

Dr. Babasaheb Ambedkar Marathwada University,

Aurangabad.



Department of Botany

Academic Flexibility

Credit Based Grading System

M. Sc. Botany

2016-2017

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

Department of Botany

This syllabus was finalized in the meeting of all the following members of teaching staff held on 04-05-2015.

- 1. Dr. Aravind S. Dhabe Chairman**
- 2. Dr. Milind. M. Sardesai**
- 3. Dr. Narayan B. Pandhure**

Credit Based Cafeteria Approach
M. Sc. Course in Botany
Course Structure of M. Sc. Syllabus to be Implemented from 2016-2017.

Sr. No.	Course No.	Title of the Course	Hrs	Credits Allotted	Theory				Practical	
					internal	External	Total (Maximum)	Minimum	Maximum	Minimum
Semester I										
01.	BOT 401	Cell Biology	07	3T + 2 P	20	80	100	40	50	20
02.	BOT 402	Molecular Biology	07	3T + 2 P	20	80	100	40	50	20
03.	BOT 403	Biology and diversity of Virus, Phytoplasma, Bacteria, algae and fungi	07	3T + 2 P	20	80	100	40	50	20
04.	BOT 404	Taxonomy of Angiosperms	07	3T + 2 P	20	80	100	40	50	20
05	IC001	Indian Constitution	02	2T	10	40	50	20	--	--
Total				30 Credits						
Semester II										
06.	BOT 406	Cytology and Genetics	07	3 T + 2 P	20	80	100	40	50	20
07.	BOT 407	Plant development and reproduction	07	3T + 2 P	20	80	100	40	50	20
08.	BOT 408	Biotechnology	07	3T + 2 P	20	80	100	40	50	20
09.	BOT 409	Plant Physiology and Metabolism	07	3T + 2 P	20	80	100	40	50	20
10	BOT 410	Research Methodology - I	03	3T	20	80	100	40	--	--
Total				31 Credits						
Semester III										
11.	BOT 501	Biology and Diversity of Bryophytes, Pteridophytes and Gymnosperms	07	3T + 2 P	20	80	100	40	50	20
12.	BOT 502	Ecology and Conservation	07	3T + 2 P	20	80	100	40	50	20
1.	BOT 521 A BOT 521 B BOT 521 C BOT 521 D	Crop Genetics and Plant Breeding - I Plant Pathology-I Taxonomy of Angiosperms - I Advanced Plant Physiology and Biochem. - I	07	3T + 2 P	20	80	100	40	50	20
15.	BOT 522 A BOT 522 B BOT 522 C BOT 522 D	Crop Genetics and Plant Breeding - II Plant Pathology-II Taxonomy of Angiosperms - II Advanced Plant Physiology and Biochem. II	07	3T + 2 P Each	20	80	100	40	50	20
		Project Work	03	3T	--	--	--	--	--	--
16	Service Course BOT 525/ BOT 526	Plant Tissue Culture/ Medicinal Plants	03	3T	--	--	100	40	--	--
Total				34 Credits						
Semester IV										
17.	BOT 503	Bioprospecting and Plant Resource Utilization	07	3T +2 P	20	80	100	40	50	20
18.	BOT 504	Genetic Engineering and Bioinformatics	07	3T + 2P	20	80	100	40	50	20
19	BOT 505	Research Methodology - II	03	3T						
20.	BOT 523 A BOT 523 B BOT 523 C BOT 523 D	Advanced Genetics & Molecular Biology – I Plant Pathology – III Taxonomy of Angiosperms – III Advanced Plant Physiology & Biochem – III	07	3T + 2P	20	80	100	40	50	20
21.	BOT 524 A BOT 524 B BOT 524 C BOT 524 D	Research Component - Project Work	07	3T + 2 Project Work	20	80	100	40	50	20
Total				31 Credits						

Total Credits required obtaining M. Sc. Degree in Botany

Semester I 30

Semester II 31

Semester III 34

Semester IV 31

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Total credits 126

*** At least one service course**

BOT 401

Cell Biology

Unit I .i.Prokaryotic and eukaryotic Cell: The ultra-structural details and comparative assessment.

Unit II i. Plasma membrane: Molecular organization, current models and functions. Cell wall architecture, biosynthesis, assembly, growth and cell expansion.

ii Plasmodesmata: Structure and role in movement of molecules and macromolecules.

Unit III. i. Cytoskeleton: Organization and role of microtubules and microfilaments. Implications in flagellate and other movements.

ii. Plant vacuole: Tonoplast membrane, ATPases, transporters, as storage organelle.

Unit IV. Chloroplast and Mitochondria: Ultrastructure, function and biogenesis. The organization of genome and patterns of gene expression.

Unit V. Nucleus: Microscopic and submicroscopic organization. Structure and function of nuclear Envelope. The ultrastructure of nucleolus and its role in rRNA biosynthesis.

Unit VI. Ribosomes: Structure and site of protein synthesis. Mechanism of translation, details of initiation, elongation and termination. The structure and role of RNA.

Practicals based on Bot-401

1. To determine mitotic Index in different plant materials.
2. Karyomorphological studies from slide/photograph.
3. Induction of mitotic abnormalities through chemical treatment.
4. Determination of chiasma Frequency in plants.
5. Fluorescence staining with FDA for cell viability and cell wall staining with calcofluor.
6. Demonstration of SEM and TEM organelles.
7. Demonstration of acid phosphatases and succinic dehydrogenase activity in plants.
8. Localization of nuclear DNA by using Feulgen as a DNA specific stain.

BOT-402

Molecular Biology

Unit I. Cell signaling: Signal transduction, signaling pathways, second messengers, cAMP, genetic disorders ; due to the G protein defect. Lipid derived second messengers. Receptor tyrosine kinase and signaling pathway. Molecular biology of signaling.

Unit II. Other cellular organelles: Structure and functions of micro bodies, Golgi apparatus, Lysosomes and Endoplasmic reticulum.

Unit III. Protein sorting: Targeting of proteins to organelles. Translocation of secretory proteins across the ER membrane. The post translational modifications in RER.

Unit IV. Cell Cycle and its molecular aspects: Control mechanism, the role of cyclin and cyclin dependent kinases, Retinoblastoma and E₂F proteins. Cytokinesis and cell plate formation. Mechanism of programmed cell death (Apoptosis) and Senescence.

Unit V. Molecular Cytogenetics

i. **Nuclear DNA Content:** The C-value paradox, the COT value curve & its significance

ii. **Restriction mapping:** Concept and techniques, multigene families and their evolution.

iii. Computer assisted chromosome analysis, chromosome micro-dissection and micro cloning.

Practicals based on BOT-402

1. Demonstration of native and SDS PAGE profiles of seed proteins.
2. Isolation of plant DNA and its quantitation by spectrophotometric method.
3. Isolation of DNA and preparation of Cot curve.
4. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis and visualization by ethidium bromide staining.
5. Isolation of RNA and its quantitation by spectrophotometric method.
6. Separation of plant RNA by agarose gel electrophoresis and visualization by ethidium bromide staining,
7. Demonstration of Western blotting.
8. Estimation of seed proteins by Lowry's method.

Suggested Readings (For BOT-401 & 402 Theory)

1. Lewin, B. 2000, Genes VII, Oxford University Press, New York.
2. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. 1999. Molecular Biology of the cell. Garland Publishing, Inc. New York.

3. Wolfe, S.L. 1993. Molecular and cellular biology. WodsworthPublishing Company, California, U.S. A.
4. De, D.N. 2000. Plant cell vacuoles. An introduction. CSIRO Publication, Collingwood, Australia.
5. Kleinsmith, I.J. and Kish, V.M. 1995. Principles of Cell and MolecularBiology (End Edition). Harper Collins College publishers, New York, U.S.A.
6. Lpdish, H., Berk, A., Zipursky, S.Z., Matsudaira, P., Baltimore, D. and Darnell, J., 2000. Molecular Cell Biology. (4th Edition). W.H. Freeman and company, New York, U.S.A.

Review Journals

1. Annual review of plant physiology and molecular biology.
2. Current advances in Plant Sciences.
3. Trends in Plant Sciences.
4. Nature reviews: Molecular and Cell Biology.

Suggested Readings (For Course BOT401 and 402 Practicals)

1. Click, B.R. and Thompson, J.E. 1998. Methods in Plant Molecular biology and biotechnology. CRC Press, BOCA RBTON Florida.
2. Glover, D.M. and Hames, B.D. (Eds.) 1995. DNA cloning I: A practical approach, Core techniques, first edition, TASIRL Press at Oxford University Press, Oxford.
3. Gunning B.E.S. and Steer, M.W. 1996. Plant cell biology, structure and function. Jones and Bartlet Publishers, Boston, Massachusetts.
4. Hackett, P.B., Funchs, J.A. and Messing, J.W. 1998. An Introduction to recombinant DNA techniques: Basic experiments in gene manipulation. The Benjamin Cummings Publishing Company, Inc. Memno Park, California.
5. Hall, J.L. and Moore, A.L. 1983. Isolation of membranes and organelles from plant cells. Academic Press, London, U.K,
6. Harris, N. and Opataks, K. J. 1994. Plant Cell Biology: A practical approach. IRL Press at Oxford University Press, Oxford, U.K.
7. Shaw, C.H. (Ed.) 1988. Plant Molecular Biology: A Practical Approach. IRL Press, Oxford.

BOT 403**(Biology and Diversity of Algae, Fungi and microbes)****UNIT- I. Algae:**

- Introduction of phycology with special reference to Indian work.
- Algae in diversified habitats (Terrestrial, fresh water, marine)
- Criteria used in classification of algae, pigments, reserve food and flagella; and important systems of classification of algae.
- A general account of thallus organization, reproduction and life history of algae.
- Study of important groups of algae with reference to General account, cell structure and method of reproduction in
 - o **Cyanophyta** - *Nostoc* and *Oscillatoria*.
 - o **Chlorophyta**- salient features of Volvocales, Oedogonials and zygnematales (Desmids)
 - o **Xanthophyta** - *Botrydium*, *Vaucheria*.
 - o **Bacillariophyta** - *Diatoms*.
 - o **Phaeophyta** - *Ectocarpus*.
 - o **Rhodophyta** - *Batrachospermum*.
- Algal blooms, Role of Algae in human welfare, bio fertilizer.

UNIT- II. Fungi:

General Characters, Classification.

- Economic importance of fungi in medicine, Agriculture (Biopesticide and biofertilizers), food (SCP. Mushrooms)
- Fungi as plant pathogen – General account of different groups and type study of fungi as pathogen.
 - o Mastigomycotina - *Phytophthora*, *Albugo*,
 - o Zygomycotina – *Rhizopus*,
 - o Ascomycotina – *Claviceps*, *Erysiphe*,
 - o Basidiomycotina – *Puccinia*, *Ustilago*,
 - o Deuteromycotina – *Alternaria*, *Fusarium*, *Cercospora*, *Helminthosporium*.

UNIT- III. Bacteria:

General characters, ultrastructure, classification, Koch's postulates, archaebacteria and eubacteria.

- o Role of agrobacterium in GM crops.
- o Citrus canker.
- o Angular leaf spot of cotton.

UNIT- IV. Phytoplasma: General Account, ultrastructure and economic importance

- Grassy shoot of sugarcane.
- Little leaf of brinjal.

UNIT- V. Viruses: General account, ultrastructure and economic importance of viruses.

- TMV
- Papaya leaf curl.

Practicals: Based On BOT 403

(Biology and Diversity of Algae, Fungi and microbes)

Algae:

01. Collection and study of algae from different localities, Identification up to generic level.
02. Morphological study of algal forms: *Microcystis*, *Oscillatoria*, *Lyngbya*, *Nostoc*, *Anabaena*, *Scytonema*, *Tolypothrix*, *Rivularia*, *Gloeotrichia*, *Cyathoxylon*, *Chlamydomonas*, *Pandorina*, *Eudorina*, *Volvox*, *Hydrodictyon*, *Scenedesmus*, *Pediastrum*, *Ulothrix*, *Ulva*, *Oedogonium*, *Cladophora*, *Pithophora*, *Draparnaldia*, *Draparnidiopsis*, *Coleochaete*, *Cosmarium*, *Closterium*, *Caulerpa*, *Acetabularia*, *Chara*, *Nitella*, *Botrydium*, *Vaucheria*, *Pinnularia*, *Navicula*, *Fragillaria*, *Ectocarpus*, *Dicoryza*, *Fucus*, *Batrachospermum*, *Polysiphonia*, *Corallina*.

Fungi and microbes:

01. Principle and working of instruments.
02. Preparation of Media, strains and Isolation of Bacteria and Fungi from soil and infected plant tissues and pure culture.
03. Gram staining of bacteria.
04. Morphology and Taxonomy of following fungi - *Albugo*, *Phytophthora*, *Mucor*, *Rhizopus*, *Plasmopara*, *Sclerospora*, *Taphrina*, *Phyllochora*, *Claviceps*, *Chaetomium*, *Puccinia*, *Ustilago*, *Sphacelotheca*, *Agaricus*, *Potytorus*, *Volveriella*, *Cyathus*, *Lycoperdon*, *Geaster*, *Alternaria*, *Aspergillus*, *Penicillium*, *Helminthosporium*, *Cercospora*, *Curvularia*, *Fusarium*, *Rhizoctonia*, *Colletotrichum*, *Phoma*.
05. Growth of Fungi on liquid and solid media — *Fusarium* and *Helminthosporium*.
06. Study of bacterial plant diseases - Citrus canker, Angular leaf spot of cotton, soft rot of fruits.

07. Study of Phytoplasma diseases - Little leaf of brinjal, Sesamumphyllody, Grassy shoot of sugarcane.
08. Study of viral plant diseases - Papaya mosaic, Tomato leaf curl, Yellow vein mosaic of Bhindi.
09. Collection and submission of fungal, viral, phytoplasma and bacterial diseases of plants.

Suggested Readings on BOT 403 Algae:

1. Chapman V.J. & D.J. Chapman (1983) *The Algae*, The MacMillan Press Ltd., London.
2. Desikachary T.V. (1959) *Cyanophyta*, 1CAR, New Delhi.
3. Fritsch F.E. (1961) *The Structure and Reproduction of the Algae*, Vol. I & H, Cambridge University Press, London.
4. Kumar H.D. (1988) *Introductory Phycology*, Affiliated East-West Press Pvt. Ltd., New Delhi.
5. Prescott G. W. (1969) *The Algae: A Review*, Thomas Nelson .and Sons Ltd., Melbourne.
6. Round F.E. (1981) *The Ecology of Algae*, Cambridge University Press, London.
7. Smith G.M. (1950) *The fresh water algae of the United states*, McGrawHill Hoc Co., New York.
8. Vijayraghavan & Sunita Kumari (1995) *Chlorophyta*, Bisen Singh M. P. Singh, Dehra Dun.

Suggested Readings — (Fungi and microbes)

1. U. Sinha and Sheela Shrivastava (1985) *An Introduction to Bacteria*, Vikas Publishing House Pvt. Ltd., New Delhi.
2. Burgey's *Manual of Systematic Bacteriology*, Vol. 1-4(1986-1989) Williams & Wilkins, Baltimore.
3. J.P, Verma (1992) *The Bacteria*, Malhotra Publishing House, New Delhi,
4. A.J. Salle (1974) *Fundamental Principles of Bacteriology*, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. K.G.Hardy (1987) *Plasmids - a Practical Approach*, IRL Press, Oxford, Washington D.C.
6. Bruce A. Voyles (2002) *The Biology of Viruses*, McGraw Hill, Boston.
7. Luria S.E., J.E. Darnel!, D. Baltimore & A. Campbell (1978) *General Virology*, John Wiley & Sons, New York.
8. E.W. Mester, C.E. Roberts, M.M. Pearsall and B. J.McCarthy- *General Microbiology*, Holt, Rinehart & Winston, New York.
9. Powar & Dagainawala (2004) *General Microbiology Vol. II*, Himalaya Publishing House, Mumbai.

10. R.F. Boyd (1984) General Microbiology, Times Mirror/Mosby College Publishing St. Louis.
11. S.B. Biswas & .Amrita Biswas (1993) An Introduction to Viruses, Vikas Publishing House Pvt. Ltd., New Delhi.
12. V.K. Gupta & M,K. Behl (1994) Indian Plant Viruses & Mycoplasma, Kalyani Publishers, Ludhiana.
13. S.P. Raychoudhari& T. K. Nariani (1977) Virus & Mycoplasma Diseases of plants in India, Oxford & IBH Publishing Co., New Delhi.
14. K.B. Deshpande& P.B, Papadiwal (1979) A Laboratory course in Bacteriology, COSIP- ULP - Botany Publication, Marathwada University, Aurangabad.
15. P.B. Papdiwal (1980) Biotechniques, COSIP- ULP - Botany Publication, Marathwada University, Aurangabad.
16. Alexopoulous C.J., C.W.Mims& M. Blakwel (1996) - Introductory Mycology, John Wiley & Sons Inc.
17. Dube H.C. (1994) - An Introduction to Fungi ,Vikas Publishing House, New Delhi.
18. Sharma P.O. (2000) - Microbiology and plant pathology, Rastogi Publication, New Delhi.
19. Mukadam D.S. (1997) 'The Illustrated Kingdom of Fungi', Aksharganga Publication, Aurangabad.
20. Mukadam D. S. (2004) - Modern Topics in Fungi, Saraswati Printing Press, Aurangabad.
21. Rangaswaini G. & A. Mahadevan (2001) - Diseases of Crop Plants in India., Prentice Hall of India, New Delhi.

BOT 404

(Taxonomy of Angiosperms)

UNIT- I: Angiosperms: Definition, its characteristic features and probable causes of their evolutionary success. Taxonomy: Definition, scope, principles, aims and objectives of taxonomy. History of Botanical Explorations in Maharashtra with special reference to Marathwada.

UNIT- II: Phylogeny of Angiosperms: A general account of origin of Angiosperms with reference to time and place and possible ancestors: euanthial theory (Bennettitales, Caytoniales, Cycadales) and pseudanthial theory (Pentoxylales, Glossopteridae).

UNIT- III: Criteria used for classification; phases of plant classification and brief history on account of artificial, natural, phylogenetic systems of classifications with special reference to Bentham and Hooker, Cronquist's system, Takhtajan's system and Broad outline of APG III (2009) system of classification and its merits and demerits.

UNIT-IV: Botanical Nomenclature: Concept of nomenclature, Binomial nomenclature and its advantages, formation of code, Melbourne Code 2011, Principles of International Code of Nomenclature of Algae, Fungi and Plants (ICN), ending of taxa names, Typification. Taxonomic literature: Flora, manuals, monographs, periodicals, dictionaries, indices, journals, pictorial encyclopedias and books.

UNIT-V: Taxonomic evidences: Morphology, anatomy, embryology, palynology, cytology, phyto-chemistry and numerical taxonomy. Taxonomic tools: Serological and molecular techniques, GIS, GPS, Use of computers in angiosperms taxonomy (Use of computer and data bases for identification of plants with the help of website). Herbarium Techniques, Major herbaria of the World and India. Contributions of Herbarium BAMU.

UNIT-VI: Causes of variations in population; Speciation, Species Concepts; Taxonomic Hierarchy.

UNIT-VII: Angiosperm Families: Nymphaeaceae, Hydatellaceae, Magnoliaceae, Papaveraceae, Malvaceae, Sapotaceae, Apiaceae, Asteraceae, Arecaceae and Poaceae.

Practicals Based on BOT-404
TAXONOMY OF ANGIOSPERMS

1. Morphology: Terminologies related to Habit and life span, root, stem, leaves, inflorescence, Flower, fruits.
2. Phytography: preparation of scientific botanical description of a plant specimen.
3. Study of at least 20 locally available families of flowering plants.
4. Identification of genus and species of locally available wild plants.
5. Preparation of botanical keys at generic level by locating key characters.
6. Knowledge of at least 10 medicinal plant species.
7. Demonstration of the utility for secondary metabolites in the taxonomy of some appropriate genera.
8. Field trips within and around the University Campus, compilation of field notes and preparation of herbarium sheets of plants.
9. Botanical excursion of about one week duration to any botanically rich location preferable outside the State.

Suggested Readings

1. Cole, A.J. 1969. Numerical Taxonomy. Academic Press. London.
2. Daris, P.H. and Heywood, V.H. 1973. Principles of Angiosperms Taxonomy. Robert E. Krieger Pub. Co. New York.
3. Grant, V. 1971. Plant Speciation, Columbia, University Press, New York.
4. Grant, W.F. 1984. Plant Biosystematics, Academic Press, London.
5. Harrison, H.J. 1971. New concepts in Flowering Plant Taxonomy. Hieman Educational Book Ltd., London.
6. Heslop-Harrison, J. 1967. Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub. Ltd. U.K.
7. Heywood, V.H. and Moore, D.M. 1984. Current Concepts in Plant Taxonomy, Academic Press, London.
8. Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptions in Plant species. Hieman & Co. Educational Ltd. London.
9. Jones S.B. Jr. & Luchsinger, A.E. 1986. Plant Systematics, (2nd Edition) McGraw-Hill Book Co. New York.
10. Radford, A.E. 1986 Fundamentals of Plant Systematics. Harper & Row Publications, U.S.A.

11. Soibrig. O.T. &Solbrig D.J. 1979. Population Biology and Evolution. AddisonwesleyPublicating Co. Inc.U.S.A.
12. Stebbins, G.L. 1974 Flowering Plant- EvolutionAbove Species Level. EdwardArnold Ltd,.London.
- 13.Stace,C.A. 1989. Plant Taxonomy and Biosystematics. (2ndEdition)Edward Arnold,, London.
14. Takhtajan A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press,New York.
15. Woodland D.W. 1991. Contemporary Plant Systematics.Prentice Hall, New Jersey.

BOT-405
Indian Constitution