Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(AUTONOMOUS)

Lead college

of

Karmaveer Bhaurao Patil University, Satara

Syllabus For

Master of Science

Part - II

BOTANY

Syllabus to be implemented w.e.f. June 2024

As Per NEP-2020

Preamble:

The M. Sc. Botany course under autonomy will be effective from the academic year 2024 – 2025. It has been prepared keeping in view the unique requirements of M. Sc. Botany students. The emphasis of the contents is to provide students the latest information along with due weightage to the concepts of classical botany so that they are able to understand and appreciate the current interdisciplinary approaches in the study of plant sciences and its rolein societal development. The course content also lists new practical exercises so the students gets a hands on experience of the latest techniques that are currently in use. Project curriculum spanning over the two years of the course is designed in a way to give the students first hand research experience as it consists of writing of synopsis, literature review along with actual table work. The course will also inspire students to pursue higher studies and research in botany, for becoming an entrepreneur and enable students to get employed in plant based industries.

➢ Credit Structure of Course: M.Sc. – II Semester – III BOTANY

Level	Semester	Course Code	Course Title	No. of Lectures Per Week	Credits
		Discipline Specific Courses (Mandatory)			
6.5	III	MBT 531	Cytogenetics and Plant Improvement	4	4
		MBT 532	Biotechnology and Genetic Engineering	4	4
		MBT 533	533.1 Plant Diversity I (Introductory Biodiversity)	4	4
			533.2 Plant Protection I (Crop Diseases and their Management		
		Discipline Specific Elective (Choose any one among two)			
		MBT 534 E-I	534.1 Plant Diversity II (Conservation of Biodiversity)	2	2
		MBT 534 E-II	534.1 Plant Diversity II (Global scenario of Biodiversity 534.2 Plant Protection II (Animate Pests of Crops and their Management) 534.2 Plant Protection II (Animate Pests of Crops, their Management & Industrial Entomology)		
		MBP 535	Research Project (RP)	12	6
		MBP 536	536.1 LAB- III (based on MBT-531, 532 and 533.1)	4	2
			536.2 LAB- III (based on MBT-531, 532 and 533.2)		
			Total	**30**	**22**

Structure of Course: M.Sc. II Semester – IV BOTANY

Level	Semester	Course Code	Course Title	No. of Lectures Per Week	Credits
		Discipline Specific Courses (Mandatory)			
6.5	III	MBT 541	Plant Physiology and Metabolism	4	4
		MBT 542	Biodiversity conservation and Utilization	4	4
		MBT 543	543.1 Plant Diversity III (Conservation Biodiversity) 543.2 Plant Protection III (Recent Trends and Techniques)	4	4
		Discipline Specific Elective (Choose any one among two)			
		MBT 544 E-I MBT 544 E-II	544.1 Plant Diversity IV (Assessment of Biodiversity) 544.1 Plant Diversity IV (Latest techniques for Biodiversity Prediction) 544.2Plant Protection IV (Molecular Plant Pathology and Mycorrhizal Technology) 544.2 Plant Protection IV (Molecular Plant Pathology and Pant Breeding)	2	2
		MBP 545	On Job Training (OJT)	12	6
		MBP 546	LAB- III (based on MBT-541,542 and 544.1) LAB- III (based on MBT-541, 542 and 544.2	4	2
			TOTAL	**30**	**22**

SEMESTER III

MBT 531: CYTOGENETICS AND PLANT IMPROVEMENT

Course objectives: Students should be able to:

1. Understand the basic knowledge of different aspects of cytogenetics and plant breeding.
2. Apply the knowledge of methods in genome mapping and plant breeding.
3. Predict the consequences of population and evolutionary genetics.
4. Justify and analyze diversity of wild and indigenous crop genetic resources for use in crop improvement.

Credits=4	MBT 531: CYTOGENETICS AND PLANT IMPROVEMENT	Total hrs: 60
UNIT I	**Cytogenetics**	15
	1.1 Chromatin organization (Euchromatin and heterochromatin) 1.2 Chromosome structure and packaging of DNA 1.3 Molecular organization of centromere and telomere: Synaptonomal complex and telomerase 1.4 Nucleolus and ribosomal RNA genes 1.5 Karyotype analysis and banding patterns.	
UNIT II	**Population and Evolutionary Genetics**	15
	2.1 History of Evolution 2.2 Genetic variation in natural population (Natural selection, Migration, Mutation, Genetic Drift) 2.3 Theory of allele frequencies 2.4 Hardy Weinberg law and factor affecting gene and gene frequencies 2.5 Mobile genetic elements and their significance; Gene families.	
UNIT III	**Crop genetic resources**	15
	3.1 Centers of origin of cultivated plants 3.2 Gene pool (Concept and utilization in breeding program) 3.3 Management of plant genetic resources (PGR) and its conservation 3.4 International and National network for genetic conservation and utilization in major crops 3.5 Wild relatives of crop plants 3.6 Gene banks; Gene sanctuaries.	
UNIT IV	**Crop Improvement**	15
	4.1 Heterosis (Concept, Genetic basis, types, applications) 4.2 Selection methods (self-pollinated and cross pollinated crops) 4.3 QTL-mapping; Marker assisted selection (MAS) 4.4 Role of cytoplasmic male sterility (CMS) in hydrid breeding 4.5 Gene pyramiding for multi trait incorporation.	

Course Outcomes: The Students will be able to:

1. Understand the need of crop improvement.
2. Describe phylogenetic relationships in plants.
3. Appreciate the wild relative of crop plants and their need in crop improvement.
4. Understand the various breeding techniques.

References:

1. Chahal G. S. and Gosal S. S. 2003, Principles and Procedures of Plant Breeding biotechnological and conventional approaches. Narosa Publishers, New Delhi.
2. Chopra V. L. 1989. Plant Breeding .oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
3. Darnel, J., Lodish, H. and Baltimore, D. 1990 Molecular cell biology. Scientific American Books.
4. Gardner, E. J. 1991 Principles of Genetics. John Wiley and sons, New York.
5. Jahier, J. 1996 Techniques of plant Cytogenetics. Oxford and IBH Publishing.
6. Lewin, B. 2008, Genes IX. Oxford University Press.
7. Sharma, A. K. and Sharma, A. 1980. Chromosome techniques- Theory and practice. Butterworth and Co. (Publishers) Ltd., London.
8. Sharma, J. R. 1994 Principles and practice of plant breeding. Tata McGrow Hill Publ. Co. Ltd., New Delhi.
9. Singh, B. D. 2000. Plant breeding- Principles and methods. Kalyani Publishers, Ludhiana.

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SEMESTER-III
MBT 532: BIOTECHNOLOGY AND GENETIC ENGINEERING

Course objectives: Students will be able to

1. Imbibe the basic knowledge of different aspects of Biotechnology and tissue culture.
2. Describe the methods in biotechnology and genetic engineering.
3. Explain advanced techniques in molecular biology used in study ofplants.
4. Identify the basics of the 'Genomics' in plant sciences

Credit=04	**MBT 532 BIOTECHNOLOGY AND GENETIC ENGINEERING**	**Total hrs. (60)**
UNIT I	**Plant Tissue Culture:**	**15**
	1.6 Concept, Scope and importance of Biotechnology 1.7 Plant cell and tissue culture laboratory requirements 1.8 Tools and techniques for plant tissue culture 1.9 Culture media, their constituents and types of cultures 1.10 Applications of plant tissue culture 1.11 Somaclonal variation and its significance 1.12 Protoplast culture and somatic hybridization	
UNIT II	**Recombinant DNA technology**	**15**

	2.1 Concept, principles, applications and consequences of recombinant DNA technology. 2.2 Enzymes used in recombinant DNA technology 2.3 Cloning vectors 2.4 Construction of cDNA libraries 2.5 Genetic transformation of plants: Bt cotton and Golden rice 2.6 Molecular probes 2.7 Isolation of genes 2.8 Methods of Gene transfer	
UNIT III	**Advanced techniques in Molecular Biology**	**15**
	3.1 Polymerase chain reaction (PCR) and Real time Polymerase chain reaction (RT-PCR) 3.2 Gel electrophoresis: AGE and PAGE 3.3 Blotting techniques: Southern, Northern, Western and South-Western blotting 3.4 DNA sequencing techniques: SDS and NGS 3.5 DNA fingerprinting: RFLP, RAPD, ISSR 3.6 DNA barcoding: Consortium for the Barcode of Life (CBOL)	
UNIT IV	**Genomics**	**15**
	4.1 Genomics:*Arabidopsis* genome, Comparative genomics, Functional genomics 4.2 Proteomics: Rationale, basic assumptions, methods for protein engineering 4.3 Bioinformatics: Databases (NCBI, EMBL and DDBJ), Basic local alignment search tool (BLAST), Multiple Sequence Alignment Tools, Phylogenetic analysis, Applications of Bioinformatics	

Course Outcomes: Student will able to

1. Summarize the use of biotechnology in botany.
2. Classify branches of biotechnology in plant science.
3. Illustrate molecular technology in study of plants.
4. Practice application of genes, proteins and secondary metabolites in plant science.

References:

1. Baxevanis Andreas, Ouellette Francis BF and Cuellette BF. 1998. *Bioinformatics: A Practical Guide to the analysis of Genes and Proteins*. Wiley Publishers, New York.
2. Boyce COL. 1986. *Novo's Handbook of Practical Biotechnology*. Novo Industry.
3. Chawla HS. 1998. *Biotechnology in Crop Improvement*. International Book Distributing Company, Lucknow
4. Claverie J and Notredame C. 2011. *Bioinformatics for Dummies*. John Wiley and Sons, New York.
5. Dodds JH and Roberts LW. 1985. *Experiments in plant tissue culture*. Cambridge

University Press, Cambridge.

6. Durbin R, Sean R, Eddy, Anders Krogh and Graeme M. 1999. *Biological Analysis- Probabilistic Models of Proteins and Nucleic Acids.* Cambridge University Press, Cambridge.
7. Gamborg OL and Phillips GC. 1995. *Plant Cell, Tissue and Organ Culture- Fundamental Methods.* Narosa Publ. House, New Delhi.
8. Glick BR and Pasternak JJ. 1994. *Molecular Biotechnology- Principles and Applications of Recombinant DNA.* ASM Press, Washington D. C.
9. Gupta PK. 2009. *Biotechnology and Genomics*. Rastogi Publications, Meerut.
10. Gupta PK. 2010. *Plant Biotechnology*. Rastogi Publications, Meerut.
11. Jagota A. 2000. *Data Analysis and Classification for Bioinformatics*. Bay Press, University of Michigan, USA.
12. Kumar HD. 1993. *Molecular Biology and Biotechnology*. Vikas Publ., New Delhi.
13. Mount DW. 2001. *Bioinformatics Sequence and Genome Analysis*. Cold Spring Harbour Laboratory, New York.
14. Ramawat KG. 2006. *Plant Biotechnology*. S. Chand and Company Ltd., New Delhi.
15. Razdan MK. 1994. *An Introduction to plant tissue culture*. Oxford & IBH Publ .Ltd., New Delhi.
16. Reinhert J and Bajaj YPS. 1977. *Applied and fundamental aspects of plant cell, tissue andorgan culture*. Springer Verlag, Berlin.
17. Trehan K. 1994. *Biotechnology.* Wiley Eastern Limited, New Delhi.
18. Trivedi PC. 2000. *Plant Biotechnology- Recent Advances*. Panima Publishing Corporation, New Delhi.

Journals:

- Indian Journal of Biotechnology
- Trends in Biotechnology (Elsevier)
- Trends in biochemical Sciences (Elsevier)
- Journal of Molecular Plant Pathology
- Journal of Plant Biotechnology
- Gene

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SEMESTER-III

MBT 533.1: Plant Diversity I (Introductory Biodiversity)

Course Objectives: Students should be able to

1. Understand the basic knowledge of plant diversity.
2. Imbibe the knowledge of the basic knowledge of characterization of plant diversity.
3. Imbibe the knowledge the basic knowledge of present status of plant diversity with reference to crises.
4. Understand the knowledge of plant diversity in India.

Creddit=04	MBT 533.1 Plant Diversity I (Introductory Biodiversity)	Total hrs. (60)
UNIT I	**Levels of Biodiversity**	15
	1.1 Introduction to biodiversity: Concept, definition, importance of biodiversity, status in India, biodiversity values. 1.2 Diversity of plant Groups based on morphological features (Viruses, Bacteria, Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms andAngiosperms) 1.3 Levels of biodiversity: Species diversity: species richness, species evenness, alpha diversity, beta diversity, gamma diversity. 1.4 Genetic diversity: Concept, terminology used- eco-clines, ecotypes, chemotypes, cytotypes, varieties, subspecies, polytypic, monotypic and hybrids. 1.5 Ecological diversity: Concept, Agro ecosystems, Forest ecosystem- Mixed deciduous and semi evergreen	
UNIT II	**Characterization of Biodiversity**	15
	1.1 Characterization of biodiversity: Taxonomic and evolutionary characterization, characterizing flora and fauna. 1.2 Plant documentation (preparing floras, hand books, monographs, keys and database, herbarium and e-herbarium) biological concept of species. 1.3 Magnitude and distribution of biodiversity: Gradients of biodiversity (latitudinal, altitudinal, depth). 1.4 Environmental factors and centers of diversity, rarity, endemism and biodiversity, speciation and extinction, global hotspots of biodiversity (as per Mittermeier).	
UNIT III	**Present status of Biodiversity**	15
	1.1 Floral biodiversity of Western Ghats, India's share in global biodiversity, endemic and threatened forms w.r.t. Western Ghats, Threats to biodiversity, 1.2 Concept of Metacenters of global diversity (as per CI 2017) Biodiversity crisis: Concept, causes of biodiversity loss, destruction of ecosystem, adverse changes in biotic and abiotic environment due to pollution, over exploitation of species, habitat fragmentation, exotic species, natural calamities, chain extinctions, change in climate and biodiversity.	

UNIT IV	**Biodiversity in India** India as mega center of biodiversity, hot spots of India, current status of biodiversity values in different biogeographic zones of India, Red data book species of India, World heritage: Kaas Plateau and insight on presentstatus.	**15**

Course Outcomes: Students will be able to

1. Understand concept of plant diversity and its magnitude
2. Analyze biodiversity crises and solutions.
3. Decide status of plant diversity and conservation.
4. Identify the plant diversity status in India.

References:

1. Belsare D. K. 2007. Introduction to Biodiversity; APH Publishing.
2. Bharucha Erach 2005.Textbook of Environmental Studies; Universities Press.
3. Dash M. C. 2001. Fundamental of Ecology; Tata McGraw-Hill Education.
4. Galston, K. J. 1996. Biodiversity: A biology of numbers and differences. Kluwer Academic Publishers, Dordrecht, the Netherlands.
5. Heywood V. H. and Watson R. T. (Edt). 1995. Global Biodiversity Assessment; University Press.

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SEMESTER-III

MBT 533.2: Plant Protection I (Crop Diseases and Their Management)

Course Objectives: Students should be able to

1. Understand the basic knowledge of plant diseases.
2. Imbibe the knowledge of causal organisms and typcal symptoms caused.
3. Learn about post harvest diseases.
4. Analyse the physiological effects on plant diseases.

Creddit=04	**MBT 533: Plant Protection I (Crop Diseases and Their Management**	**No. of hrs. (60)**
UNIT I	**Major Crop Diseases**	**15**
	1.1 Introduction: History of Plant Pathology and Overview, Crop diseases and losses caused by them. **1.2 Study of major fungal crop diseases**: Study of fungal diseases of following crop plants with respect to distribution, causal organism, symptoms, disease cycle (wherever applicable) and their management **Cereals**: Helminthosporium of Paddy, Head smut of Jowar. **Oil** seeds: Rust of Sunflower and Soybean. **Pulses**: Anthracnose of Bean and Rust of chick pea **Cash crops**: Rhizome rot of Turmeric, Rust of Coffee. **Fruit crops:** Anthracnose of Banana **Vegetable crops**: Powdery mildew of Pea, Ripe fruit rot of Chilli.	
UNIT II	**Plant diseases based on Causal organism**	**15**
	Bacterial diseases of crop plants: Introduction, General symptoms, Types of Bacterial diseases-Vascular, Entry of bacteria in host; Dissemination of bacterial diseases; Study of bacterial diseases of following crop plants with reference to distribution, Causal organism, Symptoms and etiology, and management: a) Paddy: Leaf streak. b) Mango: Leaf spot. c) Tomato: Canker and Wilt. **2.2 Phytoplasmas crop diseases:** Features of phytoplasmas, General symptoms Study of mycoplasma diseases of following crop plants: a) Citrus: Citrus leaf greening. b) Little leaf disease (Any suitable crop) **2.3 Viral diseases of crop plants:** Introduction, Virus infection, symptoms of viral diseases, transmission of viruses, epidemiology, Nomenclature and classification of plant viruses, Detection and identification of plant viruses; Study of any mosaic disease and Papaya leaf curl diseases with reference to distribution, causal virus, symptoms, damage, transmission, management. **2.4 Angiospermic parasitic diseases**: Introduction, Parasitic flowering plants and types of parasitism, Dissemination of angiospermic parasites,	

	Control of angiospermic parasites, Study of following parasitic angiospermic plants with reference to disease symptom, damage, host range and management of a) *Loranthus*b) Dodder. c) Witchweed.	
UNIT III	**Post-Harvest Market Diseases**	**15**
	3.1 Post harvest market diseases: Introduction, General symptoms, causes and management. **3.2 Study of post-harvest diseases** with respect to causal organism, damage, and management of important locally available fruit and vegetable crop. **3.3 Seed Pathology** – Introduction, general symptoms, damages to seeds at storage, methods of management of seed pathogen, Seed borne pathogens of pigeon pea and their control.	
UNIT IV	**Pathophysiology**	**15**
	4.1 Enzymes and toxins in plant diseases: Chemical weapons of pathogenesis. **4.2 Enzymes:** - Enzymes in plant diseases, Enzymes for waxes and cutins, Pectic enzymes, Cellulolytic enzymes, Hemicellulases, Lignolytic enzymes, Proteolytic enzymes, Lipolytic enzymes and Interaction of enzymes. **4.3 Toxins:** -Introduction-Toxins and plant diseases **4.4 Effects of pathogen on the physiology of the host plant**: Effects on permeability of cell membrane, Translocation of water and nutrients in host plant, Transcription and translation, host plant respiration and photosynthesis.	

Course Outcomes: Students will be able to

1. Analyze and recognize the diseases occurring in the agricultural field.
2. Different and categorized categories the disease on the bases of causal organisms.
3. Predict the control measures to be implemented for the disease.
4. Understand about enzymes and toxins in plants.

References:

1. Agrios, G. N. 1997. Plant Pathology, 4th Edn. Academic press,San Diego.

2. Aneja, K. R. 2005. Experiments in Microbiology and Plant Pathology and biotechnology. New Age Intenational (P) Ltd. Publishers, New Delhi.

4. Bilgrami K. S. and Dube H. C. 1990.Text book of Modern pathology. Vikas Publishing House Pvt. Ltd. New Delhi.

6. Chatterjee P. B. 1997. Plant Protection Techniques. BhartiBhawan. Patana.

9. Gerhardson, B. 2002. Biological substitutes for pesticides. Trends in biotechnology 20:338- 343. ICAE, Publication.:Crop Diseases Calender.
10. Jones D. G. 1987. Plant pathology – Principles and practices.OprenUniversityPress, Stratford.
11. MehrotraR. S. and Ashok Aggarwal 2005. Plant Pathology. Tata McGrew-Hill publishing Co.Ltd. New Delhi.
12. Mehrotra, R. S. 1980. Plant pathology. Tata McGrew-Hill publishing Co. Ltd. New Delhi.
15. PathakV. N. 1980. Diseases of Fruit crops. Oxford and IBH, New Delhi.
16. Punja, Z. K. 2001. Genetic engineering of plants to enhance resistance to fungal pathogens-a review of progress and future prospects. Canadian Journal of plant pathology 23: 216-235.
19. Roberts D. A. and Bothroyd C. W. 1995. Fundamental Plant Pathology. Freeman & Co.

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Semester III

DSE (Discipline Specific Elective)

MBT 534.1 E-I: Plant Diversity II (Conservation of Biodiversity)

Course objectives: Students should be able to:

1. Understand the need of Environmental accounting.
2. Discuss different modes of conservation of biodiversity.
3. Identify the national and international efforts for conservation of biodiversity.
4. Aware about the role of government and Non-Government bodies in biodiversity conservation.

Credits=02	**MBT 534.1: Plant Diversity II (Conservation of Biodiversity)**	**No. of hours: 30**
UNIT I	**Environmental Accounting and EIA**	**07**
	1.1 Environmental accounting: Concept, importance of natural resources and environment, merits and demerits of environmental accounting, Green audit, Carbon credit. 1.2 Environmental impact assessment (EIA): Introduction, definition, approaches to EIA, importance of environmental impact assessment.	
UNIT II	**Conservation of Biodiversity**	**09**
	2.1 Conservation of biodiversity: The need for conservation of biodiversity, conservation strategies, bio-safety and bio-ethics, biodiversity conservation in India, current efforts and action programs, Joint Forest Management, Chipko movement and other important case studies in India.	

	2.2 Ex-situ conservation: Concept, botanical gardens, seed banks, germplasm, gene banks, advantages and disadvantages, justification of ex-situ conservation. 2.3 In-situ conservation: Concept, advantages and disadvantages, role of national parks, sanctuaries, biosphere reserves, conservation of habitats, restoration of degraded habitats.	
UNIT III	**National and International efforts for Biodiversity Conservation**	**08**
	3.1 National Legislations: Indian Forest act, 1927; Wild life protection act, 1972; Forest Conservation act, 1980; Biological diversity Act, 2002; Biological diversity rules, 2004; Green Tribunal Act 2009 3.2 Environmental conferences and their implications: Ramsar convention on wetland (1971), UNCHE or Stockholm Conference (1972),; Paris convention on natural heritage (1972); Washington convention on trade of flora and fauna (1973); UNCED or Rio Conference (1992); WSSD, Johannesburg (2002), Earth summits, Conference of the Parties-Convention on Biological Diversity	
UNIT IV	**Role of Government and Non-Government Organizations in Biodiversity Conservation**	**06**
	4.1 Role of Government Organizations: Concept, working and evaluation of GOs viz. MoEF, State Governments, District Municipalities and Village Panchayats. 4.2 Role of Non-Government Organizations: Concept, working and evaluation of NGOs viz. IUCN, UNCED, BNHS, TERI, CSE, ATREE, FRLHT and local NGOs involved in biodiversity conservation, 4.3 Role of taxonomy and taxonomists in conservation of biodiversity	

Course outcomes: Students will be able to:

1. Explain the concept of environmental auditing.
2. Become aware of the national and global legislations regarding biodiversity conservation.
3. Explain the concept of carbon trading and how biodiversity affects global economy
4. Enlist the various organizations working in the field of biodiversity conservation

References

1. Santra S. C. (1994) Ecology: Basic and Applied; M D Publications Pvt Ltd
2. Asthana D. K. and Asthana M. (2001) Environment: Problems & Solutions; S. Chand Limited
3. Arora V. (2002) The Biological Diversity Act; Natraj Publishers, Dehradun
4. Pramanik A. K. (2002) Environmental Accounting and Reporting. Deep and Deep Publications.
5. Groom, M. J., Meffe G. K. and Carroll C. R. (2005) Principle of conservation Biology. Sinaur Associates, IncSunderlands, Massachusetts, USA.

6. Leadlay, E. and Jury, S. (2006) Taxonomy and plant conservation. Cambridge University Press.
7. Briggs David (2009) Plant microevolution and Conservation in Human-influenced Ecosystems. Cambridge University Press
8. Primack, R. B. (2010) Essentials of Conservation Biology. Sinaur Associates, Inc Sunderlands.

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DSE (Discipline Specific Elective)

MBT 534.1 E-II: Plant Diversity II (Global Scenario of Biodiversity)

Course objectives: Students should be able to:

5. Understand the need of Environmental accounting.
6. Discuss different modes of conservation of biodiversity.
7. Identify the national and international efforts for conservation of biodiversity.
8. Aware about the global scenario and policies about biodiversity conservation.

Credits=02	**MBT 534 E-II: Plant Diversity II (Global Scenario of Biodiversity)**	**No. of hours: 30**
UNIT I	**Environmental Accounting and EIA**	**07**
	1.1 Environmental accounting: Concept, importance of natural resources and environment, merits and demerits of environmental accounting, Green audit, Carbon credit. 1.2 Environmental impact assessment (EIA): Introduction, definition, approaches to EIA, importance of environmental impact assessment.	
UNIT II	**Conservation of Biodiversity**	**09**
	2.1 Conservation of biodiversity: The need for conservation of biodiversity, conservation strategies, bio-safety and bio-ethics, biodiversity conservation in India, current efforts and action programs, Joint Forest Management, Chipko movement and other important case studies in India. 2.2 Ex-situ conservation: Concept, botanical gardens, seed banks, germplasm, gene banks, advantages and disadvantages, justification of ex-situ conservation. 2.3 In-situ conservation: Concept, advantages and disadvantages, role of national parks, sanctuaries, biosphere reserves, conservation of habitats, restoration of degraded habitats.	
UNIT III	**National and International efforts for Biodiversity Conservation**	**08**
	3.1 National Legislations: Indian Forest act, 1927; Wild life protection act, 1972; Forest Conservation act, 1980; Biological diversity Act, 2002; Biological diversity rules, 2004; Green Tribunal Act 2009 3.2 Environmental conferences and their implications: Ramsar convention	

	on wetland (1971), UNCHE or Stockholm Conference (1972),; Paris convention on natural heritage (1972); Washington convention on trade of flora and fauna (1973); UNCED or Rio Conference (1992); WSSD, Johannesburg (2002), Earth summits, Conference of the Parties-Convention on Biological Diversity	
UNIT IV	**Biodiversity Documentation**	**06**
	4.1 Role of Botanical Survey of India in Biodiversity research and documentation. 4.2 Role of taxonomy in biodiversity documentation. 4.3 Rare, Endangered Threatened and Endemic biodiversity documentation and its importance. 4.4 Panchayat biodiversity documentation: Roles of college and other education institutes.	

Course outcomes: Students will be able to:

1. Explain the concept of environmental auditing.
2. Become aware of the national and global legislations regarding biodiversity conservation.
3. Explain the concept of carbon trading and how biodiversity affects global economy
4. Create biodiversity document of local biodiversity.

References

1. Santra S. C. (1994) Ecology: Basic and Applied; M D Publications Pvt Ltd
2. Asthana D. K. and Asthana M. (2001) Environment: Problems & Solutions; S. Chand Limited
3. Arora V. (2002) The Biological Diversity Act; Natraj Publishers, Dehradun
4. Pramanik A. K. (2002) Environmental Accounting and Reporting. Deep and Deep Publications.
5. Groom, M. J., Meffe G. K. and Carroll C. R. (2005) Principle of conservation Biology. Sinaur Associates, IncSunderlands, Massachusetts, USA.
6. Leadlay, E. and Jury, S. (2006) Taxonomy and plant conservation. Cambridge University Press.
7. Briggs David (2009) Plant microevolution and Conservation in Human-influenced Ecosystems. Cambridge University Press
8. Primack, R. B. (2010) Essentials of Conservation Biology. Sinaur Associates, Inc Sunderlands.

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Semester III

DSE (Discipline Specific Elective)

MBT 534.2 E-I: Plant Protection II (Animate Pests of Crops and their Management)

Course objectives: Students should be able to:

1. Study the basic knowledge of different pests on crops.
2. Understand the knowledge animate pests.
3. Study about Insect pests.
4. Learn classical and advanced methods of the Pest management.

Credits=02	**MBT 534 E-I: Plant Protection II (Animate Pests of Crops and their Management)**	**No. of hours: 30**
UNIT I	**Types of pests on crops**	**07**
	1.1 Introduction: Introduction to animate pests and their examples. General life cycles of these animate pests, Importance of animate pests. **1.2 Non-insect pests of crops:** General account of non-insect pests, damages caused and their management with respect to rats, squirrels, birds, snails and slugs, plant mites, and nematodes. **1.3 Insect pests of crops:** Insects as a pest of crops, pest status, factors influencing pest populations, types of losses, General estimation of losses in India, Exotic pests, reasons for their introduction and losses caused by them.	
UNIT II	**Insect Pests of Crop Plants**	**09**
	2.1 Study of major insect pests: Study major insect pests of the following crops with reference to their scientific name, host range, marks of identification, nature of damage, life cycle and their management: **Cereals:** a) Wheat Aphid. b) Jowar - Stem Borer c) Cob borer of maize **Pulses:** a) Tur - Pod Borers. b) Soybean - Leaf Roller **Cash crops:** a) Scale insect b) Ginger Rhizome fly **Oil seed crops:** a) Ground nut -Leaf Miner b) Sunflower- White fly **Vegetables:** a) Tomato - Fruit Worms b) Okra - Fruit Borers **Fruits:** a) Mango stem bore b) Citrus caterpillar	
UNIT III	**Insect Pests on cash crops and stored grains**	**08**
	3.1 Insect pests of ornamental plants: Study of following pests with reference to their scientific name, host range, marks of identification, and nature of damage, life cycle and their management: a) Scale Insects, b) white fly, c) Spider mite. **3.2 Polyphagus insect pests:** Study of following polyphagus insect pests with reference to their scientific name, host range, marks of identification,	

	nature of damage, life cycle and their management. a) Aphids, b) Termites, c) Mealy bugs d) Thrips d) Leaf miner **3.3 Stored grain insect pests:** Study of following stored grain insect pests with reference to their scientific name, host range, marks of identification, nature of damage, brief life cycle and their management. a) Rice moth,b) Red flour beetle, c) Lesser grain borer.	
UNIT IV	**Pest Management**	**06**
	3.1 Pest management: Overview of methods of pest management viz. Mechanical, Physical, Chemical and Cultural Methods of pest control. **3.2 Chemical Control of Pests:** Pesticide toxicity, Modes of action-Nerve poisons, Muscle poisons and Physical toxicants; pesticide resistance; Resurgence of pests; Effects on non-target organisms, Pesticide residue. **3.3 Biological Control of Pests:-** Concept, Some successful examples of biological control, Agents of biological control.	

Course outcomes: Students will be able to:

1. Understand the different pests on crops.
2. Identify the animate peats in the farmer's field.
3. Identify the insect peats.
4. Perform the management strategies to control the pest.

References

1. Agrios, G. N. 1997. Plant Pathology, 4th Edn. Academic press, San Diego.
2. Atwal, A. S. 1936. Agricultural Pest of India and South East Asia.Kalyani Publishers, New Delhi.
3. Chatterjee, P. B. 1997. Plant protection techniques. BharatiBhawan Publishers and Distributors Patna.
4. Chattopadhya, S. P. 1987. Principles and Procedures of Plant Protection. Oxford and IBH, New Delhi.
5. Dhaliwal, G. S. and Arora Ramesh. 1994. Trends in Agricultural Pest Management. Commonwealth Publishers, New Delhi.
6. Gerhardson, B. 2002. Biological substitutes for pesticides. Trends in biotechnology
7. Jha, L. K. 1987. Applied Agricultural Entomology. New Central Book Agency, Kolkata.
8. Metcalf, C. L. and Flint, W. P. 1983. Destructive and Useful Insects. Tata McGrew-Hill publishing Co. Ltd. New Delhi.
9. Pedigo, L. P. 1996. Entomology and pest Management. Prentice-Hall Pub. Englewood clifts NJ.
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Semester III

DSE (Discipline Specific Elective)

MBT 534.2 E-II: Plant Protection II (Animate Pests of Crops, their management and Industrial Entomology)

Course objectives: Students should be able to:

1. Study the basic knowledge of different pests on crops.
2. Understand the knowledge animate pests.
3. Discuss damages by Insect pests.
4. Learn classical and advanced methods of the Pest management.

Credits=02	**MBT 534.2 E-II: Plant Protection II (Animate Pests of Crops, their management and Industrial Entomology)**	**No. of hours: 30**
UNIT I	**Types of pests on crops**	**07**
	1.1 Introduction: Introduction to animate pests and their examples. General life cycles of these animate pests, Importance of animate pests. **1.2 Non-insect pests of crops:** General account of non-insect pests, damages caused and their management with respect to rats, squirrels, birds, snails and slugs, plant mites, and nematodes. **1.3 Insect pests of crops:** Insects as a pest of crops, pest status, factors influencing pest populations, types of losses, General estimation of losses in India, Exotic pests, reasons for their introduction and losses caused by them.	
UNIT II	**Insect Pests of Crop Plants**	**09**
	2.1 Study of major insect pests: Study major insect pests of the following crops with reference to their scientific name, host range, marks of identification, nature of damage, life cycle and their management: **Cereals:** a) Wheat Aphid. b) Jowar - Stem Borer c) Cob borer of maize **Pulses:** a) Tur - Pod Borers. b) Soybean - Leaf Roller **Cash crops:** a) Scale insect b) Ginger Rhizome fly **Oil seed crops:** a) Ground nut -Leaf Miner b) Sunflower- White fly **Vegetables:** a) Tomato - Fruit Worms b) Okra - Fruit Borers **Fruits:** a) Mango stem bore b) Citrus caterpillar	
UNIT III	**Pest Management**	**08**
	3.1 Pest management: Overview of methods of pest management viz. Mechanical, Physical, Chemical and Cultural Methods of pest control. **3.2 Chemical Control of Pests:** Pesticide toxicity, Modes of action-Nerve poisons, Muscle poisons and Physical toxicants; pesticide resistance; Resurgence of pests; Effects on non-target organisms, Pesticide residue.	

	3.3 Biological Control of Pests:- Concept, Some successful examples of biological control, Agents of biological control.	
UNIT IV	**Industrial Insects**	**06**
	4.1 Introduction to Industrial Entomology: Significant insects in various industries. **4.2 Sericulture industry:** Biology of silkworms; species of silkworms and host plants; practice of sericulture **4.3 Honeybee Industry:** Biology and social organization of honeybees; modern beekeeping practices and hive mangement; by-products of bee keeping-beewax, royal jelly, propolis.	

Course outcomes: Students will be able to:

1. Explain the concept of environmental auditing.
2. Become aware of the national and global legislations regarding biodiversity conservation.
3. Explain the concept of carbon trading and how biodiversity affects global economy
4. Discuss economic benefits of industrial insects.

References

11. Agrios, G. N. 1997. Plant Pathology, 4th Edn. Academic press, San Diego.
12. Atwal, A. S. 1936. Agricultural Pest of India and South East Asia.Kalyani Publishers, New Delhi.
13. Chatterjee, P. B. 1997. Plant protection techniques. BharatiBhawan Publishers and Distributors Patna.
14. Chattopadhya, S. P. 1987. Principles and Procedures of Plant Protection. Oxford and IBH,New Delhi.
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16. Gerhardson, B. 2002. Biological substitutes for pesticides. Trends in biotechnology
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18. Metcalf, C. L. and Flint, W. P. 1983. Destructive and Useful Insects. Tata McGrew-Hill publishing Co. Ltd. New Delhi.
19. Pedigo, L. P. 1996. Entomology and pest Management. Prentice-Hall Pub. Englewood clifts NJ.
20. Shrivastava, V. P. 1988. A Textbook of Applied Entomology. KalyaniPubl. New Delhi.

MBP 535: Research Project (RP) (6 Credits; 12 Lectures per week)

The research project is an essential part of Master's program that offers students the opportunity to explore a topic in depth and make a meaningful contribution to field of Botany. We encourage students to approach this project with enthusiasm and dedication. An advisor and the faculty are here to support students throughout the process.

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SEMESTER III MBP 536.1: LAB III (based on MBT 531, 532 and 533.1)

Credit=02	LAB-III (based on MBT 531, 532 and 533.1)	Toal Hrs. (60)
	1. Karyotype analysis in any two plants. 2. Study of meiotic abnormalities in *Rhoeo* sp. 3. Study of floral biology of crop plants (any two) 4. Genetic problems on gene mapping in higher plants. 5. Determination of allele frequency in population. 6. Centres of origin of crop plants. 7. Preparation of MS medium for Plant tissue culture 8. Micro propagation 9. Isolation of genomic DNA 10. Agarose gel electrophoresis 11. Polymerase chain reaction (PCR) 12. Amino acid sequence and Nucleotide sequence blasting 13. Use of data base in study in biodiversity 14. Techniques of herbarium and museum specimen preparation. 15. Study of critically endangered & vulnerable plant species from Western Ghats 16. Study of monotypic endemic genera of Western Ghats. 17. Green audit of college campus. 18. Seed germination and viability of forest trees. 19. Assessment of the economic value of plant biodiversity 20. Visit to local centres ex-situ, in-situ and NGO conservation programme and report writing.	

Semester III

MBP 536: LAB III (Practicals based on MBT 531, 532 & 533.2)

Credit=02	LAB-III (based on MBT 531, 532 and 533.2)	Toal hrs. (60)
	1. Karyotype analysis in any two plants. 2. Study of meiotic abnormalities in *Rhoeo* sp. 3. Study of floral biology of crop plants (any two) 4. Genetic problems on gene mapping in higher plants. 5. Determination of allele frequency in population. 6. Centres of origin of crop plants. 7. Preparation of MS medium for Plant tissue culture 8. Micro propagation 9. Isolation of genomic DNA 10. Agarose gel electrophoresis 11. Polymerase chain reaction (PCR) 12. Amino acid sequence and Nucleotide sequence blasting 13. Study of following diseases with respect to causal organism, symptoms, disease cycle and their management 14. Fungal diseases Helminthosporium of Paddy, Head smut of jowar, Rust of soybean and sunflower, Rust of chickpea. 15. Fungal diseases: Rhizome rot of Turmeric, Rust of Coffee, Anthracnose of Banana, Powdery mildew of Pea, Ripe fruit rot of Chilli 16. Bacterial diseases: a) Paddy: Leaf streak. b) Mango: Leaf spot. c) Tomato: Canker and Wilt. 17. Phytoplasmas diseases: a) Citrus: Citrus leaf greening. b) Little leaf disease (Any suitable crop) 18. Viral diseases: any mosaic disease and Papaya leaf curl 19. Angiospermic parasitic diseases: a) Loranthus b) Dodder. c) Witchweed. 20. Locally available of market diseases of vegetables and fruits.	

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SEMESTER IV

MBT 541: PLANT PHYSIOLOGY AND METABOLISM

Course objectives: Students should be able to:

1. Understand the basic knowledge of different aspects of cytogenetics and plant breeding.
2. Understand basic knowledge of different aspects of plant physiology.
3. Understand the basic knowledge of plant metabolism.
4. Recognize stress alleviation in plants for use in creation of resistant plants.
5. Identify latest updates in the field of research in plant physiology and metabolism.

Credits=4	MBT 541: PLANT PHYSIOLOGY AND METABOLISM	No. of hours: 60
UNIT I	**Plant water relation and solute transport**	15
	1.1 Regulation of water supply 1.2 Aquaporins and facilitated water transport 1.3 Soil plant atmosphere continuum (SPAC) 1.4 Theories of stomatal physiology 1.5 Mechanism of xylem and phloem transport 1.6 Phloem loading and unloading (with special reference to P proteins) 1.7 Membrane transport proteins	
UNIT II	**Photosynthesis and respiration:**	15
	2.1 Photosynthesis: Photosynthetic apparatus, Photosynthetic pigments and light harvesting complexes 2.2 Photo-oxidation of water, Mechanism of electron and proton transport, RUBISCO, Calvin cycle, Photorespiration 2.3 CAM and C4 pathway and its types 2.4 Respiration: EMP pathway, Pentose Phosphate pathway (PPP), 2.5 Anaerobic respiration, TCA cycle, ETC 2.6 Gluconeogenesis.	
UNIT III	**Metabolism and Physiology of flowering:**	15
	3.1 Lipid metabolism: Synthesis of triglycerides, fatty acids, membrane lipids, and their catabolism, glyoxylate cycle, beta oxidation 3.2 Sulphur metabolism: Sulphate intake, transport, reduction and assimilation 3.3 Nitrogen metabolism: Nitrate and ammonium assimilation, nitrogen uptake, NOD factor, root nodulation and nitrogen fixation 3.4 Physiology of flowering: Photoperiodism and its significance, floral induction and development- genetic and molecular analysis, Vernalization	

UNIT IV	Phytohormones and stress physiology	15
	4.1 Concept of hormones as chemical messengers; Biosynthesis and mechanism of action of auxins 4.2 Hormones in defense against biotic and abiotic stress 4.3 Response of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses 4.4 Mechanism of resistance to biotic stress and tolerance to abiotic stress	

Course Outcomes: The Students will be able to:

1. Appreciate the plants as universal engineers.
2. Understand the basic physiological processes in plants.
3. Explain the metabolic processes in plants.
4. Identify the resilient nature of plant with respect to their ability to cope up with stress

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1. Bidwell, R. C. S. 1979: Plant Physiology, Macmillan.
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3. Buchnan, B.B., Gruissem, W. And Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. Wiley-Blackwell
4. Edwards G. and Walker D., eds. 1983. C3, C4: mechanisms, and cellular and environmental regulation, of photosynthesis. Blackwell Scientific Publications, Oxford.
5. Govindjee, H. (ed.) 1982. Photosynthesis, Vol. 1 and Vol. 2. Academic Press, N.Y. (Vol. 1); 0-12- 294302-2 (Vol. 2)
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7. Krishnamurthy, H.N. 1992. Physiology of Plant Growth and Development. Atma Ram and Sons, Delhi.
8. Marschner, H. W. 2003. Mineral nutrition of Higher Plants. Second Edition, Academic Press, Elsevier Science Ltd.
9. Mukherjee, S.P. and Ghosh A.N. (1996): Plant Physiology. New Central Book Agency (P) Limited Tata McGraw Hill.
10. Noggle, G.R. and Fritz, G. J. 1976. Introductory Plant Physiology. Prentice- Hall, Inc., Englewood Cliffs, NJ.
11. Pessarakli, M. (Ed.). 2001. Handbook of Plant and Crop Physiology, 2nd Edition, Revised and Expanded. Marcel Dekker, Inc., New York

12. Pessarakli, M. (Ed.). 2005. Handbook of Photosynthesis, 2nd Edition, CRC Press, Taylor & Francis Publishing Company, Florida
13. Sadasivam S. and Manickam A. 1996. Biochemical methods. New Age International.
14. Salisbury, F. B. and Ross, C.W. 1992. Plant Physiology IV ed. Cengage Learning
15. Smith, H. 1975. Phytochrome and Photomorphogenesis. McGraw-Hill Inc., US
16. Taiz, L. and Zeiger, F. 1998, 2002. The Plant Physiology. Second Edition, Third Edition, Sunderland: Sinauer Associates.
17. Wilkins, M. B. 1976. Physiology of Plant Growth and Development. McGrow-Hill Publishing Company Limited

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SEMESTER IV

MBT 542: BIODIVERSITY CONSERVATION AND UTILIZATION

Course objectives: Students should be able to:

1. To impart the basic knowledge of different aspects of biodiversity and conservation.
2. To impart the knowledge of methods in biodiversity conservation and utilization.
3. To impart the importance of endemic plants.
4. To impart the knowledge of geo-informatics in plant sciences.

Credits=4	**MBT 542: Biodiversity Conservation and Utilization**	**No. of hours: 60**
UNIT I	**Biological Diversity**	**15**
	1.1 Definition and concept of biodiversity; 1.2 Types of diversity (alpha, beta, gamma); Magnitude ofbiodiversity; indirectand ethical values of biodiversity; Loss and reasons for loss of biodiversity; 1.3 Global Taxonomic initiatives (GTI); Systematic agenda-2020.	
UNIT II	**Endemism and Geoinformatics**	**15**
	2.1 Endemism: Definition and types of endemism; RED list categories of IUCN; Hot spots and Hottest hotspots; Keystone and Flagship species; Plant endemism inIndia with special emphasis on Western Ghats 2.2 Geo informatics: Definition and concept of Geo informatics; GeographicPositioning System (GIS); Global Positioning System (GPS); Google earth. 2.3 Ecology and Biodiversity Services (EBS)	

UNIT III	**Biodiversity Conservation**	**15**
	3.1 Introduction; Basic principles of conservation; In-situ conservation; Ex-situ conservation. 3.2 Restoration programs; World organization for conservation; Efforts by Indian government for conservation.	
UNIT IV	**Biodiversity for sustainable development**	**15**
	4.1 Wild Plants of ornamental potential; Wild relatives of cultivated plants; Wildedible plants andtheir nutritive value; 4.2 Under exploited medicinal plants; Plants of commercial importance; Energyplants and petro crops; 4.3 Plants suitable in phyto-remediation	

Course Outcomes: The Students will be able to:

1. Understand the concept Biodiversity and Conservation.
2. Aware of the importance of endemic plant resources of Western Ghats.
3. Understand the methods of Biodiversity Conservation and Utilization.
4. Understand the application of Geo-informatics in plant sciences.

References:

1. D Briggs, Plant Microevolution and Conservation in Human-influenced Ecosystems, (2009)
2. MJ Groom, GK Meffe and CR Caroll, Principles of Conservation biology (1997)
3. VH Heywood, RT Watson, Global Biodiversity Assessment (1995)
4. E Leadlay, S Jury, Taxonomy and Plant Conservation (2006)
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7. UNEP, Global Taxonomy Initiative (GTI). Decision VI/8. UNEP/CBD/COP/6/20 Montreal, Canada (2002a)
8. TI Khan, Biodiversity Conservation and Sustainable Development (1998)
9. SL Kochhar, Economic Botany in the Tropics (2009)

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SEMESTER IV

MBT 543.1: PLANT DIVERSITY III (BIODIVERSITY AND SUSTAINABLE DEVELOPMENT)

Course objectives: Students should be able to:

1. To impart the basic knowledge of different aspects of utilization of Biodiversity.
2. To impart the knowledge of local biodiversity and biodiversity of Western Ghats.
3. To impart the fundamentals of sustainable development as the need of the times.
4. To impart the knowledge of ecosystem services of Western Ghats.

Credits=4	**PLANT DIVERSITY III (BIODIVERSITY AND SUSTAINABLE DEVELOPMENT)**	**No. of hours: 60**
UNIT I	**Biodiversity and Sustainable Development**	**15**
	1.1. Concept, prospects and concern 1.2. Biodiversity education 1.3. Rehabilitation of neglected specialized habitats like wetlands and mangroves 1.4. Community participation for sustainable development, social approach to conservation 1.5. Role of universities and educational institutes in biodiversity conservation.	
UNIT II	**Local Biodiversity**	**15**
	2.1. **Local biodiversity**: Diversity of angiosperms of Satara with special reference to Mahabaleshwar, Kas, Khatav and Ajinkyatara fort 2.2. **Domesticated biodiversity:** Domesticated biodiversity in India and its conservation, organization, working and role of NBPGR. (Role of exotic species in ecosystem degradation)	
UNIT III	**Bioprospecting and Sustainable Utilization**	**15**
	3.1. **Bioprospecting and biodiversity:** Concept, bioprospecting and indigenous traditional knowledge, bioprospecting for conservation and sustainable development, 3.2. Rio convention (1992) and bioprospecting, bioprospecting and biopiracy, bioprospecting to conserve the biodiversity 3.3. Intellectual property right	
UNIT IV	**Plant Bioresources of Western Ghats**	**15**
	4.1. **Plant bioresources of Western Ghats:** Wild edible fruit plants, gum, resins, dyes, medicine, fodder ornamental, fibre, timber, essential oil fuel, honey yielding plants (minimum five plants from each category). 4.2. Ecosystem services by Western Ghats.	

Course Outcomes: The Students will be able to:

1. Understand the concept of sustainable development.
2. Aware of the plant biodiversity resources of Western Ghats.
3. Analyze the Bioprospecting requirements in field of their study.
4. Define the ecosystem services provided by Western Ghats.

References:

1. BR Glick, JJ Pasternak, Molecular Biotechnology- Principles and Applications of Recombinant DNA (1994)
2. PK Gupta, Biotechnology and Genomics (2009)
3. PK Gupta, Plant Biotechnology (2010)
4. TI Khan, Biodiversity Conservation and Sustainable Development (1998)
5. SL Kochhar, Economic Botany in the Tropics (2009)
6. HD Kumar, Molecular Biology and Biotechnology (1993)
7. ML Narasaiah, Biodiversity and Sustainable Development (2005)
8. RL Panigrahy, Lingaraj Patro, Biodiversity Conservation and Sustainable Development (2008)
9. KG Ramawat, Plant Biotechnology (2006)
10. K Trehan, Biotechnology (1994)
11. PC Trivedi, Plant Biotechnology- Recent Advances (2000)
12. V Verma, A textbook on Economic Botany, (2009)
13. D Wood, J Lenne, Agrobiodiversity: Characterization, Utilization and Management, (1999)

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SEMESTER-III

MBT 543.2: PLANT PROTECTION III

(Recent Trends and Techniques in Plant Protection)

Course objectives: Students should be able to:

1. Understand the advanced techniques used in plant protection.
2. Study the analysis of pesticides and biostatistics.
3. Study the Disease forecasting and Weed Management.
4. Understand different advanced practices used in crop protection

Credits=4	MBT 543.2: PLANT PROTECTION III (Recent Trends and Techniques in Plant Protection)	No. of hours: 60
UNIT I	**Recent advances in Pest and Weed Management**	**15**
	1.1 Introduction: Recent advances in plant protection; Pest: Origin, factor responsible, for peststatus; Residual analysis of pesticides:- Overview of pesticideresidues in plants, pesticideresidue analysis by- TLC, GC and HPLC. **1.2 Weeds as Pathogens and Weed Management**: Weedsand damages caused bythem, exotic weeds; and their nuisance (Examples). **1.3 Weed management**: weed research in India, Myco-herbicides and insects inweed management and integrated weedmanagement.	
UNIT II	**Biotechnological advances in pest management**	**15**
	2.1 Culture Media: Overview of culture media, special culture media for Fungi and Bacteria **2.2 Biotechnology in Plant Protection**: - Introduction, Concept of transgenic plants, Biotechnologyfor plant pathology (Examples), Biotechnology for insect control (Examples) **2.3 Biotechnology for weed control(Examples)**; Mycorrhiza: - Introduction and their applications in plant protection.	
UNIT III	**Biostatistics in Plant Protection**	**15**
	3.1 Biostatistics: -Introduction-Concept of statistics.and biostatistics,importance; measures ofcentral tendency- Concept, merits, demerits, applications of Mean, Mode and Median; Measuresof dispersion-Concept, merits, demerits, applications of standarad deviation, and CV, graphicaland diagrammatic representation of data- Histogram, Polygon, Line graph and Pie diagram	

	3.2 Disease forecasting: Concept, models in diseases forecasting.	
UNIT IV	**IDM, IPM and Sustainable Agriculture**	**15**
	4.1 IDM - Concept, use of IDM in managing various diseases, limitations ofIDM. **4.2 IPM** - Concept, Need and objectives, examples of management of pests withIDM.Juvenile hormones, Antifeedants. **4.3 Plant Protection and Sustainable Agriculture**:Concepts, Indian scenario of sustainable agriculture and future outlooks	

Course Outcomes: The Students will be able to:

1) Understand the recent technologies employed in the study of plant pathology.
2) Understand the recent biotechnology techniques employed in the study of analysis of pesticides and Biostatistics.
3) Understand the concepts of biostatistics and forecasting diseases based on predictive parameters.
4) Formulate an in advance management programmes to prevent the forecasted disease.

REFERENCES:

1. Agrios, G. N. (1997). Plant Pathology, 4th Edn. Academic press, San Diego

2. Aneja K. R..: Experiments in Microbiology, Plant Pathology and Tissue Culture.Wishwa publishers

3. Bilgrami K. S. and Dube H. C. (1990).Text book of Modern pathology. VikasPublishing House Pvt. Ltd. New Delhi.

4. Chandrashekharan S. N. and S. V. Parthsarthy (1965). Cytogenetics and Plant

5. Breeding. P. Varadachary and Co. Madras. (Unit I)

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7. Chattopadhya, S. P. (1987) Principles and Procedures of Plant Protection. Oxford andIBH,New Delhi.

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SEMESTER IV

DSE (Discipline Specific Elective)

MBT 544.1 E-I: PLANT DIVERSITY IV (ASSESSMENT OF BIODIVERSITY)

Course objectives: Students should be able to:

Understand different aspects of biodiversity assessment.

2. Imbibe the practical knowledge of biotechnological tools of biodiversity assessment.

3. Study the knowledge of impact of biodiversity on human life.

4. Imbibe the basic knowledge of use of biostatistics and bioinformatics in biodiversity

Credits=2	MBT 544.1 E-I: PLANT DIVERSITY IV (ASSESSMENT OF BIODIVERSITY)	No. of hours: 30
UNIT I	**Methods of Biodiversity Assessment**	08
	1.1 Methods to study biodiversity: Sampling methods to determine alpha, beta and gamma diversity, methods for floristic diversity, aquatic biodiversity and biodiversity of soil. **1.2 Agencies for Conservation:** Concept, role and working of DBT, DST, MOEF, SERB, RGSTC, AICRP.	
UNIT II	**Role of Biotechnology in Conservation**	07
	2.1 Biotechnology in conservation of biodiversity: Role of biotechnology in conservation of biodiversity, tools of biotechnology (tissue culture, somatic embryogenesis, synthetic seed technology, cryopreservation, secondary metabolites molecular markers etc.), restoration and species recovery programme. **2.2 Molecular tools for biodiversity:** Alloenzymes, Molecular markers -RFLP, AFLP, RAPD; DNAbarcoding; Significance of molecular tools inbiodiversity.	
UNIT III	**Impact of Biodiversity**	08
	3.1 Tourism andbiodiversity: Eco-tourism, concept, principle, scope of eco-tourism in India, ecocide, sustainable tourism development, public awareness using environmental calendar activities.	

	3.2 Climate change and biodiversity: Global warming and green house effect, causes, effects and remedies, effect of climate change onbiodiversity.	
UNIT IV	**Biostatistics and Bioinformatics in Biodiversity**	**07**
	Use of Statistical Analysis and Computer Based Data Handling forAssessment of Biodiversity: **4.1 Biostatistics**: Introduction, applications, ANOVA, use of biostatistics in interpretation of biodiversity data**.** **4.2 Bioinformatics:** Introduction, applications, databases (nucleicacid, protein),use of computers and bioinformatics in study of biodiversity.	

Course Outcomes: The Students will be able to:

1) Student the techniques of accessing biodiversity.
2) Understand the techniques for the assessment of plant biodiversity in their field of Study.
3) Understand the concept of ecotourism.
4) Understand the bioinformatics applications in biodiversity assessment.

REFERENCES:

1. Banerjee P.K., Introduction to Biostatistics: S.Chand Limited. 2011.
2. ChandraA.M.And Ghosh S.K.,Remote Sensing and Geographical Information System; Alphascience: 2006.
3. ClaverieJ and Notredame C, Bioinformatics for Dummies; John Wileyand Sons, 2011.
4. Gupta, P.K., Biotechnology and Genomics. Meerut, Rastogi Publications. 2009.
5. Gupta, P.K., Plant Biotechnology: Meerut, Rastogi Publications.2010.
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10. Sharma J. R., Statistical and Biometrical techniques in Plant Breeding: NewDelhi, New Age International Publishers. 115 .1998.
11. Singh J., Ecotourism: IK International PvtLtd.2010.
12. Trivedi P. C., Plant Biotechnology- Recent Advances. New Delhi, Panima PublishingCorporation, 2000.

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SEMESTER IV

DSE (Discipline Specific Elective)

MBT 544.1 E-II: PLANT DIVERSITY IV

(LATEST TECHNIQUES IN BIODIVERSITY PREDICTION)

Course objectives: Students should be able to:

1. Understand the basic knowledge of different aspects of biodiversity assessment.
2. Imbibe the practical knowledge of biotechnological tools of biodiversity assessment.
3. Undersatand the knowledge of impact of biodiversity on human life.
4. Imbibe the basic knowledge of use of Remote Sensing in biodiversity

=2	MBT 544.1 E-II: PLANT DIVERSITY IV (LATEST TECHNIQUES IN BIODIVERSITY PREDICTION)	No. of hours: 30
UNIT I	**Methods of Biodiversity Assessment**	**08**
	1.3 Methods to study biodiversity: Sampling methods to determine alpha, beta and gamma diversity, methods for floristic diversity, aquatic biodiversity and biodiversity of soil. **1.4 Agencies for Conservation:** Concept, role and working of DBT, DST, MOEF, SERB, RGSTC, AICRP.	
UNIT II	**Role of Biotechnology in Conservation**	**07**
	2.1 Biotechnology in conservation of biodiversity: Role of biotechnology in conservation of biodiversity, tools of biotechnology (tissue culture, somatic embryogenesis, synthetic seed technology, cryopreservation, secondary metabolites molecular markers etc.), restoration and species recovery programme. **2.2 Molecular tools for biodiversity :** Alloenzymes,Molecular markers -RFLP, AFLP, RAPD; DNAbarcoding; Significance of molecular tools inbiodiversity.	
UNIT III	**Impact of Biodiversity**	**08**
	3.3 Tourism andbiodiversity: Eco-tourism, concept, principle, scope of eco-tourism in India, ecocide, sustainable tourism development, public awareness using environmental calendar activities. **3.4 Climate change and biodiversity:** Global warming and	

	green house effect, causes, effects and remedies, effect of climate change onbiodiversity.	
UNIT IV	**Remote Sensing**	**07**
	4.1 Remote Sensing Application to Biodiversity; Introduction, Loss of biological diversity, Biosphere reserves, The present issues on environment, Ecologically Hot Spot Areas, Marine environment, Wetland environment, Degradation of Ecosystems. **4.2 Forestry-Forest cover mapping** & Surveillance, Forest Type Mapping, Identification and Mapping of Major Forest Plantations, Forest Stock Mapping, Monitoring of Deforestation and Afforestation, Grassland Mapping. Coastal vegetation, Wildlife habitat Assessment, Wastelands, Desertification. **4.3 Use of space technology in Disaster Warning**/Mitigation, Geosphere-Biosphere studies.	

Course Outcomes: The Students will be able to:

1) Know the techniques of accessing biodiversity.
2) Know the concept of ecotourism.
3) Learn the basic Remote Sensing applications in biodiversity assessment.

References:

1. Banerjee P. K., *Introduction to Biostatistics*: S. Chand Limited. 2011.
2. Chandra A. M. And Ghosh S. K., *Remote Sensing and Geographical Information System*; Alpha science: 2006.
3. Claverie J and Notredame C, *Bioinformatics for Dummies*; John Wiley and Sons, 2011.
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9. Ravindran K.V., *Remote Sensing and Geographical Information System for Natural Resource Management; joint publication of Indian Society of Remote Sensing and National Natural Resources Management System*: Deptt of Space .1998.
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12. Trivedi P. C., *Plant Biotechnology- Recent Advances.* New Delhi, Panima Publishing Corporation, 2000.

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SEMESTER IV

DSE (Discipline Specific Elective)
MBT 544.2 E-I: PLANT PROTECTION IV

(MOLECULAR PLANT PATHOLOGY AND MYCORRHIZAL TECHNOLOGY)

Course objectives: Students should be able to:

1. To study plant pathology and application of molecular biology.
2. Understand disease resistance mechanism in plants
3. Study of genetics of plant pathogen interactions.
4. Learn the diagnostics and transgenic approaches.

Credits=2	MBT 544.2 E-I: PLANT PROTECTION IV (Molecular Plant Pathology and Mycorrhizal Technology)	No. of hours: 30
UNIT I	**Plant pathology and Molecular Biology**	07
	1.1 The Fundamentals of plant Pathology: The concept of plant diseases; The causal agent's fungi, protozoa, bacteria, phytoplasmas and spiroplasmas, viruses and other agents; Molecular biology in plant pathology. **1.2 Application of Molecular Biology in Disease Control:** Breeding for resistance: The basis of resistance breeding programme, the conventional and non-conventional breeding strategy; Marker assisted breeding; the identification of novel resistance genespecificities.	
UNIT II	**Resistance genes, genetics of plant pathogen interactions, and genetics of fungi**	08
	2.1 Resistance gene: Gene- for gene resistance, Features of cloned resistance genes, R gene specificity, Genetic organization of resistance genes, Co-evolution of resistance genes; Resistance genes in BT crops. **2.2 Genetics of Plant Pathogen Interactions:** Genetics of host Parasiticinteractions, Physiological specialization in fungi, Production of New races, Adaptations of fungi different Hosts, Resistance and Susceptibility.	
UNIT III	**Molecular diagnostics and application to conventional disease control**	08

	3.1 Classical approaches; Use of Antibodies-Polyclonal antibodies, Monoclonal antibodies, Serological Tests-ELISA, Recombinant DNA techniques; Nucleic acid based techniques- Identification of pathogen specific markers, PCR based technique, Gene-array based techniques, Quantitative PCR; and Phylogenetic analysis. **3.2 Transgenic approaches for crop protection:** Pathogen derived resistance - Coat –protein mediated resistance, Replicate mediated resistance; Plantibodies; Expressing defense genes under the control of inducible promoters; Use of clonal resistance genes and Expression of vaccines in plants.	
UNIT IV	**Mycorrhizal Technology**	**07**
	4.1 Mycorrhizal fungi: Introduction and classification; Types of mycorrhizas- Arbutoid mycorrhizas, ectomycorrhizas, vesicular arbuscular mycorrhizas or arbuscular mycorrhizas, ectendomycorrhizas, ericoid mycorrhizas, monotropoid mycorrhizas and orchid mycorrhizas; **4.2 Phoshate solubilisation**; Ecological significance of AM fungi; Importance of mycorrhiza in evolution of land plants; **4.3 Role of mycorrhiza in agriculture**, horticulture and forestry.	

Course Outcomes: The Students will be able to:

1. Validate the pathogen through molecular approach.
2. Recognize the resistance mechanism in plants.
3. Estimates an account of mycorrhizal fungi in general and agriculture, horticulture and forestry.
4. Understand the concept of transgenic resistant to pests and pathogen.

References:

1. . Dickinson M. 2008. Molecular Plant Pathology. Second edition. BIOS Scientific Publishers, London and NewYork
2. Agrios, George N. 2005. Plant Pathology, 5th Edn.Academic press, San Diego.
3. Luberstedt Thomas. 2013. Diagnostics in Plant Breeding, first edition: Springer, Netherlands.
4. Langridge P and K. Chalmers. 2005. Molecular marker systems in Plant Breeding and Crop Improvement, first edition: Springer, Berlin.

5. Dickinson Matthew and James Beynon. 2000. Molecular Plant Pathology. CRC press, Sheffild.
6. Punja, Z. K. 2001. Genetic engineering of plants to enhance resistance to fungal pathogens-a review of progress and future prospects. Canadian Journal of plant pathology 23: 216-235.
7. Roberts D. A. and Bothroyd C. W. 2001. Fundamental Plant Pathology. W. H. Freeman & Co, London.
8. Rommens, C. M. and G. M. Kishore. 2000. Exploiting the full potential of disease resistance genes for agricultural use. Current Opinions in Biotechnology 11:120-125.
9. Sambamurty, A. V. S. S. 2008. Molecular biology: Alpha Science International, United Kingdom.
10. Schillberg, S., S. Zimmermann, M. Y. Zhang and R. Fisher. 2001. Antibody-based resistance to plant pathogens. Transgenic research.10:1-12.
11. Singh, R. S., U. S. Singh, W. M. Hess and D. J. Weber. 1988. Experimental and conceptual plant pathology. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
12. Stuiver, M. H. and J. H. H. V.Custers. 2001. Engineering disease resistance in plants. Nature 411: 865-868.
13. Tepfer, M. 2002. Risk assessment of Virus-resistant transgenic plants. Annual Review of Phytopathology 40: 467-491.

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SEMESTER IV

DSE (Discipline Specific Elective)

MBT 544.2 E-II: PLANT PROTECTION IV

(MOLECULAR PLANT PATHOLOGY AND PLANT BREEDING)

Course objectives: Students should be able to:

1. To study plant pathology and application of molecular biology.
2. Understand disease resistance mechanism in plants
3. Study of genetics of plant pathogen interactions.
4. Discuss the role of conventional and adavanced breeding techniques in plant protection.

Credits=2	**MBT 544 E-II: PLANT PROTECTION IV (Molecular Plant Pathology and Plant Breeding)**	**No. of hours: 30**
UNIT I	**Plant pathology and Molecular Biology**	**07**
	1.1 The Fundamentals of plant Pathology: The concept of plant diseases; The causal agent's fungi, protozoa, bacteria, phytoplasmas and spiroplasmas, viruses and other agents; Molecular biology in plant pathology. **1.2 Application of Molecular Biology in Disease Control:** Breeding for resistance: The basis of resistance breeding programme, the conventional and non-conventional breeding strategy; Marker assisted breeding; the identification of novel resistance genespecificities.	
UNIT II	**Resistance genes, genetics of plant pathogen interactions, and genetics of fungi**	**08**
	2.1 Resistance gene: Gene- for gene resistance, Features of cloned resistance genes, R gene specificity, Genetic organization of resistance genes, Co-evolution of resistance genes; Resistance genes in BT crops. **2.2 Genetics of Plant Pathogen Interactions:** Genetics of host Parasiticinteractions, Physiological specialization in fungi, Production of New races, Adaptations of fungi different Hosts, Resistance and Susceptibility.	

UNIT III	**Molecular diagnostics and application to conventional disease control**	**08**
	3.3 Classical approaches; Use of Antibodies-Polyclonal antibodies, Monoclonal antibodies, Serological Tests-ELISA, Recombinant DNA techniques; Nucleic acid based techniques- Identification of pathogen specific markers, PCR based technique, Gene-array based techniques, Quantitative PCR; and Phylogenetic analysis. **3.4 Transgenic approaches for crop protection:** Pathogen derived resistance - Coat –protein mediated resistance, Replicate mediated resistance; Plantibodies; Expressing defense genes under the control of inducible promoters; Use of clonal resistance genes and Expression of vaccines in plants.	
UNIT IV	**Plant Breeding**	**07**
	4.1 Plant breeding: Concept, scope in disease resistance and importance with reference to example. **4.2 Mutation Breeding:** Concept; mutagenesis for disease and pest resistance. **4.3 Marker Assisted Selection:** Concept; scope in relation to disease resistance. Marker assisted breeding.	

Course Outcomes: The Students will be able to:

1. Validate the pathogen through molecular approach.
2. Recognize the resistance mechanism in plants.
3. Estimates an account of mycorrhizal fungi in general and agriculture, horticulture and forestry.
4. Learn the concept and role of plant breeding in disease resistance.

References:

1. . Dickinson M. 2008. Molecular Plant Pathology. Second edition. BIOS Scientific Publishers, London and NewYork
2. Agrios, George N. 2005. Plant Pathology, 5th Edn.Academic press, San Diego.
3. Luberstedt Thomas. 2013. Diagnostics in Plant Breeding, first edition: Springer, Netherlands.
4. Langridge P and K. Chalmers. 2005. Molecular marker systems in Plant Breeding and Crop Improvement, first edition: Springer, Berlin.
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6. Punja, Z. K. 2001. Genetic engineering of plants to enhance resistance to fungal pathogens-a review of progress and future prospects. Canadian Journal of plant pathology 23: 216-235.
7. Roberts D. A. and Bothroyd C. W. 2001. Fundamental Plant Pathology. W. H. Freeman & Co, London.
8. Rommens, C. M. and G. M. Kishore. 2000. Exploiting the full potential of disease resistance genes for agricultural use. Current Opinions in Biotechnology 11:120-125.
9. Sambamurty, A. V. S. S. 2008. Molecular biology: Alpha Science International, United Kingdom.
10. Schillberg, S., S. Zimmermann, M. Y. Zhang and R. Fisher. 2001. Antibody-based resistance to plant pathogens. Transgenic research.10:1-12.
11. Singh, R. S., U. S. Singh, W. M. Hess and D. J. Weber. 1988. Experimental and conceptual plant pathology. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
12. Stuiver, M. H. and J. H. H. V.Custers. 2001. Engineering disease resistance in plants. Nature 411: 865-868.
13. Tepfer, M. 2002. Risk assessment of Virus-resistant transgenic plants. Annual Review of Phytopathology 40: 467-491.

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MPP 545: On Job Training (OJT) (4 Credits)

OJT will provide the opportunities for internship with local/regional industries, business organization, health and allied areas, local government, etc. so that students may actively engaged with the employability opportunities. Students will undergo 4 credit work based learning/OJT/internship.

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Semester IV

MBP 546: LAB IV (Practicals based on MBT 541, 542 & 543.1)

Credit=02	LAB-IV (Based on MBT 541, 542 & 543.1)	Total hrs.(60)
	1. Determination of chlorophyll a/b ratio of C3 and C4 plants. 2. Determination of lipid peroxidation in plants under stress. 3. Estimation of proline from stressed and non-stressed plants. 4. Determination of sulphate from crop plants. 5. Study of enzyme lipase. 6. Study of enzyme nitrate reductase. 7. Extraction of proteins plant tissue and their quantitative (Lowry/Bradford's method) and qualitative (SDS-PAGE) analysis. 8. Geographical location of hotspots and hottest hot-spots of the world 9. Endemic plants of Western Ghats (minimum 10 plant species) 10. RED list categories of IUCN and local examples for each category Wild plants of Ornamental potential (minimum 10 plant species) 11. Wild relatives of cultivated plants (*Abelmoschus, Cucumis, Vigna, Oryza* etc.) 12. Underexploited medicinal plants (minimum 10 plant species) 13. Use of GIS and GPS in biodiversity assessment 14. Awareness programme/ Plantation/ NGO Visit10. Nucleotide sequence and blasting. 15. Extraction and isolation of secondary metabolites (TPC and TFC) from natural sources. 16. Extraction of phytochemicals from natural resources and screening for antimicrobial compounds from them. 17. Study of antioxidants properties of any one plant species by phosphormolybdenum assay (From leaves or Fruits) 18. Awareness programme for villagers with special focus on RET and endemic plants. 19. Qualitative analysis of gum, resin, dye, fibre yielding plants. 20. Assessment of Biodiversity of local area (Kaas, Ajinkytara fort, Mahabaleswar) by suitable sampling methods (line transect and belt transect) for determination of frequency, species abundance and species area curve.	

Semester IV

MBP 546: LAB III (practicals based on MBT 541, 542 & 544.2) per week)

Credit=02	LAB-IV (based on MBT 541, 542 & 544.2)	Total hrs.(60)
	1. Determination of chlorophyll a/b ratio of C3 and C4 plants. 2. Determination of lipid peroxidation in plants under stress. 3. Estimation of proline from stressed and non-stressed plants. 4. Determination of sulphate from crop plants. 5. Study of enzyme lipase. 6. Study of enzyme nitrate reductase. 7. Extraction of proteins plant tissue and their quantitative (Lowry/Bradford's method) and qualitative (SDS-PAGE) analysis. 8. Geographical location of hotspots and hottest hot-spots of the world 9. Endemic plants of Western Ghats (minimum 10 plant species) 10. RED list categories of IUCN and local examples for each category 11. Wild relatives of cultivated plants (*Abelmoschus, Cucumis, Vigna, Oryza* etc.) 12. Underexploited medicinal plants (minimum 10 plant species). 13. Study of soil mycoflora of field crops. 14. To study viability of weed seeds and germination rate. 15. Study of fungal diseases of weeds 1) Powdery mildew *Parthenium* 2) *Cercospora* on *Eicchornia* 3) Rust of *Euphorbia* 4) Tar Spot disease *Cynadon* 5) Powdery mildew on *Xanthium*. 16. Screening of disease resistance crop plants with conventional method. 17. Isolation and identification of fungal pathogen from leaves stem and fruits. 18. Production of pathogen free plants through meristem culture. 19. Isolation and identification of arbuscular mycorrhizal fungi. 20. Root clearing and staining technique to study arbuscular mycorrhizal fungi.	