

**Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
(Autonomous)**

Course Structure for M. Sc. I (Botany)

WEF: 2022-23 to 2024-25

Preamble

The curriculum of post graduation in Botany of this autonomous institute is a road map towards achieving excellence in the diverse fields like industry, service, research and academics. The academics framework is designed in tune with national academic professional standard. Also special attention is given to have know how thrust areas, instrumentation acquaintance and skills at par. Surely the student will acquire knowledge, skills and futuristic goals to serve better with responsibility as again knowledge of plants has cone in forefront of 21st century.

Yes we are committed.....!

Course Structure for M. Sc. I (Botany)

Semester	Paper Code	Title of Paper	No. of Credits
I	PSBT111	Plant Systematics-I	4
	PSBT112	Cell Biology	4
	PSBT113	Genetics and plant Breeding	4
	PSBT114	Advanced Botanical techniques	4
	PSBT115	Practical's based on PSBT111 and PSBT112	4
	PSBT116	Practical's based on PSBT113 and PSBT114	4
	HR1	Human Rights – I	4
	CYS1	Introduction to Cyber Security – I	4
	PSBT...	Plant Systematics II	4
	PSBT...	Plant physiology and Biochemistry	4
	PSBT...	Molecular Biology and Genetic Engineering	4
	PSBT...	Plant Ecology and Biodiversity	4
	PSBT...	Practical's based on PSBT.... and PSBT....	4
	PSBT...	Practical's based on PSBT..... and PSBT.....	4
	HR..	Human Rights – II	4
	CYS...	Introduction to Cyber Security – II	4

SYLLABUS (CBCS) FOR M. Sc. Botany I (w. e. from June, 2022)

Academic Year 2022-2023

Class	: M.Sc. (Semester- I)	
Paper Code	: PSBT111	
Paper	: I	Title of Paper: Plant Systematics I
Credit	: 4	No. of lectures: 60

A) Learning Objectives:

1. To create awareness and need of inculcating knowledge of Cryptogamic diversity.
2. To give idea of applied importance of Cryptogams.

B) Learning Outcome:

1. Expert in cryptogams useful to conserve Cryptogamic diversity.
2. Exposure to lower and higher cryptogams.

TOPICS / CONTENTS:

Unit -1 (22 Lectures) Algae

Systematics and Taxonomy – Principles, outline of classification of algae up to family level according to Fritsch system and Recent developments in algal classification with special emphasis on emerging trends in molecular phylogeny and their relationships **5 L**

Algological studies – Algal habitats, Pigment constitution in algae, Reserve food, Modes of perennation in algae, Origin and evolution of sex, Contribution of algal studies in India and world.(three)..... **4 L**

Cyanophyta – Distinguishing characters, thallus organization, ultra-structure of heterocyst and its significance **2 L**

Chlorophyta- Thallus organization, reproduction – asexual and sexual, diagrammatic life cycle pattern in unicellular, filamentous and multicellular green algae. **4L**

Brief Introduction, Comparative structure and reproduction in Charophyta, Euglenophyta, Xanthophyta, Bacillariophyta and Chrysophyta **4 L**

Phaeophyta and Rhodophyta – External and Internal, reproduction and life cycle patterns. (any one example)... **2 L**

Applications of algae- Commercial applications of algae - Biofertilizer, Medicine, pollution (Palmer's pollution indices). **1 L**

Unit - 2 (23 Lectures) Fungi

Thallus structure, Nutrition, Cell structure, Hyphal modifications in Fungi.

Classification of fungi as per Ainsworth et al system (1973), Alexopoulos and Mims (1993) Contribution of fungal studies in India and world.(any three). **5 L**

Myxomycotina - Distinguishing characters, types of plasmodium, fruiting bodies and life cycle pattern **3 L**

Mastigomycotina - Distinguishing characters, structure of thallus in Chytridiomycetes and Oomycetes **3 L.**

Zygomycotina - Distinguishing characters, Thallus structure, Heterothallism and sexual reproduction **3 L.**

Ascomycotina-Thallus structure, Fructifications, Comparative study of Hemiascomycetes and Euascomycetes **3 L.**

Basidiomycotina – Distinguishing characters, thallus structure, types and structure of basidia and basidiocarps **2 L**

Deuteromycotina – Distinguishing characters, thallus structure, fructifications, types of conidia, conidial ontogeny. **2 L**

Applications of fungi- Biofertilizers, biocotrol, biopesticides, food, disease and medicine **2 L**

Unit - 3 (15 Lectures) Bryophytes

Introduction, characters, Affinities with thallophytes and pteridophytes, Contributions of bryologists in world and India (any three), Comparative system of classification according to G. M. Smith and R. M. Schuster (1972), Origin of Bryophytes, evolution of sporophyte, theory of sterilization and reduction, apogamy and apospory. **4 L**

Distribution, Distinguishing characters, morphology and anatomy of gametophyte and sporophytes of following orders. **10 L**

Takakiales, Calobryales and Sphaerocarpaceales (3 L Marchantiales (1L), Jungermanniales (1L), Anthocerotales(1L), Sphagnales(1L), Polytrichales(1L), Funariales(1L) Eubryales (1L).

Applications of bryophytes- Indicators of pollution, Conservation and need importance **1 L.**

References:

Algae :

1. **Brodie J. and Lewis J.** (2007). (Ed.) Unravelling the algae: the past, present and future of algal systematics. CRC press, New York, pp 335.
2. **Bellinger E.G. and Sigeo D.C.** (2010). Freshwater algae: Identification and use as bioindicators, Willey-Blackwell, UK, pp. 271.
3. **Graham L.E. and Wilcox L.W.** (2000). Algae. Penticce-Hall, Inc, pp. 640
4. **Krishnamurthy V.** (2000). Algae of India and neighboring countries I. Chlorophycota, Oxford & IBH, New Delhi.
5. **Lee R.E.** (2008). Phycology. Cambridge University Press, pp.547.
6. **Prescott G.W.** (1969). The algae.
7. **Smith G.M.** (1950). The fresh water algae of the United States, Mc-graw Hill New York.
8. **Vashista B.R, Sinha A.K and Singh V.P.** (2005). Botany for degree students Algae, S. Chand's Publication.
9. Sharma O.P. Algae

Fungi:

1. **Ainsworth, Sussman and Sparrow (1973).** The fungi. Vol IV A & IV B. Academic Press.
2. **Alexopolous C.J., Minms C.W. and Blackwell M.** (1999). (4th edn) Introductory Mycology. Willey, New York, Alford R.A.
3. **Deacon J.W.** (2006). Fungal Biology (4th Ed.) Blackwell Publishing, ISBN. 1405130660.
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7. **Webster J. and Rpland W.** (2007). Introduction to fungi (3rd Edn) Cambridge University Press, 978-0-521-80739-5.

Bryophytes:

1. **Chopra R.N. and Kumar P.K.** (1988). Biology of Bryophytes. John Wiley & Sons, New York, NY.
2. **Kashyap S.R.** (1929). Liverworts of the Western Himalayas and the Punjab Plain. Part 1, Chronica Botanica, New Delhi.
- 4 **Parihar N. S.** (1980). Bryophytes: An Introduction to Embryophyta. Vol I.

Central Book Depot, Allahabad

6. **Prem Puri** (1981). *Bryophytes: Morphology, Growth and Differentiation*. Atma Ram and Sons, New Delhi.
7. **Udar R.** (1975). *Bryology in India*. Chronica Botanica, New Delhi.
8. **Udar R.** (1970). *Introduction to Bryophytes*. Shashidhar Malaviya Prakashan. Lucknow.
9. **Watson E.V.** (1971). *Structure and Life of Bryophytes*. 3rd Edn. Hutchinson University Library, London.
10. **Vashista B.R., Sinha A.K., Kumar A.** (2008). *Botany for degree students – Bryophyta*, S.Chands Publication.

Class : M.Sc. (Semester- I)

Paper Code: PSBT112

Paper : II

Credit : 4

Title of Paper: Cell Biology

No. of lectures: 60

A) Learning Objectives:

1. To study structure of cell organelles and their functions.
2. To pertain knowledge of different cytological techniques.

B) Learning Outcome:

1. Students will explain basic cell structure.
2. This course is to acquaint students with some cytological techniques.

TOPICS/CONTENTS:

Credit 1 = (15 Lectures)

Unit 1: Introduction to cell biology, Cell theory and cell structure **1L**

Cell Wall- Biogenesis, Ultra Structure and function, Growth- primary and secondary wall.

2L

Cell membranes- Molecular organization, Fluid mosaic model, Membrane protein diffusion, Electrical properties of membranes, Transport across membranes-Facilitated diffusion, Carrier and channel proteins, Transporters, Active transport, Transport of ions and solutes **5L.**

Unit 2: Molecular organization and biogenesis of chloroplast and mitochondrial membrane.

2L

Vacuoles- Biogenesis, transporters, Mechanism of sorting and regulation of intracellular transport, Role as storage organelle, Transport across vacuolar membrane. **2L**

Endoplasmic reticulum- Ultra structure of ER, Role in synthesis and transport of secretory proteins. **2L**

Golgi complex- Ultra structure of golgi complex, Role in sorting, storage and secretion. **1L**

Credit 2 = (15 Lectures)

Unit 1: Nucleus- Structure, Organization and regulation of nuclear pore complex,

Transport across nuclear membrane **2L**

Ribosomes- Structure, Assembly and dissociation of subunits, function **2L**

Lysosomes- Ultra structure of lysosomes, Membrane integrity and role. **2L**

Glyoxysomes - Structure and functions **1L**

Peroxisomes- Structure and functions **1L**

Unit 2: Cytoskeleton- Composition and organization of microtubules, Intermediate filaments, microfilaments, signaling and intracellular traffic, flagella- Structure and organization, Role in motility. **4L**

Techniques in cell biology- In Situ hybridization to locate transcripts in cell types, FISH, GISH, confocal microscopy. **3L**

Credit 3 = (15 Lectures)

Unit 1: Signal transduction-Types of receptors: Ion channel linked receptor, Enzyme linked receptor, G Protein linked receptor. **3L**

Phospholipid signaling, secondary messengers, Ca²⁺, Calmodulin cascade, regulation of signaling pathways. Diversity in protein kinases and phosphatases, **3L**

Specific signaling mechanisms with suitable examples- Biotic and abiotic stress, ABA induced stomatal closure, Stomatal guard cell signaling **3L**

Unit 2: Nuclear- organelle signaling during plastid development **1L**

Ethylene mediated two component system. **2L**

Cellular communication- general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins and its regulation. **3L**

Credit 4 = (15 Lectures)

Unit 1: Cell cycle- Phases of cell cycle, functional importance of each phase, Molecular events during cell cycle, Regulation of cell cycle, Check points, Cyclins and protein kinase, MPF (Maturaton promoting factor). **6L**

Method to study cell cycle- labeled mitotic curve, flow cytometry, use of mutants. **3L**

Unit 2: Cell aging and cell senescence, programmed cell death-moleular aspects, regulation of cell death, PCD in response to stress. **3L**

Apoptosis- Role of different genes, cell organelles during apoptosis, genetic control of apoptosis **3L**

REFERENCES:

1. **Alberts B., Bray D., Lewis J., Raff M., Roberts K., Watson J.D.** (1989). Molecular Biology of the Cell. 2nd Edn. Garland Publ. Inc. New York.
2. **Karp G.** (1999). Cell and Molecular Biology- Concept and Expts. John Wiley and Scene Inc., USA.
3. **Lodish S., Baltimore B., Bek C., Lawrence K.** (1995).Molecular Cell Biology. 3rd Edn. Scientific American Books, New York.
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5. **Buchanan, Grisse and Jones** (2000). Biochemistry and Molecular Biology of Plants. American Soc. Plant Biologists, Waldorf.
6. **Lewin B.** (2000). Gene VII. Oxford University Pres. New York, USA.
7. **De Robertis and De Robertis** (2005). (8th edition) (Indian) Cell and Molecular Biology, Lippincott Williams, Philadelphia. [B.I Publications Pvt. Ltd. New Delhi].
8. **David S.** (2004) (1st Indian Edition). Cell Biology, New Delhi.
9. **Albert et al** (2002). (4th Edn). Molecular Biology of the cell, Garland Science (Taylor and Francis) New York Group (wt)
10. **Lodish et al** (2004). 5th Edn). Molecular Cell Biology, W H Freeman and company, New York.
11. **Arthur G** (1979) (5th Edn). Cell Physiology, Toppan company Ltd., Tokyo, Japan.
12. **Verma P.S and Agarwal V.K.** (2006) Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S.Chand and Company, New Delhi.

Class : M.Sc. (Semester- I)
 Paper Code: PSBT113
 Paper : III Title of Paper: Genetics and plant Breeding
 Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To study genetic inheritance and gene interactions in plants.
2. To make aware about plant breeding

B) Learning Outcome:

1. Students will come to know applications of gene interactions
2. Students will use breeding techniques in field.

Credit 1 = INHERITANCE OF GENES :(15 Lectures)

Unit 1: Principles of Mendelian inheritance and Interaction of genes:- 6L

Mendel's Laws - Dominance, Segregation, Independent assortment, Interaction of genes- Complementary, epistasis, inhibitory, polymeric and additive. Extensions of Mendelian principles: Phenocopy, Pleiotropy

Unit 2 : Cytoplasmic inheritance:- 3L

Mitochondrial chloroplast genomes, Inheritance of chloroplast genes (*Mirabilis jalapa*), Inheritance of mitochondria genes (Petit yeasts), Cytoplasmic male sterility in Maize), Interaction between nuclear and cytoplasmic genes

Unit 3: Inheritance: Quantitative and Sex linked 6L

Quantitative traits, Inheritance of quantitative traits, Polygenic traits :corolla length in *Nicotiana*, Cob length in *Zea mays*, Heritability and its measurement

Chromosomal theory of inheritance: Inheritance of X and Y linked genes, Sex limited and sex influenced genes.

Credit 2 = ALLELE, LINKAGE AND RECOMBINATIONS :(15 Lectures)

Unit 1: Concept of gene, allele, multiple allele, pseudo allele, Complementation test 4L

Unit 2: Hardy Weinberg's Law, Factors affecting gene and gene frequencies,

Pedigree analysis in Human genetics, Genomic Imprinting **4L**

Unit 3: Linkage and Recombination in Chromosomes: homologous, non-homologous,

site specific recombination, Linkage maps, LOD score for linkage testing, Tetrad analysis in

Yeast (unordered), *Neurospora* (ordered) **7L**

Credit 3 = MICROBIAL GENETICS AND CYTOGENETICS: (15 Lectures)

Unit 1: Methods of genetic transfers- transformation, conjugation and transduction in bacteria, Genetic recombination in Bacteria **4L**

Unit 2: Lytic and lysogenic cycles in phages, Genetic recombination, specialized transduction, Mapping the bacteriophage genome **4L**

Unit 3: Structure, Organization of chromosome, Concept of karyotype, Preparation of chromosome for Karyotype, Chromosomal alterations :Deletion, duplication, inversion, translocation, complex translocations, Robertsonian and BA translocations **7L**

Credit 4 = PLANT BREEDING: (15 Lectures)

Unit 1: Centers of origin, distribution and areas of diversity, Importance of genetic diversity in crop improvement, Importance of genetic diversity in conservation and regulation. **3L**

Unit 2: Cross and self pollination, Pollination control mechanisms and implications, Selection methods in self pollinated and cross pollinated, asexually, propagated crops, Marker Assisted selection in plants, Hybridization and its role in crop improvement, Inter-varietal and wide/distant Crosses **9L**

Unit 3: Physical and chemical mutagens, General method of induction of mutations in crop plant, Role of induced mutations, Induction of polyploidy in crop plants, Role of polyploidy in plant breeding **3L**

REFERENCES: -

1. **Hartk D.L and Jones, E.W** 1998 Genetics: Principles and Analysis (Fourth Edition). Jones and Bartlett Publishers, Massachusetts, USA.
2. **Lewin, B.** 2000. Gene VII. Oxford University Press, New York, USA.
3. **Snustad, D.P and Simmons, M.J** 2000. Principles of Genetics (Second Edition). John Wiley and Sons Inc., USA.
4. **Gardner and Simmons Snustad** 2005 (Eighth Edition). Principles of Genetics, John Wiley and Sons, Singapore.
5. **Sariu C** 2004 (Sixth Edition) Genetics. TATA McGraw-Hill Publishing Company Ltd., New Delhi.
6. **Ahluwalia K.B** 2005 (First Edition). Genetics. New Age International Private Ltd. Publishers, New Delhi.
7. **Pawar C.B** 2003 (First Edition). Genetics Vol. I and II. Himalaya Publishing House, Mumbai.

8. **Strickberger** 2005. (Third Edition). Genetics. Prentice Hall of India Pvt. Ltd., New Delhi.
9. **Allard R.W** 1995. Principles of Plant Breeding. John Wiley and Sons, Inc., Singapore.
10. **Sharma J.R** 1994 Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers Company Ltd., New Delhi.
11. **Singh B.D** 1996 Plant Breeding – Principles and methods. Kalyani Publications, Ludhiana.
12. **Chahal G.S** and Gosal S.S 2002. Principles and procedures of Plant Breeding, Narosa Publishing House, New Delhi.
13. **Verma and Agarwal**, Genetics, S. Chand Co, New Delhi.
14. **Toun N and TrempeyJanire** 2004 (First Indian Reprint). Fundamental Bacterial Genetics. Blackwell Publishing Co.
15. **Singh B.D** 2004. Genetics. Kalyani Publication, Ludhiana. 26. **Gupta P.K** Genetics and Cytogenetics, Rastogi Publications.

Class : M.Sc. (Semester- I)
Paper Code : PSBT 114
Paper : IV Title of Paper : Advanced Botanical techniques
Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To train the students in instrumentation useful in research methodology.
2. To make technosavy students.

B) Learning Outcome:

1. Enrich student knowledge with advance botanical techniques.

TOPICS/CONTENTS:

Credit 1 = (15 Lectures)

Image formation (properties of light), Lens- refraction, magnification concept, resolution concept. Light microscopy, Confocal microscopy, Phase Contrast microscopy, Fluorescence microscopy, Electron microscopy (SEM and TEM), Flow Cytometry

8L

Microtomy- serial sectioning, double or multiple staining, Lesser assisted Microtomy

4L

Histochemical and cytochemical techniques- Localization of specific Compounds/ reactions/ activities in tissues and cells

3L

Credit 2 = (15 Lectures)

Chromatography techniques:-

Introduction, concept of partition coefficient, Column, Gel filtration, Affinity, Ion exchange, HPLC and HPTLC, Gas chromatography (Principle, method and applications of each)

8L

Electrophoretic techniques:-

History, Principles, Agarose gel electrophoresis (AGE), Pulsed Field Gel Electrophoresis, Polyacrylamide Gel Electrophoresis (PFGE), Sodium Dodecyl Sulphate polyacrylamide gel electrophoresis (SDS-PAGE/ Denaturing), Isoelectric focusing, 2 Dimensional Gel Electrophoresis (2-D method)

7L

Credit 3 = (15 Lectures)

Spectroscopic techniques:-

General principles, Beer and Lambert's Law, Molar extinction coefficient, Spectrophotometer (working and application), UV-Visible spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy, X-ray crystallography, Spectofluometry, AAS, MS, IR Spectroscopy **9L**

Radioactive techniques:-

Radioisotopes used in biology and their properties, Units of radioactivity, Interaction of radioactivity with matter, Detection and measurement of radioactivity, Autoradiography, Safe handling of radio isotopes, Non-Radio labeled techniques, Green Fluorescent Proteins, Incorporation of radioisotopes in biological tissues and cells, Molecular imaging of radioactive material. **6L**

Credit 4 = (15 Lectures)

Centrifugation techniques:-

Principles, Types (Analytical and Preparative), Rotors and their types, Ultra centrifugation, Density Gradient Centrifugation, High speed centrifuges **4L**

Electrochemical techniques:-

Electrical conductivity, pH meter, Oxygen electrode **2L**

Immunological techniques:-

Principles, Antigen-antibody interaction, Immuno diffusion, Immuno precipitation, Radio-immuno assay, Rocket immuno-electrophoresis, ELISA, In-Situ localization by techniques such as FISH and GISH. **4L**

Molecular biology techniques:-

DNA sequencing techniques- Sanger's method, Maxam- Gilbert's method, Automated DNA sequencing, Pyrosequencing, Sequencing of proteins, Different types of PCR, DNA microarray, Gene delivery, Yeast two hybrid, Protein crystallography **5L**

REFERENCES:-

1. **P. Gunadegaram** (1995). Laboratory Manual in Microbiology. New Age International (P) Ltd.
2. **Srivistava M.L.** (2008). Bioanalytical Techniques. Narosa Publishing House (P) Ltd.
3. **Gamborg O.L., Philips G.C.** (Eds.) (1995). Plant Cell, Tissue and Organ Culture Fundamental Methods. Narosa Publishing House (P) Ltd.
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7. **Khasim S.M.** (2002). Botanical Microtechniques: Principles and Practice. Capital Publishing Company.
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18. **Sass John E.** (1984). Botanical Mcrotechniques. Tata McGraw-Hill Publishing Company Ltd.
19. **Pal and Ghaskadabi** (2009). Fundamentals of Molecular Biology. Oxford Publishing Co.

Class : M.Sc. (Semester- I)
Paper Code: PSBT115
Paper : I Title of Paper : Practical's based on PSBT111 and 112
Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To study Cryptogamic habit and habitat diversity.
2. Hand on training for the identification and study of methods of reproduction of cryptogams and ultrastructure of cell organelles.

B) Learning Outcome:

1. To develop skilled cryptogamist
2. Student will train in cell biology techniques.

TOPICS/CONTENTS:

Practical's based on PSBT111

Practical's on Algae: (Any Two Practical's)

Morphological observations, documentation (description and illustrations) and classification according to Fritsch (1935) with reasons of taxa belonging to:

- 1 **Cyanophyta** and **Chlorophyta**: Any one form. **1P**
- 2 **Charophyta** and **Phaeophyta** any one form **Rhodophyta**: Any one form. **1P**

Practical's on Fungi: (Any Two Practical's)

Study of the representative genera belonging to following sub-divisions of fungi with respect to vegetative, reproductive structures and classification with reasons according to Ainsworth (1973).

- 1 Sub-division: **Myxomycotina** ; **Mastigomycotina**: Any one form.
Sub-division: **Zygomycotina** ; **Ascomycotina** : Any one form. **1P**
- 2 Sub-division: **Basidiomycotina** ; Any one form.
Sub-division: **Deuteromycotina** : Any one form. **1P**

Practicals on Bryophytes: (Any Two Practical's)

Morphological, anatomical and reproductive studies of the following members:
Classification with according to G. M. Smith (1972)

- | | | |
|----|--|-----------|
| 1 | Marchantiophyta : <i>Plagiochasma</i> and <i>Targionia</i>
Anthocerotophyta : <i>Anthoceros</i> | 1P |
| 2. | Bryophyta : <i>Polytrichum</i> and <i>Funaria</i> | 1P |

Note: Excursion tour arranging for to study cryptogamic diversity.

Practical's based on PSBT112: Cell Biology

- | | | |
|----|---|-----------|
| 1. | Differential centrifugation for isolation of cell fractions- Nuclear fraction | 1P |
| 2. | Isolation of Chloroplasts to study Hill reaction to measure intactness | 1P |
| 3. | Isolation of mitochondria for: Estimation of succinic dehydrogenase activity | 1P |
| 4. | Isolation of Lysosomal fraction and estimation of acid phosphatase activity | 1P |
| 5. | Study of Electron Micrographs of cell organelles | 1P |
| 6. | Cytochemical / Histochemical studies of special cell types: guard cells, senescent cells, bundle sheath cells, meristematic cells, laticiferous cells, glandular cells, Pollen grains, stigma | 1P |

Class : M.Sc. (Semester- I)
Paper Code: PSBT 116
Paper : I Title of Paper: Prac. based on PSBT113 and 114
Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To pertain cytological and botanical techniques.
2. To provide the knowledge of different genetic interaction and plant breeding techniques.

B) Learning Outcome:

The learning outcome of this training useful to develop new methods in plant breeding.

Practical's based on PSBT1113 Genetics and Plant Breeding (Any 5 Practical's)

1. Preparation of stains, Fixatives, Preservatives and pretreatments to plant material 1P
2. Preparation of somatic C- metaphase chromosomes of appropriate material and Karyotype analysis (*Allium*) 2P
3. Study of Polygenic inheritance. 1P
4. *Neurospora* tetrad analysis. 1P
5. Study of Pollen Viability, in-vitro germination (Suitable material) 1P
6. Emasculation 1P

Practical's based on PSBT1114: Botanical Techniques (Any 12 Practical's)

1. Electrical conductivity and pH measurements 1P
2. Absorption spectra of BSA/DNA & determination of absorption maxima 1P
3. Detection of Radioactivity by using GM Counter 1P
4. Determination of heavy metals / Minerals by AAS 1P
5. Separation of proteins using Electrophoresis technique 1P
6. Isolation and purification of enzymes/ DNA/ Protein (Ultracentrifugation / Refrigerated Centrifugation) 1P
7. Visit to plant breeding station / sophisticated instrumentation laboratory 1P
