Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Two Year Degree Program in Botany

(Faculty of Science & Technology)

CBCS Syllabus

M.Sc. (Botany) Part-I Semester -I

For Department of Botany

Tuljaram Chaturchand College, Baramati

Choice Based Credit System Syllabus (2019 Pattern)

M.Sc. Botany

Program Outcomes (Pos) for M. Sc. Program

PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the discipline that forms a part of a postgraduate programme. Execute strong theoretical and practical understanding generated from the specific programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and also evaluate them in terms of generic conventions. Identify the problem by observing the situation closely, take actions and apply lateral thinking and analytical skills to design the solutions.
PO3	**Social competence:** Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies. Elicit views of others, present complex information in a clear and concise way and help reach conclusions in group settings.
PO4	**Research-related skills and Scientific temper :** Infer scientific literature, build a sense of enquiry and able to formulate, test, analyse, interpret and establish hypothesis and research questions; and to identify and consult relevant sources to find answers. Plan and write a research paper/project while emphasizing on academics and research ethics, scientific conduct and creating awareness about intellectual property rights and issues of plagiarism.
PO5	**Trans-disciplinary knowledge:** Create new conceptual, theoretical and methodological understanding that integrates and transcends beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence:** Perform independently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

Course Structure For M. Sc. I (Botany)

Semester	Paper Code	Title of Paper	No. of Credits
I	BOT4101	Plant Systematics I	4
	BOT4102	Cell Biology	4
	BOT4103	Genetics and plant Breeding	4
	BOT4104	Advanced Botanical techniques	4
	BOT4105	Practicals based on BOT. 4101 and BOT. 4102	4
	BOT4106	Practicals based on BOT. 4103 and BOT. 4104	4
II	BOT4201	Plant Systematics II	4
	BOT4202	Plant Physiology and Biochemistry	4
	BOT4203	Molecular Biology and Genetic Engineering	4
	BOT4204	Plant Ecology and Biodiversity	4
	BOT4205	Practical on BOT 4201and BOT4202	4
	BOT4206	Practical on BOT 4203 and BOT 4204	4

SYLLABUS (CBCS) FOR M. Sc. Botany I (w. e. from June, 2019)

Academic Year 2019-2020

Class : M.Sc. (Semester- I)
Paper Code : BOT4101
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 economic importance of Cryptogams.

B) Course Outcome:

CO1. Get knowledge about cryptogams to conserve Cryptogamic diversity.
CO2. Classify the cryptogams up to species level.
CO3. Get aware about the importance of Cryptogams.
CO4. Get knowledge about life history of algae, fungi bryophytes.
CO5. Explain the role of Algae, Fungi and Bryophytes in human welfare.
CO6. Aware about plant conservation in society.
CO7. Analyze industrial applications of algae.

TOPICS / CONTENTS:

Credit -1 (20 Lectures) Algae

1.1 Systematics and Taxonomy – Principles, Concept of species and hierarchial taxa, Classification of algae up to order level- Fritsch system **3 L**

1.2 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)…… **5 L**

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

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

1.5 Brief Introduction, Comparative structure and reproduction in Charophyta, Euglenophyta, Xanthophyta, Bacillariophyta and Chrysophyta **3 L**

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

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

Credit - 2 (20 Lectures) Fungi

2.1 Thallus structure, Nutrition, Cell structure, Hyphal modifications in Fungi. Classification of fungi as per Ainsworth et al system (1973), Contribution of fungal studies in India and world.(any three). **3 L**

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

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

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

2.5 Ascomycotina-Thallus structure, Fructifications, Comparative study of Hemiascomycetes and Euascomycetes **2L**.

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

2.7 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**

Credit - 3 (20 Lectures) Bryophytes

3.1 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. Schster (1972), evolution of sporophyte, theory of sterilization and reduction, apogamy and apospory. **5 L**

3.2 Distribution, Distinguishing characters, morphology and anatomy of gametophyte and sporophytes of following orders. **14 L**

3.2.1 Takakiales, Calobryales and Sphaerocarpales (3 L Marchantiales (1L), Jungermanniales (2L),

3.2.2 Anthocerotales(1L), Sphagnales(1L), Polytrichales(1L), Funariales(1L), Andreaeales (1L), Eubryales(3L).

3.2.3 Applications of bryophytes- Therapeutical and horticultural **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 Sigee D.C.** (2010). Freshwater algae: Identification and use as bioindicators, Willey-Blackwell, UK, pp. 271.
3. **Cole K.M. and Sheath R.G.** (1990). Biology of the red algae. Cambridge University Press.USA. pp. 503.
4. **Desikachary T.V.** (1959). Cyanophyta. ICAR, New Delhi.
5. **Graham L.E. and Wilcox L.W.** (2000). Algae. Penticce-Hall,Inc, pp. 640
6. **Krishnamurthy V.** (2000). Algae of India and neighboring countries I.Chlorophycota, Oxford & IBH, New Delhi.
7. **Lee R.E.** (2008). Phycology. Cambridge University Press, pp.547.
8. **Misra J.N.** (1996). Phaeophyceae in India. ICAR, New Delhi.
9. **Prescott G.W.** (1969). The algae.
10. **Smith G.M.** (1950). The fresh water algae of the United States, Mc-graw Hill NewYork.
11. **Srinivasan K.S.** (1969). Phycologia India. Vol. I & II, BSI, Calcutta.
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13. **Vashista B.R, Sinha A.K and Singh V.P.** (2005). Botany for degree students – Algae, S. Chand's Publication.
14. **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) IntroductoryMycology. Willey, New York, Alford R.A.
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5. **Kirk et al.** (2001). Dictionary of fungi, 9th edn, Wallingford: CABI, ISBN: 085199377X.

5. **Mehrotra R.S. and Aneja K.R.** (1990). An introduction to mycology. New Age Publishers, ISBN 8122400892.
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8. **Webster J. and Rpland W.** (2007). Introduction to fungi (3rd Edn) Cambridge University Press,978-0-521-80739-5.

Bryophytes:

1. **Cavers F.** (1976). The interrelationships of the Bryophytes. S.R. Technic, Ashok Rajpath, Patana
2. **Chopra R.N. and Kumar P.K.** (1988). Biology of Bryophytes. John Wiley & Sons, New York, NY.
3. **Kashyap S.R.** (1929). Liverworts of the Western Himalayas and the Punjab Plain. Part 1, Chronica Botanica, New Delhi.
4 **Kashyap S.R.** (1932). Liverworts of the Western Himalayas and the Punjab Plain (illustrated): Part 2. Chronica Botanica, New Delhi
6. **Parihar N.S.** (1980). Bryophytes: An Introduction to Embryophyta. Vol I. Central Book Depot, Allahabad
7. **Prem Puri** (1981). Bryophytes: Morphology, Growth and Differentiation. Atma Ram and Sons, New Delhi.
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11. **Vashista B.R., Sinha A.K., Kumar A.** (2008). Botany for degree students – Bryophyta, S. Chand Publication.

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. I) **Subject**: Botany
Course: Plant Systematics I **Course Code**: BOT 4101
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2		3							
CO 3			3						
CO 4	3								
CO 5						3			
CO 6			2						
CO 7	2	3							

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Get knowledge about cryptogams to conserve Cryptogamic diversity.
CO4. Get knowledge about life history of algae, fungi bryophytes.
CO7. Analyze industrial applications of algae.

PO2: Critical Thinking and Problem Solving

CO2. Classify the cryptogams up to species level.
CO7. Analyze industrial applications of algae.

PO 3: Social competence

CO3. Get aware about the importance of Cryptogams.
CO6. Aware about plant conservation in society.

PO6: Personal and Professional Competence

CO5. Explain the role of Algae, Fungi and Bryophytes in human welfare.

Class : M.Sc. (Semester- I)
Paper Code: BOT4102
Paper : II Title of Paper: Cell Biology
Credit : 4 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) Course Outcome:

By the end of course students will be able to

CO1. Explain the concepts of the cell.
CO2. Understand basic cell structure.
CO3. Describe the structure and function of cell membrane.
CO4. Expert with some cytological techniques.
CO5. Understand current findings in cell biology.
CO6. Demonstrate and explain different phases of cell cycle.
CO7. Get knowledge of different types of cell communication.

TOPICS/CONTENTS:

Credit 1 = (15 Lectures)

1.1 Introduction to cell biology- Cell theory and cell structure **1L**

1.2 Cell Wall- Biogenesis, Ultra Structure and function, Growth- primary and secondary wall. **2L**

1.3 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**.

1.4 Molecular organization and biogenesis of chloroplast and mitochondrial membrane **2L**

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

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

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

Credit 2 = (15 Lectures)

2.1 Nucleus- Structure, Organization and regulation of nuclear pore complex, Transport

across nuclear membrane **2L**.

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

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

2.4 Glyoxysomes and Peroxisomes- Structure and functions **2L**

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

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

Credit 3 = (15 Lectures)

3.1 Signal transduction-Types of receptors G-protein and G-protein coupled receptors. **2L**

3.2 Phospholipid signaling, $Ca^{2+,}$ Calmodulin cascade, Diversity in protein kinases and phosphatases, secondary messengers, regulation of signaling pathways. **3L**

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

3.4 Nuclear- organelle signaling during plastid development **1L**.

3.5 Receptor Serine/ Threonine kinase, bacterial and plant two component system. Bacterial chemotaxis and quorum sensing **3L**.

3.6 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)

4.1 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). **5L**

4.2 Method to study cell cycle- labeled mitotic curve, flow cytometry, use of mutants. **2L**

4.3 Cell aging and cell senescence, programmed cell death-moleular aspects, regulation of cell death, PCD in response to stress, Apoptosis- Role of different genes, cell organelles during apoptosis, genetic control of apoptosis **5L**.

4.4 Cancer- Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells. **3L**

REFERENCES:

1. **Ambhast, R. S.** (1998). A Text Book of Plant Ecology, 9th edition, Friend and Co..
2. **Begon, M., Townsend, C. R., Harper, J. L.** (2005). Ecology: From Individuals to Ecosystems, 4th edition, Wiley Blackwell..
3. **Coleman, D. C., Crossley, D. A., Handrix, P. F.** (2004). Fundamentals of Soil Ecology, 2nd edition, Elsevier academic press.
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7. **Mukherjee, B.** (2000). Environmental Management: Basic and Applied Aspects of Management of Ecological Environmental System, 1st edition, Vikas Publication.

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. I) **Subject**: Botany
Course: Cell Biology **Course Code**: BOT 4102
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3								
CO 3	3								
CO 4						3			
CO 5	2	3							
CO 6				3					
CO 7				2					

Justification for the mapping

PO1: Disciplinary Knowledge
CO1. Explain the concepts of the cell.
CO2. Understand basic cell structure.
CO3. Describe the structure and function of cell membrane.
CO5. Understand current findings in cell biology.

PO2: Critical Thinking and Problem Solving

CO5. Understand current findings in cell biology.

PO 4: Research-related skills and Scientific temper
CO6. Demonstrate and explain different phases of cell cycle.
CO7. Get knowledge of different types of cell communication.

PO6: Personal and Professional Competence
CO4. Expert with some cytological techniques.

Class : M.Sc. (Semester- I)
Paper Code: BOT4103
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 different linkage, microbial genetics and plant breeding with its importance in enhancement of economy of country.

B) Learning Outcome:

By the end of course students will be able to
CO1. Know applications of gene interactions.
CO2. Use breeding techniques in field on plants.
CO3. Expert in evaluation of conclusions based on genetic data.
CO4. Get knowledge about gene expression and regulation of gene.
CO5. Demonstrate emasculation and pollination methods.
CO6. Explain floral biology for breeding techniques.
CO7. Demonstrate mutation in plant cells.

TOPICS/CONTENTS:

Credit 1 = INHERITANCE OF GENES :(15 Lectures)

1.1 Principles of Mendelian inheritance and Interaction of genes:- 6L

a Introduction to genetics

b Early concepts of inheritance

c Mendel's Laws - Dominance, Segregation, Independent assortment, Discussion on Mendel's paper, Chi Square test, Probability

d Interaction of genes- Complementary, epitasis, inhibitory, polymeric and additive

1.2. Cytoplasmic inheritance:- 3L

a Mitochondrial and chloroplast genomes

b Inheritance of chloroplast genes (*Mirabilis jalapa* and *Zea mays* Inheritance of mitochondria genes (Petit yeasts and cytoplasmic male sterility in plants)

c Interaction between nuclear and cytoplasmic genes

d Maternal effect in inheritance (*Limnaea peregra*)

1.3. Inheritance: Quantitative and Sex linked 4L

a Quantitative traits, Continuous variation

b Inheritance of quantitative traits, (Polygenic traits) in - corolla length in *Nicotiana*,

c Cob length in *Zea mays*

d Heritability and its measurement

e Chromosomal theory of inheritance: Inheritance of X and Y linked genes,

f Sex limited and sex influenced genes.

1.4. Population Genetics 2L

a Hardy Weinbergs Law, Factors affecting gene and gene frequencies

b Pedigree analysis in Human genetics, Genomic Imprinting

Credit 2 = ALLELE, LINKAGE ANDRECOMBINATIONS :(15 Lectures)

2.1. Concept of gene, allele, multiple allele, pseudo allele- complementation tests 2L

2. 2Recombination, Linkage and mapping of eukaryotes :- 9L

a Linkage and crossing over

b Recombination in Chromosomes: homologous and non-homologous, sitespecific recombination

c Genetic markers

d Linkage maps, LOD score for linkage testing,

e Mapping by tetrad analysis in Yeast (unordered) and *Neurospora*(ordered)

f Mapping by using somatic cell hybrids

2.3. Mutation: - 4L

a Mutation- causes and detection

b Types of Mutation- lethal, conditional, biochemical, Loss of function, gain of function

c Induced ,Point mutagenesis and Germinal and somatic mutants

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

3.1. Microbial Genetics:- 3L

a Methods of genetic transfers- transformation, conjugation and transduction in bacteria

b Genetic recombination in Bacteria

c Mapping of bacterial genome by interrupted mating

3.2. Genetics of phages: 3L

a Lytic and lysogenic cycles in phages

b Genetic recombination, specialized transduction

c Mapping the bacteriophage genome

d Fine structure analysis of rII gene in T4 bacteriophage

3.3. Karyotype: 2L

a Structure and Organization of chromosome, Concept of karyotope
b Karyotype evolution
c Preparation of chromosome for Karyotype and its analysis
d Chromosome banding
e Role of karyotype in plant species identification

3.4. Structural alterations of chromosomes: 3L

a Deletion, duplication, inversion, translocation, complex translocation heterozygotes
b Robert sonian and BA translocations
c Genetic disorders

3.5. Numerical alterations of chromosomes: 4L

a) Classification of polyoploids: cytological and genetical method of identification of autopolyploids and allopolyploids
b) Classification, method of production, identification of aneuploids (Monosomics, Nullisomics and trisomics)

Credit 4 = PLANT BREEDING: (15 Lectures)

4.1. Plant Breeding: - 1L

a) History
b) Objectives
c) Patterns of evolution and Plant breeding in India.

4.2. Plant Genetic resources: - 2L

a) Centers of origin, distribution and areas of diversity
b) Importance of genetic diversity in crop improvement
c) Importance of genetic diversity in conservation and regulation.

4.3. Reproductive systems, population structure and breeding strategies: - 2L

a) Asexual reproduction
b) Sexual reproduction (Cross and self pollination)
c) Pollination control mechanisms and implications
d) Genetic structure of populations

4.4. Selection methods:- 5L

a) Selection methods in self pollinated and cross pollinated crops
b) Selection methods in asexually propagated crops
c) Marker Assisted selection in plants

4.5. Hybridization: - 3L

a) Hybridization and its role in crop improvement
b) Inter-varietal and wide/distant crosses
c) Plant genetic erosion

4.6. Induced mutations in crop plants: - 2L

a) Physical and chemical mutagens
b) General method of induction of mutations in crop plant
c) Role of induced mutations
d) Induction of polyploidy in crop plants
e) Role of polyploidy in plant breeding

REFERENCES: -

1. **Albert B. Bray, D Lewis, J Raff, M. Robert, K. and Walter** 1989, Molecular Biology of the Cell (Second Edition) Garland Publishing Inc, New York.
2. **Atherly, A.G., Girton, J.R. and McDonald, J.F** 1999. The Science of Genetics Saunders College Publishing, Frot Worth, USA.
3. **Burnham, C.R** 1962. Discussions in Cytogenetics. Burgess Publishing Co. Minnesota.
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11. **Russel, P.J.** 1998. Genetics (Fifth Edition). The Benjamin/Cummings Publishing Company IND., USA.
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22.**Chahal G.S** and Gosal S.S 2002. Principles and procedures of Plant Breeding, Narosa Publishing House, New Delhi.

23. **Verma and Agarwal**, Genetics, S. Chand Co, New Delhi.

24.**Toun N and TrempyJanire**2004 (First Indian Reprint). Fundamental Bacteial Genetics. Blackwell Publishing Co.

25.**Singh B.D** 2004. Genetics. Kalyani Publication, Ludhiana. 26. **Gupta P.K** Genetics andCytogenetics, Rastogi Publications.

27.**Maloy S.R, Cronan J.R and Freifelter D** 2006. Narosa Publishing House, New

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. I) **Subject**: Botany
Course: Genetics and Plant Breeding **Course Code**: BOT 4103
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3	3							
CO 2	2		3						2
CO 3				3					

CO 4	3								
CO 5						2			
CO 6	2					3			
CO 7	3								

Justification for the mapping

PO1: Disciplinary Knowledge

CO1. Know applications of gene interactions.
CO2. Use breeding techniques in field on plants.
CO4. Get knowledge about gene expression and regulation of gene.
CO6. Explain floral biology for breeding techniques.
CO7. Demonstrate mutation in plant cells.

PO2: Critical Thinking and Problem Solving

CO1. Know applications of gene interactions.

PO 3: Social competence

CO2. Use breeding techniques in field on plants.

PO 4: Research-related skills and Scientific temper

CO3. Expert in evaluation of conclusions based on genetic data.

PO6: Personal and Professional Competence

CO5. Demonstrate emasculation and pollination methods.

CO6. Explain floral biology for breeding techniques.

PO 8: Environment and Sustainability

CO2. Use breeding techniques in field on plants.

PO 9: Self-directed and Life-long Learning

CO2. Use breeding techniques in field on plants.

Class : M.Sc. (Semester- I)
Paper Code : BOT4104
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) Course Outcome:

By the end of course students will be able to

CO1.Get acquainted in advance botanical techniques.
CO2. Understand different types and working of microscopes.
CO3. Students' expertise in microscopic techniques.
CO4. Expertise in different centrifugation techniques.
CO5. Train to use different electrochemical techniques.
CO6.Understand DNA sequencing techniques.
CO7. Analyze antigen –antibody interaction.

TOPICS/CONTENTS:

Credit 1 = (15 Lectures)

1.1 Image formation (properties of light), Lens- refraction, magnification concept, resolution concept. **2L**

1.2 Light microscopy, Confocal microscopy, Phase Contrast microscopy, Fluorescence microscopy, Electron microscopy (SEM and TEM), Flow Cytometery **6L**

1.3 Microtomy- serial sectioning, double or multiple staining, Lesser assisted Microtomy **3L**

1.4 Histochemical and cytochemical techniques- Localization of specific Compounds/ reactions/ activities in tissues and cells **3L**

1.5 Micrometry and camera lucida **1L**

Credit 2 = (15 Lectures)

2.1 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**

2.2 Elctrophoretic techniques:-

History, Principles, Agarose gel electrophoresis (AGE), Pulsed Field Gel

Electrophoresis, Polyacrylamide Gel Electrophoresis (PFGE), Sodium Dodecyl Sulphate polyacrylamide gel electrophoresis (SDS-PAGE/ Denaturing), Isoelctric focusing, 2 Dimensional Gel Electrophoresis (2-D method) **7L**

Credit 3 = (15 Lectures)

3.1 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, Spectoflurometry, AAS, MS, IR Spectroscopy **9L**

3.2 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)

4.1 Centrifugation techniques:-

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

4.2 Electrochemical techniques:-

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

4.3 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**

4.4 Molecular biology techniques:-

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

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Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. I) **Subject**: Botany
Course: Advanced Botanical Techniques **Course Code**: BOT 4104
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3			3					
CO 2	3								
CO 3						3			
CO 4						3			
CO 5									3
CO 6	2				2				
CO 7	2				3				

Justification for the mapping

PO1: Disciplinary Knowledge

CO1.Get acquainted in advance botanical techniques.
CO2. Understand different types and working of microscopes.
CO6.Understand DNA sequencing techniques.
CO7. Analyze antigen –antibody interaction.

PO 4: Research-related skills and Scientific temper

CO1.Get acquainted in advance botanical techniques.

PO5: Trans-disciplinary Knowledge

CO6.Understand DNA sequencing techniques.
CO7. Analyze antigen-antibody interaction.

PO6: Personal and Professional Competence

CO3. Students' expertise in microscopic techniques.
CO4. Expertise in different centrifugation techniques.

PO 9: Self-directed and Life-long Learning

CO5. Train to use different electrochemical techniques.

Class : M.Sc. (Semester- I)
Paper Code: BOT 4105
Paper : I Title of Paper: Practicals based on BOT. 4101 & 4102
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) Course Outcome:

By the end of course students will be able to

CO1. Develop identification skill in cryptogams.
CO2. Train in cell biology techniques.
CO3. Understand basic knowledge about life cycle of cryptogams.
CO4. Internal and external structure of cryptogams.
CO5. Explain basic knowledge about evolution of lower cryptogams.
CO6. Discuss spore dispersal mechanism.
CO7. Understand variations in cryptogamic diversity.

TOPICS/CONTENTS:

Practicals based on BOT. 4101

Practicals on Algae: (Any Four practicals)

1. Morphological observations, documentation (description and illustrations) and classification According to Fritsch with reasons of taxa belonging to:

a. Chlorophyta: Any Four forms. Charophyta: Any one form. **1P**

b. Phaeophyta: Any three forms. Rhodophyta: Any three forms. **1P**

c. Cyanophyta: Any three forms. Minor groups: Any two forms. **1P**

2. Phytochemical analysis of local area sample ($_P$H, Temperature, TDS, EC, COD and BOD) **1P**

Practicals on Fungi: (Four practicals)

1. 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 *et al* (1973).

Sub-division: Myxomycotina : Any two forms. Sub-division: Mastigomycotina: Any two forms. **1P**

Sub-division: Zygomycotina : Any one forms. Sub-division: Ascomycotina : Any four forms. **1P**

Sub-division Basidiomycotina : Any two forms. Sub-division: Deuteromycotina **:** Any two forms. **1P**

2. Isolation of fungi from rhizosphere soil **1P**

Practicals on Bryophytes: (Four practicals)

1. Morphological, anatomical and reproductive studies of the following members:
Marchantiales: *Astrella, Plagiochasma, Targionia* and *Cyathodium.* **1P**

Jungermanniales: *Porella, Frullania* **1P**

Anthocerotales: Anthoceros, *Notothylus* **1P**

Sphagnales: *Sphagnum.* Funarilales: *Funaria* **1P**

Polytrichales: *Polytrichum and Pogonatum* **1P**

Andreales: *Andrea.* Eubryales: *Bryum, Hyophila* **1P**

2. Study of antimicrobial properties of bryophytes (any two thalloid and moss) **1P**

Practicals based on BOT 4102: Cell Biology

1. Differential centrifugation for isolation of cell fractions- Nuclear fraction **1P**

2. Isolation of Chloroplasts to study: **2P**

a. Hill reaction to measure intactness,

b. Chlorophyll estimation

3. Isolation of mitochondria for: **2P**

a. Estimation of succinic dehydrogenase activity **2P**

b. Microscopic observations using MitoTracker Green FM/ MitoTracker Red 580/ Janus green B

4. Isolation of Lysosomal fraction and estimation of acid phosphatase activity **1P**

5. Study of Electron Micrographs of cell organelles **1P**

6. Study of cell cycle using BrdU (demonstration) **1P**

7. Isolation of protoplasts and viability staining to determine % viability **1P**

8. Study of metaphase nucleus: Localization of Euchromatin and heterochromatin **1P**

9. Cytochemical / Histochemical studies of special cell types: guard cells, senescent cells, bundle sheath cells, meristematic cells, laticiferous cells, glandular cells, polle grains **2P**

10. Study of induced cell senescence in leaf discs **1P**

11. Study of programmed cell death in plants **1P**

12. Study of vacuoles from different plants **1P**

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. I) **Subject**: Botany
Course: Practical based on BOT 4101 and BOT 4102 **Course Code**: BOT 4105
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1				3					
CO 2	3								
CO 3	3								
CO 4	3								
CO 5									
CO 6	2	3	3		2				
CO 7		2							

Justification for the mapping

PO1: Disciplinary Knowledge

CO2. Train in cell biology techniques.

CO3. Understand basic knowledge about life cycle of cryptogams.

CO4. Internal and external structure of cryptogams.

CO5. Explain basic knowledge about evolution of lower cryptogams.

PO2: Critical Thinking and Problem Solving

CO6. Discuss spore dispersal mechanism.

CO7. Understand variations in cryptogamic diversity.

PO 3: Social competence

CO6. Discuss spore dispersal mechanism.

PO 4: Research-related skills and Scientific temper

CO1. Develop identification skill in cryptogams.

PO5: Trans-disciplinary Knowledge

CO6. Discuss spore dispersal mechanism.

Class : M.Sc. (Semester- I)
Paper Code: BOT4106
Paper : I Title of Paper: Prac. based on BOT. 4103 & 4104
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) Course Outcome:

By the end of course students will be able to

CO1. Explain basic cell structure.
CO2. Understand basic biological concepts.
CO3.Get acquainted with some cytological techniques.
CO4. Understand basic knowledge about structure of cell organelles.
CO5. Explain mechanism of cells in plant.
CO6. Train in different isolation techniques in cell organelle.
CO7. Interprets cell structure and their function.

TOPICS/CONTENTS:

Practicals based on BOT 4103 Genetics and Plant Breeding (Any 12 Practicals)

1. Preparation of stains, Fixatives, Preservatives and pretreatments to plant material 1P
2. Karyotype analysis, preparation of somatic C- metaphase chromosomes of appropriate material using camera lucida drawing and Karyotype analysis in *Allium* / Aloe. 2P
3. Study of meiotic configuration in maize/ *Allium*, *Rhoeo*/ Aloe, *Tradescantia* (prophase I, Chiasma analysis). 2P
4. Induction of mutation in plant material using suitable mutagen 1P
5. Study of Polygenic inheritance. 1P
6. Problems of Mendelian inheritance and estimation of gene frequencies and heterozygotic Frequencies, population genetics and Linkage. 1P
7. *Neurospora* tetrad analysis. 1P
8. Study of *Drosophilla* sexual dimorphism and mutants 1P
9. Linear differentiation of chromosomes through banding techniques such as C-Banding, Banding and Q-Banding. 2P
10. Penetrance and expressivity of PTC testing ability in humans and tonge rollers/non Rollers 1P
11. Floral Biology, Study of Pollen Viability, germination in vitro and staining (any two major crops) 1P
12. Study of monohybrid and dihybrid cross and interactions. 1P
13. Use of Colchicine for induction of polyploidy in appropriate plant material. 2P

14. Conventional Plant breeding techniques (Emasculation) 1P

Practical's based on BO 4104: Botanical Techniques (Any 12 practicals)

1. Study of Binocular microscope **1P**

2. Micrometry and Camera Lucida **2P**

3. Maceration technique **1P**

4. Electrical conductivity and pH measurements **1P**

5. Absorption spectra of BSA/DNA & determination of absorption maxima **2P**

6. Gel filtration **1P**

7. Rocket immunoelectrophoresis **1P**

8. Detection of secondary metabolites by using HPLC **2P**

9. Separation of isozymes by native polyacrylamide gel electrophoresis **2P**

12. Detection of Radioactivity by using GM Counter **2P**

13. PCR **2P**

14. Determination of heavy metals / Minerals by AAS **2P**

Choice Based Credit System Syllabus (2019 Pattern)

Mapping of Program Outcomes with Course Outcomes

Class: M. Sc. I (Sem. I) **Subject**: Botany
Course: Practical based on BOT 4103 and BOT 4104 **Course Code**: BOT 4106
Weightage: 1= weak or low relation, 2= moderate or partial relation, 3= strong or direct relation

	Programme Outcomes (POs)								
Course Outcomes	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9
CO 1	3								
CO 2	3								
CO 3						3			
CO 4	2								
CO 5	2								
CO 6									3
CO 7					3				

Justification for the mapping

PO1: Disciplinary Knowledge
CO1. Explain basic cell structure.
CO2. Understand basic biological concepts.
CO4. Understand basic knowledge about structure of cell organelles.
CO5. Explain mechanism of cells in plant.

PO5: Trans-disciplinary Knowledge
CO7. Interprets cell structure and their function.

PO6: Personal and Professional Competence

CO3.Get acquainted with some cytological techniques.

PO 9: Self-directed and Life-long Learning

CO6. Train in different isolation techniques in cell organelle.