Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar

(Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)

Choice Based Credit System (CBCS)

Master of Science (M. Sc.)

Syllabus of

M. Sc. Botany

Implemented from

Academic year 2022 -23

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Board of studies in Botany

Sr. No.	Name	Designation
1.	Dr. C. S. Arsule	Chairman
2.	Dr. D. D. Ahire	Member
3.	Dr. Y. R. Gahile	Member
4.	Dr. P. P. Sharma	Academic Council Nominee
5.	Dr. M. L. Ahire	Academic Council Nominee
6.	Dr. S. G. Auti	Vice-Chancellor Nominee
7.	Mr. D. K. Jadhav	Alumni
8.	Dr. S. A. Punekar	Industry Expert
9.	Mr. A. S. Wani	Member (co-opt)
10.	Dr. A. A. Kulkarni	Member (co-opt)
11.	Dr. B. N. Sonawane	Subject expert

1. PROLOGUE/INTRODUCTION OF THE PROGRAMME:

M. Sc. Botany program is designed with an objective to encourage and support the growing demands and challenging trends in the educational scenario. Our training focuses on the all-round development of the students to face the competitive World.

Objectives of the M. Sc. Botany programme:

1. Understand the scope and significance of the discipline.
2. Imbibe love and curiosity towards nature through the living plants.
3. In order to make students open-minded and curious, we try our best to enhance and develop a scientific attitude.
4. We make the students fit for the society by enabling them to work hard.
5. Make the students exposed to the diverse life forms.
6. Make them skilled in practical work, experiments, laboratory equipment and to interpret correctly on biological materials and data.
7. Develop interest in Biological research.
8. Encourage the students to do research in related disciplines.
9. Develop a thirst to preserve the natural resources and environment.
10. Develop the ability for the application of acquired knowledge in various fields of life so as to make our country self-sufficient
11. Appreciate and apply ethical principles to biological science research and studies

2. PROGRAM SPECIFIC OUTCOMES (PSO) OF M.Sc. BOTANY:

Plant science is now an amalgamation of basic and applied science. Plants besides being the unique capability of plants to trap solar energy and provide food to all cannot be replicated by any system. Conventional studies like plant identification are now being supplemented with molecular techniques like DNA Barcoding. The courses have been designed to benefit all Botany students to study various aspects of plant science including its practical applications. Keeping in mind that these students can take up teaching at different levels, research work in research institutes and or industry, doctoral work, environment impact assessment, biodiversity studies, entrepreneurship, scientific writing relevant topics have been included in the curriculum.

I. Understanding the classification of plants from cryptogams to Spermatophyte. Identification of the flora within field enhances basics of plants. Study of biodiversity in relation to habitat will correlates with climate change, land and forest degradation. Application of Botany in agriculture is through study of plant pathology.

II. Understand the ultra-structure and function of cell membranes, cell communications, signaling, genetics, anatomy, taxonomy, ecology and plant Physiology and biochemistry. To understand the multi functionality of plant cells in production of fine chemicals and their wide spread industrial applications.

III: Molecular and Physiological adaptations in plants in response to biotic and abiotic stress. Genes responsible for stress tolerance genetic engineering of plants.

IV. Obtain strong foundation in classical botany, interdisciplinary subjects such as Bioinformatics, Biostatistics, Plant Biotechnology, Cell and Molecular biology, Biochemistry and Bioinstrumentation.
V. Build life skills in Edible mushroom cultivation, Biofertilizer production, pomoculture maintenance and Seed technology through value-added courses.
VI. Prepare for NET/SET examinations to fetch research fellowship/lecturership.
VII. Carry out individual short term project work to acquire knowledge on research using basic and advanced instruments/equipments.
VIII. Find opportunities for higher studies in top ranking universities
IX. Gain career in teaching/research in Botany.

3. Programme Structure and Course Titles

Sr. No.	Class	Semester	Course Code	Course Title	Credits
1.	M.Sc.	I	MSC-BO 111T	Plant Systematics I	4
2.	M.Sc.	I	MSC-BO112 T	Cell Biology and Evolution	4
3.	M.Sc.	I	MSC-BO113 T	Cytogenetics and Plant Breeding	2
4.	M.Sc.	I	MSC-BO114 P	Practicals Based on BO 111	2
5.	M.Sc.	I	MSC-BO115 P	Practicals Based on BO 112	2
6.	M.Sc.	I	MSC-BO116 P	Practicals Based on BO 113	2
7.	M.Sc.	I	MSC-BO117 T	A.Biofertilizer and Algal Technology OR B. Pomoculture and Fruit Processing Technology	2
8.	M.Sc.	I	MSC-BO118 P	Practicals based on BO 117 A OR Practicals based on BO 117 B	2
9.			MSC-BO118 B P	Practicals based on BO 117	
10.	M.Sc.	I	MSC-BO119 T	GE-1 Biofuel Technology	2
11.	M.Sc.	II	MSC-BO211 T	Plant Systematics -II	4
12.	M.Sc.	II	MSC-BO212 T	Molecular Biology	4
13.	M.Sc.	II	MSC-BO213 T	Biochemistry	2
14.	M.Sc.	II	MSC-BO214 P	Practicals Based on BO 211	2
15.	M.Sc.	II	MSC-BO215 P	Practicals Based on BO 212	2
16.	M.Sc.	II	MSC-BO216 P	Practicals Based on BO 213	2
17.	M.Sc.	II	MSC-BO217 T	A)Floriculture and Nursery Management OR (B)Mushroom Cultivation and Biopesticide Technology	2
18.	M.Sc.	II	MSC-BO218 P	Practicals based on BO 217 A OR Practicals based on BO 217 B	2
19.	M.Sc.	II	MSC-BO219 T	GE-2 Plant Organism Interaction	2

20.	M.Sc.	III	MSC-BO311 T	Botanical Techniques	4
21.	M.Sc.	III	MSC-BO312 T	Plant Physiology	4
22.	M.Sc.	III	MSC-BO313 T	Advanced Ecology	2
23.	M.Sc.	III	MSC-BO314 P	Practicals Based on BO 311	2
24.	M.Sc.	III	MSC-BO315 P	Practicals Based on BO 312	2
25.	M.Sc.	III	MSC-BO316 P	Practicals Based on BO 313	2
26.	M.Sc.	III	MSC-BO317 T	A) Mycology OR B) Angiosperm Taxonomy	2
27.	M.Sc.	III	MSC-BO318 P	Practicals based on BO 317 A OR Practicals based on BO 317 B	2
28.	M.Sc.	III	MSC-BO319 T	GE-3 Industrial Botany	2
29.	M.Sc.	IV	MSC-BO411 T	Computational Botany	4
30.	M.Sc.	IV	MSC-BO412 T	Developmental Botany	4
31.	M.Sc.	IV	MSC-BO413 T	Plant Tissue culture Technology	2
32.	M.Sc.	IV	MSC-BO414 P	Practicals Based on BO 411	2
33.	M.Sc.	IV	MSC-BO415 P	Practicals Based on BO 412	2
34.	M.Sc.	IV	MSC-BO416 P	Practicals Based on BO 413	2
35.	M.Sc.	IV	MSC-BO417 T	a) Applied Mycology OR b) Advanced Medicinal Botany	2
36.	M.Sc.	IV	MSC-BO418 P	Practicals based on BO 417 A OR Practicals based on BO 417 B	2
37.	M.Sc.	IV	MSC-BO419	Project	2
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Semester-III	**Paper-I**
Course Code :MSC-BO 311T	**Title of Course: Botanical Techniques**
Credits: 04	**Total lecture:** 60 Hours

Course Outcome:

On completion of the course, students are able to:

1. Understand the different techniques in Botany.
2. Know the different types of microscopy and its applications.
3. Understand the separation techniques.
4. Understand the process of electrophoresis and its significance.
5. Understand the different types of spectroscopy.
6. Know the centrifugation techniques.
7. Understand the electrochemical and immunological techniques.
8. Understand the applications of botanical techniques.

Detailed syllabus:

Credit- I **(15 Hours)**

UNIT I: Microscopic Techniques- Image formation (properties of light), Lens- refraction, dispersion of light, objects, images, image quality, magnification concept, resolution Optical microscopy- Light microscopy, Confocal microscopy, Phase Contrast microscopy, Fluorescence microscopy, Electron microscopy (SEM TEM and STEM), Flow cytometery and Atomic force microscopy **(8)**

UNIT II: Dissection, maceration, squash, peeling and whole mount- pretreatment and procedures Microtomy- serial sectioning, double or multiple staining, Lesser assisted Microtomy,

Histochemical and cytochemical techniques- Localization of specific Compounds/ reactions/ activities in tissues and cells, Micrometry and camera lucida **(7)**

Credit II **(15 Hours)**

UNIT I: **Chromatography techniques:-** **(8)**

Introduction, Types, Solvent systems, immobilized and mobilized phase, retention time Peak Area,

Principle, method and applications of: Paper, TLC,

Gel filtration, Affinity, Ion exchange Column Chromatography, Flash chromatography

HPLC, Gas chromatography,

UNIT II: **Elctrophoretic techniques:-** **(7)**

History, Principles, Comparative study of Horizontal and Vertical Electrophoresis

Agarose gel electrophoresis, Polyacrylamide Gel Electrophoresis (Native PAGE/ SDS-PAGE),Isoelctric focusing, 2-Dimensional Gel Electrophoresis (2-D method), MALDI-TOF, Pulsed Field Gel Electrophoresis,

Credit III **(15 Hours)**

UNIT I: **Spectroscopic techniques:-** **(10)**

General principles, Beer and Lambert's Law, Molar extinction coefficient, Electromagnetic radiations (Dual nature), Wavelength, Frequency, Properties of Electromagnetic radiations, electromagnetic spectra, Light absorption and excitation of spectra,

Spectrophotometer- Principle, working and applications of UV-Visible spectroscopy

Spectroflurometry, Nuclear Magnetic Resonance (NMR) spectroscopy, AAS, MS, IR Spectroscopy, X-ray crystallography

UNIT II: **Radioactive techniques:-** **(5)**

Radioisotopes used in biology and their properties, Units of radioactivity.

Interaction of radioactivity with matter,

Detection and measurement of radioactivity, Scintillation counter

Autoradiography, Safe handling of radio isotopes,

Fluorochromes, Green Fluorescent Proteins

Credit IV **(15 Hours)**

UNIT I: **Centrifugation techniques:-** **(5)**

Principle, Rotors, Speed and Unit, Factors affecting centrifugation,

Conversion g to rpm

Ultra-centrifugation, Density Gradient Centrifugation

UNIT II: **Electrochemical techniques**:- **(3)**

Electrical conductivity, pH meter, Oxygen electrode

UNIT III: **Immunological techniques:-** **(7)**

a) Introduction and Principles,
b) Antigen–antibody interaction, Immuno diffusion,
c) Immuno precipitation,
d) Radio-immuno assay, Rocket immumo-electrophoresis, ELISA

Suggested Readings:-

1. Srivistava M.L. (2008). Bioanylatical Techniques. Narosa Publishing House (P) Ltd.
2. Plummer David (1987). An Introduction to Practical Biochemistry. 3rd Eds. Tata McGraw-Hill Publishing Company Ltd.
3. SadasivamS.,Manickam A. (1996). Biochemical Methods. 2ndEdn. New Age International (P) Ltd.
4. Khasim S.M. (2002). Botanical Microtechniques: Principles and Practice. Capital Publishing Company.
5. Harborne J.B. (1998). Phytochemical Methods. Springer (I) Pvt. Ltd.
6. Wilson K., Walker J. (2005). Principles and Techniques in Biochemistry and Molecular Biology. Cambridge University Press.
7. Wilson K., Walker J. (2000). Practical Biochemistry Principles and Techniques. Cambridge University Press.
8. Bisen P.S. Mathur S. (2006). Life Science in Tools and Techniques. CBS Publishers, Delhi.

9. Marimuthu R. (2008). Microscopy and Microtechnique. MJP Publishers, Chennai.
10. Sharma V.K. (1991). Techniques in Microscopy and Cell Biology. Tata McGraw-Hill Publishing Company Ltd.
11. Prasad and Prasad (1984). Outline of Microtechnique. Emkay Publications, Delhi.
12. Srivastava S. and Singhal V. (1995). Laboratory Methods in Microbiology. Anmol Publication Pvt. Ltd. Delhi.
13. Pal and Ghaskadabi (2009). Fundamentals of Molecular Biology. Oxford Publishing Co.

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Semester-III	**Paper-II**
Course Code: MSC-BO 312T	**Title of Course:** Plant Physiology
Credits: 04	**Total lecture:** 60 Hours

Course Outcome:

By the end of this course, the students will:

1. Able to understand fundamentals of plant physiology.
2. To learn different nutrients and their role in plants life.
3. Understand the details of photosynthesis and its role in plants life.
4. Study the respiration metabolism and its significance.
5. Learn the lipid metabolism and its functioning in plant cell.
6. Understand the mechanism of solute transport in plants.
7. Understand the overall processes of growth and development in plants.

Detailed Syllabus:

Credit I: Plant Nutrition: **(15 Hours)**

UNIT I: Soil- Formation, structure, composition, classification and role **(1)**

UNIT II: Essential elements- Mineral and nonmineral, criteria of essentiality, role-structural, catalytic osmotic and others; influence of pH, mineral elements interaction and microbes on availability of essential elements **(4)**

UNIT III: Mechanism of absorption of mineral elements; mechanism of assimilation of sulfur, phosphorus and nitrogen **(4)**

UNIT IV: Active and passive transport, Transporters, role of ATPase and PPase **(2)**

UNIT V: Merits and demerits of use of natural and chemical fertilizers, conventional and modern methods of application of fertilizers, Transpiration ratio and water conservation strategies in plants **(4)**

Credit II: Photosynthesis: (**15 Hours)**

UNIT I: Light Harvesting Complex, Photosystem I and II (composition, light harvesting mechanism and functioning). **(2)**

UNIT II: Organization of Photosynthetic electron transport system (evidence from Membrane chemical composition, electro-potential gradient and use of ETS Component inhibitors) Photo-oxidation of water, Mechanism of establishment of proton gradient across the thylakoid membrane. Production of assimilatory powers of photosynthesis (ATP and NADPH) **(8)**

UNIT III: Fixation of CO_2: Calvin (C3), steps and regulation, Photorespiration-mechanism and significance **(2)**

UNIT IV: Fixation of CO2: C4 cycle, Kranz anatomy, biochemical sub-types, Single cell C4 Photosynthesis. **(2)**

UNIT V: CAM pathway **(1)**

Credit III: Respiration and lipid metabolism: **(15 Hours)**

UNIT I: Organization of respiratory electron transport system (evidence from membrane chemical composition, electro-potential gradient and use of ETS component inhibitors) **(2)**

UNIT II: Mechanism of NADPH and NADH oxidation, establishment of proton gradient across the membrane and ATP formation **(1)**

UNIT III: Schematic presentation of Glycolysis, TCA cycle and PPP (Home assignment). Release of energy in Glycolysis, TCA cycle and PPP and their significance **(7)**

UNIT IV: Cyanide resistance pathway **(1)**

UNIT V: Fatty acid biosynthesis, Oxidation metabolism, Properties and significance of lipids (energy storage, defense, structure and others) Synthesis of membrane lipids **(4)**

Credit IV: Solute transport, Growth and development: **(15 Hours)**

UNIT I: Growth- Relative growth rate and net assimilation rate, IRGA **(1)**

UNIT II: Plant growth regulators-types and the physiological roles of PGRs. **(1)**

UNIT III: Physiological organization phloem element for transport, Loading and unloading of phloem and mechanism of transport of solutes (Munch hypothesis); Source and sink relationship. **(3)**

UNIT IV: Stress physiology: Definition, Types: biotic and abiotic stress, effect of stress on Plants, Abiotic and biotic stress tolerance mechanism. **(9)**

Suggested Readings:

1. Berg J.M., Tymoczko J.L., Stryrer L. (2002) Biochemistry. 5th Ed. Wlt. Freeman and Company, New York.
2. Biology of Plants. American Society of Plant Physiologists Maryland, USA.
3. Buchanan B.B, Gruissem W. and Jones R.L 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologistsm Maryland, USA.
4. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
5. Davis P. J. (Eds.)(2004) Plant Hormones.Kluwer Academic Publishers, Dordrecht, Netherlands.
6. Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997. Plant Metabolism (Second Edition) Longman, Essex, England.
7. Galstone A.W. 1989. Life processes in Plants. Scientific American Library, Springer Verlag, New York, USA.
8. Goodwin T.W., Mercer E.I. (1998) Introduction to Biochemistry. CBS Publishers, New Delhi.
9. Heldt H. W. (2004) Plant Biochemistry. Academic Press, California.
10. Hopkins W. G. 1995. Introduction to Plant Physiology. John Wiley and Sons, Inc., New York, USA
11. Lawlor D.W. (2001) Photosynthesis in C3 and C4 Pathway. 3rd Ed. Viva. New Delhi.
12. Leninger A.C 1987. Principles of Biochmistry, CBS Publishers and Distributers (Indian Reprint)
13. Lincolin Taiz and Eduardo Zeiger (2010) Plant Physiology, Fifth edition. Sinauer Associates, Inc. Publishers. Sunder land, USA.
14. Lodish H., Berk A., Zipursky S, L., Matsudaira P., Baltimore D and Darnell J. 2000. Molecular Cell Biology (Iv Edition) W. H. Freeman and Company, New York, USA.

15. Metabolism (Second Edition) Longman, Essex, England.
16. Moore T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer –Verlag, New York, USA.
17. Nelson David and Cox Michael. (2007) Lehninger Principles of Biochemistry.W.H.Freeman and Company. New York.
18. Nobel P.S 1999. Physiochemical and Environmental Plant Physiology (Second Edition) Academic Press, San Diego, USA.
19. Salibury F.B and Ross C.W 1992. Plant physiology (Fourth Edition) Wadsworth Publishing Company, California,USA.
20. Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
21. Lincolin Taiz and Eduardo Zeiger (2010) Plant Physiology, Fifth edition. Sinauer Associates, Inc. Publishers. Sunder land, USA.
22. Thomas B. and Vince-Prue D. 1997. Photoperiodism in Plants (Second Edition) Academic Press, San Diego, USA.
23. Verma S.K. and Verma Mohit 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications.

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Semester-III	**Paper-III**
Course Code: MSC-BO 313T	**Title of Course:** Advanced Ecology
Credits: 02	**Total lecture:** 30 Hours

Course Outcome:

By the end of this course, the students will

1. Acquire knowledge about the nature and function of ecology.
2. Understand the concept of population and community ecology.
3. Understand the concept of ecological successions.
4. To understand the nature of ecosystems and their functioning.
5. To understand the concept of species interaction.
6. To introduce the concept of biogeography.

Detailed Syllabus:

Credit-I **(15 Hours)**

UNIT I: Introduction to science of ecology: **(4)**

Definition, concept, and scope, interdisciplinary science, autecology and synecology, branches of ecology

Environmental factors controlling plant distributions: geology, topography, elevation, soils, light, temperature, precipitation, water and humidity, fire

UNIT II: Population Ecology: **(4)**

Characteristics of a population; age structured populations, population growth curves; population regulation; life history strategies (r and K selection); concept of meta-population – demes and dispersal, interdemic extinctions.

UNIT III: Species Interactions: **(3)**

Types of interactions, interspecific / Intraspecific competition, herbivory, carnivory, symbiosis.

UNIT IV: Community Ecology: **(4)**

definition, nature, composition and characteristics of community, structure/ stratification of community, levels of species diversity and its measurement; edges and ecotones, habitat, niche and guild.

Credit-II **15 Hours**

UNIT I: Ecological succession: **(3)**

Types, mechanisms, changes involved in succession; concept of climax; relationship between ecosystem stability and diversity, ecological indicator plants

UNIT II: Ecosystems: **(6)**

Concept, nature, structure and function; Structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Energy flow in ecosystem, food chain, food web, biogeochemical cycles (C, N, P), primary production and decomposition; ecological pyramids, homeostasis, concept of limiting factors

UNIT III: Biogeography: **(3)**

Major terrestrial biomes; theory of island biogeography; floristic regions and vegetation zones of Maharashtra, India, and world and its characters, principals of classification, key species of each region.

UNIT IV: Applied Ecology: **(3)**

Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

Suggested Readings:

1. Ambasht R.S. and N.K. Ambasht (2017). A Textbook of Plant Ecology (15/E). CBS Publishers & Distributors-New Delhi.
2. Ambasht R.S., and N.K. Ambasht (2003). Modern Trends in Applied Terrestrial Ecology. Springer
3. Avery Thomas E. and Burkhart Harold E. (2015). Forest Measurements. (5/E). McGraw-Hill.

4. Barbier E.B., Burgess J.C. and Folke C. (1994). Paradise Lost? The Ecological Economics of Biodiversity; Earthscan, London
5. Bhatnagar Aditya (2010). Ecology and Environment. Oxford Book Company
6. Bowles M.L. and Whelan C.J (1996) edt. Restoration of Endangered Species Cambridge Univ. Press.
7. Chapman, J.L. and Reiss, M.J. (1998). Ecology: Principles and applications.Cambridge University Press.
8. Dash M.C. and S.P. Dash (2009). Fundamentals of Ecology (3/E). McGraw Hill Education (India) Private Limited
9. Gadgil M. and Guha R (1992). This Fissured Land: An Ecological History of India. Oxford University Press, New Delhi
10. Hajra P.K. and V. Mudgal (1997) Edt. Plant Diversity Hotspots in India - An Overview, BSI.
11. Henderson Peter A., and T.R.E. Southwood (2016). Ecological Methods. (4/E). Wiley-Blackwell Publishers
12. Heywood and Watson (1995), Edt. Global Biodiversity Assessment UNEP, Cambridge University Press.
13. Hill David, Matthew Fasham, Graham Tucker, Michael Shewry and Philip Shaw (2004) Edt. Handbook of Biodiversity Methods – Survey, Evaluation and Monitoring; Cambridge
14. Kent Martin (2011). Vegetation Description and Data Analysis: A Practical Approach (2E). Wiley-Blackwell.
15. Kormondy Edward (1995). Concepts of Ecology. Pearson Publ.
16. Krebs Charles J. (1999). Ecological Methodology (2/E). Pearson Education.
17. Krishnamurthy K.V. (2003). An Advanced Textbook on Biodiversity-Principles and Practice, Oxford and IBH Publ. New Delhi
18. Magurran Anne (1988). Ecological Diversity and Its Measurement Chapman and Hall India
19. Mani, M.S. (1974). Biogeography of India, 1st Edn.Springer Publ.
20. Michael J. Jeffries (2005). Biodiversity and Conservation, Routledge, London
21. Michael P. (1984). Ecological Methods for field and Laboratory investigations Tata McGraw-Hill Co. Ltd.
22. Misra R. (1968). Ecology Workbook. Oxford and IBH, New Delhi.
23. Odum E.P and Gray Barrett (2004) Fundamentals of Ecology. Thomson Brooks

24. Ramchandra T.V., R. Kiran, N. Ahalya (2002). Status, Conservation and Management of Wetlands. Allied Publ. New Delhi.
25. Rana S.V.S. (2013). Essentials of Ecology & Environmental Science, (5/E). PHI Learning Press.
26. Shailaja Ravindranath and Sudha Premnath (1997). Biomass Studies – Field Methods for Monitoring Biomass. Oxford and IBH, New Delhi.
27. Sutherland William J. (2006). Ecological Census Techniques – A Handbook. Cambridge Univ. Press.
28. Uma Shaanker, R. Ganeshiah, KN. and Bawa KS (2001). (Eds). Forest Genetic Resources: Status, Threats and Conservation Strategies. Oxford and IBH, New Delhi
29. Wheater C Philip, James R. Bell, Penny A. Cook (2011). Practical Field Ecology: A Project Guide. John Wiley.

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Semester-III	**Paper-IV**
Course Code: MSC-BO314 P	**Title of Course:** Practicals Based on BO 311T Botanical Techniques
Credits: 02	**Total lecture:** 60 hours

Practicals:

1. Use of fluorochromes to visualize specific cell components. **(1P)**
2. Measurement of pollen grains/algal specimen/stomata by using Micrometry. **(2P)**
3. Identification of plant tissues by maceration technique. **(1P)**
4. Electrical conductivity and pH measurements. **(1P)**
5. Absorption spectra of BSA/DNA and determination of absorption maxima. **(1P)**
6. Rocket immune electrophoresis. **(1P)**
7. Separation of leaf pigments by paper chromatography and TLC. **(1P)**
8. Separation of isozymes by native polyacrylamide gel electrophoresis. **(2P)**
9. Microtomy- Processing, double staining, sectioning. **(1P)**
10. To study of Centrifugation techniques. **(1P)**
11. Demonstrations of advanced microscopes / camera Lucida/ Microphotography **(1P)**

Note:

- Compulsory visit to Instrumental Laboratory and submission of report

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Semester-III	**Paper-V**
Course Code: MSC-BO315 P	**Title of Course:** Practicals Based on BO 312 TPlant Physiology
Credits: 02	**Total lecture:** 60 hours

Practicals:

1. Preparation of standard solutions (%, ppm, molar, normal) of different concentrations, Preparation of buffers solutions, EC and pH measurements. **(1P)**
2. Study of deficiency symptoms of essential elements on different crop plants. **(1P)**
3. Study of transpiration under biotic and abiotic stress. **(1P)**
4. Detection of amino acids/sugars using paper chromatography/ TLC from pulses **(1P)**
5. To determine the chlorophyll a/chlorophyll b ratio in C3 and C4 plants. **(1P)**
6. Estimation of soluble proteins in germinating and non-germinating seed by Lowry /Bradford's method **(2P)**
7. Survey of C4 plants and CAM plants by titration method (TAN) **(2P)**
8. To determine the activity of enzyme amylase in germinating seeds and its induction by GA. **(1P)**
9. Determination of activity of nitrate reductase. **(1P)**
10. Effect of salt /Drought stress on accumulation of proline and its estimation. **(1P)**

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Semester-III	**Paper-VI**
Course Code :MSC-BO316 P	**Title of Course:** Practicals Based on BO 313 T Advanced Ecology
Credits:02	**Total lecture:**60

Practicals:

1. Find out the minimum number and area of quadrats required to study the herbaceous ecosystem. **(2P)**
2. Study of biotic structure by List Counts Quadrat method to find out IVI. **(2P)**
3. Study of ecological indicator plants (any five) **(1P)**
4. To study the texture of the soil and determination of water holding capacity, moisture content, color and pH of different soils. **(2P)**
5. Determination of the temperature, pH, and turbidity of polluted and non-polluted water sample. **(2P)**
6. Study of wetland plants: marshy, emergent, submerged, free floating, (two examples each) **(1P)**
7. Study the map of Phytogeographical regions of India. **(1P)**
8. Biological analysis of water - DO and BOD. **(1P)**
9. Physicochemical analysis of water- Chlorine and hardness. **(1P)**
10. Visit to any one plant diversity hotspots / National Parks/Wildlife Sanctuary/ coastal area **(1P)**

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Semester-III	**Paper-VII**
Course Code: MSC-BO 317 T (A)	**Title of Course:** Mycology
Credits: 02	**Total lecture:** 30 Hours

Course Outcome:

By the end of this course, the students will

1. Learn the characteristics, identification and structure of fungi.
2. Know about affinities of fungi with other organisms.
3. Studied the general characters of different group of fungi.
4. Learn the structural details of different group of fungi.
5. Get knowledge on classification systems of fungi.
6. Learn the reproductive features of fungi.

Detailed Syllabus:

Credit I – Fungi **(15 Hours)**

UNIT I: Fungi –Affinities with plants, animals and their significance **(2)**

UNIT II: Outline classification of fungi upto order- **(4)**

- E. A. Bessey System (1950)
- Alexopoulos System (1962),
- L. E. Hawkers System (1966),
- Alexopoulos and Mims System (1979),
- Webster and Weber System (2007)

UNIT III: General characters and structural variations in- **(9)**

A) Myxomycota- Acrasiomycetes, Protosteliomycetes, Dictyosteliomycetes, Myxomycetes

B) Straminipila- Plasmodiophoromycota, Hyphochytridiomycota, Labyrinthulomycota and Oomycota

C) Mastigomycota-Chytridiomycetes

D) Zygomycota- Zygomycetes, and Trichomycetes

Credit II –Higher Fungi – **(15 Hours)**

UNIT I: General characters, structural variations in- **(5)**

Ascomycota- Archiascomycetes, Hemiascomycetes, Plectomycetes, Pyrenomycetes, Loculoascomycetes, Discomycetes

UNIT II: General characters, structural variations in- **(6)**

Basidiomycota- Hymenomycetes- Agarics and Polypores, Homobasidiomycetes - Gasteromycetes,Heterobasidiomycetes- AuricularialsDacrymycetales, TremellalesTeliomycetes–Uredinales and Ustilaginales fungi

UNIT III: General characters, structural variations in- **(4)**

Deuteromycota- Hyphomycetes- Moniliales, Mycelia Sterilia, Coelomycetes - Melanconiales, Sphaeropsidales

Suggested Readings:

1. Ainsworth et al., 1973. The fungi VI –A, VI – B, Academic press.
2. John Webster and Weber, 2007. Introduction to Fungi, Cambridge.
3. Alexopolous C.J. Minms C.W. and Blackwell M., 1999. Introductory Mycology (4th Edition), Willey, New York.
4. Deacon J. W. Fungal Biology (4th Edition) , Blackwell Publishing, ISBN 1405130660
5. Kendrick B., 1994. The Fifth Kingdom, North America, New York Publisher.
6. Kirk et al., 2001. Dictionary of fungi, 9th edition, Wallingford.
7. Mehrotra R.S. and Aneja K.R., 1990. An introduction to mycology, New Age Publication.
8. Miguel U., Richard H., and Samuel A. 2000. Illustrated dictionary of mycology Elvira Aguirre Acosta Publisher.
9. WebsterJ., and Rpland W. 2007. Introduction to fungi (3rd Edition), Cambridge University Press.
10. Dube H.C. 2010.An Introduction to fungi, Vikas Publication.
11. Vashista B. R. and Sinha A.K. 2008. Botany for Degree students- Fungi, S. Chand's Publication.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Syllabus of M. Sc. Botany
under
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Semester-III	**Paper-VII**
Course Code: MSC-BO 317 T (B)	**Title of Course:** Angiosperm Taxonomy
Credits: 02	**Total lecture:** 30 Hours

Course Outcome:

On completion of the course, students are able to:

1. Learn Scope and Importance of Taxonomy.
2. Gain the knowledge of Botanical nomenclature and classification of plants.
3. Knowledge of different tools of taxonomy.
4. Understand the process of identification of plants.
5. Learn the types and importance of biodiversity.
6. Study the role of modern trends in Taxonomy
7. This course will helpful to enhance the skill of herbarium techniques.

Detailed Syllabus:

Credit I: **(15 Hours)**

UNIT I: Introduction to Taxonomy **(4)**

Botanical Nomenclature: Brief history, Scientific names, ICN, Principles, typification, Principle of priority, effective and valid publication, rank of taxa

UNIT II: Tools of taxonomy: Floras, monographs, revisions, websites. **(4)**

Herbarium and botanical gardens, their role in teaching, research and conservation, important herbaria and botanic gardens of the World.

Botanical Survey of India

UNIT III**:** Identification of Plants: Introduction, Morphological features used in identification.

Keys: Types and Importance **(4)**

UNIT IV: Biodiversity, types, importance and methods of conservation **(3)**

IUCN and its categories, Endemism, Hotspots

Credit II: **(15 Hours)**

UNIT I: Modern Trends in Angiosperm Taxonomy **(5)**

Embryology in relation to taxonomy: Embryological characters of taxonomic importance, Anatomy in relation to taxonomy: Anatomical characters of taxonomic importance, Palynotaxonomy: pollen characters of taxonomic importance.

UNIT II: Chemotaxonomy **(3)**

Classes of compounds and their biological significance, stages in chemotaxonomic investigations, Techniques-Criteria for use of chemical in plant taxonomy

UNIT III: Serology and taxonomy **(3)**

History, precipitation reaction, techniques, antigen, antisera antibody, application of serological data in systematic

UNIT IV: Cytotaxanomy and Micromorphology **(4)**

Molecular Systematics, Molecular data and systematic position of Hydatellaceae. Herbarium Techniques- Digital herbarium

Suggested Readings:

1. A.K. Mondal, 2009 Advanced Plant Taxonomy, New Central Book Agency; 2nd Revised edition edition (1 January 2009)
2. Cooke, T. 1903-1908. The Flora of Presidency of Bombay, Vol. I-III.
3. Cronquist, A. 1981.An Integrated System of Classification of Flowering Plants. ColumbiaUniversity Press, New York.
4. Cronquist, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press,U.S.A
5. Naik, V. N. 1984. Taxonomy of Angiosperms. Tata McGraw-Hill, New Delhi.
6. Nair, P.K.K. 1966. Pollen morphology of Angiosperms.Periodical Expert Book Agency, New Delhi.
7. Paech, K. and M.V. Tracey. 1956. Modern Methods of Plant Analysis. Vol-I &II.Springer-Verlag.
8. Quicke, Donald L. J. 1993. Principles and Techniques of Contemporary Taxonomy. BlakieAcademic& Professional, London.

9. Sharma A.K. and A. Sharma. 1980. Chromosome Technique: Theory and Practices (3rded.) Butterworths, London.
10. Shivanna, K.R. and N.S. Rangaswamy. 1992. Pollen Biology- A Laboratory Manual.Springer-Verlag.
11. Singh, Gurcharan. 2010. Plant Systematics: An Integrated approach..3rd edition. Science Publishers Inc., New Hampshire, USA.

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New Arts, Commerce and Science College, Ahmednagar (Autonomous)

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under

Faculty of Science

Semester-III	**Paper-VIII**
Course Code :MSC-BO318 P (A)	**Title of Course :**Practicals based on BO 317 (A) Mycology
Credits: 02	**Total lecture:** 60 hours

Practicals:

1. Preparation of culture medium for fungi-PDA medium, CDA medium, Sabourard's medium & preparation of fungal stain & mounting medium **(1P)**
2. Isolation of aquatic and soil fungi by baiting method **(2P)**
3. Isolation of fungi from rhizosphere and non-rhizosphere soil. **(2P)**
4. Study of fungi from the following groups **(10P)**

   Myxomycetes- any four

   Chytridiomycetes- any two

   Oomycetes- any four

   Pyrenomycetes- any four

   Loculoascomycetes- any two

   Discomycetes- any four

   Teliomycetes – any eight

   Gasteromycetes- any four

   Hymenomycetes- any six

   Deuteromycetes- any six

Note:

- *Compulsory visit to Western Ghats for collection and observation of fungi (2-3 days).*
- *Visit to any one Mycology Institute/ Laboratory.*
- *Student should submit minimum 10 fungal specimens and 20 digital photographs. Minimum 5 permanent slides of fungal spores.*

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Semester-III	**Paper-VIII**
Course Code :MSC-BO318 P (B)	**Title of Course :**Practicals based on BO 317 (B) Angiosperm Taxonomy
Credits: 02	**Total lecture:** 60 Hours

Practicals:

1. Preparation of bracketed and indented key by using vegetative and reproductive plant material **(2P)**
2. Study of type specimens of any two plant species **(1P)**
3. Excursion tour for study of vegetation, ecology and flowering pattern. **(1P)**
4. Identification of wild and cultivated plants represented in local flora. **(1P)**
5. Study of wood character, vessels, storied and non storied wood **(2P)**
6. Microtome technique for study of embryological characters **(2P)**
7. Pollen preparations by Acetolysis method (Semi-permanent) and study of different pollen morphotypes. **(2P)**
8. Study of chromosomes and Karyotype analysis (Any two species) **(2P)**
9. Study of plant surface attributes with the help of SEM photographs and sieve tube plastid and dilated cisternae of endoplasmic reticulum with the help of TEM photographs **(1P)**

Note:

- *Student should submit minimum 10 conventional herbarium specimens and 20 digital herbarium specimens. Minimum 5 permanent slides of wood anatomy and 5 slides of floral anatomy (microtomy cut sections of flower specimens).*

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Semester-III	**Paper- IX**
Course Code :GE-03 MSC-BO319 T	**Title of Course :**Industrial Botany
Credits: 02	**Total lecture:** 30 Hours

Course Outcome:

On completion of the course, students will:

1) Know about the different industries based on plants.
2) Understand the role of plants and products of forest industries.
3) Learn the processes of seed industry.
4) Understand different plants used in food industry and as fodder.
5) Know the sources of alcoholic and non- alcoholic beverages.
6) Know the sources for textile and cosmetics industries.
7) Know the sources and preparation of herbal medicines.
8) Learn the concepts of tissue culture, floriculture and nurseries.

Credit I **(15 Hours)**

UNIT I: Agri industry- Production and advantages of biofertilizers, biopesticides, biofuels. **(3)**

UNIT II**:** Forest industry- Major and minor products, economics of forest industry. Production of gum, timber, rubber, dyes from their natural sources. Cultivation of *Santalum album* and *Tectona grandis.* **(4)**

UNIT III: Seed industry- Seed processing, production of hybrid seed and seedless varieties. Major seed research institutes and industries in Maharashtra and India. Concept and importance of seed bank. **(2)**

UNIT IV: Food and fodder industry– Plants used in production of jam, jelly, sauces, pickle, jaggery and its packaging. Major fodder plants in India. **(3)**

UNIT V: Beverage industry- Plant material used in production of tea, coffee, soft drinks, alcoholic beverages. Fruit juices, syrup and pulp from different plants. **(3)**

Credit II **(15 Hours)**

UNIT I: Textile industry – Plants used in production of cotton, jute, fibers, rope, coir. Natural dyes used in textile and silk industry. **(3)**

UNIT II: Cosmetics industry- Plants used in preparation of essential and aromatic oils, perfumes, gels, hair dyes, creams, lotions, soaps and shampoos. Concept of herbal cosmeceuticals, **(3)**

UNIT III: Herbal medicines- Plants used in preparation of asava, arishta, chyawanprash, churna, kalp, medicinal mushrooms. **(3)**

UNIT IV: Plant tissue culture industry- Laboratory design, infrastructure- technical and commercial aspects. Tissue culture of Banana- case study. Major tissue culture laboratories in Maharashtra. **(3)**

UNIT V: Floriculture and nursery- Concept of floriculture, aesthetic value of flowers, economically important flowers and their market value. Types and scope of nursery. Major floricultural nurseries. **(3)**

Suggested Readings:

1. Economic Botany, B. P. Pandey
2. Economic Botany, S. L Kochar
3. Indian medicinal Plants, Kirtikar and Basu
4. Handbook of Fruits and Fruit Processing, Y.H. Hui, John Wiley & Sons.
5. Narturing Hair: Indian Medicical Plants Used in Hair Care. Dr. B. A. Karle

6. Advances in Fruit Processing Technologies, Sueli Rodrigues, Fabiano Andre Narciso Fernandes, CRC Press.
7. Quality Control in Fruit and Vegetable Processing, Issue 39, Food & Agriculture Org.
8. Small Scale Food Processing: A Guide to Appropriate Equipment, Peter Fellows, Ann Hampton, Intermediate Technology Publications.
9. Introductory ornamental horticulture, Arora, Kalyani publishers.
10. Plant Tissue Culture, K.K. De.
11. Seed Technology, S. K. Jain
12. An Introduction To Herbal Medicine In Ethnobotany, Dr. Rahat ali.
13. Biofertilizer Technology, Tanuja Singh

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Semester-IV	**Paper-I**
Course Code: MSC-BO 411 T	**Title of Course: Computational Botany**
Credits: 04	**Total lecture:** 60 Hours

Course Outcome:

On completion of the course, students are able to:

1. Identify appropriate tests to perform hypothesis testing for biological experiment and interpret the output adequately.
2. Use of statistical software for data analysis
3. Compute and interpret the results of correlation and regression
4. Understand the designing and function of various databases and bioinformatics resources.
5. They are able to select specific software and tools to solve certain biological problems with respect to Nucleotides and Proteins.
6. Use the Bioinformatics tools in Biological data analysis.
7. Develop the ability to apply the methods while working on a research project work
8. Develop an appropriate framework for research studies.

Detailed syllabus:

Credit I-Basic Biostatistics **(15 Hours)**

UNIT I: Introduction to Statistics : **(3)**

Visualization techniques: diagram and graphs

Bar diagrams: simple bar diagram, subdivided bar diagram, multiple bar diagram,

Graphs : Histogram, frequency polygon, frequency curve.

UNIT II: Measures of central tendency **(4)**

Central tendency: Mean, mode, median and their merits and demerits.

Measures of dispersion – Range, variance, standard deviation, coefficient of variance.

Skewness and Kurtosis – skewness and their types, kurtosis and their types.

UNIT III: Sampling and methods **(3)**

Concept population and sample, Parameter, statistic, standard error, Types sampling (Random and non-random sampling and their types)

UNIT IV: Correlation and regression: **(5)**

Scatter diagram, correlation and types of correlations Measures of correlation: Karl-Pearson's coefficient of correlation, Spearman's rank correlation coefficient.

Regression – Equations of regression lines using least square method, regression estimate

Credit II- Experimental Biostatistics **(15 Hours)**

UNIT I: Probability Distributions: **(3)**

Bernoulli distribution, Binomial. poison distribution, Normal Distribution (only definition, PMF, PDF Mean, Variance and numerical examples)

UNIT II: Testing of hypothesis: **(4)**

Hypothesis, statistical hypothesis (Null and alternative) critical region, Acceptance region, level of significance, p-value, Type I and Type II error.

Small sample tests: Chi-square test: chi square test for goodness of fit

t-test: mean, equality of two means, paired t-test, unpaired t-test, ANOVA (one way and two way), concept of non-parametric test

UNIT III: Computational statistics **(4)**

SPSS/ Excel: Introduction, features, installation, concept and applications of Biology Statistical methods in SPSS: Diagrams, graphs: Measures of central tendency, Dispersion, Skewness and Kurtosis, Correlation and Regression, t – test, ANOVA

UNIT IV: Testing of Hypothesis by SPSS: **(4)**

Critical difference for pairs of treatments Tukey's test for pairwise comparison of treatments, Dunnet's test for comparison of treatment means with control Duncan's multiple range test Mann–Whitney U test

Credit III – Scientific Communication **(15 Hours)**

UNIT I: Introduction to scientific communication **(3)**

Importance of scientific communication, Types of scientific communications, Logical organization of scientific data and documentation,

UNIT II: Different modes of scientific communication **(5)**

Details of Steps involved in Proposal writing (Funding agencies), Research paper writing, Thesis writing, Oral forms of scientific communication Popular and Scientific talks, Poster presentations

UNIT III: Introduction to Research communication **(3)**

Journal, periodicals, monograph revision, Concepts of Citations index, h index, i10 index, impact factor, care list, Scopus, Web of science, ISSN, ISBN, Google Scholor,

UNIT IV: Legal forms of communication **(4)**

Ethics in scientific communication, concept and applications of plagiarism, IPR, Patent submissions.

Credit IV: Bioinformatics **(15 Hours)**

UNIT I: Introduction to Bioinformatics : **(2)**

Definition, Concept and Application of Bioinformatics

UNIT II: Biological databases: **(6)**

Database concept, Types of Biological databases (Primary, Secondary and Specialized) Nucleic acid sequence databases (GenBank, EMBL, DDBJ), Sequences and nomenclature, IUPAC symbols, Protein sequence databases (Swiss-prot, Uniprot), Protein

structure database (PDB), Literature database (PDB)

UNIT II: Biological Sequence Analysis – **(7)**

Global and Local alignment, Pairwise sequence alignment (Dot Matrix, Dynamic programming, word method), Scoring matrices for Protein and Nucleotide sequences (PAM series and BLOSUM series), Gap Penalty and Penalty Scheme, Database similarity searching by BLAST and FASTA, Multiple sequence alignment (Progressive, Iterative and Block based method)

NOTE –

- *Emphasis be given on methodology and numerical problem solving rather than derivations and proofs.*

Suggested Reading:

1. P.N. Arora and P.K. Malhan (2002) Biostatistics, Himalaya publishing House.
2. Rama Krishnan, P. (1995) Biostatics, Saras publication A.R.P. camp Road, Periavilai, Kottar, po. Nagercoil, Kanyakumari- Dist. Pin- 629 002.
3. Banerjee, P.K. (2005) Introduction to Biostatics' S. Chand and Company Ltd. Ram Nagar, New Delhi- 110 055.
4. Norman T.J. Bailey (2004), Statistical methods in biology (Third Edition) Cambridge University press (Low price Editions).
5. Dr. Mungikar A.N. (1997) an introduction to Biometry, Saraswati publication, Aurangabad.
6. Mungikar, A. M. (2003) Biostatistial Analysis. Saraswati Printing Press. Aurangabad.
7. Lab Math – Adams, D.S. I.K. InternationsPvt Ltd. New Delhi, 2004
8. T. M. Apostol: Mathematical Analysis (Narosa publishing house).
9. Satguru Prasad (2012) Elements of Biostatistics, Rastogi publication

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Semester-IV	**Paper-II**
Course Code :MSC-BO 412 T	**Title of Course:** Developmental Botany
Credits: 04	**Total lecture:** 60 Hours

Course Outcome:

On completion of the course, students are able to:

1. Will develop the understanding of growth, development and reproduction in plants.
2. Understand the physiological and metabolic changes happening along with the environmental impact.
3. Understand synthesis, transport and signal transduction of plant hormones and its importance for growth and development in plants.
4. Gain knowledge about the mechanism of double fertilization and its significance.
5. To know the concepts of Polyembryony, Parthenogenesis and Apomixis and its significance.
6. To understand the different mutants at various developmental patterns.
7. Understand the concept of ABC model in flower development and homeotic gene.

Detailed Syllabus:

Credit I: Basic concepts of Plant development **(15 Hours)**

UNIT I: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development. **(7)**

UNIT II: Difference between Plant and Animal development **(2)**

UNIT III: Polarity & Symmetry, Factors for development- intrinsic and extrinsic, Juvenility- Characteristics, Transition- vegetative to reproductive phase, histochemical Changes. **(6)**

Credit II: Embryology **(15 Hours)**

UNIT I: Introduction- Reproductive structure in plant **(1)**

UNIT II: Gametophyte development- Stamen and Microsporogenesis, Male gametophyte development, Carpel and Megasporogenesis, Female gametophyte development. **(4)**

UNIT III: Fertilization-Pollen tube growth and its path,itsentry into embryo sac, gametic fusion, significance of double fertilization, abnormalities in fertilization, Development of embryo in dicot and monocot, Development of Endosperm. **(6)**

UNIT IV: Polyembryony- concept and classification, special cases and causes of polyembryony Apomixis - concept, categories- agamospermy and vegetative reproduction apospory, arthenogenesis. **(4)**

Credit III: Physiological & Molecular Basis of Plant Development **(15 Hours)**

UNIT I: Physiology of plant development-

Photo-morphogenesis, Light mediated development, Photoreceptors, phytochrome, cryptochrome, Hormonal Signaling in development **(6)**

UNIT II: Molecular and Cellular Events in Vegetative development

Root development and Root Hair Development, Shoot development, Leaf development, Stomatal development, Radial and Axial Pattern of development, Process of Senescence. **(9)**

Credit IV: Molecular and Cellular Events in Reproductive development **(15 Hours)**

UNIT I: Inflorescence development, Flower development (ABC model), Homeotic genes, Flower Mutants in Developments **(9)**

UNIT II: Molecular events during Embryogenesis **(2)**

UNIT III: Vernalization-Genetic and Epigenetic Mechanisms Underlying Vernalization **(4)**

Suggested Readings:

1. Embryology of Angiosperm. Maheswari
2. Embryology of Angiosperm. Bhojwani and Bhatnagar
3. Plant Physiology by Taize and Zeiger
4. Arabidopsis Book –Howell
5. Current Trends in the Embryology of Angiosperms by SS Bhojwani
6. Developmental Biology of Flowering Plants by V. Raghavan
7. Flowering Plant Embryology By Nels R. Lersten.
8. Gifford, E. M. and A. S. Foster. 1989. *Morphology and Evolution of Vascular Plants.* W. H. Freeman, New York.
9. Levy Y Y , Dean C . The transition to flowering. Plant Cell. 1998;10:1973–1989. [PMC free article] [PubMed]
10. McDaniel C N , Singer S R , Smith S M E . Developmental states associated with the floral transition. Developmental Biology. 1992;153:59–69. [PubMed]
11. Weigel D . The genetics of flower development: From floral induction to ovule morphogenesis. Annu. Rev. Genet. 1995;29:19–39. [PubMed]
12. Benfey P N , Linstead P J , Roberts K , Schiefelbein J W , Hauser M -T , Aeschbacher R A . Root development in *Arabidopsis*: Four mutants with dramatically altered root morphogenesis. Development. 1993; 119:53–70. [PubMed].
13. Blázquez M A , Soowai L N , Lee, Weigel D . *LEAFY* expression and flower initiation in *Arabidopsis*. Development. 1997;124:3835–3844. [PubMed]

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Semester-IV	**Paper-III**
Course Code :MSC-BO413 T	**Title of Course :**Plant Tissue Culture Technology
Credits: 02	**Total lecture:** 30 Hours

Course Outcome:

On completion of the course, students will able to:

1. Understand the Plant tissue culture techniques.
2. Understand the principle and basic protocols for Plant Tissue Culture.
3. Learn growing plants in aseptic environments.
4. Perform callusing, Rooting, Shooting and Hardening.
5. Use various in vitro culture techniques for plant / crop improvement.
6. Learn genetic transformation methods.
7. Understand bacterial transformation.
8. Become an entrepreneur by developing its own Plant Tissue Culture lab.

Detailed Syllabus:

Credit I: **(15 Hours)**

UNIT I: Introduction, History and applications **(1)**

UNIT II: Totipotency of plant cells, de- and re-differentiation, Organogenesis and somatic embryogenesis, *In vitro* responses of plant cells, tissue and organs- effect of source of explants, nutrient medium constituents, growth regulators and environmental factors **(4)**

UNIT III: Stages of micro propagation, Factors affecting micro-propagation, Merits and demerits of in vitro propagation, Case studies- Banana and Sugarcane **(2)**

UNIT IV: Protoplast culture, somatic hybridization and cybridization, synthetic seeds, applications, In vitro production of haploids and their applications, Physiological and genetic basis of somaclonal variation and their applications **(7)**

UNIT V: Cryopreservation and germplasm conservation **(1)**

Credit II: **(15 Hours)**

UNIT I: ***In vitro* production of secondary metabolites and genetic transformation**

Screening and selection of high secondary metabolite producing cell lines. **(1)**

UNIT II: Standardization of Culture media, immobilization of cells, elicitation using biotic and abiotic elicitors, Biotransformation **(3)**

UNIT III: Case studies for production of secondary metabolite: Scaling up and use of Bioreactor **(2)**

UNIT IV: Genetic transformation of plants - transfer of foreign DNA into host plant tissues using Direct DNA transfer to plants – Electroporation, biolistic transfer, *Agrobacterium* based vectors, *m*echanism of integration of DNA into plant genomes. **(5)**

UNIT V: Factors affecting transformation, Screening and analysis of transformants. **(3)**

UNIT VI: Modifications of plant secondary metabolism by genetic engineering: case studies **(1)**

Suggested Readings:

1. U. Satyanarayan, Biotechnology Published by Books and Allied PVT. LTD.
2. B. D. Singh. Biotechnology: Expanding Horizons Kalyani Publishers
3. S. C. Dubey Biotechnology, Rastogi publication
4. Plant Tissue Culture:
5. Plant Tissue Culture: Theory and Practice. S.S. Bhojwani and M.K. Razdhan
6. Plant tissue culture. Kalyan Kumar Day.
7. Plant Cell and Tissue Culture. S Narayanaswamy.
8. Introduction to Plant Cell, Tissue and Organ Culture. Purohit S. D.
9. Plant Cell and Tissue Culture. Dr Mahipal Singh Shekhawat
10. Plant Cell and Tissue Culture. Indra K Vasil and Trevor A Thorpe

11. Plant Cell and Tissue Culture – A Tool in Biotechnology: Basics and Application (Principles and Practice. Karl-Hermann Neumann and Ashwani Kumar.
12. Plant Cell and Tissue Culture (Methods in Molecular Biology). Jeffrey W Pollard and John M Walker.
13. Plant Cell, Tissue and Organ Culture: Fundamental Methods (Springer Lab Manuals). Oluf L Gamborg and Gregory C Phillips

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Semester-IV	**Paper-IV**
Course Code :MSC-BO414 P	**Title of Course :**Practicals Based on BO 411 T Computational Botany
Credits: 02	**Total lecture:** 60 hours

Practicals:

1. Measurement of central tendency (mean, mode and median), variance, standard deviation, coefficient of variance and standard error from the given ungrouped data. **(1P)**
2. Measures of skewness and measures of Kurtosis (ungrouped data). **(1P)**
3. Determination of regression lines and calculation of correlation coefficient – ungrouped data. **(1P)**
4. Analysis of data by using t – test/SPSS/Excel. **(2P)**
5. Chi-square test for goodness of fit and independent attributes. **(1P)**
6. Analysis of variance on the given data (ANOVA) SPPS/Excel. **(1P)**
7. Tukey's test for pairwise comparison of treatments SPPS/Excel. **(1P)**
8. Dunnet's test for comparison of treatment means with control SPPS/Excel **(2P)**
9. Duncan's multiple range test for comparing treatment means SPPS/Excel **(2P)**
10. Determination of Karl-Pearson's coefficient of correlation from the given ungrouped data **(2P)**
11. Databases and database searching and DNA/protein sequence comparisons **(1P)**
12. Pair wise comparison of DNA and protein sequences using BLAST **(1P)**

Note:

- *compulsory submission of a) book review b) list of life sciences research journals (20) c) Presentation on any research article.*

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Semester-IV	**Paper-V**
Course Code :MSC-BO415 P	**Title of Course :**Practicals Based on BO 412 T Developmental Botany
Credits: 02	**Total lecture:** 60

Practicals:

1. Histochemical analysis of secondary growth primary to secondary axis. **(1P)**
2. Histochemical comparison between vegetative and reproductive induced SA **(1P)**
3. In-Vitro Germination of Spore/Pollen. **(2P)**
4. Dissection & Isolation of Developing Embryo. **(1P)**
5. Dissection Isolation of Endosperm. **(1P)**
6. Stomatal development and observations on Stomatal types. **(1P)**
7. Study of Induced Leaf Senescence. **(1P)**
8. Observations on Microsporogenesis and Development of Male Gametophyte. **(2P)**
9. Observations on Megasporogenesis and Dissection of Female Gametophyte. **(2P)**

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Semester-IV	**Paper-VI**
Course Code :MSC-BO416 P	**Title of Course :** Practical Based on BO 413 T Plant Tissue Culture
Credits: 02	**Total lecture:** 60 Hours

Practicals:

1. Study of different Laboratory instruments used in Plant Tissue culture Laboratory. **(1P)**
2. Study of different sterilization techniques used in Plant tissue culture. **(1P)**
3. Preparation and sterilization of MS- medium. **(1P)**
4. Study of different growth regulators and their role in PTC. **(1P)**
5. Study of dedifferentiation of a suitable plant tissue to induce callus. **(2P)**
6. Study of the method of isolation of protoplast from suitable plant material for somatic hybridization. **(2P)**
7. Studies on use of any one Biotic/Abiotic elicitor for enhancement of secondary metabolite production through Callus culture. **(2P)**
8. Studies on methods of DNA transfer in plant cell (Demonstration) **(1P)**
9. Visit to any Commercial tissue culture laboratory and write a case study report. **(1P)**
10. Visit to *Ex situ Germplasm Bank* and write a visit report. **(1P)**

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Semester-IV	**Paper-VII**
Course Code :MSC-BO 417 T (A)	**Title of Course:** Applied Mycology
Credits: 02	**Total lecture:** 30 Hours

Course Outcome:

On completion of the course, students are able to:

1. Learn Scope and Importance of mycology.
2. Know the role of fungi in bioremediation and pollution control.
3. Do cultivation of fungi for biopesticides and biofertilizers.
4. Know about mycosis and clinical aspects of fungi.
5. Learn Commercial production of antibiotics, alcohols, organic acids and enzymes from fungi.
6. Acquire Knowledge of fungal food and fungi as genetic tool.

Detailed Syllabus:

Credit I: **(15 Hours)**

UNIT I: Introduction to applied mycology **(5)**

Fungi- Colonization strategies in fungi and their ecological role, Soil mycoflora Fungi as mycoremediation and pollution indicators

UNIT II: Fungal food spoilage, Biodeterioration of organic and inorganic materials by fungi with examples. **(3)**

UNIT III: Fungi as biopesticides: mycofungicides, mycoweedicides, myconematicides and mycoinsecticides, *Trichoderma* **(4)**

UNIT IV: Fungi as biofertilizers: Mycorrhiza types and significance as biofertilizers. **(3)**

Credit II: **(15 Hours)**

UNIT I: Medical mycology- **(3)**

Superficial, Intermediate and Deep mycosis (Types, symptoms and clinical aspects).

UNIT II: Industrial mycology- **(4)**

Medically important Fungal metabolites, production of alcohol, antibiotics, enzymes, organic acids (their production and importance).

UNIT III: Fungi as food- **(5)**

A) SCP, *Ganoderma*, Mushrooms- types, food and medicinal value, methods of production of different mushrooms in brief

B) Fermented foods- Mycoprotein, Bread, Cheese, Tempeh, Miso, Sauce.

UNIT IV: Fungi as genetic tool (Tetrad analysis, YAC, *Neurospora*, etc.) **(3)**

Suggested Readings:

1. Introduction to Fungi- John Webster and Roland W.S. Weber
2. Introductory Mycology -Alexopoulos C.J., C.W. Mims and M. Blackwell
3. The Mycota- Esser, K. and Bennet J. W. (Eds.)
4. An Introduction to Mycology - Mehrotra, R.S. and Aneja, K.R.
5. Fundamentals of Mycology -Burnett, J. H.
6. Chemical fungal taxonomy - Frisvad, J.C. Bridge, P.D. and Arora, D.K.
7. The Filamentous Fungi - Smith, J.E.
8. Fungal Nutrition and Physiology - Garraway, M. O. and Evans, R. C.
9. Mushroom Biology - Miles, P.G. and Chang, S.T.
10. MycorrhizaeVerma - A. and Hock, B.
11. Ectomycorrhizal Fungi - Cairney, J.W.G. and Chambers, S.M.
12. Industrial mycology - Berry, R.
13. Plant Pathology - Agrios, G.N.
14. Plant Pathology - Mehrotra, R.S.
15. Annual Review of Phytopathology - APS Press
16. Biotechnology in Plant Disease Control- Cheet,I.
17. Post infectional defense mechanisms - Mahadevan, A.

18. Pathogenesis and host specificity in plant diseases. Vol. III.-Rudra P. Singh, Uma S. Singh and KeiisukeKohmoto (eds.) 1995.

19. The nature of disease in plants - Scheffer, R.P.

20. Principles of Plant Pathology -Tarr, S.A.J .

21. Edible mushrooms and their cultivation Change. S.T. and P.G. Miles -

22. MycorrhizaeMosses, B.V.A. -

23. V.A. MycorhizaePowel, C and D. J. Bagyaraj -

24. Industrial mycology (Vol. I) Berry, R. -

25. Biotechnology.Dubey, S.C. -

26. Fungal biotechnology by smith.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Syllabus of M. Sc. Botany
under
Faculty of Science

Semester-IV	**Paper-VII**
Course Code :MSC-BO 417 T (B)	**Title of Course :**Advanced Medicinal Botany
Credits: 02	**Total lecture:** 30 Hours

Course Outcome:

On completion of the course, students are able to:

1. Learn scope of pharmacognosy.
2. Get knowledge of medicinal and aromatic plants of India.
3. Know about research institutes of Medicinal plants in India.
4. Learn about drug adulteration and drug evaluation.
5. Know about sources and processing of herbal drugs.
6. Learn industrial aspects of herbal drugs.
7. Learn natural pesticides and commercialization of biopesticides.

Detailed Syllabus:

Credit I **(15 Hours)**

UNIT I: General Pharmacognosy **(7)**

Definition and scope of Pharmacognosy, Research institutes of medicinal plants in India

Utilization of medicinal and aromatic plants in India

Indian trade in medicinal and aromatic plants

Case study of any two Ayurvedic drug industries from India

WHOS's guidelines for herbal medicines

UNIT II: Analytical Pharmacognosy **(8)**

Drug adulteration, Natural excipients in drug formulation,

Drug evaluation –Morphological, microscopical, chemical, physical and biological methods, Quality control of herbal drugs

Biosynthesis of glycosides and alkaloids

Credit II- **(15 Hours)**

UNIT I: Plant Drugs **(7)**

Classification of crude drugs, Processing of herbal drugs

Pharmacognostic study of the following drugs w.r.t. source, cultivation, collection, macroscopic characters, and application – Isabgol (*Plantago ovata* Forssk), Aloe (*Aloe vera* (L.) Burm.f.*)*, *Digitalis (Digitalis purpurea* L.*)*, *Dioscorea (Dioscorea bulbifera* L.), Safed Musli (*Chlorophytum borivilianum* Santapau and Fernandes), Shatavari (*Asparagus racemosus* Willd.), Brahmi (*Bacopa monnieri* (L.)Penn), Arjuna (*Terminalia cuneata* Roth.), Ashwagandha (*Withania somnifera* (L.) Dunal), Vinca *(Catharanthus roseus* (L.) G.Don*)*, Vasaka (*Justicia adhatoda* L.*)*, and Turmeric (*Curcuma longa* L.), Amla (*Emblica officinalis* Garten.), Hirda (*Terminalia chebula* Retz.) Behada (*Terminalia bellirica* (Gaertn.) Roxb.), Gulvel (*Tinospora cordifolia* (Willd.Miers ex Hook.f. and Thoms.)

UNIT II: Industrial Aspects **(8)**

1. Phytopharmaceuticals prospects
2. Biogenesis of phytopharmaceuticals
3. Neutraceuticals and cosmeceuticals
4. Natural pesticides- Pyrethrin, Azadiractin, Deris, Nicotin
6. Immunomodulatory medicinal plants

Suggested Readings:

1. Pharmacognocy and phytochemistry-vinod Rangari
2. Pharmacognocy- A. Roseline . MJP publisher chennai
3. Pharmacognosy. Tylor and Brady
4. Pharacognosy. Wallis
5. Pharmacognosy. Trease and Evans
6. Pharmacognosy. Kokate, Gokhale, and Purohit
7. Eonomic Botany. Hill Albert F.
8. Econoic Botany. Panday
9. Economic Botany. V Verma

10. Medicinal Plants of India and Pakistan. Kirtikar and Basu
11. Medicinal Plants. S K Jain
12. Phytochemistry of Plants. McDaniels
13. Plant Physiology. Salisbury and Ross

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Semester-IV	**Paper-VIII**
Course Code: MSC-BO 418 P (A)	**Title of Course:** Practicals based on BO 417 (A)Applied Mycology
Credits: 02	**Total lecture:** 60 hours

Practicals:

1. Study of plant diseases with reference to histopathology of symptoms, causal organisms of downy and powdery mildews of crops of local importance, leaf spot diseases and rusts and Smuts of local significance (atleast One of each). **(2P)**
2. Study of effect of Mycorrhizae on plant growth **(2P)**
3. Production of Alcohol and Citric acid by fermentation by Aspergilus niger **(2P)**
4. Fermentation of yeast for SCP production **(1P)**
5. Cultivation of Pleurotus mushroom. **(1P)**
6. Isolation any one mycorrhizal fungi and Trichoderma as biofertilizer. **(1P)**
7. Study of Biodeterioration of inorganic material using fungi. **(2P)**
8. Isolation of any 1 plant pathogen to study Koch's postulates. **(1P)**
9. Study of any 4 fungal food, industrial metabolites, antibiotics with their importance **(1P)**

Note:

- *Compulsory Visit to local market to study post harvest diseases and survey of fungal products.*

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Semester-IV	**Paper-VIII**
Course Code :MSC-BO 418 P (B)	**Title of Course :**Practicals based on BO417 (B) Advanced Medicinal Botany
Credits: 02	**Total lecture:** 60 hours

Practicals:

1. Identification of with the help of organoleptic and microscopic evaluation techniques. **(2P)**
2. Study of different extraction methods. **(1P)**
3. Determination of ash values of drugs. **(1P)**
4. Histochemical studies of drugs. **(1P)**
5. Biological activity of any two drugs. **(2P)**
6. Estimation of alkaloids from suitable medicinal plants. **(1P)**
7. Estimation of glycosides from suitable medicinal plants. **(1P)**
8. Extraction of essential oils from suitable medicinal plants. **(1P)**
9. Preparation of Chyawanprash, Arishta and TriphalaChurna. **(2P)**
10. Preparation of herbal cosmetics and neutraceuticals **(2P)**

Note:

- *At least one short and one long study tour be arrange for industry visits and study of medicinal plants.*
- *Student must carry out detail pharmacognostic investigation of at least one crude drug and should submit a report at the time of practical examination as a project.*

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Semester-IV	**Paper-IX**
Course Code:MSC-BO419	**Title of Course :**Project
Credits: 02	**Total lecture:** 30 Hours

Course Outcome:

After the completion research project, the students will be able to

1. Design the experiments of her/his interest and execute it.
2. Train in handling of basic and advanced instruments.
3. Generate the data, compile and analyze and interpret the data.
4. Presentation skills will develop among the students.
5. The students will ready to work in any Research and Development set up.

Details:

1. Writing of research proposal w.r.t Rationale of works, Review of literature, Title, Aims, Objectives, Material and Methods, expected outcomes, plan of work.
2. Experimental work
3. Data Analysis
4. Writing of research project report w.r.t. Introduction, Review of literature, Material and Methods, Results, Discussion, Summary and Conclusion, Bibliography.
5. Submission and presentation of research project work during final examination.
6. Compulsory paper presentation in National/ International Conference/Research Publication in reputed journal.