CHAITANYA SCIENCE AND ARTS COLLEGE

(AUTONOMOUS)

PAMGARH, JANJGIR-CHAMPA (C.G.)

ACCREDITED "A" GRADE BY NAAC

DEPARTMENT OF BOTANY

COURSE CURRICULUM & MARKING SCHEME

POSTGRADUATE PROGRAMME

MASTER OF BOTANY

PROGRAM CODE: CCMS04

THIRD & FOURTH SEMESTER

Approved By	Board of Studies	Academic Council
Date	16/08/26	

ACADEMIC YEAR 2026-27

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16/8/26

Master of Botany

SESSION 2026-27

Proposed Scheme For 2-Year Postgraduate Program

PROGRAMME STRUCTURE: PART	YEAR	SEMESTER	SEMESTER
Part-I	First Year	Semester-I	Semester-II
Part-II	Second Year	Semester-III	Semester-IV

COURSE STRUCTURE:

The syllabus with the paper combination is as under:

SEMESTER-III

Semester – III

PAPER	COURSE CODE	TITLE OF COURSE
I	MBOT301	Plant Development
II	MBOT302	Plant Reproduction
III	MBOT303	Plant Ecology
IV	MBOT304	Elective Paper:(A) Plant Pathology – I(B) Weed Biology – I
V	MBOT305	Based on Paper I & II
VI	MBOT306	Based on Paper III & IV

SEMESTER -IV

Semester – IV

PAPER	COURSE CODE	TITLE OF COURSE	
I	MBOT401	Plant Cell, Tissue and Organ Culture	
II	MBOT402	Plant Resource Utilization and Conservation	
III	MBOT403	Genetic Engineering of Plant and Microbes & Biostatistics	
IV	MBOT404	Elective Paper:(A) Plant Pathology – II(B) Weed Biology – II	
V	MBOT405	based on paper i & ii practical lab-1,	or dissertation
VI	MBOT406	based on paper iii & iv practical lab-2,	

SYLLABUS AND MARKING SCHEME FOR THE FIRST & SECOND SEMESTER SESSION-2026-27

SEMESTER III

Paper No.	Title of the Paper(s)	Nature	Internal Assessment	Term End Exam	Total Marks
1	Plant Development	Theory	30	70	100
2	Plant Reproduction	Theory	30	70	100
3	Plant Ecology	Theory	30	70	100
4	Elective Paper:(A) Plant Pathology – I(B) Weed Biology – I	Theory	30	70	100
Lab-1	Based on Paper I & II	Practical	–	–	100
Lab-2	Based on Paper III & IV	Practical	–	–	100
Total					**600**

SEMESTER-IV

Paper No.	Title of the Paper(s)	Nature	Internal Assessment	Term End Exam	Total Marks
1	Plant Cell, Tissue and Organ Culture	Theory	30	70	100
2	Plant Resource Utilization and Conservation	Theory	30	70	100
3	Genetic Engineering of Plant and Microbes & Biostatistics	Theory	30	70	100
4	Elective Paper:(A) Plant Pathology – II(B) Weed Biology – II	Theory	30	70	100
Lab-1	Based on Paper I & II	Practical	–	–	100
Lab-2	Based on Paper III & IV	Practical	–	–	100
Total					**600**
Grand Total					**2400**

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SEMESTER III
Paper-1

PROGRAMME	**M.Sc. Botany – III SEMESTER**	
TITLE	**PLANT DEVELOPMENT**	
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**	
Course Objective	1. To understand the fundamental concepts and principles of plant development, seed germination, seedling growth and differentiation. 2. To recognize and analyse the organization and development of shoot apical meristem, root apical meristem, leaves and vascular tissues. 3. To apply knowledge of plant hormones, gene expression, tropism, cell division, tissue differentiation and root–microbe interactions in understanding plant growth and development. 4. To examine the structure, origin and differentiation of plant tissues and evaluate the process of secondary growth in monocot and dicot plants.	
Course Outcomes	**CO1** – To understand the basic concepts and mechanisms of plant development, including seed germination, shoot, root and leaf development. **CO2** – To analyse the organization, differentiation and development of plant tissues, shoot apical meristem, root apical meristem and vascular tissues. **CO3** – To apply knowledge of plant hormones, gene expression, tropism and environmental factors in understanding plant growth and development. **CO4** – To evaluate the structural and functional aspects of plant tissues and secondary growth, including normal and abnormal development in monocots and dicots.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**Introduction**-Basics plant development,differences between plant and animal development. **Seed Germination and seedling Growth**: Metabolism of nucleicacid ,protein and mobilization of food reserve, tropism, hormonal control of seedling growth, gene expression use of mutants in understanding seedling development.	**15**
UNIT - II	**Shoot_development:** Organization of shoot apical meristem(SAM), cytological and molecular analysis of SAM, control of cell division and cell COMMUNICATION, control of tissue differentiation especially xylem and phloem, secretary duct sand lactifers, wooddevelopment inrelation to environmentalfactors.	**15**
UNIT - III	**Root development:** Organization of rootapical meristem(RAM), cell fates andlineages, vascular tissue differentiation, lateral tissue, hairs, root-microbe interaction. **Leaf Growth and differentiation:** determination: phyllotaxy, control of leaf formation, differentiation of epidermis (with reference to stomata and trichomes), mesophyll.	**15**
UNIT - IV	**Plant Tissues:** Meristem and permanent tissues, parenchyma, colenchyma, sclerenchyma scleroids and fibres, xylem and phloem, structure, origin and differentiation. **Secondary Growth:** Structure, function and origin of cambium and cork cambium, ray and fusi form cells, secondary growth in dicot stem and root, abnormal secondary growth in monocot and dicot stem in various plants	**15**

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Suggested Readings

1. Atwell, B. J., Kriedrmann, P. E., and Jumbull, C. G. N. (1999). *Plants in Action: Adaptation in Nature, Performance in Cultivation*. Macmillan Education, Sydney, Australia.
2. Bewley, J. D., and Black, M. (1994). *Seeds: Physiology of Development and Germination*. Plenum Press, New York.
3. Fahn, A. (1982). *Plant Anatomy*. Pergamon Press, Oxford.
4. Fosket, D. E. (1994). *Plant Growth and Development: A Molecular Approach*. Academic Press, San Diego.
5. Howell, S. H. (1998). *Molecular Genetics of Plant Development*. Cambridge University Press, Cambridge, U.K.

Practical / Laboratory Exercises

1. Effect of gravity, unilateral light, and plant growth regulators on the growth of young seedlings.
2. Effect of dark, red light, and far-red light on the expansion of cotyledons and epicotyl hook opening in *Pisum sativum*.
3. Study of living shoot apices by dissection of aquatic plants such as *Hydrilla* and *Ceratophyllum*.
4. Study of cytohistological zonation in the shoot apical meristem (SAM) using sectioned and double-stained permanent slides of suitable plants such as *Coleus*, *Kalanchoe*, and tobacco.
5. Study of shoot apices of monocots in transverse section (T.S.) and longitudinal section (L.S.) to show the original arrangement of leaf primordia.
6. Study of different types of phyllotaxy—distichous, alternate, opposite, and whorled.
7. Microscopic examination of vertical sections of leaves such as *Cannabis*, tobacco, *Nerium*, maize, and wheat.
8. Study of epidermal peels of leaves of *Coccinia*, *Gaillardia*, *Tradescantia*, *Nerium*, etc.
9. External study of whole roots in monocot and dicot plants.
10. Study of longitudinal sections (L.S.) of dicot and monocot roots using permanent and temporary double-stained slides.
11. Study of different types of plant tissues—parenchyma, collenchyma, and sclerenchyma.

Study of normal and abnormal secondary growth in various dicot and monocot plants.

SEMESTER III
Paper-II

PROGRAMME	**M.Sc. Botany – III SEMESTER**	
TITLE	**PLANT REPRODUCTION**	
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**	
Course Objective	1. To understand the fundamental concepts and processes of vegetative and sexual reproduction, floral development, sex determination and gametophyte formation in plants. 2. To recognize and analyse the development and structure of male and female gametophytes, including microsporogenesis, megasporogenesis, pollen development and embryo sac organization. 3. To apply knowledge of pollination, pollen–pistil interaction, self-incompatibility, fertilization, embryo culture, apomixis and hybrid seed production in plant reproductive biology. 4. To examine the processes of seed and fruit development, maturation, senescence and programmed cell death, including the role of hormones and environmental factors.	
Course Outcomes	**CO1** – To understand the basic concepts of plant reproduction, including vegetative and sexual reproduction, floral development, male and female gametophyte development. **CO2** – To analyse the processes of microsporogenesis, megasporogenesis, pollination, pollen-pistil interaction, fertilization and seed development. **CO3** – To apply knowledge of reproductive biology, self-incompatibility, pollen tube growth, embryo culture, apomixis and hybrid seed production in plant breeding and biotechnology. **CO4** – To evaluate the mechanisms of seed and fruit development, maturation, senescence and programmed cell death, including the role of hormones and environmental factors.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**Reproduction:** Vegetative option and sexual reproduction flower structure and development, genetics of floral organ differentiation, sex determinationplant. **Male Gametophytes:** Structure of anther ,micro-sporogenesis ,role of tepetum ,pollen developmentandgene expression,male sterility sperm dimorphism and hybrid seed production, pollen germination, pollentube growth and guidance, pollen storage,pollen allergy ,pollen embryos.	**15**
UNIT - II	**Female Gametophytes:** Ovule development, mega-sporogenesis, organization of theembryo sac, structure of embryo sac. **Pollination,Pollen-pistil Interaction and Fertilization:** Floral characteristic, pollination mechanism andbvectors, breeding system, commercial consideration, structure of pistil.pollen-stigma interaction,sporophytic And gametophytic self incompatibility (cytological biochemical and molecular aspect),double fertilization, in-vitrofertilization .	**15**
UNIT - III	**Seed Development and Fruit Growth:** Endosperm development during early, maturation and desiccation stages, embryogenesis, ultra structure and nuclear cytology and cell lineages during late embryo development, storage protein of endosperm and embryo polyembryo, apomixes embryo culture,	**15**

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	dynamics of fruit growth, biochemistry and molecules biology of fruit maturation.	
UNIT - IV	**Senescence and Programmed Cell Death(PCD):** BasicConcept, type of cell death , PCD in the life cycle of plants, metabolic changemassociated with senescence and its, regulation, influence of hormone and environmental factors on senescence.	**15**

Suggested Readings

1. Bhojwani, S. S., and Bhatnagar, S. P. (2000). *The Embryology of Angiosperms*. Vikas Publishing House, New Delhi.
2. Proctor, M., and Yeo, P. (1973). *The Pollination of Flowers*. William Collins Sons, London.
3. Raghavan, V. (1997). *Molecular Embryology of Flowering Plants*. Cambridge University Press, Cambridge, U.K.
4. Sedgley, M., and Griffin, A. R. (1989). *Sexual Reproduction of Tree Crops*. Academic Press, London.
5. Shivanna, K. R., and Sawhney, V. K. (1997). *Pollen Biotechnology for Crop Production and Improvement*. Cambridge University Press, Cambridge.

Suggested Laboratory Exercises

1. Study of the ontogeny of floral parts by cutting longitudinal sections (L.S.) of buds of various sizes in different plants.
2. Study of microsporogenesis and megasporogenesis in sections of anthers and ovules.
3. Study of modes of anther dehiscence in various plants.
4. Collection and microscopic examination of microspores from various plants such as maize, grasses, *Cannabis sativa*, *Crotalaria*, *Tradescantia*, *Brassica*, *Petunia*, *Solanum melongena*, *Lycopersicum esculentum*, etc.
5. Testing of pollen viability using stains and in-vitro germination.
6. Study of pollen germination by suspension culture and surface culture.
7. Study of pollinium in *Calotropis procera*.
8. Study of pollen tube growth in the stigma of *Datura alba*.
9. Study of the internal structure of ovules using permanent slides.
10. Study of monosporic, bisporic, and tetrasporic embryo sac development in ovules through permanent slides.
11. Study of the external structure of different types of ovules in locally available flowers.
12. Field study of different types of pollination mechanisms, such as wind and bee/butterfly pollination.
13. Study of cleistogamous flowers and their adaptations.
14. Study of emasculation, bagging, tagging, and hand pollination techniques.
15. Study of nuclear and cellular endosperm through dissection and staining.
16. Isolation of zygotic embryos at the globular, heart-shaped, torpedo, and mature stages by disse

SEMESTER III
Paper-III

PROGRAMME	**M.Sc. Botany – III SEMESTER**	
TITLE	**PLANTECOLOGY (CLIMATE, VEGETATION AND ECOSYSTEM)**	
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**	
Course Objective	1. To understand the fundamental concepts of ecological factors, ecosystem organization, energy flow, nutrient cycling and vegetation dynamics. 2. To recognize and analyse the structure and functioning of terrestrial and aquatic ecosystems, major biomes, ecological communities, ecological niches and succession. 3. To apply ecological principles to understand air, water and soil pollution, climate change, plant invasions, environmental impact assessment and ecosystem restoration. 4. To examine ecological stability, resistance and resilience, ecosystem responses to natural and anthropogenic disturbances, and the principles of sustainable development and ecological management.	
Course Outcomes	**CO1** – To understand the fundamental concepts of ecology, including ecological factors, ecosystem organization, vegetation patterns, pollution and climate change. **CO2** – To analyse the structure and functioning of ecosystems, energy flow, nutrient cycling, ecological succession, community organization and ecological interactions. **CO3** – To apply ecological principles in understanding pollution, climate change, plant invasion, environmental impact assessment and ecosystem restoration. **CO4** – To evaluate ecological stability, ecosystem responses to natural and anthropogenic disturbances, and the principles of sustainable development and ecological management.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**Ecological Factors:** Qimatic-light, temperature, air and water topographic, edaphic, soil formation, soil texture,type of soil profile, classification , physio-chemical properties, soil organic matter ,biotic factor,inter relationships,major soil type of the world. **Ecosystem Organization:** Structure and function primary productions (methodsof measurements, global pattern, controlling factors) energy dynamics, tropic organization energy flow pathway logical efficiencies, letter fall and decomposition-mechanism, substrate quality and climatic factors , global biochemical cycle of C,N,P,S minerals cyclepathway processes budgets in terrestrial andaquatic ecosystems.	**15**
UNIT - II	**Vegetation Organization:** life zone major biomes andvegetation of the world concept of community, and continuum analysis of communities (analytic and synthetic character)community coefficients, interspecific associated ordination concept of ecological niche. **Vegetation Development:** Temporal change (Cyclic and non-cyclic), mechanism of ecological succession (relay floristic and initial floristic Composition, facilitation, tolerance and inhibition modal), changes in ecosystem properties during succession.	**15**
UNIT - III	**Air Water and Soil Pollution:** Kinds, source, quality parameters, effect on	**15**

	plant and ecosystem. **Climate Change:** Green house gases (CO2,CH4,N2O,CFCs) sources, trend and role ozone layer and ozone hole consequences of climate changes, (CO fertilization, global warming ,sea level rise UV radiation).	
UNIT - IV	**Ecological Stability:** Concept (resistance and resilience), ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystem , ecology of plant invasion environmental impact assessment, ecosystem restoration **Ecological management:** Concepts, Sustainable. Development, Sustainability indicators.	**15**

Suggested Readings

1. Brady, N. C. (1990). *The Nature and Properties of Soil*. Macmillan, Sydney, Australia.
2. Begon, M., Harper, J. L., and Townsend, C. R. (1996). *Ecology*. Blackwell Science, Cambridge, U.S.A.
3. Chapman, J. L., and Reiss, M. L. (1988). *Ecology: Principles and Applications*. Cambridge University Press, Cambridge, U.K.
4. Kumar, H. D. (1986). *Modern Concepts of Ecology*. Vikas Publishing House Pvt. Ltd., New Delhi.
5. Hill, M. K. (1997). *Understanding Environmental Pollution*. Cambridge University Press, Cambridge, U.K.
6. Odum, E. P. (1971). *Fundamentals of Ecology*. Saunders, Philadelphia.
7. Odum, E. P. (1983). *Basic Ecology*. Saunders, Philadelphia.

Suggested Laboratory Exercises

1. To calculate mean, variance, standard deviation, standard error, coefficient of variation, and use of the *t*-test for comparing ecological data.
2. To determine the minimum size and number of quadrats required for a reliable estimate of biomass in a grassland ecosystem.
3. To study the frequency, abundance, and density of dominant plants in the local ecosystem by the quadrat method.
4. To determine gross and net productivity by the light and dark bottle method.
5. To determine soil moisture content, porosity, and bulk density of soil collected from different locations.
6. To determine the percentage of organic carbon and organic matter in the soil of grassland, cropland, and forest ecosystems.

SEMESTER III
Paper-IV

PROGRAMME	**M.Sc. Botany – III SEMESTER**	
TITLE	**PAPER-IVELECTIVE-1(A)** **Microbial Characters, Symptoms, Pathogenecity and Host Parasite Relation**	
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**	
Course Objective	1. To understand the fundamental concepts, nature, importance and development of plant pathology, including the history and impact of plant diseases. 2. To recognize and analyse the symptoms, causes and classification of parasitic and non-parasitic plant diseases, including airborne, soil-borne and seed-borne diseases. 3. To apply knowledge of the characteristics, parasitism, virulence, pathogenicity, infection mechanisms and inoculum potential of fungi, bacteria and viruses in plant disease studies. 4. To examine host–parasite interactions, pathogenesis and plant defence mechanisms, including the role of enzymes, toxins, resistance, susceptibility and phytoalexins.	
Course Outcomes	**CO1** – To understand the basic concepts, history, importance and development of plant pathology, including the nature and impact of plant diseases. **CO2** – To analyse the causes, symptoms, classification and transmission of plant diseases, including airborne, soil-borne and seed-borne diseases. **CO3** – To apply knowledge of the characteristics, parasitism, virulence, pathogenicity and infection mechanisms of fungi, bacteria and viruses in the study of plant diseases. **CO4** – To evaluate host–parasite interactions, mechanisms of pathogenesis and plant defence, including resistance, susceptibility, enzymes, toxins and phytoalexins.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**General Introduction:** Nature and Concept of diseases in plant , importance of plant diseases and their effect on human affairs. definition andterms in plant pathology history and development of plant pathology , contribution of plant pathology in India and aboard ,pathology and trend sin2P1 century.	**15**
UNIT - II	**Cause of Plant Diseases**: Symptomatology of parasitic and non-parasitic diseases, classification of plant diseases. Methods of studying Plant Diseases : Airborne, soil borne and seed borne diseases.	**15**
UNIT - III	**General Characteristics:** Fungi, bacteria and viruses,their hetero traction behavior with emphasis on parasitism, parasitic ability and virulence. **Pathogenicity:** Distribution on plant pathogens, mode of infection , inoculums and inoculums potential , Koch's postulates.	**15**
UNIT - IV	**Host Parasite Relation:** Parturition of infection, role of enzyme and toxicity, pathogenesis, defence of plant against pathogens, resistance and susceptibility by Para sensitive reaction phytoalexis diseases syndrome.	**15**

Suggested Readings

1. Agrios, G. N. (1997). *Plant Pathology*. Academic Press, London.
2. Bridges, P. (1988). *Molecular Variability of Fungal Pathogens*. CAB International, U.K.
3. Bilgrami, K. S., and Dubey, H. C. (1985). *Plant Pathology*. Vikas Publishing House, Sahibabad, U.P.
4. Ali, S. S., and Kulshrestha, P. (1986). *Plant Pathology*. Adeeb Education, Raipur.
5. Singh, R. S. (1980). *Plant Pathology*. Oxford & IBH Publishing Co., New Delhi.

Suggested Laboratory Exercises

1. Calibration of the microscope.
2. Determination of the dimensions of pathogenic determinants, bacteria, fungal spores, and mycelia using a micrometer slide and camera lucida.
3. Isolation of microorganisms from soil, water, and air using artificially prepared media.
4. Study of symptoms of various plant diseases caused by viruses, bacteria, and fungi.
5. Demonstration of the effects of various biopesticides (essential oils, neem, turmeric, and garlic) against microbes/pathogens.
6. Culturing of plant pathogens such as *Fusarium*, *Colletotrichum*, and *Alternaria* on culture media, and study of artificial pathogenesis induced by *Fusarium*, *Colletotrichum*, and *Alternaria* on specific hosts.

SEMESTER III
Paper-IV

PROGRAMME	**M.Sc. Botany – III SEMESTER**	
TITLE	**ELECTIVE PAPER IV(B)** **WEEDBIOLOGY**	
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**	
Course Objective	1. To understand the fundamental concepts, distribution, characteristics and classification of weeds and their importance in agricultural and aquatic ecosystems. 2. To recognize and analyse the relationships and interactions between weeds and crops, including succession, evolutionary development and r- and K-selection strategies. 3. To apply knowledge of weed morphology, reproduction, propagation, dispersal and survival mechanisms to understand weed diversity in terrestrial and aquatic habitats. 4. To examine the nature and mechanisms of weed–crop competition, including critical periods of competition, allelopathy and the effects of weed and crop density.	
Course Outcomes	**CO1** – To understand the definition, distribution, characteristics, classification and importance of weeds in agricultural and aquatic ecosystems. **CO2** – To analyse the relationships and interactions between weeds and crops, including succession, evolutionary development and ecological selection strategies. **CO3** – To apply knowledge of weed morphology, reproduction, propagation, dispersal and survival mechanisms to understand weed diversity in different habitats. **CO4** – To evaluate weed–crop competition, including competitive interactions, critical periods, allelopathy and the effects of weed and crop density on crop productivity.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**Definition and distribution of weed.** World wide distribution and importance of weed Ideal characters of weed. Classification of weed.Weed menace in agriculture, aquatic ecosystems.	**15**
UNIT - II	**Relationship and interactions among weed and crops** Suitability of succession tocrops Pattern of Evolutionary Development. Concept of r and K selection.Weeds as strategists-competitive Ruderals and stress Tolerant Weeds.	**15**
UNIT - III	Morphology, Reproduction, Propagation, Dispersal and Survival of Weeds. The Diversity of Weeds of different habitats-Terrestrial and aquatic weeds.	**15**
UNIT - IV	Weed Competition-Nature of Competition ,Method to study Competition ,critical period for competition, Allelopathy, Weed andcropdensity effect.	**15**

PRACTICALS BASED ON PAPER 1& 2(Lab-1), BASED ON PAPER 3&4 (Lab-2)

1. Survey of Weed Flora
   a. Agricultural fields
   b. Vegetable orchards
   c. Forests
   d. Roadsides

e. Aquatic ecosystems

2. Identification of Weeds and Preparation of Herbarium

3. Phytosociological Studies of Weeds

- Determination of the minimum size of the quadrat for sampling the maximum number of weeds using the species–area curve.
- Determination of density and abundance of weed populations.
- Determination of frequency of weed populations.
- Determination of basal area/cover of weed populations.
- Determination of Importance Value Index (IVI) of different weed populations.

4. Weed Seed Technology

- Measurement of seed size and shape.
- Determination of seed weight.
- Determination of seed output and reproductive capacity.
- Determination of seed viability.
- Determination of percentage germination.

SEMESTER IV
Paper-1

PROGRAMME	**M.Sc. Botany – IV SEMESTER**	
TITLE	**PLANTCELL,TUSSE ANDORGANCULTURE**	
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**	
Course Objective	1. To understand the fundamental concepts, principles and scope of biotechnology, plant cell and tissue culture, cellular differentiation and totipotency. 2. To recognize and analyse the mechanisms, techniques and applications of organogenesis, somatic embryogenesis, androgenesis and somatic hybridization. 3. To apply plant tissue culture techniques for clonal propagation, artificial seed production, hybrid and somaclone development, secondary metabolite production and germplasm conservation. 4. To examine the importance and applications of biostatistics and analyse biological data using measures of central tendency, including mean, mode and median.	
Course Outcomes	CO1 – To understand the basic concepts, principles and scope of biotechnology, plant cell and tissue culture, cellular differentiation and totipotency. CO2 – To analyse the techniques and mechanisms of organogenesis, somatic embryogenesis, androgenesis and somatic hybridization through protoplast isolation, fusion and regeneration. CO3 – To apply plant tissue culture techniques for clonal propagation, artificial seed production, hybrid and somaclone development, secondary metabolite production and germplasm conservation. CO4 – To evaluate the applications and limitations of plant biotechnology and tissue culture, along with the fundamental concepts and measures of biostatistics, including mean, mode and median.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**Biotechnology:** Basicconcept, principal and scope **Plant cell and Tissue culture:** General Introduction,history, scope, concept of cellular differentiation, tot potency.	**15**
UNIT - II	**Organogenesis and adventure embryo genesis:** Fundamentalism orogenesis somatic embryogenesis and androgenizes, mechanism, techniques and utility. **Somatic hybridization:** Protoplast isolation fusion and culture hybrid selection and regeneration, possibilities achievements and limitations of protoplast research.	**15**
UNIT - III	**Application of Plant Tissue Culture:** Clonal propagations, artificial Seed, production of hybrid sand soma clones and production of secondary metabolites /natural products, cryopreservation and germplasma storage.	**15**
UNIT - IV	**Biostatistics:** Definition and importance of BIOSTATISTICS, Measurement of central tendencies- mean mode and median.	**15**

Suggested Readings

1. Bhojwani, S. S., and Razdan, M. K. (1996). *Plant Tissue Culture: Theory and Practice*. Elsevier Science Publishers, New York, U.S.A.
2. Collin, H. A., and Edwards, S. (1998). *Plant Cell Culture*. Bios Scientific Publishers, Oxford, U.K.
3. Kartha, K. K. (1985). *Cryopreservation of Plant Cells and Organs*. CRC Press, Boca Raton,

Florida, U.S.A.
4. Vasil, I. K., and Thorpe, T. A. (1994). *Plant Cell and Tissue Culture*. Kluwer Academic Publishers, Netherlands.
5. Smith, R. H. (2000). *Plant Tissue Culture: Techniques and Experiments*. Academic Press, New York.

Suggested Laboratory Exercises

1. Preparation of tissue culture (MS) medium.
2. Study of tissue culture techniques:
3. Sterilization of glassware and plant materials.
4. Transfer or inoculation of plant materials onto culture media.
5. Incubation of cultures.
6. Isolation of plant protoplasts by enzymatic and mechanical methods.
7. Counting of protoplasts by the haemocytometry method.
8. *Encyclopaedia of Indian Literature.* Vols. 1–6. New Delhi: Sahitya Akademi.

SEMESTER IV
Paper-II

PROGRAMME	**M.Sc. Botany – IV SEMESTER**	
TITLE	**PLANTRESOURCEUTILISATIONANDCONSERVATION**	
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**	
Course Objective	1. To understand the fundamental concepts, levels, patterns and importance of biological and plant biodiversity, including speciation, extinction, global distribution and conservation status. 2. To recognize and analyse the centres of origin and diversity of domesticated plants and the origin, evolution, cultivation and uses of important food, forage, fibre, medicinal, aromatic, vegetable and oil-yielding crops. 3. To apply knowledge of economic botany and plant biodiversity for the utilization and sustainable management of timber, firewood and non-wood forest products, as well as understanding the benefits and consequences of the Green Revolution. 4. To examine and evaluate the principles and strategies of in-situ and ex-situ conservation, including protected areas, botanical gardens, field gene banks, seed banks, cryobanks and the role of national conservation organizations in India.	
Course Outcomes	**CO1** – To understand the concepts, levels, patterns and importance of biological and plant biodiversity, including speciation, extinction and conservation status. **CO2** – To analyse the origin, evolution, diversity, cultivation and uses of important food, forage, fibre, medicinal, aromatic, vegetable and oil-yielding plants. **CO3** – To apply knowledge of plant biodiversity and economic botany in understanding the utilization of forest resources, non-wood forest products, Green Revolution and sustainable plant resources. **CO4** – To evaluate the principles and strategies of in-situ and ex-situ conservation, including protected areas, botanical gardens, seed banks, gene banks, cryopreservation and national conservation initiatives.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**Biological Diversity:** Conceptand level, role of biodiversity in ecosystem,functionand stability,speciation and extinction, IUCN categories of threat,distribution and global pattern ,terrestrial biodiversity , hot spots inventory. **Plant Biodiversity:** Concept,status in India, utilization and concerns.	**15**
UNIT - II	**World Centers of Primary Diversity of Domesticated Plants:** The IndoBermis centre, plant introduction and secondary centers. **Origin, Evolution,Botany Cultivation and Uses of:** (i)food , forage and fodder crop,(ii) fiber crops (iii)medicinal and aromatic plants (iv)vegetable and(v) oil yielding crops.	**15**
UNIT - III	**Important Fire-Woodand Timber Yielding Plant and Non wood Forest Products(NWFPS):** such as bamboos,rattans,raw materials for paper-making,gums, tanins ,dyes ,resins and fruits .	**15**

	GreenRevolution: benifits and consequence, Innovations for meeting world Good demands., plant used as avenue trees for shade ,pollution control and aesthetics.	
UNIT - IV	**Principal of Conservation:** Extinctions, environmental status of plant-based on international Union for conservation of nature. **Strategies for conservation in situ Conservation:** International efforts and Indian initiatives,protected areas in Indian-sanctuaries , national park , biosphere reserves wetlands , mangrove sand coral reefs FOR conservation for wild biodiversity. **Strategies for conservation-Exsitu Conservation**: Principles and practices ,botanical garden,field gene bank,seedinvitro repositories,cry banks general accounting the activities of botanical survey of India (BSI) ,National Bureau of Plant Genetic Resources (NBPGR) India Council of Agriculture Research (ICAR) ,Council of Scientific and Industrial Research (CSIR) and the Department of Biotechnology (DBT) for conservation non-formal conservationefforts.	**15**

Suggested Readings

1. Anonymous. (1997). *National Gene Bank: Indian Heritage in Plant Genetic Resources* (Booklet). NBPGR, New Delhi.
2. Baker, H. G. (1978). *Plants and Civilization*. C. A. Wadsworth, Belmont.
3. Frankel, O. H., Brown, A. H. D., and Burdon, J. J. (1995). *Conservation of Plant Diversity*. Cambridge University Press, Cambridge, U.K.
4. Heywood, V. (1995). *Global Biodiversity Assessment*. UNEP. Cambridge University Press, Cambridge, U.K.
5. Heywood, V. H., and Wyse Jackson, P. S. (1991). *Tropical Botanical Gardens: Their Role in Conservation and Development*. Academic Press, San Diego.
6. Kocher, S. L. (1998). *Economic Botany of the Tropics*. Macmillan India Ltd., New Delhi.
7. Kothari, A. (1997). *Understanding Biodiversity: Life, Sustainability and Equity*. Orient Longman.
8. Paroda, R. S., and Arora, R. K. (1991). *Plant Genetic Resources and Conservation and Management*. IPGRI Publications, South Asia Office, c/o NBPGR, Pusa Campus, New Delhi.
9. Pinstrup-Andersen, P. et al. (1999). *World Food Prospects: Critical Issues for the Early 21st Century*. International Food Policy Research Institute, Washington, D.C., U.S.A.
10. Rogers, N. A., and Panwar, H. S. (1988). *Planning a Wildlife Protected Area Network in India, Vol. I: The Report*. Wildlife Institute of India, Dehradun.
11. Schery, R. W. (1972). *Plants for Man*. Prentice-Hall, Englewood Cliffs, New Jersey.
12. Swaminathan, M. S., and Kocher, S. L. (1989). *Plants and Society*. Macmillan Publication Ltd., London.

Suggested Laboratory Exercises

1. Study of the morphology, anatomy, and microchemical tests for stored food materials present in food crops such as wheat, rice, maize, chickpea, potato, and sugarcane.
2. Study of any five important fodder/forage plants of the locality.
3. Study of the morphology, anatomy, and microscopic characteristics of whole fibres of cotton,

jute, linen, sunn hemp, *Cannabis*, and kapok.

4. Study of various medicinal and aromatic plants available in the locality/college/university.
5. Study of herbarium specimens.

SEMESTER IV
Paper-III

PROGRAMME	**M.Sc. Botany – IV SEMESTER**	
TITLE	**GENETIC ENGINEERING PLANTS AND MICROBES**	
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**	
Course Objective	1. To understand the fundamental concepts and principles of recombinant DNA technology, including gene cloning, genomic and cDNA libraries, vectors, DNA sequencing, PCR and DNA fingerprinting. 2. To recognize and analyse the techniques and strategies of plant genetic engineering, including transgenic development, *Agrobacterium*-mediated transformation, T-DNA and transposon-mediated gene tagging and chloroplast transformation. 3. To apply genetic manipulation techniques for the improvement of microorganisms, including bacterial transformation, selection of recombinants, industrial microbes, nitrogen fixers and fermentation technology. 4. To examine and evaluate the applications of genomics and proteomics, molecular markers, genome projects, bioinformatics, functional genomics, microarrays and protein profiling, along with statistical methods for biological data analysis.	
Course Outcomes	**CO1** – To understand the principles and techniques of recombinant DNA technology, including gene cloning, genomic and cDNA libraries, vectors, DNA sequencing, PCR and DNA fingerprinting. **CO2** – To analyse the strategies and techniques of genetic engineering in plants and microorganisms, including transgenics, *Agrobacterium*-mediated transformation, T-DNA tagging and bacterial transformation. **CO3** – To apply genetic engineering and molecular biology techniques for the improvement of plants and industrial microorganisms, including nitrogen fixers and fermentation processes. **CO4** – To evaluate the applications of genomics, proteomics, molecular markers, bioinformatics, functional genomics and microarrays, along with statistical methods for analysis and interpretation of biological data.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**Recombinant DNA Technology:** Gene Cloning principal and techniques, construction of genomic/cDNA libraries,choice ofvectors, DNA synthesis and sequencing , polymerase chain reaction (PCR), DNA finger printing.	**15**
UNIT - II	**Genetic Engineering of Plants:** Aims strategies for development of transgenic (with suitable example), Agro bacterium- the nature genetic engineer , T-DNA and transposon mediated gene tagging ,chloroplast transformation and its utility ,intellectual property right , possible ecological risk andconcerns.	**15**
UNIT - III	**Microbial Genetic Manipulation:** Bacterial transformation, selection of recombinants and transform ants genetic improvement of industrial microbes and nitrogen fixer's fermentation technology.	**15**
UNIT - IV	**Genomics And Proteomics:** Genetic and physical mapping of genes, molecular markers for introgression of useful traits , artificial chromosome,DNA sequencing , genome project's, bioinformatics , functional genomics,micro-arrays, protein profiling and its significance. Biostatistics: Measurement of dispersion, standard deviation (S.D) and standard errors (S.E.)comparison of data by chi-square(x2) and test.	**15**

Suggested Readings

1. Brown, T. A. (1999). *Genomes*. John Wiley and Sons (Asia) Ltd., Singapore.
2. Callow, J. A., Ford-Lloyd, B. V., and Newbury, H. J. (1997). *Biotechnology in Genetic Resources: Conservation and Use*. CAB International, Oxon, U.K.
3. Glazer, A. N., and Nikaido, H. (1995). *Microbial Biotechnology*. W. H. Freeman and Company, New York, U.S.A.
4. Henry, R. J. (1997). *Practical Applications of Plant Molecular Biology*. Chapman & Hall, London, U.K.
5. Jollès, O., and Jörnvall, H. (2000). *Proteomics in Functional Genomics*. Birkhäuser Verlag, Basel, Switzerland.
6. Old, R. W., and Primrose, S. B. (1989). *Principles of Gene Manipulation*. Blackwell Scientific Publications, Oxford, U.K.
7. Primrose, S. B. (1995). *Principles of Genome Analysis*. Blackwell Scientific Publications, Oxford, U.K.
8. Raghavan, V. (1997). *Molecular Biology of Flowering Plants*. Cambridge University Press, Cambridge, U.K.

Suggested Laboratory Exercises

1. Preparation of liquid and solid culture media for bacterial culture.
2. Study of the growth characteristics of *E. coli* using a turbidometric/biodometric method.
3. Isolation of total DNA from *E. coli* by the lysozyme lysis method and its quantification by spectrophotometric method.
4. Isolation of plasmid DNA from *E. coli* by the alkaline lysis method and its quantification by spectrophotometric method.
5. Restriction digestion of plasmid DNA and estimation of the size of various DNA fragments.
6. Isolation of *Rhizobium* from root nodules of leguminous plants.
7. Isolation of *Agrobacterium tumefaciens* from tumourous plant tissues.

SEMESTER-IV
PAPER IV ELECTIVE-I(A)

PROGRAMME	**M.Sc. Botany – IV SEMESTER**	
TITLE	**PLANTPATHOLOGY-II** **EFFECTOFENVIRONMENT,CONTROLANDPLANTDISEASECYCLE**	
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**	
Course Objective	1. To understand the effect of environmental factors on plant diseases. 2. To analyse the sources, spread and recurrence of plant diseases. 3. To apply different methods of plant disease control and management. 4. To evaluate disease cycles, crop losses and control measures of major crop diseases.	
Course Outcomes	**CO1** – To understand the effects of environmental factors on plant disease development, including predisposition, stress, epidemiology, disease forecasting and sources of infection. **CO2** – To analyse disease cycles, sources of inoculum and the significance of phyllosphere and rhizosphere in the development and recurrence of plant diseases. **CO3** – To apply principles and methods of plant disease management, including regulatory, chemical, biological, host resistance and plant quarantine measures. **CO4** – To evaluate crop losses and recommend suitable control measures for important diseases caused by fungi, bacteria, viruses, mycoplasma and nematodes in major crops such as wheat, rice, bajra, maize, sugarcane, arhar, gram and pea.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**Effect of Environment on Disease Development:** Predisposition and stress epidemiology and disease forecasting, sources of infectioni.e.,seed.Soil,waterandair born disease of plants, significance of phyllo sphere and rhizosphere studies, recurrence of disease.	**15**
UNIT - II	**Control of Plant Disease: Principles :** plant disease control, method of controller regulatory, chemical, biological and BREEDING varieties of Host , plant quarantine.	**15**
UNIT - III	**Details of Disease Cycle:** Crop loss estimate an recommended control for important plant disease caused by fungi bacteria , viruses , mycoplasma and nematodes in the following crop plants) a)Wheat, Rice, Bajra, Maize Sugarcane. b) Arhar, Gram, Pea.	**15**
UNIT - IV	**Details OF Disease Cycle:** Crop loss estimate and recommended control for important plant disease caused by fungi bacteria, viruses, mycoplasma and nematodes in the following crop plants-	**15**

Suggested Readings

As described for Paper IV, Elective I (A), Plant Pathology, Semester III.

Suggested Laboratory Exercises

1. Study of various bacterial and fungal plant pathogens of different crop plants.
2. Study of the life cycle of bacterial pathogens such as *Xanthomonas citri*, *X. oryzae*, etc., and fungi causing white rust, black rust, loose smut, and covered smut in various crop plants.
3. Demonstration of the effect of antibiotics using bacterial cultures and known antibiotics.
4. Isolation of cellulose from diseased plants.
5. Study of antagonism between isolated antagonists and plant pathogens.

SEMESTER IV
Paper-IV

PROGRAMME	**M.Sc. Botany – IV SEMESTER**	
TITLE	**ELECTIVE-I(B)** **WEEDBIOLOGY**	
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**	
Course Objective	1. To understand weed germination, establishment, growth and emergence. 2. To analyse different methods of weed control and integrated weed management. 3. To apply knowledge of herbicide classification, mode of action and application methods. 4. To evaluate critical weed-control periods, aquatic weed management and herbicide–environment interactions.	
Course Outcomes	**CO1** – To understand the processes of weed germination, establishment, growth, emergence patterns, seed longevity, mortality and the safe-site concept. . **CO2** – To analyse different approaches to weed management, including prevention, suppression, eradication and physical, chemical and biological methods of weed control. **CO3** – To apply knowledge of herbicide classification, mode of action, application methods and precautions for effective weed management, including integrated weed management. **CO4** – To evaluate the effectiveness of important herbicides, critical periods of weed control, aquatic weed management, weed thresholds and plant–environment–herbicide interactions.	
Syllabus	**Description**	**No. of Lectures / Hours**
UNIT - I	**Germination, Establishment and growth-Godown** Light Requirement for Germination, Seed longevity And Mortality.Pattern of emergence,The Safe-Site Concept.	**15**
UNIT - II	**Management of Weeds-** Type of weedcontrol:Prevention,Suppression and Eradication; physical, chemical and Biologicalcontrolofweeds.concept of Integrated Weed Management	**15**
UNIT - III	**Classification of Herbicides** Selective and non-parasitic Herbicides, contact and Trans located herbicides. Mode of Action of Herbicides. Application method of Herbicides and precautions.	**15**
UNIT - IV	**Chemistry of some importance herbicides:** Phenoxyacidas2,4-0 , Pendimethalin Butachlorand Nitrofen.Critical Periodfor weed control,Aquatic weed management.Plant Environment and Herbicides interactions. Weed Thresholds and management.	**15**

PRACTICAL BASED ON PAPER 1&2 (Lab-1) PRACTICAL BASED ON PAPER 2&3(Lab-2)

Exercises involving:

1. Study of different factors affecting the percentage germination of some important weeds.
2. Measurement of seedling growth of weeds.
3. Study of a weed plant using different growth parameters.
4. Measurement of the effectiveness of weed-control treatments on the mortality of weed plants.
5. Measurement of the effect of weed density on competition.
6. Calculation of the competition index.

Suggested Books

1. Rao, V. S. *Principles of Weed Science*. Oxford & IBH Publishing Pvt. Co. Ltd., New Delhi.
2. Gupta, O. P. *Modern Weed Management*. Agrobios, Jodhpur.
3. Joshi, N. C. *Research Co.* Publication, Delhi.
4. Ashton, F. M., and Crafts, A. S. *Mode of Action of Herbicides*. Wiley-Interscience Publication, New York.
5. Shree Ramulu, U. S. *Chemistry of Herbicides*. Oxford & IBH Publishing Co. Ltd., New Delhi.
6. Majid, F. Z. *Aquatic Weeds: Utility and Development*. Agrobotanica, Bikaner, India.

PRACTICAL LAB-1, LAB-2,

Or

Dissertation