study of external morphology and microscopic preparations of thallus and sporophytes of

*Riccia*, *Marchantia*, *Anthoceros* and gametophore of *Sphagnum*.

2. Microscopic examination of fossil slides, specimen/photographs: *Rhynia* and *Williamsonia*.
3. Microscopic temporary, double stained preparations and anatomical study of vegetative parts of *Psilotum*, *Lycopodium*, *Selaginella*, *Equisetum* and *Marsilea*.
4. Study of temporary, single stained, microscopic preparations of cones of *Lycopodium*, *Selaginella*, *Equisetum* and sporocarp of *Marsilea*.
5. Microscopic temporary, double stained preparations of stem and needle of *Pinus*, stem of *Ephedra*, leaflet, rachis, normal and coralloid roots of *Cycas*.
6. Study of male cone and megasporophyll of *Cycas* and female cone of *Pinus*.
7. Microscopic preparation of male cone of *Pinus* and male and female cones of *Ephedra*.

### Marking Scheme (40 marks):

There shall be a practical examination of four hours duration and the distribution of marks shall be as follows:

		Regular/NC students	Ex-students
1	A microscopic preparation of Bryophyte	5	6
2	A double stained section of Pteridophyte (vegetative)	5	6
3	A double stained section of Gymnosperm (vegetative)	5	6
4	A double stained section of Pteridophyte/Gymnosperm (reproductive)	5	6
5	Spots - Five (a) Bryophyte (b) Pteridophyte (c) Gymnosperm (d) Pteridophyte/Gymnosperm (Reproductive) (e) Fossils	(2*5=10)	(2*5=10)
6	Viva-voce	5	6
7	Practical record	5	-
8	<b>Total</b>	40	40

**Reference Books:**

1. A Text Book of Botany Vol. I/II - Saxena and Sarabhai, Ratan Prakashan Mandir, Agra.
2. A Text Book of Botany - Singh, Pandey and Jain, Rastogi Publications, Meerut.
3. Algae, Lichens and Bryophyta - Gena, Verma and Chaudhary, Alka Publications, Ajmer.
4. Pteridophyta, Gymnosperms and Palaeobotany - Tyagi and Saxena, RBD, Jaipur.
5. Pteridophyta, Gymnosperms and Palaeobotany - Gena, Verma and Chaudhary, Alka Publications, Ajmer.
6. A Text Book of Practical Botany I - Bendre and Kumar, Rastogi Publications, Meerut.

**Marking Scheme:**

**For 80 Theory course:** A course will contain 5 units. The question paper shall contain three sections:

**Section A (10 marks):-** shall contain 10 questions two from each Unit. Each question shall be of 1 mark (questions I through V are multiple-choice questions, while questions VI through X will be fill-in-the-blank questions.). All the questions are compulsory.

**Section B (25 marks):-** shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words.

**Section C (45 marks):-** shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

**BOTANY****Semester III****Total 6 credits; 150 marks**

Type of Course	Course Code	Title	Credit	Marks (External + Internal)	Hours in a week
Paper I Core course (DCC) (Theory) [BOT-T-3]	BOT-T-3-5.0DCCT12	BOTANY – III	4	100 (80 + 20)	6
Paper II Core course (DCC) (Lab) [BOT-L-3]	BOT-L-3-5.0DCCP12	Lab-3	2	50 (40 + 10)	4
	<b>Total</b>		<b>6</b>	<b>150 (120 + 30)</b>	<b>10</b>

The marks of internal examination should be given on the basis of term tests/regular class tests/seminars/quizzes/artwork/chart or model preparation/student fest/plantation work/science club activities etc.

## **Theory Paper**

### **TAXONOMY, ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS**

#### **Unit-I**

Herbarium technique; important herbaria and botanical gardens of India.

General terminology in taxonomy (inflorescence, flowers and fruits); nomenclature and classification (Bentham and Hooker) of angiosperms; flora, monograph and icons; flora of Rajasthan.

#### **Unit - II**

Vegetative, floral characteristics and economic importance of following families:

1. Capparidaceae,
2. Fabaceae (Mimosoideae, Caesalpinioideae and Papilionoideae),
3. Cucurbitaceae,
4. Apiaceae (Umbelliferae),
5. Asteraceae (Compositae),
6. Apocynaceae,
7. Asclepiadaceae,
8. Solanaceae,
9. Euphorbiaceae,
10. Poaceae (Gramineae).

#### **Unit - III**

Meristems and various theories related to organization of apical meristems (root and stem). Simple and complex permanent tissues and their functions, secretory tissues and tissue systems.

Primary internal structure of root, stem and leaves. Structure of leaf epidermis, trichomes and stomata.

## Unit - IV

Normal secondary growth in dicot root and stem, periderm, commercial cork, heart wood, sap wood, tyloses, annual rings. Anomalous secondary growth in roots and stems, origin of lateral roots.

Primary anomalous structures (stems and roots), abscission of leaves.

## Unit - V

Structure of stamen and pistil, microsporogenesis and megasporogenesis, types of ovules, development and types of embryo sacs, double fertilization; Structure, types and development of endosperm, types of embryogeny.

Apomixis, polyembryony and parthenogenesis. Seed structure and types.

## PRACTICALS

### TAXONOMY:

1. Capparidaceae: *Cleome*, *Capparis*.
2. Fabaceae: *Acacia*, *Albizia*, *Cassia*, *Clitoria*.
3. Cucurbitaceae: *Citrullus*, *Cucumis*.
4. Apiaceae: *Coriandrum*, *Foeniculum*.
5. Asteraceae: *Helianthus*, *Tagetes*.
6. Apocynaceae: *Catharanthus*, *Nerium*, *Thevetia*.
7. Asclepiadaceae: *Calotropis*, *Leptadenia*.
8. Solanceae: *Datura*, *Solanum*.
9. Lamiaceae: *Ocimum*, *Salvia*.
10. Euphorbiaceae: *Ricinus*, *Euphorbia*.
11. Poaceae: *Triticum*.

(Locally available plants be substituted, if necessary)

## EMBRYOLOGY: Slides/Specimens

1. Inflorescence: Cyathium, Hypanthodium, Capitulum, Verticillaster and Umbel.
2. Placentation: Axile, free central, parietal, marginal and basal.
3. Ovules: Anatropous and Orthotropous.
4. Ovary: Different types.
5. T.S. of anther, L.S. of mature seed, pollinium whole mount.

## ANATOMY:

1. Stems: *Boerhavia*, *Achyranthes*, *Bignonia*, *Bougainvillea*, *Leptadenia*, *Nyctanthes*, *Salvadora*, *Casuarina* and *Dracaena*.
2. Roots: Assimilatory roots of *Tinospora*, aerial roots of *Ficus*.
3. Leaves: *Nerium*, *Ficus*, *Maize*, epidermal studies.
4. Types of stomata.

## Marking Scheme (40 marks):

There shall be a practical examination of four hours duration and the distribution of marks shall be as follows:

		Regular/NC students	Ex-students
1	Description of given flower in semi technical language with: (i) Diagrams (ii) Description (iii) Identification and systematic position with characters (iv) F.F. and F.D.	7	8
2	Material for anatomical study with (i) Double stained T.S. preparation (ii) Labelled cellular sector diagram (iii) Identification with characters (iv) Special anatomical characters	7	8
3	Embryology (2 exercises)	2*3=6	2*4=8
4	Spots - Five	(2*5=10)	(2*5=10)
6	Viva-voce	5	6
7	Practical record	5	-
8	<b>Total</b>	40	40

**Reference Books:**

1. Plant Taxonomy – Saxena and Saxena, Pragati Prakashan, Meerut.
2. Taxonomy of Angiosperms and Embryology - Gena, Verma and Chaudhary, Alka Publications, Ajmer.
3. Anatomy of Angiosperms and Economic Botany - Gena, Verma and Chaudhary, Alka Publications, Ajmer.
4. A text Book of Botany - Singh, Pandey and Jain, Rastogi Publications, Meerut.
5. A Text Book of Practical Botany 2 - Bendre and Kumar, Rastogi Publications, Meerut.

**Marking Scheme:**

**For 80 Theory course:** A course will contain 5 units. The question paper shall contain three sections:

**Section A (10 marks):-** shall contain 10 questions two from each Unit. Each question shall be of 1 mark (questions I through V are multiple-choice questions, while questions VI through X will be fill-in-the-blank questions.). All the questions are compulsory.

**Section B (25 marks):-** shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words.

**Section C (45 marks):-** shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

**BOTANY****Semester IV****Total 6 credits; 150 marks**

Type of Course	Course Code	Title	Credit	Marks (External + Internal)	Hours in a week
Paper I Core course (DCC) (Theory) [BOT-T-4]	<b>BOT-T-4-</b> 5.0DCCT12	<b>BOTANY – IV</b>	4	100 (80 + 20)	6
Paper II Core course (DCC) (Lab) [BOT-L-4]	<b>BOT-L-4-</b> 5.0DCCP12	<b>Lab-4</b>	2	50 (40 + 10)	4
	<b>Total</b>		<b>6</b>	<b>150 (120 + 30)</b>	<b>10</b>

The marks of internal examination should be given on the basis of term tests/regular class tests/seminars/quizzes/artwork/chart or model preparation/student fest/plantation work/science club activities etc.

## **Theory Paper**

### **CYTOLOGY, GENETICS, PLANT BREEDING, EVOLUTION, BIOSTATISTICS AND ECONOMIC BOTANY**

#### **Unit-I**

Concept of cell and cell theory, structure and functions of cell organelles.

Cell division, physical and chemical structure of chromosome.

Types of chromosomes: Lampbrush, polytene and supernumerary. Chromosomal mutations.

Mendel's laws of inheritance, monohybrid and dihybrid cross, incomplete dominance, lethal genes.

Gene interactions: Epistasis, complementary, supplementary, duplicate and inhibitory genes.

#### **Unit - II**

Structure and functions of nucleic acids, types of RNA and DNA.

Replication of DNA, evidences of DNA as genetic material. Synaptonemal complex, crossing over, chiasma, linkage and mapping of genes.

#### **Unit - III**

Principles of Plant breeding.

Methods of plant breeding: Introduction and acclimatization, selection (mass, pure line and clonal), hybridization, pedigree analysis, hybrid vigour; use of mutations and polyploidy in breeding.

#### **Unit - IV**

Lamarckism and Neo-Lamarckism, Darwinism and Neo-Darwinism. De Vries concept, origin of species.



Elementary study of biostatistics: Mean, mode, median, standard error, chi-square test and standard deviation.

### **Unit - V**

Origin, cultivation of starch and sugar yielding crops: Wheat, Rice, Maize, Potato and Sugarcane.

General account and economic importance of following groups of plants:

Medicinal plants: *Cinchona*, *Rauwolfia*, *Papaver*, *Withania* and *Aloe*.

Fibre yielding plants: Cotton, Jute.

Oil yielding plants: Groundnut, Mustard, Sunflower and Coconut.

Timber yielding plants: *Tectona*, *Dalbergia* and *Tecomella*.

Spices and condiments: Red pepper, Clove, Coriander, Zinger, Asafoetida and Turmeric.

Beverages: Tea, Coffee.

General account of Rubber plants.

Ethnobotany: Definition, methods of study and importance.

### **PRACTICALS**

1. Cytology: Smear preparation of root tips and floral buds of onion for studying different stages of mitotic and meiotic cell division.
2. Genetics: Monohybrid and dihybrid cross, back cross, test cross.
3. Plant breeding: Emasculation technique.
4. Biostatistics: Exercise on mean, mode and median.
5. Economic Botany:

Medicinal: *Cinchona*, *Rauwolfia*, *Papaver*, *Withania* and *Aloe*.

Fibres: Cotton, Jute.

Oil Seeds: Groundnut, Mustard, Sunflower.

Timber: Heartwood, sapwood, annual rings.

Spices and condiments: Red pepper, Clove, Coriander, Zinger, Asafoetida and Turmeric.

Beverages: Tea, Coffee.

### Marking Scheme (40 marks):

There shall be a practical examination of four hours duration and the distribution of marks shall be as follows:

		Regular/NC students	Ex-students
1	Smear preparation: two stages of cell division	5	6
2	Exercise on genetics	5	6
3	Exercise on plant breeding (Emasculation technique)	2	2
4.	Economic botany (Two plants)	4	6
4	Biostatistics exercise	4	4
5	Spots - Five (one each from cytology, genetics, plant breeding, economic botany and biostatistics)	(2*5=10)	(2*5=10)
6	Viva-voce	5	6
7	Practical record	5	-
8	<b>Total</b>	40	40

### Reference Books:

1. Cytology, Genetics, Plant Breeding, Evolution and Biostatistics - P. K. Gupta, Rastogi Publications, Meerut.
2. Cytology, Genetics, Plant Breeding, Evolution and Biostatistics - Gena, Verma and Chaudhary, Alka Publications, Ajmer.
3. A Text Book of Economic Botany – V. Verma, Emkay Publications, Delhi.
4. Anatomy of Angiosperms and Economic Botany - Gena, Verma and Chaudhary, Alka Publications, Ajmer.
5. A Text Book of Practical Botany 2 - Bendre and Kumar, Rastogi Publications, Meerut.
6. Practical Botany- Trivedi, Sharma, Sharma and Dhankhad, RBD Publications, Jaipur.

## Marking Scheme:

**For 80 Theory course:** A course will contain 5 units. The question paper shall contain three sections:

**Section A (10 marks):-** shall contain 10 questions two from each Unit. Each question shall be of 1 mark (questions I through V are multiple-choice questions, while questions VI through X will be fill-in-the-blank questions.). All the questions are compulsory.

**Section B (25 marks):-** shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words.

**Section C (45 marks):-** shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

## BOTANY

### Semester V

**Total 6 credits; 150 marks**

Type of Course	Course Code	Title	Credit	Marks (External + Internal)	Hours in a week
Paper I Core course (DCC) (Theory) [BOT-T-5]	BOT-T-5-5.5DCCT12	BOTANY – V	4	100 (80 + 20)	6
Paper II Core course (DCC) (Lab) [BOT-L-5]	BOT-L-5-5.5DCCP12	Lab-5	2	50 (40 + 10)	4
	<b>Total</b>		<b>6</b>	<b>150 (120 + 30)</b>	<b>10</b>

The marks of internal examination should be given on the basis of term tests/regular class tests/seminars/quizzes/artwork/chart or model preparation/student fest/plantation work/science club activities etc.

## Theory Paper

### PLANT PHYSIOLOGY, BIOCHEMISTRY AND PLANT TISSUE CULTURE

#### Unit-I

Water relations: Osmosis, plasmolysis, imbibition; concept of water potential; Absorption of water, Ascent of sap; Transpiration: types, mechanism of stomatal movement, factors affecting transpiration.

Carbohydrates: Classification and structure.

Photosynthesis: Photosynthetic pigments, photosystems, Light reaction, mechanism of carbon fixation in C<sub>3</sub>, C<sub>4</sub> and CAM plants; compensation point; factors affecting photosynthesis.

## **Unit - II**

Respiration: Glycolysis, Krebs's cycle and electron transport system; oxidative phosphorylation: chemiosmotic mechanism; factors affecting respiration; respiratory quotient.

Photorespiration: mechanism and significance.

Fats: Structure, synthesis and degradation ( $\beta$ -oxidation).

Enzymes: General characteristics, classification, mode of action, factors affecting enzyme activity.

## **Unit - III**

Plant growth regulators: Discovery, structure, physiological effects and applications of auxins, gibberellins, cytokinins, ethylene and abscisic acid.

Seed dormancy, abscission, senescence, photoperiodism and vernalisation.

Principle and uses of following techniques/instruments: Centrifugation, pH meter, colorimetry/spectrophotometry, chromatography (paper and thin layer).

## **Unit - IV**

History and scope of plant tissue culture, basic techniques and tools of plant tissue culture.

Brief account of protoplast culture and fusion.

Micropropagation and somatic embryogenesis.

## **Unit - V**

Plant tissue culture in agriculture, forestry and industry.

Secondary plant products: Definition, types and uses of alkaloids, factors affecting production of secondary products in cultures grown in bioreactors (fermentors).

## PRACTICALS

### PLANT PHYSIOLOGY AND BIOCHEMISTRY:

1. Demonstration of phenomenon of osmosis by potato osmoscope.
2. Demonstration of phenomenon of plasmolysis using *Rhoeo discolor* leaves.
3. Demonstration of unequal transpiration by four leaf method.
4. Demonstration of unequal transpiration in dorsiventral leaf using cobalt chloride paper.
5. Effect of different wavelengths of light on the process of photosynthesis.
6. Demonstration that light, CO<sub>2</sub> and chlorophyll are necessary for photosynthesis.
7. Demonstration of evolution of oxygen in photosynthesis.
8. Determine respiratory quotient of different respiratory substrates by Ganong's respirometer.
9. Demonstration of activity of respiratory enzymes (peroxidase, catalase, dehydrogenase) in plant tissue samples.
10. Growth measurements by auxanometer.
11. Introduction and demonstration of centrifugation, pH meter, colorimetry/spectrophotometry and paper chromatography techniques.
12. Phytochemical tests for the following: Glucose, starch, ascorbic acid and lipids.

### PLANT TISSUE CULTURE:

1. Principle and application of the following: Laminar air flow/sterile bench, autoclave, ultrafiltration.
2. Preparation of culture media for microbial growth (Nutrient agar and P.D.A) and solutions of nutrients and growth regulators.
3. Demonstration of inoculation technique, aseptic transfer of explant and microbial transfer techniques.
4. Demonstration of resistance sensitivity using antibiotic discs.
5. Germination of pollen of *Catharanthus roseus* in 10% sucrose solution.
6. Phytochemical tests for proteins (xanthoproteic, biuret, ninhydrin), tannins and anthocyanins.

## Marking Scheme (40 marks):

There shall be a practical examination of four hours duration and the distribution of marks shall be as follows:

		Regular/NC students	Ex-students
1	Experiment in plant physiology/biochemistry	8	8
2	Experiment in tissue culture	6	7
3	Phytochemical tests (one each from biochemistry and tissue culture)	4	6
4	Respiratory enzymes	2	3
5	Spots – Five	(2*5=10)	(2*5=10)
6	Viva-voce	5	6
7	Practical record	5	-
8	<b>Total</b>	40	40

## Reference Books:

1. Plant Physiology and Biochemistry – H. S. Srivastava, Rastogi Publications, Meerut.
2. A text book of Plant Physiology – Verma and Verma, Emkay Publications, Delhi.
3. Plant Physiology and Biochemistry – Verma and Choudhary, Alka Publications, Ajmer.
4. Plant Biotechnology – P. K. Gupta, Rastogi Publications, Meerut.
5. A text book of Biotechnology – R. C. Dubey, S. Chand and Company, New Delhi.
6. A Text Book of Practical Botany 2 - Bendre and Kumar, Rastogi Publications, Meerut.
7. Practical Botany – Saini and Agrawal, College Book House, Jaipur.

## Marking Scheme:

**For 80 Theory course:** A course will contain 5 units. The question paper shall contain three sections:

**Section A (10 marks):-** shall contain 10 questions two from each Unit. Each question shall be of 1 mark (questions I through V are multiple-choice questions, while questions VI through X will be fill-in-the-blank questions.). All the questions are compulsory.

**Section B (25 marks):-** shall contain 5 questions (two from each unit with internal choice). Each question shall be of 5 marks. The candidate is required to answer all 5 questions. The answers should not exceed 150 words.

**Section C (45 marks):-** shall contain 5 questions, one from each Unit. Each question shall be of 15 marks. The candidate is required to answer any three questions by selecting these three questions from different units. The answers should not exceed 400 words.

## **BOTANY**

### **Semester VI**

**Total 6 credits; 150 marks**

<b>Type of Course</b>	<b>Course Code</b>	<b>Title</b>	<b>Credit</b>	<b>Marks (External + Internal)</b>	<b>Hours in a week</b>
Paper I Core course (DCC) (Theory) <b>[BOT-T-6]</b>	<b>BOT-T-6-5.5DCCT12</b>	<b>BOTANY – VI</b>	4	100 (80 + 20)	6
Paper II Core course (DCC) (Lab) <b>[BOT-L-6]</b>	<b>BOT-L-6-5.5DCCP12</b>	<b>Lab-6</b>	2	50 (40 + 10)	4
	<b>Total</b>		<b>6</b>	<b>150 (120 + 30)</b>	<b>10</b>

The marks of internal examination should be given on the basis of term tests/regular class tests/seminars/quizzes/artwork/chart or model preparation/student fest/plantation work/science club activities etc.

### **Theory Paper**

## **PLANT ECOLOGY, PHYTOGEOGRAPHY AND GENETIC ENGINEERING**

### **Unit-I**

Plant Ecology: Ecosystem structure, biotic and abiotic components, food chain and food web, ecological pyramids, energy flow, biogeochemical cycles.

Productivity: Primary and secondary productivity and their measurements.

### **Unit - II**

Plant succession: Hydrosere, xerosere (lithosere and psammosere); Community Structure and development.

Plant adaptations: Hydrophytes, xerophytes and halophytes (morphological, anatomical and physiological adaptations).

Pollution: Air, water and noise pollution, their causes, consequences and control.

### **Unit - III**

Natural Resources: Renewable and nonrenewable.

Biodiversity: Levels, gradients, threats and conservation, hot spots, continuous and discontinuous distribution.

Management of problem of depletion of natural vegetation, endangered plants, Red data book; National parks and sanctuaries.

Phytogeography of India, Vegetation regions of India, Plant indicators.

Ecology of Rajasthan Desert.

### **Unit - IV**

Gene concept: From Mendel to molecular level. Genetic code.

Proteins: Structure and protein synthesis (transcription and translation in prokaryotes).

Brief account of PCR, gene sequencing and genomic library.

### **Unit - V**

Principles and tools of genetic engineering: Recombinant DNA technology, restriction enzymes.

Vector mediated gene transfer in higher plants using plasmids and cosmids.

Brief account of vectorless gene transfer (particle gun, liposomes, chemical methods).

Interaction and expression of transgenes, Bt-toxin and Nif gene.

## **PRACTICALS**

### **PLANT ECOLOGY AND PHYTOGEOGRAPHY:**

1. To find out minimum size of the quadrat.
2. Find out density, frequency and abundance of herbaceous species by quadrat method.
3. Plant adaptive modifications (specimens/slides):



*Opuntia, Euphorbia, Capparis, Leptadenia, Hydrilla, Eichhornia and Typha.*

4. Soil analysis Field tests:
  - a. Soil texture
  - b. Soil moisture
  - c. Water holding capacity
  - d. Soil pH
5. Water analysis:
  - a. Hardness of water
  - b. Water temperature
  - c. Carbonate, bicarbonate and chloride tests
6. Ecological instruments and their working:
  - a. Maximum-minimum thermometer
  - b. Oven.

#### **GENETIC ENGINEERING:**

1. Tools of genetic engineering: PCR, gene sequencing, restriction enzymes, genomic library.
2. Recombinant DNA technology, restriction enzymes.
3. Plasmids and Cosmids.
4. Particle gun and liposomes.
5. Transgenes in plants.

#### **Marking Scheme (40 marks):**

There shall be a practical examination of four hours duration and the distribution of marks shall be as follows:

		<b>Regular/NC students</b>	<b>Ex-students</b>
1	Ecological exercise: Morphology and anatomy	7	8
2	Molecular biology exercise	6	7
3	Soil/Water tests	3	4
4	Field Exercise (community study)	4	5
5	Spots - Five (3 - Ecology, 2 – Genetic engineering)	(2*5=10)	(2*5=10)
6	Viva-voce	5	6
7	Practical record	5	-
8	<b>Total</b>	40	40

#### **Reference Books:**

1. Ecology and Environment – P. D. Sharma, Rastogi Publications, Meerut.

2. Plant Ecology and Phytogeography – Verma, Gupta and Yadav, Alka Publications, Ajmer.
3. Ecology and Phytogeography – Saxena and Tyagi, College Book House, Jaipur.
4. Molecular Biology and Biotechnology – Ramawat and Goyal, S. Chand and Company, New Delhi.
5. Molecular Biology and Biotechnology – M. L. Verma, Alka Publications, Ajmer.
6. A Text Book of Practical Botany 2 - Bendre and Kumar, Rastogi Publications, Meerut.
7. Practical Botany – Saini and Agrawal, College Book House, Jaipur.