Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

(An Autonomous College)

Syllabus under Autonomy

For

M. Sc. II (Botany)

Academic Year 2022 – 2023

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

(An Autonomous College)

Syllabus for Masters' Degree in Science (M. Sc.) Part – II

1. **TITLE: Botany**

2. YEAR OF IMPLEMENTATION: 2022-23

3. PREAMBLE:

The M. Sc. Botany course under autonomy will be effective from the academic year 2022 – 2023. 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 role in 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.

4. **GENERAL OBJECTIVES OF THE COURSE:**

- To impart the knowledge of plant science is the basic objective of the course.
- To develop scientific attitude among the students and to make the students open minded, critical and curious so that they enter research field with a positive approach.
- To develop skill in practical work, experiments and laboratory materials.
- To make the students understand scientific terms, concepts, facts, phenomenon and their relationships.
- To make the students aware of natural resource and environment.

- To enable the students to acquire knowledge of plants and related subjects so as to understand nature and environment in the benefit of human beings.
- To develop ability for the application of acquired knowledge to improve agriculture and related fields to make the country self-reliant.

5**. DURATION: 01 year**

6. PATTERN: Semester

7. MEDIUM OF INSTRUCTION: English

8. STRUCTURE OF COURSE:

1) THIRD SEMESTER (NO. OF PAPERS – 04)

Code No.	Title of Paper	Credit
MBT 301	Cytogenetics and Plant Improvement	**04**
MBT 302	Biotechnology and Genetic Engineering	**04**
MBT 303	Plant Diversity I (Elective)	**04**
MBT 304	Plant Diversity II (Elective)	**04**
MBT 305	Plant Protection I (Elective)	**04**
MBT 306	Plant Protection II (Elective)	**04**
MBP 307	Practical Paper V	**04**
MBP 308	Practical Paper VI	**04**

2) FOURTH SEMESTER (NO. OF PAPERS – 04)

Code No.	Title of Paper	Credit
MBT 401	Plant Physiology and Metabolism	**04**
MBT 402	Biodiversity, Conservation and Utilization	**04**
MBT 403	Plant Diversity III (Elective)	**04**
MBT 404	Plant Diversity IV (Elective)	**04**
MBT 405	Plant Protection III (Elective)	**04**
MBT 406	Plant Protection IV (Elective)	**04**
MBP 407	Practical Paper VII	**02**
MBP 408	Practical Paper VIII	
	PROJECT	**02**

2) **Structure and titles of papers of M. Sc. II Course**

M. Sc. II Semester III

MBT 301: Cytogenetics and Crop Improvement

MBT 302: Biotechnology and Genetic Engineering

MBT 303: Plant Diversity I: Introductory Biodiversity

MBT 304: Plant Protection I: Crop Diseases and their Management

MBT 305: Plant Diversity II: Conservation of Biodiversity

MBT 306: Plant Protection II: Animate Pests of Crops and their Management

MBP 307: Practical based on MBT 301 and 302

MBP 308: Practical based on MBT 303 and 304/ MBT 305 and 306

M. Sc. II Semester IV

MBT 401	Plant Physiology and Metabolism
MBT 402	Biodiversity, Conservation and Utilization
MBT 403	Plant Diversity III: Biodiversity and Sustainable Development
MBT 404	Plant Diversity IV: Assessment of Biodiversity
MBT 405	Plant Protection III: Recent Trends and Techniques in Plant Protection
MBT 406	Plant Protection IV: Molecular Plant Pathology
MBP 407	Practical based on MBT 401 and 402
MBP 408	Practical based on MBT 403 and 404/ MBT 405 and 406

3) **OTHER FEATURES:**

A) LIBRARY:

Reference books, Textbooks, Journal, Periodicals available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

B) SPECIFIC EQUIPMENTS:

a) Computer, LCD projector, visualizer, smart board, Softwares

b) Laboratory Equipment's:

1. Microscope with digital camera
2. Stereo zoom microscope
3. Phase contrast microscope
4. Trinocular research microscope
5. Digital weighing balance
6. pH meter
7. Microtome
8. Autoclave
9. Hot Air Oven
10. Microwave oven
11. Rota evaporator
12. Rotary shaker
13. Water bath
14. Incubator

15. Refrigerator
16. -20^{O}C deep fridge
17. Refrigerated Centrifuge
18. UV-VIS Spectrophotometer
19. Sonicator
20. Thermal Cylcer (For PCR)
21. Gel electrophoresis (Horizontal and Verticle)
22. Laminar air Flow
23. Distillation unit
24. Nephlometer
25. Suction pump
26. Heating mantle
27. Conductivity meter
28. HPLC
29. Gas chromatography Atomic Absroption Spectrophotometer
30. FT-IR

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Master of Science (M. Sc.) Part – II

M.Sc. Part II
Semester III
Theory Paper – MBT -301 Cytogenetics and Plant Improvement

Course objectives: Students will be able to

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

Credits=4	**SEMESTER-III** **MBT - 301: Cytogenetics and Plant Improvement**	**No. of hours per unit/ credits**
Credit –I **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 1.4 Nucleolus and ribosomal RNA genes 1.5 Karyotype analysis and banding patterns	
Credit –1 **UNIT II**	**Population and Evolutionary Genetics**	**(15)**
	2.1 Genetic variation in natural population (Natural selection, Migration, Mutation, Genetic Drift) 2.2 Theory of allele frequencies 2.3 Hardy Weinberg law and factor affecting gene and gene frequencies 2.4 Mobile genetic elements and their significance	

	2.5 Gene families	
Credit –1 UNIT III	**Crop genetic resources**	**(15)**
	3.1 Centres 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 Global network for genetic conservation and utilization in major crops of world 3.5 Institutes engaged in conservation and improvement of crop genetic resources 3.6 Wild relatives of crop plants, Gene banks, Gene sanctuaries	
Credit –1 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: Student should able to

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

References:

1. Bahekar VS. *Problems in Genetics.* Aurangabad: Vol. I AratiPrakashan, 1993. (UNIT-II)
2. Chahal GS and Gosal SS. *Principles and Procedures of Plant Breeding biotechnological and conventional approaches.* New Delhi: Narosa Publishers, 2003. (UNIT-III)
3. Chopra VL. *Plant Breeding*. New Delhi: oxford and IBH Publishing Co. Pvt. Ltd., 1989. (UNIT-III)
4. Gardner EJ. *Principles of Genetics*. New York: John Wiley and sons, 1991. (UNIT-I)

5. Jahier J. *Techniques of plant Cytogenetics*. Oxford and IBH Publishing, 1996. (UNIT-I)
6. Lewin B. *Genes IX*. Oxford University Press, 2008. (UNIT-II)
7. Mayo O. *The theory of Plant Breeding*. Clarendon Press, Oxford. 1980. (UNIT-III)
8. Mitra S. *Genetics a blueprint of life*. New Delhi: Tata McGraw- Hill Publishing Company Ltd, 1994 .(UNIT-I)
9. Poehlman JM. *Breeding Field Crops*. NEW YORK: AVI Publishing Company Connecticut. 1986. (UNIT-III)
10. Roy Darbeshwar. *Plant breeding analysis and exploitation of variance*. New Delhi: Narosa Publishers, 2000. (UNIT-IV)
11. Sharma AK and Sharma A. *Chromosome techniques- Theory and practice*. London: Butterworth and Co. (Publishers) Ltd., 1980. (UNIT-I)
12. Sharma JR. *Principles and practice of plant breeding*. New Delhi: Tata McGrow Hill Publ. Co. Ltd., 1994.
13. Sharma JR. *Statistical and Biometrical techniques in Plant Breeding*. New Delhi: New Age International Publishers, 1998.
14. Singh BD. *Plant breeding- Principles and methods*. Ludhiana: Kalyani Publishers, 2000. (UNIT-III; UNIT-IV)
15. Snustad DP and Simmons MJ. *Principles of Genetics, (Third edition).* John Wiley and Sons Inc. 2003. (UNIT-II)
16. Strickberger MW. *Genetics*. New York: The Macmillan Company, 1968. (UNIT-II)
17. Swaminathan MS, Gupta PK and Sinha U. *Cytogenetics of crop plants*. Delhi: Macmillan India Ltd., 1983. (UNIT-II)
18. Swanson CP. *Cytology and Cytogenetics*. London: Macmillan and Co. Ltd., 1968. (UNIT-I)
19. Winkler U, Ruger W and Wackernagel W. *Bacterial, phage and molecular genetics*. New Delhi: Narosa Publication, 1979. (UNIT-II)

Journals:

- Indian Journal of Genetics and Plant Breeding.
- Journal of Genetics.
- Journal of Cytology and Genetics.
- Cytologia. Caryologia.
- International Journal of Food Science and Technology.
- Plant Breeding.

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Master of Science (M. Sc.) Part – II: Sem-III

Theory Paper - MBT 302 Biotechnologies and Genetic Engineering

Course objectives: Students will be able to

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

Credits=4	**SEMESTER-III** **MBT 302: Biotechnology and Genetic Engineering**	**No. of hours per unit/ credits**
Credit –I **Unit-I:**	**Plant Tissue Culture** 1.1 Concept, Scope and importance of Biotechnology 1.2 Plant cell and tissue culture laboratory requirements 1.3 Tools and techniques for plant tissue culture 1.4 Culture media, their constituents and types of cultures 1.5 Applications of plant tissue culture 1.6 Somaclonal variation and its significance 1.7 Protoplast culture and somatic hybridization	**(15)**
Credit –1 **UNIT II**	**Recombinant DNA technology** 2.1 Concept, principles, applications and consequences of recombinant DNA technology. Case study.	**(15)**

	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	
Credit –1 **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)	
Credit –1 **UNIT IV**	**Genomics**	**(15)**
	4.1Genomics:*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 should able to

1) Understand the use of biotechnology in botany.
2) Understand the various branches of biotechnology in plant science.
3) Understand the recent molecular technology in study of plants.
4) Understand application of genes, proteins and secondary metabolites in plant science.

References:

1. Baxevanis Andreas, Ouellette Francis BF and Cuellette BF. *Bioinformatics: A Practical Guide to the analysis of Genes and Proteins*. New York: Wiley Publishers, 1998. (UNIT-IV)
2. Boyce COL. *Novo's Handbook of Practical Biotechnology*. Novo Industry, 1986.
3. Chawla HS. *Biotechnology in Crop Improvement*. Lucknow: International Book Distributing Company, 1998. (UNIT-1)
4. Claverie J and Notredame C. *Bioinformatics for Dummies*. John Wiley and Sons, 2011. (UNIT-IV)
5. Dodds JH and Roberts LW. *Experiments in plant tissue culture*. Cambridge: Cambridge University Press, 1985. (UNIT-I)
6. Durbin R, Sean R, Eddy, Anders Krogh and Graeme M. *Biological Analysis- Probabilistic Models of Proteins and Nucleic Acids.* Cambridge University Press. 1999. (UNIT-IV)
7. Gamborg OL and Phillips GC. *Plant Cell, Tissue and Organ Culture- Fundamental Methods.* New Delhi: Narosa Publ. House, 1995. (UNIT-I)
8. Glick BR and Pasternak JJ. *Molecular Biotechnology- Principles and Applications of Recombinant DNA*. Washington D. C.: ASM Press, 1994. (UNIT-II)
9. Gupta PK. *Biotechnology and Genomics*. Meerut: Rastogi Publications, 2009. (UNIT-II)
10. Gupta PK. *Plant Biotechnology*. Meerut: Rastogi Publications, 2010. (UNIT-I)
11. Jagota A. *Data Analysis and Classification for Bioinformatics*. University of Michigan, USA: Bay Press, 2000. (UNIT-IV)
12. Kumar HD. *Molecular Biology and Biotechnology*. New Delhi: Vikas Publ., 1993.

(UNIT-III)

13. Mount DW. *Bioinformatics Sequence and Genome Analysis*. New York: Cold Spring Harbour Laboratory, 2001. (UNIT-IV)
14. Ramawat KG. *Plant Biotechnology*. New Delhi: S. Chand and Company Ltd., 2006. (UNIT-II)
15. Razdan MK. *An Introduction to plant tissue culture*. New Delhi: Oxford & IBH Publ. Ltd., 1994. (UNIT-I)
16. Reinhert J and Bajaj YPS. *Applied and fundamental aspects of plant cell, tissue and organ culture*. Berlin: Springer Verlag, 1977. (UNIT-III)
17. Trehan K. *Biotechnology*. New Delhi: Wiley Eastern Limited, 1994. (UNIT-I)
18. Trivedi PC. *Plant Biotechnology- Recent Advances*. New Delhi: Panima Publishing Corporation, 2000. (UNIT-II)

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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Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – II

Semester - III

MBT 303: PLANT DIVERSITY I (INTRODUCTORY BIODIVERSITY)

Total Lectures: 60

Course Objectives: Students will 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.

Credits - 04	**MBT 303: PLANT DIVERSITY II (CONSERVATION OF BIODIVERSITY)**	**No. of hours per unit/ credits**
Credit -1 UNIT I	**Levels of Biodiversity** 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 and Angiosperms) 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	**15**

Credit -1 **UNIT II**	**Characterization of Biodiversity** 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).	**15**
Credit -1 **UNIT III**	**Present status of Biodiversity** 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) **1.3** 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.	**15**
Credit -1 **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 present status.	**15**

Learning Outcomes: Students should be able to

1. Understand concept of plant diversity and its magnitude

.2. Understand biodiversity crises and solutions.

3. Understand status of plant diversity and conservation.

4. Understand the plant diversity status in India.

REFRENCES:

1. Belsare D. K. 2007 Introduction to Biodiversity; APH Publishing (UNIT-I,)

2. Bharucha Erach 2005.Textbook of Environmental Studies; Universities Press (UNIT-IV)

3. Dash M. C. 2001 Fundamental of Ecology; Tata McGraw-Hill Education (UNIT-III)

4. Galston, K. J. (1996): Biodiversity: A biology of numbers and differences. Kluwer Academic Publishers, Dordrecht, the Netherlands.(UNIT-I)

5. Heywood V. H. and Watson R. T. (Edt) 1995 Global Biodiversity Assessment; University Press (UNIT-II)

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Master of Science (M. Sc.) Part – II: Sem-III

MBT 304: PLANT DIVERSITY II (CONSERVATION OF BIODIVERSITY)

Total Lectures: 60

Learning Objectives: Student will able to

1. Study of different aspects biodiversity conservation.
2. Understand the basics and significance of environmental accounting and impact assessment.
3. Understand the national legislations implemented for biodiversity conservation.
4. Understand the various organizations involved in biodiversity conservation.

Credits - 04	**MBT 304: PLANT DIVERSITY II (CONSERVATION OF BIODIVERSITY)**	**No. of credits**	**No. of hours per unit/ credits**
Credit - 1UNIT I	**1. Environmental Accounting and EIA**	**01**	**15**
	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, Carbon sequestration.		
Credit -1 UNIT II	**2. Conservation of Biodiversity**	**01**	**15**
	2.1 Conservation of national 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, and biosphere reserves, Sacred Groves, conservation of habitats, restoration of degraded habitats.		
Credit -1 **UNIT III**	**3.National and International efforts for Biodiversity Conservation** **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 International Conventions:** Ramsar convention on wetland (1971); Paris convention on natural heritage (1972); Washington convention on trade of flora and fauna (1973); UNCED (1992); Earth summit, Montreal (2005); Earth summit, Copenhagen (2009), COP21 Paris 2015.	**01**	**15**
Credit-1 **UNIT IV**	**4. Role of government and Non-Government Organizations** **4.1 Role of Government and Non-Government Organizations (NGOs) in conservation of Biodiversity:** Concept, working and evaluation of NGOs viz. IUCN, UNCED, BNHS,BSI local NGOs involved in biodiversity conservation (few case studies) **4.2 Role of Green organizations** viz. TERI, CES, MOEF, ATREE, FRLHT (few case studies); **4.3 Role of taxonomy and taxonomists in conservation of biodiversity**(case studies from India and abroad).	**01**	**15**

Learning Outcomes: Student should able to

1) Understand opportunities in environmental auditing and impact assessment.

2) Understand and implement the usage of various approaches adapted for biodiversity conservation.

3) Understand various agencies working in the field of biodiversity conservation.

4) Understand the concept of carbon trading and relate the effects of biodiversity on global economy

REFERENCES:

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

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Master of Science (M. Sc.) Part – II: Sem-III

MBT 305: PLANT PROTECTION I (CROP DISEASES AND THEIR MANAGEMENT)

Total Lectures: 60

Learning Objectives: The student will able to

1. Understand the knowledge of different aspects of crop diseases.
2. Study the knowledge of crop disease management.
3. Understand the knowledge of crop disease management.
4. Study about enzyme and toxins in plants.

Credits - 04	**MBT 305: PLANT PROTECTION I (CROP DISEASES AND THEIR MANAGEMENT)**	**No. of hours per unit/ credits**
Credit -1	**1. Major Crop Diseases**	**15**
UNIT I	**1.1 Introduction:** History of Plant Pathology and Overview, Crop diseases and losses caused by them. [2] **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**.**	

Credit -1 **UNIT II**	**2. Plant diseases based on Causal organism** **2.1 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.	**15**
Credit -1 **UNIT III**	**3.Post-Harvest Market Diseases** **3.1 Post harvest market diseases:** Introduction, General symptoms, causes and management, Study of post-harvest diseases with respect to causal organism, damage, and management of important locally available fruit and vegetable crop. [8] **3.2 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.	**15**

Credit-1 **UNIT IV**	**4. Pathophysiology**	**15**
	4.1 Enzymes and toxins in plant diseases: Chemical weapons of pathogenesis. **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. **Toxins: -**Introduction-Toxins and plant diseases **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.	

Learning Outcomes: Student should 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 (Unit I)
2. **Aneja**, **K. R** (2005). Experiments in Microbiology and Plant Pathology and biotechnology. New Age Intenational (P) Ltd. Publishers, New Delhi. (Unit I)
3. **Baruah H. K**., P Brain and A. Baruah, (1984). Textbook of plant pathology. Oxford and IBH Publ. Co., New Delhi. (Unit I)
4. **Bilgrami K. S**. and **Dube H. C**. (1990).Text book of Modern pathology. Vikas Publishing House Pvt. Ltd. New Delhi. (Unit II)
5. **Chandrashekharan**S. N. and S. V. Parthsarthy (1965). Cytogenetics and Plant Breeding. P. Varadachary and Co. Madras. (Unit IV)
6. **Chatterjee P. B**. (1997). Plant Protection Techniques. BhartiBhawan. Patana.(Unit IV)
7. **Chattopadhya**, **S. P.** (1987) Principles and Procedures of Plant Protection. Oxford and IBH, New Delhi. (Unit II)
8. **Diskson J. C**. (1964) Diseases of Field crop. McGraw –Hill , New Delhi. (Unit IV)
9. **Gerhardson**, **B** (2002). Biological substitutes for pesticides. *Trends in biotechnology* **20:**338-343. ICAE, Publication.:Crop Diseases Calender (Unit I,II,III,IV)
10. **Jones D. G**. (1987) Plant pathology – Principles and practices.OprenUniversityPress, Stratford. (Unit I,II)
11. **Mehrotra**R. S. and Ashok Aggarwal (2005) Plant Pathology. Tata McGrew-Hill publishing Co.Ltd. New Delhi. (Unit I,II,III)
12. **Mehrotra,** R. S. (1980). Plant pathology. Tata McGrew-Hill publishing Co. Ltd. New Delhi. (Unit I,II,III)
13. **Nagarajan**S. (1999) Plant Diseases and Epidemiology. Oxford and IBH, New Delhi. (Unit I)
14. **Nagarajan, S.** and K. Mualidharan (1995) Dynamics of Plant Diseases.Allied Publishers, New Delhi. (Unit III)

15. **Pathak**V. N. (1980) Diseases of Fruit crops. Oxford and IBH, New Delhi. (Unit I)

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. (Unit I)

17. **Ramakrishnan**T. S. (1974) Diseases of Millets. ICAR, New Delhi. (Unit I)

18. **Rangaswami**, G. (1975) Diseases of crop plants in India. Prentice-Hall Pub, New Delhi. (Unit I)

19. **Roberts** D. A. and Bothroyd C. W. (1995) Fundamental Plant Pathology. Freeman & Co (Unit I,II)

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Yashavantrao Chavan Institute of Science, Satara (Autonomous)

Syllabus introduced from June 2022

Master of Science (M. Sc.) Part – II: Sem-III

MBT 306: PLANT PROTECTION II (ANIMATE PESTS OF CROPS AND THEIRMANAGEMENT)

Total Lectures: 60

Learning Objectives: Student should able to

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

Credits - 04	**MBT 306: PLANT PROTECTION II (ANIMATE PESTS OF CROPS AND THEIRMANAGEMENT)**	**No. of hours per unit/ credits**
Credit -1 UNIT I	**1. Types of pests on crops** **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.	**15**

Credit -1 **UNIT II**	**2. Insect Pests of Crop Plants**	**15**
	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	
Credit -1 **UNIT III**	**3.Insect Pests on cash crops and stored grains**	**15**
	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.	
Credit-1 **UNIT IV**	**4. Pest Management**	**15**
	4.1 Pest management: Overview of methods of pest management viz. Mechanical, Physical, Chemical and Cultural Methods of pest control. **4.2 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. **4.3 Biological Control of Pests:-** Concept, Some successful examples of biological control, Agents of biological control; Mass culture and release of	

	parasitoids and predators. **4.4 Semi- chemicals Control of Pests:** Introduction, Concept of Pheromones and Allelo chemicals concept and uses of these to control of pests. **4.5 Control of Pests by Hormonal Imbalance:** Control of Pest by insect growth regulators ecdysoids, juvenoids, anti-hormones, chitin inhibitors, miscellaneous insect growth regulators.	

Learning Outcomes: Student should 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 (Unit I,II,III,IV)
2. **Atwal, A. S**. (1936) Agriculural Pest of India and South East Asia.Kalyani Publishers, New Delhi (Unit I,II,III,IV)
3. **Chatterjee**, **P. B**. (1997) Plant protection techniques. BharatiBhawan Publishers and Distributors Patna. (Unit IV)
4. **Chattopadhya**, **S. P.** (1987) Principles and Procedures of Plant Protection. Oxford and IBH,New Delhi. (Unit IV)
5. **Dhaliwal**, **G. S**. and **Arora Ramesh** (1994) Trends in Agricultural Pest Management. Commonwealth Publishers, New Delhi. (Unit I,II,III,IV)
6. **Gerhardson**, **B** (2002). Biological substitutes for pesticides. *Trends in biotechnology* **20:**338- 343. ICAE, Publication.:Crop Diseases Calender (Unit IV)
7. **Jha, L. K.** (1987) Applied Agricultural Entomology. New Central Book Agency, Culcutta. (Unit II)
8. **Metcalf,** C. L. and Flint, W. P. (19830) Destructive and Useful Insects. Tata McGrew-Hill publishing Co. Ltd. New Delhi. (Unit II,III)
9. **Pedigo**, L. P. (1996) Entomology and pest Management. Prentice-Hall Pub. Englewood clifts NJ (Unit IV).
10. **Shrivastava**, V. P. (1988). A Textbook of Applied Entomology. KalyaniPubl. New Delhi (Unit I,II,III), Journal of Entomological Society of India. (Unit I,II,III,IV).

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Master of Science (M. Sc.) Part – II: Sem-III

MBP 307
PRACTICAL COURSE – V

Course Objectives: Student will be able to:-

1) Study different aspects of cytogenetics and plant breeding.
2) Study the methods in genome mapping and plant breeding.
3) Study the population and evolutionary genetics.
4) Study the methods in biotechnology and genetic engineering.

Credits=4	**SEMESTER-III** **MBP 307: PRACTICAL COURSE – V**	**No. of hours per unit/ Credits (60)**
	Cytogenetics	
	1-2. Karyotype analysis in any two plants. 3. Orcein banding 4. Meiotic studies in *Allium cepa* 5. Study of meiotic abnormalities in *Rhoeo* sp. 6. Study of floral biology of crop plants (any two) 7. Genetic problems on gene mapping in higher plants. 8. Determination of allele frequency in population. 9. Centres of origin of crop plants. 10. Field visit (NRC/NBPGR centre/seed company)	
	Biotechnology	
	1. Preparation of MS medium for Plant tissue culture 2. Callus culture 3. Micro propagation	

	4. Isolation of genomic DNA 5. Agarose gel electrophoresis 6. Polymerase chain reaction (PCR) 7-8. SDS-PAGE 9. Amino acid sequence and blasting 10. Nucleotide sequence and blasting	

Course Outcome: Student should be able to:-

1) Understand the various branches of biotechnology in plant science.
2) Know the recent molecular technology in study of plants.
3) Understand phylogenetic relationships in plants.
4) Understand the various breeding techniques.

REFERENCES:

1. **Boyce COL.** *Novo's Handbook of Practical Biotechnology*. Novo Industry, 1986.
2. **Razdan MK.** *An Introduction to plant tissue culture*. New Delhi: Oxford & IBH Publ. Ltd., 1994.
3. **Claverie J and Notredame C.** *Bioinformatics for Dummies.* John Wiley and Sons, 2011.
4. **Dodds JH and Roberts LW.** *Experiments in plant tissue culture*. Cambridge: Cambridge University Press, 1985.
5. **Jahier J.** *Techniques of plant Cytogenetics*. Oxford and IBH Publishing. 1996
6. **Sharma JR.** *Statistical and Biometrical techniques in Plant Breeding*. New Delhi: New Age International Publishers, 1998.

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Master of Science (M.Sc.) Part–II:

PLANT DIVERSITY

Semester III

MBP 308: Practical's based on Theory Paper MBT 303 and 304

Learning Objectives: Student should able to

1. Understand the practical knowledge of plant diversity.
2. Study practical knowledge of characterization of plant diversity.
3. Understand the practical knowledge of methods in Biodiversity conservation.
4. Understand the knowledge of present status of plant diversity with reference to crises.

SECTION–II (based on Paper MBT304)

2. Use of data base in study in biodiversity
3. Techniques of herbarium and museum specimen preparation.
4. Study of critically endangered plant species from Western Ghats.
5. Study of vulnerable plant species.
6. Study of monotypic endemic genera of Western Ghats.
7. Green audit of college campus.
8. Carbon sequestration of any industrial or transport zone.

Learning Outcomes:

1. Student will learn about plant diversity and its magnitude.
2. The student will earn to relate biodiversity crises and solutions.
3. The students will be able to understand the concept of environmental auditing.
4. The students will be aware of various agencies work in the field of

biodiversity conservation.

REFERENCES:

1. Arora V.2002. The Biological Diversity Act; Natraj Publishers, Dehradun
2. Pramanik A. K. 2002. Environmental Accounting and Reporting Deep and Deep Publications
3. Belsare D. K.2007. Introduction to Biodiversity; APH Publishing
4. Bharucha Erach 2005.Text book of Environmental Studies;Universities Press
5. Heywood V, H.and Watson R.T. (Edt) 1995. Global Biodiversity Assessment; University Press
6. Rao ,R. R. 1994.Biodiversity of India (Floristic Aspects). Bishen Singh Mahendra Pal Singh, Dehra- Dun.

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Semester - IV

Master of Science (M. Sc.) Part – II:

MBT - 401 Plant Physiologyand Metabolism

Total Lectures: 60

Theory Paper MBT 401 Plant Physiology and Metabolism

Learning Objectives: Student will able to

1. Understand the basics of plant physiology.
2. Understand the metabolic processes essential in plants.
3. Understand the implementation of knowledge in plant physiology in the field of research.
4. Study the applications of plant physiology in sustaining agriculture and natural plant diversity.

Credit -4	**MBT 401: PLANT PHYSIOLOGY AND METABOLISM**	**No. of hours per unit/ credits**
Credit -1	**1. Plant water relation and solute transport**	**15**
UNIT I	**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; Phloem loading and unloading (with special reference to P proteins) **1.6** Membrane transporter proteins	

Credit -1 **UNIT II**	**2. Photosynthesis and respiration** **2.1Photosynthesis**: Photosynthetic apparatus, Photosynthetic pigments and light harvesting complexes, Photo-oxidation of water, Mechanism of electron and proton transport, RUBISCO, Calvin cycle, Photorespiration, CAM and C4 pathway and its types. **2.2Respiration**: EMP pathway, Pentose Phosphate pathway (PPP), Anaerobic respiration, TCA cycle, ETC, Inhibitors of respiration, Gluconeogenesis.	**15**
Credit -1 **UNIT III**	**3. Metabolism and Physiology of flowering** **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:**Nitrogen uptake, Nitrate and ammonium assimilation, Synthesis of amino acids with special reference to methionine, proline and tryptophan; root nodulation (NOD factors) and nitrogen fixation **3.4 Physiology of flowering:**Photoperiodism and its significance, floral induction and development- genetic and molecular analysis, Vernalization	**15**
Credit -1 **UNIT IV**	**4. Phytohormones and stress physiology** **4.1** Concept of hormones as chemical messengers; Biosynthesis and mechanism of action of auxins; Recent updates in phytohormones synthesis and regulation **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	**15**

Learning Outcomes: Student should able to

1) Apply the knowledge of the basics of plant physiology.

2) Understand the various branches of plant physiology.

3) Understand the recent trends in plant physiology.

4) Understand the application of plant metabolism regulators in agriculture and allied fields.

REFERENCES:

1. Bidwell R. C. S. *Plant Physiology*. Germany: Macmillan. 1979.
2. Bonner J., Varner J.E. *Plant Biochemistry*; Mumbai: IBH. 1972.
3. Buchnan B.B., Gruissem W., Jones R.L. *Biochemistry and Molecular Biology of Plants*. New York: Wiley-Blackwell. 2000
4. Edwards G. Walker D., *C3, C4: mechanisms, and cellular and environmental regulation of photosynthesis*. Oxford: Blackwell Scientific Publications. 1983.
5. Govindjee, H. (ed.) *Photosynthesis, Vol. 1 and Vol. 2*; New York: Academic Press. 1982.
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8. Marschner H. W. *Mineral nutrition of Higher Plants, Second Edition.* Cambridge: Academic Press, Elsevier Science Ltd. 2003.
9. Mukherjee S.P., Ghosh A.N. *Plant Physiology*. New Delhi: New Central Book Agency (P) Limited Tata McGraw Hill. 1996.
10. Noggle G.R., Fritz G. J. *Introductory Plant Physiology*. New Jersey: Prentice- Hall, Inc., Englewood Cliffs. 1976.
11. Pessarakli M. (Ed.). *Handbook of Plant and Crop Physiology, 2nd Edition*. New York: Marcel Dekker, Inc. 2001.
12. Pessarakli M. (Ed.). *Handbook of Photosynthesis, 2nd Edition*. Florida: CRC Press, Taylor & Francis Publishing Company, Florida. 2005.

    Sadasivam S., Manickam A. *Biochemical methods*. New Delhi: New Age International. 1996,

    13. Salisbury F. B., Ross C.W. *Plant Physiology* IV ed. Boston: Cengage Learning. 1992.

    14. Smith H. *Phytochrome and Photomorphogenesis*. USA: McGraw-Hill Inc. 1975.

15. Taiz L., Zeiger F. *The Plant Physiology*, Third Edition. Sunderland: Sinauer Associates. 2002.
16. Verma V. *Plant Physiology* 2nd Edition. UK: Athena Academic. 2016.
17. Wilkins M. B. *Physiology of Plant Growth and Development*; USA: McGraw-Hill Publishing Company Limited. 1976.

Journals

- Annual Review of Plant Physiology and Molecular Biology.
- Indian Journal of Plant Physiology.
- Journal of Experimental Botany.
- PhysiologiaPlantarum Sweden.
- Plant Physiology (Bethedsa, USA).
- Plant Cell.

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SEMESTER IV

Master of Science (M. Sc.) Part – II: Sem-IV

MBT 402 Biodiversity, Conservation and Utilization

Total Lectures: 60

Theory Paper MBT 402 Biodiversity Conservation and Utilization

Learning Objectives: Student will able to

1. Study the different aspects of biodiversity and conservation.
2. Study the methods in biodiversity conservation and utilization.
3. Understand importance of endemic plants.
4. Study the application of Geo informatics in plant sciences.

Credit -4	**MBT 402 Biodiversity, Conservation and Utilization**	**No. of hours per unit/ credits**
Credit -1 **UNIT I**	**Unit I Biological Diversity** 1.1 Definition and concept of biodiversity; 1.2 Types of diversity (alpha, beta, gamma); Magnitude ofbiodiversity; indirect and ethical values of biodiversity; Loss and reasons for loss of biodiversity; 1.3 Global Taxonomic initiatives (GTI); Systematic agenda-2020.	**15**
Credit -1 **UNIT II**	**Unit II Endemism and Geoinformatics** 2.1 Endemism: Definition and types of endemism; RED list categories of IUCN; Hot spots and Hottest hotspots; Keystone and Flagship species; Plant endemism in India with special emphasis on Western Ghats 2.2 Geo informatics: Definition and concept of Geo informatics; Geographic Positioning System (GIS); Global Positioning System (GPS); Google earth. 2.3 Ecology and Biodiversity Services (EBS)	**15**
Credit -1 **UNIT III**	**Unit III Biodiversity Conservation** 3.1 Introduction; Basic principles of conservation; In-situ conservation; Ex-situ	**15**

	conservation. 3.2 Restoration programs; World organization for conservation; Efforts by Indian government for conservation.	
Credit -1 **UNIT IV**	**Unit IV Biodiversity for sustainable development** 4.1 Wild Plants of ornamental potential; Wild relatives of cultivated plants; Wild edible plants andtheir nutritive value; 4.2 Under exploited medicinal plants; Plants of commercial importance; Energy plants and petro crops; 4.3 Plants suitable in phyto-remediation	**15**

Learning Outcomes: Student should able to

1) Understand and apply the knowledge of the basics of plant physiology.

2) Understand the various branches of plant physiology.

3) Understand the recent trends in plant physiology.

4) Understand of application of plant metabolism regulators in agriculture and alliedfields.

REFERENCES:

1. Briggs, D. 2009. Plant Microevolution and Conservation in Human-influenced Ecosystems.Cambridge University press. (UNIT-II)
2. Groom M. J., Meffe, G. K. and C. R. Caroll. 1997. Principles of Conservation biology.(3rd ed.)
3. Sinauer associates, Inc. publishers Sunderland, Massachusetts, USA. (UNIT-III)
4. Heywood, V. H. and Watson, R. T. (eds.). 1995. Global Biodiversity Assessment. UNEP, UK,Cambridge University Press. (UNIT-I)
5. Leadlay, E. and Jury, S. (eds.). 2006. Taxonomy and Plant Conservation. CambridgeUniversity Press. (UNIT-I)
6. Primack R. B. 2010. Essentials of Conservation Biology. (5th ed.). Sinauer associates, Inc.publishers Sunderland, Massachusetts, USA. (UNIT-III)
7. UNEP. 1992. Convention on Biological Diversity (CBD): Text and Annexes. Geneva,Switzerland: CBD Interim Secretariat. (UNIT-IV)
8. UNEP. 2002a. Global Taxonomy Initiative (GTI). Decision VI/8. UNEP/CBD/COP/6/20Montreal, Canada: CBD Secretariat. (UNIT-IV)

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Master of Science (M. Sc.) Part – II: Sem-IV

MBT 403: PLANT DIVERSITY III (BIODIVERSITY AND SUSTAINABLE DEVELOPMENT)

Total Lectures: 60

Learning Objectives: Student will able to

1. Study the different aspects of utilization of Biodiversity.
2. Understand the concept and significance of sustainable development.
3. Understand his/her role in sustainable development.
4. .Study the ecosystem services of Western Ghats.

Credit -04	**MBT 403: PLANT DIVERSITY III (BIODIVERSITY AND SUSTAINABLE DEVELOPMENT)**	**No. of hours per unit/ credits**
Credit -01 UNIT I	**1. Biodiversity and sustainable development**	**15**
	1.1 Concept, prospects and concerns related to biodiversity, the need and significance of biodiversity education **1.2** Specialized habitats and their importance, Rehabilitation of neglected specialized habitats like wetlands and mangroves, **1.3** The relevance of society with respect to biodiversity conservation; Community participation for sustainable development (with recent suitable examples) **1.4** Role of universities and educational institutes in biodiversity conservation	
Credit -01	**2. Local biodiversity**	**15**

UNIT II	**2.1 Local biodiversity**: Diversity of angiosperms of Satara with special reference to Mahabaleshwar, Kas, Khatav, Ajinkyatara fort and Vasota. **2.2 Domesticated biodiversity:** Domesticated biodiversity in India and its conservation, organization, working and role of NBPGR. (Role of exotic species in ecosystem degradation)	
Credit -01 **UNIT III**	**3. Bioprospecting and sustainable utilization** **3.1 Bioprospecting and biodiversity:** Concept, bioprospecting to conserve the biodiversity **3.2**Bioprospecting and indigenous traditional knowledge **3.3**Bioprospecting for sustainable development **3.4** Rio convention (1992) and recent global approaches towards bioprospecting **3.5**Bioprospecting and Biopiracy **3.6** Intellectual property rights.	**15**
Credit -01 **UNIT IV**	**4. Plant bioresources of Western Ghats** **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.	**15**

Learning outcomes: The student will able to

1) Understand the concept of sustainable development.
2) Understand the plant biodiversity resources of Western Ghats.
3) Analyze the bio prospecting potential of plant diversity in the field of their study.
4) Understand the ecosystem services provided by Western Ghats.

References:

2. Glick B. R., Pasternak, J. J. *Molecular Biotechnology- Principles and Applications of Recombinant DNA*. Washington D.C.: ASM Press. 1994.
3. Gupta P. K. *Biotechnology and Genomics*. Meerut: Rastogi Publications. 2009.
4. Gupta P. K. *Plant Biotechnology*. Meerut: Rastogi Publications. 2009.

5. Khan T. I. *Biodiversity Conservation and Sustainable Development*. Jaipur: Pointer Publisher. 1998.
6. Kochhar S. L. *Economic Botany in the Tropics*. Germany: Macmillan. 2009.
7. Kumar H. D. *Molecular Biology and Biotechnology*. New Delhi: Vikas Publications. 1993.
8. Narasaiah M. L. *Biodiversity and Sustainable Development*. New Delhi: Discovery Publishing House. 2005.
9. Panigrahy R. L., Lingaraj P. *Biodiversity Conservation and Sustainable Development*. New Delhi: Discovery Publishing House. 2008.
10. Ramawat K. G. *Plant Biotechnology*. New Delhi: S. Chand and Company Ltd. 2008.
11. Trehan K. *Biotechnology*. New Delhi: Wiley Eastern Limited. 1994.
12. Trivedi, P. C. (ed.) *Plant Biotechnology- Recent Advances*. New Delhi: Panama Publishing Corporation. 2000.
13. Verma V. *A textbook on Economic Botany*. Mumbai: Ane Books Pvt Ltd. 2000.
14. Wood D., Lenne' J. *Agrobiodiversity: Characterization, Utilization and Management*. New Delhi: CABI Pubications. 1999.

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Master of Science (M. Sc.) Part – II: Sem-III

MBT404: PLANT DIVERSITY IV (ASSESSMENT OF BIODIVERSITY)

Total Lectures: 60

Learning Objectives: The student should able to: -

1. 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

No. of credits 4	**SEMESTER-III** **MBT 404: PLANT DIVERSITYIV (ASSESSMENT OF BIODIVERSITY)**	**No. of hours per unit/ credits**
Credit 1 **UNIT I**	**Methods of Biodiversity Assessment**	**(15)**
	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. **1.2Agencies for Conservation:** Concept, role and working of DBT, DST, MOEF, SERB, RGSTC, AICRP.	
Credit 1 **UNIT II**	**Role of Biotechnology in Conservation**	**(15)**
	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 in biodiversity.	
Credit 1 **UNIT III**	**Impact of Biodiversity**	**(15)**
	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 on biodiversity.	
Credit 1 **UNIT IV**	**Biostatistics and Bio in formatics in Biodiversity**	**(15)**
	Use of Statistical Analysis and Computer Based Data Handling for Assessment of Biodiversity: 4.1 Biostatistics: **Introduction, applications, ANOVA, use of biostatistics in interpretation of biodiversity data.** **4.2 Bioinformatics:** Introduction, applications, databases (nucleic acid,protein),use of computers and bioinformatics in study of biodiversity.	

Learning Outcomes:

Students should be able to:-

1) Studt 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.
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Master of Science (M. Sc.) Part – II: Sem-IV

MBT 405: PLANT PROTECTION III (Recent Trends and Techniques in Plant Protection)

Total Lectures: 60

Learning Objectives: Student will 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

Credit -4	**MBT 405PLANT PROTECTION III (Recent Trends and Techniques in Plant Protection)**	**No. of hours per unit/credits**
Credit -1 **UNIT I**	**UNIT I: Recent advances in Pest and Weed Management** 1.1 Introduction: Recent advances in plant protection; Pest: Origin, factor responsible, for peststatus; Residual analysis of pesticides:-Overview of pesticide residues in plants, pesticideresidue analysis by-TLC, GC and HPLC. 1.2 Weeds as Pathogens and Weed Management: Weedsand damages caused by them, exotic weeds; and their nuisance (Examples). 1.3 Weed management:weed research in India, Myco-herbicides and insects in weed management and integrated weedmanagement.	**15**
Credit -1 **UNIT II**	**UNIT II: Biotecnological advances in pest management** 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.	**15**
Credit -1 **UNIT III**	**UNIT III Biostatistics in Plant Protection** 3.1 Biostatistics: -Introduction-Concept of statistics and biostatistics,	**15**

	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.	
Credit -1 **UNIT IV**	**UNIT IV IDM, IPM and Sustainable Agriculture**	**15**
	4.1 IDM - Concept, use of IDM in managing various diseases, limitations of IDM. 4.2 IPM - Concept, Need and objectives, examples of management of pests with IDM.Juvenile hormones, Antifeedants. 4.3 Plant Protection and Sustainable Agriculture:Concepts, Indian scenario of sustainable agriculture and future outlooks	

Learning Outcomes: 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.

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4. Chandrashekharan S. N. and S. V. Parthsarthy (1965). Cytogenetics and Plant
5. Breeding. P. Varadachary and Co. Madras. (Unit I)
6. Chatterjee, P. B. (1997) Plant protection techniques. BharatiBhawan Publishers andDistributors Patna. (Unit I,II,III,IV)
7. Chattopadhya, S. P. (1987) Principles and Procedures of Plant Protection. Oxford andIBH,New Delhi. (Unit II)

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara (Autonomous)

Syllabus introduced from June 2022

SEMESTER IV

Master of Science (M. Sc.) Part – II

Semester IV
Theory Paper MBT 406: PLANT PROTECTION IV (Molecular Plant Pathology)

Course Objectives: Student will 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. Understand molecular diagnostics and transgenic approaches.

Credits=4	**Theory Paper MBT 406: PLANT PROTECTION IV (Molecular Plant Pathology)**	**No. of hours per unit/ credits**
Credit –I Unit-I:	**Plant pathology and Molecular Biology** **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 gene specificities.	**(15)**

Credit –1 UNIT II	**Disease resistance in plants**	**(15)**
	2.1 **Resistance Mechanism in plants:** Classical concept of resistance, Preformed defenses, Induced defenses, Systematic resistance mechanism and communal resistance. 2.2 **Signaling in Plant Disease Resistance Mechanism:**Genetic analyses, MAP kinases (MAPK), Ion fluxes and calcium homeostasis, Oxidative bursts, Nitric oxide (NO), (p)ppGppsignaling molecules, Low molecular weight signaling molecules.	
Credit – 1UNIT III	**Resistance genes, genetics of plant pathogen interactions, and genetics of fungi**	**(15)**
	3.1 **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. 3.2 **Genetics of Plant Pathogen Interactions:** Genetics of host Parasitic interactions, Physiological specialization in fungi, Production of New races, Adaptations of fungi different Hosts, Resistance and Susceptibility	
Credit –1 UNIT IV	**Molecular diagnostics and application to conventional disease control**	**(15)**
	4.1 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. 4.2 **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.	

Learning outcomes: Student should able to

1) Validate the pathogen through molecular approach.
2) Understand about resistance mechanism in plants.
3) Understand the genes in plants conferring the resistance to plants against the pests and pathogen.
4) Understand the concept of transgenic resistant to pests and pathogen.

References:

1) Dickinson M. Molecular Plant Pathology. Second edition. London and NewYork: BIOS Scientific Publishers, 2008.
2) Agrios, George N. Plant Pathology, 5th Edn. San Diego:Academic press, 2005.
3) Luberstedt Thomas. Diagnostics in Plant Breeding, first edition. Netherlands: Springer, 2013.
4) Langridge P and K. Chalmers. Molecular marker systems in Plant Breeding and Crop Improvement, first edition. Berlin: Springer, 2005.
5) Dickinson Matthew and James Beynon. Molecular Plant Pathology. Sheffild: CRC press, 2000.
6) Punja, Z. K. Genetic engineering of plants to enhance resistance to fungal pathogens-a review of progress and future prospects. *Canadian Journal of plant pathology* 23 (2001): 216-235.
7) Roberts D. A. and Bothroyd C. W. Fundamental Plant Pathology. W. H. Freeman & Co, 2001.
8) Rommens, C. M. and G. M. Kishore. Exploiting the full potential of disease resistance genes for agricultural use. *Current Opinions in Biotechnology* 11 (2000):120-125.
9) Sambamurty, A. V. S. S. Molecular biology. United Kingdom:Alpha Science International, 2008.
10) Schillberg, S., S. Zimmermann, M. Y. Zhang and R. Fisher. Antibody-based resistance to plant pathogens. *Transgenic research*.10 (2001):1-12.

11) Singh, R. S., U. S. Singh, W. M. Hess and D. J. Weber. Experimental and conceptual plant pathology. New Delhi: Oxford and IBH publishing Co. Pvt. Ltd., 1988.
12) Stuiver, M. H. and J. H. H. V.Custers. Engineering disease resistance in plants. *Nature* 411 (2001): 865-868.
13) Tepfer, M. Risk assessment of Virus-resistant transgenic plants. Annual Review of Phytopathology 40 (2002): 467-491.

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Yashavantrao Chavan Institute of Science, Satara (Autonomous)

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Master of Science (M. Sc.) Part – II:

PLANT DIVERSITY

Semester IV

MBP 407: Practical based on Theory Paper MBT 401 and 402

Learning Objectives: Student will able to

1. Understand about physiological processes in plants around them.
2. Study hot spots in India and the world.
3. Understand practical knowledge about RET plants..
4. To give practical knowledge about the use of technologies like GIS and GPS.

Credits=2	**SECTION-I (based on Paper MBT 401)**	**No. of hours per unit/ credits**
Credit –I UNIT I	1. Determination of chlorophyll a/b ratio of C3 and C4 plants. 2. Determination of rate of respiration in germinating seeds under aerobic and anaerobic conditions. 3. Determination of lipid peroxidation in plants under stress. 4. Measurement of RWC in plant under stress. 5. Estimation of proline from stressed and non-stressed plants. 6. Determination of sulphate from crop plants. 7. Study of enzyme lipase. 8. Study of enzyme nitrate reductase. 9. Extraction of proteins plant tissue and their quantitative (Lowry/Bradford's method) and qualitative (SDS-PAGE) analysis.	**(15)**
Credit –1 UNIT II	**SECTION-II (based on Paper MBT 402)**	**(15)**
	10. Geographical location of hotspots and hottest hot-spots of the world 11. Endemic plants of Western Ghats (minimum 10 plant species) 12. RED list categories of IUCN and local examples for each category 13. Wild plants of Ornamental potential (minimum 10 plant species)	

	14. Wild relatives of cultivated plants (Abelmoschus, Cucumis, Vigna, Oryza etc.) 15. Study of wild edible plants (minimum 10 plant species) 16. Underexploited medicinal plants (minimum 10 plant species) 17. Plants useful in Phyto-remediation (minimum 5 plant species) 18. Use of GIS and GPS in biodiversity assessment 19. Awareness programme/ Plantation/ NGO Visit10. Nucleotide sequence and blasting	

Learning Outcomes: Student will able to

1Understand physiology experiments and interpret the results.

2. Study plants in the RET category.

3. Understand plants with ornamental potential.

4. Study cultivated plants, under exploited medicinal plants and plants useful in Phyto-remediation.

References:

1. Sadasivam S. and Manickam A. (1996): Biochemical methods. New Age International.

2. Pessarakli, M. (Ed.). (2001). Handbook of Plant and Crop Physiology, 2nd Edition, Revisedand Expanded. Marcel Dekker, Inc., New York

3. Groom M. J., Meffe, G. K. and C. R. Caroll. 1997. Principles of Conservation biology.(3rded.) Sinauer associates, Inc. publishers Sunderland, Massachusetts, USA.

4. Leadlay, E. and Jury, S. (eds.). 2006. Taxonomy and Plant Conservation. CambridgeUniversity Press.

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Syllabus introduced from June 2022

Master of Science (M. Sc.) Part – II:
PLANT DIVERSITY

Semester IV

MBP 408: Practical's based on Theory Paper MBT 403 and 404

Learning Objectives: Student will able to

The students will be

1. Understand the different aspects of utilization of Biodiversity.
2. Analyze biodiversity and biodiversity of Western Ghats.
3. Study biotechnological tools of biodiversity assessment.
4. Understand biostatistics and bioinformatics in biodiversity assessment.

	SEMESTER-III **MBP 408: PRACTICAL COURSE**	**Credits=2**	**No. of hours per unit/ credits**
UNIT I	**BIODIVERSITY AND SUSTAINABLE DEVELOPMENT**	**01**	**(15)**
	1. Extraction and isolation of secondary metabolites (TPC and TFC) from natural sources. 2. Extraction of phytochemicals from natural resources and screening for antimicrobial compounds from them. 3. Study of antioxidants properties of any one plant species by phosphor-molybdenum assay (From leaves or Fruits) 4. Awareness programme for villagers with special focus on RET and endemic plants. 5. Study of medicinal, gum, resin, dye, fibre, timber yielding plants. 6. Qualitative analysis of gum, resin, dye, fibre yielding plants. 7. 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.		
UNIT II	**ASSESSMENTOFBIODIVERSITY**	**01**	**(15)**
	1. Preparation of histogram, polygon, line graph and pie diagram using ANOVA. 2. To study principle and methods of cryopreservation. 3. Writing a proposal to funding agency on conservation of RET species. 4. Oral Presentation of proposal on conservation. 5. Synthesis of artificial seeds. 6. Study of vegetation by diversity indices, method for floristic diversity, Shanon weaver Index. 7. Visittoa Green house and plant tissue culture laboratory and writing a report.		

Learning outcomes: The student should able to

1) Understand of the plant biodiversity resources of Western Ghats.

2) Understand to analyse the Bioprospecting requirements in field of their study.

3) Imbibe be able to know and use the techniques of accessing biodiversity.

4) Understand to use the basic biostatistics and bioinformatics applications in biodiversity assessment

References:

1. Henderson P. A. *Practical Methods in Ecology.* New Jersey: John Wiley and Sons. 2009.
2. Sharma J. R. *Statistical and Biometrical techniques in Plant Breeding*. New Delhi: New Age International Publishers. 1998.
3. Gupta P. K. *Biotechnology and Genomics*. Meerut: Rastogi Publications. 2009.

   Verma V. *A textbook on Economic Botany*. Mumbai: Ane Books Pvt Ltd. 2009.

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MBP 409
PRACTICAL SECTION II

Course objectives:
Student will be able to:-

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

Credits=4	**SEMESTER-IV: Practical section II (Based on Paper MBT 406) SEMESTER-III**	**No. of hours per unit/ Credits (60)**
Credit –I UNIT I & II	**Plant pathology and Molecular Biology Disease resistance in plants**	
	1. Extraction of cellulase from pathogen (in vitro) and diseased plants (in vivo) and measurement of endoglucanase or carboxymethyl cellulose by reducing sugar determination method / viscometric method. 2. Extraction of pectolytic enzymes from pathogen (in vitro) and diseased plants (in-vivo) and assaying of polygalacturonase(PG)/ pectin transeliminases by viscosity method/ TBA (Thiobarbituric method). 3. Screening of disease resistance crop plants with conventional method. 4. Screening of disease resistance crop plants with the help of molecular markers (RAPD/ISSR).	
Credit –1 UNIT III	**Resistance genes, genetics of plant pathogen interactions, and genetics of fungi**	**(--)**

& IV	Molecular diagnostics and application to conventional disease control	
	5-7. Isolation and identification of fungal pathogen from leaves stem and fruits. 8. Isolation and identification of bacterial plant pathogens. 9. Production of pathogen free plants through meristem culture. 10. Isolation of antibiotic resistant bacteria. 11. UV induced auxotrophic mutant production and isolation of mutants by replica plating techniques. 12. Demonstration of insect resistance in BT crops with an example of any suitable crop plant.	

Learning Outcomes: The study should able to

1) Validate the pathogen through molecular approach.
2) Understand about resistance mechanism in plants.
3) sUnderstand the genes in plants conferring the resistance to plants against the pests and pathogen.
4) understand the concept of transgenic resistant to pests and pathogen.

Reference Books:

1) Dickinson M. Molecular Plant Pathology. Second edition. London and NewYork: BIOS Scientific Publishers, 2008.
2) Agrios, George N. Plant Pathology, 5th Edn. San Diego:Academic press, 2005.
3) Luberstedt Thomas. Diagnostics in Plant Breeding, first edition. Netherlands: Springer, 2013.
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6) Punja, Z. K. Genetic engineering of plants to enhance resistance to fungal pathogens-a review of progress and future prospects. *Canadian Journal of plant pathology* 23 (2001): 216-235.

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13) Tepfer, M. Risk assessment of Virus-resistant transgenic plants. Annual Review of Phytopathology 40 (2002):467-491.

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