

**Rayat Shikshan Sanstha's
Yashwantrao Chavan Institute of Science,
Satara
(Autonomous)**

**Syllabus under Autonomy
For
M. Sc. II (Botany)**

Academic Year 2019 – 2020

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara (Autonomous)

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

1. TITLE: Botany

2. YEAR OF IMPLEMENTATION: **2019-20**

3. PREAMBLE:

The M. Sc. Botany course under autonomy will be effective from the academic year 2019 – 2020. 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:

1. To impart the knowledge of plant science is the basic objective of the course.
2. 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.
3. To develop skill in practical work, experiments and laboratory materials.
4. To understand scientific terms, concepts, facts, phenomenon and their relationships.
5. To make the students aware of natural resource and environment.
6. 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.

7. 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 – 05)

Code No.	Title of Paper	Hours/Week	Credit
MBT 301	Cytogenetics and Crop Improvement	04	04
MBT 302	Biotechnology and Genetic Engineering	04	04
MBT 303	Biodiversity Conservation and Utilization	04	04
MBT 304.1	Plant Diversity I: Introductory Biodiversity	04	04
MBT 304.2	Plant Protection I: Crop Diseases and their Management	04	04
MBT 305.1	Plant Diversity II: Conservation of Biodiversity	04	04
MBT 305.2	Plant Protection II: Animate Pests of Crops and their Management	04	04
MBP 306	Practical based on MBT 301, 302 and 303	09	03
MBP 307.1	Practical based on MBT 304.1 and 305.1	06	02
MBP 307.2	Practical based on MBT 304.2 and 305.2	06	02
	Project Progress report		02
	Tutorial + day to day performance		02
	Total		29

2) FOURTH SEMESTER (NO. OF PAPERS – 03)

Code No.	Title of Paper	Hours/Week	Credit
MBT 401	Plant Physiology and Metabolism	04	04
MBT 402.1	Plant Diversity III: Biodiversity and Sustainable Development	04	04
MBT 402.2	Plant Protection III: Recent Trends and Techniques in Plant Protection	04	04
MBT 403.1	Plant Diversity IV: Assessment of Biodiversity	04	04
MBT 403.2	Plant Protection IV: Molecular Plant Pathology	04	04
MBP 404	Practical based on MBT 401	03	01
MBP 405.1	Practical based on MBT 402.1 and 403.1	06	02
MBP 405.2	Practical based on MBT 402.2 and 403.2	06	02
	Final Project Report Submission		02
	Tutorial + day to day performance		02
	Total		19

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: Biodiversity Conservation and Utilization
 MBT 304.1: Plant Diversity I: Introductory Biodiversity
 MBT 304.2: Plant Protection I: Crop Diseases and their Management
 MBT 305.1: Plant Diversity II: Conservation of Biodiversity
 MBT 305.2: Plant Protection II: Animate Pests of Crops and their Management
 MBP 306: Practical based on MBT 301, 302 and 303
 MBP 307.1: Practical based on MBT 304.1 and 305.1
 MBP 307.2: Practical based on MBT 304.2 and 305.2

M. Sc. II Semester IV

MBT 401	Plant Physiology and Metabolism
MBT 402.1	Plant Diversity III: Biodiversity and Sustainable Development
MBT 402.2	Plant Protection III: Recent Trends and Techniques in Plant Protection
MBT 403.1	Plant Diversity IV: Assessment of Biodiversity
MBT 403.2	Plant Protection IV: Molecular Plant Pathology
MBP 404	Practical based on MBT 401
MBP 405.1	Practical based on MBT 402.1 and 403.1
MBP 405.2	Practical based on MBT 402.2 and 403.2

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°C deep fridge
17. Refrigerated Centrifuge
18. UV-VIS Spectrophotometer
19. Sonicator
20. Thermal Cycler (For PCR)
21. Gel electrophoresis (Horizontal and Vertical)
22. Laminar air Flow
23. Distillation unit
24. Nephelometer
25. Suction pump
26. Heating mantle
27. Conductivity meter
28. HPLC
29. Gas chromatography Atomic Absorption Spectrophotometer
30. FT-IR

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara (Autonomous)

Syllabus introduced from June 2019

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

MBT 301 Cytogenetics and Crop Improvement

Total Lectures: 60

Theory Paper MBT 301 Cytogenetics and Crop Improvement

Learning Objectives:

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

Unit I Cytogenetics

[15]

Chromatin organization (Euchromatin and heterochromatin); Chromosome structure and packaging of DNA; Molecular organization of centromere and telomere; Nucleolus and ribosomal RNA genes; Karyotype analysis and banding patterns

Unit II Population and Evolutionary Genetics

[15]

Genetic variation in natural population (Natural selection, Migration, Mutation, Genetic Drift); Theory of allele frequencies; Hardy Weinberg law and factor affecting gene and gene frequencies; Mobile genetic elements and their significance; Gene families

Unit III Crop genetic resources

[15]

Centers of origin of cultivated plants; Gene pool (Concept and utilization in breeding program); Management of plant genetic resources (PGR) and its conservation; Global network for genetic conservation and utilization in major crops of world; Institutes engaged in conservation and

improvement of crop genetic resources; Wild relatives of crop plants, Gene banks, Gene sanctuaries

Unit IV Crop Improvement

[15]

Heterosis (Concept, Genetic basis, types, applications); Selection methods (self-pollinated and cross pollinated crops); QTL-mapping; Marker assisted selection (MAS); Role of cytoplasmic male sterility (CMS) in hybrid breeding; Gene pyramiding for multi trait incorporation

Learning Outcomes:

- 1) The students will be able to understand the need of crop improvement.
- 2) The student will be able to understand phylogenetic relationships in plants.
- 3) The students will be able to appreciate the wild relative of crop plants and their need in crop improvement.
- 4) The students will be able to understand the various breeding techniques.

Reference Books:

- Bahekar V. S.** 1993. Problems in Genetics Vol. I Arati Prakashan, Aurangabad. (UNIT-II)
- Chahal G. S. and Gosal S. S.** 2003, Principles and Procedures of Plant Breeding biotechnological and conventional approaches. Narosa Publishers, New Delhi. (UNIT-III)
- Chopra V. L.** 1989. Plant Breeding .oxford and IBH Publishing Co. Pvt. Ltd. New Delhi. (UNIT-III)
- Darnel, J., Lodish, H. and Baltimore, D.** 1990 Molecular cell biology. Scientific American Books. (UNIT-II)
- Gardner, E. J.** 1991 Principles of Genetics. John Wiley and sons, New York. (UNIT-I)
- Jahier, J.** 1996 Techniques of plant Cytogenetics. Oxford and IBH Publishing. (UNIT-I)
- Lewin, B.** 2008, Genes IX. Oxford University Press, (UNIT-II)
- Mandal, A. K., Ganguli, P. K. and Banarjee, S. P.** 1991 Advances in plant breeding Vol. I and II. CBS Publishers & Distributors. (UNIT-III)
- Mayo, O.** 1980. The theory of Plant Breeding. Clarendon Press, Oxford. (UNIT-III)
- Mitra Sandhya** 1994 Genetics a blueprint of life. Tata McGraw- Hill Publishing Company Ltd, New Delhi. (UNIT-I)

- Poehlman J.M.** 1986. Breeding Field Crops AVI Publishing Company Connecticut. NEW YORK (UNIT-III)
- Roy Darbeshwar** 2000, Plant breeding analysis and exploitation of variance. Narosa Publishers, New Delhi. (UNIT-IV)
- Russell P. J.** 1998. Genetics (Fifth edition) Benjamin / Cummings Publishing Company Canada. (UNIT-I)
- Sharma, A. K. and Sharma, A.** 1980. Chromosome techniques- Theory and practice. Butterworth and Co. (Publishers) Ltd., London. (UNIT-I)
- Sharma, J. R.** 1994 Principles and practice of plant breeding. Tata McGraw Hill Publ. Co. Ltd., New Delhi.
- Sharma, J. R.** 1998 Statistical and Biometrical techniques in Plant Breeding New Age International Publishers, New Delhi.
- Singh, B. D.** 2000. Plant breeding- Principles and methods. Kalyani Publishers, Ludhiana. (UNIT-III; UNIT-IV)
- Snustad D. P. and Simmons M. J.** 2003, Principles of Genetics, (Third edition) John Wiley and Sons Inc. (UNIT-II)
- Strickberger, M. W.** 1968. Genetics. The Macmillan Company, New York. (UNIT-II)
- Swaminathan, M. S., Gupta, P. K. and Sinha, U.** 1983. Cytogenetics of crop plants. Macmillan India Ltd., Delhi. (UNIT-II)
- Swanson, C. P.** 1968. Cytology and Cytogenetics. Macmillan and Co. Ltd., London. (UNIT-I)
- Sybenga, J.** 1975. Meiotic configurations. Springer Verlag, Berlin, Germany. (UNIT-I)
- Winkler, U. Ruger W. and Wackernagel W.** 1979. Bacterial, phage and molecular genetics. Narosa Publication, New Delhi. (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.
- Theoretical and Applied Genetics.

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara (Autonomous)

Syllabus introduced from June 2019

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

MBT 302 Biotechnology and Genetic Engineering

Total Lectures: 60

Theory Paper MBT 302 Biotechnology and genetic Engineering

Learning Objectives:

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

Unit I Plant Tissue Culture

[15]

Concept, Scope and importance of Biotechnology; Plant cell and tissue culture laboratory requirements; Tools and techniques for plant tissue culture; Culture media, their constituents and types of cultures; Applications of plant tissue culture; Somaclonal variation and its significance; Protoplast culture and somatic hybridization

Unit II Recombinant DNA technology

[15]

Concept, principles, applications and consequences of recombinant DNA technology; Enzymes used in recombinant DNA technology; Cloning vectors; Construction of cDNA libraries; Genetic transformation of eukaryotes; Molecular probes; Isolation of genes

Unit III Advanced techniques in Molecular Biology

[15]

Polymerase chain reaction (PCR) and Real time Polymerase chain reaction (RT-PCR); Gel electrophoresis: AGE and PAGE; Blotting techniques: Southern, Northern, Western and South-Western blotting; DNA sequencing techniques: Sanger and NGS; DNA fingerprinting: RFLP, RAPD, ISSR; DNA barcoding: Consortium for the Barcode of Life (CBOL)

Unit IV Omics

[15]

Genomics: *Arabidopsis* genome, Comparative genomics, Functional genomics; **Proteomics:** Rationale, basic assumptions, methods for protein engineering; **Bioinformatics:** Databases (NCBI, EMBL, DDBJ), Basic local alignment search tool (BLAST), Multiple Sequence Alignment Tools, Phylogenetic analysis, Applications of Bioinformatics

Learning Outcomes:

- 1) The students will be able to understand the use of biotechnology in botany.
- 2) The students will be able to understand the various branches of biotechnology in plant science.
- 3) The students will be able to know the recent molecular technology in study of plants.
- 4) The students will be able to know of application of genes, proteins and secondary metabolites in plant science.

REFERENCES:

- Andreas Baxevanis, B. F. Francis Ouellette and B. F. Cuellette** 1998 Bioinformatics: A Practical Guide to the analysis of Genes and Proteins, Wiley Publishers, New York (UNIT-IV)
- Boyce, C.O.L.** 1986. Novo's Handbook of Practical Biotechnology. Novo Industry. (UNIT-III)
- Chawla, H. S.** 1998. Biotechnology in Crop Improvement. International Book Distributing Company, Lucknow. (UNIT-1)
- Claverie J and Notredame C** 2011 Bioinformatics for Dummies; John Wiley and Sons (UNIT-IV)
- Dodds, J. H. and Roberts, L. W.** 1985. Experiments in plant tissue culture. Cambridge University Press, Cambridge. (UNIT-I)
- Durbin R, Sean R., Eddy, Anders Krogh, Graeme M.** 1999 Biological Analysis-Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press. (UNIT-IV)
- Gamborg, O. L., Phillips, G. C.** 1995. Plant Cell, Tissue and Organ Culture- Fundamental Methods. Narosa Publ. House, New Delhi. (UNIT-I)
- Glick, B. R. and Pasternak, J. J.** 1994. Molecular Biotechnology- Principles and Applications of Recombinant DNA. ASM Press, Washington D. C. (UNIT-II)

- Gupta, P. K.** 2009. Biotechnology and Genomics. Rastogi Publications, Meerut. (UNIT-II)
- Gupta, P. K.** 2010. Plant Biotechnology. Rastogi Publications, Meerut. (UNIT-I)
- Jagota A.** 2000 Data Analysis and Classification for Bioinformatics. Published by Bioinformatics by the bay Press. University of Michigan, USA (UNIT-IV)
- Kumar, H. D.** 1993. Molecular Biology and Biotechnology, Vikas Publ., New Delhi. (UNIT-III)
- Mount D. W.** 2001 Bioinformatics Sequence and Genome Analysis. Cold Spring Harbour Laboratory. New York. (UNIT-IV)
- Ramawat, K. G.** 2006. Plant Biotechnology. S. Chand and Company Ltd., New Delhi. (UNIT-II)
- Razdan, M. K.** 1994: An Introduction to plant tissue culture. Oxford & IBH Publ. Ltd., New Delhi. (UNIT-I)
- Reinhert, J. and Bajaj ,Y. P. S.** 1977. Applied and fundamental aspects of plant cell, tissue and organ culture, Springer Verlag, Berlin. (UNIT-III)
- Trehan, K.** 1994. Biotechnology. Wiley Eastern Limited, New Delhi. (UNIT-I)
- Trivedi, P. C.** (ed.) 2000. Plant Biotechnology- Recent Advances. Panima Publishing Corporation, New Delhi. (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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Master of Science (M. Sc.) Part – II: Sem-IV

MBT 303 Biodiversity, Conservation and Utilization

Total Lectures: 60

Theory Paper MBT 303 Biodiversity Conservation and Utilization

Learning Objectives:

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 knowledge of importance of endemic plants.
4. To impart the knowledge of application of Geoinformatics in plant sciences.

Unit I Biological Diversity

[15]

Definition and concept of biodiversity; Types of diversity (alpha, beta, gamma); Magnitude of biodiversity; indirect and ethical values of biodiversity; Loss and reasons for loss of biodiversity; Global Taxonomic initiatives (GTI); Systematic agenda-2020.

Unit II Endemism and Geoinformatics

[15]

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

Geoinformatics

Definition and concept of Geoinformatics; Geographic Positioning System (GIS); Global Positioning System (GPS); Google earth; Ecology and Biodiversity Services (EBS)

Unit III Biodiversity Conservation

[15]

Introduction; Basic principles of conservation; *In-situ* conservation; *Ex-situ* conservation; Restoration programs; World organization for conservation; Efforts by Indian government for conservation

Unit IV Biodiversity for sustainable development

[15]

Wild Plants of ornamental potential; Wild relatives of cultivated plants; Wild edible plants and their nutritive value; Under exploited medicinal plants; Plants of commercial importance; Energy plants and petrocrops; Plants suitable in phyto-remediation

Learning Outcomes:

- 1) The students will be able to understand the various aspects of plant biodiversity.
- 2) The students will be able to understand the concept and applications of Geoinformatics.
- 3) The students will be able to know about the restoration programmes for biodiversity conservation.
- 4) The student will understand the importance of sustainable development.

REFERENCES:

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

UNEP. 2002b. Global strategy for Plant Conservation. Decision VI/9. UNEP/CBD/COP /6/20
Montreal, Canada: CBD Secretariat. (UNIT-IV)

WEHAB Working Group. 2002. A Framework for Action on Biodiversity and Ecosystem
Management. (UNIT-II)

Journals

- Biodiversity conservation (Springer)
- Flora
- Plant Systematics and Evolution
- Genetic Resources and Crop Evolution

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Master of Science (M. Sc.) Part – II

SEMESTER III

MBP 306: Practical's based on Theory Paper MBT 301, 302 and 303

SECTION-I

- 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. Centers of origin crop plants.
10. Field visit (NRC/NBPGR center/seed company)

SECTION -II

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

SECTION-III

1. Geographical location of hotspots and hottest hot-spots of the world
2. Endemic plants of Western Ghats (minimum 10 plant species)

3. RED list categories of IUCN and local examples for each category
4. Wild plants of Ornamental potential (minimum 10 plant species)
5. Wild relatives of cultivated plants (*Abelmoschus*, *Cucumis*, *Vigna*, *Oryza* etc.)
6. Study of wild edible plants (minimum 10 plant species)
7. Underexploited medicinal plants (minimum 10 plant species)
8. Plants useful in Phyto-remediation (minimum 5 plant species)
9. Use of GIS and GPS in biodiversity assessment
10. Awareness programme/ Plantation/ NGO Visit

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Syllabus introduced from June 2019

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

MBT 304.1: PLANT DIVERSITY I (INTRODUCTORY BIODIVERSITY)

Total Lectures: 60

Learning Objectives:

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

UNIT I: Levels of Biodiversity

[15]

Introduction to biodiversity: Concept, definition, importance of biodiversity, status in India, biodiversity values. Diversity of plant Groups based on morphological features (Viruses, Bacteria, Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms)

Levels of biodiversity: Species diversity: species richness, species evenness, alpha diversity, beta diversity, gamma diversity.

Genetic diversity: Concept, terminology used- eco-clines, ecotypes, chemotypes, cytotypes, varieties, subspecies, polytypic, monotypic and hybrids.

Ecological diversity: Concept, Agro ecosystems, Forest ecosystem- Mixed deciduous and semi-evergreen

UNIT II: Characterization of Biodiversity

[15]

Characterization of biodiversity: Taxonomic and evolutionary characterization, characterizing flora and fauna, Plant documentation (preparing floras, hand books, monographs, keys and database, herbarium and e-herbarium) biological concept of species.

Magnitude and distribution of biodiversity: Gradients of biodiversity (latitudinal, altitudinal,

depth), environmental factors and centres of diversity, rarity, endemism and biodiversity, speciation and extinction, global hotspots of biodiversity (as per Mittermeier).

UNIT III: Present status of Biodiversity

[15]

Floral biodiversity of Western Ghats, India; share in global biodiversity, endemic and threatened forms w.r.t. Western Ghats, Threats to biodiversity, Concept of Megacentres 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

[15]

India as mega centre 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.

Learning Outcomes:

1. Student learns concept of plant diversity and its magnitude.
2. The students learn able to relate biodiversity crises and solutions.
3. Students learn present status of plant diversity and conservation.
4. Student shall understand the plant diversity status in India.

Reference Books:

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)

6. Krattiger, A. I. et al (1994): Widening Perspectives on Biodiversity. Kluwer Academic Publishers.(UNIT-II)
7. Prashanth M. S. and Hosetti B. B. 2010. Elements of Environment Science; Prateeksha Publications(UNIT-IV)
8. Rao, R. R. 1994. Biodiversity of India (Floristic Aspects). Bishen Singh Mahendra Pal Singh, Dehra-Dun.(UNIT-III)

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

**MBT 305.1: PLANT DIVERSITY II (CONSERVATION OF
BIODIVERSITY)**

Total Lectures: 60

Learning Objectives:

1. To impart the basic knowledge of different aspects Biodiversity Conservation.
2. To impart the knowledge of methods in Biodiversity conservation.

UNIT I: Environmental Accounting and EIA [15]

Environmental accounting: Concept, importance of natural resources and environment, merits and demerits of environmental accounting, Green audit, Carbon credit.

Environmental impact assessment (EIA): Introduction, definition, approaches to EIA, importance of environmental impact assessment, Carbon sequestration.

UNIT II: Conservation of Biodiversity [15]

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.

Ex-situ conservation: Concept, botanical gardens, seed banks, germplasm, gene banks, advantages and disadvantages, justification of ex-situ conservation.

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 [15]

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

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.

UNIT IV: Role of government and Non-Government Organizations [15]

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, Role of Green organizations viz. TERI, CES, MOEF, ATREE, FRLHT; Role of taxonomy and taxonomists in conservation of biodiversity

Learning Outcomes:

- 1) The students will be able to understand the concept of environmental auditing
- 2) The students will be aware of various agencies working in the field of biodiversity conservation
- 3) The students will be able to understand the concept of carbon trading and how biodiversity affects global economy

REFERENCES:

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

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Syllabus introduced from June 2019

Master of Science (M. Sc.) Part – II:

PLANT DIVERSITY

Semester III

MBP 307.1 : Practical's based on Theory Paper MBT 304.1 and 305.1

SECTION-I

1. Preparation of maps showing biogeographic regions, hot spots of India, mega biodiversity centers of the world
2. Study of comparative diversity in bacteria and viruses
3. Study of comparative diversity in Algae
4. Study of comparative diversity in Fungi
5. Study of comparative diversity in Bryophytes
6. Study of comparative diversity in Pteridophytes
7. Study of comparative diversity in Gymnosperms
- 8-11. Study of comparative diversity in Angiosperms (Leaves, Inflorescence, Flowers, Fruits and Seeds)

SECTION -II

1. Use of database in studying biodiversity
2. Techniques of herbarium and museum specimen preparation.
3. Study of critically endangered plant species from Western Ghats.
4. Study of vulnerable plant species.
5. Study of monotypic endemic genera of Western Ghats.
6. Green audit of college campus.
7. Carbon sequestration of any industrial or transport zone.
8. Seed germination and viability of forest trees.
9. Assessment of the economic value of plant biodiversity (as food, fodder, medicine or Timber) from the nearby market.

10-12. Visit to local centres *ex-situ*, *in-situ* and NGO conservation programme and report writing.

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

**MBT 304.2: PLANT PROTECTION I (CROP DISEASES AND THEIR
MANAGEMENT)**

Total Lectures: 60

Learning Objectives:

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

UNIT I Major Crop Diseases

[15]

Introduction: History of Plant Pathology and Overview, Crop diseases and losses caused by them. [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 [13]

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. [4]

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) [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. [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. [4]

UNIT III Post Harvest Market Diseases [15]

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]

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 [7]

UNIT IV Pathophysiology [15]

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 [8]

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. [7]

Learning Outcomes:

- 1) The students will be able to recognize the diseases occurring in the agricultural field.
- 2) The students will be able to categorize the disease on the bases of causal organisms.
- 3) The students will be able to predict the control measures to be implemented for the disease.
- 4) The students will be obtaining knowledge about enzymes and toxins in plants.

Reference Books:

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- **Aneja, K. R.** (2005). Experiments in Microbiology and Plant Pathology and biotechnology. New Age International (P) Ltd. Publishers, New Delhi. (Unit I)
- **Baruah H. K., P. Brain and A. Baruah,** (1984). Textbook of plant pathology. Oxford and IBH Publ. Co., New Delhi. (Unit I)
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- **Chattopadhyaya, S. P.** (1987) Principles and Procedures of Plant Protection. Oxford and IBH, New Delhi. (Unit II)
- **Diskson J. C.** (1964) Diseases of Field crop. McGraw –Hill , New Delhi. (Unit IV)
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- **Jones D. G.** (1987) Plant pathology – Principles and practices. Open University Press, Stratford. (Unit I,II)
- **Mehrotra R. S. and Ashok Aggarwal** (2005) Plant Pathology. Tata McGraw-Hill publishing Co.Ltd. New Delhi. (Unit I,II,III)
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- **Nagarajan S.** (1999) Plant Diseases and Epidemiology. Oxford and IBH, New Delhi. (Unit I)
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- **Pathak V. N.** (1980) Diseases of Fruit crops. Oxford and IBH, New Delhi. (Unit I)
- **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)
- **Ramakrishnan T. S.** (1974) Diseases of Millets. ICAR, New Delhi. (Unit I)
- **Rangaswami, G.** (1975) Diseases of crop plants in India. Prentice-Hall Pub, New Delhi. (Unit I)
- **Roberts D. A.** and Bothroyd C. W. (1995) Fundamental Plant Pathology. Freeman & Co (Unit I,II)

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

**MBT 305.2: PLANT PROTECTION II (ANIMATE PESTS OF CROPS AND THEIR
MANAGEMENT)**

Total Lectures: 60

Learning Objectives:

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

UNIT I: Types of pests on crops

[15]

Introduction: Introduction to animate pests and their examples. General life cycles of these animate pests, Importance of animate pests. **[4]**

Non-insect pests of crops: General account of non-insect pests, damages caused by them and their management with respect to rats, squirrels, birds, snails and slugs, plant mites, and nematodes. **[5]**

Insect pests of crops: Insects as a pest of crops, Attainment of 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 **[6]**

UNIT II: Insect Pests of Crop Plants

[15]

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, brief 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 [15]

Insect pests of ornamental plants: Study of following pests with reference to their scientific name, host range, marks of identification, nature of damage, brief life cycle and their management: a) Scale Insects b) white fly c) Spider mite. [4]

Polyphagus insect pests: Study of following polyphagus insect pests with reference to their scientific name, host range, marks of identification, nature of damage, brief life cycle and their management. a) Aphids b) Termites c) Mealy bugs d) Thrips d) Leaf miner [7]

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) Khapra beetle c) Red flour beetle d) Lesser grain borer [5]

UNIT IV: Pest Management [15]

Pest management: Overview of methods of pest management viz. Mechanical, Physical, Chemical and Cultural Methods of pest control.

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. [6]

Biological Control of Pests:- Concept, Some successful examples of biological control, Agents of biological control; Mass culture and release of parasitoids and predators. [4]

Semi- chemicals Control of Pests: Introduction, Concept of Pheromones and Allelochemicals concept and uses of these to control of pests. [2]

Control of Pests by Hormonal Imbalance: Control of Pest by insect growth regulatorsecdysoids, juvenoids, anti-hormones, chitin inhibitors, miscellaneous insect growth regulators. [3]

Learning Outcomes:

- 1) The students will be learned about different pests on crops.
- 2) The students will be able to identify the animate peats in the farmer's field.
- 3) The students will be able to identify the insect peats.
- 4) The students will be able to employ the management strategies to control the pest.

References Book:

- **Agrios, G. N.** (1997). Plant Pathology, 4th Edn. Academic press, San Diego (Unit I,II,III,IV)
- **Atwal, A. S.** (1936) Agricultural Pest of India and South East Asia.Kalyani Publishers, New Delhi (Unit I,II,III,IV)
- **Chatterjee, P. B.** (1997) Plant protection techniques. Bharati Bhawan Publishers and Distributors Patna. (Unit IV)
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- **Gerhardson, B** (2002). Biological substitutes for pesticides. *Trends in biotechnology* **20**:338- 343. ICAE, Publication.:Crop Diseases Calender (Unit IV)
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- **Metcalf, C. L. and Flint, W. P.** (19830) Destructive and Useful Insects. Tata McGrew-Hill publishing Co. Ltd. New Delhi. (Unit II,III)
- **Pedigo, L. P.** (1996) Entomology and pest Management. Prentice-Hall Pub. Englewood clifts NJ (Unit IV)
- **Shrivastava, V. P.** (1988). A Textbook of Applied Entomology. Kalyani Publ. 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

PLANT PROTECTION

Semester III

MBP 307.2 :Practical's based on Theory Paper MBT 304.2 and 305.2

SECTION I

Study of following diseases with respect to causal organism, symptoms, disease cycle and their management

- 1. Fungal diseases** *Helminthosporium* of Paddy, Head smut of jowar, Rust of soybean and sunflower, Rust of chickpea.
- 2. Fungal diseases:** Rhizome rot of Turmeric, Rust of Coffee, Anthracnose of Banana, Powdery mildew of Pea, Ripe fruit rot of Chilli
- 3. Bacterial diseases:** a) Paddy: Leaf streak. b) Mango: Leaf spot. c) Tomato: Canker and Wilt.
- 4. Phytoplasmas diseases:** a) Citrus: Citrus leaf greening. b) Little leaf disease (Any suitable crop)
- 5. Viral diseases:** any mosaic disease and Papaya leaf curl
- 6. Angiospermic parasitic diseases:** a) *Loranthus* b) Dodder. c) Witchweed.
- 7.** Locally available of market diseases of vegetables and fruits.
- 8.** Study of the various methods of seed treatment and chemicals, bio-agents used in seed treatment.

SECTION II:

- Study of major insect pests of the following crops with reference to their scientific name, classification, host range, marks of identification, nature of damage, life cycle and their management.
- 9. Cereals:** a) Wheat aphid. b) Jowar - Stem Borer **Pulses:** a) Tur - Pod Borers. b) Soybean - Leaf Roller

- 10. Cash crops:** a) Scale insect b) Ginger- Rhizome fly. **Oil seed crops:** a) Ground nut -Leaf Miner b) Sunflower- White fly.
- 11. Vegetables:** a) Tomato - Fruit Worms b) Okra - Fruit Borers. **Fruits:** a) Mango stem bore b) Citrus caterpillar
- 12. Pests of ornamental plants:** a) Scale Insects b) white fly c) Spider mite.
Polyphagous Pests: a) Aphids b) termites c) Mealy bug d) Thrips e) Leaf miner
- 13. Stored grain insect pests:** a) Rice moth b) Khapra beetle c) Red flour beetle d) Lesser grain borer
- 14. Biocontrol agents:** Study of some common bio control agents.

References:

- Aneja, K. R** (2005). Experiments in Microbiology and Plant Pathology and biotechnology. New Age International (P) Ltd. Publishers, New Delhi.
- Chatterjee P. B.** (1997). Plant Protection Techniques. Bharti Bhawan. Patana.
- Chattopadhyaya, S. P.** (1987) Principles and Procedures of Plant Protection. Oxford and IBH, New Delhi.
- Atwal, A. S.** (1936) Agricultural Pest of India and South East Asia. Kalyani Publishers, New Delhi

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

MBT 401 Plant Physiology and Metabolism

Total Lectures: 60

Theory Paper MBT 401 Plant Physiology and Metabolism

Learning Objectives:

1. To impart the basic knowledge of different aspects of plant physiology.
2. To impart the basic knowledge of plant metabolism.
3. To impart the knowledge of stress alleviation in plants for use in creation of resistant plants.
4. To impart the latest updates in the field of research in plant physiology and metabolism.

Unit I Plant water relation and solute transport

[15]

Regulation of water supply; Aquaporins and facilitated water transport; Soil plant atmosphere continuum (SPAC); Theories of stomatal physiology; Mechanism of xylem and phloem transport; Phloem loading and unloading (with special reference to P proteins); Membrane transport of proteins

Unit II Photosynthesis and respiration

[15]

Photosynthesis: 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.

Respiration: EMP pathway, Pentose Phosphate pathway (PPP), Anaerobic respiration, TCA cycle, ETC, Inhibitors of respiration, Gluconeogenesis.

Unit III Metabolism and Physiology of flowering

[15]

Lipid metabolism: Synthesis of triglycerides, fatty acids, membrane lipids, and their catabolism, glyoxylate cycle, beta oxidation;

Sulphur metabolism: Sulphate intake, transport, reduction and assimilation;

Nitrogen metabolism: Nitrate and ammonium assimilation, nitrogen uptake, NOD factor, root nodulation and nitrogen fixation;

Physiology of flowering: Photoperiodism and its significance, floral induction and development-genetic and molecular analysis, Vernalization

Unit IV Phytohormones and stress physiology

[15]

Concept of hormones as chemical messengers; Biosynthesis and mechanism of action of auxins; Hormones in defense against biotic and abiotic stress; Response of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; Mechanism of resistance to biotic stress and tolerance to abiotic stress

Learning Outcomes:

- 1) The students will be able to appreciate the plants as universal engineers.
- 2) The students will be able to understand the basic physiological processes in plants.
- 3) The students will be able to understand the metabolic processes in plants.
- 4) The students will be able to understand the resilient nature of plant with respect to their ability to cope up with stress

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Buchnan, B.B., Gruissem, W. And Jones, R.L. (2000) Biochemistry and Molecular Biology of Plants. Wiley-Blackwell (UNIT-I)

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Master of Science (M. Sc.) Part – II

SEMESTER IV

MBP 404: Practical's based on Theory Paper MBT 401 Plant Physiology and Metabolism

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.
- 9-10. Extraction of proteins plant tissue and their quantitative (Lowry/Bradford's method) and qualitative (SDS-PAGE) analysis.

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

MBT 402.1: PLANT DIVERSITY III (BIODIVERSITY AND SUSTAINABLE DEVELOPMENT)

Total Lectures: 60

Learning Objectives:

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.

UNIT I: BIODIVERSITY AND SUSTAINABLE DEVELOPMENT [15]

Concept, prospects and concern, biodiversity education, rehabilitation of neglected specialized habitats like wetlands and mangroves, community participation for sustainable development, social approach to conservation, role of universities and educational institutes in biodiversity conservation.

UNIT II: LOCAL BIODIVERSITY [15]

Local biodiversity: Diversity of angiosperms of Satara with special reference to Mahabaleshwar, Kas, Khatav, Ajinkyatara fort and Vasota.

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]

Bioprospecting and biodiversity: Concept, bioprospecting and indigenous traditional knowledge, bioprospecting for conservation and sustainable development, Rio convention (1992) and bioprospecting, bioprospecting and biopiracy, bioprospecting to conserve the biodiversity, intellectual property right.

UNIT IV: PLANT BIORESOURCES OF WESTERN GHATS

[15]

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). Ecosystem services by Western Ghats.

Learning outcomes:

- 1) The student will be able to understand the concept of sustainable development.
- 2) The student will be aware of the plant biodiversity resources of Western Ghats.
- 3) The student will be able to analyse the Bioprospecting requirements in field of their study.
- 4) The student will be able to define the ecosystem services provided by Western Ghats.

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1. Glick, B, R. and Pasternak, J. J. 1994. Molecular Biotechnology- Principles and Applications of Recombinant DNA. ASM Press, Washington D. C. (UNIT-II)
2. Gupta, P. K. 2009. Biotechnology and Genomics. Rastogi Publications, Meerut. (UNIT-II)
3. Gupta, P. K. 2010. Plant Biotechnology. Rastogi Publications, Meerut. (UNIT-I)
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6. Kumar, H. D. 1993. Molecular Biology and Biotechnology, Vikas Publ., New Delhi. (UNIT-IV)
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8. Panigrahy R. L. and LingarajPatro 2008 Biodiversity Conservation and Sustainable Development; Discovery Publishing House (UNIT-I)
9. Ramawat, K. G. 2006. Plant Biotechnology. S. Chand and Company Ltd., New Delhi. (UNIT-III)
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11. Trivedi, P. C. (ed.) 2000. Plant Biotechnology- Recent Advances. Panima Publishing Corporation, New Delhi. (UNIT-III)

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13. Wood D and Lenne' J 1999 Agrobiodiversity: Characterization, Utilization and Management; CABI Pub. (UNIT-IV)

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

MBT 403.1: PLANT DIVERSITY IV (ASSESSMENT OF BIODIVERSITY)

Total Lectures: 60

Learning Objectives:

1. To impart the basic knowledge of different aspects of biodiversity assessment.
2. To impart the knowledge of biotechnological tools of biodiversity assessment.
3. To impart the knowledge of impact of biodiversity on human life.
4. To impart the basic knowledge of use of biostatistics and bioinformatics in biodiversity assessment.

UNIT I: Methods of Biodiversity Assessment **[15]**

Methods to study biodiversity: Sampling methods to determine alpha, beta and gamma diversity, methods for floristic diversity, aquatic biodiversity and biodiversity of soil.

Agencies for Conservation: Concept, role and working of DBT, DST, MOEF, SERB, RGSTC, World Bank, AICRP.

UNIT II: Role of Biotechnology in Conservation **[15]**

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.

Molecular tools for biodiversity: Allozymes, molecular markers, RFLP, AFLP, RAPD, PCR, DNA barcoding; Significance of molecular tools in biodiversity.

UNIT III: Impact of Biodiversity **[15]**

Tourism and biodiversity: Eco-tourism, concept, principle, scope of eco-tourism in India, ecocide, sustainable tourism development, public awareness using environmental calendar activities.

Climate change and biodiversity: Global warming and green house effect, causes, effects and remedies, effect of climate change on biodiversity. Ecosystem responses to long term climate pattern.

UNIT IV: Biostatistics and Bioinformatics in Biodiversity

[15]

Use of Statistical Analysis and Computer Based Data Handling for Assessment of Biodiversity:

Biostatistics: Introduction, applications, ANOVA, use of biostatistics in interpretation of biodiversity data.

Bioinformatics: Introduction, applications, databases (nucleic acid, protein), use of computers and bioinformatics in study of biodiversity.

Learning outcomes:

- 1) The student will be able to know the techniques of accessing biodiversity.
- 2) The student will be in position to employ these techniques for the assessment of plant biodiversity in their field of study
- 3) The students will be able to understand the concept of ecotourism.
- 4) The students will learn the basic biostatistics and bioinformatics applications in biodiversity assessment.

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2. BrijGopal. and Bhardwaj, N. (1979). Elements of Ecology. (UNIT-I)
3. Chandra A. M. And Ghosh S. K. 2006 Remote Sensing and Geographical Information System; Alpha science (UNIT-II)
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8. Greig Smith, P. (1983). Quantitative Plant Ecology. (UNIT-I)
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Master of Science (M. Sc.) Part – II:
PLANT DIVERSITY

Semester IV

MBP 405.1: Practical's based on Theory Paper MBT 402.1 and 403.1

SECTION-I

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, Ajinkyatara fort, Mahabaleswar) by suitable sampling methods (line transect and belt transect) for determination of frequency, species abundance and species area curve

SECTION-II

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. Isolation of genomic DNA from any plant and qualitative estimation of DNA by Agarose Gel Electrophoresis.
6. PCR amplification of DNA and southern blotting.
7. Study of vegetation by diversity indices, method for floristic diversity, Shanon weaver Index.
8. Visit to a Green house and plant tissue culture laboratory and writing a report.

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

**MBT 402.2: PLANT PROTECTION III (RECENT TRENDS AND TECHNIQUES IN
PLANT PROTECTION)**

Total Lectures: 60

Learning Objectives:

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

UNIT I: Recent advances in Pest and Weed Management [15]

Introduction: Recent advances in plant protection; **Pest:** Origin, factor responsible, for pest status; **Residual analysis of pesticides:**-Overview of pesticide residues in plants, pesticide residue analysis by-TLC, GC and HPLC; **Weeds as Pathogens and Weed Management:** Weeds and damages caused by them, exotic weeds; and their nuisance (Examples), Weed management: weed research in India, Myco-herbicides and insects in weed management and integrated weed management.

UNIT II: Biotechnological advances in pest management [15]

Culture Media: Overview of culture media, special culture media for Fungi and Bacteria

Biotechnology in Plant Protection: - Introduction, Concept of transgenic plants, Biotechnology for plant pathology (Examples), Biotechnology for insect control (Examples), Biotechnology for weed control(Examples); **Mycorrhiza:** -Introduction and their applications in plant protection.

UNIT III Biostatistics in Plant Protection [15]

Biostatistics: -Introduction-Concept of statistics and biostatistics, importance; measures of central tendency- Concept, merits, demerits, applications of Mean, Mode and Median; Measures

of dispersion-Concept, merits, demerits, applications of standard deviation, and CV, graphical and diagrammatic representation of data- Histogram, Polygon, Line graph and Pie diagram

Disease forecasting: Concept, models in diseases forecasting.

UNIT IV IDM, IPM and Sustainable Agriculture

[15]

IDM - Concept, use of IDM in managing various diseases, limitations of IDM.

IPM - Concept, Need and objectives, examples of management of pests with IDM.

Juvenile hormones, Antifeedants.

Plant Protection and Sustainable Agriculture:

Concepts, Indian scenario of sustainable agriculture and future outlooks.

Learning Outcomes:

- 1) The students will be able to know the recent technologies employed in the study of plant pathology.
- 2) The students will be able to know the recent biotechnology techniques employed in the study of analysis of pesticides and biostatistics.
- 3) The students will be able to understand the concepts of biostatistics and forecasting diseases based on predictive parameters.
- 4) The students will be able to formulate an in advance management programmes to prevent the forecasted disease.

References Book:

- **Agrios, G. N.** (1997). Plant Pathology, 4th Edn. Academic press, San Diego (Unit I,II,III,IV)
- **Aneja K. R.:** Experiments in Microbiology, Plant Pathology and Tissue Culture. Wishwa publishers (Unit I)
- **Bilgrami K. S. and Dube H. C.** (1990).Text book of Modern pathology. Vikas Publishing House Pvt. Ltd. New Delhi. (Unit I,II,III,IV)
- **Chandrashekhara S. N. and S. V. Parthasarthy** (1965). Cytogenetics and Plant Breeding. P. Varadachary and Co. Madras. (Unit I)
- **Chatterjee, P. B.** (1997) Plant protection techniques. Bharati Bhawan Publishers and Distributors Patna. (Unit I,II,III,IV)
- **Chattopadhyaya, S. P.** (1987) Principles and Procedures of Plant Protection. Oxford and IBH,New Delhi. (Unit II)

- **Gerhardson, B** (2002). Biological substitutes for pesticides. *Trends in biotechnology* **20**:338- 343. ICAE, Publication.:Crop Diseases Calender (Unit I)
- **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)
- **Rashid S. N. and M. M. A. Khan** : Dictionary of Remote Sensing. Manak Publication Pvt. Ltd., New Delhi. (Unit IV)
- **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. (Unit I)
- **Sambamurty, A. V. S. S.** (2008). Molecular biology. Narosa Publishing House, New Delhi. ISBN 978-81-7319-837-3. (Unit I)
- **Schillberg, S., S. Zimmermann, M. Y. Zhang and R. Fisher** (2001). Antibody-based resistance to plant pathogens. *Transgenic research*.**10**:1-12. (Unit I)
- **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. (Unit II)
- **Tepfer, M.** (2002). Risk assessment of Virus-resistant transgenic plants. *Annual Review of Phytopathology* **40**:467-491. (Unit I)

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

MBT 403.2: PLANT PROTECTION IV (MOLECULAR PLANT PATHOLOGY)

Total Lectures: 60

Learning Objectives:

1. To impart the basic knowledge of Fundamentals of plant pathology and application of molecular biology.
2. To impart the basic knowledge of Resistance Mechanism in plants
3. To impart the knowledge of genetics of plant pathogen interactions.
4. To impart the knowledge of molecular diagnostics and application to conventional disease control.

UNIT I Fundamentals of plant pathology and application of molecular biology to conventional disease control strategies [15]

The Fundamentals of plant Pathology:

The concept of plant diseases; The causal agents fungi, protozoa, bacteria, phytoplasmas and spiroplasmas, viruses and other agents; Molecular biology in plant pathology.

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

UNIT II Disease resistance in plants [15]

Resistance Mechanism in plants:

Classical concept of resistance, Pre-formed defenses, Induced defenses, Systematic resistance mechanism and communal resistance.

Signaling in Plant Disease Resistance Mechanism:

Genetic analyses, MAP kinases (MAPK), Ion fluxes and calcium homeostasis, Oxidative bursts, Nitric oxide (NO), (p)ppGpp signaling molecules, Low molecular weight signaling molecules, RNA as a signal.

UNIT III Resistance genes, genetics of plant pathogen interactions, and genetics of fungi [15]

Resistance gene: Gene- for gene resistance, Features of cloned resistance genes, R gene specificity, Genetic organization of resistance genes, Mechanism of generating new R gene specificities, Co-evolution of resistance genes, Recessive resistance genes, Quantitative resistance.

Genetics of Plant Pathogen Interactions: Genetics of host Parasitic interactions, Physiological specialization in fungi, Production of New races, Adaptations of fungi to different Hosts, Resistance and Susceptibility

UNIT IV: Molecular diagnostics and application to conventional disease control: [15]

Molecular Diagnostics:

Classical approaches; Use of antibodies-Polyclonal antibodies, Monoclonal antibodies, Recombinant DNA techniques; Serological Tests-ELISA, Lateral flow techniques, other uses of antibodies; Nucleic acid based techniques- Identification of pathogen specific markers, Hybridization techniques, PCR based technique, Gene-array based techniques, Quantitative PCR; and Phylogenetic analysis.

Transgenic approaches for crop protection:

Pathogen derived resistance - Coat –protein mediated resistance, Replicate mediated resistance, Movement protein mediated resistance, RNA mediated resistance, Pathogen derived resistance against bacterial and fungal diseases; Plantibodies; Over expressing defense genes; Expressing defense genes under the control of inducible promoters; Use of clonal resistance genes; Engineering broad –spectrum resistance; Resistance based on antagonistic microbes; and Expression of vaccines in plants.

Learning Outcomes:

- 1) The students will be able to validate the pathogen through molecular approach.
- 2) The students will be learn about resistance mechanism in plants.

- 3) The students will be able to understand the genes in plants conferring the resistance to plants against the pests and pathogen.
- 4) The students will be able to understand the concept of transgenic resistant to pests and pathogen.

Reference Books:

- **Dickinson M.**(2008). Molecular Plant Pathology. BIOS Scientific Publishers, London and new York. (Unit I,II,III,IV)
- **Agrios, G. N.** (1997). Plant Pathology, 4th Edn. Academic press, San Diego (Unit I)
- **Chandrashekharan S. N.** and **S. V. Parthasarthy** (1965). Cytogenetics and Plant Breeding. P. Varadachary and Co. Madras. (Unit I,III)
- **Dickison, M. J.** and **J. Beynon** (2000). Annual Plant Reviews, Volume 4-Molecular plant Pathology. Sheffield Academic press,Sheffild. (Unit I,II,III,IV)
- **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 II)
- **Roberts D. A.** and **Bothroyd C. W.** (1995) Fundamental Plant Pathology. W. H. Freeman & Co (Unit I)
- **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. (Unit I,II,III,IV)
- **Sambamurty, A. V. S. S.** (2008). Molecular biology. Narosa Publishing House, New Delhi. ISBN 978-81-7319-837-3. (Unit I,II,III,IV)
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- **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. (Unit IV)
- **Stuiver, M. H.** and **J. H. H. V.Custers** (2001). Engineering disease resistance in plants. *Nature* **411**: 865-868. (Unit III)
- **Tepfer, M.** (2002). Risk assessment of Virus-resistant transgenic plants. *Annual Review of Phytopathology* **40**:467-491. (Unit II)

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

PLANT PROTECTION

Semester IV

MBP 405.2: Practicals based on Theory Paper MBT 402.2 and 403.2

SECTION I

1. To study viability of weed seeds and germination rate
2. To study mycoflora of soil from crop fields.
3. To study Mycorrhiza and VAM fungi
4. To Study effect of herbicides on weeds regarding.
 - 1) Relative water content.
 - 2) Chlorophyll content
5. 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.
6. Preparation of special culture media for pathogenic fungi. (Any Two)
7. Mictometry and Biostatistics as per theory syllabus.
8. Pathophysiology – Estimation of plant pigmentsts
9. Pathophysiology – Estimation of polyphenols.
10. Residual analysis of methyl parathion by TLC.

SECTION II

- 1-3. Isolation and identification of fungal pathogen from leaves stem and fruits.
4. Isolation and identification of bacterial plant pathogens.

5. Production of pathogen free plants through meristem culture.
6. Isolation of antibiotic resistant bacteria.
7. UV induced auxotrophic mutant production and isolation of mutants by replica plating techniques.
8. 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.
9. 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).
10. Screening of disease resistance crop plants with conventional method.
11. Screening of disease resistance crop plants with the help of molecular markers (RAPD/ISSR)
12. Measurement of fungal pathogen genetic diversity by PCR based technique- RAPD/ ISSR markers

References:

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

Chattopadhyaya, S. P. (1987) Principles and Procedures of Plant Protection. Oxford and IBH, New Delhi.

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.