SHIVAJI UNIVERSITY KOLHAPUR

Syllabus for M. Sc. Botany (Regular)

(To be implemented from June 2009.)

Course Titles

Semester I.

BO - 101. Biology and Diverstiy of Viruses, Bacteria and Fungi.

BO – 102. Biology and Diversity of Algae, Bryophytes and Pteridophytes.

BO – 103. Biology and Diversity of Gymnosperms and Paleobotany.

BO – 104. Taxonomy of Angiosperms.

BO – 111. Practical course based on BO – 101 and BO – 102.

BO – 112. Practical course based on BO – 103 and BO - 104.

Semester II.

BO – 201. Plant Structure, Development and Palynology.

BO – 202. Tools and Techniques in Botany.

BO – 203. Cell and Molecular Biology of Plants.

BO – 204. Cytogenetics and Evolution.

BO – 211. Practical course based on BO – 201 and BO – 202.

BO – 212. Practical course based on BO – 203 and BO – 204.

Semester III.

BO – 301. Plant Ecology, Forestry and Phytogeography.

BO – 302. Plant Biochemistry.

BO – 303. Special Paper I : Plant Protection / Plant Biodiversity.

BO – 304. Special Paper II : Plant Protection / Plant Biodiverstiy.

BO – 311. Practical course based on BO – 301 and BO – 302.

BO – 312. Practical course based on BO – 303 and BO – 304.

Semester IV.

BO – 401. Plant Physiology.

BO – 402. Plant Propagation and Utilization of resources.

BO – 403. Special Paper III : Plant Protection / Plant Biodiversity.

BO – 404. Special Paper IV : Plant Protection / Plant Biodiversity.

BO – 411. Practical course based on BO – 401 and BO – 402.

BO – 412. Practical course based on BO – 403 and BO – 404.

BO - 101. Biology and Diversity of Viruses, Bacteria and Fungi.

1.1 General account of Archaebactria and Eubacteria , ultra structure, nutrition and reproduction, biology and economic importance. (3)

1.2 Viruses – characteristics and ultra structure of various isolation and Purification methods of viruses, chemical nature, replication, transmission of viruses, economic importance. (5)

1.3 Fungi – General characters, substrate relationship in fungi, ultra structure, unicellular and multicellular organization, cell wall composition, nutrition (saprobic, biotrophic symbiotic), reproduction (vegetative,asexual and sexual) heterothallism, heterokaryosis, parasexuality, recent trends in classification. (5)

1.4 Taxonomical groups to understand life cycle patterns, growth ,development and phylogeny with respect to the following major classes up to the level of order. (As per Alexopolous and Mims) (19)

Class	Order
Myxomycetes	Stemonitales
Plasmodiophoromycetes	Plasmodiophoromycetales
Chytridiomycetes	Chytridiales
Omycetes	Perenosporales
Zygomycetes	Mucorales
Hemiascomycetes	Taphrinales
Plectomycetes	Eurotiales
Pyrenomycetes	Meliolales, Claviciptales
Discomycetes	Pezizales
Loculoascomycetes	Dothideales
Teliomycetes	Uredinales, Ustilaginales
Hymenomycetes	Agaricales, Aphyllsophorales
Gastromycetes	Lycoperdales , Nidulariales
Hypomycetes	Hypomycetales
Coelomyctes	Sphaeropsidales

1.5 Economic Fungi :- Fungi in industry and medicine, as food, fungal diseases in Human beings, Mycorrhizae fungi as a biocontrol agent (Diseases and Pests) (5)

1.6 Lichens : Different forms, structure, classification and economic importance. (3)

Total lectures : 40

BO - 102. Biology and Diversity of Algae, Bryophytes and Pteridophytes.

1.1 Phycology – Reproduction and Recent classification of algae. (2)

1.2 Salient features, interrelationship and phylogeny of the following classes : Prochlorophyceae, Chlorophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae, Rhodophyceae and Cyanophyceae. (10)

1.3 Algae and Human welfare : (1)

2.1 Bryology – Recent classification of Bryophytes (3)

2.2 Salient features, phylogeny interrelationships and Important Genera of the following classes – Hepaticopsida, Anthoceratopsida and Bryopsida. (9)

2.3Economic importance of Bryophytes. (1)

3.1 Pteridology –Recent classification of Pteridophytes (2)

3.2 Salient features, phylogeny and interrelationship and Important Genera of the following Classes – Psilopsida, Lycopsida, Sphenopsida and Pteropsida. (10)

3.3 Economic importance of Pteridophytes. (1)

Total Lectures : 40

BO – 103. Biology and Diversity of Gymnosperms and Paleobotany.

1.1 Modern system of classification of Gymnosperms (As per Sporne, 1965)
Econimic importance of gymonosperms and their distribution in India. (4)

1.2 Salient features, phylogeny, affinities inter-relationships and important genera of the following orders – Cycadales, Coniferales, Ginkgoales, Taxales, Ephedrales, Welwitschiales. (18)

2.1 Paleobotany – Objectives, Nomenclature and Geological Time Scale. (2)

2.2 Process of fossilization, types of fossils, techniques used in fossil studies. (2)

2.3 Study of morphology, anatomy and evolutionary trends of following groups of fossil plants :- (10)

a. Psilophytales.
b. Lepidodendrales.
c. Calamitales.
d. Filicales.
e. Coenopteridales.
f. Pterdospernales.
g. Bennettitales.
h. Pentoxylales.
i. Cordiatales.
j. Cycadales.
k. Coniferales.

2.4 Fossil Angiosperms of India. : (4)

i) Palmae : *Palmoxylon, Rhizopalmoxylon, Palmocarpon*,

ii) Cyclanthaceae: *Cyclanthodendron, Viracarpon*

iii) Musaceae : *Musa, Cardiospermum*,

iv) Sonneratiaceae : *Sonertioxylon, Sonnertiorhizos, Sahanianthus, Enigmocarpon*.

v) Myrtacea : *Sahanipushpum*

Total Lectures : 40

BO – 104. Taxonomy of Angiosperms.

1.1 Taxonomy – A key science in tropics. (2)

1.2 Modern trends in taxonomy – Taxometrics, chemotaxonomy and Cladistics (3)

1.3 Plant speciation – Allopatric, Sympatric, Hybrid, Apomictic, Abrupt and Phylletic Speciation, Mechanism of reproductive isolation. (5)

1.4 Species concept – Typological and Biological (2)

1.5 Nomenclature – ICBN principles, rules, recommendations, articles, typification, principle of priority, effective and valid publications, citation of authority, synonyms and homonyms. (4)

1.6 Systems of classification – principles, outlines, merits and demerits of Bentham and Hookers', Cronquist's and APG system. (4)

1.7 Biodiversity – Importance, lass, conservation and sustainable utilization of Biodiversity. Endemism – concept, hot-spots, key stone and flagship species. (6)

1.8 Salient features, morphological diversity inter-relationships and Economic importance in following families as per Cronquist's system of classification : (12)

Class : Magnoliopsida

1. Sub-class : Magnolidae – Magnoliaceae, Sub-class : Hamamelidae – Urticaceae.
2. Sub-class : Caryophyllidae –, Polygonaceae.
3. Sub-class : Dillenidae – Tiliaceae,
4. Sub-class : Rosidae – Myrtaceae,.
5. Sub-class : Asteridae – Scrophulariaceae, Class : Liliopsida.
1. Sub-class : Alismatidae – Hydrocharitaceae.
2. Sub-class : Arecidae – Arecaceae
3. Sub-class : Commelinadae – Commelinaceae.
4. Sub-class : Zingiberidae – Zingiberaceae.
5. Sub-class : Lilidae – Orchidaceae.

1.9 Floristic works with reference to Maharashtra (2)

Total Lectures : 40

BO – 111. Practical course based on BO – 101 and BO – 102.

I. Practicals based on BO-101. Biology and Diversity of Viruses, Bacteria and Fungi

1. Study of various forms of bacteria - Gram +ve and Gram -ve staining.
2. Isolation of plant pathogenic bacteria.
3. Study of different viral diseases.
    a. Bean Mosaic Virus (BMV)
    b. Leaf curl of Papaya
    c. Study of TMV - electron photomicrograph.
4. Study of various lichens.

5-6. Isolation and identification of air and soil fungi.

7-12. Detailed study of types from each of the following.

Class and Order	**Types**
Myxomycetes-Stemonitales	*Stemonites(Specimen)* / *Hermitrichia*
Plamodiophoromycetes - Plasmodiophorales-	*Plasmodiophora(slide)*
Chytridiomycetes –Chtridiales-	*Physoderma/Synchytrim*.
Oomycetes-Perenosporales-	*Albugo / Plasmopara/Bremia*.
Zygomycetes-Mucorales-	*Mucor / Rhizopus*.
Plectomycetes-Eurotiales-	*Penicillum / Aspergillus.*
Pyrenomycetes-Meliolales-	*Meliola,*
Clavicipitales-	*Balantia.*
Discomycetes-Pezizales-	*Peziza/Hymenocypha*
Loucloascomycetes-Dothideales-	*Capnodium/Asterina/*any suitable available material
Teliomycetes-Uredinales-	*Melampsora/Uromyces /* any suitable material
Agaricales-	*Agaricus*
Aphyllophorales-	*Polyporus*, *Hexagonia/Ganoderma*
Gastromycetes- Lycoperdales-	*Lycoperdon*
Nidularials -	*Cyathus*
Hyphomycetales-	*Alternaria/Cercospora*,
Coelomycetes-	*Ascochyta/phoma*

Submission of at least 10 specimens of fungi.

Excursion Report.

II. Practicals based on BO 102 : Biology and Diversity of Algae, Bryophytes and Pteridophytes.

1 – 4. Study of at least three algal types from the classes with the help of specimens and slides.:

Chlorophyceae : *Volvox, Pithophora, Ulothrix, Zygnema, Chara, Nitella*.

Xanthophyceae :*Botrydium/ Vaucheria*

Bacillariophyceae : *Diatoms*

Phaeophyceae : *Dictyota, Padina , Sargassum*

Rhodophyceae : *Batrachospermum, Gracilaria, Polysiphonia*

Myxophyceae : *Scytonema, Tolypothrix Gleocacpsa, Aphanotheca*.

5 – 7. Study of Morphological, anatomical and reproductive structure of the following members. (by using specimens and slides) : *Marchantia / Targionia, Cyathodium, Porella*, *Fossombronia, Notothallus,Pogonatum / Polytrichum* and *Sphagnum*.

8 – 11. Study of Morphology Pteridophytes mentioned against each calss (by using specimen / slides)

Psiolopsida : *Psilotum* /

Lycopsida : *Lycopodim / Selaginalla / Isoetes*

Sphenopsida :- *Equisetum*

Pteropsida : *Adiantum / Azolla / Pteris*.

Submission of at least 05 dry specimens and Excursion report.

BO – 112. Practical course based on BO – 103 and BO – 104.

I. Practicals based on BO – 103. Biology and Diversity of Gymnosperms and Palaeobotany.

1-5 Study of morphology , anatomy and reproductive parts by using specimens and slides of the following

a. Cycadales – *Zamia*.

b. Coniferales – *Araucaria / Podocarpous / Cupressus*.

c. Ginkgoales – *Ginkgo*.

d. Taxales – *Taxus*.

e. Euphedrales – *Ephedra*.

6 . Types of fossils – Impression, compression, petrifaction, coal balls.

7-12 Study of following fossil genera.

a. Psilophytales – *Rhynia, Asteroxylon, Psilophyton*.

b. Lepidodendrales – *Lepidodendron, Stigmaria, Lepidocarpon*.

c. Calamitales – *Arthropitys, Annularia, Neocalamites*.

d. Coenopteridales – *Saturopteris, Bortyopteris*.

e. Filicales – *Rhodeities, Gleichenities*.

f. Pteridospermales – *Lyginopteris, Medullosa*.

g. Coniferales – *Elatocladus, Brachyphyllum*.

h. Cycadales – *Ptilophyllum, Pteophyllum, Dictyozamites*.

i. Angiosperms – *Tricoccities, Enigmocarpon*.

II. Practicals based on BO -104. Taxonomy of Angiosperms.

1. Preparation of dichotomous keys for identification of taxa.
2. Preparation of botanical description of plant species.

3 – 7. Study of Families as per theory syllabus.

8. Knowledge of identification of common local flowering plants with the help of flora.

9. Problems on nomenclature

10. Study of endemic plants

11. Numerical analysis of any suitable genus

12. Identification of families of flowering plants by using multi-access keys.

Submission : Herbarium sheets preferably of weeds (at least 10) and Excursion report.

SUGGESTED READINGS

BO – 101. Biology and Diversity of Viruses, Bacteria and Fungi

1. Alexopolos C. J. and C. W. Mims Introductory Mycology, 1962.
2. Sharma O. P. Text Book of Fungi, 1989.
3. Ainsworth G. F. and A. S. Sussman. The Fungi Vo. I, II, III, IVA and IVB.
4. Gangulee H. S. and K. Kar 1992. College Botany Vol. I and II.
5. Thind K. S. 1977. The Myxomycetes of India.
6. Cummins G. B. 1984. The Rust of Leguminoceae and Compositae.
7. Sparrow F. K. 1960. Aquatic Fungi of India.
8. Wolf F. A. and Wolf F. T. 1947. The Fungi Vol. I and II, John Wiely and Sons, Inc. New York.
9. Dayal 1995. Aquatic Fungi of India.
10. Mandahar C. L. 1978. Introduction to Plant Viruses.
11. Mehrotra R. S. and Aneja R. S. 1998. An Introduction to Mycology.
12. Clifton A. 1958. Introduction to the Bacteria.
13. Mehrotra R. S. 1976. The Fungi. Oxford and IBH, Publ.
14. Webster J. 1985. Introduction to Fungi.
15. Hale M. Toe E. Jr. 1967. Biology of Lichens.
16. Gaumann G. S. 1952. The Fungi.
17. Pandy B. P. 1994. A Text Book of Botany.
18. Whittaker R. H. 1969. New Concepts of Plant Kingdoms of organisms, Science 163 : 150 – 160.
19. Mundkur B. B. and M. J. Thirumalachar. 1952. Ustilaginales of Inida.
20. Subramanian C. V. 1971. Hypomycetes.

BO - 102. Biology and Diversity of Algae, Bryophytes and Pteridophytes.

1. Parihar N. S. 1991. Bryophyta.
2. Parihar N. S. 1996. Biology and Morphology of Pteidophytes.
3. Puri P. 1980. Bryophytes.
4. Morris L. 1986. An Introduction to Algae.

5. Sporne K. K. 1991. Morphology of Pteridophytes.
6. Kumar H. D. 1988. Introduction to Phycology.
7. Round F. E. 1986. The Biology of Algae.
8. Sharma O. P. 1986. Text Book of Algae.
9. Desikachary T. V. 1972. Taxonomy and Biology of Blue Green Algae.
10. Venkatraman G. S. et al. 1974. Algae Form and Function.
11. Fritsch F. E. 1955. Structure and Reproduction of Algae.
12. Chapman V. J. and Chapman D. J. 1973. Manual of Phycology.
13. Cavers F. 1964. Interrelationships of Bryophytes
14. Ram Udar. 1976. Bryology in India
15. Watson E. V. 1964. The Structure and Life of Bryophytes
16. Verdoorn F. 1933. Manual of Bryology.
17. Smith G. M. 1955. Cryptogamic Botany. Vol I.and II.
18. Bierhorst D. W. 1971. Morphology of Vascular Plants.
19. Foster A. S. and Gifford E. M. 1959. Comparative Morphology of Vascular Plants.
20. Bower F. O. 1963. The Ferns.
21. Jermy A. J. 1973. The Phylogeny and Classification of Ferns.
22. Rashid A. 1978. An Introduction to Pteridophytes.
23. Sprorne K. R. 1966. Morphology of Pteidophytes.

BO – 103. Biology and Diversity of Gymnosperms and Palaeobotany.

1. Coulter and Chamberlin J. M. 1978. Morphology of Gymnosperms.
2. Bierhost D. W. 1971. Morphology of Gymnosperms.
3. Chamberlein C. J. 1966. Gymnosperms – Structure and Evolution.
4. Foster A. S. and Gifford E. M. 1959. Comparative Morphology of Vascular Plants.
5. Ramanujan C. G. K. 1979. Indian Gymnosperms, in the time and Space.
6. Sporne K. R. 1967. Morphology of Gymnosperms.
7. Vashistha P. C. 1976.Gymnosperms.
8. Stewart W. N. and Rathwell G. W. 1993. Palaeobotany and Evolution of Plants.

9. Shukla A. C. and Mishra S. D. 1975. Essentials of Palaeobotany.

10. Arnold C. A. 1972. An Introduction to Palaeobotany.

11. Darroh W. C. 1960. Principles of Palaeobotany.

12. Surange K. R. Indian Fossil Pteridophytes.

BO – 104. Taxonomy of Angiosperms.

1. Ahmedullah M. and M. P. Nair. 1978. Endemic Plants of Indian Region.
2. Benson L. Plant Taxonomy.
3. Cronquist A. 1981. An Integrated System of Classification of Flowering Plants.
4. Davis P. H. and V. M. Heywood. 1963. Principles of Angiosperm Taxonomy.
5. Dhalgreen P. M. T. 1981. Angiosperm Classification and Phylogeny – A rectifying comment, Bot. J. Linn. Society. 82 : 89 – 92.
6. Eames A. J. 1961. Morphology of Angiosperms.
7. Lawrence G. H. M. 1951. Taxonomy of Vascular Plants.
8. Naik V. N. 1984. Taxonomy of Angiosperms.
9. Nayar M. P. 1966. Hotspots of Endemic Plants of India, Nepal and Bhutan.
10. Rao R. R. 1994. Biodiversity of India.
11. Stece C. A. 1980. Plant Taxonomy and Biosystematics.

SEMESTER II

BO – 201. Plant structure, Development and Palynology.

1. Plant Structure (Plant Anatomy.) (10)

1.1 Phloem & Xylem – major components and ultra structure.

1.2 Periderm, Lenticels and Rhytidomes-structure, origin, functions.

1.3 Stomata – structure, classification and their taxonomic significance.

1.4 Nodal anatomy.

1.5 Root – Stem transition.

1.6 Anomalous secondary growth – causes, types, adaptive and non-adaptive from Bignoniaceae, Nyctaginaceae and Amaranthaceae.

2. Plant Development – Embryology. (20)

2.1 Gametophytes in angiosperms, brief outline of development of male and female gametophytes.

2.2 Ultra structure of male gametophytes, abnormal male gametophytes and their features.

2.3 Ultra structure of female gametophytes.

2.4 Pollen pistil interactions – structure of sigma and style, stigma surface proteins, structure of pollen, pollen wall proteins, pollen tube growth, chemotropism, pollen pistil interaction and its significance, incompatibility and control of fertilization.

2.5 Experimental Embryology – techniques for anther, ovary, nucellus, endosperm and embryo cultures and their significance.

2.6 Apomixis – causes, diplospory, apospory, consequences and significance.

2.7 Polyembryony – classification, causes, experimental induction and practical importance.

3. **Palynology.** (10)

3.1 Pollen morphology : NPC System, exine stratification excrescences

3.2 Palynology –in relation to taxonomy

3.3 Aeropalynology – Principal, Technique and Significance.

Total Lectures : 40

BO – 202. Tools and Techniques in Botany.

1.1 Preparatory techniques – standard units of expression, pH and buffers. (3)

1.2 Microscopy – principles and applications of phase contrast, fluorescence, SE, TE microscopes, cyto-photometry and photomicrography. (5)

1.3 Microbial Techniques – isolation and pure culture techniques in bacteria, theory and practice of sterilization, (3)

1.4 Techniques in virology – Isolation of viruses, Thermal Inactivation Point (TIP), Dilution End Point (DEP), Longevity In Vitro (LIV). (2)

1.5 Mycological techniques – isolation and pure culture of fungi, staining techniques in fungi, dry and wet preservation in fungi, isolation of VAM, staining techniques of VAM and phytoplasma. (3)

1.6 Phycological techniques – isolation and culture of blue-green algae from soil. (2)

1.7 Microtomy techniques – general account, types of microtome. (2)

1.8 Herbarium techniques – preparation, significance and important herbaria in India. (2)

1.9 Principles and applications of colorimetry and spectrophotometry, visible, UV, fluorescence and flame spectrophotometry. (6)

1.10 Separation techniques – principles and applications of gel filtration, ion exchange and affinity chromatography, gas chromatography, HPLC, gel electrophoresis, iso-electric focussing, ultracentrifugation. (8)

1.11 Tissue culture techniques – principles and applications. (2)

1.12 Cytological techniques – fixatives, treatments, staining, permanent preparation, O-banding. (2)

Total Lectures : 40

BO – 203. Cell and Molecular Biology of Plants.

1.1 The cell – structural organization of the plant cell, specialized plant cell types, (2)

1.2 Cell wall – structure and functions, biogenesis growth. (1)

1.3 Plasma membrane - structure, models, functions. (2)

1.4 Plasmodesmata – structure, role in movements of molecules and macromolecules, comparison with gap junctions. (2)

1.5 Chloroplast – structure, genome organization gene expression, RNA editing nucleoplasmic interaction. (5)

1.6 Mitochondria – structure, genome organization biogenesis. (4)

1.7 Plant vacuole – tonoplast membrane, ATPases, transporters, as storage organelle. (2)

1.8 Nucleus – structure, nuclear pores, nucleosome organization, DNA structure replication damage and repair, transcription, plant promoters and transcription factors, splicing. mRNA transport, nucleolus. rRNA biosynthesis. (6)

1.9 Ribosomes – structure, site of protein synthesis, mechanism of translation, initiation elongation and termination structure and role of rRNA. (2)

1.10 Protein sorting – targeting of proteins to organelles. (3)

1.11 Cell shape and motility – the cytoskeleton, organization and role of microtubules and microfilaments, motor movements, implication in flagellar and other movements. (4)

1.12 Cell cycle and apoptosis - control mechanism, role of cyclin and cyclin dependant kinases, retinoblastoma and E2F proteins, cytokinesis and cell plate formation, mechanism of programmed cell death. (4)

1.13 Other cellular organelles – structure and functions of microbodies, golgi apparatus, lysosomes, ER. (3)

Total Lectures : 40

BO – 204. Cytogenetics and Evolution.

1.1. Genetics of prokaryotes and eukaryotic organelles : mapping the bacteriophage genome, page phenotypes, genetic recombination in phage, genetic transformation, conjugation and transduction in bacteria, genetics of mitochondria and chloroplast, cytoplasmic sterility. (6)

1.2. Gene structure and expression : genetic fine structure, cis-trans test, fine structure analysis of eukaryotes, introns and their significance, RNA splicing, regulation of gene expression in prokaryotes and eukaryotes. (5)

1.3. Genetic recombination and genetic mapping : recombination, independent assortment and crossing over, molecular mechanism of recombination, role of RecA, recBCD enzymes, site specific recombination, chromosome mapping, linkage groups, genetic markers, construction of molecular maps, correlation of genetic and physical maps, somatic cell genetics – an alternative approach to gene mapping. (6)

1.4. Mutation : molecular basis of gene mutation, transposable elements in prokaryotes and eukaryotes, mutations induced by transposons, site – directed mutagenesis, DNA damage and repair mechanisms, inherited human diseases and defects in DNA repair, initiation of cancer at cellular level, proto-onco genes and oncogenes. (6)

1.5. Cytogenetics of aneuploids and structural heterozygotes : effect of aneuploidy phenotype in plants, transmission of monosomics and trisomics and their use in chromosome mapping of diploid and polyploidy species, breeding behaviour and genetics of structural heterozygotes, complex translocation heterozygotes, translocation of tester sets, Robertsonian translocations, B – A translocations. (6)

1.6. Molecular cytogenetics – Nuclear DNA content : C – value paradox, cot-curve and its significance, restriction mapping, concept and techniques; muligene families and their evolution; in situ hybridization – concept and technique; physical mapping of genes on chromosomes, computer assisted chromosome analysis; chromosome micro-dissection and micro – cloning; flow cytometry and confocal microscopy in karyotype analysis. (6)

1.7. Alien gene transfer through chromosome manipulations : Transfer of whole genome, examples from wheat. (2)

1.8. Evolution : Origin and history of life on earth, theories of evolution, natural selection, adaptation and speciation. (3)

Total Lectures : 40

BO – 211. Practical course based on BO – 201 and BO – 202.

I. Practicals based on BO – 201. Plant Structure, Development and Palynology.

1. Study of phloem and xylem components and ultrastructure (microphotograph).
2. Study of periderm, lenticels and rhytidomes structure with the help of plant material and permanent slides.
3. Study of major types of stomata.
4. Study of anomalous secondary growth as per theory syllabus.
5. Study of ultrastructure of male and female gametophyte with the help of micrograph.
6. Study of types of styles – solid, hollow, filamentous, Stigma – dry, wet and subtypes.
7. Culture of any one organ as per syllabus – anther / ovary / endosperm / nucellus / embryo.
8. Study of apomicts and embryo mounting.
9. Study of pollen morpho-types by acetolysis.
10. Honey analysis and microfossils from coal.
11. Study of aerospora by Tilak air sampler and gravity slide method.
12. Study of allergic plants and their pollens.

Submission : 1. Two slides each of anatomy, embryology and palynology.

II. Practicals based on BO – 202. Tools and Techniques in Botany.

1. Preparation of standard solutions, stain and buffers.
2. Study of gel filtration.
3. Thin Layer Chromatography.
4. Separations of proteins by gel electrophoresis.
5. Verification of Beer and Lambert's law.
6. Study of photomicrograph (SEM and TEM).
7. Preparation of culture media – natural and synthetic, callus induction.
8. Isolation of viruses.
9. Isolation of VAM and phytoplasma and their staining.

10-12. Microtomy.

BO – 212. Practical course based on BO – 203 and BO – 204.

I. Practicals based on BO – 203 : Cell and Molecular Biology of Plants.

1. Identification of various stages of meiosis I and II in a suitable plant material and a technique of making permanent slides. (Students should submit at least five permanent slides at the time of examination). (2P)
2. Orcein and feulgen staining of salivary gland chromosomes of *Chironomas* / *Drosophila*. (Students should prepare at least one slide of the salivary gland chromosomes and Drosophila / *Chironomaus* and submit at the time of examination). (1P)
3. Study of metaphase chromosomes from colchicine treated onion root tips. (Student should submit at least two permanent slides at the time of examination). (1P)
4. Demonstration of SEM and TEM. (1P)
5. Isolation of plant DNA and its quantification by spectrophotometric method. (2P)
6. Isolation of plant RNA and its quantification by spectrophotometric method. (2P)
7. Isolation of plasmid DNA, its separation by agarose gel electrophoresis and visualization by ethidium bromide staining. (2P)
8. Isolation of globuline from seeds and their identification by SDS – PAGE. (2P)

II. Practicals based on BO – 204 : Cytogenetics and Evolution.

1. Culture of *Drosophila.* (1P)
2. Linear differentiation of chromosomes through banding technique, O – banding. (1P)
3. Silver banding for staining nucleus – organizing region, where 18S and 28S rDNA are transcribed. (1P)
4. Characteristics and behavior of B chromosomes using maize or any other suitable material. (2P)
5. Induction of polyploidy using colchicines; different methods of applications of colchicines. (2P)
6. Estimation of nuclear DNA content through microdensitometry and flow-cytometry. (2P)
7. Meiosis of complex translocation heterozygotes. (2P)

SUGGESTED READING

BO – 201. Plant Structure, Development and Palynology.

1. Bhojawani S. S. and S. P. Bhatnagar 1998. The Embryology of Angiosperms.
2. Johri M. B. 1984. Embryology of Angiosperms.
3. Johri M. B. 1963. Experimental Embryology of Vascular Plants.
4. Maheshwari P. 1950. An Introduction to the Embryology of Angiosperms.
5. Maheshwari P. 1963. Recent Advances of Embryology of Angiosperms.
6. Stanley R. G. and E. L. Linkens 1974. Pollen Biology, Biochemistry and Management.
7. Shivanna K. R. and B. M. Johri. 1989. The Angiosperm Pollen – Structure and Function.
8. Erdtman G. 1988. Pollen Morphology and Plant Taxonomy.
9. Shivanna K. R. and N. S. Rangaswamy. 1992. Pollen Biology – A Laboratory Mannual.
10. Gregory P. H. 1973. Microbiology of Atmosphere.
11. Moor P. D. et. al 1989. Pollen Analysis.
12. Nair P. K. K. 1966. Essentials of Palynology.
13. Nair P. K. K. 1964. Advances in Palynology.
14. Tilak S. T. 1989. Air borne pollen and fungal spores.
15. Cutler E. G. 1971. Plant Anatomy.
16. Emmes E. J. and Mac Daniales. 1947. An Introduction to Plant Anatomy.
17. Essau K. 1962. Plant Anatomy – Anatomy of Seed Plants.
18. Fahn A. 1969. Plant Anatomy.
19. Foster A. S. 1969. Practical Plant Anatomy.
20. Metcalfe C. R. and L. Chalk 1950. Anatomy of the Dicotyledons.
21. Soerender H. 1908. Systematic Anatomy of the Dicots.
22. Tomlinson P. S. 1961. Anatomy of the Monocotyledons.

BO – 202. Tools and Techniques in Botany.

1. Bray, Lewis Ralf, Roberts and Watson 1983. Molecular Biology of the Cell.
2. Goswami H. K. and R. Goswami 1993. Practical Cytology, Applied Genetics and Biostatistics.
3. Schwer M. A. 1989. Methods in Plant Molecular Biology.
4. Jensen. Plant Histochemistry.
5. Hall, Seurlik, Bolhar, Nordenkempf. 1993. Photosynthesis and Production in a changing environment – A field and laboratory manual.
6. Arditti J. and Dunn. 1970. Experimental Plant Physiology.
7. Coombs, Hall Long and Scurlock. 1985. Techniques in Bioproductivity and Photosynthesis.
8. Colowick and Kaplan. Methods in Enzymology.
9. S. K. Jain and R. R. Rao. Hand-book of field and herbarium techniques.
10. Aneja K. R. 1993. Experimental Microbiology, Plant Pathology and Tissue Culture.
11. Plant Microtechniques. :
12. Wilson K. and J. Walker 2000. Practical Biochemistry – Principles and Techniques.
13. Glover D. N. and Hames B. D. (Eds.) 1995 DNA cloning – A practical approach, core techniques.

BO – 203. Cell and Molecular Biology of Plants.

1. Lewis B. 2000. Genes VII.
2. Alberts B., Bray D., Lewis J., Raff M., Roberts K. and Watson J. D. 1999. Molecular Biology of Cell.
3. Wolf S. L. 1993. Molecular and Cellular Biology.
4. Rost T. et al 1998. Plant Biology.
5. Harris N. and Oparka K. J. 1994. Plant Cell Biology – A Practical Approach.
6. Shaw C. H. (Ed.) 1988. Plant Molecular Biology – A Practical Approach.
7. Glick B. R. and Thompson J. E. 1993. Methods in Plant Molecular Biology and Biotechnology.

8. Gunning B. E. S. and Steer M. W. 1996. Plant Biology – Structure and Function.
9. Haekett P. B., Fuchs J. A. and Messing J. W.1988. An Introduction to Recombinant DNA techniques – basic experiments in gene manipulation.
10. Hall J. L. and Moor A. L. 1983. Isolation of Membranes and organelles from plant cell.

BO – 204. Cytogenetics and Evolution.

1. Atherly A. G., Girton J. R. and McDonald J. F. 1999. The Science of Genetics.
2. Burnham C. R. 1962. Discussions in Cytogenetics.
3. Busch H. and Rothblum L.1982. Vol. X The Cell nucleus and DNA, Part A.
4. Hartl D. L. and Jones D. W. 1998. Genetics, Principles and Analysis.
5. Khush G. S. 1973. Cytogenetics of Aneuploids.
6. Karp G. 1999. Cell and Molecular Biology – Concepts and Experiments.
7. Lewis R. 1997. Human Genetics – Concepts and Applications.
8. Malacinski G. M. and Freifelder, D. 1998. Essentials of Molecular Biology.
9. Russel P. J. 1998. Genetics.
10. Snustad D. P. and Simmons M. J. 2000. Principles of Genetics.
11. Fukui K. and Nakayama S. 1996. Plant Chromosomes – Laboratory Methods.
12. Sharma A. K. and Sharma A. 1999. Plant Chromosomes - analysis, manipulation and engineering.
13. Winkler U. Bacterial, Phage and Molecular Genetics.
14. Jahier J. Techniques of Plant Cytogenetics.