

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.



Department of Botany

Academic Flexibility

Credit Based Grading System

M. Sc. Botany

First Semester

2011-2012

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 04-06-2011.

1. Prof. Vijay S. Kothekar- Chairman
2. Dr. Ms. Bharati Jadhav
3. Dr. Prakash B. Papdiwal
4. Dr. Mrs. Suniti S. Barve
5. Dr. Milind. M. Sardesai
6. Dr. Aravind S. Dhabe
7. Dr. Narayan B. Pandhure

Credit Based Cafeteria Approach
M. Sc. Course in Botany
Course Structure of M. Sc. Syllabus to be Implemented from 2011-2012.

Semester – I			
Sr. No	Course No.	Title of the Course	Credits Allotted.
01.	BOT 401	Cell Biology	3 T + 2 P
02.	BOT 402	Molecular Biology	3 T + 2 P
03.	BOT 403	Biology and Diversity in Viruses, Phytoplasma, Bacteria and fungi	3 T + 2 P
04.	BOT 404	Biology and Diversity of algae and Bryophytes	3 T + 2 P
05.	BOT 405	Taxonomy of Angiosperms	3 T + 2 P
Semester II			
06.	BOT 406	Cytology and Genetics	3 T + 2 P
07.	BOT 407	Genetics and Cytogenesis	3 T + 2 P
08.	BOT 408	Biology and Diversity of Pteridophytes & Gymnosperms	3 T + 2 P
09.	BOT 409	Plant Physiology	3 T + 2 P
10.	BOT 410	Plant Metabolism, Growth & Development	3 T + 2 P
Semester III			
11.	BOT 501	Plant Development	3 T + 2 P
12.	BOT 502	Plant Reproduction	3 T + 2 P
13.	BOT 503	Plant Ecology	3 T + 2 P
14.	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 Biochemistry - I	3T + 2 P Each
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 Biochemistry - II	3T + 2 P Each
16	BOT S C I	Plant Tissue Culture	3 T
Semester IV			
17.	BOT 504	Plant Resource Utilization and Conservation	3 T + 2 P
18.	BOT 505	Plant Tissue Culture & DNA Recombinant Technology	3 T + 2 P
19.	BOT 506	Biotechnology & Bioinformatics	3 T + 2 P
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 Plant Physiology - III	3T + 2 P Each
21.	BOT 524 A BOT 524 B BOT 524 C BOT 524 D	Advanced Genetics & Molecular Biology – II Plant Pathology – IV Taxonomy of Angiosperms – IV Advanced Plant Physiology	3T + 2 P Each
22.	BOT SC II	Medicinal Plants	3 T

Total Marks for M.Sc. I, II, Semester

Semester	Theory	Practical	Theory + Practical
I	500	250	750
II	500	250	750
III	500	250	750
IV	500	250	750
Total	2000	1000	3000

Theory Examinations (Marks) First Semester

Course	Internal Tests	Term End Exam	Total Marks
BOT401 - Cell Biology	20	80	100
BOT402 - Molecular Biology	20	80	100
BOT403 - Biology & Diversity in Viruses, Phytoplasma, Bacteria and Fungi	20	80	100
BOT404 - Biology & Diversity of Algae and Bryophytes	20	80	100
BOT405 - Taxonomy of Angiosperms	20	80	100
Total Marks	100	400	500

First Semester
SYLLABUS FOR M. SC. BOTANY
BOT 401
Cell Biology

Theory

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. 1Cytoskeleton: 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.

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 calcoflour.
6. Demonstration of-SEM and TEM organelles.
7. Demonstration of acid phosphataes and succinic dehydrogenase activity in plants.
8. Localization of nuclear DNA by using Feulgen as a DNA specific stain.

BOT-402

Molecular Biology

Theory

- 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.** **i. Ribosomes:** Structure and site of protein synthesis. Mechanism of translation, details of initiation, elongation and termination. The structure and role of RNA.
ii. Other cellular organelles : Structure and functions of micro bodies, Golgi apparatus, Lysosomes and Endoplasmic reticulum.
- Unit III.** **Proteinsorting:** 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.)
- Unit V.** **Techniques in Molecular biology :** Ultracentrifugation, fractionation, Electrophoresis, PCR, GISH, FISH and Immunochemical techniques.

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. Wodsworth publishing 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 Molecular Biology (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 BOT401and 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 al 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.

Biology and Diversity in Viruses, Phytoplasma, Bacteria and Fungi.

Theory

Unit I. Viruses - Characteristics, Ultrastructure and chemical nature of viruses,

Transmission and multiplication of viruses, isolation and purification of viruses, general account of plant diseases, TMV and papaya leaf curl.

Unit II. i. Phytoplasma- General characteristics, ultrastructure and role in causing plant diseases.

ii. Bacterial Plant diseases: General account, Citrus canker, Angular leaf spot of cotton, Soft rot of fruits and vegetables

Unit III. Bacteria - General characteristics, ultrastructure, classification, Koch's' Postulates archaeobacteria and eubacteria, nutrition, reproduction (fission and genetic recombination), Plasmids and their characteristics, role of bacteria in nitrogen fixation,.

Unit IV. Fungi - General characteristics of fungi. Reproduction in fungi (Vegetative, asexual, sexual) Trends in classification of fungi. General account and outline of classification of- Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina,

Unit V. i. Economic importance of fungi - Fungi in medicine, Fungi in Agriculture (Biopesticides and Biofertilizers), Fungi in industry, Fungi as source of food (SCP, Mushrooms).

ii. Fungi as plant pathogens, *Albugo, Pythium, Phytophthora, Plasmopara, Claviceps, Cercospora, Helminthosporium, Alternaria, Fusarium, Rhizoctonia', Puccinia', Ustilago.*

Practicals Based on BOT- 403

(Bacteria, Viruses, Phytoplasma and Fungi).

1. Sterilization Methods.
2. Preparation of Media.
3. Preparation of stains.
4. Isolation of Bacteria and Fungi from soil and infected plant tissues and pure culture.
5. Antibiotic assay.
6. Koch's postulates.
7. Gram staining.
8. Study of bacterial plant diseases - Citrus canker, Angular leaf spot of cotton, soft rot of fruits.
9. Study of viral plant diseases - Papaya mosaic, Tomato leaf curl, Yellow vein mosaic of Bhindi.
10. Study of Phytoplasma diseases - Little leaf of brinjal, Sesamum phyllody, Grassy shoot of sugarcane.
11. Morphology and Taxonomy of following fungi -
Albugo, Phytophthora, Mucor, Rhizopus, Plasmodiopsis, Sclerospora, Taphrina, Phyllosticta, Claviceps Chaetomium, Puccinia, Ustilago, Sphaeria, Agaricus, Polyporus, Volvariella, Cyathium, Lycoperdon, Geaster, Alternaria, Aspergillus, Penicillium, Helminthosporium, Cercospora, Curvularia, Fusarium, Rhizoctonia, Colletotrichum, Phoma.
12. Spore germination of *Alternaria, Helminthosporium, Curvularia.*
13. Growth of Fungi on liquid and solid media — *Fusarium and Helminthosporium.*
14. Collection and submission of fungal, viral, phytoplasma and bacterial diseases of plants.

Suggested Readings — (BOT403-Viruses, Phytoplasma, Bacteria and Fungi)

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, 1RL Press, Oxford, Washington D.C.
6. Bruce A. Voyles (2002) The Biology of Viruses, McGraw Hill, Boston.
7. Luria S.E., J.E. Darnell, 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.Mc Carth- 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. Alexopoulos 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.

(Biology and Diversity of Algae and Bryophytes)

Theory :

- Unit I. Algae**
- i. Introduction and history of phycology with special reference to Indian work.
 - ii. Algae in diversified habitats (Terrestrial, fresh water, marine)
 - iii. Criteria used in classification of algae, pigments, reserve food and flagella; and important systems of classification of algae.
- Unit II. Algae** A general account of thallus organization, reproduction and life history of algae. Study of important groups of algae with reference to
- a) **Cyanophyta** - General account, cell structure and method of reproduction.
 - b) **Prochlorophyta** — General account,
 - c) **Chlorophyta** - Thallus structure, Cell structure, salient features of *Volvocales*, *Chlorococcales*, *Oedogoniales*, *Chaetophorales*, *Zygnematales*(Desmids).
- Unit III**
- a) **Xanthophyta**- With special reference to *Eoizidium* and *Vaucheria*.
 - b) **Bacillariophyta**- Diatoms
 - f) **Phaeophyta** - With special reference to alternation of generation.
 - c) **Rhodophyta**: With reference to triphasic life cycle
 - d) Algal blooms, Algal bio fertilizers, Algae as food, feed and uses in industry.
- Unit IV. Bryophytes:** Systems of classification, distribution, Economic importance. Habitat, external and internal morphology, reproduction, evolutionary tendencies, phylogeny and interrelationships of gametophytes and sporophytes of the following orders: Sphaerocarpaceae, Takakiales, Marchantiales and Jungermanniales,.
- Unit V.** Habitat, external and internal morphology, reproduction, evolutionary tendencies, phylogeny and interrelationships of gametophytes and sporophyte of the following orders : Anthocerotales, Sphagnales, Andreales, and Bryales.

Practicals: Based On BOT404

Algae :

1. Collection and study of algae as mentioned in theory. Identification up to generic level.
2. Morphological study of algal forms:

Microcystis, Oscillatoria, Lyngbya, Nostoc, Anabaena, Scytonema, Tolypothrix, Rivularia, Gloeotrichia, Cahthrix, Chlamydomonas, Pandorina, Eudorina, Volvox, Hydrodictyon, Scenedesmus, Pediculus, Ulothrix, Ulva, Oedogonium, Cladophora, Pithophora, Draparnaldia, Draparnidiopsis, Coleochaete, Cosmarium, Closterium, Caulerpa, Acetabularia, Chara, Nitella, Botrydium, Vaucheria, Pinnularia, Navicula, Fragillaria, Ectocarpus, Dicyyota, Fucus, Batrachospermum, Polysiphonia, Corallina.

3. Separation of Algal Pigments

Bryophyta:

- i. **Vegetative Organization**- *Marchantia, Riccia, Anihoceros, Porella, Sphagnum, Polytrichum.*
- ii. **Anatomical Organization** : *Marchantia, Cyalhodhim, Anthoceros, Porella, Sphagnum.*
- iii. **Archegonia and Antheridia and their Organization**- *Riccia, Marchantia, Porella, Anthoceros, Sphagnum.*
- iv. **Sporophytes** —*Riccia, Marchantia, Pellia, Porella, Anthoceros, Funaria, Sphagnum, Polytrichum.*

Suggested Readings on BOT404

Algae:

1. Chapman V.J. & D.J. Chapman (1983) *The Algae*, The MacMillan Press Ltd., London.
2. Desikachary T.V. (1959) *Cyanophyta*, ICAR, New Delhi.
3. Fritsch F.E. (1961) *The Structure and Reproduction of the Algae*, Vol. I & II, 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*, McGraw-Hill Co., New York.
8. Vijayraghavan & Sunita Kumari (1995) *Chlorophyta*, Bisen Singh Mahendra P. Singh, Dehra Dun.

Bryophytes:

1. Smith (1955) *Cryptogamic Botany I & II*, McGraw-Hill, New York.
2. Prem Puri (1980) *Bryophytes*, Atmaram & Sons, Delhi.
3. Parihar (1991) *Bryophytes*, Central Book Dept., Allahabad.
4. Verdorn - (1932) *Manual of Bryology*, The Hague.
5. Bower P.O. (1935) *Primitive; land Plants*, Macmillan and Co., London.
6. Campbell (1940) *Evolution of land Plants*, Stanford University Press.
7. Kashyap S.R. (1929, 1932), *Liverworts of Western Himalays and the Panj;* plain, Vol. I & II, The University of Panjab, Lahore.

BOT 405

(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.

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, Engler and Prantl's system and Takhtajan's system of classification and its merits and demerits.

UNIT-IV: Botanical Nomenclature: Concept of nomenclature, Binomial nomenclature and its advantages, formation of code, Principles of International Code of Botanical Nomenclature (ICBN), ending of taxa names; concept of type and its types.

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.

Practicals Based on BOT-405

TAXONOMY OF ANGIOSPERMS

1. Morphology: Terminologies related to Habit and life span, root, stem, leaves, inflorescence,
2. Flower, fruits.
3. Phytography: preparation of scientific botanical description of a plant specimen.
4. Study of at least 20 locally available families of flowering plants.
5. Identification of genus and species of locally available wild plants.
6. Preparation of botanical keys at generic level by locating key characters.
7. Knowledge of at least 10 medicinal plant species.
8. Demonstration of the utility for secondary metabolites in the taxonomy of some appropriate genera.
9. Field trips within and around the University Campus, compilation of field notes and preparation of herbarium sheets of plants.
10. 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. 1-973. 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 Wilkins, 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. II. Soibrig. O.T. & Solbrig D.J. 1979. Population Biology and Evolution.
11. Addisonwesley Publicating Co. Inc. U.S.A. 12. Stebbins, G.L. 1974 Flowering Plant- Evolution Above Species Level Edward
12. Arnold Ltd., London. 13. Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd Edition) Edward Arnold,, London.
13. Takhtajan A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, .New York.
14. Woodland D.W. 1991. Contemporary Plant Systematics, rentice Hall, New Jersey.

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Department of Botany

Academic Flexibility

Credit Based Grading System

M. Sc. Botany

Second Semester

2011-2012

Total Marks for M. Sc II Semester

Semester	Theory	Practical	Theory + Practical
I	500	250	750
II	500	250	750
III	500	250	750
IV	500	250	750
Total	2000	500	3000

Theory Examinations (Marks) Second Semester

Course	Internal Tests	Term End Exam	Total Marks
BOT-406- Cytology & Genetics	20	80	100
BOT 407-VII- Genetics & Cytogenetics	20	80	100
BOT-408- Biology & Diversity of Pteridophytes and Gymnosperms	20	80	100
BOT-409- Plant Physiology	20	80	100
BOT-410- Plant Metabolism, Growth & Development	20	80	100
Total Marks	100	400	500

BOT-406 Cytology and Genetics

Theory

Unit I. Chromatin organisation :

1. Chromosome structure and packaging of DNA.
2. Nucleosome organisation , DNA Structure (A, B and Z forms)
3. Organization of centromere and telomere.
4. Karyotype analysis and the banding patterns.
5. The flow cytometry and confocal microscopy in karyotype analysis.
6. Special types of chromosomes- Polytene, Lampbrush, B-chromosome and sex chromosomes.
7. Molecular basis of chromosome pairing.

Unit II. **Structural and Numerical alterations in chromosomes:**

1. The origin, meiosis and breeding behaviour of duplication, deficiency, inversion, translocation heterozygotes, haploids, aneuploids and autopolyploids.
2. The allopolyploids and evolution of major crop plants.

Genetics

Unit III. **Genetics of prokaryotic and eukaryotic organelles:**

1. **Phage and Bacterial Genetics** —Mapping of the bacteriophage genome, genetic recombination in phage, transformation, transduction and conjugation in bacteria

Unit IV.

1. Genetics of mitochondria and chloroplast, and cytoplasmic male sterility.
2. **Genetic fine structure.** Cis -trans test, introns and their significance, RNA splicing.
3. Regulation of gene expression in prokaryotes and eukaryotes. .

Unit V.

Genetic recombination and genetic mapping:

1. Recombination-independent assortment and crossing over. , ,,
2. The molecular mechanism of recombination.
3. Role of Rec A and Rec BCD enzymes.
4. Chromosome mapping, linkage groups and genetic markers.
5. Construction of molecular maps.

Practicals Based On BOT-406:

1. Utilization of banding technique for identification of chromosomes in karyotype.
2. Orcein and Feulgen staining of the polytene chromosomes of Chironomus.
3. Characteristics and behaviour of B chromosomes using appropriate material.
4. Meiotic behaviour of monosomy in plants & its effect.
5. Meiotic behaviour of trisomy in plants and its effect.
6. Study of chromosome pairing and disjunction in translocation heterozygote.
7. Meiosis of complex translocation heterozygotes.

BOT 407

Genetics and Cytogenetics

Unit I. Mutation:

- i. Spontaneous and induced mutations.
- ii. Physical and chemical mutagens.
- iii. Molecular basis of gene mutations.
- iv. Transposable elements and mutation induced by transposons.
- v. Site directed mutagenesis.

Unit II.

- i. DNA damage and repair mechanism.**
- ii. Initiation of cancer at cellular level. Proto-oncogenes and oncogenes.

Unit III. Cytogenetics of aneuploids and structural heterozygotes :

- i. Effect of aneuploids on plant phenotypes.
- ii. The use of monosomics and trisomics in chromosome mapping of diploid and polyploid species.
- iii. The breeding behaviour and genetics of structural heterozygotes.
- IV. The complex translocation heterozygotes.
- v. Robertsonian translocation.
- vi. B-A translocation.

Unit IV. Molecular Cytogenetics:

1. Nuclear DNA content : The c-value paradox, the cot curve and its significance.
2. Restriction mapping - concept and technique, multigene families and their evolution.
3. Computer assisted chromosome analysis, chromosome micro dissection and micro cloning.

Unit V. Alien gene transfer through chromosome manipulation:

1. The transfer of whole genome, individual chromosome and chromosome segments.
2. The characterization and utility of alien addition and substitution lines.
3. The genetic basis of inbreeding and heterosis, the exploitation of hybrid vigour.

Practicals Based On BOT407

1. Effect of spontaneous allo-polyploidy on plant phenotype, fruit set and meiosis.
2. Induction of polyploidy in plants using colchicine. Different methods of application of colchicine.
3. Effect of induced polyploidy on plant phenotype, fruit set and meiosis.
4. Isolation of chlorophyll mutants following physical and chemical mutagenic treatments.
5. Isolation of morphological mutants following physical and chemical mutagenic treatments.
6. Isolation of biochemical mutants following physical and chemical mutagenic treatments.
7. Mitotic/ meiotic chromosomal behaviour in mutagen treated materials.

Suggested Readings :

1. Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K. and Watson, J.D. 1989. Molecular Biology (Ed.) Garland Publishing Inc. New York.
2. Atherly, A.G., Girton, J.R. and McDonald, J.F. 1999. The Science of Genetics. Saunders College USA.
3. Burnham, C.R. 1962. Discussions in Cytogenetics, Burgess Publishing Co., Minnesota.
4. Busch. H. and Rothblum, L. 1982 Volume X. The cell nucleus: DNA part A, Academic Press.
5. Hartl, D. L. and Jones E.W. 1998. Genetics : Principles and Analysis (4th Ed.) Jones and Barew Publishers, Massachusetts, USA.
6. Khush G.S. 1973 Qto genetics of Aneuploids, Academic Press, New York, London.
7. Karp, G. 1999 Cell and molecular biology ; Concepts and Experiments, John Wiley and Sons Inc. USA.
8. Lewin, B. 2000. Genes VII. Oxford University Press, New York, USA. . Lewis, R. 1997. Human Genetics: Concepts and applications (2nd Ed), WCB, McGraw Hill, USA.
9. Malacinski, G. M. and Friefelder, D. 1998. Essentials of Molecular Biology (3rd Ed.), John and Bartlet Publishers Inc. London.. Russel, P. J. 1998. Genetics (5th Ed) The Benjamin / Cummings Publishing Company, Inc. USA.
10. Snustad, D. P. and Simmons. MJ. 2000. Principles of Genetics (2nd Ed.), John Wiley and Sons Inc. USA.

Biology and Diversity of Pteridophytes and Gymnosperms

Theory

Unit I. Pteridophyta:

1. Classification, Origin and evolution,
2. Phylogenetic relationship with Bryophyta,
3. Psilopsida-Psilotales and Psilophytales,
4. Lycopside- Lycopodiales, Selaginellales, Isoetales,
5. Equisetopsida - Equisetales,

Unit II. Pteropsida - a broad outline of orders and genera.

1. Sporophyte and gametophyte in Pteridophytes,
2. Stelar organization and evolution,
3. Origin of leaf and Telome concept,
4. Sporocarp,
5. Heterospory and seed habit,
6. Comparison of Pteridophyta with Bryophyta and Gymnosperms.

Unit III. Gymnosperms I:

1. Introduction, Classification and distribution of Gymnosperms.
2. Morphology, anatomy, reproduction, phylogeny of the following orders -
3. Pteridospermales (Caytoniaceae, Medullosaceae)
4. Bennettiales (Williamsoniaceae, Cycadeoideaceae)

Unit IV. Gymnosperms II:

1. Cycadales (Cycadaceae)
2. Ginkgoales
3. Coniferales (Pinaceae, Araucariaceae)
4. Taxales (Taxaceae)v. Gnetales (Gnetaceae)
5. Economic importance of gymnosperms.

Unit V. Paleobotany:

1. Introduction, Contribution of Prof. Birbal Sahani.
2. Geological time scale.
3. Fossils and fossilization.
4. Continental drift.
5. Applied paleobotany- Oil, Coal.

Practicals: BASED On BOT 408

Pteridophytes: Morphological and anatomical studies of

- 1) *Psilotum* 2) *Lycopodium*. 3) *Selaginella*, 4) *Isoetes*, 5) *Equisetum*,
- 6) *Ophioglossum*, 7) *Osmunda*, 8) *Gleichenia*, 9) *Pteris*, 10) *Adiantum*,
- 11) *Marselia*, 12) *Salvinia*, 13) *Azolla* and additional forms/species collected during study tour.

Gymnosperms :

1. Study of the vegetative and reproductive parts, including anatomy of the following genera : *Cycas*, *Zamia*, *Pinus*, *Cedrus*, *Taxodium*, *Cryptomeria*, *Cupressus*, *Thuja*, *Juniperus*, *Podocarpus*, *Cephalotaxus*, *Agathis*, *Araucaria*, *Taxus*, *Ginkgo*, *Gnetum*._

Suggested Readings :

Gymnosperms:

1. Agashe, S.N. (1995) Paleobotany, Oxford & IBH, New Delhi
2. Biswas, C. and B.N, John (2004) The Gymnosperms, Narosa publishing Bourse, New Delhi
3. Coulter J.M, and C J. Chamberlain (1978) Morphology of Gymnosperms, Central Book Depot, Allahabad
4. Kakkar, R.K. and B.R. Kakkar (1995). The Gymnosperms (Fossils and Living), Central Publishing House, Allahabad.
5. Sharma O.P. (2002) Gymnosperms, Pragati Prakashan, Meerut.
6. Siddiqui K. A. (2002) Elements of Paleobotany, Kitab Mahal, Allahabad.

Pteridophytes :

1. Arnold , C.A. (1947) Introduction to Paleobotany, Me Graw-Hill Book Co. Inc., New York and London.
2. Eames, A.J. (1974) Morphology of Vascular Plants- lower groups, Tata Me Graw-Hill Publishing Co. New Delhi.
3. Foster, A.S. & F.M.Gifford (1967) Comparative morphology of vascular plants, Freeman Publishers, San Fransisco.
4. Parihar, N.S. (1976) The biology and morphology of the pteridophyta, Central Book Depot, Allahabad.
5. Rashid, A. (1976) An introduction to pteridophyta, Vikas Publishing House Ltd., New Delhi.
6. Smith, G.M. (1976) Cryptogamic Botany - Vol.11, Tata Me Graw-Hill Publishing Co. Ltd. New Delhi.
7. Spome, K.R. (1976) Morphology of pteridophyta, Hutchinson Univesity Library, London.

Plant Physiology

Theory

Unit I. Energy Transformation: The laws of thermodynamics, Enthalpy, Entropy, Free Energy, Structure & Function of ATP, Bioenergetics.

Unit II. Plant water relations: Water Potential, Absorption and Transpiration, Stomatal Physiology, Active and passive transport of solutes, Phloem loading and unloading, source-sink relationship, Physiology of plants under water stress.

Unit III. Enzyme: Nomenclature, Properties and classification of enzymes, Mechanism of Enzyme action, regulation of enzyme action, isoenzymes.

Unit IV. Photosynthesis: Light and dark reactions, pigments and mechanism of light absorption, Photosystem I and II, Emerson enhancement effect, C₃, C₄ and CAM pathways, significance of C₄ and CAM pathways, photorespiration, Photo synthetic productivity.

Unit V. Respiration: Glycolysis, TCA cycle and its role in synthesis of bio-molecules Mitochondrial electron transport, oxidative phosphorylation, Pentose phosphate pathway, cyanide resistance, Bioenergetics principles.

Practicals Based On BOT409

1. Extraction of Chlorophyll pigments with the help of solvent.
2. Separation of chlorophyll pigments by paper and thin layer chromatography,
3. Spectrophotometry - Absorption spectrum for chlorophyll pigments extracted from green leaves.
4. Estimation of total chlorophyll, chlorophyll 'a' and chlorophyll b
5. Estimation of reducing sugars using Fehling's solution A and B.
6. Isolation of starch from potato.
7. Isolation of pectin from fruit rinds.
8. Hydrolysis of starch by acid and crude enzyme extract from germinating seeds.
9. Effect of temperature on permeability.
10. Difference between C₃ and C₄ plants- chlorophyll content and leaf anatomy.
11. Demonstration of Hill reaction activity.
12. Estimation of Ascorbic acid from fruit juice and germinating seeds.
13. Autonomous behavior of stomata.
14. Isolation of DNA from suitable plant material.
- 15) Estimation of proline in normal plant and that under stress.

Plant Metabolism, Growth and Development

Theory

Unit I Nitrogen Metabolism: Nitrification and denitrification, Nitrate assimilation,

Biological nitrogen fixation, Biosynthesis of amino acids - reductive amination and transamination, Protein synthesis, classification of amino acids and proteins, amphoteric nature and zwitter ions, structure of proteins, protein denaturation, Isolation and purification of proteins.

Unit II. Lipid Metabolism: Fatty acids, lipid triglycerides, saponification, oxidation of Fatty acids - alpha and beta oxidation.

Unit III. Plant Growth: Growth curve, growth analysis, plant growth regulating substance (PGRS), Gibberellins, Cytokines, Abscisic acid, Ethylene, role of PGRs in agriculture.

Unit IV Plant Development: Physiology of flowering, Phytochrome, flowers induction, Seed germination and dormancy, senescence and aging, stress physiology, vernalization and abscission.

Unit V. Gene Technology: Isolation of DNA from plant material, Purification of DNA from living cell, Recombinant DNA technology, Vectors, Methods of Gene Transfer, Agrobacterium Mediated Gene Transfer, Use of gene technology in applied plant science.

Practicals Based on 409 and 410

1. Separation of amino acids by paper and thin layer chromatography.
2. Chemical tests for protein.
3. Estimation of protein by Lawry's method.
4. Estimation of protein by Biuret method.
5. Isoelectric point of casein.
6. Determination of activity of nitrate reductase.
7. Immobilization of enzymes using sodium alginate.
8. Preparation of leaf protein concentrate (LPC) by heat coagulation method.
9. Extraction/Estimation of crude fat using Soxhlet extractor.
10. Iodine number of fat,
11. Saponification number of fat
12. Growth analysis - RGR, NAR and LAI.
13. Biostatistics: mode, median, mean, range, mean deviation, standard deviation, coefficient of variation (C.V.) in simple or classified data (frequency distribution).
14. Comparison of two samples means –T test.

Suggested Readings :

1. Plant physiology: F.N. Salisbury and C.W. Ross, CBS Publishers and Distributors, New Delhi.
2. Principles of Biochemistry, A.L. Lehninger, CBS Publishers and Distributors, New Delhi.
3. Plant physiology: R.G.S. Bidwell, Mac Millan Publishers Co., New York.
4. Advanced plant physiology, M.B. Wilkins, English Language Book Society, London.
5. Principles of plant physiology, Borner, J. and Galston, A.W.
6. Introductory plant physiology, Noggle G.R. and Fritz, G.S., Prentice Hall, USA.
7. Plant Water Relationships, Slyter, R.O. Academic Press, New York.
8. Plant physiology, D. Hess, Narosa Publishing House, New Delhi.
9. Elementary Biochemistry, Mertz, E.T. Vakils, Fetter and Simons Pvt Ltd. Mumbai.
10. Essentials of Biological Chemistry, Fairley, J.L. and Kilgus, G.L., Altilised Earr west Press Pvt. Ltd., New Delhi.
11. Plant physiology, Devlin, R.M. and Hostan, F.H., CBS Publishers and Distributors, New Delhi.
12. Plant Physiology, S.C.Datta, Willey Eastern Limited, Calcutta.
13. Plant Physiology, S. Mukharji, A.K.Ghosh, New Central Book Agencies, Kolkatta.
14. An Introduction to Biometry, A.M.Mungikar, Sarswati Printing Press, Aurangbad.
15. Biostatical Analysis, A.M.Mungikar, SarswatiPrinting Press, Aurangabad.
16. Laboratory Manual in Biochemistry, Jayraman, J., New Age International Publishers, Mumbai.
17. Experiment in Plant Physiology, D. Bajrachrys Narosa Publishing House, New Delhi.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.



Department of Botany

Academic Flexibility

Credit Based Grading System

M. Sc. Botany

Third Semester

2012-2013

Total Marks for M.Sc. I, II, III and IV Semester

Semester	Theory	Practical
	Marks	Marks
I	500	250
II	500	250
III	500	250
IV	500	250
Total	2000	1000

Theory Examination (Third Semester) Marks

Subject Code	Name of Course	Internal Test	Term End Exam	Total Marks	Practical
BOT 501	Plant Development	20	80	100	50
BOT 502	Plant Reproduction	20	80	100	50
BOT 503	Plant Ecology	20	80	100	50
BOT 521	Elective — A To Elective- D	20	80	100	50
BOT 522 BOT SC-I	Service courses Basic Plant Tissue Culture	20	80	100	50
	Total	100	400	500	500

BOT-501

Plant Development

- Unit I.** **i. Meristems:** Organization of shoot and root apical meristem, various theories, Cytological and Molecular analysis of SAM, control of tissue differentiation especially Xylem and Phloem.
- ii. Tissue systems:** Differentiation and functions of different tissue systems such as epidermis, parenchyma, chlorenchyma, sclerenchyma, laticifers and glands.
- Unit II.** **i. Secondary cambium:** Concept, classification, origin and activities.
Cork cambium and Abnormal cambium.
- ii. Vascular tissues:** Origin, structure and functions Xylem and Phloem elements and their taxonomic significance, Wood development in relation to Environment.
- Unit III.** **Leaf :** Growth and differentiation, differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.
- Unit IV.** **Root :** Initiation and development; lateral roots, root hair, root microbe Interaction.
- Unit V** **i. Dormancy:** Types, importance and its occurrence.
- ii. Senescence and programmed cell death:** Basic concepts, types of cell death, PCD in life cycle of plants. Metabolic changes associated and its regulation; influence of hormones and environmental factors on senescence.

Practicals Based on BOT-501

1. Diversity in cells and tissues in monocot and dicot plants with respect to position, distribution, structure and function.
2. Dermatology - Trichomes and stomata.
3. Mechanical tissues (Collenchyma, Sclerenchyma, Stone cells and Xylem) , Secretary tissues (Mucilage Canals, Resin canals, Nectories, and oil glands), laticifers (Latex cells and Vessels).
4. Vascular tissues and its constituents by sections and maceration.
5. Nodal anatomy,
6. Wood anatomy, TS, TLS and FLLS
7. Leaf anatomy- *Nerium* and *Terminalia*.
8. Abnormal secondary growth in *Dracaena Bignonia*, *Aristolochia*, *Achyranthus*, *Nyctanthus*, *Salvadora*, *Beta*, *Mirabilis*, *Tinospora*.

Suggested readings

1. Burjes, J. (1985). "An Introduction to Plant cell development Cambridge University Press, Cambridge.
2. Fahn, A. (1977), "Plant Anatomy"³ⁱ (3rd edition, 1982), Pergamon Press, Oxford.
3. Esau, K, 1965. "Plant Anatomy" (Second edition; 7th reprint 1991), Wiley Eastern, New Delhi.
4. Foskt D.E. 1994 'Plant growth and development' - A molecular approach Academic press, Santiago.
5. Howell, S.H. 1998, Molecular genetics of plant development, Cambridge University Press, Cambridge.
6. Cutter, E.G. 1978 Plant Anatomy - Experiments and interpretations' Part I and II, Edward Arnold
7. Hyndon, R,F. 1990, Plant development - the cellular basis Univ. Hyman, London.
8. Murphy, T.M. and Thompson, WF. 1988 'Molecular plant development Prentice Hall, New Jersey.
9. Raghavan, V. 1999, 'Developmental biology of flowering plants' Springer Verlag, New York.
10. Reven, P.H., Evert, R.F. and Eichhom, S.E. 1992 'Biology of Plants' (5th Edition), New York.
11. Sleeves, T.A. and Sussex, LM. 1989, 'Patterns in plant development (*T*[~] edition) Cambridge Press, Cambridge.
12. Waisel, Y., Eshel, A. and Kalkaki, U. (eds) 1996. Plant Roots; The Hidden Hall (2nd edition) Dekker, New York.
13. Forster, A.S. 1960. 'Practical plant anatomy D.van Nostrand company. Inc.
14. Roberts, L.W. 1976. Cyto-differentiation in plants (Cambridge University Press, Cambridge.

BOT-502

Plant Reproduction

Unit I. i. **Flower:** Structure and development

ii **Pollination:** Types of pollination, attractions and rewards of pollination, pollen interaction and fertilization.

Unit II. Reproduction:

i. **Vegetative reproduction;** Grafting and other modes, economic aspects of vegetative reproduction.

ii **Sexual reproduction:** Genetics of floral organ differentiation, sex determination.

Unit III. Male gametophyte: Structure of anthers, micro-sporogenesis, role of tapetum, male

sterility, pollen germination, pollen tube growth and development, pollen storage, pollen allergy, pollen embryos.

Unit IV. Female gametophyte; Ovule development, megasporogenesis, organization

of the embryo sac. Structure of the embryo sac.

Unit V. i. Floral characteristics: Pollination mechanism and vectors, breeding systems, structure

of pistil, sporophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspects) double fertilization, *In vitro* fertilization.

ii **Seed development and fruit growth:** Endosperm development, Embryogenesis, Ultra-structure and nuclear cytology; Development of dicot and monocot embryos, polyembryony, apomixes, embryo culture,

Practicals Based on BOT502

1. Study of microsporogenesis and gametogenesis in sections of anthers.
2. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Crotolaria*, *Tradescantia*, *Brassica*, *Petunia*, *Solanum* etc.)
3. Test for pollen viability using stains and vitro pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
4. Estimation of percentage and average pollen tube length *in vivo*
5. Role of transcription and translation inhibitors on pollen germination and pollen growth
6. Pollen storage, pollen pistil interaction, *in vitro* pollination.
7. Study of ovules and embryo sacs.
8. Field study of types of flowers and pollination mechanism. .
9. Emasculation, hand pollination.
- 10) Study of nuclear and cellular endosperms.

Suggested Reading

1. Procton, M. and Yeo, P. (1973), 'The pollination of flowers', William Collins Sons, London.
2. Raghavan, V. (1997), 'Molecular embryology of flowering plants', Cambridge University Press, Cambridge.
3. Raghavan, V. (1999) 'Developmental Biology of flowering plants', Springer Verlag, New York.
4. Shivanna, K.R. and V.K. Sarobney, (Ed) 'Pollen Biotechnology for crop production and improvement' Cambridge University Press. Cambridge.
5. Shivanna, K.R_ and Rangaswamy, N.S. (1992), 'Pollen Biology: A laboratory manual', Springer Verlag, Berlin.
6. Shivanna, K.R. and John, B.M. (1985), 'The angiosperm pollen structure and function', Wiley Eastern Ltd., New York.
7. Chopra, V.L. (2001), 'Plant Breeding; theory and practice', Oxford I BH Pvt. Ltd.
8. Chopra, V.L. (2001), 'Plant Breeding, Field Crops', Oxford, BH Pvt. Ltd, New Delhi.

BOT-503

Plant Ecology

- Unit I**
- i. An introduction to plant ecology and its scope.
 - ii. **Structure of ecosystem:** Abiotic components (climatic factors, Topographic/factors, Edaphic factors); Biotic components (Interactions among organisms, Autotrophs and Heterotrophs), Ecological Pyramids (Pyramid of numbers, Biomass and energy).
- Unit II**
- i. **Functions of ecosystem:** Productivity (Primary and secondary productivity, food chains, Grazing and detritus food chains), food webs.
 - ii. **Energy flow in ecosystem:** (single channel and Y shaped energy flow models. Biogeochemical cycles: N, P, C and S.
- Unit III**
- i. **Community ecology:** Classification, Analysis of communities, characteristics of communities, species diversity, Growth form and structure, origin, development and composition.
 - ii. **Methods of studying communities:** Floristic, physiogamic and Phytosociological methods.
 - iii. **Clementsian Units of vegetation:** Plant formation, Associations, consociations and society.
- Unit IV**
- i. **Biogeography:** Major biomes of the world (Terrestrial, Tundra, arboreal coniferous forests, temperate and tropical grasslands and deciduous forests, Mediterranean and Desert vegetation, Tropical rain forests; Aquatic - Fresh water Estuarine water and marine water).
- Unit V.**
- i. Environmental pollution in relation to air, water and soil.
 - ii. Climate change: Greenhouse gases, their sources, trends and role: Ozone layer and ozone hole (global warming, sea level line, UV radiation).
 - iii. Concepts of ecological management and sustainable development.

Practicals Based on BOT503

Plant Ecology

1. To calculate mean, variance, standard deviation, standard error, coefficient of variation and to use 't' test for comparing two means related to ecological data.
2. To find out relationship between two ecological variables using co-relation and regression analysis.
3. To find out association between important grassland species using chi-square test.
4. To determine minimum size and number of quadrates required for reliable estimate of biomass in grassland.
5. To determine diversity indices (Shannon - Wiever concentration of dominance) for protected and unprotected grass land stands.
6. To estimate FVI of the species in a wood land using point centre quadrat method.
7. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
8. To determine the water holding capacity of soils collected from different locations.
9. To estimate the DO content in water samples by Winkeler's method.
10. To estimate chlorophyll content in SO₂ fumigated and non-fumigated plant leaves.

Suggested Readings

1. Mungikar, A.M. (1997) An introduction to biometry, Saraswati Printing Press, Aurangabad.
2. Mungikar, A.M. (2003) Biostatistical Analysis. Saraswati Printing Press. Aurangabad.
3. Sharma, P.D (2001) Ecology and Environment, Rastogi Publications. Meerut.
4. Trivedi. R.K., Goel P.K., Trisal C.L. (1998) Practical 'Methods in Ecology and Environmental Science:Enviro-media Publisher. Karad
5. Muller, Dombosis, D. and H. Ellenberg (1974), Aims and methods of vegetation ecology, Wiley, New York.
6. Odum E.P. (1971) Fundamentals of Ecology, Saunders, Philadelphia.
7. Rajagopalan, R. (2005) Environmental studies, Oxford University Press, New Delhi.
8. Misra, R. (1968) Ecology work book, Oxford and IBH Publishing Co., Calcutta, New Delhi.
9. Ambasht, R.S. (1990). A text book of Plant Ecology, students Friends & Co., Varanasi.
10. Benny Joseph (2005) Environmental studies, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
11. Manju Yadav (2003) Ecology, Discovery Publishing House, New Delhi..
12. Ramkrishna, P.S. (2001) Ecology and sustainable Development' National book trust, New Delhi.
13. Trivedi, P.R. (1999) " Encyclopedia of Ecology and Environment" Vol. 1 - 10, Indian National Green party, New Delhi.

BOT-521- (Elective-A)

Crop genetics and Plant breeding-I

- Unit I** **Crop genetic resources:** Importance of genetic Conservation, global network for genetic conservation and utilization in major crops or the world. Institutes engaged in conservation and improvement of crop genetic resources.
- Unit II** **Food supplies, nutrition and crop breeding:** World food situation, nutritional problems, Nutritional objectives.
- Unit III** **Methods of plant breeding:** Introduction, selection, (Pure line selection, W.L. Johansons experiments on beans and their significance, Variety acclimatization, genetic significance of pollination methods, methods of breeding self and cross pollinated crops and asexually and vegetative propagated crops.
- Unit. IV** **Incompatibility in plant breeding:** Types, nature, characteristics genetic and biochemical basis, methods of induction and overcoming, incompatibility as a tool in breeding crops.
- Unit. Vi.** **i. Male sterility:** Definition and classification, Male sex expression and chemical Induction of male sterility, perspectives.
- ii Back cross:** Genetic basis, Methodology in selection to character under transfer, Transfer of two or more characters, Inter-varietal. Inter-specific and intergeneric transfer.

BOT 522 – (Elective –A)

Crop genetics and plant breeding - II

- Unit I** **1. Heterosis breeding:** i) Historical aspects, ii) Interbreeding depression,,
iii) Homozygous and heterozygous balance, iv) Genetic basis of inbreeding, v) Genetic
and physiological basis of heterosis, vi) Heterosis and plant breeding.
- Unit II** **Mutation Breeding:** i) Historical perspective, ii) The nature and chemical basis of
mutation, iii) Physical and chemical mutagenesis, iv) Mutagenic treatment schedules, v)
Screening of mutation in population, vi) Frequency and spectrum of mutants, micro and
macro mutants, vii) mutagenic effectiveness and efficiency, viii) environmental
mutagenesis repair mechanism, ix) Role of mutations in crop improvement programme.
- Unit III.** **i. Resistance breeding:**
- A.** Disease resistance-nature, mechanism of resistance, methodology problems and
achievements.
- B.** Insect resistance: Nature, mechanism of resistance, methodology, problem and
achievements.
- C.** Drought resistance, importance, types, nature of resistance methods and examples.
- ii. Quality breeding:** A. Nature of quality B. Genetic and biochemical basis C. Genetic
manipulation of quality and quantity.
- Unit IV.** **Distant Hybridization:** a) Importance, b) Interspecific, intergeneric gene transfers,
methodology, problem and remedial measures, c) Man made species.
- Unit-V i.** **Seed production and distribution:** Introduction variety evaluation, variety
maintenance, availability of new varieties, seed production and regulation, seeds
industry development. Breeding crops with special reference to Marathwada region like
wheat. Jowar, Bajra, Cotton, Groundnut. Safflower etc.

Practicals Elective -1 course – Bot521 and 522 (Elective A)

1. Study of floral biology of different crop plants.
2. Demonstration of hybridization technique in self and cross pollinated crops.
3. Study of pollen germination and demonstration of incompatibility.
4. Demonstration of male sterility in Jowar.
5. Study of pollen fertility.
6. Study of pollen viability.
7. Karyotype analysis in crop plants.
8. Aneuploid analysis in crop plants.
9. Induction of polyploidy in crop plants.
10. Study of seed protein profile by native and SDS-PAGE.
11. Estimation of oils from edible oil crops.
12. Estimation of leaf protein, Seed proteins in diploids and polyploids.
13. Mutagenesis: Introduction of mutations through physical / Chemical mutagenic treatments and raising M_1M_2 generations. Assess in the effect of mutagens on different M_1 parameters and M_2 chlorophyll viable mutant frequency and spectrum.
14. Study of mutagenesis data published in different journals and arriving at logical conclusions by providing theoretical reasons.
15. Designing of filed experiments.

Suggested readings

1. Plant Breeding - B.D. Sitigi.
2. Plant Breeding - J.R. Sharma.
3. An Introduction of plant breeding - H.K. Chaudhary.
4. Evolution of crop plants -Edited by Simmonds N.W (1986)
5. Breeding field crops - Poehlmann and Sleper.

6. Plant Breeding perspectives - Edited by Sheep and Mendnkasen.
7. Crop Breeding, P.B. Vose and S.G. Blixt
8. Genes. Chromosomes and Agriculture. Chrispels and Simmonds.
9. Principles of Genetics - Snusted and Simulants.
10. Manual of mutation breeding by FAO/IAEA.
11. Mutation Research -Aurebach.
12. Chemical mutagenesis - Fishbeiri et al.
13. Discussions in cytogenetics. Burnhan C.R. 1962 -
14. Genetics - Principles and analysis. Khush G.S. 1973 -
15. Genetics Principles and analysis. Haiti and Jones 1998 -
16. Molecular biology of the gene. Watson J.D. 1989

Journals

1. Cytologia
2. Caryologia
3. Nucleus
4. Nature
5. Current science,
6. Indian Journal of genetics and plant breeding.
7. Journal of cytology and genetics.
8. Journal of genetics.9. Genomes
10. Environmental and Experimental Botany.
11. Journal of Nuclear Agriculture and Biology.
12. The Journal of the Science of food and agriculture.
13. The Journal of Indian botanical society.

BOT- 521 – (Elective B)

Plant Pathology-I

Unit I. Plant disease diagnosis:

Field observations, laboratory investigations, isolation of plant pathogen and purification, Koch's postulates; identification of plant pathogens.

Unit II Classification of Plant diseases:

Based on crop plants, symptoms, causal organisms.

Unit III. Symptoms, etiology and disease cycle of diseases caused by:

a) Mastigomycotina:

Damping off of seedlings, Rhizome rots of ginger, early blight of potato, white rust of crucifers, Downy mildew of Bajra, Downy mildew of grapes.

b) Ascomycotina:

Stem galls of coriander, leaf spot of turmeric, powdery mildew of grapes, Ergot of bajra.

Unit IV. Symptoms, etiology and disease cycle of diseases caused by

a) Basidiomycotina :

Loose smut of wheat, Bunt of wheat, kernel bunt of Rice, Head smut of Jowar, grain smut of Jowar, whip smut of sugarcane. Rust: Rust of wheat, Rust of Bajra, Rust of groundnut

Unit V. Symptoms, etiology and disease cycle of diseases caused by Deuteriomycotina:

Early blight of potato and tomato leaf spot caused by *Alternaria* on brinjal, crucifers, Tikka disease of groundnut, Helminthosporium leaf spot on Rice; Blast of Rice, Red rot of sugarcane Die back of chili, Wilt of Pigeon pea, Panama disease of Banana, Blight of gram, *Rhizoctonia* stem rot of crops

BOT- 522 – (Elective B)

Plant Pathology-II

- Unit I.** **i. Agents of infections and diseases:** Biotic agents - bacteria, viruses, fungi, mycoplasma, nematodes.
- ii Abiotic agents:** Air pollution; mineral elements, temperature, toxic effects of improperly used chemicals.
- Unit II.** **Phytoplasma diseases:** Symptoms and disease cycle of little leaf of brinjal; Sesamum phylody, witches broom diseases, Grassy shoot of sugarcane.
- Unit III.** **Viral diseases:** Symptoms produced by viruses on plants, study of plant virus disease; Tobacco moosaic, leaf curl of tomato, papaya moosaic, yellow vein moosaic of bhendi, Bunchy top of Banana, Tristeza of citrus.
- Unit IV.** **Bacterial diseases:** symptoms of bacterial diseases on plants. Study of bacterial diseases: Angular leaf spot of cotton, citrus canker, Gummosis,, of sugarcane, Bacterial wilt of solanecious vegetables. Halo blight of bean, Soft rots of fruits.
- Unit V.** **Non parasitic diseases:** Non infectious diseases of plants, Nutritional deficiencies, Blossom rot of tomato, mango black tip, zinc deficiency of citrus.

Practical Course-Bot 521 and 522(Elective B)

1. Collection and preservation of diseases specimens.
2. Symptomology, histopathology of disease given in theory.
3. Virulence test for pathogens.
4. Visits to fields for study of diseases.

Suggested readings Bot 521 and 522(Elective B)

1. Agrios, G.N. (1969) Plant Pathology, Academic Press, New York.
2. Rangaswami, G. and A. Mahadevan (2001) Disease of crop plants in India, Printic Hall of India, Pvt. Ltd., New Delhi.
3. Gupta, V.K. and V.S. Paul (2001) Disease of vegetable crops. Kalyani Publ. Ludhiana,
4. Gupta, V.K. and S.K. Sharma (2000) Disease of fruit crops, Malyani Publ. Ludhiana.
5. Raychaudhari, S.P. and T.K. Nariani (1977), Virus and Mycoplasma disease of plants in India. Oxford and IBK Publ. Corp., New Delhi.
6. Bos L. (1999), Plant viruses, unique and intriguing pathogens. Backhugs Publ. Leiden.
7. Rangaswami, G. and S. Rajagopalan (1973), Bacterial plant pathology, T.N. Agri. Uni. Coimbatore.

BOT-521 (Elective C)

TAXONOMY OF ANGIOSPERMS-I

- UNIT-I: Characteristic features of angiosperms;** aims and objectives of taxonomy, functions and phases of taxonomy; taxonomy as synthetic discipline (passing remarks)
- UNIT-II: Phylogeny of angiosperms:** monophyletic and polyphyletic origin of angiosperms, herbaceous origin hypothesis, origin of monocotyledons; molecular evidence to angiosperm origin, cradle of angiosperms.
- UNIT-III: Taxonomic hierarchy:** it's major, minor and intraspecific categories and ranks
A brief history of Pre-Darwinian and post Darwinian systems of classification with special emphasis on Thorne and Cronquist's systems of classification
- UNIT-IV: Concept of taxonomic character:** analytical and synthetic, qualitative and quantitative, genetically and environmentally controlled, good and bad character, character weighing, taxonomic coefficient
- UNIT-V: Phylogenetic relationship:** Primitive and advanced characters, monophyletic, paraphyletic and polyphyletic, homology and analogy, parallel and convergent evolution, plesiomorphic and apomorphic characters. **Cladistics:** Operational Taxonomic Units (OTU), characters and coding, measuring of similarity, cladograms.

BOT-522 (Elective C)

TAXONOMY OF ANGIOSPERMS-II

UNIT-I: The concepts of species; plant speciation: allopatric/ abrupt/ sympatric/ hybrid/ apomictic speciation and isolation mechanism. Types of speciation: quantum, myrean, catastrophic, local, geographic and phyletic. Causes of variation in population, ecotypes and ecads, evolution and differentiation of species, adaptive radiations.

UNIT-II: Botanical Nomenclature: Scientific names: legitimate name, illegitimate name, autonym, homonym, synonym, basionym, tautonym, alternative name, ambiguous name, superfluous name, naked name, conserved name, rejected name; procedure to describe new taxon; Latin diagnosis and description, effective and valid publication, coining of generic names and specific epithets; citation of names(s) of author(s); Scientific Journals in plant taxonomy.

UNIT-III: Taxonomic evidences: Morphology, micro-morphology, ultrastructure systematics- SEM and TEM studies, anatomy, embryology, palynology, cytology, ecology, population biology, phyto-chemistry, molecular biology and numerical taxonomy.

UNIT-IV: Herbarium: History, Objectives and function of a herbarium, Types of herbaria, role of herbarium in Systematics, Floristics, Teaching, Research, Assessment and documentation of phyto diversity and Public Education, pests in herbarium and its control.

UNIT-V: Comparative account on distribution, floral morphology, interrelationships of families belonging to the following order as per Engler's system of classification:

- | | | | |
|----------------|------------------|-------------------|--------------|
| a) Ranales, | b) Rhoedales, | c) Centrospermae, | d) Malvales, |
| e) Geraniales, | f) Contortae and | g) Tubiflorae | |

Practicals based on BOT-521C & BOT-522 (Elective C)

TAXONOMY OF ANGIOSPERMS I & II

1. Description of species based on many specimens to study intraspecific variation.
2. Study of morphology and general evolutionary trends in flowers, stamens and carpels of primitive families viz. Magnoliaceae, Papaveraceae, Nymphaeaceae, Lauraceae
3. Study of different types of ovules, placentation and evolutionary trends therein
4. Exercises on nomenclature problems: Author citation, principle of priority, transfer of taxa, effective and valid publication.
5. Describing new taxon, deposition of type, Latin diagnosis and abbreviations used in citations.
6. Semi-permanent pollen preparations by acetolysis method and study of different pollen morphotypes.
7. Taxonomic distribution of special units of pollen dispersal- bi celled pollen, tetrads, polyads and pollinia and pollen types.
8. Study of plant surface attributes with the help of SEM photographs.
9. Descriptions, sketching, classification and identification of at least 30 families represented in local flora.
10. Classification and identification of at least 5 species of some of the genera like *Alysicarpus*, *Amaranthus*, *Cassia*, *Chlorophytum*, *Commelina*, *Cyperus*, *Euphorbia*, *Indigofera*, *Leucas*, *Sida*, *Solanum*.
11. One-day botanical excursions to botanically rich locations.
12. Botanical excursion of about one week to any botanically rich location preferable outside the State.

BOT 521 (Elective D)
Advanced plant physiology and biochemistry -1

- Unit I. Plant Composition :** Structure and biochemical role of major plant constituents, carbohydrates and its derivatives, structure and classification of proteins, glycoproteins, peptidoglycans, lipids and glycoproteins, lipid and triglycerides, fatty acid, vitamins nucleic acids.
- Unit II. Pigments:** chlorophylls, phycobiliproteins, phenolics, sterols, alkaloids, carotenoids, phytochrome, anthocyanine, phenolics, sterols, alkaloids, porphyrins, organic acids, possibilities of isolating these chemicals for human welfare.
- Unit III. Principles use and application** of colorimeters, photometry flame photometers, spectrophotometry, chromatography (ion exchange, affinity, thin layer, high pressure liquid), gel filtration, electrophoresis, electro focusing and ultracentrifugation,
- Unit IV. Application of radioactive tracer technique** in biology, radioactive isotopes
Autoradiography, Biophysical methods X ray diffraction, fluorescence UV, NMR and ESR
Atomic absorption spectroscopy
- Unit V. Growth analysis:** Growth, growth curve, lag, log and senescence phase, growth rates AGR, RGR, NAR, LAP, LAI, CGR and LAD productivity potential of dwarf varieties, causes of dwarfism, morphological and physiological factors in relation to height. Yields of dwarf plants,

BOT 522 (Elective D)

Advanced plant physiology and Biochemistry - II.

- Unit I** **Photosynthesis and plant productivity** C3, C4 and CAM pathways and photorespiration in relation to crop productivity, soil and water conservation methods, weed biology herbicides, biological weed control, intensive cropping, zero tillage use of plant growth regulators and bio-fertilizers in agriculture, Nitrogen use efficiency, optimum economic dose of nitrogen fertilizers green manuring.
- Unit II** **Biomass** : The concept of Biomass, Biomass production, Utilization of biomass as a energy agricultural. Residue and their management HDEF energy forests energy crapping hydro carbon, plants biomathylation biogas, biogas plants, biogas production from soils city wastes.
- Unit III.** **The practice of green manuring** and preparation of compost NADEP and other methods, Utilization of solid wastes for composting recent trends in solid waste management and production sources.
- Unit IV.** **Green crop fraetionation:** The GGF system and advantages of GCF. Mechanical fractionation, plants suitable for GCF, Machinery recommended for mechanical fractionation, products, pressed crop residue (PCR) Juice, leaf protein concentrate and deproteinized Juice (DPJ).
- Unit V.** **Green Crop Fractionation:** Use of PCR in animal nutrition preparation of silage, silage fermentation, use of leaf juice as a milk replacer, Preparation of LPC, chloroplastic and cytoplasmic LPC, Nutritive value of LPC, and its suitability in human nutrition as a sources of protein and vitamin - A, preservation of LPC, DPJ as a replacer of tissue culture media, LPC compared with algal protein SCP, the possibility of increasing protein productivity through green crop fractionation. Bidkin Process

Practical Based on BOT 521 & 522 (Elective-D)

1. Estimation of B - carotene with column chromatography.
2. Estimation of reducing sugars by Folin – Wu tube.
3. Estimation of cellulose by crampton and Maynord Method.
4. Estimation of free fatty acids.
5. Estimation of nitrates.
6. Thin layer chromatographic technique.
7. Techniques of flame photometry: estimation of sodium and potassium.
8. Estimation of gross energy by chromic acid oxidation method.
9. Estimation of N by micro – Kjeldhal methods.
10. Estimation of crude protein, crude fat and crude fiber.
11. Estimation of ash acid soluble / insoluble ash, Nitrogen free extracts and total carbohydrates.
12. Estimation of cell wall constituents, ADF, NDF, cellulose, hemicellulose, lignin etc.
13. Estimation of calcium by titration method.
14. Estimation of phosphorus by Subba Rao and Fiske Method,
15. Growth analysis: AGR, RGR, NAR, LAR, LAI, CGR and LAD.
16. The process of GCF and extractability of dry matter and Nitrogen.
17. Preparation of LPC, by heat coagulation, acid coagulation and fermentation.
18. Preparation of cytoplasmic and chloroplastic LPC by differential heat coagulation.
19. Preparation of TCM using DPJ and Inoculation of explant.

Suggested Readings

- 1) Hess, D. Plant Physiology, Narosa Publishing House, New Delhi.
- 2) Mukharji, S. and Ghosh, A.K. Plant Physiology. New Central Book Agencies, Kolkatta.
- 3) Noggle, G.R. and Fritz, G.S. Introductory plant physiology, Prentice Hall, U.S.A.
- 4) Vaidya, V.G., Sahasrabuddhe, K.R. and Khupse, V.S. Crop production and field experimentation, Continental Prakashan, Pune - 30.
- 5) ICAR Handbook of Agriculture^ ICAR, New Delhi.
- 6) Mungikar, A.M. Bibliography of leaf protein in Marathwada University.
- 7) Pine, N.W. (1971), Leaf protein, its preparation, quality and use, Blackwell Scientific Publ. U.K.
- 8) Telek, H. and Graham, LT. (1983), Leaf protein concentrates, AVI, Publishing Co., USA.

Service Course- I
(Basic Plant Tissue Culture)

Unit-I (Introduction to Plant Tissue culture): Introduction to Plant Tissue culture, Terms and definitions, Historical background, Laboratory organization, Tools and techniques, methods of sterilization. Laboratory contaminants- it's control and measures.

Unit-II (Media Preparation and dynamics of Growth): Introduction to tissue culture: Media composition, Preparation, Phytohormones and their usage, selection of media for specified applications, initiation of tissue culture, cellular totipotency, media for initiation of callus, dynamics of callus growth, organogenesis and factors controlling it, genome instability in reaction to morphogenesis, somaclonal variation and its applications.

Unit-III (Culture techniques)

Cell and organ culture: Plant organ culture; shoot tip, Micropropagation, shoot apical meristem, root, leaf, flower and ovary culture, embryo rescue, somatic embryogenesis, factors influencing embryogenesis, synthetic seeds, suspension culture in stationary and stirred tank reactors,

Unit-IV (Advance Culture techniques)

Isolation of single cells and their culture, measurement of growth, protoplast isolation, culture, regeneration and fusion of protoplasts, generation of cybrid and hybrids, cryopreservation of plant cells. Role of Ovary and ovule in *In-vitro* Fertilization in production of agricultural and horticultural crops. Hardening techniques

Unit-V (Recombinant Techniques in Tissue Culture)

Recombinant DNA technology: Gene cloning, principles and techniques. Techniques for gene transfer. Markergenes. Applications of tissue culture: Applications in agriculture and industry.

Suggested Books

1. Kalyankumar De. Introduction to Plant Tissue culture,
2. Bhojwani, Plant Tissue Culture.
3. DUBEY. R. C. a Textbook Of Microbiology
4. Montell. S.H. Mathews, J.A., Meker, R.A. Principles of Plant Biotechnology.
5. Glover, D.M. and Hanes, B.D. (eds.) 1995. DNA cloning 1: A practical approach, core techniques , 2nd edition, PAS, IRL press at Oxford University Press.
6. Purohit Plant Tissue Culture
7. Plant cell culture protocols. Humana Press, Inc. New Jersey, USA.
8. Shaw, C.H. (ed.) 1998, Plant Molecular Biology. A practical approach IRI Press, Oxford.
9. Smith, R.H. 2000. Plant Tissue culture: Techniques and Experiments. Academic Press, New York.
10. Modern genetic analysis, Griffith.
10. Rajdan : An introduction to plant tissue culture.
12. Sandhya Mitra: Genetic engineering.

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.



Department of Botany

Academic Flexibility

Credit Based Grading System

M. Sc. Botany

Fourth Semester

2012-2013

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 04-06-2011.

1. Prof. Vijay S. Kothekar- Chairman
2. Dr. Ms. Bharati Jadhav
3. Dr. Prakash B. Papdiwal
4. Dr. Mrs. Suniti S. Barve
5. Dr. Milind. M. Sardesai
6. Dr. Aravind S. Dhabe
7. Dr. Narayan B. Pandhure

Total Marks for M.Sc. I, II, III and IV Semester

Semester	Theory	Practical
	Marks	Marks
I	500	250
II	500	250
III	500	250
IV	500	250
Total	2000	1000

Theory Examination (Fourth Semester) Marks

Subject Code	Name of Course	Internal Test	Term End Exam	Total Marks	Practical
BOT 504	Plant Resource utilization and conservation	20	80	100	50
BOT 505	Plant Tissue Culture and Recombinant DNA technology	20	80	100	50
BOT 506	Biotechnology and Bioinformatics	20	80	100	50
BOT 523 and 524	Elective — C and D	20	80	100	50
BOT 525 BOT SC-I	Service courses Medicinal Plants	20	80	100	50
	Total	100	400	500	250

Botany-504
Plant Resource Utilization and Conservation

- Unit. I** Plant Biodiversity: Concept, situation in India.
- Unit. II.** Origin, evolution, botany, cultivation and uses of Food, fodder, fiber, medicinal, aromatic and oil yielding crops, wood and timber, non-wood forest products (NWFPS): Bamboo, gum, dye, resin and fruits etc.
- Unit.III.** Strategies of conservation, *In situ* conservation, protected regions in India: Sanctuaries, National parks, Wetlands, mangroves for conservation of wild biodiversity.
- Unit. IV.** *Ex situ* conservation: Principles and practices, Botanical gardens, gene bank, seed banks, cryobanks,
- Unit.V.** General activities of Botanical Survey of India (BSI), and National Bureau of plant Genetic Resources (NBPGR) for conservation efforts.

Laboratory exercise:

1. Food Crops: Morphology, anatomy, micro-chemical test for stored material: Wheat, rice, maize, chickpea, potato, sweet potato, sugarcane,
2. Study of any five important crops used for fodder / forage purpose: Sorghum, Bajra, lucerne, Maize etc.
3. Plant fibers: Cotton, jute, sun hemp, coir, silk cotton
Morphology microscopic study anatomy of whole fibers, using appropriate staining methods.
4. Medicinal and aromatic plants: At least 5 medicinal and 5 aromatic plants and their morphology, anatomy, phyto-chemistry.
5. Oil yielding crops: Mustard, groundnut, soybean, coconut, sunflower, castor: Morphology, microscopy of oil yielding tissue, test for oil, acid, Iodine numbers.
6. Gum, resin, tannin, dye yielding plants.
7. Fire wood and timber yielding plants.
8. Scientific visits to laboratories / Industries / Research Institutes and field and submission of report.

References

1. Arora, R.K. and Nayar, E.R. (1984), Wild relatives of crop plants in India, NBPGR Science MonographNo.7.
2. Baker, H.G. (1978), Plants and civilization. III Ed. (A. Wadsworth, Belmont).
3. Bole, P.V. and Vaghani, Y. (1986). Field guide to common Indian trees, Oxford University Press, Mumbai.
4. Thakur, R.S., Puri, H.S. and Husain, A. (1969). Major medicinal plants of India, Central Institute of medicinal and aromatic plants, Lucknow.
5. Swaminathan, M.S. and Kocchar, S.L. (Es.) (1989). Plants and Society, MacMillan Publication Ltd.,
6. Sharma, O.P. (1996). Hills Economic Botany, Tata McGraw Hill co., Ltd., New Delhi,
7. Kocchar, S.L. (1998). Economic Botany of the tropics, II Edn. MacMillan India Ltd.,
8. CSIR (1986), The useful plants of India Publication and Information directorate, CSIR^ New Delhi.
9. CSIR (1948 - 1976) The wealth of India,

BOT 505

Plant Tissue culture and Recombinant DNA technology

Unit I. Biotechnology: Basic concept, principles and scope.

Unit II. Introduction to tissue culture : Media composition, phytohormones and their usage, selection of media for specified applications, initiation of tissue culture, cellular totipotency, media for initiation of callus, dynamics of callus growth, measurement of growth, organogenesis and factors controlling it, genome instability in reaction to morphogenesis, somaclonal variation and its applications.

Unit III. Cell and organ culture: Plant organ culture; shoot tip, shoot apical meristem, root, leaf, flower and ovary culture, embryo rescue, somatic embryogenesis, factors influencing embryogenesis, synthetic seeds, suspension culture in stationary and stirred tank reactors, isolation of single cells and their culture, measurement of growth, protoplast isolation, culture, regeneration and fusion of protoplasts, generation of cybrid and hybrids, cryo preservation of plant cells.

Unit IV. Applications of tissue culture: Applications in agriculture and industry.

Unit V. Recombinant DNA technology: Gene cloning, principles and techniques, construction of genomic / cDNA libraries, choice of vectors, promoters, Reporter genes, plasmid vectors, DNA synthesis through yeast alanyl t RNA , polymerase chain reaction, DNA fingerprinting.

Biotechnology and Bio-informatics

- Unit I.** i. **Genetic engineering of plants:** Aims, strategies for development of transgenics.
- ii. **Agrobacterium:** The natural genetic engineer, T - DNA and transposon mediated gene tagging, Holistic technique, electroporation, chloroplast transformation and its utility.
- Unit II. Microbial genetic manipulations:** Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.
- Unit III. Genomics and proteomics:** Genetic and physical mapping of genes, molecular markers for introgression of useful traits, artificial, chromosomes, high through put sequencing, genome projects, functional genomics, micro assays, protein profiling and its significance.
- Unit IV. Computer applications and Bioinformatics:** Introduction to computer basics, organization of PC, mainframe and super computers, concept of hardware and software, concept of file, folders and directories, commonly used commands, introduction to MS office software concerning word processing, spread sheets and presentation software.
- Unit V. Networking concepts:** Networking fundamentals, client server, LAN, WAN, telnet, Nic net, www, html, e mail, introduction to CCOD and PUBMED for accessing biological information, introduction to hardware graphics and coral draw.

Practicals - Course 505 and 506

1. Media preparation and sterilization.
2. Introduction of callus.
3. Anther culture
4. Suspension culture,
5. Micropropagation.
6. Embryo rescue technique.
7. Plant regeneration from callus.
8. Isolation of plant protoplasts and viability testing. p_f
9. Protoplast fusion by PEG.
10. Isolation of plasmid from *E. coli* by alkaline lysis method.
11. Quantitation of plasmids by spectrophotometry.
12. Detection of mutant variants in bacterial population by replica plating technique.
13. Control and expression of the genes of Lac operon.
14. Growth curves of microorganisms by plating and turbidometry.
15. Demonstration of gene transfer during bacterial conjugation.
16. Basics of operating a computer.
17. Creating files, folders and directories.
18. MS office - creating MS Word documents, Excel spread sheet and use of power point
19. Creating an e. mail account, sending and receiving mails.
20. An introduction to INTERNET, search engines, website, Browsing, Downloading, information.

Suggested Readings:

1. Henry, R.J. Practical application of plant molecular Biology, Champman and Hall
2. Kalyan kumar De. Introduction to Plant Tissue culture,
3. Bhojwani, Plant Tissue Culture.
4. Montell S.H. Mathews, J.A., Meker, R.A. Principles of Plant Biotechnology.
5. Glover, D.M. and Hanes, B.D. (eds.) 1995. DNA cloning 1: A practical approach, core techniques , 2nd edition, PAS, IRL press at Oxford University Press.
6. Plant cell culture protocols. Humana Press, Inc. New Jersey, USA.
7. Shaw, C.H. (ed.) 1998, Plant Molecular Biology. A practical approach IRI Press, Oxford.
8. Smith, R.H. 2000. Plant Tissue culture: Techniques and Experiments. Academic Press, New York.
9. How computers work - 2000. Ron White Tech. Media.
10. How Internet work 2000, Preston Gralla Tech Media.
11. Internet - CDC publication Ind.
12. Computer analysis of sequence data cotte.
13. Modem genetic analysis, Griffith.
14. Rajdan : An introduction to plant tissue culture.
15. Sandhya Mitra: Genetic engineering.

BOT 523 (Elective A)
Advanced Genetics and Molecular Biology -1

Unit I i. Microorganisms as model systems for genetic studies, Virus and phage organization, Lytic and temperate phages, recombination in phages and gene mapping.

ii Recombination in bacteria: transformation, transduction, conjugation and gene mapping, Tetrad analysis in fungi.

Unit II Mutagenesis: Spontaneous mutations, mutation frequency, Physical mutagens, ionizing and non-ionizing radiations, radio-sensitivity, cytological and genetic effects, chemical mutagens, mutagenic compounds, mode of action, molecular basis of mutations. Ames test. *In - vitro* site directed mutagenesis, DNA repair mechanism.

Unit III. Human genetics: In born errors of metabolism - Human karyotype, the chromosomal basis of genetic disorders and syndromes, amniocentesis, genetic counseling.

Unit IV. DNA replication: Overview, enzymes of replication, Replication apparatus, primosome and replisome, Replication mechanism, continuous and discontinuous DNA synthesis, supercoiling and termination of replication, Eukaryotic DNA replication.

Unit V. Transcription: Central dogma, role of DNA in protein synthesis, RNA polymerase, mechanism of transcription, eukaryotic transcription, Post transcriptional modification of in RNA, mapping and poly acetylation, split gene, introns, exons and gene splicing, reverse transcription.

BOT 524 (Elective A)

Advanced Genetics and Molecular Biology — II

- Unit I. i. Genetic code:** Triplet code, deciphering the code, degeneracy, Translation: ribosomes, chain initiation, elongation and termination. Inhibitors of protein synthesis.
- ii. Regulation of gene expression:** Prokaryotic operon model, lac operon inducible system, CAP proteins and catabolic repression, his operon repressible system, Lac-operon attenuation control. Post transcriptional control, feedback inhibition and protein degradation, Eukaryotes : short term regulation, heat shock proteins, hormonal regulation, DNA methylation, Heterochromatin and gene inactivation,
- Unit II. Genome organization:** Genome size variation, cot curve analysis, DNA complexity, LINES and SINES, gene amplification and gene families, Mitochondria and chloroplast genome.
- Unit III. Genomics:** Structural genomics, cytogenetic maps, RFLP, RAPD, QT maps, FISH and chromosome specific library. Genome sequencing, human, yeast, *Arabidopsis*, genome projects, functional genomics expressed sequences, DNA chips and genome evolution.
- Unit IV. Genetic engineering:** Isolation of DNA, restriction endonucleases, construction of genomic library, screening of DNA library for desired gene, Southern, Northern and Western blotting, prokaryotic and eukaryotic vectors, DNA sequencing, Maxam and Gilbert's procedure, Sanger Coulson method, automated DNA sequencing machine, PCR and DNA amplification, Marker gene, reporter and selection marker gene, Ti plasmids and viral vectors, Direct gene transfer through electroporation, biolistic gun, micro injection, liposome and PEG mediated gene transfers. Application of recombinant DNA technology in medicine, industry and agriculture,
- Unit V. Genetic basis of cancer:** Forms of cancer, genetic basis, cancer and cell cycle, oncogenes, genetic pathway to cancer, genetic counseling.

Practical based on 523 and 524

Advanced genetics and molecular biology I & II

1. Comparative radio-sensitivity in two crop species.
2. Isolation of genomic DNA using CT AB method and quantification.
3. Evaluation of quality of isolated DNA.
4. Restriction and ligation reactions.
5. Agarose gel electrophoresis of DNA.
6. PCR amplification and RAPD marker.
7. Isolation of plasmid DNA
8. Conjugation in *E. coli*
9. Study of growth curve in *E. coli*.
10. Substrate induced enzyme induction in plants.
11. Transformation in bacteria.
12. Isolation and quantification of total RNA and agarose gel electrophoresis.
13. Cytological effects of radiations and chemical mutagens in higher plants.

Suggested Readings:

1. Snustad, P.D. and Simmons, M.J. 2000, Principles of Genetics, 2nd Ed, John, Wiley and Sons, Inc., London.
2. Lewin, R. 1999, Human genetics, Concepts and applications. 3rd Ed, McGraw Hill, Dubuque, IA.
3. Lewin, B. 2000, Genes VII, Oxford University, New York.
4. Griffith, A.J.F., Miller, J.H. Suzuki, D.T. Lewontin, R.C. and Gilbert, W.M, 2000. Introduction to genetic analysis, 5th Ed. W.H. Freeman, N. Y.
5. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. Molecular cell Biology, Freeman, W.H. and Co., N. Y.
6. Watson, J.D., Gilman, M., Witkowski, J. and Zoller, M. 1992, Recombinant DNA W.H. Freeman and Co., N.Y. A. c (Hi. (1994). Molecular Biology of cell, 3rd Ed. Garland
7. Albart A.et.al 1914 J.M.and Gingold, E.B. 1993, Molecular biology and Biotechnology, Royal Soc., Publications,
8. U.K. If ftinaiin, R. 1991, Principles of Genetics, 3rd Ed. Win Brown, Dubuque, USA.
9. Brown J.A. 1992. Genetics, a molecular approach II Ed.
10. Tamarin, R. 1991 principles of Genetics III edition, Win brown , Duabuque, USA

BOT 523 (Elective B)

Plant Pathology – III

- Unit I. History:** Beginning of modern plant pathology; Contribution of Anton De Bary; Benedict Prevost; J.C. Kuhn; M.S. Woromin; B.C. Stakman; Paul Neergaard, P.H. Gergory, K.C. Mehta. History of the development of plant pathology in India; plant disease clinics.
- Unit II. Dispersal of plant pathogens:** Direct transmission; Indirect transmission; Plant disease epidemiology; Some important epiphytotics; Methods used in plant disease forecasting.
- Unit III. Seed Pathology:** Scope and importance; seed health testing; methods and procedures; Detection of seed borne-fungi, Bacteria and viruses. Seed bio deterioration: Biochemical changes, Morphological abnormalities, loss in germinability. Mycotoxins, fusarium toxin and aflatoxins. Control of Post-harvest spoilage of grains.
- Unit IV. Enzymes of plant pathogens:** Cell wall degrading enzymes; Proeolytic enzymes - Macerating enzyme, Polygalacturonase, Pectin esterase; trans-aminase and their role in disease development. Cellulolytic enzymes and their role in disease development.
- Unit V. Disease Management:** Cultural Methods- Avoidance of pathogen, exclusion of inoculum, eradication of pathogen, Chemical methods- sulphur fungicides, Copper fungicides, Mercury fungicides, Quinone fungicides, Systemic fungicides, Antibiotics, Breeding for disease resistance, Integrated Pest Management, Biopesticides and bioagents; *Trichoderma* and VA mycorrhiza. Application of Biotechnology in disease management.

BOT 524 (Elective B)

Plant Pathology – IV

Unit I. Nature, origin and evolution of parasitism: Interrelationship of parasitism and pathogenicity; physiology of pathogenicity; Natural process of pathogenesis, evolution of parasitism and pathogenicity. Effect of environment on different classes of parasitism; law of host - parasite balance, host genetics in relation to type of pathogenicity; search for effective disease control.

Unit II. Pathogenesis: Penetration and entry by plant pathogen; Pre-penetration; Entry through natural opening, Direct penetration, Entry through wounds, root hairs and buds,

Unit III Toxins of Plant pathogens: Phytotoxins ; Classifications of toxins, Fusaric acid, Lycopersin, Piricularin, Alteraric acid, Tabtoxin, Phaseolotoxin, Victorin

Unit IV Physiological imbalances in disease plants: Photosynthesis, respiration, protein metabolism, phenol metabolism, plant growth regulators.

Unit V. i. Disease Resistance in Plants: Primary infection resistance, Structural and Chemical defences; Post infection resistance : Production and activities of phytotoxins. Histological accumulation of phenols, hypersensitive substances and enzymes, detoxification.

ii. Genetics of host Pathogen interaction: Resistance and susceptibility, Vertical and horizontal resistance, Gene for Gene hypothesis, PR-Proteins, physiological specialization, mutation, heterokaryosis.

Practicals Based on Course-BOT523 and 524

1. Production and assay of macerating enzymes.
2. Production and assay of polygalacturonase, cellulolytic enzymes, amylase, toxins, phytoalexins etc.
3. Evaluation of fungicide against plant pathogenic fungi.
4. Evaluation of antibiotics against pathogenic bacteria.
5. Extraction and estimation of pigments in healthy and diseased plants.
6. Estimation of Nucleic acids,

Suggested readings

1. Chandnivala, M. (1955). Recent advances in plant pathology, Amol Publication, Pvt. Ltd.,
2. Nurenburg, H.W. (1985) Pollution and their ecotoxicological significance, John Wiley and Sons, New York.
3. Mehrotra, R.S. Plant Pathology, Tata McGraw Hill Publication Co., Ltd., New Delhi.
4. Agriso, G.N. Plant Pathology, Academic Press, New York and London.
5. Bilgrami, K.S. and H.C. Dubey, A text book of Modern plant pathology, Vikas Publishing House, New Delhi.
6. Nene, Y. and P.N. Thaphyal Fungicides in plant disease control II Idiv Oxford and IBH Publishing Co., New Delhi
7. Vyas, S.C. Systemic fungicides, Vol. 1 - 3, Tata Mc(Jrnw Hill Publishing Co., Ltd., New Delhi.
8. Dekker, J. and S.G. Georgopoulos (Ed), Fungicides Resistance in plnnl Protection, CARD Publications,
10. Gangawane, L.V. and Jayashree Deshpande. Pesticides and crop plnntn in India, Ajay Prakashan, Aurangabad.
11. Holton, C.S., Fischr, C.N. Fulton, R.W., Hart, H. and S.K.A.Macallan. Plant Pathology: Problems and progress (1908 - 1958), The University of Wisconsin, USA.

BOT- 523 (Elective C)

TAXONOMY OF ANGIOSPERMS-III

- UNIT-I:** Phylogeny of Angiosperms: Isoetes-monocotyledone theory, Coniferales-amentiferae theory, Gnetales-angiosperms theory, anthostrobilus theory, Bennettitalean theory, Caytonialean theory, Stachyspory-phylospermae theory, pteridosperm theory, Pentoxylales theory and Durian theory; Co-evolution of insect and plants.
- UNIT-II:** Study of fossil angiosperms: Malvaceae: Sahnioarpon; Myrtaceae: Sahnipushpam; Soneratiaceae: Sahnianthus, Enigmocarpon; Palmae: Palmoxylon.
- UNIT-III:** 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). Taxonomic keys: suggestions for construction and use of keys: types of keys.
- UNIT-IV:** Recent system of classification: Angiosperm Phylogeny Group (APG) system.
- UNIT-V:** Phytogeography: World vegetation, theories of plant distribution, vicarious areas, centres of origin, theory of tolerance.

BOT-524 (Elective C)

TAXONOMY OF ANGIOSPERMS- IV

- UNIT-I:** Trends in evolution of characters in flowering plants in habit and habitat, phyllotaxy, stomatal apparatus, nodal anatomy, xylem, phloem, cambium, vascular cambium, inflorescence, flower, androecium gynoecium, pollination, fertilization, placentation, fruit, seed and seedling.
- UNIT-II:** **Numerical Taxonomy:** Principles of taxometrics, operational taxonomic units, taxonomic characters, measuring resemblances, cluster analysis, classification.
- Biosystematics:** Aims, objectives and steps in biosystematic studies, biosystematic categories, importance of biosystematic studies.
- UNIT-III:** **Molecular Biology:** Acquisition of Molecular Data, sources of DNA sequence data, Plant genomes, Polymerase Chain Reaction (PCR) analysis, DNA Sequencing Reaction, Types of DNA Sequence Data, Generation and analysis of DNA Sequence Data, Restriction Fragment Length Polymorphism analysis (RFLP), allozymes, micro-satellite DNA, Random Amplified Polymorphic DNA (RAPDs), Amplified Fragment Length Polymorphism (AFLPs).
- UNIT-IV:** **Botanic Gardens:** Definition, criteria, history and role of botanic gardens, special types of botanic gardens: Arboretum, Pineatum, Orchidarium, Bambusetum, Fernary. Important Botanic Gardens in India and World.
- UNIT-V:** History of botanical explorations in Maharashtra and Marathwada. Contributions of Botanical Survey of India.

Practicals based on BOT 523 C & BOT 524

TAXONOMY OF ANGIOSPERMS-

1. Assessment of taxonomic characters (a) analytical and synthetic characters, (b) qualitative and quantitative characters.
2. Study of different taxonomic features (a) stomata, (b) trichomes, (c) crystals, (d) pollen grains.
3. Describing new taxon, deposition of type, Latin diagnosis and abbreviations used in citations.
4. Detection of taxonomically important chemical compounds by various tests.
5. Detection of variations in a given population.
6. Exercises on nomenclature problems: Author citation, principle of priority, transfer of taxa, effective and valid publication etc.
7. Practical based on numerical taxonomy/ cluster analysis.
8. Study of different types of ovules, placentations and evolutionary trends therein.
9. Study of following fossil angiosperm specimens: Palmoxyton, Enigmocarpon, Sahnianthus, Glossopteris with the help of slides/ specimens.
10. To identify family with the help of computerized Key.
11. Preparation and standardization of some simple Ayurvedic Drugs.

Suggested Readings:

1. AHMEDULLAH, M., AND M.P. NAYAR. 1987. Endemic Plants of the Indian Region. Vol. I. Botanical Survey of India. Howrah.
2. BENSON, L.D. 1962. Plant Taxonomy: Methods and Principles. Ronald Press, New York.
3. BHOJWANI, S. S. AND BHATNAGAR, S. P. 1984. Embryology of Angiosperms. Vikas Publ. House, New Dehli.
4. BILGRAMI, K.S. AND J.V. DOGRA. 1990. Phyto Chemistry and Plant Taxonomy. New Delhi, CBS Publishers
5. CRONQUIST, A. 1968. The Evolution and Classification of Flowering Plants. Houghton Mifflin. Boston.
6. CRONQUIST, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
7. CRONQUIST, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.
8. DANIEL, M. 2009. Taxonomy: Evolution at work. Narosa Publishing House Pvt. Ltd. New Delhi.
9. DAVIS, P.H., AND V.H. HEYWOOD. 1965. Principles of Angiosperm Taxonomy. Oliver & Boyd. Edinburgh.
10. DAVIS, P.H., AND V.H. HEYWOOD. 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi
11. DOBSON, A.P.1996. Conservation and Biodiversity. Scientific American Library. New York, U.S.A.
12. ERDTMAN, G. 1952. Pollen Morphology and Plant Taxonomy. Angiosperms. Almquist and Wiksell. Stockholm.
13. ERDTMAN, G. 1986. Pollen Morphology and Plant Taxonomy : Angiosperms An Introduction to Palynology. Netherland, E.J.Brill, Leiden.
14. FORMAN, L. AND D. BRIDSON. 1989. The Herbarium Handbook. Royal Botanic Gardens, Kew, U.K.
15. GRAHAM, L.E. 1993. Origin of Land Plants. John Wiley & Sons. Inc. New York.
16. GREUTER, W, (Ed.). 2007. International Code of Botanical Nomenclature. (VIENNA CODE). Koeltz Vesentific Books. Germany.

17. GROOMBRIDGE, B, (Ed.). 1992. Global Biodiversity: Status of The Earth's Living Resources. Chapman and Hall. London.
18. HENRY, A.N., M.CHANDRABOSE. 1980. An Aid to International Code of Botanical Nomenclature. Today & Tomorrow's Printers and Publishers. New Delhi.
19. HESLOP-HARRISON, J. 1953. New Concepts in Flowering Plant Taxonomy. Heinemann Ltd. London.
20. HEYWOOD, V.H. 1967. Plant Taxonomy. Edward Arnold Ltd. Great Britain.
21. HEYWOOD, V.H. 1995. Global Biodiversity Assessment. Cambridge University Press, Cambridge, U.K.
22. HUTCHINSON, J. 1973. The Families of Flowering Plants. 3rd Edition. Oxford University Press. Oxford.
23. JAIN, S.K. and R.R. RAO. 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers, New Delhi.
24. JOHRI, B.M. 1994. Botany in India: History and Progress. Vol-I. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
25. JONES, S.B., AND A.E. LUCHSINGER. 1987. Plant Systematics. 2nd Edition. McGraw-Hill Book Company. New York.
26. JUDD, W. S, C. S. CAMPBELL, E. A, KELLOG, P. F. STEVENS AND N. J. DONOGHUE. 2008. Plant Systematics. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.
27. LAWRENCE, G.H.M. 1951. Taxonomy of Vascular Plants. The Macmillan Company. New York.
28. MABBERLEY, D.J. 2005. The Plant-Book, A portable dictionary of the vascular plants. Cambridge University Press, United Kingdom
29. MANILAL, K. S. AND M. S. MUKTESH KUMAR [ed.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.
30. MINELLI, A. 1993. Biological Systematics: The State of the Art. London, Chapman & Hall.
31. MONDAL, A.K. 2005. Advanced Plant Taxonomy. New Central Book. Agency Pvt. Ltd. Kolkata.
32. MOORE, R., W.D. CLARK, K.R. STERN AND D. VODOPICH. 1995. Botany: Plant Diversity. Wm. C. Brown Publishers. London.
33. NAIK, V. N. 2000. Taxonomy of Angiosperms. Tata McGraw – Hill Publishing Company Limited, New Delhi.

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35. NAYAR, M.P., 1996. "Hot Spots" of Endemic plants of India, Nepal and Bhutan. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, India.
36. NAYAR, M.P., AND R.K. SASTRY. 1987-1990. Red Data Book on Indian Plants. Vols. I - III. Botanical Survey of India. Howrah.
37. QUICKE, D.L.J. 1993. Principles and Techniques of Contemporary Taxonomy. Chapman and Hall. London.
38. RADFORD, A.E., W.C. DICKISON, J.R. MASSEY, AND C.R. BELL. 1974. Vascular Plant Systematics. Harper & Row. New York.
39. RAVEN, P.H., R.F. EVERT, AND S.E. EICHHON. 1992. Biology of Plants. 5th Edition. Worth Publishers. New York.
40. SANTAPAU, H. 1955. Botanical Collector's Manual. Botanical Survey of India.
41. SANTAPAU, H. AND H.A. HENRY. 1994. A dictionary of the flowering plants in India, CSRI, New Delhi.
42. SHARMA A. AND A. SHARMA. 1980. Chromosome Technique: Theory and Practices (3rd ed.) Butterworths, London.
43. SHIVANNA, K. R. AND N. S. RANGASWAMY. 1992. Pollen Biology- A Laboratory Manual. Springer-Verlag
44. SIMPSON, M. G. 2006. Plant Systematics. Elsevier Academic Press, California, USA.
45. SIMPSON, M.G. Plant Systematics. Elsevier Academic Press. Burlington, U.S.A.
46. SINGH, G. 2005. Plant Systematics – Theory and Practice. Oxford and YBH Publishing Co. Pvt. Ltd., New Delhi.
47. SIVARAJAN, V.V. 1989. Introduction to Principles of Plant Taxonomy. Oxford and IBH Publishing Co. New Delhi.
48. SOLTIS, D. E., P. S. SOLTIS, P. K. ENDRESS AND M. W. CHASE. 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates, Inc, Massachusetts, USA.
49. STACE, C.A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.
50. STUESSY, T. F. 2002. Plant Taxonomy. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
- SUBRAMANIAM, N.S. 1995. Modern Plant Taxonomy. Vikas Publishing House. New Delhi.
51. TAKHTAJAN, A. 1997. Diversity and Classification of Flowering Plants. Bishen Singh and Mahendra pal Singh, Dehra Dun, India.
52. TAYLOR, D. V. AND L. J. HICKEY. 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributors, New Delhi.
53. WILEY, E.O. 1981. Phylogenetics : The Theory and Practice of Phylogenetic Systematics. New York, John Wiley & Sons.

BOT 523 (Elective D)

Plant Physiology - III

- Unit I. Plant water relations:** molecular structure of. water, water potential, Absorption of water by land plants, transpiration and its significance, physiology of stomatal movements, anti-transpirants.
- Unit II Stress physiology:** Biotic and abiotic environmental stresses, effect on plant metabolism and growth, high temperature stress, water stress, chilling stress, thermogenesis, salinity and salt stress, salt respiration, salinity and agriculture.
- Unit III** Seed germination, seedling growth, seed dormancy, light and temperature sensitive seeds, Biochemical changes associated with seed germination, Hormonal regulation, conditions for seed germination, Mobilization of reserve food material, longevity of seed and seed viability.
- Unit IV** Organic farming, mixed fanning, crop rotation and inter-cropping, weed management and control, Herbicides, weed biomass as green manure, organic matter recycling and preparation of compost / vermicompost, Production of crop plants under organic and conventional fanning system, Bio-fertilizers, Bio-methylation
- Unit V** Biostatistics: Collection and tabulation of data, Frequency distribution, normal curve, location, dispersion, normal distribution, tests of significance, t test, F test, chi square test, correlation and regression. Experimental designs, Analysis of data: RBD, LSD, Factorial and split plot RBD.

Practicals Based on BOT523 (Elective D):

1. Determination of water potential.
2. Determination of relative water content (RWC).
3. Effect of growth regulators on seed germination.
4. Estimation of starch in fresh, germinating and germinated seed.
5. Estimation of glucose at various stage of seed germination.
6. Estimation of protein content during seed germination – Lawry's method, burette method
7. Estimation of non-protein nitrogen (NPN) content in germinating seeds,
8. Estimation of vitamin C in germinating seeds.
9. Accumulation of praline in normal and stressed plants.
10. Determination of seed viability.
11. Seed dormancy and breaking of seed dormancy by using physical, scanning, hot water, acid and PGRs.
12. Studies on effect of 2,4 - D on seed germination.
13. Measures of central value - mode, median, mean, range, standard deviation, mean deviation and coefficient of co-relation.
14. Frequency distribution - Graphic representation, frequency curve and Histogram.
15. Calculation of central value of dispersion in classified data,
16. Statistics in agricultural science - ANOVA for various field experimentation,
17. Correlation, regression and calculation of optimum economic use for fertilizers.

BOT 524 (Elective D)

Advanced Plant Physiology-IV

- Unit I** Role of nucleic acids as carriers of genetic Information, transformation and transduction. Auto catalytic function of DNA-replication, Hetero catalytic functions -Transcription and translation, totipotency, differential gene activity and its regulation. Gene technology, Recombinant DNA, GM plants, Application of Gene technology in agriculture,
- Unit II** Senescence and aging, cellular, tissue, organ and organism senescence, physiological changes associated with senescence, Biological significance.
- Unit-III** Microbial physiology, carbohydrate metabolism, energy production, substrate metabolism, utilization of sugar, starch, cellulose, pectin, hydro carbons, aromatic hydrocarbons and other compound, microbial biomass production, production of useful microbial metabolites - enzymes, organic acids, single cell protein, toxins, antibiotics, alcohol etc. Industrial microbiology.
- Unit IV** Enzyme technology - Enzyme production, sources and uses of enzymes, microbial enzyme, production, isolation and purification of enzymes, Applications of enzymes in various industrial processes, Immobilization of enzymes - techniques and advantages, Biocatalysis, Enzyme production and application.
- Unit V** Productivity of crop plants, integrated fertilizer management, bio-fertilizers, productivity potential and cultural practices for fiber plants (e.g. cotton), cereals (rice, wheat), millets (Sorghum, pearl millet), pulses (gram), oil seed crops (safflower, groundnut), commercial crops (sugarcane), vegetables, fodder crops (lucerne, hybrid Napier, maize),

Practical Based On Bot 524

- 1) Isolation and estimation of nucleic acids
- 2) Study of leaf senescence.
- 3) Changes in chlorophyll content in leaf discs during senescence.
- 4) Biochemical changes during leaf senescence - sugars, protein -nitrogen, non-protein nitrogen, etc.
- 5) Effect of PGRs on senescence.
- 6) Chemical changes associated with fruit ripening.
- 7) Growth of microbes (yeast, bacteria and fungi) on synthetic and biological media,
- 8) Assay and chemical tests for enzymes, organic acids, antibiotics, toxins etc.
- 9) Estimation of the activities of hydrolytic enzymes - amylase, lipase, protease, cellulose etc.
- 10) Estimation of alcohol content in fermented plant material.
- 11) Immobilization of enzymes with wax.
- 12) Activity of enzyme a - amylase, cellulose and protease under the influence of substrate concentrate,
- 13) Activity of enzyme a - amylase, cellulose and protease under the influence of substrate Concentrate of enzymes.
- 14) Activity of enzyme - amylase, cellulose¹ and protease under the influence of substrate concentrate pH values,
- 15) Visit to the fields for studies on crop plants.
- 16) Estimation of protein in pulse seeds.
- 17) Estimation of starch in seeds.
- 18) Estimation of fat content in seeds,
- 19) Chlorophyll content in crop plants*
- 20) Growth of crop plants, growth curve and growth analysis.

Suggested Reading:

1. Mukharji S and A.K. Ghosh. Plant Physiology - New Central Book Agency, Kolkatta.
2. Mertz, E.T. Elements Biochemistry Vakils, Fe Her and Simson Pvt Ltd, Bombay.
3. Fains, J.L. and Kilgour, G.L. Essentials of Biological Chemistry, Affiliated East - West Press, Pvt. Ltd., New Delhi.
4. Moat, A.G., Foster, J.W. and Spectok, M.P. Microbial Physiology, Wileys Liss, A. John Wiley and Sons, Inc., Singapore.
5. Trevan, M.D., Botey, S., Goulding, K.H. and Stanburn, P. Biotechnology. The Biological principles. Tata Mc Graw Hill Publishing Company Limited, New Delhi.
6. Salisbury, J.B. and Ross, C.W., Plant Physiology CBS Publishers and Distributors, New Delhi.
7. Noggle, G.R. and Fritz, G.S. Introductory Plant Physiology. Printice Hall, USA.
8. Styter, R.O. Plant water relationship, Academic Press, New York.
9. Hess, D. Plant Physiology, Narosa Publishing House, New Delhi.
10. Devlin, R.M. and Hostan, F.H. Plant Physiology, CBS publishers and Distributors, New Delhi.
11. Mukharji, S. and Ghosh A.K. Plant Physiology, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
12. Datta, C.S. Plant Physiology, Wiley Eastern Limited, New Age International Ltd., New Delhi.
13. Vaidya, V.G., Sahasrabudhe, K.R. and Khupse, V.S. Crop production and field experimentation, Continental Prakashan, Pune - 30.
14. Mungikar, A.M. An Introduction for Biometry, Saraswati Printing Press, Aurangabad.

SERVICE COURSE-2
MEDICINAL PLANTS

Unit I Introduction of Systems of Medicines- a) Ayurved b) Siddha d) Unani e) Chinese f) Naturopathy g) Homeopathy.

Unit II a) Health Concept in Ayurved, b) Dincharya and Rutucharya
c) Anupan d) Pathya and Apathy e) Viruddha Ahaar.

Unit III Classification of Drugs:

- a) **Root drugs:** *Withania somnifera* (L.)Dunal, *Asparagus racemosus* Willd.,
Chlorophytum borivillianum, *Vetiveria zizanoides* (1.) Nash, *Glycyrrhiza glabra*
- b) **Rhizome drugs:** *Zingiber officinale* Rose, *Curcuma longa* L, *Acorus calamus* L.
- c) **Stem and wood drugs:** *Tinospora cordifolia* (Willd.) Miers , *Santalum album* L,
Pterocarpus marsupium Roxb., *Pterocarpus santalinus*
- d) **Bark drugs:** *Terminalia cuneata* Roth, *Crateva adansonii* DC subsp. *odora* (Buch.- Ham.)
Jacobs, *Acacia nilotica* (L.) Del, *Azadirachta indica* A. Juss.,
- e) **Leaf drugs:** *Aloe vera* (L.) Burm.f, *Adhatoda zeylanica* Medic., *Cymbopogon citratus*,
kalanchoe pinnata (Lamk.) Pers. *Mentha* sp.
- f) **Flower drugs:** *Syzigium aromaticum*, *Crocus sativus*
- g) **Fruit drugs:** *Emblica officinale*, *Terminalia bellirica* (Gaertner) Roxb., *T. Chebula*(Gaertner) Retz., *Aegle marmelos*(L) Corr, h)
- h) **Seed drugs:** *Syzigium cumini* (L.) Skeel , *Celastrus paniculatus* Willd., *Semecarpus anacardium* L. f i) Entire plant drugs: *Ocimum tenuiflorum* L, *Bacopa monnieri* (L.) Penn,

Unit IV a) Identification of Medicinal Plants

b) Harvesting, Storage and preservation of Medicinal plants

Unit V Introduction of formulations of some Ayurvedic drugs: a) Asava and Arishta,
b) Churna c) Vati and ghuti d) Aark e) Pak and Avaleha f) Font and Kadha
g) Satva h) Tailam and ghritam

Suggested Readings:

1. Anonymous 2000, "The Ayurvedic Formulary of India" - Part - II, Govt. Of India Publication, New Delhi.
2. Daniel, M. 2006, "Medicinal Plants - Chemistry and Properties" Oxford & IBM Publishing Co. Pvt. Ltd. New Delhi.
3. Desai W. G. 1975, "*Aushadhi Sangraha*" Rajesh Publication, Pune.
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6. Kameshwara Rao C. 2000, "Material for the Database of Medicinal Plants" Karnataka state Council for Science and Technology for the Department of Forests, Environment and Ecology, Govt of Karnataka Publication.
7. Kirtikar K. R. and Basu B. D. 2001(Reprint) "Indian Medicinal Plants" Oriental enterprises Utteranchal.
8. Manilal K. S. 2001, "Van Rheed's Hortus Malabaricus" English Edition. University of Kerala Publication.
9. Nadkarni K. M. 1976, (Revised Edition) "Indian Materia Medica" Popular Prakashan, Mumbai.
10. Sharma O. P. 1996, "Hills Economic Botany" Tata McGraw Hill Publication, New Delhi.
11. Yoganarasimhan S. N. 1996, " Medicinal Plants of India" vol. I. Karnataka. Interline Publication Pvt. Ltd. Bangalore.
12. Anonymous, "*Upchar Paddhati aur Pathya*" Baidyanath Publication.
13. Anonymous, "*Vividh Upchar paddhati*"