Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

(Autonomous)

Syllabus under Autonomy

For

M. Sc. I (Botany)

Academic Year 2021 – 2022

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

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

1. TITLE: **Botany**
2. YEAR OF IMPLEMENTATION: 2021 – 2022
3. PREAMBLE:

The M. Sc. Botany course under autonomy 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 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: CBCS Semester

7. MEDIUM OF INSTRUCTION: English

8. STRUCTURE OF COURSE:

1) SEMESTER FIRST (NO. OF COURSES – 04)

Code No.	**Title of Course**	**Hours/Week**	**Credit**
MBT 101	Tools and Techniques in Botany	04	04
MBT 102	Biology and Diversity of Cryptogams (Fungi, Algae and Bryophytes)	04	04
MBT 103	Plant Ecology	04	04
MBT 104	Biology and Diversity of Trachaeophytes (Pteridophytes and Gymnosperms)	04	04
MBP 105	Practical Course I (based on MBT 101 and 102)	06	02
MBP 106	Practical Course II(based on MBT 103 and 104)	06	02
	Seminar		02
	Tutorial + day to day performance		02
	Total		24

2) SEMESTER SECOND (NO. OF COURSES – 04)

Code No.	**Title of Course**	**Hours/Week**	**Credit**
MBT 201	Cell and Molecular Biology	04	04
MBT 202	Taxonomy of Angiosperms	04	04
MBT 203	Plant Pathology	04	04
MBT 204	Developmental and Reproductive Biology	04	04
MBP 205	Practical Course III (based on MBT 201 and 202)	06	02
MBP 206	Practical Course IV (based on MBT 203 and 204)	09	03
	Tutorial + day to day performance		02
	Total		27

3) SEMESTER THIRD (NO. OF COURSES – 04)

Code No.	**Title of Course**	**Hours/Week**	**Credit**
MBT 301	Cytogenetics and Plant Improvement	04	04
MBT 302	Biotechnology and Genetic Engineering	04	04
MBT 303	Plant Diversity I (Elective)	04	04
MBT 304	Plant Diversity II (Elective)	04	04
MBT 305	Plant Protection I (Elective)	04	04
MBT 306	Plant Protection II (Elective)	04	04
MBP 307	Practical Course V (based on MBT 301 and 302)	06	02
MBP 308	Practical Course VI (based on MBT 303 and 304/ MBT 305 and 306)	06	02
	Tutorial + day to day performance		02
	Total		27

4) SEMESTER FOURTH (NO. OF COURSES – 04)

Code No.	**Title of Course**	**Hours/Week**	**Credit**
MBT 401	Plant Physiology and Metabolism	04	04
MBT 402	Biodiversity, Conservation and Utilization	04	04
MBT 403	Plant Diversity III (Elective)	04	04
MBT 404	Plant Diversity IV (Elective)	04	04
MBT 405	Plant Protection III (Elective)	04	04
MBT 406	Plant Protection IV (Elective)	04	04
MBP 407	Practical Course VII (based on MBT 401 and MBT 402)	06	02
MBP 408	Practical Course VIII (based on MBT 403 and MBT 404/ MBT 405 and MBT 406)		
	PROJECT		02
	Tutorial + day to day performance		02
	Total		14

2) Structure and titles of courses of M. Sc. Course

M. Sc. I Semester I

Course I: Tools and Techniques in Botany

Course II: Biology and Diversity of Cryptogams (Fungi, Algae and Bryophytes)

Course III: Plant Ecology

Course IV: Biology and Diversity of Trachaeophytes (Pteridophytes and Gymnosperms)

Botany Practical I: Practicals based on Theory course I and II

Botany Practical II: Practicals based on Theory course III and IV

M. Sc. I Semester II

Course V: Cell and Molecular Biology

Course VI: Taxonomy of Angiosperms

Course VII: Plant Pathology

Course VIII: Developmental and Reproductive Biology

Botany Practical III: Practicals based on Theory course V and VI

Botany Practical IV: Practicals based on Theory course VII and VIII

3) OTHER FEATURES:

A) LIBRARY:

Reference books, Text books, Journals, 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 Equipments:

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
21. Gel Electrophoresis (Horizontal and Vertical)
22. Laminar Air Flow
23. Distillation unit
24. Nephalometer
25. Suction pump
26. Heating mantle
27. Conductivity meter
28. HPLC
29. Gas Chromatography
30. Atomic Absorption Spectrophotometer
31. FT-IR

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester I

Theory Course I (MBT 101) Tools and Techniques in Botany

Learning Objectives:

1. To understand and apply statistical methods for the design of life science research and analysis of data.
2. To learn about separation of biomolecules and biochemicals based on size, shape, charge and state by using basic techniques such as centrifugation, chromatography and electrophoresis.
3. To learn microscopy basics, different types of microscopes, and working of microscopes.
4. To develop understanding of techniques for tissue culture, cell culture and organ transplantation.

Unit I: General techniques

Collection and preservation of plant material, Cryopreservation – introduction, steps involved and applications. **(03)**

Biochemistry Laboratory: Laboratory disciplines, safety and care, experimental report, SI units, pH and Buffers. **(03)**

Equipments: Laminar Air Flow, Autoclaves, Thermal Water Bath, Shaker, Stirrers, Oven, Incubators. **(02)**

Culture Techniques: Principles, Types (Bacterial, Fungal, Plant), Media Preparation, Sterilization, Inoculation and Incubation. **(05)**

Palaeobotanical Techniques: Peel technique, Palaeopalynological techniques. **(02)**

Unit II: Microscopic and Spectroscopic Techniques

Microscopy- Introduction, Principles, Working and Applications of Light Microscope, Compound Microscope, Con-focal Microscope, Stereomicroscope, Phase Contrast Microscope, Transmission Electron Microscope, Scanning Electron Microscope **(07)**

Spectroscopy- Introduction, Principles and Applications of X-Ray Diffraction, UV-Vis, Fluorescence, AAS, Infrared and Raman Spectroscopy and NMR **(08)**

Unit III: Separation Techniques

Centrifugation: Basic principles of centrifugation, types, care and safety aspects of centrifuges, Density gradient centrifugation **(05)**

Chromatography: Principles, working and applications of Course, Thin Layer Chromatography (TLC), Column, High Performance Liquid Chromatography (HPLC), High Performance Thin Layer Chromatography (HPTLC) and Gas Chromatography (GC) **(05)**

Electrophoresis: General principle, Support Media, Electrophoresis of proteins and nucleic acids, Capillary Electrophoresis, Microchip Electrophoresis. **(05)**

Unit IV: Computational Techniques

Biostatistics: Introduction, Collection and Preparation of Data **(02)**

Measures of central tendency – Introduction, Mean, Mode and Median **(03)**

Measures of dispersion – Introduction, Mean Deviation, Standard Deviation, Variability, Variance, Coefficient of Variation; Tests of Significance – T-test, Chi-square Test **(04)**

Presentation of data: Tabular, Graphical and Diagrammatic Presentations **(03)**

Computers in Biology: Excel and SPSS **(03)**

References:

Unit I:

1. SK Jain and RR Rao, Handbook of field and herbarium techniques (Today and Tomorrow Publishers, 1978)
2. Wilson and Walker, Practical Biochemistry: Principles and Techniques. (Ed. E. Cambridge Publ., 2000)
3. HN Andrews Studies in Paleobotany, 1961

4. MJ Purvis and DC Collier and D Wallis, Laboratory techniques in Botany
5. KR Aneja, Text Book of Experimental Biology
6. Verma and Agarwal, Text book of Biotechnology (S. Chand Publication)
7. Verma and Agarwal, Text book of Microbiology (S. Chand Publication)
8. MJ Purvis and DC Collier and D Wallis, Laboratory techniques in Botany

Unit II:

1. Horst Piller-Microscope photometry
2. MJ Purvis and DC Collier and D Wallis, Laboratory techniques in Botany
3. Verma and Agarwal, Text book of Biotechnology (S. Chand Publication)
4. Verma and Agarwal, Text book of Microbiology (S. Chand Publication)
5. GA Meek and HY Elder, Analytical and quantitative methods in microscopy
6. Horst Piller Microscope photometry
7. A Engstrom and JB Finean, Biological Ultrastructure
8. Ruthmann August, Methods in Cell Research
9. Brain and Ten Cate, Techniques in Photomicrography
10. Roger P. Loveland, Photomicrography: A comprehensive treatise

Unit III:

1. Schwer and Zeclinskin, Methods in plant molecular biology (Academic Press New York, 1989)
2. Jensen, Plant histochemistry
3. Coombs, Hall, Long and Sourlock, Techniques in Bioproductivity and photosynthesis (Pergamon press Oxford, 1985)
4. Colowick and Kaplan, Methods in enzymology (Academic Press)
5. Wilson and Walker, Practical Biochemistry: Principles and Techniques. (Ed. Cambridge Publication, 2000)

Unit IV:

1. Goswami HK and R. Goswami, Practical cytology, applied genetics and Bio-statistics (Himalayan Publication House, Bombay, 1993)
2. Text Book of Biostatistics (S. Chand Publication)
3. Biostatistics: Basic Concepts and Methodology for the Health Sciences, Isv 9th Edition

4. Bernard Rosner, Fundamentals of Biostatistics

Learning Outcomes:

1. The students should be able to explain different techniques used in plant sciences.
2. The students should be able to define the principles and method to be utilized for respective botanical technique.
3. The students should be able to write answers and brief notes about all the techniques studied.

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester I

Theory Course II (MBT 102) Biology and Diversity of Cryptogams (Fungi, Algae and Bryophytes)

Learning Objectives

1. To impart knowledge of plants of lower groups and their uses in wellbeing of mankind
2. To create the awareness of plant conservation in society.

Unit I: Algae

General Characters of Algae **(1)**

Diversity and Distribution of Algae - Habitat diversity (Freshwater, Marine, Edaphic, Epiphytes, Endophytes, Parasites, Algal Blooms) **(3)**

Classification of Algae: Classical Systems of Algal Classification by Smith and Fritsch, Recent developments in algal classification with special emphasis on emerging trends in molecular phylogeny and their relationships **(4)**

Thallus Organization and Reproduction, Phylogeny and interrelationship of following classes: Cyanophyceae, Chlorophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae, Rhodophyceae **(6)**

Contribution of any two Phycologists **(1)**

Unit II: Fungi

General characters of Fungi **(1)**

Classification of Fungi by Ainsworth, et al 1971, Alexopoulus, Mims and Blackwell (1993) **(2)**

Thallus organization, Reproduction and Life cycle pattern in

Myxomycetes – Types of plasmodia and fruit bodies; Chytridiomycetes – Chytridiales; Zygomycetes – Mucorales; Ascomycetes – Types of fruit bodies and study of life cycle pattern of Saccharomycetales, Erysiphales, Xylariales, Pezizales; Basidiomycetes – Types of basidia and basidiocarp and study of life cycle pattern in Uredinales, Ustilaginales, Agaricales, Aphyllophorales, Lycopodales; Deuteromycetes – Types of conidia and conidiomata, Conidiogenesis **(11)**

Contribution of any two Indian and any two foreign Mycologists **(1)**

Unit III: Bryophytes

General characters of Bryophytes **(1)**

Classification of Bryophytes - old and modern systems of classification of bryophytes **(2)**

Distribution, Habit, Morphology, Reproduction, Phylogeny, and Inter-relationship of following orders: Sphaerocarpales, Takakiales, Calobryales, Jungermanniales, Anthocerotales, Sphagnales, Polytrichales **(8)**

Origin of Bryophytes **(2)**

Contributions of any two Bryologists **(2)**

Unit IV: Applied aspects of Algae, Fungi and Bryophytes

Cultural Techniques in Algae, Fungi and Bryophytes **(5)**

Economic importance of Algae, Fungi and Bryophytes (**5)**

Use of algae and fungi in bioremediation **(3)**

Bryophytes as indicators of pollution, Conservation of Bryophytes: need and importance **(2)**

References:

Unit I:

1. V.J. Chapman, and D. J. Chapman The Algae, (1965)
2. T.V Desikachary,. Taxonomy and Biology of Blue -green algae, (1972)
3. F. E. Fritsch, Structure and Reproduction of Algae (1965)
4. H.D Kumar,. and H. N. Singh Text book of Algae (1971)
5. B. P. Pandey, Text book of Botany – Algae (1994)
6. O.P. Sharma, Text book of Algae (1986)
7. B. R. Vashista, Botany for degree students-Algae (1995)
8. Venkataraman et al. Algae-Form and Function (1974)

Unit II:

1. G. C. Ainsworth, and A.S. Sussman : The Fungi Vols. I, II, III, IV- A and IV-B

2. , C.J Alexopoulos. and C. W. Mims, Introductory Mycology (1979) :

3. C. J. Alexopoulus, Introductory Mycology (1960)

4. Alexopoulus, Mims and Blackwell, Introductory Mycology (1993)

5. B. R. Vashistha and A. K. Sinha Botany for degree students- Fungi

6. E. A. Bessey,: Morphology and Taxonomy of Fungi (1967)

7. Dayal, Aquatic Fungi of India (1995)

8. H.C. Gangulee, and A. K. Kar, College Botany Vol. I (1992)
9. H C Dube, An Introduction to Fungi
10. Mehrotra and Aneja, An Introduction to Mycology
11. Mundkur B.B. and M.J.Trimukchar, Ustilaginales of India (1952)
12. O.P. Sharma, Textbook of Fungi (1989)
13. Sparrdo F.K., Aquatic phycomycetes (1960)
14. Subramanan, C. V., Hyphomycetes (1971)
15. Thind K. S., The Myxomycetes of India (1977)

Unit III:

1. R. N. Chopra and P. K. Kumra, Biology of Bryophytes. (1988)
2. S. R Kashyap,. Liverworts of Western Himalayas and the Punjab Plains Part I (1929)
3. N. S. Parihar, An introduction to Embryophyta. Bol. I –Bryophyta (1959)
4. Ram Udar, Bryology in India (1976) :
5. G. M. Smith, Cryptogamic Botany Bol. II (1955)
6. B. R. Vashista, Botany for degree students –Bryophyta (1996)
7. E. V, Watson, British Mosses and Liverworts (1963)
8. E. V, Watson, The Structure and life of Bryopytes (1964)

Unit IV:

1. B. R. Vashista, Botany for degree students-Algae (1995)
2. B. P. Pandey, Textbook of Botany – Algae (1994)
3. O.P Sharma, Textbook of Algae (1986)
4. B. R. Vashistha and A. K. Sinha Botany for degree students- fungi
5. H.C. Gangulee, and A. K. Kar, College Botany Vol. III (1992)
6. H.C. Gangulee, and A. K. Kar, College Botany Vol. I (1992)
7. Mehrotra and Aneja An Introduction to Mycology
8. O.O. Sharma, Textbook of Fungi (1989)
9. B.R. Vashista, Botany for degree students –Bryophyta (1996)
10. G. M. Smith, Cryptogamic Botany Bol. II (1955)

Learning Outcomes:

1. The students should be able to explain the role of Algae, Fungi and Bryophytes in human welfare.
2. The students should be able to define concepts regarding industrial applications of Algae, Fungi and Bryophytes.
3. The students should be able to write answers and brief notes about the role of Algae, Fungi and Bryophytes in economic development society.

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Yashavantrao Chavan Institute of Science, Satara

Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester I

Theory Course III (MBT 103) Plant Ecology

Learning Objectives:

1. To enable the students to understand and recognize types of ecosystems, concept of population and community.
2. To make the students aware about the environmental issues.

Unit I: Major ecosystems of the world

Biomes: Concept, biomes of world, biome distribution

Biomes of North America: Tundra, Boreal coniferous forest, Temperate deciduous forest

Grassland, Eastern pine-oak biome

Sub-tropical biome, Broad-sclerophyll biome

Tropical biomes: Tropical rain forest, Tropical savannah,

Temperate deciduous forest

Some important biomes in India

Aquatic Ecosystems: Fresh water ecosystems: Lotic and Lentic ecosystems

Marine Ecosystems: Oceans, seas, estuaries and wetlands

Unit II: Population Ecology

Properties of Population: Population density, biomass, trophic relationship, methods of estimating population density, natality, mortality, survivorship curves, population age distribution. **(02)**

Basic concepts of Rate: Birth rate, percentage growth rate, instantaneous rate. Intrinsic rate of natural increase: Specific growth rate, biotic potential **(02)**

Concepts of carrying capacity: J-shaped growth form, S-shaped growth form, Maximum carrying capacity **(01)**

Population fluctuations and cyclic oscillations: Seasonal changes, annual fluctuations, various examples of population cycles, extrinsic theories, intrinsic theories **(02)**

Density independent and density dependent mechanisms of population regulation **(01)**

Patterns of Dispersion: Basic patterns of dispersion of individuals within a population, The Allee Principle of Aggregation and Refuging **(03)**

Meta population Dynamics: Concept, Meta population distribution **(01)**

Energy partitioning and Optimization: r & k selection, A general model for r & k selection **(01)**

Population genetics: Gene frequency, genotypes. Life History Traits and Tactics: Four life history traits and predictive theories **(02)**

Unit III: Community Ecology

Types of interaction between two species- Co-evolution, Co-operation- Mycoheterotrophs, Competition- Inter and intra specific competition and Co-existence **(04)**

Positive interactions: Commensalism, mutualism **(03)**

Negative interactions: Predation, Herbivory, Parasitism **(02)**

Ammensalism and Allelopathy **(01)**

Concept of Habitat: Ecological niche, Guild, Biodiversity & stability, Biodiversity & productivity **(04)**

Synecology and Autecology **(01)**

Unit IV: Succession and Environmental Awareness

Succession: Allogenic, Autogenic, Climatic climax, Regulation of Communities and Role of species diversity, Role of predators, Models of succession, Temporal and Spatial aspects **(07)**

Environmental Education Programmes: Role of GO's and NGO's, Institute involved in various ecological activities like UNESCO, MAB, UNEP, WWF, MOEFCC, NBA etc. **(08)**

References:

Unit I

1. RS Ambasht, Plant Ecology (1990)
2. CJ Krens, Horper and Row, Ecology: The experimental analysis of distribution and abundance (1978)
3. H.F.W. Lieth, Patterns of primary production in the biosphere (1978)
4. SK Agarwal, Fundamentals of Ecology (1992)
5. IK Bradbury, The Biosphere (1990)
6. SM Das, Handbook of Limnology and water pollution with practical methodology (1989)

Unit II

1. JR Etherington, Environment and Plant Ecology (1975)
2. HI Freedman, Deterministic mathematical models in population ecology (1980)
3. Greig Smith P, Quantitative Plant Ecology (1983)
4. JP Grisms et al., Comparative Plant Ecology (1988)
5. KS Kershaw, Quantitative and dynamic ecology (1964)
6. EJ Kormondy Concept of ecology (1966)

Unit III

1. CJ Krebs, Ecology (1978)
2. KC Misra, Manual of plant Ecology (1989)
3. R Misra and RR Das, Proceedings of the school of plant ecology (1971)
4. EP Odum, Ecology, (1971)
5. EP Odum, Fundamentals of Ecology (3rd ed.) (1996)
6. EP Odum and G W Barrett, Fundamentals of Ecology (6th ed.) (2010)

Unit IV

1. SC Pandeya et al., Principles of Environment Sciences (1963)
2. PD Sharma, Ecology and Environment (2007)

Learning Outcomes:

1. The students should be able to explain ecological features.
2. The students should be able to define ecological concepts with respect to plants.
3. The students should be able to write answers and brief notes about ecological scenario in present times with respect to plants.
4. The students should undertake excursion tour to various ecological habitats.

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Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester I

Theory Course IV (MBT 104) Biology and Diversity of Trachaeophytes (Pteridophytes and Gymnosperms)

Learning Objectives:

1. To give the knowledge of Trachaeophytes and Paleoenvironment.
2. To impart the knowledge of importance of study of palaeofossils in Coal and Oil exploration.

Unit I: Pteridophytes – General and fossil types

Distinguishing characters, origin of Pteridophytes, apospory, apogamy, telome theory, stelar evolution, contribution of any two pteridologists (**03)**

Pteridophytes – Classification as per Pichi-Sermolli (1958), KR Sporne (1975) **(03)**

Current trends of Pteridophytes – molecular aspects **(01)**

Economic Importance **(01)**

Heterospory and seed habit **(01)**

Fossil Pteridophytes – *Rhynia*, *Lepidodendron*, *Lepidophyllum*, *Stigmaria*, *Lepidostrobus*, *Lepidocarpon*, *Sigillaria*, *Calamites*, *Annularia*, *Calamostachys*, *Cheirostrobus* **(06)**

Unit II: Pteridophytes – Living

Psilopsida – Distinguishing characters, External and Internal morphology and reproduction of *Psilotum* and *Tmesipteris*. **(03)**

Lycopsida – Distinguishing characters, external and Internal morphology and reproduction of Lycopodiales, Selaginellales, Isoetales **(03)**

Sphenopsida – Distinguishing characters, external and Internal morphology and reproduction of Equisitales **(03)**

Pteropsida – Distinguishing characters, external and Internal morphology and reproduction of Ophioglossales, Marratiales, Osmundales, Filicales, Marsileales, Salviniales **(06)**

Unit III: Gymnosperms (General Aspects)

Introduction, Distinguishing characters, affinities with Pteridophytes and Angiosperms. **(02)**

Gymnosperms – Classification as per Sahni (1920), Chamberlain (190), Distribution of Gymnosperms. **(02)**

Fossil gymnosperms - Pteridospermales – Important characters of *Lyginopteris*, *Medullosa*, *Neuropteris*, *Glossopteris*, *Caytonia* **(03)**

Cycadeoidales – Important characters, *Cycadeoidea*, *Williamsonia* **(02)**

Pentoxylales – Important characters of *Pentoxylon*, *Nipaniophyllum*, *Sahnia*, *Carnoconites* **(04)**

Cordaitales – *Cordaites*, *Callixylon*, *Cordaites* **(02)**

Unit IV: Gymnosperms – Living Cycads and Conifers **15**

Cycadales – Interrelationship and phylogeny, distribution, morphology and reproduction**. (02)**

Gingkoales – Living fossil, external and internal morphology and reproduction. **(02)**

Coniferales – Morphology, sporophyte and gametophyte in Pinaceae, Taxodiaceae, Cupressaceae, Araucariaceae, Podocarpaceae, Taxaceae and their interrelationships. **(07)**

Ephedrales, Welwitschiales, and Gnetales- Interelationship, Morphology of sporophyte, gametophyte **(02)**

Economic Importance **(02)**

References:

Unit-I

1. N.S. Parihar, An Introduction to Pteridophyta (1959)
2. A.Rashid, An introduction of Peridophytes (1978)
3. K.R. Sporne, Morphology of Pteridophytes (1966)
4. K. R. Surange, Indian Fossil Pteridophytes (1968)
5. A. N. Trivedi, Advances in Pteridology (2002)

6. B.R. Vashishta, Botany for degree students – Pteridophytes (1996)

Unit - II

1. F. O. Bower, The Ferns, (1963)
2. A. J. Eames, and E. M. Gifoard, Comparative morphology of vascular plants (1950)
3. A. S. Foster, and E. M. Gifford, Comparative morphology of vascular plants (1959)
4. A. G. Jermy, The Phylogeny and Classification of ferns (1973)

Unit - III

1. H.N. Andrews, Studies in Paleobotany (1961)
2. C. A. Arnold, An Introduction to Paleobotany (1972)
3. C.A. Arnold, An introduction to Paleobotany (1972)
4. S.P. Bhatnagar and Moitra Alok, The Gymnosperms (1975)
5. S.P. Bhatnagar, and Moitra Alok, The Gymnosperms (1996)
6. C. J. Chamberlain, Gymnosperms, Structure and Evolution (1966)
7. Coulter and Chamberlain, J. M. - Morphology of Gymnosperms
8. W. C. Darroh, Principles of Paleobotany (1960)
9. W. C. Darroh, Principles of Paleobotany (1968)

Unit - IV :

1. H.N. Andrews, Studies in Paleobotany (1961)
2. C. A. Arnold, An Introduction to Paleobotany (1972)
3. S.P. Bhatnagar, and Alok Moitra, The Gymnosperms (1996)
4. C. J. Chamberlain, Gymnosperms, Structure and Evolution (1966)
5. Coulter and J. M. Chamberlain, Morphology of Gymnosperms
6. W. C. Darroh, Principles of Paleobotany (1960)
7. W. C. Darroh, Principles of Paleobotany (1968)
8. C. G. K. Ramanujan, Indian Gymnosperms in Time and Space (1979)
9. K. R. Spome, Morphology of Gymosperms (1967)
10. W. N. Stewart, Paleobotany and the evolution of plants, Cambridge U.S (1983)
11. P.C. Vashistha, The Gymnosperms (1976)

Learning Outcomes:

1. The students should be able to explain the concepts of fossil and living Trachaeophytes.

2. The students should be able to define the characteristic features of fossil and living Trachaeophytes.
3. The students should be able to write answers and brief notes on morphology and diversity of extinct and extant Trachaeophytes and their importance in present global economic scenario.

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester I

Practical Course I (MBP 105) Practicals based on Theory Course I and II

Learning Objectives:

1. To give practical knowledge to students about different techniques and instruments used in plant sciences.
2. To give the practical knowledge about diversity of lower plants.

Practicals:

Section I

1. ANOVA use of computer.
2. Determination of Correlation Coefficient.
3. Accessing biological data bases and E-mail operations.
4. Preparation of standard solutions: %, M, N, ppm, etc.
5. Verification of Beer and Lambert's law.
6. Density gradient centrifugation
7. Separation of proteins by gel electrophoresis.
8. Study of instruments / equipments.- Photomicrography, Flame photometer, R.C., GC, HPLC, AAS, SEM.
9. Media Preparation and Shoot Tip Culture.
10. Micrometry.

Section II

11-13. Study of Algae: Types mentioned against each class in theory course (available specimens / slides) Charophyceae (any one form); Chlorophyceae (3 forms), Cyanophyceae (3 forms), Bacillariophyceae (2 forms), Phaeophyceae (3 forms), Rhodophyceae (3 forms).

14. Culturing of algae.

15. Isolation of fungi from soil and air their inoculation on culture media.

16-18. Detailed study of following types from each of the following orders: Myxomycetes (two forms), Chytridiomycetes (two forms), Oomycetes (two forms), Ascomycetes (six forms), Basidiomycetes (six forms), Deuteromycetes (two forms).

19-20. Morphological, anatomical and reproductive studies of the following members (available specimens / slides) Hepaticopsida (four forms), Anthocerotopsida (two forms), Musci (three forms).

Learning outcomes:

1. Students get the knowledge about ANOVA and can use in experimental research work.
2. Students get the knowledge about statistics and can use in experimental result.
3. Students get the knowledge to operate email and exchange the biological information.
4. Students get the knowledge about Preparation of standard solutions.
5. Student understand the use Spectrophotometer.
6. Student understand the use Centrifuge.
7. Student understand the use Gel Electrophoresis.
8. Students get the knowledge about use of instruments / equipments.-Radioactive counters, Photomicrography, Flame photometer, R.C, GC, HPLC, AAS, SEM.
9. Student understands the Media preparation and technique of shoot tip culture.
10. Students learn about Micrometry technique and its applications.

11-13. Students get the knowledge of different Algal Forms.

14. Students learn about Culture technique of Algae.
15. Students learn about Isolation and Culture technique of Fungi.

16-18. Students get the knowledge of different Fungal Forms.

19-20. Students get the knowledge of different Bryophytes.

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester I

Practical Course II (MBP 106) Practicals based on Theory Course III and IV

Learning Objectives:

1. To give practical knowledge to students about ecology of plants.
2. To give the practical knowledge about morphological and anatomical variations in living and fossil Trachaeophytes.

Practicals:

Section I

1. Study of Phytoplanktons.
2. Evaluation of abiotic components of aquatic ecosystem (pH, Temperature and Transparency).
3. Determination of Phytomass.
4. Study of Species diversity index.
5. Study of population dynamics.
6. Determination of field capacity of soil.
7. Estimation of primary productivity of an aquatic ecosystem.
8. Determination of hardness of water.
9. Determination of residual Chlorine from water sample.
10. Ecological reports based on tour and / analysis.

Section II

11-15. Morphological, Anatomical and Reproductive studies of the following members (available specimens / slides) (Extant) - Psilotales –*(Psilotum)*; Lycopodiales - *Lycopodium*; Isoetales - *Isoetes*; Filicales - *Microsorium*; Marattiales – *Angiopteris*; Salviniales - *Salvinia*.

16. Study of the Morphology and Anatomy of (Extant) the vegetative and reproductive parts of: *Araucaria*, *Cupressus*, *Podocarpus*, *Ginkgo*, *Taxus*, and *Ephedra* from available specimens / slides. (Any four)

17-20. Study of following fossil specimens: Psilophytales - *Rhynia* stem; Lepidodendrales - *Lepidocarpon*, *Lepidodendron*, *Lepidophyllum*; Sigillariales - *Sigillaria* Stem; Sphenophyllales - *Sphenophyllum* Stem, *Calamites* stem, *Annularia* stem (any one); Marattiales - *Psaronius* stem; Medullosales - *Medullosa*/ *Pachytesta* Seed; Coniferales - *Elatocladus*, *Brachyphyllum*; Cycadaless - *Ptilophyllum*, *Pterophyllum*; Glossopteridales - *Gangamopteris* leaf, *Glossopteris* leaf; Angiosperms - *Palmoxylon* stem, *Pentoxylon* Stem, *Sahnianthus* flower, *Sahnipushpam* flower.

Learning out-come:

1. The student shall learn how to collect samples of phytoplanktons and to identify them under the microscope.
2. The student shall learn to measure the abiotic components by different techniques available.

3-9. The student shall get acquainted with the techniques employed in the field for the study of ecological parameters related to ecosystem, soil and water.

10. The student shall visit different areas to study the ecology of the place and learn to record the observations in their field diaries.

11-15. The students shall learn about extant Pteridophyte species through slide preparations.

16. The students shall learn to study the morphological, anatomical characters of vegetative and reproductive parts of the available extant gymnosperm plant species.

17-20. The student shall learn about the fossil specimen through permanent slides.

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester II

Theory Course V (MBT 201) Cell and Molecular Biology

Learning Objectives:

1. To introduce various aspect of Cell biology to the students
2. To impart the knowledge of modern techniques in cell Biology
3. To motivate the students to take Keen interest in applied aspects of cell biology

Syllabus:

Unit I: The Cell

Dynamic cell: Ultra structure of Plant cell and cell organelles, organization and their functions **(05)**

Plasma membrane: Structure, models and functions, Channels and pumps, receptors: GPCR and RTK, transport: uniport, symport and antiport, Cell signalling: introduction, primary and secondary signallng molecules **(05)**

Cell wall: Structure and its functions **(01)**

Plasmodesmata and Gap junctions: Structure and role in intracellular transport of molecules **(04)**

Unit II: Cell Motility and Multiplication

Organellar Genomes: Organization and function of chloroplast and mitochondrial genome **(02)**

Cell shape and motility: The cytoskeleton, organization and role of microtubules and microfilaments, motor movements, implications in flagellar and other movements **(05)**

Cell division: Mitosis and Meiosis **(02)**

Cell multiplication and turnover: Cell Cycle, Steps in cell cycle, control system, Cell cycle check points, Cyclin dependent kinases, and cyclines, Meiotic cell division and Dynamics of chromosome movement during cell division, proteolysis, apoptosis **(06)**

Unit III: Gene and Organization of Genetic Material

Concept of gene and overview of chemistry of gene **(02)**

DNA replication in prokaryotes and eukaryotes **(03)**

DNA damage: spontaneous damage, damage due to physical and chemical mutagens **(02)**

DNA repair systems: Direct repair, Excision repair (NER, BER), Mismatch repair and SOS repair **(04)**

Packaging of DNA in prokaryotes and eukaryotes **(01)**

DNA modifications **(01)**

Repetitive and Unique DNA sequences **(01)**

Split genes, Overlapping genes, Pseudo genes and Cryptic genes **(01)**

Unit IV: Gene expression and Gene regulation in Prokaryotes and Eukaryotes

Introduction, Central Dogma, Sense and antisense strand **(01)**

Transcription: Concept and requirement of transcription, Transcription Unit, Transcription process in Prokaryotes and Eukaryotes, Reverse transcription **(04)**

RNA processing and editing **(01)**

Translation: Introduction, requirement, Genetic code and Translation Process in Prokaryotes and Eukaryotes **(03)**

Post translational processing of proteins and protein transport **(01)**

Regulation of Gene Expression: Introduction, levels of regulation, regulation of gene expression in Prokaryotes, and regulation of expression in eukaryotes with variety of mechanisms **(05)**

References:

Unit I:

1. Johnson Lewis, Cell Biology (Sarup and sons, New Delhi, 2004)
2. CB Powar, Cell Biology (Himalaya Publishing House, 1992)
3. Sandhya Mitra, Elements of Molecular Biology (McMillan India Ltd., N. Delhi, 1988)

4. B Alberts et al, Molecular Biology of Cell; 6th edition (Garland Science, Taylor and Francis, New York, 2014)
5. GM Cooper and RE Housemen, The Cell: Molecular Approach; 7th edition (2015)

Unit II:

1. John PCL (Ed.), The Cell Cycle (Cambridge University Press, 1981)
2. EJ Dupraw, Cell and Molecular Biology, (Academic Press, London, 1970)
3. De Robertis and De Robertis, Cell and Molecular Biology (VIII) (B.I. Waverly Pvt. Ltd., New Delhi, 1997)
4. CP Swanson, T Merz and WJ Young, Cytogenetics (Prentice – Hall of India Pvt. Ltd., New Delhi,1982)

Unit III:

1. Benjamin Lewin, Genes – VI, VII and VIII, Oxford Press.
2. Watson et al, Molecular Biology of the Gene (V) (Pearses Educatias, Inc India, 2004)
3. JA Charlothe, Molecular Cell Biology (Addison. Wesley Publ. Company, 1986)
4. Turner PC et al, Molecular Biology (II) (Viva Books, Pvt. Ltd., New Delhi 2002)
5. Wolfgang Schumann, Principles of Gene Regulation, (2006)

Unit IV:

1. RA Chapoldi, Membrane proteins and their interactions with lipids, Marcel Dekker, Inc. N. York (1977)
2. AN Mortonosi (ed.) The enzymes of Biological Membranes Vol. I, II and III (Plenum Press, New York, 1985)
3. W Ream and KG Field, Molecular Biology Techniques (Academic Press, London, 1999)
4. Bruce Alberts et al, Molecular Biology of the cell (Garland Publ. Inc., New York 1983)

Current and Back Volumes of following Periodicals:

Annual review of plant Biology:

• Cell

• Cytologia

• Journal of Genetics

- The Journal of Cytology and Genetics
- Journal of Experimental Biology
- The Journal of Biochemistry
- Indian Journal of Biochemistry and Biophysics.
- Trends in Biotechnology

Learning Outcomes:

1. The students should be able to explain the concepts of the cell.
2. The students should be able to define the characteristic features of cell and gene.
3. The students should be able to write answers and brief notes on the current findings in the field of cell and molecular biology.

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester II

Theory Course VI (MBT 202) Taxonomy of Angiosperms

Learning Objectives:

1. To convey the basic rules of classification of angiosperms.
2. To make students aware of the recent systems of classification in angiosperms.
3. To motivate the students to identify the plants around them.

Unit I: General Aspects and History of Classification

Principles, aims and basic components of taxonomy, Principles, aims and basic components of taxonomy **(03)**

History of classification, Units of classification **(02)**

Outline of current systems of classification and their merits and demerits: Cronquist, Dahlgren, Thorne,

Wettstein (up to subclass level) and APG III (2009) and APG IV (2018) **(06)**

Origin of Angiosperms, the Cradle and Ancestors of angiosperms: Coniferales-Amentiferae Theory, Ephedrales Theory, Gnetales-Angiosperms Theory, Durion Theory and Gigantopteridalean **(04)**

Unit II: Nomenclatural Aspects of Classification

History and principles of ICBN **(03)**

Importance and major codes of nomenclature **(03)**

Names of taxa, the type method, author citation, effective and valid publications, retention and choice of names, rejection and conservation of names **(03)**

Literature in taxonomy – Floras, Manuals, Monographs, Icones, Journals and Checklists **(02)**

Taxonomic keys – Indented and Bracketed **(04)**

Unit III: Modern Trends of Classification

Modern trends in taxonomy – Embryology, Palynology, Chemotaxonomy, Numerical Taxonomy, Molecular systematics and Computerized systematics **(11)**

Taxonomic tools – Herbarium techniques, Importance of herbaria in Botanical research, purpose of digital herbarium. **(02)**

Botanical gardens of India and their role in teaching, research and conservation **(02)**

Unit IV: Taxonomic Aspects of Classification

Study of selected families of angiosperms as per classification of APG IV (2018) with reference to diversity in Morphological characters, distinguishing characters, affinities and economic importance **(15)**

MAGNOLIIDS: Magnoliaceae, Annonaceae;

MONOCOTS: Araceae, Liliaceae; Arecaceae, Cannaceae, Zingiberaceae; Orchidaceae

EUDICOTS: Papaveraceae, Ranunculaceae;

Super Asterids: Caryophyllaceae; ROSIDS: Myrtaceae; Rosaceae, FABIDS- Cucurbitaceae COM clade; Placement uncertain- Oxalidaceae; Malvids: Malvaceae, Brassicaceae ASTERIDS: Sapotaceae, Lamiaceae, Gentianaceae, Apiaceae, Acanthaceae

References:

Unit I

1. A Cronquist An Integrated System of Classification of Flowering Plants (Columbia University Press, New York, 1981)
2. A Cronquist, The Evolution and Classification of Flowering Plants (2nd ed.) (Allen Press, USA 1988)

Unit II

1. PH Davis, VH Heywood, Principles of Angiosperm Taxonomy (Today and Tomorrow Publications, New Delhi., 1991)
2. GHM Lawrence, Taxonomy of Vascular Plants (Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi 1951)
3. VN Naik, Taxonomy of Angiosperms (Tata McGraw-Hill Publication Com. Ltd. New Delhi 1984)

Unit III

1. KS Manilal, Muktesh Kumar MS, A Handbook of Taxonomic Training (DST, New Delhi, 1998)

2. Gurucharan Singh, Plant Systematics, Science Publishers US, 2004)
3. WS Judd, CS Campbell, EA Kellogg, PF Stevens, MJ Donoghue, Plant Systematics: A phylogenetic Approach (Sunderland, Massachusetts, USA, 2008)
4. GHM Lawrence, Taxonomy of Vascular Plants (Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi, 1951)

Unit IV

1. Gurucharan Singh, Plant Systematics (Science Publishers US, 2004)
2. Bharati Bhattacharya, Systematic Botany (Alpha Science International, 2009)
3. J Hutchinson, Families of Flowering plants (1959)
4. A Takhtajan, Flowering plants- Origin and Dispersal (1962)
5. DV Taylor, LJ Hickey, Flowering Plants: Origin, Evolution and Phylogeny (CBS Publishers & Distributers, New Delhi, 1997)
6. R. N. Sutaria, Textbook of Systematic Botany (Publ. Ramniklal P. Kothari, 1998)

Learning Outcomes:

1. The students should be able to explain the concepts of angiosperm classification.
2. The students should be able to define the characteristic features classification systems.
3. The students should be able to write answers and brief notes on the current trends in the field of angiosperm systematics.
4. The student should undertake short tour to different floristic regions.

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester II

Theory Course VII (MBT 203) Plant Pathology

Learning Objectives:

1. To impart the knowledge of Plant pathogens, diseases and management.
2. To impart the knowledge of applications and significance of plant pathology.

Syllabus:

Unit I: General Aspects

Introduction, definition, importance and scope of plant pathology **(02)**

History of plant pathology; Socio economic importance of plant diseases **(02)**

Discovery and role of fungi, bacteria, viruses, nematodes and MLO's as plant pathogens; Development in chemical control of plant diseases **(02)**

Discovery of Bordeaux mixture, Confirmation of Prevost's work, Koch's postulates **(01)**

Contribution of Anton de Bary, Brefeld, Woronin, J. G. Horsefall, E J Butler, E C Stakman, K C Mehta, B B Mundkar, M J Thirumalachar **(03)**

Plant diseases and classification of plant diseases **(01)**

Symptoms of plant diseases- necrotic, hypertrophic and hypoplasic **(02)**

Causes of plant diseases- animate and inanimate causes, plant disease Clinic **(02)**

Unit II: Pathogenesis

Dispersal of plant pathogens: Methods of autonomous and passive dispersal of plant pathogens, diseases and epidemiology (03)

Stages in development of disease cycle- Inoculation, Prepenetration, penetration, infection, invasion, colonization of host (04)

Pathogenesis- Penetration and infection by plant pathogen (03)

Enzymes and toxins in Plant diseases: Pectic enzymes, macerating enzymes, cellulolytic enzymes, ligninolytic enzymes, proteolytic enzymes, lipolytic enzymes, toxins and plant diseases, classification of toxins (05)

Unit III: Physiological Plant Pathology

Alteration in plant physiological functions due to disease- Permeability, Translocation, photosynthesis, respiration, nitrogen metabolism, protein metabolism, growth regulators in plant diseases **(05)**

Plant defense mechanism- Morphological and structural defense, biochemical defense, Defense through induced synthesis of proteins, enzymes, detoxification of pathotoxins, hypersensitive defense reaction, phytoncides **(05)**

Effect of environmental factors and nutrition on disease development—temperature, humidity, moisture, soil, pH, soil texture, light, nutrients **(05)**

Unit IV: Study of Important Diseases w.r.t causal organism, symptoms, control measures

Rots and Downy Mildews - Late blight of potato, Fruit rot of cucurbit, Downy mildew of grapes, White rust of crucifers **(02)**

Powdery mildew- Powdery mildew of peas, grapes, roses and cucurbits **(02)**

Smuts - Loose smut of wheat, Bunt of wheat, Grain smut of jowar, Whip smut of sugarcane **(02)**

Rusts - Wheat rust, Rust of pea and beans, Rusts of gram and groundnut, Rust of jowar and bajra **(03)**

Wilt and leaf spots - Wilt of cotton, wilt of *Cajanus*, Panama disease of banana, Leaf spot of turmeric, Early blight of potato, Blast of rice, Tikka of groundnut, Red rot of sugarcane, Fruit rot of chillies **(03)**

Bacterial diseases – Angular leaf spot of cotton, Brown rot of potato **(01)**

Viruses, MLO's and nematodal diseases – Mosaic of Tomato, Viral disease of Papaya, Yellow Vein Mosaic of Bhindi, Bunchy top of Bananas, Root knot of vegetables, Grassy shoot of Sugarcane **(02)**

References:

Books

Unit I

1. G. N. Agrios, Plant Pathology, 5th Edition (2006)
2. A. Agarwal and R. S. Mehrotra, Plant Pathology (2012)
3. J. Kuijit, The Biology of parasitic flowering plants (1969)

Unit II

1. G. N. Agrios, Plant Pathology, 5th Edition (2006)
2. J. E. Planke, Vander. Plant Diseases, Epidemics and control (1963)
3. S. Gangopadhyay, Clinical Plant Pathology (2004)
4. Hachiro Oku, Plant Pathogenesis and Disease Control (1993)

Unit III

1. K. R Aneja, Experiments in Microbiology, plant pathology and Tissue culture (1993)
2. R. Heitefuß, Paul Williams, (Eds.) Physiological Plant Pathology (1976)
3. A. Mahadevan, and R. Shridhar, Methods in Physiological Plant Pathology (1982)
4. J. E. Planke, Vander, Disease Resistance in plants (1968)

Unit IV

1. G. N. Agrios, Plant Pathology, 5th Edition (2006)
2. A. A. Cooke, Diseases of Tropical and Subtropical field, Fiber and oil plants (1981)
3. Nyvall RF, Field Crop Diseases Handbook (1979)
4. Paul Khurama, Pathological Problems of Economic crop plants and their management (1998)
5. G. Rangaswami, Diseases of Crop Plants in India (1979)
6. R. S. Singh, Plant Diseases, 9th Edition (2009)

Current and back – Volumes of following periodicals:

1. Journal of Phytopathology
2. Indian Journal of Phytopathology
3. Journal of Mycology and Plant Pathology
4. Annual reviews of Plant Pathology

Learning Outcomes:

1. The students should be able to explain the concepts of plant diseases, pathogens and plant disease clinic.
2. The students should be able to define the symptoms of plant diseases.

3. The students should be able to write answers and brief notes on symptoms and control measures of plant diseases.
4. The students should undertake pathology based institute/ agricultural fields, College/ University visits.

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester II

Theory Course VIII (MBT 204) Developmental and Reproductive Biology

Learning Objectives:

1. To give the knowledge of various developmental processes in embryology
2. To introduce various techniques used in embryological studies

Unit I: Anatomy

Shoots development: Organization of Shoot Apical Meristem (SAM) Cytological and Molecular aspects of SAM; Control of cell division and cell to cell communication; Control of tissue differentiation especially xylem and phloem. **(04)**

Leaf growth and Differentiation: Determination, control and leaf forms: Differentiation of epidermis and mesophylls. **(03)**

Root development: Organization of Root Apical Meristem (RAM), Vascular tissue differentiation, Lateral roots, root hairs, root- microbe's interaction. **(03)**

Nodal Anatomy: Unilacunar, Trilacunar, and Multilacunar nodes: Split-lateral condition, Root stem transition **(05)**

Unit II: Embryology

Male gametophyte: Pollen development and Gene expression male sterility, Sperm dimorphism and Hybrid seed production; Pollen tube growth and guidance; Pollen storage; Pollen embryos. **(05)**

Female gametophyte: Structure and Types of embryo sac. **(05)**

Seed development and Fruit growth: Endosperm development during early Maturation and Dessication stages: Embryogenesis, Ultrastructure and Nucellar cytology **(05)**

Unit III: Pollen Studies

Pollen: Structure of stigma and style, Chemotropism, Pollen wall proteins, Stigma surface proteins, Post fertilization events. **(03)**

Experimental Embryology: Techniques of culture for anther, ovary, nucellus, endosperm, embryo and their significance. **(03)**

Types of Apomixis: Diplospory, Apospory. Causes, consequences and Significances of Apomixis. **(03)**

General account of pollen morphology: Polarity, size shape, Symmetry, apertures (NPC Classification included), Exine, Stratification, dimorphism and hybrid seed production; pollen tube growth and guidance; pollen storage; pollen embryos. **(06)**

Unit IV: Applications of Palynology

Palynology: Scope and branches. **(02)**

Palyno-taxonomy: Pollen morphology and plant taxonomy with reference to Gymnosperms and Angiosperms. **(03)**

Paleopalynology: Principles, microfossil recovery theory and techniques, microfossil groups and oil exploration. **(03)**

Aeropalynology: General account of aerobiology and its application in human respiratory allergy and immunology, Allergic properties of pollen, Pollen calendar and its importance, Principles, techniques, Methods used in atmospheric pollen monitoring (Indoor and Outdoor). **(03)**

Melittopalynology: Bee colony, Foraging behavior of bees, Unifloral & Multifloral honey, application in crop productivity. **(02)**

Agropalynology: Pollen viability, Pollen germination, Pollen Storage and their significance **(02)**

References:

Unit –I

1. M A. Barnova, Historical developments of the present classification of morphological types of stomata (Bot.Res., 1987) 53:53-79.
2. E G Cutter, Plant Anatomy. (1971)
3. E J. Eames, and M C Danials, An introduction to plant anatomy (1947)
4. K. Easau, Plant anatomy –anatomy of seed plants (1962)
5. A Fahn, Secretary Tissue system (1969)
6. A S Foster, Practical plant anatomy (1942)

7. P S Tomlinson, Anatomy of the monocotyledons. (1961)
8. H. Solender, Systematics anatomy of the dicots (1908)

Unit –II

1. B M. Johari, Experimental embryology of vascular plants. (1963)
2. P. Maheshwari, An introduction to the embryology of Angiosperm. (1950)
3. P. Maheshwari, Recent advances on the embryology of Angiosperm. (1963)

Unit –III

1. K. Bhattacharya, M R Majumdar and S G Bhattacharya, A Text book of Palynology. (2006)
2. K R Shivanna and B M Johari, The Angiosperm Pollen, structure and function (1985)
3. K R Shivanna and N S Rangaswami, Pollen Biology, A Laboratory manual. (1992)
4. K. R. Shivanna, and B M Johari, The Angiosperm pollen structure (1989)

Unit –IV

1. K. Bhattacharya, M R Majumdar and S G Bhattacharya, A Text book of Palynology. (2006)
2. K R Shivanna and B M Johari, The Angiosperm Pollen, structure and function (1985)
3. K R Shivanna and N S Rangaswami, Pollen Biology, A Laboratory manual. (1992)
5. K. R. Shivanna, and B M Johari, The Angiosperm pollen structure (1989)
1. P. K. Nair, Essentials of Palynology (1985)

Journals:

1. Journal of Plant Sciences,
2. Experimental Biology
3. Developmental Biology
4. Phytomorphology
5. Current science
6. Plant Biology
7. Int. Journal of Plant Sciences
8. Pollen Biology and Fertilization
9. Pollen Morphology
10. Journal of Paleontology

Learning Outcomes:

1. The students should be able to explain the concepts of developmental and reproductive biology of plants.
2. The students should be able to define the concepts of plant developmental and reproductive biology.
3. The students should be able to write answers and brief notes on developmental and reproductive aspects of plant biology.

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester II

Practical Course III (MBP 205) Practicals based on Theory Course V and VI

Learning objectives:

1. To enable the students to perform experiments related to study of cell and molecular biology along with latest techniques.

2. To enable the students to identify the plants using classical and modern system of classification.

Practicals:

Section I

1. Isolation of chloroplasts.
2. Study of enzyme peroixidase.
3. Study of enzyme catalase.
4. Study of acid phosphatase.
5. Estimation of DNA from dividing root tip cells of *Allium cepa.*
6. Preparation of feulgen stained chromosome in root tip cells.
7. Effect of colchicine on chromosome movements during mitosis.
8. Demonstration of Nitrate reductase (Substrate inducible enzyme).
9. Demonstration of ATPase.
10. Estimation and separation of protein from germinating and developing seeds.

Section II

11-15. Study of families of angiosperms as per theory.

i. Data base on morphology ii. Determination of family iii. Diagnostic features of series, order and family iv. Complete classification by Bentham and Hookers System of classification v. Floral formula vi. Floral diagram.

16-17. Identification of genus and species of locally available wild plants using Floras (minimum 15 plants).

18-19. Preparation of botanical keys.

20. Field trips within and around the Institute campus, compilation of field notes and preparation of herbarium sheets of such plants.

Learning Outcomes:

1. The student will learn to the isolation technique for organelles.

2-4, 8-9. The student shall learn to experimentally quantitate the activity of different enzymes in plant systems under different environmental conditions.

5. The student shall learn the technique of estimation of DNA from plant tissues

6-7. The students shall learn to prepare slides for karyotypic and chromosome studies

10. The students shall learn to isolate and quantitate the different proteins present in plant system

11-15. To understand the system of plant classification as per Bentham and Hooker.

To describe the plant based on vegetative, reproductive characters to know floral formula and to draw floral diagram.

To classify the given plant up to family level according to Bentham and Hooker

16-17. To know how to use floras to get scientific name of plant with the help of regional floras

To understand the plant diversity

18-19. To prepare artificial keys to classify the plants based on vegetative and reproductive characters

20. Field trips are arranged to know the plant diversity, plant uses and plant products prepared by the local people.

To learn the methods for preservation of plants through herbarium techniques

Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara

Syllabus introduced from June 2020

Master of Science (M. Sc.) Part – I: Botany

Semester II

Practical Course IV (MBP 206) Practicals based on Theory Course VII and VIII

Learning Objectives:

1. To give practical knowledge to students about identification of plants around them.
2. To give the practical knowledge about morphological and anatomical variations in plants.

Practicals:

Section I

1. Demonstration of Koch's postulates.
2-4. Study of Fungal diseases as per theory: Club root, Damping off, White rust of crucifers, Early and late Blight of potato, Downy mildew of grapes, Powdery mildew of cucurbits, Smut of jowar, Rust of wheat, Bunt of rice, Blast of rice, leaf spot (Tikka), Anthracnose of bean, Black rot of onion and Wilt of pomegranate.
5. Study of Bacterial Diseases as per theory: Bacterial Blight of Pomegranate and Leaf Spot.
6. Study of Mycoplasmal Diseases as per theory: Grassy shoot disease of sugarcane and Little leaf of chilli/brinjal.
7. Study of Viral Diseases as per theory: TMV, PMV and YVMV.
8. Phanerogamic plant Diseases: Total and Partial root and stem parasites.
9. Study of Nematode Diseases as per theory: Root knot.
10-13. Estimation of chlorophylls, proteins, enzymes and polyphenols from healthy and infected leaves.

Section II

11. Study of cyto-histological zonation in the Shoot Apical Meristem (SAM) in sectioned and doubled stained permanent slides of suitable plant such as *Coleus*, *Kalanchoe*, Tobacco.
12. Examine of shoot apices in a monocotyledons in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
13. Examine of L.S. of root from a permanent preparation to understand the organization of Root Apical Meristem and its derivatives (use maize, aerial roots of banyan, *Pistia* etc.), origin of lateral roots.
14. Study of leguminous roots with different types of nodules.
15. Study of leaf anatomy – structure, stomata, trichomes, types of stomata.
16. Study of ultrastructure of male and female gametophyte with the help of slides and microphotographs.
17. Culture of any one organ: anther / ovary / endosperm / nucellus / embryo.
18. Study of apomicts and polyembryonic seeds with the help of any suitable material.
19. Study of Acetolysis, pollen morphotypes and pollen fertility.
20. Study of aerospora in the vicinity of allergic plants by Tilak Air Sampler and Gravity slide method.

Learning Outcomes:

1. Students should be come to know process of pathogenesis and genuineness of plant diseases.
2. Students should be able to identify fungal diseases of plants according to symptoms and microscopic characters.
3. Students should be able to identify bacterial diseases of plants according to symptoms.
4. Students should be able to identify mycoplasma diseases of plants according to symptoms.
5. Students should be able to identify viral diseases and their symptoms.
6. Students should be learn parasitic angiosperm plants and their adverse effects on hosts.
7. Students should be able to identify root knot disease in plants and the role of nematodes in that disease.

8-10. After the estimation of various phytochemical components, student should know physiological changes in hosts after infected by a pathogen.

11-15. The student should be able to make well stained sections, observe the anatomical features under low and high power of the microscope, be able to diagrammatically sketch the structures observed under the microscope and be able to identify and comment on the significance of the structures observed.

16. The student shall learn how to study and interpret ultrastructures from electron micrographs.

17. The student shall learn the technique of organ culture of plants to raise new plantlets.

18. The student shall learn histological techniques to study the stages of development in apomicts and polyembryonic seeds.

19. The students shall learn the various techniques employed in palynological studies.

20. The students shall learn the techniques employed in study of aerospora of an area.