Shiksha Mandal's
Bajaj College of Science, Wardha

Proposed Syllabus for M.Sc. semester-II Program

(Academic Session 2023-24)

Syllabus
DISCIPLINE SPECIFIC CORE (DSC), DISCIPLINE SPECIFIC ELECTIVES (DSE), AND OTHER COURSES

MSc- Semester II / BSc- semester-VIII courses
in Botany
Syllabus under Autonomy
As per National Education Policy (NEP) 2020

Master of Science (Botany)	**Semester II**
Course Code	**DSC-V**
Course Name	**Genetics and Plant breeding**
Course Credit	**04 + 02 (06)**
Course working Hours	**60 Hrs (L)**
Course Structure	**Theory and Practicals**

Course objectives: This course aims to recognize principles of Mendelian and non-Mendelian inheritance, quantitative genetics, epigenetics, cytogenetic and crop genetics resources.

Course Learning Outcomes:

CO1: Students will be able to explain Mendel's laws of inheritance, multiple alleles and isoalleles, gene interactions, suppressors, and pleiotropic genes; multigene families; extrachromosomal inheritance, chromatin organization.

CO2: Students will construct Karyotype analysis and evolution, banding patterns, chromosomal aberrations, and their use in chromosome mapping; population genetics.

CO3: Students will illustrate molecular basis of gene mutations; transposable genetic elements; plant genetic resources, epigenetics.

CO4: Understand objectives of plant breeding, compare various selection methods to improve cultivars with desirable and understand hybridization process.

Module I Mendelian & Classical Genetics 15 hrs

Mendel's laws of inheritance; penetrance, expressivity, multiple alleles and isoalleles (example Corn, Drosophila and Nicotiana, gene interactions (non-epistatic and epistatic), Modifiers, suppressors, and pleiotropic genes; multigene families (globin, immunoglobin genes);

Extrachromosomal inheritance: inheritance of mitochondria and chloroplast genes, maternal inheritance and its effect.

Chromatin organization: rRNA genes, euchromatin and heterochromatin, C-value paradox, Cot curve and its significance.

Module II Chromosomal Genetics and Population Genetics 15 hrs

Karyotype analysis and evolution, banding patterns, specialized types of chromosomes: Polytene, Lampbrush, B-chromosome, sex chromosome; molecular basis of chromosome pairing.

Origin and breeding behaviour of duplications, deficiency, inversion and translocation heterozygotes, effect of aneuploidy on plants, transmission of trisomics and mono-somics and their use in chromosome mapping, complex translocation heterozygotes, translocation tester sets, Robertsonian translocation.

Population genetics: Hardy-Weinberg equilibrium, factors affecting Hardy-Weinberg Equilibrium.

Module III Mutation and plant genetic resources 15 hrs

Mutations: Molecular basis of gene mutations; transposable genetic elements; site directed mutagenesis- definition, applications and PCR based oligonucleotide muta genesis; role of mutations in crop improvement; induction of polyploidy.
Plant Genetic Resources: importance of genetic diversity in crop improvement, and its erosion. Epigenetics: introduction, histone code, base modification, paramutations in maize, epigenetics and Lamarckism, Introduction to epigenome and epigenomics.

Module IV Plant breeding 15 hrs

Objectives of plant breeding; Mass selection- Introduction, Applications, Procedure of mass selection; Purelines selection- Characters of purelines, Applications, Procedure of purelines selection; Pedigree selection- Procedure of Pedigree method; Bulk method, procedure of bulk method.
Objectives and types of hybridisations, Development, evaluation and production of hybrid seeds, Release of new varieties.

Practicals based on genetics and plant breeding

1. To study cell division (mitosis and meiosis) in the given material.
2. To study the effect of mutagen treatment on germination and seedling height.
3. To study effect of mutagen on the rate of cell division.
4. To study effect of mutagen on genetic material by scoring the chromosomal aber- rations.
5. To study the translocation heterozygote in Rheo discolor or any other suitable material.
6. To study polytene chromosomes in Chironomus larvae.
7. To study O banding pattern of any plant material.
8. To solve the given problems on interaction of genes (at least five).
9. To study the karyotype of given organism.
10. To study the chiasma frequency in the given material.
11. Preparation of Plant Breeder's kit, Study of germplasm of various crops.
12. Study of male sterility in different crop varieties.
13. Study genetic variability and heritability by using methods of calculating mean, range, variance, standard deviation, genetic coefficient of variability, phenotypic coefficient of variability (heritability).
14. Emasculation and hybridization techniques in self-pollinated crop

Suggested Readings

Gupta P K (2015). Cytogenetics. Rastogi Publication. Meerut.
Strickberger M W (2015) Genetics 3rd edition. Pearson Publishers
Klug W S, Cummings M R, Spencer C A, Palladino M A (2019) Concept of Genetics 11th edition, Pearson Publishers.
Singh B D (2018). Plant breeding: Principles and Methods, Kalyani Publishers, India
Arora, M. (2011). Cytogenetics. Himalaya Publishing House Pvt Limited. Mumbai Mahabal, R. (2010). Fundamentals of Cytogenetics and Genetics., PHI Learning Pvt Limited, Delhi. Rajan, S. (2000). Cytogenetics. Anmol Publication Pvt Limited, Delhi. Roy, D.((2009). Cytogenetics. Narosa Publishing house, Pvt Limited, Delhi.
Jahier, J (1996). Techniques of plant Cytogenetics. Oxford and IBH Publishing Copy, Limited New Delhi.

Tyagi,S (2009). A Textbook of Cytology. Dominant Publisher Distributor, New Delhi. Arora ,M.P. (2013). A Textbook of Organic Evolution. Himalaya Publishing House, Pvt Limited. Verma and Agrawal. (2008). Cytology. S.Chand Company Pvt Limited, New Delhi. Dua and Garg. (2010). Biochemical Methods Of Analysis. Narosa Publishing House Pvt Ltd, New Delhi.

Suggested URLs/Websites:

- http://egyankosh.ac.in/bitstream/123456789/16312/1/Experiment-7.pdf
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=35
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2
- https://ocw.mit.edu/courses/biology/7-03-genetics-fall-2004/lecture-notes/
- https://jru.edu.in/studentcorner/lab-manual/agriculture/Laboratory%20Manual%20FPB.pdf

Master of Science (Botany)	**Semester II**
Course Code	**DSC-VI**
Course Name	**Cell Biology and Molecular Biology- I**
Course Credit	**04 + 02 (06)**
Course Working Hours	**60 Hrs (L)**
Course Structure	**Theory and Practicals**

Course objectives: This course aims to prepare basics of cell structure in relation to functions and provide cellular and molecular events in response to various stresses.

Course Learning Outcomes:

CO1: Students will be able to explain cell membrane features, transport mechanisms and structure and function of plasmodesmata.

CO2: Students will elucidate cytoskeleton, microtubules, microfilaments and intermediate filaments and their role in cell division.

CO3: Students will describe ultrastructure of nucleus, forms of DNA and DNA replication.

CO4: Students will compare stages of transcription in both prokaryotes and eukaryotes

CO5: Students will compare salient features of organelle genomes.

Module I Membrane transport, cell membrane and cell wall 15 hrs

Cell wall: Structure; function; biogenesis and growth.
Plasma membrane: Membrane architecture (fluid mosaic model); sites for ATPases; membrane transport- ion carriers, channels, pumps and aquaporins; receptors;
Plasmodesmata: Structure, role in movement of molecules and macromolecules; comparison with gap junction.

Module II Nucleus, cytoskeleton and vacuolar organisation 15 hrs

Cell shape and motility: The cytoskeleton; organization and role of microfilaments, intermediate filaments, and microtubules; motor movements, implications in cell division, flagellar & other movements; Nucleus: Ultrastructure, nuclear pores, nucleolus,

Module III Molecular biology of gene 15 hrs

DNA structure A, B and Z forms, Stages of DNA replication in prokaryotic and eukaryotic cells, DNA replication proteins, Transcription: Transcription in prokaryotic and eukaryotic cells, plant promoters, transcription factors, types of RNA and their function, RNA splicing, mRNA transport, Stages of transcription in prokaryotes and eukyarotes
Translation: Stages in prokaryotic and eukaryotic cells, structural levels of proteins, post-translational modification; structure and role of rRNA and tRNA.

Module IV Molecular biology of gene 15 hrs

DNA damage and repair: Types of DNA damage, Repair system: Single base change, direct repair, mismatch repair, SOS response. Organellar genomes: Organization and function of mitochondrial and chloroplast genomes, chloroplast protein targeting to different

compartments, mitochondrial DNA and male sterility, transfer of genes between nucleus and organelles.

Practicals based on cell biology and molecular biology-I

1.To isolate bacterial DNA and quantify them by spectrophotometric method.
2.To demonstrate the semi-permeability of the plasma membrane.
3.To demonstrate different components of cytoskeleton in the suitable material.
4.To perform flagellar staining.
5. Isolation of plant genomic DNA using CTAB method.
6. Separation of plant genomic DNA and bacterial DNA on agarose gel electrophoresis
7. Isolation and purification of nuclei and their staining with Feulgen stain or DAPI.
8. In silico analysis (sequence comparison) of mitochondrial and chloroplast genes for identification of the loci for interspecific discrimination.
9. Conversion of DNA sequence to RNA sequence by manual method and by bioinformatics tool.
10. Conversion of RNA sequence to protein sequence by manual method and by bioinformatics tool.

Suggested Readings

- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. 1999. Molecular Biology of Cell, Garland Publishing, Inc., New York.
- Buchanan, B.B., Gruissem, W. and Jones, R. L. 2000 Biochemistry and Molecular Biology of Plants. American Soc. Of Plant Physiologists, Maryland, USA.
- De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology 8th Ed. B. I. Waverly Pvt. Ltd., New Delhi.
- Karp, G. 1999 Cells and Molecular Biology; Concepts and Experiments. John Wiley & Sons, Inc.,USA.
- Kleinsmith, L.J. and Kish, V.M. 1995 Principles of Cell and Molecular Biology (2 nd Edi.) Harper Collins Coll. Publisher, New York, USA.
- Lewin, B. 2000 Gene VII Oxford Univ. press, New York.
- Lodish, H., Berk, A. Zipursky, S. L. Matsudaira, P., Baltimore, D. and Darnell, J. 2000 Molecular Cell Biology Edi. W.H. Freeman and Co., New York, USA.
- Malacinski, G. M. and Freifelder, D. 1998 Essentials of Molecular Biology (3rd Edi.) Jones and Bartiet Pub. Inc., London.

Suggested URLs/Websites:

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=4
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=35

Master of Science (Botany)	**Semester II**
Course Code	**DSE-II**
Course Name	**Angiosperm Morphology and Economic Botany**
Course Credit	**04 + 02 (06)**
Course working Hours	**60 Hrs (L)**
Course Structure	**Theory and practicals**

Course objectives: This course aims to introduce principles of angiosperm morphology, species concept, evolutionary inferences of important morphological characters and biodiversity assessments.

Course Learning Outcomes:

CO1: Students will be able to explain angiosperm morphology, floral organs, and their evolutionary significance.

CO2: Students will construct hierarchy in taxonomy, understand species and taxon concept with help of qualitative and quantitative characters.

CO3: Students will evaluate herbaria, monographs, biochemical and molecular tools for plant identification and diversity assessment.

CO4: Students will be able to describe the origins, morphology, and uses of these important cereal crops, legumes, spices, beverage crops, and fibre yielding plants.

Module I Angiosperm Morphology 15 hrs

Angiosperm Morphology, structural units and floral symmetry, dicot and monocot flower; structure, diversity origin and evolution of stamen, carpels; placentation types and evolution. Floral adaptation to different pollinators

Module II Angiosperm 15 hrs

Angiosperm Taxonomy: Relative merits and demerits of major systems of classifications. Taxonomic structure: taxonomic hierarchy, concept of taxa, concept of species, concept of genus and family; Taxonomic character: HETEROBATHMY, ANALYTIC versus synthetic character, qualitative versus quantitative characters.

Taxonomic tools: herbarium, floras, monographs, botanical gardens, biochemical and molecular techniques, computers and GIS.

Module III Biosystematics & Ethnobotany 15 hrs

Biosystematics: The population concept phenotypic plasticity, biosystematic categories, methods of biosystematics studies. Numerical taxonomy: principles, aims and objectives, cladistics in taxonomy, polarity of characters, homology, homoplasy, monophyly, polyphyly. Plant nomenclature: Salient features of ICBN

Ethnobotany: Definition; scope and significance; Sacred groves and their role in conservation.

Module IV Economic Botany 15 hrs

Origin of Cultivated Plants: Concept of centres of origin, their importance with reference to Vavilov's work
Cereals: Wheat, Rice, Jawar -Origin, morphology, uses
Legumes : General account with special reference to Gram and soybean
Spices: General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)
Beverages: Tea , Coffee (morphology, processing, uses)
Fibre Yielding Plants: General description with special reference to Cotton (Botanical name, family, part used, morphology and uses).

Practicals based on Angiosperm and Economic Botany

1. To study the floral symmetry in various taxa.
2. To study and work out the differences in dicot and monocot flower.
3. To study the variation stamens and carpels.
4. To study placentation types in various taxa.
5. To study the floral adaptations for pollination.
6. To study anatomical features of various taxa.
7. To study embryological features of various taxa.
8. To study palynological features of various taxa.
9. To study cytological features of various taxa.
10. To prepare a cladogram on the basis of various morphological features of the species belonging to a genus.
11. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests

Suggested Readings

1. Kochhar, S.L. 2011. Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Sivarajan, V.V. 1991. Introduction to Principles of Plant Taxonomy. Oxford & IBH, New Delhi.
3. Sporne, K.R. 1974. Morphology of Angiosperms. Hutchinson University Press London.
4. Radford, A.E. 1986. Fundamentals of plant systematics. Harper & Row Publishers, New York.
5. Naik, V.N. Taxonomy of Angiosperms. TATA McGraw Hill, New Delhi
6. Gurucharan Singh, 2001. Plant systematics - Theory and Practice. Oxford & IBH, New Delhi.
7. Davis, P.H. & V.H. Heywood, 1963. Principles of Angiosperm Taxonomy. Oliver & Boyd Ltd., London.
8. Henry, A.N. & Chandrabose An aid to International Code of Botanic Nomenclature.
9. Jeffrey, C. 1968. An introduction to Plant Taxonomy, London.
10. Simpson, M.G. 2006. Plant Systematics. Elsevier Academic Press, London
11. Stuessy, T.F. 1990. Plant Taxonomy – The systematic evaluation of Comparative data. Columbia University Press, New York.
12. Sharma, B.D. et al. (Eds.) Flora of India vol. I. Botanical Survey of India, Calcutta.
13. Sambamurthy A..S.S. 2005;Taxonomy of Angiosperms, i.K. International Pvt. Ltd, New Delh.
14. Pandey, S.N. & S.P. Misra. 2008. Taxonomy of Angiosperms. Ane Books India, New Delhi.

15. Sharma, O.P. 1996. Plant Taxonomy. TATA McGraw Hill, New Delhi.
16. Bharati Bhattacharyya 2009; Systematic Botany, Narosa Publishing House Pvt. Ltd., New Delhi.

Suggested URLs/Websites:

- http://www.mobot.org/MOBOT/research/APweb/
- http://lifeofplant.blogspot.com/2011/05/cladistics.html
- http://sanjeetbiotech.blogspot.com/2013/02/homology-and-homoplasy-in-plant-taxonomy.html
- https://www.deshbandhucollege.ac.in/pdf/resources/1585201567_BT(H)-IV-Plant_SystematicsPhlogeny-2.pdf

Master of Science (Botany)	**Semester II**
Course Code	**FP/CS**
Course Name	**Field Project in Botany**
Course Credit	**08**
Course working Hours	**60 Hrs**
Course Structure	**Project based or Field work based**

Course Description:
The Fieldwork in Botany course provides MSc Botany students with a unique opportunity to immerse themselves in real-world research and data collection experiences. Over a period of eight to ten weeks, students will have the chance to conduct fieldwork in various settings, locally to address specific research questions related to the field of botany. This course is designed to complement the theoretical knowledge acquired during previous courses and enable students to gather primary and/or secondary data that cannot be accessed through desk research alone.

Course Learning Objectives:
To develop practical research skills in the field of botany.
To design and implement a fieldwork project relevant to botany.
To gain hands-on experience in data collection techniques specific to botany.
To analyze and interpret field-collected data to address research questions.

Course Learning Outcomes:
Upon successful completion of the Fieldwork in Botany course, students will be able to:

CO1: Design a research project with a clear research question related to botany.
CO2: Demonstrate proficiency in various data collection methods, including plant observation, specimen collection, and environmental data recording.
CO3: Conduct semi-structured interviews and surveys to gather relevant information for botanical research.
CO4: Analyze and interpret field data to draw meaningful conclusions and prepare comprehensive fieldwork reports and presentations.
CO5: Collaborate effectively in fieldwork teams and adapt to diverse cultural and environmental contexts during fieldwork.

Course Content:
The course will cover the following key topics and activities:

Week 1-2: Introduction to Fieldwork in Botany
Overview of course objectives and expectations
Selection of research topics and formulation of research questions
Ethical considerations in fieldwork
Preparing a fieldwork plan and proposal
Week 3-4: Data Collection Techniques
Plant identification and specimen collection
Environmental data collection (e.g., soil analysis, climate data)
Introduction to equipment and tools used in botany fieldwork
Week 5-6: Research in Local Settings
Conducting fieldwork in local locations (e.g., local parks, villages, agricultural farms, forests, and Industrial area)

Implementing structured surveys and interviews
Data recording and management

Week 7-8: Fieldwork

Planning and executing fieldwork (subject to safety recommendations)
Engaging with diverse communities wherever necessary

Week 9-10: Data Analysis and Reporting

Data analysis techniques specific to botany research
Interpretation of field-collected data
Preparing fieldwork reports and presentations
Peer review and feedback sessions

Course Assessment:

Assessment in the Fieldwork in Botany course will be based on the following components:

Fieldwork Proposal and Plan (20%)
Fieldwork Data Collection and Management (30%)
Fieldwork Report and Presentation (40%)
Active Participation and Collaboration (10%)

Students will be advised on suitable locations and conditions for their fieldwork projects.

Suggested Readings:

- Tomović, G., Mitrović, V., & Stevanovic, B. (2002). Methods of field studies in botany. *Genetika*,*34*. https://doi.org/10.2298/GENSR0203085T
- Narayana P S , Varalakshmi D and Pullaiah T (2021) Research Methodology in Plant Science, Scientific Publishers, India.