PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR

NAAC Accredited (2015)

'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: Botany

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

[Draft Syllabus to be implemented- w.e.f. June 2021]

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science- New Choice Based Credit System (CBCS) [w.e.f. 2021-22]

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	4.0	--	--	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.	**DSE- 1A Plant Systematics**	Paper- IX	4	--	--	100	80	20	4.0
	DSE- 2 A	Paper -X	4	--	--	100	80	20	4.0

	Genetics								
	DSE- 3 A **Molecular Biology**	Paper- XI	4	--	--	100	80	20	4.0
	DSE 4 A **Plant Breeding** **Economic Botany**	Paper-XII Paper-XII	4	--	--	100	80	20	4.0
	(Add-on-self learning)-Skill deveoplment course / College run courses /MOOC/SWAIM/ INTRSHIP/Apprentiship		--	--	--	100	80	20	4.0
Grand Total			**20.0**	**--**	**--**	**450**	**360**	**90**	**22**
Class:	**B.Sc. Part- III Semester- VI**								
Ability Enhancement Course (AECC)	**English** **(Business English)**	Paper IV	4.0	--	--	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	4.0	--	--	100	80	20	4.0
	DSE- 2B- **Plant Biotechnology**	Paper-XIV	4.0	--	--	100	80	20	4.0
	DSE- 3B- **Cell Biology**	Paper-XV	4.0	--	--	100	80	20	4.0
	DSE 4B- **Nursery, Gardening & Horticulture**	Paper-XVI	4.0	--	--	100	80	20	4.0

	DSE 4B- Biostatistics	Paper XVI	4.0	--	--	100	80	20	4.0
Total (Theory)			**20.0**	**--**	**--**	**450**	**360**	**90**	**18**
DSE - Practical (Annual Exam)	**DSE- 1 A & B**	Practical- 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			**32.0**		**20**	**1300**	**1040**	**260**	**56**

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

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
SEC: Skill Enhancement Course
CA: Continuous Assessment

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

Semester- V

PLANT SYSTEMATICS

Paper- IX

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

Unit 1: Descriptive Terminology **(25 Lecture)**

1.1 : Habitat.

1.2 : Habit and life span.

1.3 Roots- Types and modification.

1.4 : Stems- Types and modification.

1.5 : Leaves- Types and modification.

1.6: Inflorescence- Racemose types, Cymose types, Specialized types.

1.7: Flower- Calyx, Corolla, Perianth, Androecium, Gynoecium.

1.8: Fruit- Simple fruits, Aggregate fruits, Multiple fruits.

1.9: Floral formula and Floral diagram.

Unit 2: Species Concept, Identification and Nomenclature **(05 Lectures)**

2.1: Species definition and Species concept (Typological, Non-dimensional Multi-dimensional species concept).

2.2 : Identification of plants.

2.3 : Nomenclature, Binomial nomenclature of plants.

2.4: Principles of ICBN.

Unit 3: Herbarium and Botanical Garden **(7 Lectures)**

3.1 : Herbarium- Steps in preparation and significance.

3.2 : Botanical gardens of India- Sir J. C. Bose Botanical Garden, Calcutta & Lead Botanical Garden of Shivaji University Kolhapur.

Unit 4: Systems of Classification **(8/ Lectures)**

4.1: Outline of Bentham and Hookers system of classification. Merits and demerits of Bentham and Hookers system of classification.

4.2 Outline of APG III system of classification of Angiosperm Phylogeny Group.

4.3: Merits and Demerits of APG III system of classification.

Unit 5: Families of Angiosperms (15 Lectures)

5.1 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. Polygoniaceae	9. Orchidaceae
10. Poaceae.		

Suggested Readings-

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.& IIBotanical 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

Paper- X

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

Unit1: Heredity **(15 Lectures)**

1.1: Introduction to genetics.

1.2: Brief life history of Mendel.

1.3: Terminologies.

: Mendel's Laws of Inheritance:

A) Law of dominance,

B) Law of segregation,

C) Law of independent Assortment.

1.5: Back cross, Test cross.

1.6. Gene Interaction.

Unit 2: Linkage and Crossing over **(10 Lectures)**

2.1: Linkage: concept & history

2.2: Complete & Incomplete linkage, Bridges experiment.

2.3: Coupling& Repulsion, recombination frequency.

2.4: Linkage maps based on two and three factor crosses.

2.5: Crossing over: concept and significance,

cytological proof of crossing Over.

Unit 3: Sex-determination and Sex-linked Inheritance **(15 Lectures)**

3.1: Autosomes and sex chromosomes.

3.2: Mechanism of sex determination.

3.3: Sex chromosomes in *Drosophila*.

3.4: Sex chromosomes in man.

3.5:Balance concept of sex determination in *Drosophila*- Bridge's Experiment.

3.6 : Sex linked inheritance in man:

a) Colour blindness.

b) Haemophilia.

c) Holandric gene

Unit 4: Quantitative inheritance (5 Lectures)

4.1: Quantitative traits, continuous variation.

4.2: Polygenic trait in corolla length in *Nicotiana*, cob length in *Zea mays.*

4.3: Population genetics. Hardy –Weinberg's law, Factors affecting on gene and gene frequencies.

Unit 5: Cytoplasmic inheritance (15 Lectures)

5.1: Mitochondrial and Chloroplast genome.

5.2: Inheritance of chloroplast genes (*Mirabilis jalapa* and *Zea mays*).

5.3: Inheritance of mitochondrial genes (Petite in Yeast and cytoplasmic male sterility in plants).

5.4: Interaction between cytoplasmic and nuclear gene.

5.5: Maternal effect in inheritance.

Suggested Readings-

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

Paper- XI

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

Unit 1: Nucleic acids **(05 Lectures)**

1.1: Introduction.

1.2: Historical perspective.

1.3: DNA as the carrier of genetic information (Griffith's experiment).

Unit 2: The Structures of Genetic Material **(15 Lectures)**

2.1: Introduction.

2.2: Structure of DNA: Watson and Crick model.

2.3: Salient features of double helix.

2.4: Types of DNA.

2.5: Denaturation and renaturation of DNA.

2.6: Organization of DNA in Prokaryotes and Eukaryotes.

2.7: Structure of RNA.

2.8: Types of RNA.

Unit 3: Replication of DNA **(10 Lectures)**

3.1: Introduction.

3.2: Synthesis of DNA (Kornberg's discovery).

3.3: Replication of DNA in prokaryotes and eukaryotes.

3.4: Enzymes involved in DNA replication.

Unit 4: Transcription **(15 Lectures)**

4.1: Introduction.

4.2: Transcription in prokaryotes and eukaryotes.

4.3: Principles of transcriptional regulation.

4.4: Prokaryotes: Regulation of lactose metabolism in *E. coli.*

4.5: Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormone.

Unit 5: Translation **(15 lecture)**

5.1: Introduction.

5.2: Structure of Ribosome.

5.3: Assembling of Ribosome and m-RNA.

5.4: Charging of t-RNA and aminoacyl t-RNA synthetases.

5.5: Steps in protein synthesis

5.6: Proteins involved in initiation, elongation and termination of polypeptides.

5.7: Post-translational modifications of proteins.

Suggested Readings-

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

Paper- XII **Elective Paper**

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

Unit1: Plant Breeding: **(5 Lecture)**

1.1: Introduction.

1.2: Aim and objectives.

1.3: Scope of plant breeding.

Unit 2: Methods of Crop Improvement **(25 Lecture)**

2.1: Introduction.

2.2: Methods of crop improvement.

2.3: Centres of origin and domestication of crop plants.

2.4: Plant genetic resources.

2.5: Introduction and acclimatization.

2.6: Selection methods: Pure line, Mass and Clonal selection.

2.7: Hybridization: Procedure.

2.8: Hybridization in self-pollinated crop plants.

2.9: Hybridization in cross pollinated crop plants.

Unit 3: Mutation and Plant Breeding **(15 Lecture)**

3.1: Role of mutation

3.2: Role of

polyploidy .

3.3: Role of biotechnology in crop improvement.

Unit 4: Intellectual Property Rights **(10 Lecture)**

4.1: Introduction

4.2: Types of Property.

4.3: Intellectual Property.

4.4: Forms of Intellectual Property.

4.5: Advantages and Disadvantages of IPR.

Unit 5: Crop Breeding Institutes/Centers **(05 Lectures)**

5.1: Introduction.

5.2: International Institutes.

5.3: National Institutes.

Suggested Readings-

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

Paper- XII **Elective Paper**

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

Unit 1: Legumes **(10 Lecture)**

1.1 Botanical names, Morphology, Source and Economic importance of Pulses-Chickpea and Red gram, legumes - Lucerne and *Sesbania*

Unit2: Plant Fibres **(10 Lecture)**

2.1 Botanical names, Morphology, Source and Economic importance of Cotton and Coir.

Unit3: Vegetable Oil Sources **(10 Lecture)**

3.1 Botanical name, source and economic importance of – Groundnut, Soybean; Brief account of cultural practices of Ground nut and Soybean.

Unit4: Drug Yielding Plants **(15 Lecture)**

4.1 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*

Unit5: Natural Products **(15 Lecture)**

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.

Suggested Readings-

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

PLANT PATHOLOGY

Paper- XIII

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

Unit 1: Introduction (07 Lectures)

1.1: Terms, Nature, and concept of plant diseases.

1.2: Cause of disease.

1.3: Classification of Plant Diseases Based on- 1. Symptoms, 2. Spread and Severity of Infection.

1.4: Importance of plant diseases.

Unit 2: Rots, Damping offs, Downy mildews, Powdery Mildews, White rusts and Smuts (13 Lectures)

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

Unit 3: Rusts, Wilts, Leaf spots & blights and Anthracnoses (15 Lectures)

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

Unit 4: Mycoplasmas, Bacteria and Viruses (15 Lectures)

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

Unit 5: Aerobiology and Seed Pathology (10 Lectures)

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.

Suggested Readings-

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

Paper- XIV

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

Unit1: Recombinant DNA Technology **(15 Lectures)**

1.1: Introduction and principles.

1.2: Enzymes involved in recombinant DNA Technology.

1.3: Vectors.

1.4: Southern and northern blotting technique.

1.5: DNA finger printing.

: PCR.

: DNA libraries.

Unit 2: Methods of Gene Transfer **(10 Lectures)**

2.1: Introduction.

2.2: Marker and Reporter genes.

2.3:Methods of gene delivery-Physical, Chemical and Biological (*Agrobacterium* mediated gene transfer).

2.4: Transgenic plants (Flavr-Savr tomato, Golden rice).

Unit 3: Gene Cloning **(10 Lectures)**

3.1: Introduction.

3.2: Bacterial Transformation and selection of recombinant clones

3.3: PCR- mediated gene cloning.

3.4: Complementation, colony hybridization.

Unit 4: Plant Tissue Culture **(15 lectures)**

4.1: Introduction.

4.2: Terminology in tissue culture.

4.3: Techniques of tissue culture.

4.4: Micro propagation.

4.5: Anther culture.

4.4: Protoplast isolation and culture.

4.5: Somatic Hybridization.

Unit 5: Applications of Biotechnology (10 lectures)

5.1: Introduction.

5.2 : Role of Biotechnology in agriculture, Industry, Forestry.

5.3: Biotechnological Institutes and their role (any two).

Suggested Reading-

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

Paper- XV

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

Unit 1: Microscopic Techniques in Biology **(15 Lectures)**

1.1: Principles of microscopy.

1.2: Light microscopy.

1.3: Sample preparation for light microscopy.

1.4: Phase contrast microscopy.

: Electron microscopy (EM)- Scanning electron microscopy (SEM) and Scanning transmission electron microscopy (STEM).

: Sample Preparation for electron microscopy.

Unit2: Cell- Unit of Life **(10 Lectures)**

2.1: The Cell Theory.

2.2: Prokaryotic cell- structure, cell size and shape.

2.3: Eukaryotic cells- structure, cell size and shape.

2.4: Eukaryotic cell components.

Unit 3: Cell Organelles **(10 Lectures)**

3.1: Ultra structure and function- Mitochondria, Chloroplast, Nucleus, ER, Golgi body, Lysosomes, Peroxisomes and Glyoxisomes, Cell-Membrane and Cell wall.

3.2: Structure and function of cytoskeleton & its role in motility.

Unit 4: Chromosome **(15 Lectures)**

4.1: Introduction.

4.2: History of chromosome.

4.3: Morphology, shape, size.

4.4: Types of Chromosome.

4.5: Karyotype.

Unit 5: Cell Division **(10 Lectures)**

5.1: Mitosis & Meiosis, their regulations.

5.2: Steps in cell cycle.

5.3: Regulation & Control of cell cycle.

5.4: Significance of cell cycle (Mitosis and Meiosis).

Suggested Reading-

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 & HORTICULTURE

Paper- XVI **Elective Paper**

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

Unit1: Nursery & Gardening **(15 Lectures)**

1.1: Introduction.

1.2: Objectives and scope.

1.3: Types of gardening–landscape, home gardening and parks

1.4: Computer applications in land scaping.

Unit 2: The Seed **(10 Lectures)**

2.1: Introduction.

2.2: Structure and types.

2.3: Seed dormancy; causes and methods of breaking dormancy.

2.4: Seed storage: Seed banks, factors affecting seed viability, genetic erosion.

2.5: Seed production technology.

2.6: Seed testing and certification.

Unit 3: Vegetative Propagation **(10 Lectures)**

3.1: Introduction.

3.2: Types of layering, cutting, budding and grafting.

Unit 4: Horticultural Techniques **(15 Lectures)**

4.1: Introduction.

4.2: Application of manure, fertilizers, nutrients and PGRs.

4.3: Weed control, Biofertilizers and biopesticides.

Unit 5: Floriculture **(10 Lectures)**

5.1: Introduction.

5.2: Cut flowers.

5.3: Bonsai, commerce (market demand and

supply).

5.4: Importance of flower shows and exhibitions.

Suggested Reading-

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

Paper- XVI **Elective Paper**

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

Unit1: Introduction **(10 Lectures)**

1.1: Definition.

1.2: Basic principles.

1.3: Statistical methods.

1.4: Variables - measurements, functions, limitations and uses of statistics.

Unit 2: Collection of Primary and Secondary Data **(15 Lectures)**

2.1: Introduction

2.2: Types of data

2.3: Methods of data collection.

2.4: Merits and demerits.

2.5: Classification of data.

2.6: Tabulation and presentation of data

2.7: Sampling methods

Unit3: Measures of Central Tendency **(15 Lectures)**

3.1: Introduction.

3.2: Mean, median and mode, merits & demerits.

3.3: Measures of dispersion- range, standard deviation and mean deviation, merits &demerits.

3.4: Co- efficient of variations.

Unit 4: Probability **(10 Lectures)**

4.1: Introduction.

4.2: Basic Concepts.

4.3: Kinds of Probabilities.

4.4: Measures of Probability.

Unit 5: Statistical Inference **(10 Lectures)**

5.1: Introduction.

5.2: Hypothesis - Student ‘t’ test and chi square test and its significance.

Suggested Readings-

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.

PLANT SYSTEMATICS & PLANT PATHOLOGY

Practical- IV

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's- 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.

GENETICS & PLANT BIOTECHNOLOGY

Practical- V

1. Solve the problems based on Mendelian inheritance (Monohybrid ratio and Dihybrid ratio)

2. Studies on Mendelian trait by using pea plant.

3. Studies on genetic trait related to the Colour blindness, Haemophilea, Holandric genes by using photograph.

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 equipments (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 of karyotype and prepare ideogram of plant by photograph.
17. Estimation of 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.

14. Method of preparing Bonsai, Bottle garden/Terrarium, Hanging Baskets, Dish Garden.
15. Preparation of garden layout.
16. List of plants suitable for garden locations- 2 to 3 plants for each location.

17-18. 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 submit 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 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.

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