Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2022
'B^{++}' Grade (CGPA 2.96)

Name of the Faculty: Science & Technology

Choice Based Credit System

Syllabus: Botany

Name of the Course: B. Sc. III (Sem. -V & VI)

(Syllabus to be implemented June 2024)

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 FOR CHOICE BASED CREDIT SYSTEM (CBCS)

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 four theory papers of 100 marks for each. Similarly, in semester –VI there will be four theory paper of 100 marks for each. Paper XII and XVI are Discipline specific elective. Student should select either DSE- 1 or DSE- 2 for each semester. If Student selected DSE 1 for Semester V then student must be select DSE 1 in semester VI. 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 400 marks shall be conducted at the end of second semester. Each practical examination of 100 marks shall also consist of 70 marks for University practical assessment and 30 marks for college internal assessment. 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:**

As per the norms of the grading system of evaluation, out of 100 Marks, the candidate has to appear for College internal assessment of 30 marks and external evaluation (University Assessment) of 70 marks. The respective B.O.S. may decide the nature of College internal assessment after referring to the scheme given below or may be used as it is.

The details are as follows:

Semester – V (Total Marks 400)**:**

University Examination (280 marks) No. of Theory papers (4):

Paper – IX, X, XI, XII	:	UA 70 marks (for each paper)
College Assessment (120 marks)	:	CA 30 Marks (for each paper)
Scheme of Marking (for each paper) CA	:	15 Marks: Unit Test 15 Marks: Home assignment/Tutorials/Seminars/ Group discussion/ Viva/Field visit/Industry visit.

Semester – VI (Total Marks 400)**:**

University Examination (280) No. of Theory papers (4):

Paper – XIII, XIV, XV, XVI	:	UA 70 marks (for each paper)
College Assessment (120 marks)	:	CA 30 Marks (for each paper)
Scheme of Marking (for each paper) CA	:	15 Marks: Unit Test 15 Marks: Home assignment/Tutorials/Seminars/ Group discussion/ Viva/Field visit/Industry visit.

Practicals (Total Marks 400):

University Examination (280 Marks**)**	:	No of Practicals: I, II, III, IV (U. A. 70 marks for each practical)
College Assessment (120Marks)	:	CA 30 Marks (for each paper)
Scheme of Marking (for each paper) CA	:	20 Marks: Internal Test on any two practicals 10 Marks: Lab Journal/viva, attendance, attitude etc.(for each practical)

6. **Passing Standard**

The student has to secure a minimum of 4.0 grade points (Grade C) in each paper. A student who secures less than 4.0 grade point (39% or less marks, Grade FC/FR) will be declared fail in that paper (subject) and shall be required to reappear for respective paper. A student who failed in University Examination (Theory) & passed in internal assessment of a same paper (subject) shall be given FC Grade. Such student will have to appear for University Examination only. A student who fails in Internal Assessment and passed in University examination (Theory) shall be given FR Grade. Such student will have to appear for both University examination as well as internal assessment. In case of year down candidates from the mark scheme the candidates shall appear for the same 70 marks paper of the external examination and his performance shall be scaled to 100 marks.

P.A.H. SOLAPUR UNIVERSITY, SOLAPUR.

Theory syllabus (Semester pattern)

In Botany at B.Sc. III

W.E.F. June 2024

The present syllabus is in continuation with the previous class B.Sc. Part II. This syllabus has been prepared as per UGC curriculum. There will be **four** theory papers for Semester **Vth** and **four** papers for semester **VIth** which will be covered by engaging three lectures per paper per week. Each theory paper will carry **70** Marks. So the total marks for theory will be **280**. There will be **four** practicals per week, each of five periods. At the end of the year (**Sem-VIth**), there will be a practical examination to be conducted on **four** consecutive days for not less than five hours per day. Each practical will be of 70 marks. So the total marks for practical's will be **280.**

SEMESTER V

Paper IX	**:**	Plant Systematics	**60 Periods.**
Paper X	**:**	Genetics	**60 Periods.**
Paper XI	**:**	Molecular Biology	**60 Periods.**
Paper XII	**:**	Plant Breeding	**60 Periods.**
Paper XII	**:**	Nursery and Gardening	**60 Periods.**

SEMESTER VI

Paper XIII	**:**	Plant Pathology	**60 Periods.**
Paper XIV	**:**	Plant Biotechnology	**60 Periods.**
Paper XV	**:**	Cell Biology	**60 Periods.**
Paper XVI	**:**	*Biostatistics*	**60 Periods.**
Paper XVI	**:**	*Horticultural practices and post harvest technology*	

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science- New Choice Based Credit System (CBCS) [w.e.f. 2024-25]

Draft Structure for B.Sc. Part- III

Subject/ Core Course	Name and Type of the Paper	No. of papers/ Practical	Hrs/week			Total Marks Per Paper	UA	CA	Credits
	Name		L	T	P				
Class:	**B.Sc. Part- III Semester- V**								
Ability Enhancement Course (AECC)	**English (Business English)**	Paper- III	2	--	--	50	40	10	2.0
Discipline Specific Elective (DSE) (Students can opt any one) Subjects among the three Subjects excluding interdisciplinary offered at B.Sc. Part- II.	**BOTANY DSE- 1A Plant Systematics**	**Paper- IX**	3	--	--	100	80	20	4.0
	DSE- 2 A Genetics	**Paper X**	3	--	--	100	80	20	4.0
	DSE- 3 A Molecular Biology	**Paper XI**	3	--	--	100	80	20	4.0
	DSE 4 A Plant Breeding OR Economic Botany	**Paper XII**	3	--	--	100	80	20	4.0
	(Add-on-self learning) Plant Tissue Culture Mushroom Cultivation		--	--	--	100	80	20	4.0
Grand Total			**12**	**--**	**--**	**450**	**360**	**90**	**22**

B.Sc. Part- III Semester- VI									
Ability Enhancement Course (AECC)	**English (Business English)**	Paper IV	4	--	--	50	40	10	2.0
DSE (Students can opt any one subjects among the three Subjects excluding interdisciplinary offered at B.Sc. II.	**DSE- 1B Plant Pathology**	Paper XIII	3	--	--	100	80	20	4.0
	DSE- 2B- Plant Biotechnology	Paper- XIV	3	--	--	100	80	20	4.0
	DSE- 3B- Cell Biology	Paper- XV	3	--	--	100	80	20	4.0
	DSE 4B- Nursery, Gardening & Horticulture OR Biostatistics	Paper- XVI	3	--	--	100	80	20	4.0
Total (Theory)			**12**	**--**	**--**	**450**	**360**	**90**	**18**
DSE - Practical (Annual Exam)	**DSE- 1 A & B**	Practical based on Paper - IX & XIII	--	--	5	100	80	20	4.0
	DSE -2 A & B	Practical- X&XIV	--	--	5	100	80	20	4.0
	DSE- 3 A & B	Practical- XI&XV			5	100	80	20	4.0
	DSE- 4 A & B	Practical- XII & XVI			5	100	80	20	4.0
Total (Practical's)					**20**	**400**	**320**	**80**	**16**
Grand Total			**12**		**20**	**1400**	**1120**	**280**	**58**

Summary of the Structure of B.Sc. Programme as per CBCS pattern 2024

Class	Semester	Marks-Theory	Credits-Theory	Marks-Practical	Credits-Practical's	Total – credits
B.Sc.-I	I	500	20	--	--	20
	II	550	20	400	16	36
B.Sc.-II	III	350	14	--	--	14
	IV	350	14	300	12	26
B.Sc.-III	V	500	22	--	--	22
	VI	500	18	400	16	34
Total		2750	110	1100	44	154

B.Sc. Programme:

Total Marks : Theory + Practical's = 2750 +1100 =3950

Credits : Theory + Practical's = 110 + 44 = 154

Numbers of Papers:	Theory: Ability Enhancement Course (AECC)	05
	Theory: Discipline Specific Elective Paper (DSE)	08
	Theory: DSC	12
	Skill Enhancement Courses/Add on	01
Total:	Theory Papers	31
	Practical Papers	11

Abbreviations:

L: Lectures
P: Practical's
CA: College Assessment
AEC: Ability Enhancement Course
Paper SEC: Skill Enhancement Course
CA: Continuous Assessment

T: Tutorials
UA: University Assessment
DSC/CC: Core Course
DSE: Discipline Specific Elective
GE: Generic Elective
ESE: End Semester Examination

1. General objectives of the course:

Plant Systematics: This syllabus will provide detailed ideas about terminology, methods of classification, evolutionary trends in Angiosperms & different plant families.

- To understand basic terminology used in taxonomy
- To understand methods of identification of plants
- To understand classification systems used to classify the plants
- To get knowledge about evolutionary trends in angiosperms
- To get knowledge about different angiosperm families

Genetics: This syllabus will provide detailed ideas about terminology, medalian inheritance, qualitative & quantitative inheritance.

- To get knowledge about different terminologies in genetics
- To understand sex linked inheritance
- To get knowledge about qualitative & quantitative inheritance
- To get knowledge about linkage & crossing over

Molecular Biology: This syllabus will provide detailed ideas about concepts in molecular biology, structures of nucleic acids, composition, methods of transcription

- To get knowledge about concepts in molecular biology
- To get knowledge about structure of DNA/RNA
- To get knowledge about composition & enzymes involved in molecular biology
- To get knowledge about methods of transcription & translation

Plant Breeding: This syllabus will provide detailed ideas about techniques of breeding

- To understand terminologies used in plant breeding
- To get knowledge about methods in plant breeding
- To get knowledge about crop improvement strategies
- To get knowledge about mutational breeding
- To get knowledge about centers working on plant breeding

Economic Botany:

Plant Pathology: This syllabus will provide detailed ideas about terms & concepts in plant pathology

- To understand concepts & terms in plant pathology
- To understand different diseases causal agents, symptoms of diseases
- To understand preventive measures of diseases

Plant Biotechnology: This syllabus will provide detailed ideas about concepts in plant biotechnology

- To get knowledge about enzymes involved in genetic engineering
- To understand concept & process of genetic engineering
- To understand vectors, methods of gene transfer in genetic engineering
- To understand concepts & terms used in plant tissue culture
- To understand applications of genetic engineering & plant tissue culture

Cell Biology: This syllabus will provide detailed ideas about different cell organelles their functions, various microscopy techniques & their applications

- To get knowledge about various cell organelles & their functions
- To understand ultra structures of various cell organelles
- To understand microscopic techniques & their applications
- To understand cell cycle & types of cell division

Nursery, Gardening & Horticulture: This syllabus will provide detailed ideas about methods & techniques used in Nursery, Gardening & Horticulture

Biostatistics: This syllabus will provide detailed ideas about concepts & methods used in biostatistics.

- To get knowledge about basic concepts in biostatistics.
- To get knowledge about primary & secondary data
- To get knowledge about measures of central tendency
- To get knowledge about measures of Probability
- To get knowledge about use of biostatistics methods in research

SEMESTER- V
Paper- IX
PLANT SYSTEMATICS

Credits: Theory- 4, Practical- 2 **Lectures: 60**

Unit 1:	**Descriptive Terminology - Vegetative** Habitat. Habit and life span Roots- Types and modification. Stems- Types and modification. Leaves- Types and modification.	**(12 L)**
Unit 2:	**Descriptive Terminology - Reproductive** Inflorescence- Racemose types, Cymose types, Specialized types. Flower- Calyx, Corolla, Perianth, Androecium, Gynoecium. Fruit- Simple fruits, Aggregate fruits, Multiple fruits. Floral formula and Floral diagram.	**(12 L)**
Unit 3:	**General Evolutionary Trends in Angiosperms** Habitat & Growth Habit; Leaf structure & Phyllotaxy; Stomatal apparatus. Nodal anatomy; Xylem; Phloem; Cambium & Vascular bundle. Inflorescence; Flower; Androecium; Pollination Gynoecium (ovule); Fertilization, Seeds & Seedlings. Fruits.	**(12 L)**
Unit 4:	**Systems of Classification** Introduction Outline of Engler and Prantl system of classification. Merits and Demerits. Outline of APG III system of classification of Angiosperm Phylogeny Group. Merits and Demerits of APG III system of classification.	**(12 L)**
Unit 5:	**Families of Angiosperms** 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.	**(12 L)**

Paper- X

GENETICS

Credits: Theory- 4, Practical- 2 **Lectures: 60**

Unit 1:	**Heredity** Introduction, History and terminology Mendel's experiment Monohybrid ratio, dihybrid ratio, back cross, test cross Laws of inheritance. Gene interaction: Supplementary gene, Complementary gene Inhibitory gene	**(12 L)**
Unit 2:	**Linkage and Crossing over** : Linkage: concept & history : Complete & Incomplete linkage, : Coupling & Repulsion, recombination frequency. : Linkage maps based on two and three point crosses. : Crossing over: concept and significance cytological proof of crossing Over.	**(12 L)**
Unit 3:	**Sex-determination and Sex-linked Inheritance** 3.1: Autosomes and sex chromosomes. 3.2: Mechanism of sex determination. 3.3: Sex chromosomes in *Drosophila*. 3.4: Sex chromosomes in man. : Balance concept of sex determination in *Drosophila*- Bridge's Experiment. : Sex linked inheritance in man: a) Colour blindness. b) Hemophilia. c) Holandric genes	**(12 L)**
Unit 4:	**Quantitative inheritance** : Quantitative traits, continuous variation. : Polygenic trait in corolla length in *Nicotiana*, plant height in tobacco ear length in *Zea mays.* : Population genetics. Hardy –Weinberg's law, Factors affecting gene and gene frequencies.	**(12 L)**
Unit 5:	**Cytoplasmic inheritance** : Mitochondrial and Chloroplast genome. : Cytoplasmic inheritance in chloroplast (*Mirabilis jalapa* and *Zea mays*). : Cytoplasmic inheritance in mitochondria (Petite in Yeast and cytoplasmic male sterility in plants). : Interaction between cytoplasmic and nuclear genes. 5.5: Maternal effect in inheritance.	**(12 L)**

Paper- XI

MOLECULAR BIOLOGY

Credits: Theory- 4, Practical- 2 **Lectures: 60**

Unit 1:	**Nucleic acids** : Introduction. : Historical perspective. : DNA as the carrier of genetic information (Griffith's experiment).	**(12 L)**
Unit 2:	**The Structures of Genetic Material** : Introduction. :Structure of DNA: Watson and Crick model.2.3: :Salient features of double helix. : Types of DNA. : Denaturation and renaturation of DNA. : Organization of DNA in Prokaryotes and Eukaryotes. 2.7: Structure of RNA. 2.8: Types of RNA.	**(12 L)**
Unit 3:	**Replication of DNA** : Introduction. : Synthesis of DNA (Kornberg's discovery). : Replication of DNA in prokaryotes and eukaryotes. 3.4: Enzymes involved in DNA replication.	**(12 L)**
Unit 4:	**Transcription** : Introduction. : Transcription in prokaryotes and eukaryotes. 4.3: Principles of transcriptional regulation. : Prokaryotes: Regulation of lactose metabolism in *E. coli.* : Eukaryotes: transcription factors, heat shock proteins,	**(12 L)**
Unit 5:	**Translation** : Introduction. : Structure of Ribosome. : Assembling Ribosome and m-RNA. : Charging of t-RNA and aminoacyl t-RNA synthetases. : Proteins involved in initiation, elongation and termination of polypeptides. : Post-translational modifications of proteins.	**(12 L)**

Paper- XII

PLANT BREEDING

Elective Paper

Credits: Theory- 4, Practical- 2 **Lectures: 60**

Unit 1:	**Plant Breeding:** : Introduction : Aim and objectives. 1.3: Scope of plant breeding.	**(12 L)**
Unit 2:	**Methods of Crop Improvement** : Introduction. : Centers of origin and domestication of crop plants. 2.3: Plant genetic resources : Introduction and acclimatization. : Selection methods: Pure line, Mass and Clonal selection. 2.7: Hybridization technique 2.8: Hybridization in self-pollinated crop plants. 2.9: Hybridization in cross pollinated crop plants.	**(12 L)**
Unit 3:	**Mutation and Plant Breeding** : Introduction : Role of mutation in plant breeding 3.3: Role of polyploidy in plant breeding	**(12 L)**
Unit 4:	**Intellectual Property Rights** : Introduction : Types of Property. 4.3: Intellectual Property. : Forms of Intellectual Property. : Advantages and Disadvantages of IPR.	**(12 L)**
Unit 5:	**Crop Breeding Institutes/Centers (2 Lectures)** : Introduction. : International Institutes. (IRRI, ICRISAT) : National Institutes (agricultural university, Dapoli, Rahuri, ICAR, ICMR, NRCP Solapur)	**(12 L)**

Paper- XII
ECONOMIC BOTANY
Elective Paper

Credits: Theory- 4 Practical- 2 **Lectures: 60**

Unit 1:	**Legumes** Botanical names, Morphology, Source and Economic importance of a) Pulses-Chickpea and Red gram, *b)* legumes - Lucerne and *Sesbania*	**(12 L)**
Unit 2:	**Plant Fibres** Botanical names, Morphology, Source and Economic importance of Cotton and Coir.	**(12 L)**
Unit 3:	**Vegetable Oil Sources** 3.1 Botanical name, source and economic importance of – Groundnut, Soybean; Brief account of cultural practices of Groundnut and Soybean.	**(12 L)**
Unit 4:	**Drug Yielding Plants** A brief account of plant drugs and their chief constituents used in Indigenous and allopathic systems in- *A)* Rhizome – *Zingiber officinale* *B)* Root –*Withania somnifera* *C)*Stem – *Tinospora cordifolia* *D) Leaf –Adhatoda zeylanica.* *E)* Floral bud – *Syzigium aromaticum* *F)* Fruit – *Emblica officinalis*	**(12 L)**
Unit 5:	**Natural Products** A- Rubber- Introduction, properties of rubber, source (*Hevea brasilensis*), morphological characters, extraction method and economic importance B- Botanical pesticides: Botanical name, morphological characters, source and importance of Neem, Tobacco, Custard apple. C- Plant Dyes - Botanical name, source and economic importance. a) Wood-Log wood, Kutch. b) Bark-Oak, Teak. c) Root and rhizome -Manjista, Turmeric, d) Leaves- Indigo, Henna. e) Flowers-Saffron, Palas.	**(12 L)**

Suggested Readings:

Plant Systematics

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, Dicotyledones.* 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.

Genetics:

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

Molecular Biology

1. 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.
2. Snustad, D. P. and Simmons, M. J. (2010). Principles of Genetics. John Wiley and Sons Inc., U. S. A. 5thedition.
3. Klug, W. S., Cummings, M. R., Spencer, C. A. (2009). Concepts of Genetics. Benjamin Cummings U.S.A. 9th edition.
4. Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.
   S. A. 3rd edition.
5. 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.

Plant Breeding:

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. 2nd edition.
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.

Economic Botany:

1. R.C. Grewal – Medicinal plants, Campus Books International

4825/24, Prahiadstreet, Ansari Road, Darya Ganj, New Delhi.
2. F.O. Bower – Plants and Man Ariana Publishing House, New Delhi.
3. Fuller, K.W. and Galon, J.r. 5985. Plant Products and New Technology. CalrendonPress, Oxford, New York.
4. Kocchar, S.L. 5998. Economic Botany in Tropics, 2nd edition. Macmillan India Ltd.,New Delhi.
5. Sambamurthy, A.V.S.S. and Subramanyam, N.S. 5989. A Textbook of Economic Botany, Wiley Eastern Ltd., New Delhi.

Semester- VI
Paper- XIII
PLANT PATHOLOGY

Credits: Theory- 4, Practical- 2 **Lectures: 60**

Unit 1:	**Introduction** 1.1: Terms, Nature, and concept of plant diseases. 1.2: Cause of disease. : Classification of Plant Diseases Based on- 1. Symptoms, 2. Spread and Severity of Infection. 1.4: Importance of plant diseases.	**(12 L)**
Unit 2:	**Rots, Damping offs, Downy mildews, Powdery Mildews, White rusts and Smuts** 2.1 Study of following plant diseases with respect to causal organisms, symptoms, and control measures- 1. Fruit rot of Cucurbits. 2. Late blight of Potato. 3. Downy mildew of Grapes. 4. Powdery mildew of Mango 5. White rust of Crucifers. 6. Smut of Jowar	**(12 L)**
Unit 3:	**Rusts, Wilts, Leaf spots & blights and Anthracnoses** Study of following plant diseases with respect to causal organisms, symptoms, and control measures- 1. Brown rust of Wheat 2. Wilt of Pigeon pea (*Cajanus cajan*) 3. Brown spot of Maize 4. Tikka disease of Groundnuts 5. Red-rot of Sugarcane	**(12 L)**
Unit 4:	**Mycoplasmas, Bacteria and Viruses** 4.1 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	**(12 L)**
Unit 5:	**Aerobiology and Seed Pathology** 5.1: Aerobiology- Definition, scope and importance and disease forecasting. 5.2: Seed pathology- Definition, seed borne pathogens (external and internal) seed treatment (hot water, solar, chemical) and seed certification.	**(12 L)**

Paper- XIV

PLANT BIOTECHNOLOGY

Credits: Theory- 4, Practical- 2 **Lectures: 60**

Unit 1:	**Recombinant DNA Technology** : Introduction and principles. : Enzymes involved in recombinant DNA Technology. 1.3: Vectors. 1.4: Southern and northern blotting technique. 1.5: DNA fingerprinting. : PCR. : DNA libraries.	**(12 L)**
Unit 2:	**Methods of Gene Transfer** : Introduction. : Marker and Reporter genes. : Methods of gene delivery- Physical, Chemical and Biological (*Agrobacterium* mediated gene transfer). : Transgenic plants (Flavr-Savr tomato, Golden rice).	**(12 L)**
Unit 3:	**Gene Cloning** : Introduction. : Bacterial Transformation and selection of recombinant clones : PCR- mediated gene cloning. : Complementation, colony hybridization.	**(12 L)**
Unit 4:	**Plant Tissue Culture** : Introduction. : Terminology in tissue culture. 4.3: Techniques of tissue culture. 4.4: Micro propagation. : Anther culture. : Protoplast isolation and culture. 4.7: Somatic Hybridization.	**(12 L)**
Unit 5:	**Applications of Biotechnology** : Introduction. : Role of Biotechnology in agriculture, Industry, Forestry. 5.3: Biotechnological Institutes and their role (CCMB, RGCB)	**(12 L)**

Paper- XV

CELL BIOLOGY

Credits: Theory- 4, Practical- 2 **Lectures: 60**

Unit 1:	**Microscopic Techniques in Biology** 1.1: Principles of microscopy. 1.2: Light microscopy. : Phase contrast microscopy. : Electron microscopy (EM): Scanning electron microscopy (SEM) and transmission electron microscopy (TEM).	**(12 L)**
Unit 2:	**Cell- Unit of Life** : The Cell Theory. : Prokaryotic cell- structure, cell size and shape. 2.3: Eukaryotic cells- structure, cell size and shape. 2.4: Eukaryotic cell components.	**(12 L)**
Unit 3:	**Cell Organelle** 3.1: Ultra structure and function- Mitochondria, Chloroplast, Nucleus, ER, Golgi body, Lysosomes, Peroxisomes and Glyoxisomes, 3.2. Composition of Cell Membrane and Cell wall 3.3: Structure and function of cytoskeleton & its role in cell motility.	**(12 L)**
Unit 4:	**Chromosome** : Introduction. : History of chromosomes. 4.3: Morphology, shape, size. : Types of Chromosomes: Polytene and Lampbrush chromosomes. : Karyotype.	**(12 L)**
Unit 5:	**Cell Division** 5.1: Mitosis & Meiosis, and its significance 5.2: Steps in cell cycle. 5.3: Regulation & Control of cell cycle.	**(12 L)**

Paper- XVI
NURSERY, GARDENING & HORTICULTURE
Elective Paper

Credits: Theory- 4, Practical- 2 **Lectures: 60**

Unit 1:	**Nursery & Gardening** : Introduction. : Objectives and scope. : Types of gardening–landscape, home gardening and parks : Computer applications in landscaping.	**(12 L)**
Unit 2:	**The Seed** : Introduction. : Structure and types. : Seed dormancy; causes and methods of breaking dormancy. 2.4: Seed storage: Seed banks, factors affecting seed viability, genetic erosion. : Seed production technology. : Seed testing and certification.	**(12 L)**
Unit 3:	**Vegetative Propagation** : Introduction. : Types of layering, cutting, budding and grafting.	**(12 L)**
Unit 4:	**Horticultural Techniques** : Introduction. : Application of manure, fertilizers, nutrients and PGRs. 4.3: Weed control, Biofertilizers and biopesticides.	**(12 L)**
Unit 5:	**Floriculture** : Introduction. : Cut flowers. : Bonsai, commerce (market demand and supply). 5.4: Importance of flower shows and exhibitions.	**(12 L)**

Paper- XVI
BIOSTATISTICS
Elective Paper

Credits: Theory- 4, Practical- 2 **Lectures: 60**

Unit 1:	**Introduction** : Definition. : Basic principles. : Statistical methods. : Variables - measurements, functions, limitations and uses of statistics. Significance of biostatistics	**(12 L)**
Unit 2:	**Collection of Primary and Secondary Data** 2.1: Introduction 2.2: Types of data 2.3: Methods of data collection. 2.4: Merits and demerits. : Classification of data. : Tabulation and presentation of data : Sampling methods	**(12 L)**
Unit 3:	**Measures of Central Tendency** : Introduction. : Mean, median and mode, merits & demerits. : Measures of dispersion- range, standard deviation and mean deviation, merits & demerits. : Co- efficient of variations.	**(12 L)**
Unit 4:	**Probability** : Introduction. : Basic Concepts. : Kinds of Probabilities. 4.4: Measures of Probability. 4.5: Application of probability in biological science	**(12 L)**
Unit 5:	**Statistical Inference** : Introduction. : Hypothesis - Student 't' test and chi square test and its significance.	**(12 L)**

Suggested Readings-

Plant Pathology

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

Plant Biotechnology:

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.

Cell Biology:

1. Lewin B.2000 Genes VII Oxford University Press, New York.
2. Wolfe, S. L. (1993) Molecular and cell Biology-Wadsworth publishing Co. California, U.S.A.
3. Krishnmourthy, K. V. (2000) Methods in Cell Wall chemistry. CRC Press, Boca Raton, Florida.
4. 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.
5. Harris, N. and Oparka, K.J.1994. Plant cell Biology: A Practical Approach, IRL press at Oxford university Press, Oxford, U.K.

Nursery Gardening and Horticulture:

1. Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.
2. Swaminathan, M. S. and Kochhar, S. L. (2007). Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India. Macmillan Publishers, India.
3. NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.
4. Kader, A. A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, U. S. A.
5. Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.

Biostatistics:

1. Biostatistics Danniel, W.W., 1987. New York, John Wiley Sons.
2. An introduction to Biostatistics, 3rd edition, Sundarrao, P. S. S and Richards, J. Christian Medical College, Vellore.
3. Statistical Analysis of epidemiological data, Selvin, S., 1991. New York University Press.
4. Statistics for Biology, Boston, Bishop, O. N. Houghton, Mifflin.
5. Statistics for Biologists, Campbell, R. C., 1998.Cambridge University Press.

Practical- IV

PLANT SYSTEMATICS & PLANT PATHOLOGY

1. Preparation of botanical description of a plant species.
2. Study of root types.
3. Study of stem modifications.
4. Study of inflorescence types (Cymose, Racemose & Specialized).
5. Study of fruit types.

6-11. Study of families as per theory syllabus (Available plant families and Bentham and Hooker's system to be followed).

1. Annonaceae	2. Malvaceae	3. Rutaceae
4. Rubiaceae	5. Bignoniaceae	6. Lamiaceae
7. Nyctaginaceae	8. Polygoniaceae	9. Orchidaceae
10. Poaceae.		

12. Identification of genus and species with the help of regional (any available) flora.
13. Preparation & submission of herbarium specimens preferably of weeds (10).
14. Study of laboratory equipment- Autoclave, Hot Air Oven, Inoculating chamber, Laminar Air Flow, Air Sampler, Incubator, Centrifuge etc.
15. Preparation of culture media (PDA).
16. Micrometry- Calibration of microscope and measurement of fungal spores.
17. Study of air-borne pathogen by exposed petri plates/air sampler.
18. Isolation of plant pathogens (Serial Dilution Agar Plate Method).
19. Estimation of chlorophylls (Any healthy & diseased/infected plant material).
20. 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.
21. 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
22. 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
23. 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
24. Study of symptoms and causal organisms of-
    1. Bacteria- Citrus canker, Oily spot of Pomegranate (Telya diseases)
    2. Viruses- Tobacco & Tomato mosaic
25. Study Excursion Report & Collection and submission of plant diseases as per the theory syllabus.

Practical- V

GENETICS & PLANT BIOTECHNOLOGY

1. Solve the problems based on Mendelian inheritance (Monohybrid ratio and Dihybrid ratio)
2. Studies on Mendelian traits by using pea plants.
3. Studies on genetic traits related to the Colour blindness, Haemophilia, Holandric genes by using photographs.
4. Solve the problems based on Linkage and crossing over (two point cross, three point cross)
5. Solve the problems based on polygenic inheritance
6. Solve the problems based on Population genetics.
7. Study of *Mirabilis jalapa* with respect to Plastid inheritance
8. Studies on biotechnological equipment (Principle and working).
9. Study of recombinant vectors with the help of photographs.
10. Studies on transgenic plant (Bt-cotton and golden rice)
11. Demonstration of Gene transfer techniques (Video/Photograph).
12. Demonstration of gel-electrophoresis techniques
13. Organization of plant tissue culture laboratory.

14-16. Aseptic culture techniques for establishment and maintenance of cultures

Techniques in Plant Tissue Culture.

17. Demonstration of Southern blotting technique with the help of Chart/photograph
18. Demonstration of Northern blotting technique with the help of Chart/photograph

19-20. Preparation of plant tissue culture medium (M.S.)

21-23. Study of anther, embryo culture and micropropagation.

24. Isolation of protoplast from given plant material
25. Visit to Biotechnology laboratory

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MOLECULAR BIOLOGY & CELL BIOLOGY

Practical- VI

1. Preparation of LB medium and raising *E. Coli*.
2. Isolation of genomic DNA from *E. Coli*.
3. DNA isolation from cauliflower head (or any suitable plant material).
4. Qualitative and Quantitative estimation of DNA by diphenylamine reagent.
5. Qualitative and Quantitative estimation of RNA by Orcinol reagent.
6. Dialysis of starch and simple sugar.

7-8. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and Semi-discontinuous replication).

9. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase-II through photographs.

10. Photographs establishing nucleic acid as genetic material (Griffith's experiments). 11.Mitosis and the cell cycle in onion root-tip cells.

12. Meiotic cell division in *Allium* spp.
13. Study of permeability of plasma membrane.
14. Isolation of Mitochondria
15. Isolation of chloroplasts.
16. To study karyotype and prepare an ideogram of a plant by photograph.
17. Estimation of the amount of chlorophyll present in the leaf tissue.
18. Observation of growth and differentiation in single cells.
19. Structure of onion peel cell.

20-24. Microtome technique.

25. Submission (submit at least 5 slides per student- Microtome technique).

PLANT BREEDING & NURSERY GARDENING AND HORTICULTURAL PRACTICES

Practical- VII (Elective)

1. To study floral biology in self-pollinated crop plants.
2. To study floral biology in cross pollinated crop plants.
3. To study pollen viability.
4. Calibration of ocular micrometer and estimate the size of pollen grain.
5. To study hybridization techniques in Malvaceae.
6. To study hybridization techniques in Fabaceae.
7. To study hybridization techniques in Brassicaceae.
8. To study hybridization techniques in Poaceae.
9. Study of male sterility in sorghum in field or in laboratory by staining the pollen grain.
10. Studies on Learning the precautions on handling of different mutagenic agents: Physical and chemical mutagens.
11. Different types of pots and potting medium & Potting and Repotting.

12-13. Propagation practices by seed, vegetative propagation, cutting, budding, layering and grafting.

Method of preparing Bonsai, Bottle garden/Terrarium, Hanging Baskets, Dish Garden.

14. Preparation of garden layout.

15. List of plants suitable for garden locations- 2 to 3 plants for each location.

16-18. Identification of important horticultural plants- herbs (Foliage and flowering); shrubs(Foliage and flowering); trees (Foliage and flowering); climbers; Lianas; Epiphytes; Creepers; Trailers; Aquatic plants; Succulents;(from all types- any two plants).

19-20. Flower Arrangements- Indian (Gajara, Veni, Garland, Bouquet, Pot, Hanging).

21-22. Green house plants- Information regarding soil, temperature, irrigation and fertilizer, requirements and propagation methods for- Anthurium, Gerbera, Orchids, Tuberose, Carnation, Roses and Capsicum.

23-24. **Project-** Each student should individually present a project to any topic related to nursery and garden development. It should be duly certified by HOD and submitted in the practical examination (Compulsory).

25. Visits:

1. Visit to breeding/research stations.
2. Visit to garden/Parks/Nurseries/Exhibition/Horticulture industries etc. and record should be duly certified by HOD and submit in practical examination.

ECONOMIC BOTANY & BIOSTATISTICS

Practical- VII (Elective)

1. Study of Vegetative, Floral morphology and pod in Chickpea, Red gram.
2. Study of fodder legumes- Source and uses-Sesbania and Lucerne.
3. Study of structure of oil storing tissues in sectioned seeds of Groundnut and Coconut endosperm using micro chemical tests.
4. Study of vegetative, Floral and Fruit morphology of Cotton. Microscopic structure Cotton fibres.
5. Study of plants (live or herbarium) used as a resource of drugs as per theory. 6.Study of plant pesticides (as per theory).
7. Study of dyes- source and uses (as per theory).
8. Study of ornamental plants, seasons of flowering plants, botanical name morphology and uses (as per theory).
9. Study of plant perfumes and cosmetics (as per theory).
10. Horticultural term Paper-Based on- Seasonal/Perennials/Climbers/Cacti/ Succulents/Bonsai/Indoor plants and Cut flowers etc.

11-13. Methods of estimation of Heterosis (i) Mid- Parent Heterosis (ii) Better parent Heterosis (iii) Standard Heterosis (Demo).

14. Determination of interspecific variation in chromosome number in Allium.

15-16. Collection of Data and tabulation.

17-18. Methods of sampling.

19-20. Presentation of Data.

21. Measures of central tendency (Mean, mode and median) of given plant material.
22. Calculation of Standard Deviation.
23. Examples based on probability.
24. Calculation of ‘t’ test.
25. Calculation of chi square test.

PLANT BREEDING & BIOSTATISTICS

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