

Deccan Education Society's
FERGUSSON COLLEGE, PUNE
(AUTONOMOUS)

SYLLABUS UNDER AUTONOMY

FIRST YEAR M.Sc. Botany
SEMESTER – I

Academic Year 2016-2017

**Deccan Education Society's
Fergusson College (Autonomous), Pune
Faculty of Science
M.Sc. (Botany) Syllabus**

Semester	Course Code	Title of the Course	No. of Credits
I	BOT4101	Classic Botany - I (Algae, Fungi, Bryophytes)	4
	BOT4102	Plant Physiology and Biochemistry	4
	BOT4103	Genetics and Plant Breeding	4
	BOT4104	Botanical Techniques	4
	BOT4105	Practical - 1: Practicals based on Classic Botany - I and Botanical Techniques	4
	BOT4106	Practical - 2: Practicals based on Plant Physiology, Biochemistry, Genetics and Plant Breeding	4
	BOT 4107	Field Research Work	1
II	BOT4201	Classic Botany - II (Pteridophytes, Gymnosperms)	4
	BOT 4202	Cell Biology	4
	BOT4203	Molecular Biology and Genetic Engineering	4
	BOT4204	Plant Ecology and Phytogeography	4
	BOT4205	Practical - 1: Practicals based on Classic Botany - II, Plant Ecology and Phytogeography	4
	BOT4206	Practical - 2: Practicals based on Cell Biology, Molecular Biology and Genetic Engineering	4
	BOT4207	Recent Trends in Plant Sciences	1

Extra Credits

Semester	Course Code	Title of the Course	No. of Credits
I	XHR0001	Human Rights - I	1
	XCS0002	Introduction to Cyber Security - I / Information Security - I	1
	XSD0003	Skill Development - I (Methods in Plant Biotechnology – I)	1
II	XHR0004	Human Rights - II	1
	XCS0005	Introduction to Cyber Security - II / Information Security - II	1
	XSD0006	Skill Development - II (Methods in Plant Biotechnology - II)	1

Research Methodology credits

BOT4107-Field research work Sem I -

Students have to visit nearby areas for listing the plants diversity. They should submit the report with 50 digital herbaria taking photographs of the plants of herbs, shrubs, trees and climbers of that area. They should identify the plants of digital herbarium from flora and collect the information on geographical location

BOT4207- Recent trends in Plant Sciences Sem II -

Student has to prepare a review of literature at the end of third semester. Every student has to read at least 30 papers of selected topic. The topic should be from Industrial Botany. The students will be evaluated on the basis of power point presentation and report. The students have to submit the report in the beginning of 4th semester.

BOT5307- Industrial / field Training Sem III -

Students have to undergo summer training after M.Sc. I examination in a biotech industry or company or research institute for the period of 4-6 weeks. Students have to write a detailed report of the same and get it certified from guide. Report submission is to be done in first week of M.Sc. II commencement. Student will be evaluated on the basis of report and powerpoint presentation which will be arranged during continuous assessment of third semester.

BOT5407-Techno Commercial Case studies Sem IV -

Students will visit at least four units of the following to prepare report for submission:

1. Biofertilizer unit
2. Mushroom cultivation unit
3. Greenhouse unit
4. Floriculture unit
5. Plant nursery unit
6. Garden designing and maintenance unit
7. Fruit processing unit
8. Bio-pesticide unit
9. Biomass briquette unit
10. Biofuel unit
11. Plant tissue culture industries
12. Farmhouse management
13. Pomoculture unit
14. Organic farming
15. Fresh vegetables and flower supply unit
16. Herbal product industry
17. Forest department unit
18. Medicinal plant garden
19. Effluent treatment plant
20. Solid waste management unit

BOT4101: Classic Botany - I

Credits - 1.5 (22 L) Algae

1. Algae and their position in “Domains and Kingdoms” System, Trends in classification of algae **2L**
2. Cyanophyta: Ultrastructure; strategy of cell division; thallus organization, heterocyst **3L**
3. Brief introduction, structural and reproductive features of Chrysophyta, Xanthophyta, Bacillariophyta, Dinophyta **4L**
4. Chlorophyta - structure and evolution of thallus, morphogenesis in Acetabularia, Life cycle pattern in unicellular, filamentous and Multicellular green algae, reproduction and life histories with reference to orders of green algae **5L**
5. Charophyta and Euglenophyta: structure and reproduction and interrelationship **2L**
6. Phaeophyta: general account of morphology, anatomy, reproduction and life histories **3L**
7. Rhodophyta: classification, thallus structure, reproduction, reproductive strategies and life histories **3L**

Credits - 1.5 (23 L) Fungi

1. Taxonomy of fungi: Characters of fungi used of classification, various systems of classification of fungi **3L**
2. Chromista - Its present status in classification; general characters, classification up to orders. Lichen: types, morphology and reproduction **4L**
3. Fossil fungi: Occurrence and their significance **1L**
4. An outline of latest classification system proposed by Ainsworth or Alexopoulos **3L**
5. Myxomycotina: structure, life cycle patterns of major classes **1L**
6. Mastigomycotina: structure, life cycle patterns of major classes **2L**
7. Zygomycotina: structure, thallus organization, evolution of sexual reproductive structures **2L**
8. Ascomycotina: thallus organization, centrum development, different types of ascocarps **3L**
9. Basidiomycotina: tissue differentiation, development of basidia and basidiospore **2L**
10. Deuteromycotina: types of conidial ontogeny and fruit body organization **2L**

Credit - 1 (15 L) Bryophytes

1. Taxonomy of Bryophytes: Morphological characters used for classification; Systems of classification of Bryophytes **1L**
2. Distribution, morphological, anatomical, reproductive studies and comparative account of sporophytes and gametophytes and interrelationships along with their fossil relatives of the following orders:
 - a. Sphaerocarpaceae, Calobryales, Takakiales **2L**
 - b. Marchantiales **2L**
 - c. Jungermanniales **3L**
 - d. Anthocerotales **1L**
 - e. Sphagnales **1L**
 - f. Andraeales **1L**
 - g. Polytrichales, Buxbaumiales **2L**
 - h. Eubryales, Funariales **2L**

References - Algae:

1. Brodie, J. and Lewis, J. (2007). (Ed.) Unravelling the algae: the past, present and future of algal systematics. CRC press, New York, pp. 335.
2. Bellinger, E. G. and Sigeo, D. C. (2010). Freshwater algae: Identification and use as bioindicators. Wiley-Blackwell, UK, pp. 271.
3. Cole, K. M. and Sheath, R. G. (1990). *Biology of the red algae*. Cambridge University Press. USA, Pp. 503.
4. Desikachary, T.V. (1959). *Cyanophyta*. ICAR, New Delhi.
5. Graham, L. E. and Wilcox, L. W. (2000). *Algae*. Prentice-Hall, Inc. pp. 640.
6. Krishnamurthy, V. (2000). Algae of India & neighbouring countries I. Chlorophycota, Oxford & IBH, New Delhi.
7. Lee, R. E. (2008). *Phycology*. Cambridge University Press, pp. 547.
8. Misra, J. N. (1966). *Phaeophyceae in India*. ICAR, New Delhi.
9. Prescott, G. W. (1969). *The algae: A review*. Nelson, London.
10. Smith, G. M. (1950). The fresh water Algae of the United States, Mc-graw Hill, Newyork.
11. Srinivasan, K. S. (1969) *Phycologia India*. Vol I & Vol II B.S.I. Calcutta.

References - Fungi:

1. Alexopolus, C. J., Minms, C. W. and Blackwell, M. (1999). (4th edn) *Indtrodutory Mycology*. Wiley, New york. Alford, R. A..
2. Deacon, J. W. (2006). *Fungal biology*. (4th Ed.) Blackwell publishing, ISBN. 1405130660.
3. Kendrick, B. (1994). *The fifth kingdom* (paperback), North America, New York, Publisher: 3rd edition, ISBN- 10: 1585100226.
4. Kirk et al., (2001). Dictionary of the fungi, 9th edition, published Wallingford : CABI, ISBN: 085199377X.
5. Mehrotra, R. S. and Aneja, K.R. (1990). *An introduction to mycology*. New age publishers, ISBN 8122400892.
6. Miguel U., Richard, H. and Samuel, A.(2000). Illustrated dictionary of the Mycology, Elvira Aguirre Acosta, Publisher: St. Paul, Minn: APS press, ISBN 0890542570.
7. Webster, J. and Rpland W. (2007). *Introduction to fungi*. (3rd Ed.), Cambridge University Press, 978-0-521-80739-5.

Reference - Bryophytes:

1. Cavers, F. (1976). *The inter relationships of the bryophyte*. S.R. Technic, Ashok Rajpath, Patna.
2. Chopra, R. N. and Kumar, P. K. (1988). *Biology of bryophytes*. John Wiley&Sons, New York, NY.
3. Kashyap, S. R. (1932). *Liverworts of the Western Himalayas and the Panjab plain* (illustrated): Part 2 The Chronica Boanica New Delhi.
4. Kashyap, S. R. (1929). *Liverworts Of The Western Himalayas And The Panjab Plain Part 1* Chronica Botanica New Delhi.
5. Parihar, N. S. (1980). *Bryophytes: An introduction to Embryophyta Vol I*, Bryophya central Book Depot.
6. Prem puri (1981). *Bryophytes: Morphology, Growth and Differentiation*, Atma ram and Sons, New delhi.
7. Udar, R. (1975). *Bryology in India*: Chronica Botanica Co., [c], New Delhi.
8. Udar, R. (1970). *Introduction to bryophyta* Shashidhar Malaviya Prakashan Lucknow
9. Watson, E. V. (1971). *Structure and life of bryophytes 3rd*, Hutchinson University Library London.

BOT4102: Plant Physiology and Biochemistry

Credit 1 -

Structure and properties of water, its biological significance. Ionization of water, pH, buffers **3L**

Bioenergetics - free energy, changes in free energy during chemical reactions, entropy and enthalpy, high energy compounds, synthesis of ATP, activation energy **2L**

Building blocks of biological macromolecules – amino acids, sugars, fatty acids, purine and pyrimidine bases. Their biosynthesis and metabolism. **5L**

Structure, biosynthesis and metabolism of polysaccharides, lipids, proteins and nucleic acids. **5L**

Credit 2-

Enzymology: Classification and properties of enzymes, coupled reactions, units of enzyme activity.

Enzyme kinetics - substrate concentration and rate; K_m . Competitive and noncompetitive inhibitors.

Covalent and allosteric regulation. Coenzymes, Isoenzymes and co-factors **5L**

Water uptake, transport and transpiration. Stomatal physiology **3L**

Uptake and assimilation of nitrogen, enzymes involved, biological nitrogen fixation **3L**

Mineral nutrition of plants, Ion transport - passive and active **4L**

Credit 3 –

Photosynthetic pigments, absorption and transformation of radiant energy, Light

harvesting complexes, Kok curve, Kautsky curve, ETS, photo inhibition O_2 and H_2 evolution, Regulation of Calvin cycle, RUBISCO activity, Photorespiration, CAM, C_4 Pathway and its type **5L**

Reduction of carbon dioxide - RuBPCase and Calvin cycle, photorespiration. CO_2 concentrating mechanisms in C_4 and CAM plants. **4L**

Respiration - Glycolysis, citric acid cycle, pentose phosphate pathway. Organization of mitochondrial electron transport system, ATP synthesis. Respiratory control Anaerobic respiration **6L**

Credit 4 -

Plant growth hormones – Structure, biosynthesis, metabolism and physiological role of auxins, cytokinins, gibberellins, abscisic acid and ethylene. Physiological role of other hormones like salicylate, jasmonate, brassinosteroids and polyamines. **8L**

Photoperiodism and vernalization. Tropic and nastic movements in plants **4L**

Secondary metabolites – Terpenoids, Phenolics, Alkaloids. Major secondary metabolite synthesis pathways in plants. Role of secondary metabolites **3L**

References:

1. Berg J.M., Tymoczko J.L., Stryrer L. (2002) Biochemistry. 5th Ed. Wlt. Freeman and Company, New York.
2. Buchanan B.B., Gruissem W., Jones R.L. (2000) Biochemistry and Molecular Biology of Plants. IK International, Mumbai.
3. Davis P. J. (Eds.).(2004) Plant Hormones.Kluwer Academic Publishers, Dordrecht, Netherlands.
4. Goodwin T.W., Mercer E.I. (1998) Introduction to Biochemistry. CBS Publishers, New Delhi.
5. Heldt H. W. (2004) Plant Biochemistry. Academic Press, California.
6. Lawlor D.W. (2001) Photosynthesis in C3 and C4 Pathway. 3rd Ed. Viva. New Delhi.
7. Nelson David and Cox Michael. (2007) Lehninger Principles of Biochemistry.W.H.Freeman and Company. New York.
8. Lincoln Taiz and Eduardo Zeiger (2010) Plant Physiology, Fifth edition. Sinauer Associates, Inc. Publishers. Sunder land, USA.

BOT4103 Genetics and Plant Breeding

Credit 1 = GENETIC INHERITANCE: (15 Lectures)

Principles of Mendelian inheritance and Interaction of genes:- 6L

- Introduction to genetics
- Early concepts of inheritance
- Mendel's Laws - Dominance, Segregation, Independent assortment, Discussions on Mendel's paper
- Interaction of genes- Complementary, epistasis, inhibitory, polymeric and additive
- Chromosomal theory of inheritance

Cytoplasmic inheritance:- 3L

- Mitochondrial and chloroplast genomes
- Inheritance of chloroplast genes (*Mirabilis jalapa* and *Zea mays*)
- Inheritance of mitochondria genes (Petit yeasts and cytoplasmic male sterility in plants)
- Interaction between nuclear and cytoplasmic genes
- Maternal effect in inheritance (*Limnaea peregra*)

Quantitative inheritance and Inheritance of complex traits:- 4L

- Quantitative traits, Continuous variation
- Inheritance of quantitative traits, (Polygenic traits) in - corolla length in *Nicotiana*, cob length in *Zea mays*
- Introduction to complex traits
- Heritability and its measurement
- Marker assisted selection

Population Genetics 2L

- Hardy -Weinberg's Law, Factors affecting gene and gene frequencies

Credit 2 = ALLELE, RECOMBINATION AND LINKAGE: (15 Lectures)

Concept of gene, allele, multiple allele, pseudo allele- complimentation tests 2L

Recombination, Linkage and mapping of eukaryotes:- 9L

- Linkage and crossing over
- Recombination: homologous and non-homologous, Inducing transposition, Site specific recombination
- Genetic markers
- Linkage maps, lod score for linkage testing, mapping by 3 point test cross
- Mapping by tetrad analysis in Yeast (unordered) and *Neurospora* (ordered)

Mutation:- 4L

- Mutation- causes and detection
- Types of Mutation- lethal, conditional, biochemical, Loss of function, gain of function
- Germinal vs somatic mutants
- Insertional mutagenesis
- Point mutagenesis

Credit 3 = MICROBIAL GENETICS AND CYTOGENETICS: (15 Lectures)

Microbial Genetics:- 3L

- Methods of genetic transfers- transformation, conjugation and transduction in bacteria and genetic recombination
- Mapping of bacterial genome by interrupted mating
- Mutant phenotypes

Phage genetics:- 3L

- Lytic and lysogenic cycles in phages
- Genetic recombination, specialized transduction, site specific recombination in phage
- Mapping the bacteriophage genome
- Fine structure analysis of rII gene in T4 bacteriophage
- Phage mutants

Karyotype:- 2L

- Structure and Organization of chromosome, Concept of karyotype
- Chromosome banding
- Preparation of chromosome for karyotype
- Karyotype evolution
- Role of karyotype in plant species identification

Numerical alterations of chromosomes:- 4L

- Classification of polyoploids: cytological and genetical method of identification of autopolyploids and allopolyploids
- Classification, method of production, identification and meiotic behavior of aneuploids (Monosomics, Nullisomics and trisomics)

Structural alterations of chromosomes:- 3L

- Deletion, duplication, inversion, translocation, complex translocation heterozygotes
- Robertsonian translocations
- BA translocations

Credit 4 = PLANT BREEDING: (15 Lectures)

Plant Genetic resources: Centers of origin and centers of diversity, Importance of genetic diversity in crop improvement and its erosion. **2L**

Breeding methods in self, cross pollinated and clonally propagated crops:

Self pollinated crops: Mass selection, Pureline selection, Pedigree selection, Bulk method, Backcross method **3L**

Cross pollinated crops: Mass selection, Progeny selection, Recurrent selection **3L**

Clonally propagated crops: Clonal selection, Hybridization **3L**

Mutation breeding: Types, Mutagens: Physical and chemical mutagens, Mutant types, Role of mutation in breeding. **2L**

Role of polyploidy in plant breeding 2L

References:

1. Albert B. Bray, D Lewis, J Raff, M. Robert, K. and Walter 1989, Molecular Biology of the Cell (Second Edition) Garland Publishing Inc, New York.
2. Atherly, A.G., Girton, J.R. and McDonald, J.F 1999. The Science of Genetics Saunders College Publishing, Frot Worth, 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 rDNA part A. Academic Press.
5. Hartk D.L and Jones, E.W 1998 Genetics: Principles and Analysis (Fourth Edition). Jones and Bartlett Publishers, Massachusetts, USA.
6. Khush, G.S 1973. Cytogenetics of Aneuploids. Academic Press, New York, London.
7. Karp, G. 1999. Cell and Molecular Biology : Concept and Experiments. John Wileyand Sons, Inc., USA.
8. Lewin, B. 2000. Gene VII. Oxford University Press, New York, USA.
9. Lewis, R. 1997. Human Genetics : Concepts and Application (Second Edition). WCBMcGraw Hill, USA.
10. Malacinski, G.M and Freifelder, D. 1998 : Essentials of Molecular Biology (Third Edition). Jones and B. Artlet Publisher, Inc., London.
11. Russel, P.J. 1998. Genetics (Fifth Edition). The Benjamin/Cummings Publishing Company IND., USA.
12. Snustad, D.P and Simmons, M.J 2000. Principles of Genetics (Second Edition). John Wiley and Sons Inc., USA.
13. Gardner and Simmons Snustad 2005 (Eighth Edition). Principles of Genetics, JohnWiley and Sons, Singapore.
14. Sariu C 2004 (Sixth Edition) Genetics. TATA McGraw-Hill Publishing Company Ltd., New Delhi.
15. Ahluwalia K.B 2005 (First Edition). Genetics. New Age International Private Ltd. Publishers, New Delhi.
16. Burus and Bottino 1989. (Sixth Edition). The Science of Genetics. Macmillan Publishing Company, New York (USA).
17. Pawar C.B 2003 (First Edition). Genetics Vol. I and II. Himalaya Publishing House, Mumbai.
18. Strickberger 2005. (Third Edition). Genetics. Prentice Hall of India Pvt. Ltd., NewDelhi.
19. Allard R.W 1995. Priniples of Plant Breeding. John Wiley and Sons, Ice., Singapore.
20. Sharma J.R 1994 Principles and practices of Plant Breeding. Tata McGraw-HillPublishers Company Ltd., New Delhi.

21. Singh B.D 1996 Plant Breeding – Principles and methods. Kalyani Publications, Ludhiana.
22. Chahal G.S and Gosal S.S 2002. Principles and procedures of Plant Breeding, Narosa Publishing House, New Delhi.
23. Verma and Agarwal, Genetics, S. Chand Co, New Delhi.
25. Singh B.D 2004. Genetics. Kalyani Publication, Ludhiana. 26. Gupta P.K Genetics and Cytogenetics, Rastogi Publications.

BOT4104: Botanical Techniques

Credit 1

SI System of measurement: Fundamental and derived units. **1L**

Making solutions: Moles and molarity, stock solutions and dilutions, making media and reaction mixtures, pH measurements and preparation of buffers **3L**

Microscopy and microscopic techniques: Light, phase contrast, fluorescence, electron, confocal microscopy. Micrometry. Flow cytometry. **8L**

Microtomy: Principle of tissue fixation for microtomy, types of microtome, serial sectioning and staining. **3L**

Credit 2

Chromatographic techniques: Paper, thin layer and column chromatography, gel filtration, ion exchange and affinity chromatography, high pressure liquid chromatography, gas chromatography. **8L**

Electrophoretic techniques: Supports, electroosmosis, electrophoresis under native, dissociating and denaturing conditions, isoelectric focusing, staining, activity staining. 2-D electrophoresis **7L**

Credit 3

Radioactive techniques: Isotopes and their half-life, Specific activity of radioisotopes, making radioisotope solutions, detection and measurement of radioactivity - radiation counters, liquid scintillation counters, autoradiography. **5L**

Spectroscopic techniques: UV -Visible, IR spectroscopy, spectrofluorimetry, NMR and ESR spectroscopy, circular dichroism spectroscopy, atomic absorption spectroscopy.

Spectrometric techniques: mass spectrometry, MALDI-TOF **10L**

Credit 4

Electrochemical techniques: Construction and working of equipments for measurement of electrical conductivity, pH meter. **3L**

Centrifugation techniques: High speed centrifuges, rotors, ultracentrifugation, density gradient centrifugation. **3L**

Measurement of water potential and osmolarity: Osmolarity equation, Osmolarity and osmotic pressure measurement, types of osmometers. Construction and working of osmometers. Measurement of water potential. **2L**

Gas exchange measurements: Types, Construction and working of Infra red gas analyzer, O₂ electrode. **2L**

Immunological techniques: Immune response. Antibodies and their specificity, antigen-antibody interactions, Immunodiffusion, immunoprecipitation & immunoelectrophoresis techniques, RIA, ELISA. **5L**

References:

1. P. Gunadegaram (1995). Laboratory Manual in Microbiology. New Age International (P) Ltd.
2. Srivastava M.L. (2008). Bioanalytical Techniques. Narosa Publishing House (P) Ltd.
3. Gamborg O.L., Philips G.C. (Eds.) (1995). Plant Cell, Tissue and Organ Culture Fundamental Methods. Narosa Publishing House (P) Ltd.
4. Krishnamurthy K.V. (1999). Methods in Cell Wall Cytochemistry. CRC Press. LLC.
5. Plummer David (1987). An Introduction to Practical Biochemistry. 3rd Eds. Tata McGraw-Hill Publishing Company Ltd.
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8. Harborne J.B. (1998). Phytochemical Methods. Springer (I) Pvt. Ltd.
9. Wilson K., Walker J. (2005). Principles and Techniques in Biochemistry and Molecular Biology. Cambridge University Press.
10. Wilson K., Walker J. (2000). Practical Biochemistry Principles and Techniques. Cambridge University Press.
11. Egerton R.F. Physical Principle of Electron Microscopy: an Introduction to TEM, SEM and AEM.
12. Bisen P.S. Mathur S. (2006). Life Science in Tools and Techniques. CBS Publishers, Delhi.
13. Marimuthu R. (2008). Microscopy and Microtechnique. MJP Publishers, Chennai.
14. Sharma V.K. (1991). Techniques in Microscopy and Cell Biology. Tata McGraw-Hill Publishing Company Ltd.
15. Prasad and Prasad (1984). Outline of Microtechnique. Emkay Publications, Delhi.
16. Srivastava S. and Singhal V. (1995). Laboratory Methods in Microbiology. Anmol Publication Pvt. Ltd. Delhi.
17. Annie and Arumugam (2000). Biochemistry and Biophysics, Saras Publishing, Tamilnadu.
18. Sass John E. (1984). Botanical Microtechniques. Tata McGraw-Hill Publishing Company Ltd.
19. Pal and Ghaskadabi (2009). Fundamentals of Molecular Biology. Oxford Publishing Co.

BOT4105 Practicals based on Classic Botany - I and Botanical Techniques

Algae, Fungi, Bryophytes (Any 10 Practicals)

Algae

1. Morphological observations, documentation (description and illustrations) and classification according to Fritsch with reasons of taxa belonging to (At least one example from each order):

- a. Chlorophyta- Any eight forms, Charophyta - Any two forms **2P**
- b. Phaeophyta - Any five forms **1P**
- c. Rhodophyta - Any five forms **1P**
- d. Cyanophyta- Any five forms & Minor Groups - Any three forms **1P**

Fungi

1. Study of Lichens - Any three forms **1P**

2. Study of representative genera belonging to following subdivisions of fungi with respect to vegetative, reproductive structures and classification with reasons according to Ainsworth et al. (1973) (At least one example from each class):

- a. Myxomycotina -Any three forms & Mastigomycotina - Any five forms **1P**
- c. Zygomycotina - Any three forms & Deuteromycotina - Any five forms **1P**
- d. Ascomycotina - Any five forms **1P**
- e. Basidiomycotina- Any five forms **1P**

Bryophytes

1. Hepaticopsida (Any 4 forms) **2P**
2. Anthocerotopsida. **1P**
3. Musci (Any 2 forms) **1P**

Botanical Techniques (Any10 Practicals)

1. Study of microscopes **1P**
2. Micrometry **2P**
3. Maceration technique **1P**
4. Electrical conductivity and pH measurements **1P**
5. Absorption spectra of BSA/DNA and determination of absorption maxima **2P**
6. Gel filtration **1P**
7. Ouchterlony immunodiffusion technique for testing of antigens and antibody **1P**
8. Rocket immunoelectrophoresis **1P**
9. Separation of leaf pigments by paper chromatography and TLC **2P**
10. Microtomy- Processing, double staining, sectioning **2P**

BOT4106 Practicals based on Plant Physiology, Biochemistry, Genetics and Plant Breeding

Plant Physiology and Biochemistry (Any 10 Practicals)

1. Preparation of solution of different concentrations, Buffers, Conductivity and pH Measurements **1P**
2. Enzyme assays – extraction and estimation of enzyme activity- Catalase/ peroxidase/ invertase (Any one) **1P**
3. Effect of pH and enzyme concentrations on enzyme activity **1P**
4. Effect of substrate concentration on rate of enzyme action and calculation of K_m by Michaelis's Menten Curve **2P**
5. Estimation of soluble proteins in germinating and non-germinating seed by Lowry and Bradford's method **2P**
6. Estimation of total amino acid in germinating and non germinating seed **1P**
7. Estimation of ascorbic acid in ripe and unripe fruits **1P**
8. Assaying IAA oxidase activity in green and senescent leaves **1P**
9. Studies on induction of amylase activity by GA_3 in germinating cereal grains **1P**
10. Estimation of reducing sugars **1P**
11. Effect of salt stress on proline accumulation and its estimation **1P**

Genetics and Plant Breeding (Any 10 practicals)

1. Preparation of stains, Fixatives, Preservatives and pretreatments to plant material **1P**
2. Karyotype analysis, preparation of somatic C- metaphase chromosomes of appropriate material using camera lucida drawing and Karyotype analysis in *Allium* / *Aloe*. **2P**
3. Study of meiotic configuration in maize/ *Allium*, *Rhoe*/ *Aloe*, *Tradescantia* (prophase I, Chiasma analysis).**3P**
4. Induction of mutation in plant material using suitable mutagen **1P**
5. Study of Polygenic inheritance. **1P**
6. Problems of Mendelian inheritance and estimation of gene frequencies and heterozygotic Frequencies, population genetics and Linkage. **1P**
7. Study of *Drosophilla* sexual dimorphism and mutants **1P**
8. Penetrance and expressivity of PTC testing ability in humans and tongue rollers/non Rollers **1P**
9. Floral Biology, Study of Pollen Viability, germination in vitro and staining (any two major crops) **1P**
10. Study of monohybrid and dihybrid crosses and interactions. **1P**
11. Use of Colchicine for induction of polyploidy in appropriate plant material. **2P**

BOT4201 - Classic Botany - II

Credit 1 - Pteridophytes

Introduction, characteristic features and diversity of Pteridophytes **3L**

Migration to land, affinities with Bryophytes, Algae **3L**

Recent systems of classification **1L**

Study of Fossil groups-

Psilopsida- salient features of Psilophytes, *Rhynia* **2L**

Lycopsidea- salient features of Lepidodendrales **2L**

Sphenopsida – salient features of Calamitales *Calamites*, *Annularia*, *Calamostactys*. **2L**

Pteridosperms - salient features of pteridosperms *Lyginopteris*, *Oldhamia*, *Lagenostoma*. **2L**

Credit 2- Pteridophytes

Comparative account of distribution, morphology, anatomy, gametophyte, sporophyte and interrelationships of following orders–

Psilotales **1L**

Lycopodiales **1L**

Isoetales **1L**

Equisetales **1L**

Ophioglossales **1L**

Maratiales **1L**

Osmundales **1L**

Filicales **1L**

Marsileaales **1L**

Salviniales **1L**

Alternation of generations, Apogamy, Apospory. **1L**

Telome concept **1L**

Stelar evolution & Soral evolution **2L**

Gametophyte evolution, Heterospory and seed habit **1L**

Credit 3- Gymnosperms

Study of fossil groups, Bennettiales, Caytoniales, Glossopteridales. Geographical distribution, characteristic features, affinities with Pteridophytes and Angiosperms. **4L**

Classification systems **1L**

Distinct features of Progymnosperms, Pteridospermales, Cycadeoidales, Cycadales, Caytoniales, Glossopteridales, Pentoxylales, Ginkgoales **4L**

Comparative account of morphology, anatomy, sporogenesis, gametogenesis, embryology and interrelationships of Cycadales, Ginkgoales. **6L**

Credit 4 - Gymnosperms

Comparative account of morphology, anatomy, sporogenesis, gametogenesis, embryology, and interrelationships of

Cordiales **3L**

Voltziales **2L**

Coniferales **3L**

Taxales **2L**

Welwitschiales, Ephedrales, Gnetales **3L**

Seed development **2L**

References:

1. Agashe SN (1995) Paleobotany, Oxford and IBH Publ. Co.Pvt. Ltd., New Delhi.
2. Anold AC (2005 Repr.) An Introduction to Paleobotany, Agrobios (India), Jodhpur.
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6. Eames EJ (1983) Morphology of Vascular Plants. Standard University Press.
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10. Singh VP (2006) Gymnosperms (Naked seed plants): Structure and development, Sarup and sons, New Delhi.
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13. Stewart WN and Rothwell GW (2005) Paleobotany and the Evolution of plants, 2nd Edn. Cambridge University Press.
14. Sundara Rajan S. (1999) Introduction to Pteridophyta. New Age International Publishers, New Delhi.
15. Surange KR (1966) Indian fossil Pteridophytes. Council of Scientific and Industrial research.
16. Parihar NS (1976) Biology and morphology of the Pteridophytes. Central Book Depot.

BOT4202 - Cell Biology

Credit 1 Cell organelles (I) –functional aspects

1. Cell wall – biogenesis, ultra structure and function. Growth - primary and secondary wall **3L**
2. Cell membranes: molecular organization, Fluid mosaic model, membrane protein diffusion, electrical properties of membranes, transport across membranes - facilitated diffusion, carrier & channel proteins, transporters, active transport, transport of ions and solutes **4L**
3. Molecular organization of chloroplast and mitochondrial membranes. **3L**
4. Plasmodesmata – Structure and role in movement of molecules, virus transport **2L**
5. Vacuoles – Tonoplast membrane biogenesis, transporters, role as storage organelle, transport across vacuolar membrane **3L**

Credit 2 Cell organelles (II) –functional aspects

1. Endoplasmic reticulum- Role in synthesis and transport of Secretory proteins **2L**
2. Golgi complex – role in sorting, storage and secretion **2L**
3. Lysosomes, membrane integrity and role Glyoxysomes and Peroxisomes- structure and functions **2L**
4. Cytoskeleton – composition and organization of microtubules, microfilaments. Treadmilling, role in cell division, signaling and intracellular traffic. Role in motility- flagella- Structure and organization. **4L**
- 5 Nucleus – Structure, organization and regulation of nuclear pore complex. Transport across nuclear membrane. **2L**
6. Ribosomes – Structure, assembly and dissociation of subunits, function. **2L**
7. Biogenesis of chloroplasts and mitochondria **1L**

Credit 3 Signal transduction

1. Signal transduction: Types of receptors, G-proteins and G-protein coupled receptors **4L**
2. Phospholipid signaling, Ca⁺⁺-calmodulin cascade, diversity in protein kinases and phosphatases, secondary messengers, regulation of signaling pathways **5L**
3. Specific signaling mechanisms with suitable examples – biotic and abiotic stress, ABA induced stomatal closure, **4L**
4. Nuclear-organelle signaling during plastid development **1L**
5. Receptor Serine / Threonine kinase, Ethylene mediated two component system **1L**

Credit 4 Cell cycle, aging and cell death

1. Cell Cycle – Phases of Cell Cycle, functional importance of each phase, Molecular events during cell cycle, Check points, Cyclins and protein kinases, MPF (maturation promoting factor), Regulation of cell cycle. Methods to study cell cycle – labeled mitotic curve, flow cytometry, use of mutants. **8L**

2. Cell aging and cell senescence, programmed cell death- molecular aspects, regulation of cell death, PCD in response to stress **4L**

3. Apoptosis- Role of different genes, cell organelles during apoptosis, genetic control of apoptosis. **3L**

References:

1. Alberts B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1989. Molecular biology of the Cell (2nd edition). Garland Pub. Inc., New York.
2. Karp, G. 1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA.
3. Lodish S, Baltimore B , Berk, C and Lawrence K, 1995 , Molecular Cell Biology , 3rd edn, Scientific American Books, N.Y
4. De Robertis and De Robertis, 1988, Cell and Molecular Biology, 8th edn, Info-Med, Hongkong.
5. Buchanan, Grisse and Jones, 2000, Biochemistry and Molecular Biology of Plants, American Soc. Plant Biologists, Waldorf.
6. Lewin, B. 2000. GENE VII. Oxford University Press, New York, USA
7. Cooper G M and Hausman R E, 2007, The Cell: Molecular Approach 4th Edn, Sinauer Associates, USA.

BOT4203 - Molecular Biology & Genetic Engineering

Credit – 1 DNA

1. DNA structure – types of base pairing, unusual structures, topology **2L**
2. Melting and reassociation of DNA, Cot curves and kinetic complexity of DNA. Organization of genomes (from whole genome sequences), repetitive and unique sequences, C value paradox, gene duplication and divergence. Number of genes, exons. Rot curves and gene expression **3L**
3. Packaging of genomes in viruses, bacteria, organelles and nuclei. Structure of Chromatin, nucleosome positioning. Histone modifications. Chromosome organization, centromeres, telomeres, specialized chromosomes **3L**
4. Initiation, elongation and termination of DNA replication, molecular machinery of DNA replication in prokaryotes and eukaryotes. **4L**
5. DNA damage and repair. **3L**

Credit – 2 RNA

1. Organization of gene
RNA structure – modified bases, pairing, secondary structure **2L**
2. Transcription units, RNA polymerases, initiation, elongation and termination of transcription in prokaryotes and eukaryotes, proof reading **5L**
3. RNA processing – Processing of tRNA, rRNA and mRNA **4L**
4. Regulation of transcription - Operons, repressors and inducers, positive and negative control, regulation of lytic and lysogenic cycles in phages. **4L**

Credit – 3 Proteins

1. Protein synthesis – tRNA charging, ribosomal organization. Initiation, elongation and termination of protein synthesis in prokaryotes and eukaryotes. Proof reading **6L**
2. Post-translational processing of proteins, Proteases and their role in processing and degradation of proteins **4L**
3. Targeting of organelle and secretory proteins. Localisation of membrane proteins. Chaperones and protein folding. **3L**
4. Regulation of protein synthesis, post-translational regulation **2L**

Credit 4 - Genetic Engineering

1. Introduction to recombinant DNA technology 2L

Steps involved in construction of recombinant DNA molecule

2. Enzyme used in genetic engineering 2L

Restriction endonucleases, other endonucleases, Exonucleases, Ligases, Polymerases, Kinase and Phosphatase, DNA methylases, Topoisomerases, Reverse transcriptase

3. Use of vectors in cloning 6L

Plasmids, Phages, Cosmids, Phagemids, BACs and YACs, Shuttle vectors, Expression vectors, Ti based vectors.

4. Plant Genetic Engineering:- 5L

Gene Transfer Methods- chemical method, electroporation, biolistic gun, floral dip, *Agrobacterium* mediated gene transfer.

Factors affecting transformation, Screening for transformants, Handling transformants in subsequent generations

References:

1. Lewin B. (2000). Genes VII. Oxford University Press, New York.
2. Alberts, B., Bray, D Lewis, J., Raff, M., Roberts, K and Walter (1999). Molecular Biology of the Cell. Garland Publishing Inc., New York.
3. Wolfe S.L (1993) Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA.
4. Rost, T. et al (1998). Plant Biology. Wadsworth Publishing Company, California, USA.
5. Krishnamurthy, K.V. (2000). Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
6. Buchanan B.B, Gruissem W. and Jones R.L (2000). Biochemistry and Molecular Biology of Plant. American Society of Plant Physiologist, Maryland, USA.
7. De D.N (2000). Plant Cell Vacuoles: An Introduction. CISRO Publication, Collingwood, Australia.
8. Kleinsmith L.J and Kish V.M (1995). Principles of Cell and Molecular Biology (Second Edition). Happer Collins College Publishers, New York, USA.
9. Lodish H., Berk A., Zipursky, S.L Matsudaira P., Baltimore D. and Darnell J. (2000). Molecular Cell Biology (Fourth Edition). W.H. Freeman and Company, New USA.
10. David Freifelder (1996). Essentials of Molecular Biology, Panima Publishing Company, New Delhi.
11. Brow T.A (2007) Genomes – 3 – Garland Science House, New York.
12. Malacinski G.M (2006) (Fourth Edition). Freifelders Essentials of Molecular Biology, Narosa Publishing House, New Delhi.
13. Rastogi V.B Concepts in Molecular Biology.
14. Twxman R.M (2003) (Third Reprint). Advanced Molecular Biology. Viva Books Pvt. Ltd., New Delhi.
15. Watson J.D. et al. Molecular Biology of Gene. Forth Edition, Benjamin and Cummings Publishing Co., California.

BOT4204 PLANT ECOLOGY AND PHYTOGEOGRAPHY

Credit 1-Plant relation with the environment

1. Plant relations with the climatic factors and its effect on plant distribution: water, precipitation, temperature, light and radiation **5L**
2. Plant relation with the edaphic factors: types of soil, soil moisture and water holding capacity of the soil, soil nutrients, soil microbes **4L**
3. Environmental pollution and its impact – Air, water, soil and noise **6L**

Credit 2- Population Ecology

1. Ecological limits and the size of population, factors affecting population size, Demes **3L**
2. Life history strategies, r and k selection, C-S-R triangle **3L**
3. Concept of metapopulation, extinction events, population viability analysis **3L**
4. Community structure and species diversity. Diversity types and levels (alpha, beta and gamma), ecotone and edge effect **3L**

Credit 3- Ecosystems

1. Ecosystem: Components and organization **1L**
2. Energy flow and mineral cycling **2L**
3. Ecosystem types **4L**

Terrestrial: Forests, grasslands and deserts

Aquatic: Fresh water and marine

Artificial: Agricultural

4. Eco-physiology: Adaptive responses of plants to variation in: **4L**

Light: Photo inhibition, protection against light-induced damage

Temperature: Winter hardness, vernalization, adaptation to high temperature

Water availability: Adaptation to light drought and flooding

Plant succession: Autogenic and allogenic, mechanism and phases

5. Serial communities and climax communities: Hydroseres, xeroseres **4L**

Credit 4 - Phytogeography

1. Introduction, major plant communities of world, phytogeographic regions of world (vegetation of belts), soil, climate, flora and vegetation of India, floristic (Botanical) regions of India **7L**
2. Biomes: Classification and components **2L**
3. Habitat ecology: Fresh water, Marine water, Estuarine ecology, Terrestrial Ecology, Dessert ecology **3L**
4. Endemism and EIA **3L**

References:

1. Ambhast, R. S. (1998). A Text Book of Plant Ecology, 9th edition, Friend and Co.
2. Barbour, M. G., Pits, W. D. and Burk, J. H. (1967). Terrestrial Plant Ecology, Addison-Wesley Publisher.
3. Begon, M., Townsend, C. R., Harper, J. L. (2005). Ecology: From Individuals to Ecosystems, 4th edition, Wiley Blackwell.
4. Canter, L. (1996). Environmental Impact Assessment, 2nd edition, McGraw Hill Publishing Company.
5. Coleman, D. C., Crossley, D. A., Handrix, P. F. (2004). Fundamentals of Soil Ecology, 2nd edition, Elsevier academic press.
6. Collier, B. D., Cox, G. W. and Miller, P. C. (1973). Dynamic Ecology, Prentice-Hall, Inc. Englewood Cliffs, New Jersey.
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8. De, A. K. (1994). Environmental Chemistry, Wiley Eastern publication.
9. Gurevitch, J., Scheiner, S. M., Fox, G. A. (2006). The Ecology of Plants, Sinauer associates.
10. Hynes, H. B. N. (1978). Biology of Polluted Water, 1st edition, Liverpool University Press.
11. Kershaw, K. A. (1978). Quantitative and Dynamic Ecology, 2nd edition, Edward Arnold Publication.
12. Kumar H. D. (1981). Modern Concept of Ecology, 8th edition, Vikas Publication.
13. Mishra, R. (1968). The Ecology of Work Book, Oxford and IBH Pub. Co. Kolkata.
14. Mukherjee, B. (1996). Environmental Biology, 1st edition, Tata McGraw Hill.
15. Mukherjee, B. (2000). Environmental Management: Basic and Applied Aspects of Management of Ecological Environmental System, 1st edition, Vikas Publication.
16. Odum E. P. (2007). Fundamentals of Ecology, 5th edition, Thomson Books.
17. Yadav, P. R. and Mishra, S. R. (2004). Environmental Biology, Discovery Publication, New Delhi.

BOT4205 - Practicals based on Classic Botany - II, Plant Ecology and Phytogeography

Pteridophytes– (Any 5 Practicals)

Morphological and/or anatomical and/or reproductive studies of the following members with the help of live material/or herbarium specimens and/or museum specimens and/or permanent slides of the following orders: (any 8 orders) **4P**

1. Psilotales: *Psilotum, Tmesipteris*
2. Lycopodiales: *Lycopodium*
3. Selaginellales: *Selaginella*
4. Isoetales: *Isoetes*
5. Equisetales: *Equisetum*
6. Ophioglossales: *Ophioglossum, Angiopteris*
7. Osmundales: *Osmunda*
8. Filicales: *Lygodium, Pteris, Pteridium, Pleopeltis, Cheilanthus, Adiantum.*
9. Salviniiales: *Salvinia*

Study of available fossils of Pteridophytes **1P**

Gymnosperms – (Any 5 Practicals)

1. Study of available fossils of gymnosperms **1P**

2. Morphological and / or anatomical and/or reproductive studies of the following members with the help of live material / or herbarium specimens and/or museum specimens and / or permanent slides of the following orders: **4P**

- Cycadales
- *Coniferales*
- *Taxales*
- *Ginkgoales*
- *Gnetales*

Plant Ecology and Phytogeography – (Any 10 Practicals)

1. Study of morphological and anatomical characteristics of plants under stress **2P**
2. Allelopathic analysis of the plants **1P**
3. Finding minimum size of sampling unit for studying specific plant community **1P**
4. Determination of frequency, density, abundance, dominance and IVI of the plant Community **1P**
5. Determination of species richness, similarity and diversity indices in different plant communities **2P**
6. Study of polluted water with respect to DO, free CO₂, phosphates and Palmer's algal Indices **2P**
7. Comparison of stomata index, chlorophyll contents and pollution fertility of the plants from polluted and non-polluted area **2P**
8. Physicochemical analysis of water (EC, TS,TDS, TSS, Chloride and Hardness)

9. Interpretation of satellite images and aerial photographs with respect to major vegetation/ landforms/ land use patterns.

BOT4206 - Practicals based on Cell Biology, Molecular Biology and Genetic Engineering

Cell Biology (Any 10 practicals)

1. Differential centrifugation for isolation of cell fractions – Nuclear fraction **1P**
2. Isolation of chloroplasts to study: **2P**
 - a. Hill reaction to measure intactness,
 - b. measurement of size of chloroplasts using micrometry and chlorophyll estimation
3. Isolation of mitochondria for **2P**
 - a. Estimation of succinic dehydrogenase activity
 - b. Microscopic observations using MitoTracker Green FM/ MitoTracker Red 580 / Janus green B
4. Isolation of lysosomal fraction and estimation of acid phosphatase activity **1P**
5. Study of electron micrographs of cell organelles **1P**
7. Isolation of protoplasts and viability staining to determine % viability. **1P**
8. Study of metaphase nucleus: Localization of euchromatin and heterochromatin. **1P**
9. Cytochemical studies of special cell types- guard cells, senescent cells, bundle sheath cells, meristematic cells, laticiferous cells, glandular cells, pollen grains **2P**
10. Study of induced cell senescence in leaf discs **1P**
11. Determination of permeability of living cells to acids and bases **1P**

Molecular Biology - (Any 10 practicals)

1. Isolation of plasmid DNA and quantification **2P**
2. Electrophoretic separation of plasmid isoforms **1P**
3. Restriction digestion of plasmid DNA, electrophoresis and molecular weight determination of DNA fragments. **2P**
4. Isolation of plant genomic DNA and quantification **2P**
5. Effect of temperature and alkali on absorbance of DNA – hyperchromicity **1P**
6. Separation of seed-storage proteins from leguminous seed and quantitation of each fraction **2P**
7. SDS-PAGE separation of seed storage proteins from legumes. **3P**