Punyashlok Ahilyadevi Holkar
Solapur University, Solapur

Name of the Faculty: Science & Technology

Syllabus: BOTANY

(As per New Education Policy NEP 2020)

Name of the Course: B.Sc. Part- III (Sem V & VI)
[Syllabus to be implemented from June- 2026]

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology
NEP 2020 Compliant Curriculum
B.Sc. (Botany): Program Preamble

The Bachelor of Science (B.Sc.) in Botany is a comprehensive and dynamic program designed to provide students with a deep understanding of the fundamental principles of Botany, along with the practical skills required to apply this knowledge in various scientific and technological contexts. Aligned with the vision of the National Education Policy (NEP) 2020, the program offers a flexible, multidisciplinary, and learner-centric curriculum that encourages critical thinking, innovation, and holistic development. The B.Sc. Botany program spans four years, with each year offering a progressively advanced curriculum designed to build a strong foundation in Botany while allowing for specialization and interdisciplinary learning. The curriculum is structured around several key components:

1) **Major Courses:** These core courses form the backbone of the program, providing in-depth knowledge and understanding of essential Botany concepts, theories, and methodologies. Students will engage with topics ranging from Phycology, Mycology, Archigoniates, Taxonomy, Anatomy, Embryology, Plant Physiology, Cell & Molecular Biology, Nursery, Gardening, Genetics etc.
2) **Minor Courses:** Students have the opportunity to choose minor courses from related or distinct disciplines, promoting an interdisciplinary approach to learning. This flexibility allows students to complement their Botany education with insights from fields such as mathematics, Physics or microbiology, zoology, Geology for enhancing their versatility and broadening their career prospects.
3) **Open Electives/General Electives:** The program encourages intellectual exploration beyond the core discipline by offering a wide range of elective courses. These electives enable students to pursue their interests in diverse subjects, fostering creativity, critical thinking, and a well- rounded educational experience.
4) **Vocational and Skill Enhancement Courses:** Practical skills and technical proficiency are integral to the program, with vocational and skill enhancement courses providing hands-on experience in areas such as Algology, Mycology, Archigoniates, Taxonomy, Anatomy, Embryology, Plant Physiology, Cell & Molecular Biology, Nursery, Gardening, Genetics. These

courses are designed to prepare students for immediate employment and equip them with the tools necessary for career advancement in various scientific and technological fields.

5) **Ability Enhancement Courses (AEC),** Indian Knowledge System (IKS), and Value Education Courses (VEC): In alignment with NEP 2020, the program integrates courses that emphasize the Indian Knowledge System, ethical values, and life skills. These courses foster a deep appreciation for India's rich cultural heritage, while also developing essential communication and ethical decision-making skills that are vital for personal and professional growth.

6) **Field Projects/Internships/Apprenticeships/Community Engagement Projects/On-Job Training:** To bridge the gap between theoretical knowledge and real-world applications, the program includes opportunities for field projects, internships, apprenticeships, and community engagement. These experiences provide students with practical insights, problem-solving abilities, and exposure to professional environments, enhancing their readiness for careers in Botany and related fields.

7) **Research Methodology and Research Projects:** Research is a critical component of the BSc Botany program, with students acquiring skills in research methodology, data collection, analysis, and scientific inquiry. By engaging in independent research projects, students are encouraged to develop innovative solutions to complex scientific problems, preparing them for advanced studies and research-oriented careers.

- **Multiple Entry and Multiple Exit Options**

In accordance with the NEP 2020, the BSc Botany program incorporates a Multiple Entry and Multiple Exit framework, offering students the flexibility to enter or exit the program at various stages. This approach ensures that students can tailor their educational journey according to their personal and professional goals, with options to earn certificates, diplomas, or degrees based on the duration of study completed.

- Year 1: Upon completion of the first year, students may exit with a Certificate in Botany.
- Year 2: After two years, students may choose to exit with a Diploma in Botany.
- Year 3: Completion of the third year qualifies students for a BSc Degree in Botany.
- Year 4: The fourth year offers an advanced curriculum with a focus on research, allowing students to graduate with an Honors Degree in Botany.

Eligibility for B.Sc. III Botany: The candidate passed the B.Sc. Part II course OR having ATKT or Repeater student and the candidate who passed B.Sc. I will be eligible to take the admission.

B.Sc. Part- III Botany NEP 2020 Structure w.e.f. June- 2026

<table>
<tr><th colspan="8">B.Sc. Part- III Botany NEP 2020 Structure</th></tr>
<tr><th rowspan="2">SEM</th><th colspan="2">Faculty</th><th rowspan="2">GE/OE</th><th rowspan="2">VSC</th><th rowspan="2">IKS</th><th rowspan="2">Field Project</th><th rowspan="2">Credits</th></tr>
<tr><th>DSC</th><th>DSE</th></tr>
<tr><td rowspan="3">V</td><td>DSC1-7 (3+2)
Plant Systematics
(45 Period)</td><td rowspan="3">(Select any one)
DSE1-1 (2+1)
Plant Breeding
(30 Period)
DSE1-2 (2+1)
Plant Resources and Utilization
(30 Period)
DSE1-3 (2+1)
Cyber Security foundation Program
(30 period)</td><td rowspan="3">---</td><td rowspan="3">VSC 3 (2)
(Hands on training related to DSE)</td><td rowspan="3">IKS 2 (2)
IKS in Plant Sciences
(Related to Major subject)</td><td rowspan="3">---</td><td rowspan="3">22</td></tr>
<tr><td>DSC1-8 (3+2)
Genetics
(45 Period)</td></tr>
<tr><td>DSC1-9 (3+2)
Cell Biology
(45 Period)</td></tr>
<tr><td rowspan="3">VI</td><td>DSC1-10 (3+2)
Plant Pathology
(45 Period)</td><td rowspan="3">DSE1-4 (2+1)
Horticulture Practices & Post Harvest Technology
(30 Period)
<u>OR</u>
DSE1-5 (2+1)
Biostatistics
(30 Period)</td><td rowspan="3">---</td><td rowspan="3">VSC 4 (2)
(Hands on training related to DSE)</td><td rowspan="3">---</td><td rowspan="3">FP2/CEP2/OJT1 (2)</td><td rowspan="3">22</td></tr>
<tr><td>DSC1-11 (3+2)
Plant Biotechnology
(45 Period)</td></tr>
<tr><td>DSC1-12 (3+2)
Molecular Biology
(45 Period)</td></tr>
</table>

- **SUBJECT PREAMBLE:**

Today plant science is a fusion of the traditional components with the modern aspects of biochemistry, molecular biology and biotechnology. Over the years, plant science (Botany) has shown enormous gain in information and applications owing to tremendous inputs from research in all its aspects. With global recognition of the need for conservation, field plant biologists have contributed significantly in assessing plant diversity. Taxonomists have explored newer dimensions for the classification of plants. New insights have been gained in functional and structural aspects of plant development by utilizing novel tools and techniques for botanical research. Challenging areas of teaching and research have emerged in ecology and reproductive biology. Concern for ever increasing pollution and climate change is at its highest than ever before. Keeping these advancements in view, a revision of the curriculum at the undergraduate level is perfectly timed. From the beginning of 2024-25 session, the Botany students across Indian Universities shall have the benefit of a balanced, carefully- crafted course structure taking care of different aspects of plant science, namely plant diversity, physiology, biochemistry, molecular biology, reproduction, anatomy, taxonomy, ecology, economic botany and the impact of environment on the growth and development of plants. All these aspects have been given due weightage over the six semesters. It is essential for the undergraduate students to acquaint themselves with various tools and techniques for exploring the world of plants up to the sub- cellular level. A paper on this aspect is proposed to provide such an opportunity to the students before they engage themselves with the learning of modern tools and techniques in plant science. Keeping the employment entrepreneurship in mind, applied courses have also been introduced. These courses shall provide the botany students hands on experience and professional inputs. On the whole, the curriculum is a source of lot of information and is supported by rich resource materials. It is hoped that a student graduating in Botany with the new curriculum will be a complete botanist at Honours level.

Students should be encouraged to opt for at least 1 or 2 Generic Electives from other Life Sciences like Zoology/Microbiology/Biochemistry/Biotechnology and Chemistry courses.

- **GENERAL GUIDELINES:**

1. The University follows Semester system.
2. Each B.Sc. course shall consist of three years i.e. six semesters.
3. An academic year shall consist of two semesters.
4. B. Sc. Part-III shall consist of two semesters: Semester V and Semester VI. In semester V, there will be Discipline specific papers three theory papers of 75 marks for each. Similarly, in each semester there will be three theory paper of 75 marks for each. DSE 1-1 and DSE 1-2, DSE 1- 3 in semester V and DSE 1-4 and DSE 1-5 are Discipline specific elective have 50 marks. Student should select any one DSE subject in each semester.

   If Student selected DSE 1-1 for Semester V then student must be select DSE 1-4 in semester VI, If Student selected DSE 1-2 for Semester V then student must be select DSE 1-5 in semester VI as far as possible for practical convenience point of view. If student selected DSE 1-3 then student can select either DSE 1-4 or DSE 1-5.

   The scheme of evaluation of performance of candidates shall be based on university assessment as well as College internal assessment as given below. For B. Sc. Part III Sem V& VI the internal assessment will be based on Unit-Tests, Home-Assignment, Viva, Practicals etc. as given below. Practical course examination of 225 marks shall be conducted at the end of V & VI semester. Each practical examination of DSC 50 (30 UA & 20 CA) & DSE 25 (15 UA & 10 CA) & VSC (30 UA & 20 CA) marks. For University practical examination there will be two external examiners and will be appointed by the University. The internal practical assessment shall be done as per scheme given below.

5. Scheme of evaluation:

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

B.Sc. Part- III Subject: BOTANY

[According to NEP 2020 W.E.F. June 2026]

Sem.	Paper	Paper Code	Title of Paper	Credits		Marks			
				T	PR	T-CA	PR-CA	T-UA	PR-UA
V	DSC 1-7	G04-DSC1-0507	Plant Systematics	3	2	30	20	45	30
	DSC 1-8	G04-DSC1-0508	Genetics	3	2	30	20	45	30
	DSC 1-9	G04-DSC1-0509	Cell Biology	3	2	30	20	45	30
	DSE 1-1	G04-DSE1-1-503	Plant Breeding	2	1	20	10	30	15
	DSE 1-2	G04-DSE1-2-503	Plant Resources and Utilization	2	1	20	10	30	15
	DSE 1-3	G04-DSE 1-3-503	Cyber Security foundation Program	2	1	20	10	30	15
	VSC 3	G04-VSC-503	Hands on training related to DSE	---	2	---	20	---	30
	IKS 2	G04-IKS-503	IKS in Plant Sciences	2	---	20	---	30	---
VI	DSC 1-10	G04-DSC1-0607	Plant Pathology	3	2	30	20	45	30
	DSC 1-11	G04-DSC1-0608	Plant Biotechnology	3	2	30	20	45	30
	DSC 1-12	G04-DSC1-0609	Molecular Biology	3	2	30	20	45	30
	DSE 1-4	G04-DSE 1-4-603	Horticulture Practices & Post Harvest Technology	2	1	20	10	30	15
	DSE 1-5	G04-DSE1-5-603	Biostatistics	2	1	20	10	30	15
	VSC 4	G04-VSC-603	Hands on training related to DSE	---	2	---	20	---	30
	FP2 CEP2 OJT1	G04-FP-601 G04-CEP-601 G04-OJT-601	FP2 CEP2 OJT1	---	2	---	20	---	30

Objectives of B.Sc. Part III Botany Syllabus:

- The aim of B.Sc. Part III Botany syllabus is to provide students with advanced and integrative knowledge of plant sciences, focusing on the structure, function, reproduction, genetics, ecology, and economic importance of plants, along with practical and analytical skills required for higher studies, research, and plant-based industries.
- The course aims to develop scientific thinking, laboratory competence, environmental awareness, and problem-solving ability related to plant life and biological systems.
- The course is designed to develop theoretical knowledge, practical laboratory skills, scientific attitude, and environmental awareness, preparing students for higher studies, research, teaching, and careers in plant and life sciences.
- **Course Outcomes of B.Sc. Part III Botany Syllabus:** After successful completion of B.Sc. Botany, the student will be able to:
- Understand advanced concepts of plant biology including Plant systematics, cell biology, genetics, plant biotechnology, Molecular biology, and biotechnology.
- Explain cellular organization and molecular processes such as cell division, gene expression, and metabolic pathways in plants.
- Analyse plant growth and development, including photosynthesis, respiration, transpiration, mineral nutrition, and plant hormones.
- Apply genetic principles to understand inheritance, variation, mutations, and plant breeding techniques.
- Evaluate ecological principles related to ecosystems, biodiversity conservation, environmental pollution, and sustainable use of plant resources.
- Perform laboratory techniques competently, including microscopy, cytological preparations, physiological experiments, and basic biochemical and molecular methods.
- Interpret experimental data and present observations, results, and conclusions in a scientific manner.
- Recognize the economic importance of plants in agriculture, medicine, industry, and environmental management.
- Develop readiness for higher education, competitive examinations, research, teaching, and careers in plant sciences, biotechnology, agriculture, and allied fields.

- Demonstrate scientific ethics, teamwork, and environmental responsibility in academic and professional contexts.
- Understand plant diversity and classification, including algae, fungi, bryophytes, pteridophytes, gymnosperms, and angiosperms.
- Explain the structure and function of plant cells, tissues, and organs, and relate them to physiological processes.
- Describe fundamental biological processes such as photosynthesis, respiration, transpiration, mineral nutrition, and plant growth regulation.
- Apply principles of genetics and plant breeding to understand inheritance, variation, and crop improvement.
- Analyse ecological concepts, including ecosystems, biodiversity, conservation, and environmental sustainability.
- Perform laboratory experiments competently, using microscopy, cytological techniques, physiological experiments, and basic biochemical methods.
- Interpret experimental data, record observations systematically, and present results scientifically.
- Recognize the economic and medicinal importance of plants in agriculture, horticulture, forestry, pharmaceuticals, and industry.
- Develop critical thinking, problem-solving ability, and scientific communication skills relevant to biological sciences.
- Prepare for higher education and careers in botany, biotechnology, agriculture, environmental science, research, and allied fields.

FP/CEP/OJT : FP2/CEP2/OJT1

A) Objectives :

1. Field Project (FP):

1. Apply theoretical knowledge of botany in real-life field settings.
2. Observe and document plant diversity, distribution, and ecological interactions.
3. Develop skills in plant identification, ecological sampling, and herbarium techniques.
4. Understand habitat-specific environmental factors affecting plant growth and conservation.
5. Enhance scientific reporting and communication skills through preparation of field reports, presentations, and posters.

2. Community Engagement Project (CEP):

1. Connect plant science with community needs, such as medicinal plants, agro-biodiversity, or sustainable practices.
2. Document traditional ecological knowledge and ethnobotanical practices from local communities.
3. Develop interpersonal and teamwork skills by working collaboratively with community members or organizations.
4. Foster a sense of social and environmental responsibility through applied projects.
5. Translate scientific knowledge into community awareness and action, such as awareness campaigns or conservation initiatives.

3. On-the-Job Training (OJT):

1. Integrate academic knowledge with real-world professional practice in laboratories, nurseries, research institutions, or agro-industrial settings.
2. Develop practical competencies, including technical skills, safety protocols, and professional work ethics.
3. Understand workflow and operational standards in plant science careers.
4. Explore career opportunities and professional pathways in botany, horticulture, biotechnology, and environmental sectors.
5. Document and reflect on learning experiences, developing skills in report writing and professional communication.

B) Outcomes:

1. Field Project (FP):

1. Apply botanical knowledge to real field settings, including plant biodiversity survey, vegetation analysis, ecological observations, and identification of species in natural habitats.
2. Develop practical skills in plant data collection and recording, for example, herbarium preparation, ecological sampling, mapping, and use of field tools.
3. Interpret ecological interactions and understand plant–environment relationships through direct observation and field experimentation.
4. Enhance scientific communication skills by preparing structured reports, presentations, or posters based on field findings.
5. Promote environmental awareness and conservation outlook by studying habitats, threats to local flora, and sustainable practices.

2. Community Engagement Project (CEP):

1. Understand socio-ecological contexts and local environmental issues through active

engagement with community stakeholders.

2. Document and communicate plant resources and their uses in community settings, including traditional knowledge, medicinal plant usage, and conservation practices.
3. Develop teamwork and communication skills while working collaboratively with residents, NGOs, or community groups.
4. Apply ecological knowledge in real-world community projects, such as awareness campaigns, biodiversity conservation initiatives, or sustainable plant-based practices.
5. Produce comprehensive reports summarizing project activities, outcomes, analyses, and community impact.

3. On-the-Job Training (OJT):

1. Acquire work-readiness skills by performing supervised tasks in relevant workplaces (e.g., research labs, nurseries, botanical gardens, agro-industries).
2. Integrate theoretical knowledge with professional practice, applying plant science concepts to problems in plant biotechnology, conservation, horticulture, or environmental management.
3. Develop professional competencies, such as time management, adherence to safety protocols, communication with peers, and ethical workplace conduct.
4. Gain insight into career opportunities, professional standards, and industry expectations relevant to plant sciences.
5. Produce a reflective training report or portfolio, documenting tasks, learning experiences, skills acquired, and future professional goals.

SEMESTER- V

DSC 1-7: Plant Systematics [G04-DSC1-0507]

Credits: 3+2 **Lectures: 45**

A) Course Preamble: Plant Systematics is a branch of Botany that deals with the identification, nomenclature, classification, and evolutionary relationships of plants. It integrates information from morphology, anatomy, cytology, genetics, and molecular biology to understand plant diversity and their evolutionary history.

B) Objectives:

1. Introduce the principles and scope of plant systematics, including taxonomy, nomenclature, and classification.
2. Familiarize students with systems of classification of plants, with special reference to natural and phylogenetic systems.
3. Study taxonomic characters derived from morphology, anatomy, embryology, palynology, cytology, phytochemistry, and molecular data & understand modern trends in taxonomy, including numerical taxonomy, cladistics, and molecular systematics.
4. Provide knowledge of plant identification techniques, herbarium methods, and the use of floras, keys, and manuals.
5. Enable recognition and classification of angiosperms, with emphasis on important families, their diagnostic features, and economic significance.

C) Outcomes:

1. Explain the scope and significance of plant systematics, taxonomy, and classification in biological sciences.
2. Compare and evaluate different systems of classification, including artificial, natural, and phylogenetic systems.
3. Identify and analyses taxonomic characters derived from morphology and other allied disciplines used in plant classification.
4. Use taxonomic tools such as floras, keys, manuals, and herbaria for plant identification.
5. Recognize and describe important angiosperm families, their diagnostic characters, affinities, and economic importance.

Unit	Contents	Lectures
1.	**Descriptive Terminology: Vegetative & Reproductive** **1.1 :** Habitat & Habit and life span **1.2 :** Roots- Types and modification. **1.3 :** Stems- Types and modification. **1.4 :** Leaves- Types and modification. **1.5 :** Inflorescence- Racemose types, Cymose types & Specialized types. **1.6 :** Flower- Calyx, Corolla, Perianth, Androecium, Gynoecium. **1.7 :** Fruit- Simple fruits, Aggregate fruits, Multiple fruits. **1.8 :** Floral formula and Floral diagram.	**15**
2.	**General Evolutionary Trends in Angiosperms & Systems of Classification:** **2.1 :** Habitat & Growth Habit; Leaf structure & Phyllotaxy; Stomatal apparatus. **2.2 :** Nodal anatomy; Xylem; Phloem; Cambium & Vascular bundle. **2.3 :** Inflorescence; Flower; Androecium; Pollination. **2.4 :** Gynoecium (ovule); Fertilization, Seeds & Seedlings & Fruits. **2.5 :** Outline of Engler and Prantl system of classification & its merits and demerits. **2.6 :** Outline of APG III system of classification of Angiosperm Phylogeny Group & its merits and demerits.	**15**
3.	**Families of Angiosperms:** **3.1 :** Study of following Angiosperms families; follow the Bentham & Hookers System of classification. 1. Annonaceae 2. Malvaceae 3. Rutaceae 4. Rubiaceae 5. Bignoniaceae 6. Lamiaceae 7. Nyctaginaceae 8. Polygonaceae 9. Orchidaceae 10. Poaceae.	**15**

- **Suggested Books:**

1. Cooke, T. 1901–1908. The Flora of The Presidency of Bombay. London. (B.S.I. Reprint). Calcutta, Vols. I, II & III, 1958.
2. Gaikwad, S. P. & Garad K. U. 2016. Flora of Solapur District. Laxmi Book Publication, Solapur.

3. Singh, N. P. & Karthikeyan, S. (edt.) 2000. Flora of Maharashtra State, Dicotyledons. vol. I.& II Botanical Survey of India, Calcutta.
4. Gurucharan S. 2010. Plant Systematics- Theory and Practice. Science Publishers, Enfield, NH, USA an imprint of Edenbridge Ltd., British Channel Islands Printed in India.
5. Naik V. N. 2005. Taxonomy of Angiosperms. Tata McGrew- Hill Publishing Company Limited, New Delhi.

DSC 1-8: Genetics [G04-DSC1-0508]

Credits: 3+2 **Lectures: 45**

A) Course Preamble: Genetics is a fundamental branch of Biology that deals with the study of heredity and variation in living organisms. It explains how traits are transmitted from one generation to the next and how genetic information is expressed and regulated within organisms. The foundation of modern genetics was laid by the pioneering work of Gregor Mendel, whose experiments on pea plants established the basic laws of inheritance. The course introduces students to the principles of classical and modern genetics, including Mendelian inheritance, gene interactions, linkage and recombination, mutation, and chromosomal basis of heredity.

B) Objectives:

1. Provide fundamental and advanced knowledge of genetics, including classical, molecular, and population genetics.
2. Develop understanding of chromosomal basis of inheritance, including linkage, crossing over, and sex determination.
3. Understand mutations and chromosomal aberrations, their causes, detection, and biological significance.
4. Develop analytical and problem-solving skills related to genetic crosses, pedigree analysis, and data interpretation.
5. Prepare students for higher studies, research, and careers in genetics, plant breeding, biotechnology, and allied life science fields.

C) Outcomes:

1. Explain fundamental concepts of genetics, including inheritance, variation, and the molecular basis of heredity.
2. Describe the chromosomal basis of inheritance, including linkage, crossing over, sex determination, and chromosomal mapping.
3. Identify different types of mutations and chromosomal aberrations and evaluate their genetic and evolutionary significance.
4. Interpret principles of population genetics, including Hardy–Weinberg equilibrium and factors affecting gene frequency.
5. Build a strong foundation for higher studies and research in genetics, plant sciences, biotechnology, and allied disciplines.

Unit	Contents	Lectures
1.	**Linkage, Crossing-over and Mutation** **1.1. Linkage and crossing over:** Introduction, coupling phase, repulsion phase, complete and incomplete linkage, detection of linkage, crossing over, mechanism of crossing over, factors affecting on recombination frequency, relationship between crossing over and chiasma formation, recombination frequencies from test cross (three point test cross) **1.2. Mutation:** Definition and classification Chromosomal aberration, Structural changes in chromosome, Numerical changes in chromosome, Spontaneous and Induced mutation, Disorders related to chromosomal number- Turner syndrome, Klinefelter syndrome and Down syndrome, Chemical and physical mutagenes.	**15**
2.	**Quantitative Inheritance** **2.1. Polygenic inheritance:** Definition, characteristics, Polygenic inheritance in plants e.g., Kernel colour of the wheat, Length of corolla in tobacco, effect of environment on polygenic inheritance. **2.2. Population Genetics:** Introduction, gene frequency, genotype frequency, gene pool, Hardey-Weinberg law, Hardey-Weinberg equilibrium, Migration, Mutation, Selection and random drift	**15**
3.	**Cytoplasmic Inheritance and Pedigree Analysis** **3.1. Cytoplasmic inheritance:** Evidences for cytoplasmic factors; Characteristic features of cytoplasmic inheritance; Plastidial or chloroplast inheritance: Leaf variegation in *Mirabilis jalapa*, Iojap in maize; Mitochondrial inheritance: Cytoplasmic Male Sterility (CMS) in maize, Pokiness in *Neurospora*; Characteristic features of cytoplasmic inheritance **3.2: Pedigree analysis:** Introduction, Symbols used in pedigree chart, modes of inheritance, Sporadic and non-heritable diseases, X linked and Y linked pedigree, importance	**15**

- **Suggested Books:**

1. Plant Chromosomes: Analysis Manipulation and Engineering. Hawood Sharma A K and Sharma A.1999: Academic Publishing Co. Ausrtalia.
2. Principles of Gene Manipulation. Old R. W. and Primrose, S. B.1989 Blackwell Scientific Publications. Oxford UK.
3. Genetics: M. L. Shrivastav, Shri Publishers and Distributors, Ansari Road New Delhi, 110002.
4. Genetics, P. K. Gupta, Rastogi Publications, Meerut, 250002.
5. Genetics and Evolution, H. S. Bhamrah, Kavita Juneja, Anmol Publications, Pvt. Ltd. New Delhi,110002
6. Fundamentals of Genetics, B. D. Singh. Kalyani Publishers Ludhiyana.

DSC 1-9: Cell Biology [G04-DSC1-0509]

Credits: 3+2 **Lectures: 45**

A) Course Preamble: Cell Biology is a fundamental branch of Biology that focuses on the study of cells, their structure, functions, and the complex processes that sustain life. The cell is considered the basic structural and functional unit of all living organisms, a concept first described by scientists such as Matthias Jakob Schleiden and Theodor Schwann, who proposed the Cell Theory. This course introduces students to the organization and functioning of cellular components including the plasma membrane, nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, and other organelles. It also covers key cellular processes such as cell division, intracellular transport, signal transduction, and cellular metabolism.

B) Objectives:

1. Provide fundamental and advanced knowledge of cell biology, focusing on the structure, organization, and function of plant cells.
2. Explain the chemical composition of cells and the role of biomolecules in cellular structure and metabolism.
3. Describe the structure and functions of cell organelles, such as nucleus, mitochondria, chloroplasts, endoplasmic reticulum, Golgi apparatus, and lysosomes.
4. Explain the organization and dynamics of the cytoskeleton and its role in cell shape, movement, and division.
5. Introduce the cell cycle and mechanisms of cell division, including mitosis and meiosis.

C) Outcomes:

1. Explain the structural and functional organization of plant cells, including prokaryotic and eukaryotic cell types.
2. Understand the structure and function of cell membranes and explain various membrane transport mechanisms.
3. Identify and explain the functions of major cell organelles, such as nucleus, mitochondria, chloroplasts, endoplasmic reticulum, Golgi apparatus, ribosomes, and lysosomes.
4. Explain the organization and role of the cytoskeleton in maintaining cell shape, movement, and intracellular transport.
5. Describe the cell cycle and mechanisms of cell division, including mitosis and meiosis, and their biological significance.

Unit	Contents	Lectures
1.	**The Cell** **1.1 :** Cell- Unit of Life, The Cell Theory. **1.2 :** Prokaryotic cell- structure, cell size and shape. **1.3 :** Eukaryotic cells- structure, cell size and shape. **1.4 :** Eukaryotic cell components.	**10**
2.	**Cell Organelles** **2.1 :** Ultra structure and function of Mitochondria, Chloroplast, Nucleus, ER, Golgi body, Lysosomes, Peroxisomes and Glyoxisomes, Cell-Membrane and Cell wall. **2.2 :** Structure and function of cytoskeleton & its role in motility. **2.3 :** History of chromosome, Morphology, shape, size. Types of Chromosomes. **2.4 :** Karyotypes.	**20**
3.	**Cell Division and Cell Cycle** **3.1 :** Cell Division- Mitosis & Meiosis and their regulations. **3.2 :** Steps in cell cycle. **3.3 :** Regulation & control of cell cycle. **3.4 :** Significance of cell cycle (Mitosis and Meiosis).	**15**

- **Suggested Books:**

1. A Textbook of Cell Biology: S. C. Rastogi, Rastogi Publications.
2. Buchanan, B. B. Griossem W and Jones, R.L.2000. Biochemistry and Molecular Biology of Plants American Society of plant Physologist, Maryland, U.S.A.
3. Cell Biology- C. B. Powar, H. F. Daginawala, V. L. Shinde Himalaya Publishing House
4. Genetics and Cytogenetics P. K. Gupta Rastogi Publications.
5. Harris, N. and Oparka, K.J.1994. Plant cell Biology: A Practical Approach, IRL press at Oxford university Press, Oxford, U.K.
6. Krishnmourthy, K. V. (2000) Methods in Cell Wall chemistry. CRC Press, Boca Raton, Florida.
7. Lewin B. 2000 Genes VII Oxford University Press, New York.
8. Wolfe, S. L. (1993) Molecular and cell Biology-Wadsworth publishing Co. California, U.S.A.

DSE 1-1: Plant Breeding [G04-DSE1-1-503]

Credits: 2+1 **Lectures: 30**

A) Course Preamble: Plant Breeding is an important branch of Agricultural Science and Genetics that deals with the improvement of crop plants through the manipulation of their genetic makeup. The main objective of plant breeding is to develop new plant varieties with desirable traits such as higher yield, improved quality, resistance to pests and diseases, and better adaptability to environmental conditions. This course introduces students to the basic principles and methods used in plant breeding, including selection, hybridization, mutation breeding, and the use of genetic variability in crop improvement.

B) Objectives:

1. Introduce the principles and objectives of plant breeding, emphasizing the improvement of crop yield, quality, and resistance to biotic and abiotic stresses.
2. Explain the hybridization programs and familiarize students with different methods of plant breeding, including selection, hybridization, mutation breeding, and modern biotechnological approaches.
3. Develop understanding of breeding for disease resistance, pest resistance, and environmental tolerance in crop plants.
4. Highlight the role of biotechnology, molecular markers, and genetic engineering in modern plant breeding.
5. Prepare students to apply plant breeding principles in agriculture, horticulture, forestry, and research.

C) Outcomes:

1. Understand the objectives and importance of plant breeding in improving crop yield, quality, and resistance to stresses.
2. Explain the genetic basis of variation and utilize it for selection and hybridization programs.
3. Apply different plant breeding methods, including selection, hybridization, mutation breeding, and modern biotechnological approaches.
4. Develop strategies for breeding disease-resistant, pest-resistant, and environmentally tolerant crop varieties.
5. Integrate molecular and biotechnological tools in modern plant breeding, such as marker-assisted selection and genetic engineering.

Unit	Contents	Lectures
1.	**Plant Breeding** **1.1:** Introduction **1.2:** Aim and objectives. **1.3:** Scope of plant breeding.	**5**
2.	**General Methods of Plant Breeding** **2.1:** Outline of Plant breeding methods **2.2:** Plant Introduction and acclimatization (Types, Purpose, Procedure, acclimatization, uses merits and Demerits). **2.3:** Selection methods: Pure line, Mass and Clonal selection. **2.4:** Procedure of hybridization **2.5:** Hybridization in self-pollinated crop plants: Pedigree method, Bulk method **2.6:** Hybridization in cross pollinated crop plants: Single cross	**15**
3.	**3.1: Special Breeding techniques:** **Mutational Breeding:** Types of mutation, procedure for mutation breeding, mutagens and their mode of action, applications in crop improvement. Role of polyploidy in plant breeding **3.2: Seed production** **Seed Production:** Introduction, Classes of improved seeds, seed certification, Major steps in Quality seed production, causes of varietal deterioration, seed producing organization, seed testing	**10**

- **Suggested Books:**

1. Singh, B. D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
2. Chaudhari, H. K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH.
3. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.
4. Kader, A. A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, U.S.A. 5.
5. Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.
6. Phudan Singh (2010) Introduction to plant breeding. Kalyani Publishers.

DSE 1-2: Plant Resources and Utilization [G04-DSE1-2-503]

Credits: 2+1 **Lectures: 30**

A) Course Preamble: Plant Resources and Utilization is a specialized branch of Plant Science that focuses on the study of plants as valuable resources for human use, including food, medicine, fiber, fuel, timber, and other industrial and cultural applications. Understanding the diversity, biology, and sustainable management of plant resources is essential for conservation, sustainable development, and the well-being of society. This course introduces students to the identification, classification, and sustainable exploitation of plant resources. It covers economically important plants, their parts used, methods of cultivation or collection, processing techniques, and their applications in industries such as pharmaceuticals, agriculture, forestry, and biotechnology.

B) Objectives:

1. Introduce the diversity and classification of plant resources, including medicinal, aromatic, timber, fiber, oil-yielding, and ornamental plants.
2. Explain the chemical and pharmacological properties of economically important plants and their active constituents.
3. Develop understanding of the sustainable utilization of plant resources for food, medicine, industry, and environmental management.
4. Familiarize students with methods of collection, processing, storage of plant resources.
5. Highlight the role of traditional knowledge in the identification and use of plant resources.

C) Outcomes:

1. Understand the diversity and classification of plant resources, including medicinal, aromatic, timber, fiber, oil-yielding, and ornamental plants.
2. Explain the chemical and pharmacological properties of economically important plants and their active constituents.
3. Apply knowledge of sustainable utilization of plant resources for food, medicine, industry, and environmental management.
4. Demonstrate methods of collection, processing, and storage of plant resources to maintain quality and efficacy.
5. Recognize the role of ethnobotany and traditional knowledge in the identification and utilization of plant resources.

Unit	Contents	Lectures
1.	**Food Plants & Other Economic Plant Products** 1.1 Origin, Morphology and economic importance of Maize major (bajra) and minor millets (finger millet) 1.2 Origin, Morphology and economic importance (Soyabean &Sunflower). 1.3 Origin, Morphology and economic importance (Pomegranate and Guava and vegetable yielding plants (Tomato & Brinjal). 1.4. Origin, Morphology and economic importance (Jute and Coconut).	**10**
2.	**Commercial, Medicinal and Aromatic Plant Products** 2.1 Origin, Source and economic potential of spices (Coriander seeds, Cinnamon) and condiments (Mustard, Cumin). 2.2 Plant sources and economic importance of flavoring products (Curry leaves), beverages (grapes), fumitories (Tobacco) and masticatories (Betel Vine). 2.3 Source, Active compounds and Traditional and modern uses of medicinal plants (*Adathoda zeylanica* and *Withania somnifera*) of India. 2.4 Aromatic plants and its uses in perfumery and cosmetics industry (Rose and Turmeric)	**10**
3.	**Timber yielding plants and Biofuel plants:** **3.1 Timber yielding plants:** (*Tectona* and *Dalbergia)***:** Botanical Name, Morphology and uses. **3.2 Paper yielding plants:** (Bamboos, *Eucalyptus):* Botanical name, Morphology, generation of raw material for paper industry and uses.) **3.3 Biofuel plants**: (*Pongamia pinnata* and *Jatropha curcas*): Morphology, source and role of biofuel plants in sustainable energy.	**10**

- **Suggested Books:**

1. K. V. Peter, (2004) Handbook of Herbs and Spices, CRC Press, Boca Raton.
2. J. E. Simon, J. A. Duke, and E. A. L. Bobilya, (1990) Handbook of Edible Weeds, CRC Press, Boca Raton.
3. J. Smartt and N. Haq, (2016) Handbook of Industrial Crops, Springer, New York.
4. P. N. Ravindran, (2017) The Encyclopedia of Herbs and Spices, CABI, Wallingford.
5. Beryl B. Simpson (2010) Economic Botany: Plants in Our World, Academic Press, London.

IKS 2: IKS in Plant Sciences [G04-IKS-503]

Credits: 2 **Lectures: 30**

A) Course Preamble: This course introduces students to the concepts and contributions of Indian knowledge traditions in plant sciences, including plant classification, cultivation practices, and the use of plants in traditional medicine. Ancient texts such as the Charaka Samhita and Sushruta Samhita, associated with scholars like Charaka and Sushruta, describe numerous medicinal plants and their therapeutic uses, forming the basis of Ayurveda.

The course also highlights traditional agricultural practices, ethnobotanical knowledge of indigenous communities, sacred groves, and conservation traditions that have contributed to biodiversity protection in India. Integrating traditional knowledge with modern scientific approaches can help promote sustainable agriculture, conservation of plant resources, and the development of plant-based medicines.

B) Objectives:

1. Introduce Core Concepts of Indian Knowledge Systems (IKS): Help students understand the foundations of Indian Knowledge Systems- how traditional Indigenous knowledge was developed, its philosophical base, and its significance within Indian intellectual heritage.
2. Explore Traditional Plant-Related Knowledge: Facilitate understanding of ancient Indian perspectives on plant life, ecology, and plant-based sciences, including how traditional systems like Ayurveda, ethnobotany, folk practices, and indigenous agriculture view plants and ecosystems.
3. Appreciate Indigenous Practices in Plant Use & Conservation: Enable students to recognize and value traditional applications of plant knowledge- such as medicinal uses of plants, sustainable harvesting practices, indigenous cultivation techniques, and conservation practices rooted in cultural traditions.
4. Bridge Traditional Wisdom with Modern Plant Sciences: Promote the integration of IKS perspectives with contemporary plant science, encouraging students to see complementarities between ancient insights and modern disciplines such as ecology, pharmacognosy, agriculture, and environmental studies.
5. Develop Cultural and Ethical Awareness: Foster respect for cultural botanical knowledge, traditional ecological ethics, and sustainable resource management- inspiring learners to apply IKS principles in addressing environmental and societal challenges.

C) Outcomes:

1. Explain the foundations of Indian Knowledge Systems (IKS) in relation to plant sciences, including key concepts from ancient texts and traditional botany.
2. Describe the role of classical Indian literature and traditional ecological knowledge (e.g., Vedas, Upanishads, Ayurvedic texts) in understanding plant diversity, uses, and ecological relationships.
3. Interpret the principles of Ayurveda and plant-based healing, including concepts such as Panchamahabhutas, doshas, and traditional classifications of medicinal plants.
4. Identify and document traditional and ethnobotanical practices used by various Indian cultures for food, medicine, ritual, and conservation.
5. Correlate traditional plant classification and usage systems with modern plant taxonomy and economic botany, highlighting similarities and differences.

Unit	Contents	Lectures
1.	**Indigenous Knowledge on Plants & Agriculture** **1.1 :** Traditional Indian agricultural systems and practices. **1.2 :** Sustainable land and water management techniques. **1.3 :** Indigenous pest management and soil conservation methods. **1.4 :** Traditional crop varietal knowledge (e.g., millets, pulses). **1.5 :** Heritage irrigation systems and their botanical relevance.	**10**
2.	**Traditional Uses of Medicinal & Useful Plants** **2.1 :** Role of medicinal plants in Ayurveda, Siddha, Unani, and tribal medicine. **2.2 :** Ethnobotanical knowledge of healing plants. **2.3 :** Plants used for hygiene, nutrition, and rural healthcare. **2.4 :** Traditional preparation and usage of plant-based remedies.	**10**
3.	**Indian Knowledge Traditions Applied to Ecology** **3.1 :** Sacred groves and community-based conservation. **3.2 :** Cultural and spiritual significance of forests and biodiversity. **3.3 :** Traditional ecological understanding of plant communities. **3.4 :** Indigenous ways of coexisting with nature and seasonal plant cycles.	**10**

- **Suggested Books:**

1. Ethnobotany of India (5-Volume Set) — Edited by T. Pullaiah, K. V. Krishnamurthy & Bir Bahadur.
2. Ethnobotany and Medicinal Plants of Indian Subcontinent — J. K. Maheshwari.
3. Ethnomedicinal Plants: Revival of Traditional Knowledge — Aparna Pareek.
4. Ethnobotany: Volume 1 — Dr. Suresh Kumar.
5. Medicinal Plants in Traditional Systems of Medicine (IKS-BOT-T) — Prof. (Dr.) K. N. Dhumal & Dr. Sayyed Iliyas.

PRACTICALS SEMESTER- V

DSC 1-7: Plant Systematics [G04-DSC1-0507-P]

Sr. No.	Name of the Practicals
1.	To study habitat and habit of available plants
2.	Study of root types and modifications.
3.	Study of stem types and modifications.
4.	Study of inflorescence types (Cymose, Racemose & Specialized).
5.	Study of fruit types.
6.	Identification of genus and species with the help of regional (any available) flora.
7.	Study of evolutionary trends in vegetative characters
8.	Study of primitive and advanced characters in plants (any four plants)
• Study of families as per theory syllabus (Available plant families and Bentham and Hooker's system to be followed):	
9.	Annonaceae & Malvaceae
10.	Rutaceae & Rubiaceae
11.	Bignoniaceae & Lamiaceae
12.	Nyctaginaceae & Polygonaceae
13.	Orchidaceae & Poaceae
14.	Preparation & submission of herbarium specimens (at least 10)

DSC 1-8: Genetics [G04-DSC1-0508-P]

Sr. No.	Name of the Practicals
1.	Study of chromosomal anomalies in *Rhoeo* bud.
2.	Study of Linkage using *Drosophila* traits with the help of given data/Photograph.
3.	Solve the genetic problem based on Linkage and crossing over (two point cross and three-point cross).
4.	Study numerical changes in chromosome with the help of photographs: Turner syndrome, Klinefelter syndrome and Down syndrome
5.	Study of Chromosomal Aberrations- Deletion, Duplication, Inversion and Translocation (using charts/photographs)
6.	Study of Polyploidy in Plants using Charts/Specimens or by using colchicine treatment.
7.	Study of Physical and chemical mutagens.
8.	Comparison of Normal and Abnormal Chromosome Number using Karyotype Photographs.
9.	Solve the problems based on Polygenic inheritance.
10.	Graphical Representation of Continuous Variation in Polygenic Traits in kernal color of wheat/Skin colour of human.
11.	Solve the problems based on Population genetics (Hardey Weinberg Law).
12.	Study of *Mirabilis jalapa* with respect to cytoplasmic inheritance.
13.	Cytoplasmic Male Sterility (CMS) in Maize.
14.	Study of Pedigree chart.

DSC 1-9: Cell Biology [G04-DSC1-0509-P]

Sr. No.	Name of the Practicals
1.	Mitosis cell division in onion root-tip cells.
2.	Meiotic cell division in *Allium* spp.
3.	Study of permeability of plasma membrane.
4.	Isolation of Mitochondria.
5.	Isolation of chloroplasts.
6.	To study karyotype and prepare an ideogram of a plant by photograph.
7.	Structure of onion peel cell.
8.	Test for carbohydrates, proteins, and lipids in plant cells.
09. - 13.	Microtome technique.
14.	Submission (submit at least 5 slides per student- Microtome technique).

DSE 1-1: Plant Breeding [G04-DSE1-1-503-P]

Sr. No.	Name of the Practicals
1.	Study of emasculation and bagging technique
2.	Study of self and cross pollinated methods
3.	Study of floral biology of crop plants (available any three crop plants)
4.	Calibration of ocular micrometer and estimate the size of pollen grain.
5.	To study pollen viability and pollen germination in crop plants
6.	Study of male sterility in laboratory by staining the pollen grains.
7.	Study of seed viability test by germination methods

VSC 3: Plant Breeding [G04-VSC-503]

Sr. No.	Name of the Practical's
1.	Plant breeders kit and its uses.
2.	Seed selection and seed treatment techniques before sowing
3.	Seed processing, cleaning, grading and storage
4.	To study of breaking of seed dormancy.
5.	Identification of diseased and healthy seeds
6.	Estimation of heterosis.
7.	To demonstrate the procedure of germplasm collection.
8.	To study artificial pollination technique.
9.	Identification of seeds of economically important crop
10.	Study of mutagenic agent
11.	Study of effect of colchicine treatment on crop plants (onion).
12.	To study of hybridization technique in Malvaceae and Fabaceae.
13.	To study of hybridization technique in Brassicaceae and Poaceae
14.	Field visit (Breeding station / Crop research institute).

DSE 1-2: Plant Resources and Utilization [G04-DSE 1-2-503-P]

Sr. No.	Practical
1.	Taxonomic status of food plants and other economic plants and its uses-Bajra.
2.	Taxonomic status of food plants and other economic plants and its uses- foxtail millet.
3.	Taxonomic status of food plants and other economic plants and its uses- red gram.
4.	Taxonomic status Commercial uses of – Coriander seeds and Cumin.
5.	Taxonomic status Commercial uses of – Grapes and Betel Vine.
6.	Taxonomic status of food plants and other economic plants and its uses- Mahogani, and *Eucalyptus.*
7.	Taxonomic status of food plants and other economic plants and its uses- *Withania somnifera* and Turmeric.

VSC 3: Plant Resources and Utilization [G04-VSC-603]

Sr. No.	Practical
1.	Taxonomic status of food plants and other economic plants and its uses-Maize.
2.	Taxonomic status of food plants & other economic plants & its uses- Bajara, finger millet.
3.	Taxonomic status of food plants & other economic plants and its uses- black gram.
4.	Agriculture and Industrial uses of- Soyabean and Sunflower.
5.	Taxonomic status of food plants and other economic plants and its uses- Pomegranate and Guava.
6.	Taxonomic status of food plants & other economic plants and its uses- Tomato & Brinjal.
7.	Agriculture and Industrial uses of- Jute and Coconut.
8.	Taxonomic status and Commercial uses of- Cinnamon.
9.	Taxonomic status and Commercial uses of- Mustard.
10.	Taxonomic status and Commercial uses of- Cury leaves.
11.	Taxonomic status and Commercial uses of- Tobacco
12.	Taxonomic status and Medicinal uses of- *Adathoda*.
13.	Taxonomic status and Aromatic and commercial uses of- Rose.
14.	Taxonomic status & Commercial uses of- Teak, Maize, Jatropha, Bamboos.

SEMESTER- VI

DSC 1-10: Plant Pathology [G04-DSC1-0607]

Credits: 3+2 **Lectures: 45**

A) Course Preamble: Plant Pathology is a specialized branch of Plant Science that deals with the study of plant diseases, their causes, mechanisms of infection, and methods of prevention and control. Plant diseases can significantly affect crop yield and quality, posing a major challenge to agriculture and global food security. It also covers the processes of host– pathogen interaction, disease development, and the spread of plant pathogens. Understanding these mechanisms helps in developing effective strategies for disease management.

B) Objectives:

1. Introduce the fundamentals of plant pathology, including the nature, scope, and importance of plant diseases.
2. Explain the causal organisms of plant diseases, including fungi, bacteria, viruses, nematodes, and other pathogens.
3. Familiarize students with the symptoms, signs, and diagnosis of common plant diseases in economically important crops.
4. Explain plant disease management strategies, including cultural, chemical, biological, and integrated disease management (IDM) approaches.
5. Highlight the role of plant pathology in agriculture, horticulture, forestry, and food security.

C) Outcomes:

1. Understand the fundamentals of plant pathology, including the nature, scope, and significance of plant diseases.
2. Identify the major plant pathogens, including fungi, bacteria, viruses, nematodes, and other disease-causing agents.
3. Explain the mechanisms of disease development, epidemiology, and host-pathogen interactions.
4. Recognize symptoms and signs of plant diseases in economically important crops.
5. Apply appropriate disease management strategies, including cultural, chemical, biological, and integrated disease management (IDM) practices & develops the skills for laboratory diagnosis and identification of plant pathogens.

Unit	Contents	Lectures
1.	**Introduction** **1.1 :** Terms, Nature, and concept of plant diseases. **1.2 :** Cause of disease. **1.3 :** Classification of Plant Diseases Based on- Symptoms, Spread and Severity of Infection. **1.4 :** Importance of plant diseases. **1.5 :** Mycoplasmas, Bacteria and Viruses: Study of following plant diseases with respect to causal organisms, symptoms, and control measures- 1. Little leaf of Brinjal 2. Oily spot of Pomegranate (Telya diseases) 3. Citrus canker 4. Tobacco & Tomato mosaic **1.6 : Aerobiology and Seed Pathology:** **1.6.1 :** Aerobiology- Definition, scope and importance and disease forecasting. **1.6.2 :** Seed pathology- Definition, seed borne pathogens (external and internal) seed treatment (hot water, solar, chemical) and seed certification.	**15**
2.	**Smuts** **2.1 :** Study of following plant diseases with respect to causal organisms, symptoms, and control measures: **2.1.1 :** Fruit rot of Cucurbits; **2.1.2 :** Late blight of Potato; **2.1.3 :** Downy mildew of Grapes; **2.1.4 :** Powdery mildew of Mango; **2.1.5 :** White rust of Crucifers; **2.1.6 :** Smut of Jowar.	**15**
3.	**Rusts, Wilts, Leaf spots & Blights and Anthracnoses** **3.1 :** Study of following plant diseases with respect to causal organisms, symptoms, and control measures: **3.1.1 :** Brown rust of Wheat. **3.1.2 :** Wilt of Pigeon pea (*Cajanus cajan*). **3.1.3 :** Brown spot of Maize. **3.1.4 :** Tikka disease of Groundnuts.	**15**

- **Suggested Books:**

1. Introductory Mycology John Wiley and Sons Inc. by Alexopoulos C.J., Mims
2. C.W. and Blackwel. M. (1996).
3. Introduction to Bacteria McGraw Hill book Co. New York by Clifton. A. (1958)
4. Introductory Phycology Affiliated East – West Press Ltd. New Delhi by Kumar H. D. (1988).
5. Introduction to Plant Viruses Chand and Co. Ltd. Delhi by Mandahar C. L. (1978).
6. Diseases of crop plants in India Prentice Hall of India Pvt. Ltd. New Delhi by Rangaswamy G. and Mahadevan A.

DSC 1-11: Plant Biotechnology [G04-DSC1-0608]

Credits: 3+2 **Lectures: 45**

A) Course Preamble: Plant Biotechnology is an advanced branch of Biotechnology that involves the application of modern biological techniques to improve plants for agricultural, industrial, and environmental purposes. It integrates knowledge from Molecular Biology, Genetics, and Plant Science to manipulate plant cells and genetic material for the development of improved plant varieties.

B) Objectives:

1. Introduce the fundamental concepts and scope of plant biotechnology, highlighting its applications in agriculture, medicine, and industry.
2. Develop understanding of plant tissue culture techniques, including micropropagation, callus culture, and somatic embryogenesis.
3. Explain the principles and applications of plant genetic engineering, including recombinant DNA technology and gene cloning.
4. Familiarize students with molecular markers, molecular breeding, and transgenic plants for crop improvement.
5. Provide knowledge of biotechnological approaches to plant disease resistance, stress tolerance, and secondary metabolite production.

C) Outcomes:

1. Understand the fundamental concepts and scope of plant biotechnology and its applications in agriculture, medicine, and industry.
2. Explain and apply plant tissue culture techniques, including micropropagation, callus culture, and somatic embryogenesis.
3. Understand the principles of plant genetic engineering, including recombinant DNA technology, gene cloning, and development of transgenic plants.
4. Utilize molecular markers and molecular breeding techniques for crop improvement and genetic analysis.
5. Apply biotechnological methods for developing disease-resistant, stress-tolerant, and high-value plants.

Unit I	**Introduction to plant biotechnology:** Introduction and basic concept; Origin definition and importance; Branches and industrial application; Biofertilizers, Biopesticides, secondary metabolites; Biotechnology and environment: Pollution control environment and energy; Restoration of degraded land; biodiversity conservation biosafety and ethical issue; recent advances and future prospects and IPR	**15**
Unit II	**Genetic engineering in plants:** Introduction and basic principles; Recombinant DNA technology; Enzymes involved in recombinant DNA technology; Restriction enzymes, ligase and polymerase enzyme; Cloning vectors and their features; Plasmid bacteriophage Cosmid; Biological gene transfer method; Physical method of gene transfer; Insect resistant BT cotton, herbicide resistant, Development of stress tolerant crops; Application and future prospects of plant genetic engineering.	15
Unit III	**Plant Tissue Culture:** Introduction and basic concepts, History scope and application, Totipotency and cell differentiation, Laboratory organization and sterilization, Culture media and plant growth regulators, Technique of plant tissue culture, Callus culture and its application, Cell suspension culture, Micro propagation method and stages, Anther and pollen culture technique, Somatic embryogenesis and artificial seed, Applications and limitations of plant tissue culture	15

- **Suggested Books:**

1. Bhojwani, S. S. and Razdan, M. K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Glick, 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 Wiley & Sons Inc. U. S. A.

DSC 1-12: Molecular Biology [G04-DSC1-0609]

Credits: 3+2 **Lectures: 45**

A) Course Preamble: Molecular Biology is a fundamental branch of Biology that focuses on the study of biological processes at the molecular level, particularly the structure and function of nucleic acids and proteins. It explains how genetic information is stored, replicated, and expressed in living organisms. The foundation of molecular biology was greatly influenced by the discovery of the DNA double-helix structure by James Watson and Francis Crick, which revolutionized the understanding of heredity and gene function. This course introduces students to the molecular mechanisms that govern life, including DNA replication, transcription, translation, and gene regulation. It also explores the relationship between DNA, RNA, and proteins as described in the Central Dogma of Molecular Biology.

B) Objectives :

1. Introduce the fundamental concepts of molecular biology, including the structure, organization, and function of nucleic acids and proteins.
2. Explain the molecular basis of gene expression, including DNA replication, transcription, and translation in plants.
3. Develop understanding of gene regulation mechanisms in prokaryotic and eukaryotic systems.
4. Familiarize students with molecular techniques such as PCR, gel electrophoresis, blotting methods, and recombinant DNA technology.
5. Explain the structure and function of chromosomes, chromatin organization, and the molecular basis of genetic inheritance.

C) Outcomes :

1. Understand the fundamental concepts of molecular biology, including the structure and function of nucleic acids and proteins in plants.
2. Explain the molecular basis of gene expression, including DNA replication, transcription, translation, and post-transcriptional modifications.
3. Describe mechanisms of gene regulation in prokaryotic and eukaryotic systems.
4. Apply molecular biology techniques, such as PCR, gel electrophoresis, blotting methods, and recombinant DNA technology, in plant research.
5. Understand chromosomal organization, chromatin structure, and the molecular basis of inheritance in plants.

Unit	Contents	Lectures
1.	**Nucleic Acids** **1.1 :** Structure of nitrogenous bases. **1.2 :** Structure and function of nucleotides. **1.3 :** Types of nucleic acids. **1.4 :** Structure of A, B, Z types of DNA. **1.5 :** Types of RNA & structure of t-RNA. **1.6 :** Satellite, Repetitive DNA, and Transposable element in plants (AC DS system).	**15**
2.	**DNA and RNA Metabolism** **2.1 :** Introduction. **2.2 :** Synthesis of DNA (Kornberg's discovery). **2.3 :** Replication of DNA in prokaryotes and eukaryotes. **2.4 :** Enzymes involved in DNA replication.	**10**
3.	**Transcription & Translation** 3.1 **:** Introduction to gene expression 3.2: Central Dogma 3.3 Transcription: Definition, structure of Gene, mechanism, RNA Polymerase, Post transcriptional modification 3.4: Difference between prokaryotic and eukaryotic transcription 3.5: Genetic code: Characteristic, Wobble hypothesis, codon and anticodon 3.6: Translation: Definition, structure and role of ribosome, mechanism of translation, protein synthesis in prokaryotes and eukaryotes, Post translational modifications 3.7: Regulation of Gene Expression: Operon concept in Lactose metabolism 3.8. Post translational Modification	**20**

Suggested Books:

1. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U. S. A. 10thedition.
2. Klug, W. S., Cummings, M. R., Spencer, C. A. (2009). Concepts of Genetics. Benjamin Cummings U.S.A. 9th edition.
3. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
4. Snustad, D. P. and Simmons, M. J. (2010). Principles of Genetics. John Wiley and Sons Inc., U. S. A. 5thedition.
5. Watson J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.

DSE 1-4: Horticulture Practices & Post Harvest Technology

[G04-DSE-1-4-603]

Credits: 2+1 **Lectures: 30**

A) Course Preamble: Horticulture is an important branch of Agricultural Science that deals with the cultivation, improvement, and management of fruits, vegetables, flowers, and ornamental plants. It plays a vital role in enhancing nutritional security, generating employment, and improving the economic status of farmers. Proper horticultural practices help in achieving higher productivity, better quality produce, and efficient utilization of natural resources. Post-harvest technology focuses on the processes of harvesting, grading, packaging, storage, transportation, and value addition of horticultural products. Knowledge of post-harvest handling is essential because fruits and vegetables are highly perishable, and improper management can lead to significant losses. The application of scientific techniques in post-harvest management helps in extending shelf life, maintaining nutritional quality, and improving market value.

B) Objectives:

1. Introduce the principles and scope of horticulture, including vegetable, fruit, flower, and medicinal plant cultivation.
2. Familiarize students with horticultural practices, such as soil preparation, propagation techniques, irrigation, fertilization, pruning, and pest management.
3. Develop understanding of plant propagation techniques, including sexual (seed) and asexual (cutting, grafting, budding, layering) methods.
4. Explain post-harvest physiology and technology, including harvesting, grading, storage, packaging, and transportation of horticultural crops.
5. Highlight methods to extend shelf life and maintain quality of fruits, vegetables, and flowers.

C) Outcomes:

1. Understand the principles and scope of horticulture, including vegetable, fruit, flower, and medicinal plant cultivation.
2. Apply horticultural practices such as soil preparation, propagation, irrigation, fertilization, pruning, and pest management.
3. Demonstrate knowledge of plant propagation techniques, including sexual (seed) and asexual (cutting, grafting, budding, layering) methods.
4. Understand post-harvest physiology and technology, including harvesting, grading, storage, packaging, and transportation of horticultural crops.
5. Apply methods to extend shelf life and maintain quality of fruits, vegetables, and flowers.

Unit	Contents	Lectures
1.	**Introduction & Fruit and Vegetable Crops** **1.1:** Scope and importance, Branches of horticulture; Role in rural economy and employment generation. **1.2:** Importance in food and nutritional security; Urban horticulture and ecotourism. **1.3:** Production, origin and distribution; Description of plants and their economic products; Management and marketing of vegetable and fruit crops varieties (Indian gooseberries, Citrus, Banana, Mango, Chillies and Cucurbits). **1.4:** Identification of some fruits and vegetable varieties (Indian gooseberries, Citrus, Banana, Mango, Chillies and Cucurbits).	**10**
2.	**Horticultural Techniques & Floriculture** **2.1:** Application of manure, fertilizers, nutrients and PGRs; weed control; biofertilizers & biopesticides. **2.2:** Irrigation methods (drip irrigation, surface irrigation, furrow and border irrigation); Hydroponics. **2.3:** Cut flowers, bonsai, commerce (market demand and supply); Importance of flower shows and exhibitions.	**10**
3.	**Post-Harvest Technology** **3.1:** Importance of post-harvest technology in horticultural crops; Evaluation of quality traits. **3.2:** Harvesting and handling of fruits, vegetables and cut flowers; Principles, methods of preservation and processing; Methods of minimizing loses during storage and transportation; **3.3:** Food irradiation - advantages and disadvantages; food safety.	**10**

- **Suggested Books:**

1. Horticultural Practices and Post-Harvest Technology — Dr. Subrata Mandal, Dr. Sudipa Nag & Alokesh Das.
2. *Postharvest Technology of Horticultural Crops* — Priya Awasthi, Subhash Chandra Singh & Rohit Kumar.
3. *Postharvest Management of Horticultural Crops* — Surajit Mitra
4. *Postharvest Handling of Horticultural Crops* — R. L. Bhardwaj, Yogesh K. Sharma & Latika Vyas.
5. *Handbook on Post-Harvest Management of Horticulture Crops* — Mushtaq A. Baigh & Co.

DSE 1-5: Biostatistics [G04-DSE-1-5-603]

Credits: 2+1 **Lectures: 30**

A) Course Preamble: Biostatistics is an important branch of Statistics that applies statistical methods and principles to the study of biological data. By using statistical tools, researchers can draw meaningful conclusions, test hypotheses, and make informed decisions in scientific investigations. This course introduces students to fundamental statistical concepts such as data collection, classification, presentation, measures of central tendency, measures of dispersion, probability, correlation, and regression.

B) Objectives:

1. To impart the knowledge of basic statistical concepts such as data types, sampling methods, measures of central tendency, dispersion, and probability.
2. To impart the knowledge to apply descriptive statistics to summarize biologically related data using tables, graphs, and charts.
3. To impart the knowledge of analyzing experimental and observational data using appropriate statistical tools.
4. To interpret biological variability and understand sources of error in biological measurements.
5. To Use probability distributions relevant to biological research & impart the knowledge regarding the Perform hypothesis testing using standard tests such as t-test, chi-square test.

C) Outcomes:

1. The students may understand fundamental statistical terms such as population, sample, variables, frequency distribution, and data types used in biological sciences.
2. The students should be able to apply methods of data collection, classification, and graphical representation (histograms, bar diagrams, etc.) for biological data.
3. The students should be able to compute and interpret measures of central tendency (mean, median, and mode) and dispersion (range, variance, coefficient of variation).
4. The students should be able to analyses biological data using probability concepts and basic distributions.
5. The students should be able to apply hypothesis testing techniques including t-test, chi-square test & students should be able to use statistical software or spreadsheets (e.g., Excel) for organizing, analyzing, and presenting biological data.

Unit	Contents	Lectures
1.	**Introduction & Collection of Primary and Secondary Data** **1.1 :** Definition, Basic principles. **1.2 :** Statistical methods. **1.3 :** Variable's measurements, functions, limitations and uses of statistics. **1.4 :** Types of data. **1.5 :** Methods of data collection. **1.6 :** Merits and demerits.	**10**
2.	**Classification, Tabulation of data & Measures of Central Tendency** **2.1 :** Classification of data. **2.2 :** Tabulation and presentation of data **2.3 :** Sampling methods. **2.4 :** Mean, median and mode, merits & demerits. **2.5 :** Measures of dispersion –range, standard deviation and mean deviation, merits & demerits. **2.6**: Co-efficient of variations.	**10**
3.	**Probability & Statistical inference** **3.1 :** Basic Concepts. **3.2 :** Kinds of Probabilities **3.3 :** Measures of Probability **3.4 :** Hypothesis- Student 't' test and chi-square test and its significance	**10**

- **Suggested Books:**

1. An introduction to Biostatistics, 3rd edition, Sundarrao, P. S. Sand Richards, J. Christian Medical College, Vellore.
2. Biostatistics – Suryavanshi R. S., Tembhure R. R., Bhise D. S., 2019, Phadke Prakashan.
3. Biostatistics, Danniel, W. W., 1987. New York, John Wiley Sons.
4. F.O. Bower – Plants and Man Ariana Publishing House, New Delhi.
5. Fuller, K.W. and Galon, J.r. 5985. Plant Products and New Technology. Calrendon Press, Oxford, New York.

6. Kocchar, S.L. 5998. Economic Botany in Tropics, 2nd edition. Macmillan India Ltd., New Delhi.
7. R.C. Grewal – Medicinal plants, Campus Books International 4825/24, Prahiadstreet, Ansari Road, Darya Ganj, New Delhi.
8. Sambamurthy, A.V.S.S. and Subramanyam, N.S. 5989. A Textbook of Economic Botany, Wiley Eastern Ltd., New Delhi.
9. Statistical Analysis of epidemiological data, Selvin, S., 1991. New York University Press.
10. Statistics for Biologists, Campbell, R. C., 1998. Cambridge University Press.

PRACTICAL SEMESTER- VI

DSC 1-10: Plant Pathology [G04-DSC1-0607-P]

Sr. No.	Practical
1.	Study of laboratory equipment- Autoclave, Hot Air Oven, Inoculating chamber, Laminar Air Flow, Air Sampler, Incubator, Centrifuge etc.
2. & 3.	Preparation of culture media (PDA).
4.	Study of air-borne pathogen by exposed petri plates/air sampler.
5.	Isolation of plant pathogens (Serial Dilution Agar Plate Method).
6.	Estimation of chlorophylls (Any healthy & diseased/infected plant material).
7.	Study of symptoms and causal organisms of- 1. Rots- Fruit rot of Cucurbits, 2. Damping offs- Late blight of Potato, 3. Downy mildews- Downy mildew of Grapes.
8.	Study of symptoms and causal organisms of- 1. Rots- Fruit rot of Cucurbits, 2. Damping offs- Late blight of Potato, 3. Downy mildews- Downy mildew of Grapes.
9.	Study of symptoms and causal organisms of- 1. White rusts- White rust of Crucifers, 2. Powdery Mildews- Powdery mildew of Mango, 3. Smuts- Smut of Jowar.
10.	Study of symptoms and causal organisms of- 1. Rusts- Brown rust of Wheat, 2. Wilts- Wilt of Pigeon pea (*Cajanus cajan*), 3. Leaf spots- Brown spot of Maize.
11.	Study of symptoms and causal organisms of- 1. Leaf blights- Tikka disease of Groundnuts, 2. Anthracnoses- Red-rot of Sugarcane, 3. Mycoplasmas- Little leaf of Brinjal.
12.	Study of symptoms and causal organisms of- 1. Bacteria- Citrus canker, 2. Oily spot of Pomegranate (Telya diseases) 3. Viruses- Tobacco & Tomato mosaic.
13.	Identification of seed-borne fungal pathogens using dry seed examination method.
14.	Collection and submission of plant diseases as per the theory syllabus.

DSC 1-11: Plant Biotechnology [G04-DSC1-0608-P]

1	Study of Biotechnology laboratory, Instruments, safety rules and measures
2	Preparation and application of Biofertilizers, Biopesticides and secondary metabolites
3	Isolation and study of Rhizobium/Azotobacter from soil sample
4	Production of organic compound by microbial fermentation (any one)
5	Study of recombinant vectors by using color photograph/animation by using computer
6	Physical and Biological method of gene transfer by using computer/photograph
7	Study of transgenic plants
8	Preparation of M. S. Media for plant tissue culture
9	Sterilization methods for plant tissue culture
10	Disease free plant production through meristem culture
11	Callus culture
12	Study of anther culture
13	Demonstration of cryopreservation and germplasm conservation techniques
14	Visit to Biotechnology laboratory / Tissue culture laboratory / Biogas production unit / fermentation industry

DSC 1-12: Molecular Biology [G04-DSC1-0609-P]

Sr. No.	Practical
1.	Study molecular biology laboratory equipment (micropipettes, centrifuge, water bath, UV transilluminator etc.).
2.	Study of calibration and use of micropipettes.
3.	Preparation of LB medium and raising *E. Coli.*
4.	Preparation of buffers and reagents (as per practical requirements).
5.	Isolation of genomic DNA from *E. Coli*.
6.	Estimation of proteins (any suitable method).
7.	DNA isolation from cauliflower head (or any suitable plant material).
8.	DNA estimation by diphenylamine reagent.
9.	Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).
10.	RNA estimation by orcinol reagent.
11.	Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.
12.	Study of Southern blotting & its applications (by using photograph).
13.	Study of Northern blotting & its applications (by using photograph).
14.	Study of structure of DNA & RNA types by using models/photographs.

DSE 1-4: Horticulture Practices & Post Harvest Technology

[G04-DSE3-603-P]

Sr. No.	Practical
1.	Physio-chemical composition/analysis of fruits and vegetables.
2.	Practice of judging the maturity and packing of various fruits and vegetables.
3.	Preparation of jam.
4.	Preparation and preservation of amla candy.
5.	Preparation of pickles (Citrus/Mango) & chutney (Mango).
6.	Method of Bonsai preparation.
7.	Visit to local processing unit.

VSC 4: Horticulture Practices & Post Harvest Technology

[G04-VSC-603]

Sr. No.	Practical
1.	Study of Horticultural & Harvesting instruments.
2.	Study of important tools/equipment's/machines/ & chemicals in PHT laboratory.
3.	Study of different types of packing of fruits and vegetables.
4.	Study of different types of storage techniques of fruits and vegetables.
5.	Preparation & extraction of fruit juice (any suitable fruit).
6.	Estimation of Total Soluble Solids (TSS) in fruit juices.
7.	Determination of acidity in *Citrus*.
8.	Measurements of sugar percentages in fruit juices by hand-refractometer.
9.	Study of propagation techniques: cuttings, layering, budding & grafting.
10.	Cut flowers- packing & handling technique.
11.	Flower Arrangements- Indian (Gajara, Veni, Garland, Bouquet, Pot, Hanging).
12.	Identification of common ornamental, fruit and vegetable plants.
13.	Visit to breeding/research stations (Prepare/Present report).
14.	Visit to garden/Parks/Nurseries/Exhibition/Horticulture industries etc. (Report submission).

DSE 1-5: Biostatistics [G04-DSE1-5-603-P]

Sr. No.	Name of the Practicals
1.	Collection and tabulation of biological data.
2.	Preparation of frequency distribution table.
3.	Calculation of Arithmetic Mean.
4.	Calculation of Median.
5.	Calculation of Mode.
6.	Calculation of Range and Coefficient of Range.
7.	Calculation of Mean Deviation and Coefficient of Mean Deviation.

VSC 4: Biostatistics [G04-VSC-603]

Sr. No.	Name of the Practicals
1.	Calculation of Standard Deviation and Coefficient of Variation (C.V.).
2.	Calculation of Variance.
3.	Construction of Bar Diagram.
4.	Construction of Histogram.
5.	Construction of Frequency Polygon.
6.	Construction of Pie Chart- I
7.	Construction of Pie Chart – II
8.	Problems on Probability- I
9.	Problems on Probability- II
10.	Chi-square test for goodness of fitness.
11.	t-test (comparison of two means).
12.	Construction of Bar Diagram using MS-excel sheet on computer.
13.	Construction of Histogram using MS-excel sheet on computer.
14.	Construction of Frequency Polygon using MS-excel sheet on computer.

PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

EQUIVALENT SUBJECT FOR OLD SYLLABUS

Name of the Course: B. Sc. III Botany

Sr. No.	Paper No. & Name of the Old Paper	Paper No. & Name of the New Paper
	SEMESTER V	
1	**Paper IX**: Plant Systematics	**DSC1-7(3+2):** Plant Systematics
2	**Paper X**: Genetics	**DSC1-8(3+2):** Genetics
3	**Paper XII**: Paper Bimolecular Biology	**DSC1-9(3+2):** Cell Biology
4	**Paper XII:** Plant Breeding Or **Economic Botany**	**DSE 1-1(2+1):** Plant Breeding Or **DSE 1-2** (**2+1):** Plant Resources and Utilization Or **DSE 1-3** (**2+1):** Cyber security
	SEMESTER VI	
5	**Paper XIII:** Plant Pathology	**DSC1-10(3+2):**: Plant Pathology
6	**Paper XIV:** Plant Biotechnology	**DSC1-11(3+2):**: Plant Biotechnology
7	**Paper XV:** Cell Biology	**DSC1-12(3+2):**: Molecular Biology
8	**Paper XVI:** Horticulture Practices & Post Harvest Technology **OR** Nursery, Gardening and Horticulture	**DSE 1-4(2+1):** Horticulture Practices & Post Harvest Technology Or **DSE 1-5 (2+1):** Biostatistics

Question Paper Pattern:

For Ty- DSC
UA45+CA30= 75 Marks

UA paper 45 Marks

Q .1. MCQ	09 marks
Q 2. Short answer any three	09 marks
1.	
2.	
3.	
4.	
Q.3.Answer the following	
A.	05 Marks
B.	04 Marks
Q.04. Answer the following	
A .	05 Marks
B .	04 Marks
Q .05. Answer any one	09 Marks
A.	
B.	

Question Paper Pattern

For Ty- DSE

UA30+CA20= 50Marks

UA paper 30 Marks

Q .1. MCQ	06 marks
Q 2. Short answer any three	06 Marks
1.	
2.	
3.	
4.	
Q.3.Answer the following (Any Two)	
A.	03 Marks
B.	03 Marks
C.	03 Marks
Q.04. Answer the following (Any Two)	
A .	03 Marks
B .	03Marks
C.	03 Marks
Q .05. Answer any one	06 Marks
A.	
B.	